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## Relationship between Postoperative Admission and Location of Hernia Surgery: A matched case control study in the VA

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### To the Editor

Within the VA system, ambulatory surgery centers (ASCs) are gradually replacing traditional hospitals for outpatient surgical care.<sup>1</sup> The expansion of ASCs is expected to continue as outpatient surgery increases. Although private sector studies show that patient outcomes are better in ASCs than hospital outpatient departments (HOPDs),<sup>2–4</sup> these settings have different financial incentives and a generally healthier population than the VA healthcare system. We examined postoperative outcomes (i.e., specifically hospital admissions) after inguinal hernia surgery in VA ASCs versus HOPDs.

### Methods

We used the VA Corporate Data Warehouse (CDW) FY2012-2014 outpatient procedure file to identify surgeries with a CPT code '49505' for repair of initial inguinal hernia. We obtained patient demographics, comorbidities, distance to VA hospital, median income and hospital bed supply in area of residence, ASA score, facility's geographic region and month/year of the hernia surgery from the CDW and the Area Health Resource File as model predictors. Facilities were excluded if they performed <30 hernia surgeries in FY12-14; cases were excluded if the patient lived >120 miles from a VA hospital or the surgery was emergent. Our final sample included 109 HOPDs and 18 ASCs. The VA Boston Healthcare System's Institutional Review Board approved this study and waived informed consent.

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Postoperative hospitalization was defined as an admission 1-14 days after outpatient surgery with length of stay >24hrs **or** same day admission with length of stay >48hrs (to exclude observation stays). We performed a chi-square test of proportion and logistic regression predicting admission by ASC adjusting for the predictors described above. To control for factors associated with having surgery in an ASC, we used the same set of predictors in a model estimating likelihood of ASC-based hernia surgery and obtained a propensity score for each patient. We matched ASC patients to those with surgery in a HOPD by propensity score and estimated a second logistic regression model using only ASC status to predict postoperative admission.<sup>5</sup> Analyses were performed using SAS.

## Results

Of 26,019 outpatient hernia surgeries, 6.9% were performed in an ASC and 1.8% had an admission 0-14 days postoperatively. There were significantly fewer admissions among ASC patients than HOPD patients (1.1% versus 1.9%,  $p=0.02$ ; Table 1). The initial logistic regression model measured no significant relationship between ASC surgery location and probability of admission (Table 2). The propensity score model included 1,709 matched ASC and HOPD cases; ASC surgery location remained an insignificant factor in predicting admission (odds ratio 0.76, 95% CI: 0.42, 1.38).

## Discussion

Private sector studies suggest ASCs are safer than hospitals for routine outpatient surgery, although these findings have been criticized for failing to consider a patient's likelihood of using an ASC. After controlling for patient characteristics and facility factors in a propensity score matched model, we found no evidence that risk of postoperative admission after hernia surgery differed between ASCs and HOPDs. Although this is a promising sign that VA ASCs represent a safe alternative setting for outpatient surgery, more research is needed to confirm our findings since we did not incorporate non-VA hospitalizations as outcomes. We may also be missing important predictors of having care in an ASC (e.g., patient preference) and experiencing a postoperative admission (e.g., provider availability). Finally, despite its use in private sector quality comparisons, postoperative admissions may be an inadequate marker of patient safety and quality differences between ASCs and HOPDs. Our results show that postoperative admissions after inguinal hernia surgery are rare events regardless of the location of the surgery. Future research should add other types of outpatient surgeries and examine additional outcomes such as postoperative emergency room visits and cost.

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**Table 1:**

Frequency of Patient, Provider and Facility Characteristics in 26,019 VA Hernia Surgeries (FY12-14)

Type of Predictor	Variable	HOPD (n=109, 24,216 surgeries) N (%) or Mean (SD)	ASC (n=14, 1,803 surgeries) N (%) or Mean (SD)
<b>Outcome</b>	Postoperative Admission	451 (1.9%)	20 (1.1%)
<b>Patient demographics</b>	Age (years)	63.5 (12.2)	62.0 (11.9)
	Female	108 (0.5%)	9 (0.5%)
	Race=white	16,311 (67.4%)	1,300 (72.1%)
	Race=nonwhite	6,607 (27.3%)	429 (23.8%)
	Race=unknown	1,298 (5.4%)	74 (4.1%)
	Service connected disability	595 (2.5%)	10 (0.6%)
	Distance (miles) to nearest VA hospital	33.7 (37.5)	44.7 (30.1)
	FY12 area median per capita income (USD)	41,156.4 (9,954)	40,069.0 (8,914.9)
	No zip code in VA patient data	2,080 (8%)	91 (0.4%)
<b>Patient comorbidities</b>	No comorbidities	3,897 (16.1%)	295 (16.4%)
	Patient # of comorbidities=1	5,384 (22.2%)	440 (24.4%)
	Patient # of comorbidities =2	5,058 (20.9%)	399 (22.1%)
	Patient # of comorbidities =3	3,768 (15.6%)	271 (15%)
	Patient # of comorbidities =4	2,513 (10.4%)	182 (10.1%)
	Patient # of comorbidities =5	1,576 (6.5%)	107 (5.9%)
	Patient # of comorbidities =6	909 (3.8%)	49 (2.7%)
	Patient # of comorbidities = 7	1,111 (4.6%)	60 (3.3%)
	AIDS	17 (0.1%)	255 (14.1%)
	Alcohol abuse	2,725 (11.3%)	8 (0.4%)
	Alcohol liver disease	176 (0.7%)	1 (0.1%)
	Blood loss anemia	60 (0.3%)	222 (12.3%)
	Cardiac arrhythmia	4,066 (16.8%)	25 (1.4%)
	Congestive heart failure	890 (3.7%)	279 (15.5%)
	Chronic pulmonary disease	4,345 (17.9%)	27 (1.5%)
	Coagulopathy	451 (1.9%)	121 (6.7%)
	Deficiency anemia	2,074 (8.6%)	323 (17.9%)
	Depression	3,819 (15.8%)	39 (2.2%)
	Diabetes -complicated	767 (3.2%)	224 (12.4%)
	Diabetes -uncomplicated	3,662 (15.1%)	149 (8.3%)
	Drug abuse	1,845 (7.6%)	70 (3.9%)
	Fluid and electrolyte disorders	1,176 (4.9%)	968 (53.7%)
	Hypertension	13,327 (55%)	86 (4.8%)
Hypothyroidism	1,419 (5.9%)	22 (1.2%)	
Liver disease	518 (2.1%)	4 (0.2%)	

Type of Predictor	Variable	HOPD (n=109, 24,216 surgeries) N (%) or Mean (SD)	ASC (n=14, 1,803 surgeries) N (%) or Mean (SD)
	Lymphoma	191 (0.8%)	5 (0.3%)
	Metastatic cancer	180 (0.7%)	183 (10.2%)
	Obesity	1,949 (8.1%)	48 (2.7%)
	Other neurological disease	718 (3%)	45 (2.5%)
	Renal failure	824 (3.4%)	8 (0.4%)
	Paralysis	131 (0.5%)	27 (1.5%)
	Peptic ulcer bleed	366 (1.5%)	205 (11.4%)
	Psychoses	2,602 (10.7%)	243 (13.5%)
	PTSD	2,825 (11.7%)	2 (0.1%)
	Pulmonary circulation disorders	158 (0.7%)	28 (1.6%)
	Rheumatoid arthritis	402 (1.7%)	43 (2.4%)
	Valvular disease	856 (3.5%)	57 (3.2%)
	Weight loss	922 (3.8%)	23 (1.3%)
<b>Procedure characteristics</b>	ASA Score	2.5 (0.7)	2.4 (0.6)
	No ASA (not in NSO surgical data) *	513 (2.1%)	841 (46.6%)
<b>Facility characteristics</b>	Facility outpatient surgery volume	6,523.2 (3,027.1)	3,185.9 (1,534.6)
	FY12 hospital beds in area	2,606.4 (4,554.1)	1,126.9 (1,662.1)
	Atlantic	5,539 (22.9%)	315 (17.5%)
	Southeast	4,677 (19.3%)	343 (19%)
	Midwest	4,641 (19.2%)	623 (34.6%)
	Continental	5,366 (22.2%)	204 (11.3%)
	Pacific	3,993 (16.5%)	318 (17.6%)

Note, temporal differences averaged 2.7% for HOPDs and ASCs over the course of the study; variation in rates of surgery per month/year was greater for ASCs than HOPDs. These data are available on request.

\* ASA scores are only available in National Surgery Office (NSO) collected data.

**Table 2:**

Logistic Regression Results Predicting Postoperative Admissions in 26,019 VA Hernia Surgeries (FY12-14, 109 VA Hospitals, 14 VA ambulatory surgery centers (ASCs))

Significant Predictors	$\beta$ Coefficient (Standard Error)	Odds Ratio (95% Confidence Interval)
ASC	-0.11 (0.25)	0.9 (0.56-1.45)
Age 1 <sup>st</sup> quintile	REF	REF
<b>5<sup>th</sup> quintile</b>	0.82 (0.19)	2.27 (1.55-3.33)
Distance (miles) to nearest VA Medical Center 1 <sup>st</sup> quintile	REF	REF
<b>5<sup>th</sup> quintile</b>	-0.4 (0.19)	0.67 (0.46-0.97)
FY12 area median per capita income (US Dollars) 1 <sup>st</sup> quintile	REF	REF
<b>3<sup>rd</sup> quintile</b>	-0.41 (0.18)	0.66 (0.47-0.94)
No comorbidities	REF	REF
Patient # of comorbidities =4	0.71 (0.36)	2.04 (1.01-4.14)
Patient # of comorbidities =6	0.95 (0.47)	2.6 (1.04-6.48)
<b>Cardiac arrhythmia</b>	0.43 (0.13)	1.53 (1.19-1.97)
Duration of Surgery 1 <sup>st</sup> quintile	REF	REF
<b>5<sup>th</sup> quintile</b>	0.9 (0.16)	2.46 (1.79-3.39)
FY12 hospital beds in area 1 <sup>st</sup> quintile	REF	REF
<b>2<sup>nd</sup> quintile</b>	-0.35 (0.17)	0.71 (0.51-0.98)
Surgery performed in Oct FY12	REF	REF
Surgery performed in <b>Feb FY14</b>	-1.35 (0.59)	0.26 (0.08-0.82)

Note: Bolded value indicates significant variable in model. Model performance: pseudo  $r^2=0.09$ , c-statistic=0.76. Predictors in the logistic regression model that were not significantly associated with postoperative admission include: sex, race, age quintiles 2-4, service connected disability, distance from VAMC quintiles 2-4, FY12 area median per capita income 2<sup>nd</sup>, 4<sup>th</sup> and 5<sup>th</sup> quintile, patient with 1-3, 5, 7 total comorbidities, individual comorbidities (e.g., AIDS) excepting cardiac arrhythmia, duration of surgery quintiles 2-4, ASA score, facility surgical volume, FY12 area hospital bed supply quintiles 3-5, facility's geographic region, and month/years of the hernia surgery Nov FY12 – Sep FY14 excepting Feb FY14.