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Effect of Post-Hospital Syndrome on Healthcare Utilization After Abdominal Contouring Surgery

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Abstract

Background: Post-hospital syndrome (PHS) is a transient condition after acute hospitalizations when patients are physiologically deconditioned. The objective of this study was to determine if having PHS at the time of abdominal contouring surgery increased the incidence of post-operative adverse medical events.

Methods: We conducted a retrospective cohort study of patients enrolled in the MarketScan Databases who underwent outpatient functional or cosmetic abdominal contouring surgery (i.e. abdominoplasty, liposuction, or panniculectomy) from April 2010 to August 2015. Patients were separated into two groups based upon PHS exposure, defined by hospitalization within 90 days prior to surgery. Differential healthcare utilization within 30 days after surgery was compared between cohorts.

Results: Among the 18,947 patients included in the final cohort, 1,045 patients (6%) had PHS at the time of abdominal contouring surgery. Patients with PHS experienced more emergency department visits (0.16 vs. 0.08 visits, adjusted odds ratio =1.60, $p<0.001$) and more episodes of hospitalization (0.11 vs. 0.04 episodes, AOR=1.70, $p<0.001$) within 30 days postoperatively. The mean unadjusted healthcare utilization following abdominal contouring surgery for patients with PHS was \$7,888 (SD=17,659) versus \$2,943 (SD=9,096) in patients without PHS. After controlling for confounders, such as comorbidity-burden, PHS was associated with \$3,944 greater cost than patients without PHS ($p<0.001$).

Conclusion: Among patients undergoing outpatient abdominal contouring surgery, having PHS increased the incidence of adverse medical events requiring medical attention in the 30-day post-operative period. These findings support the inclusion of PHS in pre-operative evaluation and preparation for patients seeking abdominal contouring surgery.

INTRODUCTION

Post-hospital syndrome (PHS) is a temporary state of vulnerability following hospital discharge when patients are at increased risk of adverse health outcomes. PHS is thought to be a consequence of the biological stressors associated with inpatient hospital care, including sleep deprivation, malnutrition, generalized deconditioning, and anxiety related to health decline.¹ Although difficult to disaggregate from the natural progression of illness, the impact of PHS is thought to be substantial. For example, one-in-five or 2.6 million Medicare patients are re-admitted to the hospital within 30 days of discharge. Of these patients initially admitted for serious yet common medical conditions, such as heart failure and pneumonia, the cause of re-admission is different than the cause of initial hospitalization more than 60% of the time.²

As payers shift to bundled payment systems, hospitals and providers are under pressure to decrease costs without compromising quality of care. Minimizing perioperative morbidity by recognizing the functional decline associated with PHS may present one such opportunity for improvement. Current literature focuses on PHS in the context of patients readmitted for medical complications, but little is known about the impact of PHS on patients who undergo surgery after recent hospitalization. A study by Brownlee et al. found that patients who underwent elective hernia surgery after a recent hospitalization were more than twice as likely to require medical attention compared to patients without PHS.³ The generalizability of these findings to patients undergoing abdominal contouring surgery is uncertain.

Functional and cosmetic abdominal contouring surgeries, including abdominoplasty, liposuction or panniculectomy, rank amongst the most common procedures performed across the United States.⁴ Although these surgeries are traditionally elective, these procedures are associated with some of the highest complications rates of all soft-tissue surgeries, including rates as high as 30% to 80% for post-bariatric panniculectomy.^{5–11} Given these risks, we aimed to assess the impact of PHS on the incidence of adverse medical events in the immediate post-operative period, defined by the need for emergency department visit or re-hospitalization. Secondary outcomes of interest included the financial impact of PHS on patients and payers following surgery.

METHODS

Data source and study cohort

The institutional review board granted this study exception status. The analysis utilized data from the Truven MarketScan Commercial Claims and Encounters Medicare Supplement/Coordination of Benefits (MarketScan) databases to identify a national sample of patients undergoing abdominal contouring surgery. MarketScan was chosen for its scope as a national convenience sample from large employers, governments, insurance plans, and

public entities for more than 55 million beneficiaries per year.¹² Data include information from individual patient encounters, including emergency department visits and hospitalizations, along with specifics regarding patient demographics and insurance coverage. The database includes data for procedures and services that were reimbursed partially or fully by insurance companies. Diagnoses were identified using International Classification of Diseases, ninth revision (ICD-9) and procedures were identified by Current Procedural Terminology (CPT) codes.

The study cohort included patients 18 years of age and older who underwent abdominal contouring surgery, including abdominoplasty, liposuction, or panniculectomy between April 2010 to August 2015. (Table 1). Patients were excluded if they were not continuously enrolled in MarketScan from 15 months prior to surgery to one month postoperatively. Lastly, to minimize possible confounding effects of other major surgeries often performed at time of abdominal contouring surgery, specifically breast surgery, patients were excluded if they underwent an operation within 90 days prior to or 30 days after abdominal contouring surgery. All cases were performed at ambulatory surgery centers. Figure 1 outlines the full inclusion and exclusion algorithm.

Predictor and outcome variables

Post-hospital syndrome (PHS) status was determined by any hospitalization within 90 days prior to abdominal contouring surgery. Two primary outcomes were recorded, including the number of unexpected healthcare encounters within 30 days after surgery and the associated cost of those encounters. Healthcare encounters included emergency department visits and hospitalizations. For patients who were hospitalized within 30 days after surgery, the primary diagnosis on admission was recorded. Overall cost, including insurance coverage and out-of-pocket expenditure, was calculated for all health care encounters within 30 days after surgery. Insurance coverage incorporated reimbursement for provider and facility fees. Out-of-pocket expenditure was calculated as the sum of coinsurance, deductible, and copayment for healthcare related encounter. Year-specific consumer price index was utilized to adjust all dollar cost values to 2015 USD.¹⁶

Covariates

Patient-specific-variables were incorporated in the analysis, including sociodemographic categories, insurance information, comorbidities, and comorbidity burden. Sociodemographic categories included age, sex, median income, and geographic region in which patients received care. Insurance information included managed care plans versus fee-for-service plans. Comorbidities were identified by ICD-9 codes and included hypothyroidism, hypertension, diabetes, coronary artery disease (CAD), asthma, mitral valve prolapse (MVP), obesity, coagulopathy, cancer, history of deep vein thrombosis (DVT), and smoking-status. The Elixhauser comorbidity score was calculated for each patient and included in the analysis as 0, 1–3, 4–7, or 8. We chose to include the Elixhauser comorbidity score because of its breadth, encompassing 31 conditions known to predict mortality risk, and its superiority to other co-morbidity indices in predicting mortality and adverse events after surgery.¹³

Statistical analysis

Summary statistics were computed for continuous measures as mean $\pm$ standard deviation (SD), as well as median (interquartile range, IQR), and for categorical variables as frequency and proportion (%). All continuous variables were evaluated for normality of distribution using the Shapiro-Wilk Normality Test. We also categorized certain variables into different categories according to prior clinical knowledge at the beginning of the analysis. All variables were compared between PHS group and non-PHS group using t-tests for normally-distributed data and Wilcoxon tests for non-normally-distributed data.

For patients hospitalized within 30 days after abdominal contouring surgery, the primary diagnosis for admission was tracked and compared between patients with PHS and those without PHS. Noticing that all these health care encounter outcomes are greatly inflated by value 0, we focused on logistic regressions to evaluate the effect of PHS and other risk factors on whether the patient has emergency department visits and hospitalizations. We further evaluated the impact of PHS and other risk factors on whether the patient has any health care cost, through a logistic regression, and also investigated how the PHS affect the mean health care cost adjusted for other variables through a linear regression model among those who have health care cost. The direct comparison for cost between PHS and non-PHS groups was restricted to patients who experienced health care costs ($> \$0.01$) within the first 30 days after abdominal contouring surgery. All analyses were performed using the statistical software package R (version 2.14.1).

RESULTS

Of all patients undergoing abdominal contouring surgery at outpatient surgical centers, 21,678 patients were followed in the dataset for at least 15 months prior and 30 days after surgery (Figure 1). After excluding patients younger than 18 years of age and those who underwent breast surgery at the same time of surgery, our final study cohort included 18,947 patients, where 1,045 (6%) patients had PHS, as defined by hospitalization within 90 days prior to surgery. Demographic, insurance, comorbidity, and enrollment characteristics for the final study cohort are listed in Table 2. The mean age of our study cohort was 48.7 years old (SD=14.7) and 23% of patients were male.

Patients with PHS who underwent abdominal contouring surgery experienced significantly greater utilization of health resources, including more emergency department visits (0.16 vs. 0.08) visits on average and more episodes of hospitalization (0.11 vs. 0.04 episodes) within 30 days after surgery compared to patients without PHS (Table 2). After adjusting for confounding variables and other potential risk factors, such as age, smoking, and co-morbidity-burden, our analysis showed that patients with PHS experienced a much higher risk of requiring medical care within 30 days after surgery. Compared to non-PHS patients, those with PHS were significantly more likely to visit the emergency department (adjusted OR=1.60, $p<0.001$), and their odds of hospitalization were 1.70 times ($p<0.001$) higher than the odds for patients without PHS (Table 3). Excluding patients that underwent liposuction only ($n = 2,948$) yielded similar results. Risk of emergency department visits in PHS patients remained significant when liposuction-only patients were excluded (OR=1.51, $p<0.001$). Similarly, risk of hospitalizations in PHS patients was significant (OR=1.62, $p<0.001$).

Of all patients who underwent abdominal contouring surgery, 843 were hospitalized within 30 days after surgery, including 10% of patients with PHS and 4% of patients without PHS (Table 4). Post-operative complications were the most common reason for hospitalization in both PHS and non-PHS groups without significant difference between groups, affecting 15% vs. 17% of patients, respectively. Patients with PHS were more than twice as likely to be hospitalized for infection compared to patients without PHS (OR=2.26, $p=0.028$). There was no significant difference between groups when comparing other reasons for hospitalization within 30 days after surgery.

The mean unadjusted cost of health care utilization following abdominal contouring surgery for patients with PHS was \$7,888 (SD=17,659), whereas the mean cost for patients without PHS was \$2,943 (SD=9,096). After controlling for other potential confounders in the multivariate logistic regression model, the odds of having medical cost among patients with PHS is 2.28 times higher of that among non-PHS patients ($p<0.001$) (Table 5). Among those who have medical expenses, PHS patients were associated with \$3,944 greater overall costs compared to non-PHS patients ($p<0.001$) (Table 5). Only Elixhauser comorbidity score had a greater impact on cost compared to PHS. For example, an Elixhauser comorbidity score 8 was associated with a \$4,118 increase in total cost. Excluding liposuction-only patients, adjusted odds of health care costs (OR=2.29, $p<0.001$) and total additional overall cost (\$3,876) remained significant for the PHS cohort.

DISCUSSION

Our analysis showed that post hospital syndrome was significantly associated with risk of adverse medical events requiring medical attention after elective abdominal contouring surgery. Post-hospital syndrome increased patients' risk of emergency department visits and more than doubled the odds of requiring hospitalization within 30 days after surgery. Increased healthcare utilization in the PHS-group translated to a \$3,944 increase in overall financial burden in our adjusted analysis. In fact, PHS had the single greatest impact on healthcare expenditure in the post-operative period, even after controlling for cofounders, such as comorbidity burden. Given the push toward value-based care, which rewards surgeons for minimizing complications in the post-operative period, it is critical that surgeons understand the impact of PHS so that they can identify new approaches aimed at ameliorating the burden of PHS after surgery.

Previous studies have identified several hospital-related mechanisms that contribute to the development of PHS. Hospitalized patients are at risk of skeletal muscle deconditioning,¹⁴ reduced caloric intake due to caloric restriction,¹⁵ sleep deprivation,¹⁶ and delirium.¹⁷ Additionally, they are subject to a restless environment of alarm sounds, artificial lighting, rotating healthcare providers teams, and frequent diagnostic tests and lab draws.¹⁸ Pharmacotherapies such as opioids for pain control, diuretics in patients with heart failure¹⁹ and antibiotics in patients with active infection,²⁰ may exacerbate the aforementioned hospital stressors and increase the patient's vulnerability to adverse medical events in the short-term.²¹ In separate studies, Dharmarajan et al and Jasti et al showed the impact of this vulnerability in medical patients readmitted after hospitalization for conditions such as heart failure and pneumonia. Both authors found that over two-thirds of patients were readmitted

for conditions different from those at original hospitalization.^{21,22} Our study supports the concept of PHS studied in medical populations and extends the current understanding of PHS to a subset of surgical patients.

To date, efforts aimed at reducing the impact of PHS have been made primarily at the hospital-level. In 2012 the Hospital Readmissions Reduction Program (HRRP) was initiated as a part of the Affordable Care Act to penalize hospitals for excess readmissions of patients with select medical conditions. In response to the financial pressures, many hospitals and hospital-systems established readmission reduction programs intended to improve adherence to clinical care guidelines, to enhance the transition of care from the hospital to the community, to cultivate a hospital culture around quality, and to reduce the overall stress of inpatient hospitalization.²¹ For example, one hospital used eye masks to improve sleep quality in patients with acute coronary syndrome in coronary care units.²³ With respect to transitioning care to the community setting, a group of 15 hospitals enrolled patients in discharge prescription programs (DPPs) to combat medication non-adherence and avert re-hospitalization.²⁴ In addition to targeting PHS at the initial hospitalization, our findings suggest the need for surgeons to target PHS in the clinic when consulting patients pursuing elective surgical procedure.

Surgeons rely upon the pre-operative risk assessments to determine the likelihood of complications during and after surgery. For example, risk factor considerations for patients considering abdominal contouring surgery include patient-specific characteristics, such as smoking,²⁵ obesity,²⁶ hypertension,²⁷ and previous abdominal surgery.²⁸ Depending upon the patient's calculated risk, a surgeon may or may not choose to perform the surgery. Current efforts to further reduce risk have focused on introducing technical modifications to classic surgical techniques and improving the criteria in patient risk assessments.^{29,30} Based upon our findings, we suggest that PHS should be screened for during the pre-operative risk assessment and, if identified, delay treatment until rehabilitation is completed.

To mitigate the impact of PHS in surgical candidates, surgeons should consider the benefits of pre-conditioning for recently hospitalized patients who seek out elective surgery. Just as a marathoner would not run 26.2 miles without training, evidence suggests that some patients should not undergo elective surgery without appropriate pre-conditioning. Literature has shown pre-conditioning of surgical patients can reduce post-operative complications for high-risk patients by up to 51%.³¹ For example, a randomized controlled trial of 279 patients undergoing coronary artery bypass graft (CABG) graft showed that pre-operative inspiratory muscle training reduced incidence of postoperative pulmonary complications by nearly 50% and significantly reduced length of postoperative hospitalization.³² Similar results have been found in patients undergoing elective aortic aneurysm surgery.³³ With respect to cost, a recent study of pre-habilitation and early rehabilitation after surgery of lumbar spine saved patients and payers and average of 1,625 Euro, owing primarily to shorter post-operative hospitalization and a quicker return to work.³⁴

In 2013, Michigan Medicine instituted the Michigan Surgical Home and Optimization Program (MSHOP) to optimize pre-surgical health in patients undergoing any type of surgery. This program aimed to prepare patients for surgery by targeting specific modifiable

risk factors, including functional status, smoking, nutrition, and psychological wellness. Through interventions like pedometer-based walking regimens, accountability text messages, and active daily incentive spirometry,³⁵ MSHOP has been shown to reduce post-operative hospital stay by 31% and lower insurance costs to hospitals by 28%.³⁶ Although enrollment in pre-conditioning programs like MSHOP may hold promise for averting the impact of PHS on patient undergoing abdominal contouring surgery, we recognize that a patient's suitability for surgery is patient-specific and should be determined on a case-by-case basis. Additional research is needed to better understand PHS, how long patients are susceptible to the effects of PHS, and how pre-conditioning and pre-rehabilitation can lessen the burden of PHS.

There were several limitations to this study, largely related to the population-based study design, the use of an insurance database, and the dependency on accurate coding. First, patients whose procedures were paid completely out-of-pocket or were covered by an insurance company outside the scope of MarketScan were not included in our study population. Given the requirement of partial insurance coverage, a larger proportion of our patients underwent abdominal contouring surgery for functional improvement (i.e. panniculectomy) rather than aesthetic (i.e. abdominoplasty) indications. For example, we can conjecture that the high proportion of males included in our study cohort, 23%, may be attributable, in part, to the inclusion of more post-bariatric surgery patients. Unfortunately, we were unable to identify a patient's body mass index through the database. Therefore, this population represents a heterogeneous group of patients that underwent abdominal soft-tissue surgery.

Although our results demonstrate an association between PHS and adverse events in the 30-day post-operative period after abdominal contouring surgery, association does not imply causation, and delaying surgery will not necessarily reduce rate of adverse events. Instead, these results should encourage surgeons to carefully, and perhaps more systemically, evaluate the general health of their patients prior to elective surgery. In future studies, investigating the indication for hospitalization (prior to surgery) and its temporal relationship with elective surgery, and how these variables affect postoperative outcomes, would be beneficial. Our database study identified over 500 indications for pre-surgical hospitalization, and therefore, we were unable to make generalized conclusions on higher risk diagnosis. Despite these limitations, our study highlights the impact of PHS on health care utilization after abdominal contouring surgery and can inform payers and providers of the impact on quality of care for patients, on costs to insurers, and on utilization of health care resources.

For surgeons, our findings underscore the need for consideration of delaying elective surgical intervention when if a patient was recently hospitalized. More specifically, this study justifies the critical need to develop more targeted assessments of surgical readiness, ensuring that patients have returned to their pre-morbid physical condition and by initiating pre-rehabilitation if necessary. For policy makers, this study highlights a potential cost-savings opportunity that can be realized through the aforementioned hospital-level or provider-level interventions. Lastly, for patients, this study demonstrates that PHS can impact outcomes after elective surgery, translating to lower quality of life and missed days at work and with

family. Given the increased health care utilization after surgery in patients with PHS, providers should seek to understand the impact of PHS for all recently hospitalized patients before considering them for surgery.

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Figure 1.

Study cohort selection of patients undergoing abdominal contouring surgery using MarketScan databases from April 2010 to August 2015. Source: MarketScan, 2010 to 2015.

PHS: Post-Hospital Syndrome, defined as hospitalization within 90 days prior to abdominoplasty

Table 1.**Study ICD9 and CPT Codes**

Study cohort: Any patient who underwent outpatient abdominal contouring surgery	
CPT code	Description
15847	Excision, excessive skin and subcutaneous tissue (includes lipectomy); abdomen (eg, abdominoplasty)
15830	Excision, excessive skin and subcutaneous tissue (includes lipectomy); abdomen; infraumbilical panniculectomy
15877	Suction assisted lipectomy; trunk
17999	Unlisted procedure, skin, mucous membrane and subcutaneous tissue [when specified as other abdominoplasty, excision excessive skin and subcutaneous tissue, including lipectomy, of abdomen]
Exclusions: Any patient who underwent breast surgery at the same time of abdominal contouring surgery, within 90 days prior to abdominal contouring surgery, within 30 days after abdominal contouring surgery	
Criteria	Code
Breast surgery	85, 86.65, 86.7, 86.93, 15777, 19180, 19182, 19200, 19220, 19240, 19303, 19304, 19305, 19306, 19307, 19340, 19342, 19357, 19361, 19364, 19367, 19368, 19369, V50.41
Comorbidities: Any patient diagnosed at any time during the study period	
Diagnosis	ICD-9 code
Hypothyroidism	243, 244 (244.0, 244.1, 244.2, 244.3, 244.8, 244.9), 240.9, 246.1, 246.8
Hypertension	401, 402, 403, 404, 405
Diabetes	250.4, 250.5, 250.6, 250.7, 250.8, 250.9, 250.0, 250.1, 250.2, 250.3
Asthma	493.0 (493.00, 493.01, 493.02), 493.1 (493.10, 493.11, 493.12), 493.2 (493.20, 493.21, 493.22), 493.8 (493.81, 493.82), 493.9 (493.90, 493.91, 493.92)
Smoking	305.1
Coronary artery disease	440.9, 414.00, 414.4, 414.3, 414.01, 414.06
Mitral valve prolapse	424
Obesity	278.0
Coagulopathy	286.9
Cancer	140-209, 230-239
Deep vein thrombosis	444, 453
Diagnosis category: Reason for hospitalization within 30 days after surgery	
Diagnosis	ICD-9 code
Infectious diseases	001-139
Neoplasms	130-239
Endocrine, nutritional and metabolic, immunity disorders	240-279
Disease of blood and blood forming organs	280-289
Mental disorders	290-319
Nervous system	320-359
Sensory organs	360-389
Circulatory system	390-459, 785
Respiratory system	460-519, 786

Digestive system	520-579,787
Genitourinary system	580-629,788
Skin and subcutaneous tissue	680-709,782
MSK and Connective tissue	710-739,781
Congenital anomalies	740-759
Abdonimal pain / abnormalities NOS	789
Nonspecific/Other	790-799
Injury and poisoning	800-997,999
Post-op complications	998

Table 2.

Characteristics of patients undergoing abdominal contouring surgery, 2010 to 2015

Characteristic	Study cohort, No. (%) (n=18,947)				P Value
	With PHS before surgery (n=1,045)		Without PHS before surgery (n=17,902)		
Age					
18-34	202	(19.3)	2,970	(16.6)	<0.001
35-44	158	(15.1)	3,884	(21.7)	
45-54	192	(18.4)	4,745	(26.5)	
55-64	259	(24.8)	4,358	(24.3)	
65	234	(22.4)	1,945	(10.9)	
Sex					
Male	354	(33.9)	3,980	(22.2)	<0.001
Female	691	(66.1)	13,922	(77.8)	
Median Income					
0, <40K	1	(0.11)	32	(0.21)	0.15
40K, <50K	309	(35.0)	5,128	(33.4)	
50K, <60K	428	(48.5)	7,364	(47.9)	
60K, <70K	91	(10.3)	2,019	(13.1)	
70K	53	(6.01)	835	(5.43)	
Type of Insurance					
Fee-for-service	718	(72.4)	13,080	(77.5)	<0.001
Managed care	274	(27.6)	3,807	(22.5)	
Region					
Northeast	135	(13.1)	3,086	(17.5)	<0.001
North Central	256	(24.9)	4,038	(22.9)	
South	310	(30.2)	5,600	(31.7)	
West	327	(31.8)	4,920	(27.9)	
Smoking	127	(12.2)	995	(5.56)	<0.001
Elixhauser Comorbidity Score					
0	258	(24.7)	7,330	(41.0)	<0.001
1-3	96	(9.19)	2,082	(11.6)	
4-7	216	(20.7)	4,772	(26.7)	
8	475	(45.5)	3,718	(20.8)	
Comorbidity					
Hypothyroidism	159	(15.2)	2,732	(15.3)	0.97
Hypertension	573	(54.8)	6,598	(36.9)	<0.001
Diabetes mellitus	305	(29.2)	3,094	(17.3)	<0.001
Asthma	140	(13.4)	1,784	(9.97)	<0.001

Characteristic	Study cohort, No. (%) (n=18,947)				P Value
	With PHS before surgery (n=1,045)		Without PHS before surgery (n=17,902)		
Coronary artery disease	166	(15.9)	865	(4.83)	<0.001
Mitral valve prolapse	99	(9.47)	739	(4.13)	<0.001
Obesity	343	(32.8)	4,825	(27.0)	<0.001
Coagulopathy	10	(0.96)	149	(0.83)	0.67
Cancer	307	(29.4)	4,970	(27.8)	0.26
Deep vein thrombosis	88	(8.42)	295	(1.65)	<0.001
Outcomes within 30 days after surgery					
No. Emergency Department Visits per Patient	0.16, SD =0.46		0.08, SD =0.34		<0.001
No. Hospitalizations per Patient	0.11, SD =0.36		0.04, SD =0.21		<0.001

Abbreviations: PHS, Post hospital syndrome

Logistic Regression models for the risk (probability) of having an emergency department visit or hospitalization, respectively, within 30 days after surgery in patients undergoing abdominal contouring surgery, 2010 to 2015

Table 3.

Risk of Emergency Department Visits			Risk of Hospitalizations			
N = 18,947	Adjusted odds ratios (95% CI)	P Value	Adjusted odds ratios (95% CI)	P Value		
Sex (reference group: female)						
Male	1.148	1.000-1.318	0.0499	1.288	1.089-1.522	0.0030
Type of Insurance (reference group: Fee-for-service)						
Managed care	1.154	1.006-1.325	0.0409	1.279	1.080-1.514	0.0043
Smoking						
	1.558	1.265-1.920	<0.001	1.268	0.967-1.662	0.0859
Elixhauser Comorbidity (reference group: 0)						
1-3	1.642	1.348-2.000	<0.001	2.177	1.668-2.842	<0.001
4-7	1.326	1.110-1.585	0.0019	1.817	1.433-2.304	<0.001
8	2.314	1.941-2.758	<0.001	3.854	3.071-4.836	<0.001
Comorbidity						
Hypothyroidism	1.059	0.900-1.246	0.4879	1.137	0.939-1.377	0.1876
Hypertension	1.142	1.003-1.301	0.0450	1.275	1.086-1.497	0.0029
Diabetes mellitus	1.102	0.948-1.282	0.2056	1.281	1.077-1.523	0.0052
Obesity	1.094	0.951-1.260	0.2096	1.279	1.084-1.509	0.0035
Coagulopathy	1.496	0.911-2.458	0.1118	1.464	0.838-2.557	0.1805
Cancer	0.547	0.469-0.637	<0.001	0.613	0.512-0.733	<0.001
Deep vein thrombosis	1.313	0.938-1.837	0.1121	1.792	1.273-2.522	<0.001
Post hospital syndrome						
	1.600	1.304-1.963	<0.001	1.701	1.348-2.145	<0.001

Table 4.
Diagnosis on admission for patients hospitalized within 30 days after abdominal contouring surgery, 2010 to 2015

Diagnosis type at hospitalization	Patients with PHS before surgery (n=107)		Patients without PHS before surgery (n=736)		OR	95% CI	P Value
	Number of hospitalizations	%	Number of hospitalizations	%			
Infectious diseases	10	9.4	33	4.5	2.26	1.09-4.68	0.028
Neoplasms	6	5.6	29	3.9	1.54	0.64-3.69	0.34
Endocrine, nutritional and metabolic, immunity disorders	11	3.0	88	12.0	0.87	0.45-1.68	0.68
Disease of blood and blood forming organs	3	2.8	29	3.9	0.80	0.26-2.49	0.70
Mental disorders	1	1.0	9	1.2	1.08	0.19-6.15	0.93
Nervous system	5	7.0	30	4.1	1.24	0.49-3.17	0.65
Sensory organs	0	0.0	0	0.0	--	--	--
Circulatory system	8	7.5	81	11.0	0.69	0.33-1.44	0.32
Respiratory system	9	8.4	33	4.5	2.03	0.95-4.30	0.066
Digestive system	9	8.4	74	10.1	0.86	0.42-1.75	0.67
Genitourinary system	6	5.6	28	3.8	1.59	0.66-3.84	0.30
Skin/subcutaneous tissue	8	7.5	79	10.7	0.71	0.34-1.48	0.36
MSK and connective tissue	5	4.7	26	3.5	1.44	0.56-3.70	0.45
Congenital anomalies	0	0.0	2	0.3	1.37	0.06-29.0	0.84
Abdominal pain / abnormalities NOS	2	1.9	8	1.1	2.03	0.49-8.49	0.33
Nonspecific/Other	1	1.0	3	0.4	2.95	0.43-20.3	0.27
Injury and poisoning	5	4.7	37	5.0	1.00	0.40-2.52	1.00
Post-op complications	16	15.0	125	17.0	0.88	0.50-1.54	0.65

Table 5.

Multivariable Logistic Regression model for whether having health care cost greater than \$0 among patients undergoing abdominal contouring surgery from 2010 to 2015, and Linear Regression model for health care cost among those who have health care costs

	Adjusted odds ratios (95% CI)		P Value	Regression coefficient (95% CI)		P Value
Age						
18-34	0.582	0.502-0.674	<0.001	-1240	(-2075,-404)	0.0036
35-44	0.685	0.596-0.789	<0.001	-732	(-1499,34)	0.0612
45-54	0.765	0.669-0.874	<0.001	-544	(-1245,158)	0.1287
55-64	0.790	0.692-0.901	<0.001	-555	(-1226,116)	0.1051
65			Ref.			
Sex						
Male	1.133	1.046-1.228	0.0022	653	(178,1128)	0.0071
Female			Ref.			Ref.
Median Income ^a						
0, <40K				-2875	(-7084,1334)	0.1806
40K, <50K				-2559	(-3538,-1580)	<0.001
50K, <60K				-2352	(-3254,-1451)	<0.001
60K, <70K				-2113	(-3164,-1062)	<0.001
70K						Ref.
Type of Insurance ^a						
Fee-for-service				77	(-443,597)	0.7714
Managed care						Ref.
Region ^a						
Northeast						Ref.
North Central				823	(3,1643)	0.0493
South				1020	(235,1805)	0.0109
West				1565	(795,2336)	<0.001
Smoking	1.456	1.258-1.685	<0.001	343	(-448,1135)	0.3953
Elixhauser Comorbidity						
0			Ref.			Ref.
1-3	1.624	1.455-1.812	<0.001	926	(265,1587)	0.0060
4-7	1.483	1.356-1.621	<0.001	983	(431,1535)	<0.001
8	2.306	2.070-2.569	<0.001	4118	(3515,4722)	<0.001
Comorbidity						
Hypothyroidism	1.299	1.180-1.430	<0.001	-106	(-635,423)	0.6941
Hypertension	1.309	1.211-1.415	<0.001	185	(-270,640)	0.4250

	Adjusted odds ratios (95% CI)		P Value	Regression coefficient (95% CI)		P Value
Diabetes mellitus	1.269	1.150-1.400	<0.001	636	(110,1162)	0.0177
Asthma	1.161	1.035-1.301	0.0105	-282	(-908,343)	0.3766
Coronary artery disease	1.312	1.085-1.586	0.0050	745	(-107,1596)	0.0867
Obesity	1.014	0.931-1.105	0.7499	-452	(-940,35)	0.0691
Coagulopathy	2.106	1.313-3.380	0.0020	-447	(-2273,1379)	0.6311
Cancer	1.056	0.973-1.145	0.1947	-921	(-1392,450)	<0.001
Deep vein thrombosis	1.847	1.349-2.530	<0.001	3569	(2316,4821)	<0.001
Post hospital syndrome	2.281	1.897-2.743	<0.001	3944	(3165,4724)	<0.001

^aNot included in Multivariable Logistic Regression