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Preoperative Depression Screening in Primary Lumbar Fusion: An Evaluation of Its Modifiability on Outcomes in Patients with Diagnosed Depressive Disorder

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Abstract:	Objectives: Studies have reported the detrimental effects of depression following spine surgery, however none have evaluated whether preoperative depression screening, in patients with a history of depression, is protective from adverse outcomes and lowers healthcare costs. We studied whether depression screenings/psychotherapy visits within 3 months prior to 1-2 level lumbar fusion (1-2LF) were associated with lower: 1) medical complications; 2) emergency department (ED) utilizations; 3) readmissions; and 4) healthcare costs. Methods: The PearlDiver database from 2010 to 2020 was queried for depressive disorder (DD) patients undergoing primary 1-2LF. Two cohorts were 1:5 ratio matched and included those with (n=2,622) or without (n=13,058) a pre-operative depression screen/psychotherapy visit within 3 months of LF. A 90-day surveillance period was utilized to compare outcomes. Logistic regression models computed odds ratios (OR) of complications and readmissions. P values less than 0.003 were significant. Results: DD patients without depression screening had significantly greater incidence and odds of experiencing medical complications (40.57% vs. 16.00%; OR: 2.71,p<0.0001). Rates of ED utilization were increased in patients without screening vs. screening (15.78% vs 4.23%; OR: 4.25,p<0.0001), despite no difference in readmissions (9.31% vs 9.53%; OR: 0.97,p=0.721). Finally, 90-day reimbursements ($51,160 vs $54,731) were significantly lower in the screened cohort (all p<0.0001). Conclusions: Patients who underwent a pre-operative depression screening within 3 months of lumbar fusion had decreased medical complications, ED utilizations, and lower healthcare costs. Spine surgeons may use this data to counsel their patients with depression prior to surgical intervention.

Editor/Reviewer
World Neurosurgery

April 14, 2023

Dear Editor/Reviewer:

My co-authors and I are submitting a scientific article entitled "Preoperative Depression Screening in Primary Lumbar Fusion: An Evaluation of Its Modifiability on Outcomes in Patients with Diagnosed Depressive Disorder." My co-authors and I present a manuscript describing the influence of pre-operative depression screening on postoperative complications and healthcare utilization parameters after 1-2 Level Lumbar Fusion. All authors have read the manuscript and believe the manuscript represents honest work. We look forward to hearing your comments and for the opportunity to be considered for publication in *World Neurosurgery*.

1) All authors have participated in the research and agree with the conclusions.

2) The paper has not been submitted to any other journal or presented at any meeting.

3) The paper did not require Institutional Review Board Approval.

Sincerely,

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Ethics Approval:

This study was performed in line with the principles of the Declaration of Helsinki. This study was determined to be exempt from the Institutional Review Board (IRB) of Maimonides Medical Center.

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Abbreviations

1-2LF - 1-2 level lumbar fusion

CPT: Current Procedural Terminology

DD – Depressive Disorder

ECI: Elixhauser comorbidity index

ED – Emergency Department

ICD: International Classification of Disease

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ABSTRACT

Objectives: Studies have reported the detrimental effects of depression following spine surgery, however none have evaluated whether preoperative depression screening, in patients with a history of depression, is protective from adverse outcomes and lowers healthcare costs. We studied whether depression screenings/psychotherapy visits within 3 months prior to 1-2 level lumbar fusion (1-2LF) were associated with lower: 1) medical complications; 2) emergency department (ED) utilizations; 3) readmissions; and 4) healthcare costs.

Methods: The PearlDiver database from 2010 to 2020 was queried for depressive disorder (DD) patients undergoing primary 1-2LF. Two cohorts were 1:5 ratio matched and included those with (n=2,622) or without (n=13,058) a pre-operative depression screen/psychotherapy visit within 3 months of LF. A 90-day surveillance period was utilized to compare outcomes. Logistic regression models computed odds ratios (OR) of complications and readmissions. P values less than 0.003 were significant.

Results: DD patients without depression screening had significantly greater incidence and odds of experiencing medical complications (40.57% vs. 16.00%; OR: 2.71,p<0.0001). Rates of ED utilization were increased in patients without screening vs. screening (15.78% vs 4.23%; OR: 4.25,p<0.0001), despite no difference in readmissions (9.31% vs 9.53%; OR: 0.97,p=0.721). Finally, 90-day reimbursements ($51,160 vs $54,731) were significantly lower in the screened cohort (all p<0.0001).

Conclusions: Patients who underwent a pre-operative depression screening within 3 months of lumbar fusion had decreased medical complications, ED utilizations, and lower healthcare costs.

Spine surgeons may use this data to counsel their patients with depression prior to surgical intervention.

Level of Evidence: III

Key Words: Lumbar fusion; depression; complications; lumbar spine; degenerative spine; healthcare utilization

INTRODUCTION

Depression is defined as a psychiatric condition, requiring five or more associated symptoms to be present within a 2 week period, including a depressed mood or anhedonia, appetite changes, weight changes, sleep difficulties, psychomotor agitation, fatigue or loss of energy, diminished ability to think or concentrate, feelings of worthlessness or excessive guilt, and suicidality, according to the *Diagnostic and Statistical Manual of Mental Health Disorders, Fifth Edition (DSM-V)*.[1] In the United States population alone, the prevalence of depression was reportedly 15.8% in 2019, a substantial increase from its prevalence of 8.1% in 2009.[2] Considering the current climate, COVID-19 has affected the prevalence of depression, significantly; the pooled prevalence of depression amongst various COVID studies was found to be roughly 25% in 2020, an increase in the pooled prevalence of depression of 3.44% in 2017.[3] These statistics and newfound profound increases in depression diagnoses in the United States substantiates an emergency in not just the medical field, but the political and social landscape, as well. According to the *World Health Organization's Global Burden of Disease, 2004 Update*, depression was found to be the third leading cause of death or injury, globally, with a projected increase to becoming the first leading cause of death by 2030.[4] Finally, there are associated signs and symptoms which commonly present alongside depression, including neuroticism, negative self-concept, low emotional clarity, low education status, functional impairment, chronic conditions, and anxiety, which have shown to be better indicators for predicting the risk of a depression diagnosis.[5–10]

In relation to orthopaedic surgery, recent studies have shown that those with depressive disorders (DD) are more likely to suffer increased risk for peri- and/or post-operative complications following various orthopaedic surgical interventions.[11–18] However, a multitude of these studies consolidate depression with other psychiatric comorbidities, blurring the line between the isolated impact of depression on post-operative outcomes following different orthopaedic procedures. Specifically, in relation to spine surgery, including lumbar fusion, the current literature either focuses on systematic reviews, depression in relation to pain severity, or lacks specific interventions related managing these patients.[19–21] With an almost two-fold increase in rates of lumbar fusion being performed within the United States, today, compared to rates in the year 2000, understanding how a rapidly emergent psychiatric condition may impact post-operative outcomes is essential in guiding current and future spine surgeons to better equip themselves with the knowledge necessary to reduce or prevent adverse post-surgical surgical outcomes and costs.[22] A simple cost effective screening intervention has not been evaluated among lumbar fusion patients and is hypothesized to decrease complications, healthcare utilization, and costs among these patients.

Therefore, the objectives of this study were to determine whether depression screenings/psychotherapy visits within 3 months prior to 1-2 level lumbar fusion (1-2LF) intervention were associated with lower rates of: 1) medical complications; 2) emergency department (ED) utilizations; 3) readmissions; and 4) costs to the healthcare system.

MATERIALS AND METHODS

Database and Patient Inclusion

A retrospective query of the M91Ortho dataset was performed from January 1st, 2010 to October 31st, 2020 from the subscription based PearlDiver Platform (www.pearldiver.com; PearlDiver Technologies; Fort Wayne, Indiana, USA). The database is housed within a proprietary user interface which has been used extensively for spine-related research studies involving patient demographics, medical/surgical complications, healthcare expenditures, and more. Patients are insured though Medicare or through the private insurance claims, Mariner. Patient cohorts are derived through querying Current Procedural Terminology (CPT) codes, International Classification of Disease, Ninth Revision (ICD-9), and ICD-10 diagnostic and procedural codes. The database is unable to report granular details that would compromise patient identity; therefore, this study along with all of those from our institution were deemed Health Insurance Portability and Accountability Act (HIPAA) compliant and exempt from institutional review board (IRB) approval.

Patients with a diagnosis of degenerative lumbar pathology, who underwent 1-2 level lumbar fusion were first defined. Primary lumbar fusions were identified using ICD-9 procedural codes 81.04 to 81.08. From this cohort, patients were filtered to included only those who underwent 1- to 2-level fusions using procedural code 81.62. The patient sample only included those who had degenerative lumbar spine conditions at the time of surgery. Patients with a concurrent traumatic, infectious, or malignancy diagnosis at the time of surgery were excluded from the study.

Depressive Disorder and Depression Screening

From the sample of patients undergoing 1-2 level LF, all patients with a diagnosis of depressive disorder (DD) represented the main inclusion cohort for the study. From this sample, patients were subsequently grouped based on whether they did or did not have a depression screen/psychotherapy visit within 3 months of their lumbar fusion **(Figure 1)**. True controls (ie.

patients without a diagnosis of depressive disorder) for the study were omitted as multiple prior studies have already published the outcomes of these patients using the same or similar databases.

Primary Outcomes

The primary outcomes of this study were to compare 90-day medical complications, 90-day emergency department (ED) utilizations, 90-day readmissions, in addition to day of surgery and total global 90-day episode of care reimbursements between the two groups. Economic reimbursements were conducted by analyzing reimbursements to the surgeon on the day of surgery and during the 90-day episode of care interval, as this standard has been established in previously published spine studies. All reimbursements were adjusted for inflation to 2020 U.S. Dollars (USD).

Statistical Analysis

Categorical variables including patient demographics of those with and without depression screening were compared using Pearson's Chi Square tests. To reduce any potential confounding related to disproportionally different cohort sizes, patients with screening were 1:5 ratio matched by age, sex, anxiety disorder, COPD (chronic obstructive pulmonary disease), diabetes mellitus, hypertension, obesity, and tobacco use **(Figure 1)**. Elixhauser-Comorbidity Index (ECI) was calculated for each cohort after matching. Multivariate logistic regression models were used to compute the odds ratios (OR) and 95% confidence intervals (95% CI) of developing individual and total medical complications, returning to the emergency department, and being readmitted within 90-days following LF adjusting for the aforementioned confounding comorbidities. For ease of OR interpretation, the reference group consisted of DD patients who underwent depression screening/psychotherapy visits within 3 months of surgery as they were hypothesized to have lower frequency and odds of dependent variables occurring. For continuous variables such as expenditures, comparison was performed using a student's t-test. P-values less than 0.003 were considered statistically significant after Bonferroni adjustment. Data analyses were performed using the open programming language known as R (R, Foundation for Computational Statistics; Vienna, Austria) integrated within the PearlDiver interface.

RESULTS

Baseline Demographic and Comorbidities

After ratio matching, our sample was comprised of 15,680 patients in total with depressive disorder undergoing primary 1-2 lumbar fusion **(Figure 1)**. Matching was successful as there was no difference in age, sex, and each of the comorbidities **(Table 1).** Hypertension, anxiety disorder, and tobacco use were the most frequent comorbidities in this patient population. Two-thirds of patients were diagnosed with anxiety disorder. Elixhauser comorbidity index (ECI) was clinically similar among both groups (5.4 vs 5.6).

Postoperative 90-day Medical Complications

Depressive disorder patients undergoing 1-2 level LF without depression screening within 3 months of surgery experienced significantly higher rates and odds of developing all medical complications (40.57% vs. 16.00%; OR: 2.71, 95%CI: 2.41 - 3.08, p<0.0001), including myocardial infarctions (0.76% vs. 0.00%; OR: 5.01, 95%CI: 1.84 - 13.65, p=0.002), surgical site infections (4.26% vs. 0.95%; OR: 4.64, 95%CI: 3.10 – 6.94, p<0.0001), transfusions (2.46% vs. 0.61%; OR: 4.13, 95%CI: 2.49 – 6.83, p<0.0001), cerebrovascular accidents (2.69% vs. 0.80%; OR: 3.45, 95%CI: 2.27 – 5.54, p<0.0001), pulmonary emboli (1.62% vs. 0.57%; OR: 2.87, 95%CI: 1.76 – 5.07, p<0.0001), respiratory failures (2.47% vs. 0.99%; OR: 2.54, 95%CI: 1.73 - 3.90, p<0.0001), venous thromboemboli (1.85% vs. 0.76%; OR: 2.46, 95%CI: 1.60 – 4.01, p=0.0001), and pneumoniae (5.79% vs. 2.82%; OR: 2.14, 95%CI: 1.69 – 2.75, p<0.0001) **(Table 2).**

90-day Emergency Department Utilization and Readmissions

Despite significantly greater 90-day ED utilization among DD patients without depression screening (15.78% vs 4.23%; OR: 4.25, 95%CI: 3.51-5.19, p<0.0001), there was no difference in readmissions within this time frame between groups (9.31% vs 9.53%; OR: 0.97, 95%CI: 0.84- 1.13, p=0.721).

90-Day Reimbursements

Overall day of surgery ($45,398 vs $49,303) and 90-day reimbursements ($51,160 vs $54,731) were significantly lower in patients who underwent depression screening within 3 months of lumbar fusion (all p<0.0001) **(Figure 2)**.

DISCUSSION

As rates of lumbar fusion for degenerative spine pathology continue to increase within the United States, alongside changes in the medical landscape and prevalence of depression, the importance of understanding how depressive conditions could impact surgical outcomes and costs of care will be necessary to adequately counsel patients of what expectations they should have following their intervention.[2,3,5] Though there are studies that have looked at depressive conditions and their impact on various orthopaedic-related interventions, none compare the impact of depression screening and/or psychiatric counseling on post-operative medical complications, ED utilizations, readmissions, and costs of care in patients undergoing 1-2LF. This simple intervention could potentially prevent increased healthcare utilization and impact prognosis after surgery. This study found that patients with depression who did not undergo a depression screen or psychiatric visit within 90-days prior to their scheduled 1-2LF had an increased risk for various, post-operative medical complications, and ED utilization. Patients who had a depression screen or psychiatric counseling within the allotted preoperative time frame had significantly lower day-of-surgery and overall costs of care.

The findings of this study relating to post-operative medical complications agree with the results of other investigations within the literature, although, the surrounding literature is limited in its specificity of depression and lumbar fusion outcomes.[23–26] This present study found a greater than 2.5 fold increase in the incidence and odds for adverse medical complications in patients with depression who did not undergo depression screening. O'Connell et al., using the MarketScan database from 2007 to 2014, isolated patients with depression and/or anxiety undergoing single- or multi-level lumbar fusion. They found that patients with a pre-operative diagnosis of depression had greater incidence and odds of developing a medical complication compared to a control cohort (14.2% vs. 12.2%; $p < 0.001$).[25] Similar to other studies assessing the impact of depression, the control group in the previous study consisted of patients without depression undergoing single- or multi-level lumbar fusion. Pakarinen et al. isolated patients with lumbar spinal stenosis in a hospital center between the years 2001 to 2004 who required spine surgery.[23] Questionnaires were provided to be completed pre-operatively at 3- and 6-months, and then post-operatively at 1-, 2-, and 5-years. They found that patients with a high depressive burden, compared to patients with low depressive burdens, had greater measurements for disability, post-operatively, using the Oswestry Disability Index (ODI) at 1-, 2-, and 5-year intervals (31.8 vs. 16.1, $p < 0.01$; 30.5 vs. 15.5, $p < 0.01$; 32.0 vs. 18.9, $p < 0.01$, respectively). Although rates of disability were measured, there is still a lack of evidence in the literature regarding pre-surgical depression screenings and post-operative medical outcomes. Goyal et al. isolated patients with depression and anxiety, depression or anxiety, or neither, undergoing 1- to 3-level lumbar fusion at a single academic hospital between the years 2013 and 2017.[24] Their study found that patients with a pre-operative diagnosis of depression or anxiety had greater ODI scores compared to those without depression nor anxiety (48.1 vs. 40.0, $p < 0.001$). Although not spine-related, there are other studies that have analyzed the impact of depressive conditions on post-surgical medical complications. For example, Swiggett et al., using the PearlDiver database, isolated Medicare patients with depression undergoing primary total shoulder arthroplasty from 2005 to 2014. They found that patients with depression suffered greater incidence and odds for experiencing any medical complication within a 90-day period compared to patients without depressive disorder.[26] Although there are studies populating the field of orthopaedics with depression-related analyses and their association with adverse events, none have looked at the impact of pre-operative, time-dependent depression screening or psychotherapy in patients with depression compared to those who did not receive a screening in relation to medical complication rates. This simple intervention may aid spine surgeons to optimize patients who generally may require more care and/or be at risk for increased medical complications. Discussion of preoperative screenings with other healthcare providers, such as primary care physicians, or psychiatrists could serve to improve safety and outcomes in these patients.

Despite other studies demonstrating incidence and risk factors for ED utilization following lumbar fusion, the influence of pre-operative depression screening in DD patients, compared to patients with depression without screening are devoid from the literature.[27,28] This present study found that patients with depression who received a pre-operative depression screening within 3 months of surgery had a 4-fold greater odds of returning to the ED within 90-days, post-operatively. Jain et al. isolated patients undergoing primary lumbar fusion from the PearlDiver database between the years 2007 through Q3-2015. They found that patients with depression had increased incidence and odds for returning to the ER within 30-days after their surgical intervention (29.2% vs. 22.3%; Adjusted Odds Ratio (AOR): 1.19, 95%CI: 1.10 – 1.30, $p < 0.001$).[27] Similarly, Wiley et al. isolated patients undergoing primary lumbar fusion from a prospective, multi-surgeon, single-center electronic medical record from 2013 to 2017, and found that patients with at least one chronic medical condition had increased odds for returning to the ER within 90-days post-operatively (OR: 1.40; 95%CI: 1.10 – 1.70, $p = 0.002$).[28] Our findings provide a potential avenue for further study as a depression screen or psychotherapy visit can decrease potential healthcare utilization in these patients. Understanding this potential correlation would aid spine surgeons in preparing for emergent conditions which may arise following their performed surgical intervention.

Even with greater ED utilizations, rates of readmission were found to be statistically insignificant between groups within this present study. The impact of depression on readmission rates is somewhat mixed in the existing literature.[25,26,29,30] Huang et al., utilizing the National Health Insurance Research Database, isolated patients with depression and degenerative thoracic/lumbar spine disease undergoing discectomy, laminectomy, or spinal fusion between the years 1998 to 2013. They found that patients with depression had no increased rates of readmissions compared to patients with an anxiety (OR: 1.12; 95%CI: 0.89 – 1.41, $p = 0.334$) or bipolar disorder diagnosis (OR: 1.20; 95%CI: 0.61 – 2.36, $p = 0.593$). Additionally, they found that patients with any psychiatric condition did not have an increased risk for readmission compared to patients without a psychiatric diagnosis ($p = 0.483$).[29] On the other hand, O'Connell et al. found that patients with a pre-operative diagnosis of depression had increased incidence for readmissions following lumbar fusion compared to patients without depression (6.7% vs. 4.8%, $p < 0.001$).[25] Factors which may explain the discrepancy from our study include a follow-up period limited to 30 days, while the present study utilized a 90-day follow-up period. Additionally, they compared a true control cohort of patients without a diagnosis of depression, while this present study controlled for depression to assess the influence of screening or psychotherapy. Other studies have found that a depressive diagnosis increases readmission rates in other orthopaedic-related interventions.[26,30] Swiggett et al., found that patients with depression undergoing primary total shoulder arthroplasty had a 1.5 increased odds for readmission within a 90-day period.[26] Similarly, Vakharia et al. isolated patients with or without depression undergoing primary total knee arthroplasty between the years 2005 to 2014, and found that patients with depression had greater incidence and odds of readmission compared to patients without depression.[30] Although the orthopaedic-related literature supports the notion that the presence of a depressive condition increases risk for readmissions postoperatively, there is a relative scarcity of literature pertaining to specific screening interventions which may influence readmissions after 1-2LF.

The economic effects of depression screening seem favorable. Interestingly, patients with depression who were screened within 3 months of their surgery were found to have reduced day-of-surgery and overall costs of care within a 90-day timeframe, post-operatively (\$45,398 vs. \$49,303, $p < 0.0001$ and \$51,160 vs. \$54,731, $p < 0.0001$). There are no studies that have looked at this association, although there are studies that have found that patients with depression incur greater costs of care following spine surgery and other orthopaedic-related interventions. [31,32] Ren et al. collected data from the Medical Expenditure Panel Survery from 2007 to 2015, isolating patients with depression who underwent various spine-related surgical procedures. They found that patients with depression had increased cost ratios than those without depression (Cost Ratio: 1.42; 95%CI: 1.34 – 1.52; $p < 0.001$) and had difference in expenditures of roughly \$3,400 compared to controls. [31] Ciminero et al. performed a retrospective query of the 100% Medicare Standard Analytical Files (SAF) to identify patients with depression who underwent open reduction and internal fixation (ORIF) for an acetabular fracture between the years 2005 to 2014. Their analysis found that patients with depression had significantly greater day of surgery and total global 90-day costs of care. [32] Although these studies, amongst others, support the claim that depression may result in greater healthcare expenditures in patients undergoing various orthopaedic-related surgical procedures, there is a scarcity of literature that compares pre-operative depression screenings in patients with depression. Understanding this association could aid spine surgeons and researchers to investigate exactly how a preoperative depression screen may reduce expenditures. In totality, the cumulative cost savings assessed through predictive modeling could determine if the time and cost benefit of simply screening depressive disorder patients is warranted.

There are limitations this study that may influence the findings. Limitations include a lack of medication stratification for those diagnosed with depression, inability to scale the severity of depression, the study's retrospective nature, lack of granularity of some of the outcomes assessed, and the follow-up period utilized. A depression diagnosis typically includes a medication regimen. Stratifying by medication type and dosage could allow for specific analyses on which medical complications are more prevalent in these different cohorts. Given the plethora of studies in the literature that have already analyzed the association of a depression diagnosis in various spine-related interventions, this study did not include a true control group.[19–21,33,34] The cause of ED utilizations were not analyzed in further detail and represent another limitation. Finally, the follow-up period utilized presents as another limitation of this study. A 90-day follow-up time allows for enough data to make preliminary conclusions on the primary outcomes studied, but a longer follow-up period, would allow for complete data extraction and data analysis to better validify the results found in this study. Despite these limitations, there is an absence of literature pertaining to 1-2LF in relation to pre-operative depression screenings/psychiatric counseling in patients with depression. Furthermore, this study is the first to undertake this new approach in studying depressive symptoms in a common orthopaedic-related intervention. Finally, this study provides a better picture for spine surgeons based on the primary outcomes analyzed and discussed, allowing for higher-quality patient outcomes in the future.

This study demonstrates that patients with depression who did not have depression screening or psychiatric counseling within 90-days prior to 1-2LF had greater risk for experiencing medical complications, utilizing the ED, and costs of care within 90 days following surgery. Spine surgeons treating patients with depression should recommend a depression screening prior to 1-2LF to decrease adverse events and healthcare utilization after primary lumbar fusion. Better collaboration between spine surgeons and other healthcare providers may allow for coordination of a simple depression screening into preoperative protocols. As the U.S. population continues to face an unprecedented increase in the prevalence of depression and lumbar fusion, understanding the effect of preoperative depression screening is essential to providing modified patient care to maximize patient recovery, outcomes, and expenditures.

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Legends for Figures:

Figure 1. Flow Chart Depicting Inclusion and Exclusion of Patients

Figure 2. Comparison of Day of Surgery and 90-day surgical reimbursements for depressive disorder patients with and without depression screening within 90 days of primary 1-2 level lumbar fusion. Both day of surgery ($45,398 vs $49,303) and 90-day reimbursements ($51,160 vs $54,731) were significantly lower in screened patients ($p<0.0001$).

DEMOGRAPHICS	Depressive Disorder Patients With Screening n	%	Depressive Disorder Patients Without Screening n	%	*p*-value$^{\Delta}$
Age (Years)					
15-19	*	*	*	*	0.99
20-24	*	*	*	*	
25-29	31	1.2	152	1.2	
30-34	89	3.4	443	3.4	
35-39	168	6.4	837	6.4	
40-44	298	11.4	1491	11.4	
45-49	421	16.1	2104	16.1	
50-54	493	18.8	2461	18.8	
55-59	446	17.0	2224	17.0	
60-64	320	12.2	1593	12.2	
65-69	189	7.2	942	7.2	
70-74	100	3.8	499	3.8	
75-79	52	2.0	249	1.9	
Sex					
Female	1795	68.5	8944	68.5	0.99
Male	827	31.5	4114	31.5	
Comorbidities					
Depressive Disorder	2622	100.0	13,058	100.0	-
Anxiety Disorder	1764	67.3	8784	67.3	0.99
Hypertension	2083	79.4	10400	79.6	0.84
Obesity	1475	56.3	7347	56.3	0.99
Diabetes Mellitus	1307	49.8	6503	49.8	0.98
COPD	1400	53.4	6978	53.4	0.98
Tobacco Use	1633	62.3	8141	62.3	0.97
Comorbidity Burden					
ECI	5.4		5.6		0.009

Table 1. Demographics of Depressive Disorder Patients with and without Depression Screening within 3 Months of Primary 1-2 Level Lumbar Fusion. ECI = Elixhauser Comorbidity Index; * = <11 Patients; N/A = Not Applicable; $^{\Delta}$ = Assessed by Pearson's χ^2

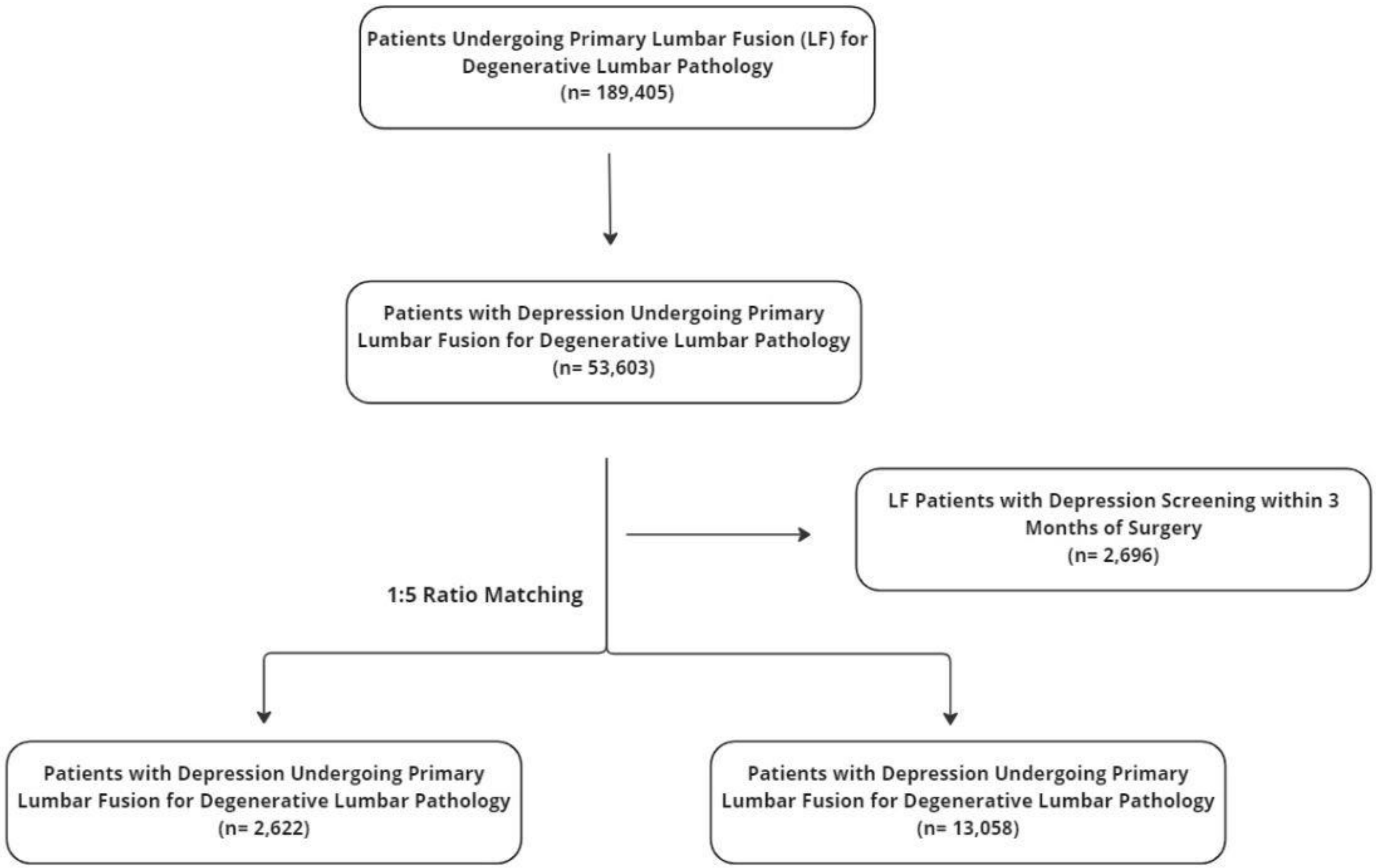
	Depressive Disorder Patients With Screening (%)	Depressive Disorder Patients Without Screening (%)	OR	95% CI	*P*-value
Urinary Tract Infections	7.17	14.22	2.21	1.89-2.59	**<0.0001**
Acute Kidney Injuries	1.33	4.14	3.26	2.34-4.60	**<0.0001**
Pneumoniae	2.82	5.79	2.14	1.69-2.75	**<0.0001**
Myocardial Infarctions	*	0.76	5.01	1.84-13.65	**0.002**
Transfusions	0.61	2.46	4.13	2.49-6.83	**<0.0001**
Surgical Site Infections	0.95	4.26	4.64	3.10-6.94	**<0.0001**
Venous Thromboemboli	0.76	1.85	2.46	1.60-4.01	**0.0001**
Pulmonary Emboli	0.57	1.62	2.87	1.76-5.07	**<0.0001**
Deep Venous Thrombosis	*	0.31	1.37	0.63-3.60	0.470
Cerebrovascular Accidents	0.80	2.69	3.45	2.27-5.54	**<0.0001**
Respiratory Failures	0.99	2.47	2.54	1.73-3.90	**<0.0001**
Total Medical Complications	16.00	40.57	2.71	2.41-3.08	**<0.0001**

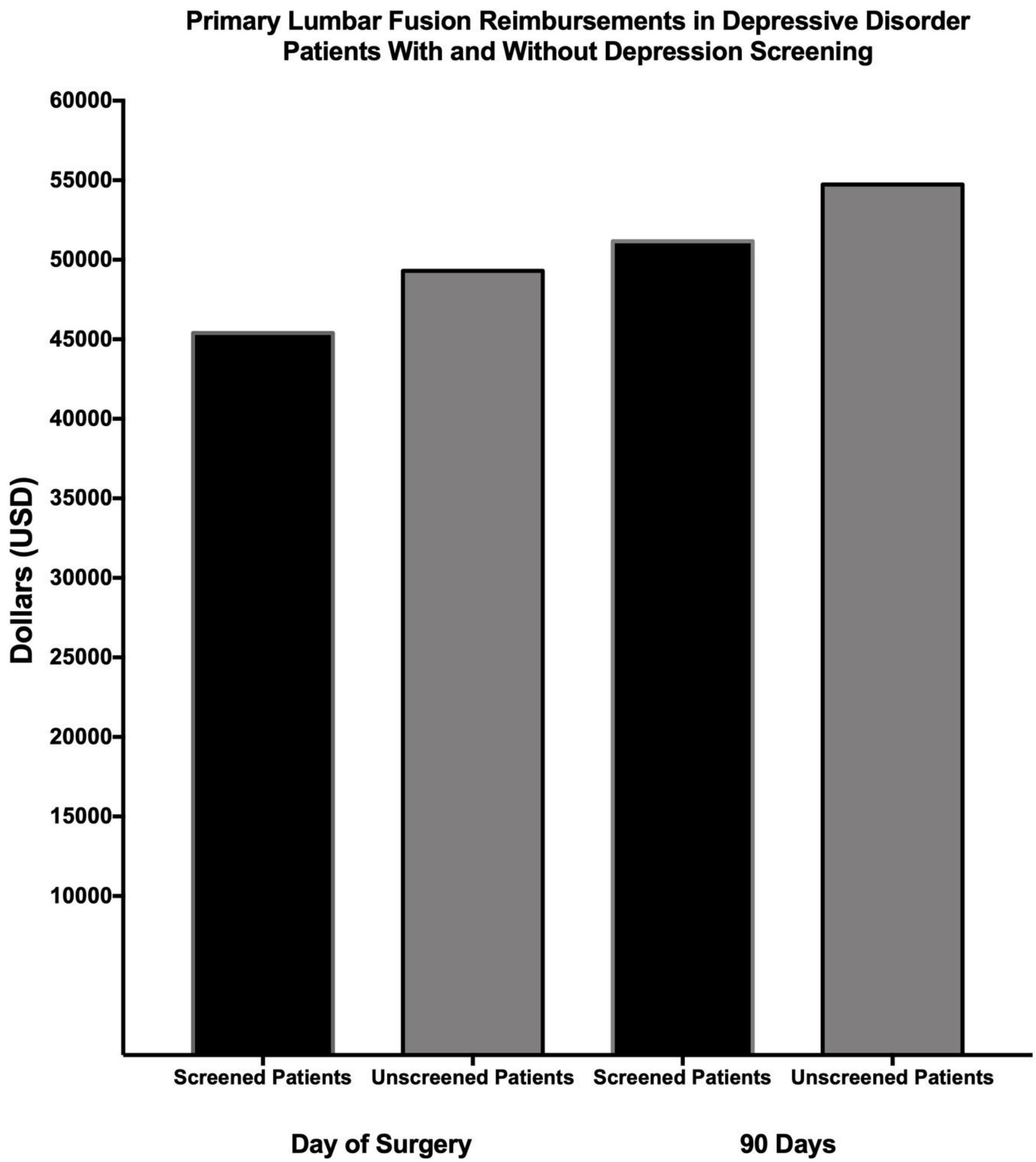
Table 2. Comparison of Incidence and Odds of Ninety-Day Medical Complications of Depressive Disorder Patients with and without Depression Screening undergoing Primary 1-2 Level Lumbar Fusion.

OR = Odds-Ratio; 95% CI = 95% Confidence Interval

* = <11 Patients

Bold Values denote statistical significance.


Patients Undergoing Primary Lumbar Fusion (LF) for Degenerative Lumbar Pathology
(n= 189,405)
Patients with Depression Undergoing Primary Lumbar Fusion for Degenerative Lumbar Pathology
(n= 53,603)
LF Patients with Depression Screening within 3 Months of Surgery
(n= 2,696)
1:5 Ratio Matching
Patients with Depression Undergoing Primary Lumbar Fusion for Degenerative Lumbar Pathology
(n= 2,622)
Patients with Depression Undergoing Primary Lumbar Fusion for Degenerative Lumbar Pathology
(n= 13,058)


Primary Lumbar Fusion Reimbursements in Depressive Disorder Patients With and Without Depression Screening
Dollars (USD)
60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
Screened Patients
Unscreened Patients
Screened Patients
Unscreened Patients
Day of Surgery
90 Days

Adam Gordon: Conceptualization, Formal analysis, Data curation, Writing - Original Draft, Writing - Review & Editing.
Faisal Elali: Writing - Original Draft, Writing - Review & Editing.
Andy Ton: Writing – Original Draft, Conceptualization
Jake Schwartz - Writing - Original Draft, Writing - Review & Editing.
Chaim Miller - Writing - Original Draft, Conceptualization, Methodology, Review & Editing.
Ram K. Alluri - Review & Editing, Supervision, Project administration