Outpatient spine surgery: defining the outcomes, value, and barriers to implementation

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Spine surgery is a key target for cost reduction within the United States health care system. One possible strategy involves the transition of inpatient surgeries to the ambulatory setting. Lumbar laminectomy with or without discectomy, lumbar fusion, anterior cervical discectomy and fusion, and cervical disc arthroplasty all represent promising candidates for outpatient surgeries in select populations. In this focused review, the authors clarify the different definitions used in studies describing outpatient spine surgery. They also discuss the body of evidence supporting each of these procedures and summarize the proposed cost savings. Finally, they examine several patient- and surgeon-specific considerations to highlight the barriers in translating outpatient spine surgery into actual practice.

<https://thejns.org/doi/abs/10.3171/2018.2.FOCUS17790>

KEYWORDS anterior cervical discectomy and fusion; cervical disc arthroplasty; lumbar laminectomy; transforaminal lumbar interbody fusion; minimally invasive surgery; ambulatory surgery; cost; outcomes; outpatient

SPINE surgery is one of the most impactful targets for reducing costs within the United States health care system.³² An estimated \$90 billion is spent each year on the diagnosis and management of low-back pain alone.²⁸ As summarized by Resnick et al., spinal disorders are an ideal target for cost reduction because of their high prevalence and significant contribution to morbidity- and disability-related costs.³⁶ Furthermore, there is significant variability in the treatment paradigms for spinal disorders—representing the entire spectrum of pain medications, acupuncture, massage therapy, steroid injections, surgical decompression and fusion, and beyond. It is the enormous clinical burden of spinal disease paired with treatment heterogeneity that creates an opportunity to empirically define real value and produce savings for the health care system.

One promising but controversial cost reduction strategy involves transitioning surgical procedures to an outpatient setting. More than 54 million outpatient procedures are performed annually in the United States. Among Medicare beneficiaries, rates of outpatient surgery have increased by 40% in the last 10 years. And the number of ambulatory

surgery centers has grown by 60% within the same time period.²¹ Although eye surgeries, arthroscopic procedures, peripheral nerve cases, and soft tissue cases represent the majority of ambulatory operations, an increasing proportion of spine surgeries has transitioned to the outpatient setting.^{2,5,7} Lumbar laminectomy with or without discectomy, lumbar fusion, anterior cervical discectomy and fusion, and cervical disc arthroplasty all represent promising candidates for outpatient surgeries in select populations.

In this focused review, we clarify the different definitions used in studies describing outpatient spine surgery. We also discuss the body of evidence supporting the transition of each of these procedures to an outpatient setting and summarize the proposed cost savings. Finally, we examine several patient- and surgeon-specific considerations to highlight the barriers in translating outpatient spine surgery into actual practice.

Definitions

Within the current body of literature describing outpatient spine surgery, there exists a heterogeneous and ill-

defined set of terms that obscures true understanding of the outcomes and cost savings. Fundamentally, any time a patient is discharged from the hospital and has not been admitted to an inpatient ward, they have undergone an outpatient surgery. However, from a reimbursement perspective, there is a clear delineation between a patient whose recovery is observed within a reasonable amount of time before discharge (for example, 4–6 hours in the *Medicare Claims Processing Manual*, Chapter 4, Section 290.2.2) and a patient who is observed for an extended period of time (< 24 hours). Both of these patient encounters, from an outcomes perspective, can be grouped together as an outpatient procedure but carry different hospital utilization costs.

Similarly, utilization differs between an outpatient procedure performed in association with a hospital and one performed at a freestanding ambulatory surgery center. Idowu et al. examined this difference and found that, although there has indeed been a dramatic increase in the number of hospital-associated outpatient spine operations, there has been a significantly less pronounced increase in spine surgery at freestanding ambulatory centers.²³ In general, the lack of granularity regarding these definitions represents a significant limitation of the literature describing outpatient outcomes.

Outcomes

Lumbar Laminectomy and Discectomy

Lumbar laminectomy with or without discectomy remains the most common spine operation performed in the United States and was one of the earliest procedures to be successfully transitioned to the outpatient setting (Table 1). Several groups have reported clinical series describing favorable outcomes.^{8,10,22,25,33,47} Helseth et al. reported on a series of 1073 consecutive patients undergoing lumbar procedures at a freestanding neurosurgical clinic with a successful discharge rate of 99.8% on the day of surgery.¹⁹ No patients died within 30 days, and the 90-day readmission rate was 1.5%. Nine patients (0.6%) suffered a postoperative hematoma, which was recognized and evacuated postoperatively, and these patients were subsequently discharged the same day. Notably, this study was conducted in Oslo, Norway, in a health care ecosystem distinct from that of the United States. Another group of investigators studied 212 consecutive patients in the United States, who had undergone a first operation for lumbar disease; the authors reported the overall success rate at 2 years as 75%–80%, as defined by the visual analog scale and Oswestry Disability Index.⁴ In their cohort, the average hospital stay was 5 hours, and only 1 patient (0.5%) was admitted to the inpatient service following surgery. Best and Sasso analyzed outcomes for 233 consecutive patients 65 years of age or older who underwent outpatient lumbar decompression, finding an inpatient admission conversion rate of 4.1% and an overall complication rate of 7.1%.⁸ In addition to single-center cohort studies, the overall trends and outcomes for lumbar laminectomy and discectomy have been analyzed using large surgical databases. Pugely and colleagues performed a propensity score–matched analysis of 4310 lumbar discectomy cases in the American College

of Surgeons database.³⁴ Interestingly, in the matched cohort, the inpatient group had a significantly higher rate of complications (OR 1.521) even after adjusting for potential confounders. Moreover, an advanced age, diabetes, and operative times longer than 150 minutes were independent predictors of a postoperative complication. All data taken together, lumbar decompression has the strongest evidence for safety in the outpatient setting.

Lumbar Fusion

The literature regarding lumbar fusion in the outpatient setting is more limited than that regarding decompression with or without discectomy (Table 2). Conceptually, as minimally invasive fusion techniques continue to evolve, this is a promising group of operations to transition to outpatient procedures. Several smaller cohort studies have reported favorable outcomes from minimally invasive transforaminal lumbar interbody fusion and posterior fusion performed in the outpatient setting.¹⁶ One technical modification to posterior fusion includes the use of mid-line cortical bone trajectory pedicle screws to reduce the amount of muscle dissection and tissue destruction without sacrificing fusion rates.¹² Another promising avenue involves the use of lateral fusion techniques, which may also reduce postoperative pain and thus enable earlier discharge. Smith et al. performed a retrospective analysis of 1033 patients treated with minimally invasive lateral interbody fusion and grouped patients according to length of stay.³⁹ They found that a younger age, lower body mass index, less advanced disease, and higher preoperative hemoglobin levels were predictive factors for discharge within 24 hours. In the prospective arm, the authors performed 54 lateral and 18 posterior fusions in an ambulatory setting with no transfers to an inpatient facility. Two additional patients (3.7%) visited the emergency department within 30 days. Another author group prospectively compared 70 consecutive patients undergoing lateral fusion in either an inpatient or outpatient setting.¹¹ There were no significant baseline differences in characteristics between the two cohorts, including age, body mass index, or pathological level treated. Additionally, fusion was achieved in all patients. Between the two groups, the outpatient cohort benefited from significant improvement in the Oswestry Disability Index, less blood loss, and shorter operative time. Overall, these studies suggest that for young, healthy patients, a lateral fusion may be well tolerated with same-day discharge. However, the overall reported readmission rates tended to be higher than those in the lumbar decompression and/or discectomy literature.

Anterior Cervical Discectomy and Fusion

There is a growing body of evidence in support of anterior cervical discectomy and fusion (ACDF) performed in the outpatient setting (Table 3). However, unlike in lumbar surgery, the specter of neck hematoma and airway compromise creates an additional barrier to changes in practice.

The first reports of outpatient ACDF were small, single-surgeon feasibility studies reporting on fewer than 100 patients undergoing 1- or 2-level surgery with same-

TABLE 1. Summary on the safety of and outcomes for outpatient lumbar laminectomy and discectomy

Authors & Year	Study Information	Type of Surgery	Observations/Conclusions	Outcomes
Asch et al., 2002	Single institution, prospective, 212 outpatients	Lumbar microdiscectomy	Workers' comp & age had negative impact on outcome	Success rate 75%–80% at 2 yrs, 1 patient (0.5%) admitted to inpatient service after surgery
Best & Sasso, 2007	2 surgeons, patient age ≥ 65 yrs, study dates 1992–2001	Lumbar decompression: 1377	Lumbar spine surgical decompression safe as outpatient procedure in elderly patients	Required hospital stay: 30 (11.4%), converted to inpatient due to complication: 10 (4.1%), any complication: 4 (7.1%), 72.5% patients who completed questionnaire said they would repeat outpatient procedure; 69.1% said surgical outcome produced good or better function than preop level
Walid et al., 2010	Reviewed patients who went through common process of surgery venue selection: 97 outpatients, 578 inpatients	ACDF (levels unspecified), lumbar microdiscectomy, lumbar decompression w/ or w/o fusion	Mean age older in inpatients ($p < 0.001$); prevalence of DM, CHF, heart disease, CABG/stent/balloon angioplasty, knee problems, & depression higher in inpatients ($p < 0.05$); prevalence of COPD & history of stroke higher in outpatient cervical surgery cohort ($p < 0.05$)	Outpatients: any complication 1 (1.0%), postop infection 1 (1.0%); inpatients: any complication 16 (2.8%), postop infection 16 (2.8%); all patients w/ complications obese
Pugely et al., 2013	NSQIP, study dates 2005–2010, 1652 (38.3%) outpatients, 2658 (61.7%) inpatients	Single-level lumbar discectomy	Complication rate higher in inpatients ($p < 0.0001$); age, DM, preop wound infection, blood transfusion, op time, & inpatient hospital stay all independent risk factors for short-term complication; surgeons should consider outpatient surgery in appropriate candidates	Complication rates: 3.5% outpatients, 6.5% inpatients
Lang et al., 2014	Two academic hospitals, study dates 2008–2012, 368 after outpatient protocol, 643 before outpatient protocol	Lumbar discectomy	w/ implementation of outpatient protocol, outpatient lumbar discectomy safe & effective; improving periop pain management & ensuring cases scheduled early in the day may decrease admissions	Before outpatient protocol: admission rate 96.4%, 30-day readmission 2.3%, ED visit w/o admission 1.1%; after outpatient protocol: admission rate 50.3%, 30-day readmission 4.6%, ED visit w/o admission 2.2%; most common reasons for admission after protocol implemented: uncontrolled pain 18.9%, late op start times 14.1%, comorbidities 13%, intraop complications (almost all dural tears) 11.9%
Best et al., 2015	National Survey of Ambulatory Surgery	Discectomy, laminectomy, fusion	Ambulatory surgeries for intervertebral disc disorders & spinal stenosis increased btwn 1994 & 2006	
Helseth et al., 2015	Private clinic, single institution, prospectively recorded complications, study dates 2008–2013, 1449 outpatients	Microsurgical decompression: lumbar 1073, cervical 376	In favor of outpatient spinal surgery for properly selected patients	Surgical mortality: 0 (0%), any complication: 51 (3.5%), same-day admission: 3 (0.2%), admission w/in 3 mos: 22 (1.5%), hematoma: 9 (0.6%), neurological deterioration: 4 (0.3%), deep wound infection: 13 (0.9%), dural lesion & CSF leakage: 15 (1.0%), persistent dysphagia: 2 (0.1%), persistent hoarseness: 2 (0.1%), severe pain/headache: 6 (0.4%), reoperation: 67 (4.6%), all life-threatening hematomas detected w/in hrs after cervical (6 hrs) & lumbar (3 hrs) surgery

CONTINUED ON PAGE 4 »

» CONTINUED FROM PAGE 3

TABLE 1. Summary on the safety of and outcomes for outpatient lumbar laminectomy and discectomy

Authors & Year	Study Information	Type of Surgery	Observations/Conclusions	Outcomes
Emami et al., 2016	Single institution, study dates Jan–Dec 2012, 32 outpatients, 64 inpatients	1- or 2-level MI TLIFs	Outpatients significantly younger, had lower ASA physical status scores & lower CCIs than inpatients; no statistical difference in overall postop complication rate, readmission rate, final ODI or VAS scores	Outpatients: neurological (allograft malposition or persistent nerve root compression) 2, postop hematoma 0, incidental durotomy 0, SSI 0, instrumentation (pedicle screw malposition, hardware prominence, rod disengagement) 1; inpatients: neurological (allograft malposition or persistent nerve root compression) 3, postop hematoma 2, incidental durotomy 1, SSI 3, instrumentation (pedicle screw malposition, hardware prominence, rod disengagement) 1
Chin et al., 2016	Multiple institutions, 30 outpatients, 40 inpatients	Single-level LLIF w/ supplemental pst fixation at each lumbar level from L-1 to L-5; LLIF performed at ASC or as inpatient procedure	LLIF as outpatient procedure has significant improvement in ODI scores compared to scores for inpatient procedure ($p = 0.013$); outpatient LLIF improves patient outcome w/ similar safety as inpatient procedure	Complication rate for inpatient > that for ASC; ASC dermatome numbness: 2 (7%); inpatient dermatome numbness: 4 (10%); weakness: 3 (7.5%); inability to walk: 1 (2.5%)
Chin et al., 2017 ¹³	Single surgeon, ASC, study dates 2008–2014, 557 ASC, 210 inpatients	Inpatient: decompression 71, fusion 138; outpatient: decompression 150, fusion/disc replacement 197	Majority of spine surgery can be done as outpatient procedure after meeting certain eligibility criteria	Overall revision surgery 14%, overall complication rate 5%
Idowu et al., 2017	Truven Health Marketscan Research Databases, study dates 2003–2014, inpatient hospital, outpatient hospital, ASC	Lumbar fusion, lumbar decompression, ant cervical fusion, pst cervical decompression, pst cervical fusion	True ambulatory surgeries (defined as at ASC) not increasing at same rate as outpatient procedures	
Yen & Albargi, 2017	Single institution, 2 18-mo periods, pre- & postimplantation of ambulatory outpatient protocol	Lumbar laminectomy	1 readmission in inpatient cohort, outpatient & overnight laminectomy safe, out of town patients also safe	No patients required postop admission to hospital or readmission in 30 days; inpatient readmission: 1

ant = anterior; ASA = American Society of Anesthesiologists; ASC = ambulatory surgery center; CABG = coronary artery bypass grafting; CCI = Charlson Comorbidity Index; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; DM = diabetes mellitus; ED = emergency department; LLIF = lateral lumbar interbody fusion; MI = minimally invasive; NSQIP = National Surgical Quality Improvement Program; ODI = Oswestry Disability Index; pst = posterior; SSI = surgical site infection; TLIF = transforaminal lumbar interbody fusion; VAS = visual analog scale.

day discharge.^{38,40,42,43} There were no reported deaths, and overall complication rates ranged from 0% to 2%. In these reports, only 1 patient required conversion to inpatient status for neck swelling and this patient did not require reoperation. The initial studies provided proof of concept but were limited by a lack of statistical power to show a difference between inpatient and outpatient ACDF. More recently, there have been several larger clinical series and database studies reporting direct comparisons of inpatient and outpatient ACDF. McGirt et al. obtained 1442 ACDF cases (650 inpatients, 792 outpatients) from the American College of Surgeons database, and after propensity matching for 32 covariates such as number of levels, medical comorbidities, age, and sex, these authors found that outpatient ACDF had 58% reduced odds of a major

morbidity and 80% lower odds of reoperation within 30 days (ORs 0.42 and 0.20, respectively).²⁹ The same author group analyzed 1000 consecutive ACDF patients, all of whom had been observed for at least 4 hours prior to discharge.¹ Notably, all of the patients had American Society of Anesthesiologists physical status class I or II, all underwent 1- or 2-level ACDF, and all cases began before noon. Overall, 8 patients (0.08%) were transferred to inpatient status. There were no significant differences between the inpatient and outpatient cohort in the 30- and 90-day readmission or reoperation rate. Several other surgical database studies have since corroborated these findings in support of outpatient 1- or 2-level ACDF with an overall low comorbidity profile.^{17,24,35} Additionally, Ban and colleagues performed a meta-analysis and systematic review,

TABLE 2. Summary on the safety of and outcomes for outpatient lumbar fusion

Authors & Year	Study Information	Type of Surgery	Observations/Conclusions	Outcomes
Walid et al., 2010	Reviewed patients who went through common process of surgery venue selection: 97 outpatients, 578 inpatients	ACDF (levels unspecified), lumbar microdiscectomy, lumbar decompression w/ or w/o fusion	Mean age older in inpatients ($p < 0.001$); prevalence of DM, CHF, heart disease, CABG/stent/balloon angioplasty, knee problems, & depression higher in inpatients ($p < 0.05$); prevalence of COPD & history of stroke higher in outpatient cervical surgery cohort ($p < 0.05$)	Outpatients: any complication 1 (1.0%), postop infection 1 (1.0%); inpatients: any complication 16 (2.8%), postop infection 16 (2.8%); all patients w/ complications obese
Best et al., 2015	National Survey of Ambulatory Surgery	Discectomy, laminectomy, fusion	Ambulatory surgeries for intervertebral disc disorders & spinal stenosis increased btwn 1994 & 2006	
Chin et al., 2017 ¹²	ASC, single surgeon, 16 outpatients	1-level PLIF or TLIF (direct open, single-level PLIF)	Direct open PLIF done safely w/ significant reduction in average pain & ODI scores	Worsened back pain & possible aseptic discitis: 1 (6.3%)
Chin et al., 2016	Multiple institutions, 30 outpatients, 40 inpatients	Single-level LLIF w/ supplemental pst fixation at each lumbar level from L-1 to L-5; LLIF performed at ASC or as inpatient procedure	LLIF as outpatient procedure has significant improvement in ODI scores compared to scores for inpatient procedure ($p = 0.013$); outpatient LLIF improves patient outcome w/ similar safety as inpatient procedure	Complication rate for inpatients > that for outpatients; ASC dermatome numbness: 2 (7%); inpatient dermatome numbness: 4 (10%), weakness: 3 (7.5%), inability to walk: 1 (2.5%)
Emami et al., 2016	Single institution, study dates Jan–Dec 2012, 32 outpatients, 64 inpatients	1- or 2-level MI TLIFs	Outpatients significantly younger, had lower ASA physical status scores & lower CCIs than inpatients; no statistical difference in overall postop complication rate, readmission rate, final ODI or VAS scores	Outpatients: neurological 2, postop hematoma 0, incidental durotomy 0, SSI 0, instrumentation (pedicle screw malposition, hardware prominence, rod disengagement) 1; inpatients: neurological 3, postop hematoma 2, incidental durotomy 1, SSI 3, instrumentation (pedicle screw malposition, hardware prominence, rod disengagement) 1
Smith et al., 2016	ASC, predictive arm: 873 d/c <24 hrs (outpatients), 160 d/c >23 hrs (inpatients); clinical study: 54 consecutive XLIF & 18 consecutive MI pst fusion	Lumbar fusion (1–4 levels), XLIF, MI pst fusion	Select patients can be treated as outpatients w/ XLIF & other MI surgical approaches; based on predictive study: younger age, higher preop hemoglobin, fewer levels, lower BMI, & less advanced disease may predict early d/c	Clinical study (72): no intraop or postop complications in either XLIF or MI pst fusion cohort; no transfers to inpatient facility
Idowu et al., 2017	Truven Health Marketscan Research Databases, study dates 2003–2014, inpatient hospital, outpatient hospital, ASC	Lumbar fusion, lumbar decompression, ant cervical fusion, pst cervical decompression, pst cervical fusion	True ambulatory surgery (defined as at ASC) not increasing at same rate as outpatient procedures	
Chin et al., 2017 ¹²	Prospective, single institution, 30 CBT pedicle screws OSC, 30 traditional pedicle screws inpatient	Pst lumbar fixation	Successful lumbar fusions in OSC using midline CBT pedicle screw; traditional method may still work as outpatient procedure, but authors claim midline technique is more advantageous; OSC led to significant improvement in VAS back pain ($p = 0.004$) and ODI ($p = 0.027$) scores; similar fusion rate at 2 yrs	
Chin et al., 2017 ¹³	Single surgeon, ASC, study dates 2008–2014, 557 ASC, 210 inpatients	Inpatient: decompression 71, fusion 138; outpatient: decompression 150, fusion/disc replacement 197	Majority of spine surgery can be done as outpatient procedure after meeting certain eligibility criteria	Overall revision surgery 14%, overall complication rate 5%

BMI = body mass index; d/c = discharge; LLIF or XLIF = lateral lumbar interbody fusion; CBT = cortical bone trajectory; OSC = outpatient surgery center; PLIF = posterior lumbar interbody fusion.

TABLE 3. Summary on the safety of and outcomes for outpatient anterior cervical spine surgeries

Authors & Year	Study Information	Type of Surgery	Observations/Conclusions	Outcomes
Silvers et al., 1996	Single institution, study dates May–Dec 1994, 50 prospectively analyzed outpatients, 53 retrospectively analyzed inpatient controls	1- to 2-level ACDF	No statistically significant difference btwn inpatient & outpatient groups on any parameters; ambulatory surgery does not compromise safety or efficacy of ACDF	Mortality: 0%, complication rate for each group: 2%; outpatients: dysphagia (partially recovered) & vocal cord paralysis (not fully resolved at >1 yr): 1 (2%); inpatients: superficial wound infection: 1 (1.9%)
Trahan et al., 2011	One physician's practice, study dates Nov 2005–Apr 2009, 59 outpatients, 58 inpatients	1- to 2-level ACDF: 1-level 68, 2-level 49	1- to 2-level ACDF can be done on an outpatient basis; complication rates low, critical postop complications including respiratory compromise occur very infrequently & in the immediate postop period	Outpatients: any complication 1 (1.4%), neck swelling & difficulty breathing & anxiety requiring readmission 1 (1.4%)
Stieber et al., 2005	Two senior authors, free-standing ASC, study dates 1998–2002, 30 ASC, 60 inpatients	1- to 2-level ACDF+P at C4–5 or below as adjunct to autogenous iliac crest bone graft or structural allograft: 1-level: 40, 2-level: 50	Outpatient group had lower complication rate than controls (likely due to selection bias); transient dysphagia most common complication in outpatients	ASC: any complication 3 (10%), dysphagia 3 (10%), readmission 0 (0%); inpatients: any complication 7 (13%), transient dysphagia 3 (5%), graft donor site pain 4 (14%), increased LOS due to complication 4 (7%), readmitted for early complication 4 (7%)
Lied et al., 2008	Single institution, 390 outpatients	ACDF: 278 fused w/ autologous iliac crest, 112 fused w/ PEEK graft	6-hr postop observation, then discharge is safe	Mortality: 0 (0%); any complication: 37 (9%), immediate complication (0–6 hrs): 17, early complication (6–72 hrs): 1, late complication (>72 hrs): 19; all life-threatening neck hematomas detected w/in first 6 hrs
Villavicencio et al., 2007	Single institution, study dates Apr 2003–Apr 2005, 103 outpatients, d/c <15 hrs postop: 99 (96.1%), d/c after 23 hrs observation after 3-level ACDF: 4 (3.9%)	1- to 3-level ACDF	ACDF w/ instrumentation as outpatient is safe & feasible & not associated w/ increased complications	Overall complication rate: 4 (3.8%), major complications (vertebral fracture & dehydration resulting in readmission): 2 (1.9%), minor complications (allergic reaction to medications that did not require hospitalization, transient ≤3 mos neurological deficit): 2 (1.9%)
Garringer & Sasso, 2010	Single surgeon, prospective, study dates Nov 1993–May 2006, 645 outpatients	1-level ACDF	1-level ACDF safe in outpatient setting w/ 4-hr observation; using postop drain is questionable	Mortality: 0 (0%), any complication: 2 (0.3%), both epidural hematomas, both occurred w/in 4-hr observation period, both resolved w/o permanent deficit; unplanned admission: 24 (6%), >80% due to pain or nausea
Shepherd & Young, 2012	ASC dedicated to spine surgery, study dates 2007–2009, 152 ASC	1- to 2-level ACDF	75 patients completed self-reported survey w/in 6 mos, reporting 100% satisfaction rate; ACDF safe in selected patients as outpatient procedure w/ high patient satisfaction	ED visit 6 (3.9%): neck pain 2 (1.3%), dysphagia 1 (0.7%), vocal cord paralysis & dysphagia 1 (0.7%), nausea 1 (0.7%), cervical swelling 1 (0.7%); required readmission: 1 (0.7%); long-term sequelae: 0 (0%); complication rate: 3.9%
Wohns, 2010	Single institution, study dates Feb 2009–May 2010, 14 ASC, 12 hospital-based outpatients	Cervical disc arthroplasty	100% patients reported improvement; outpatient cervical disc arthroplasty costs: 62% < 1-level outpatient ACDF, 84% < 1-level inpatient cervical disc arthroplasty; outpatient: 1-level cervical disc arthroplasty: \$11,144.83, 1-level ACDF: \$29,313.43; inpatient: 1-level cervical disc arthroplasty: \$68,000, 1-level ACDF: \$61,095.49	No mortality, complications, cases requiring hospital transfer, postop ED visit

CONTINUED ON PAGE 7 »

» CONTINUED FROM PAGE 6

TABLE 3. Summary on the safety of and outcomes for outpatient anterior cervical spine surgeries

Authors & Year	Study Information	Type of Surgery	Observations/Conclusions	Outcomes
Walid et al., 2010	Reviewed patients who went through common process of surgery venue selection, 97 outpatients, 578 inpatients	ACDF (levels unspecified), lumbar microdiscectomy, lumbar decompression w/ or w/o fusion	Mean age older in inpatients ($p < 0.001$); prevalence of DM, CHF, heart disease, CABG/stent/balloon angioplasty, knee problems, & depression higher in inpatients ($p < 0.05$); prevalence of COPD & history of stroke higher in outpatient cervical surgery cohort ($p < 0.05$)	Outpatients: any complication 1 (1.0%), postop infection 1 (1.0%); inpatients: any complication 16 (2.8%), postop infection 16 (2.8%); all patients w/ complications obese
Lied et al., 2013	Single institution, 96 outpatients	1- or 2-level ACDF: 1-level: 60, 2-level: 36	91% patient satisfaction using NASSQ; ACDF in select patients w/ cervical disc degeneration appears safe as outpatient procedure w/ sufficient postop observation; clinical outcomes & patient satisfaction comparable w/ those for inpatient procedure	Mortality: 0%; surgical morbidity: 5.2%, hematoma 2 (2.1%), dysphagia 2 (2.1%), neurological deterioration 1 (1%)
Baird et al., 2014	US HCUP SID & SASD for CA, NY, FL, & MD; study dates 2005–2009	Cervical spine surgery in outpatient setting	Increase in cervical spine surgeries in ambulatory setting during study period: ACDF 68%, pst decompression 21%; majority (>99%) d/c home after ambulatory surgery	
Martin et al., 2008	NSQIP, 597 outpatients, 2317 inpatients	1-level ACDF	Age >65 yrs, ASA score III or IV, current dialysis, current steroid use, recent sepsis, & op times >120 mins all independent risk factors for complications; no significant differences in complication rate btwn groups; reasonable to consider inpatient 1-level ACDF in patients w/ aforementioned risk factors	Mortality: 5 (0.2%), any complication: 92 (3.2%), reoperation: 34 (1.2%); outpatients: mortality 1 (0.2%), any complication (1.3%), reoperation (0.2%); inpatients: mortality 4 (0.2%), any complication (3.6%), reoperation (1.4%)
Best et al., 2015	National Survey of Ambulatory Surgery	Discectomy, laminectomy, fusion	Ambulatory surgeries for intervertebral disc disorders & spinal stenosis increased btwn 1994 & 2006	
Helseth et al., 2015	Private clinic, single institution, prospectively recorded complications, study dates 2008–2013, 1449 outpatients	Microsurgical decompression: lumbar 1073, cervical 376	In favor of outpatient spinal surgery for properly selected patients	Surgical mortality: 0 (0%), any complication: 51 (3.5%), same-day admission: 3 (0.2%), admission w/in 3 mos: 22 (1.5%), hematoma: 9 (0.6%), neurological deterioration: 4 (0.3%), deep wound infection 13 (0.9%), dural lesion & CSF leakage: 15 (1.0%), persistent dysphagia: 2 (0.1%), persistent hoarseness: 2 (0.1%), severe pain/headache: 6 (0.4%), reoperation: 67 (4.6%); all life-threatening hematomas detected w/in hrs after cervical (6 hrs) & lumbar (3 hrs) surgery
McGirt et al., 2015	NSQIP, study dates 2005–2011, 1168 outpatients, 6120 inpatients	1- to 2-level ACDF	Return to OR w/in 30 days & major morbidity lower in outpatients	Outpatients: major morbidity 0.94%, return to OR w/in 30 days 1.4%; inpatients: major morbidity 4.5%, return to OR w/in 30 days 2%
Adamson et al., 2016	Single institution, ASC, study dates 2006–2013, 1000 ASC, 484 inpatients	1-, 2-, >2-level ACDF; ASC: 1-level 629, 2-level 365, >2-level 6; inpatient: 1-level 274, 2-level 210	Surgical complications low & can be diagnosed in 4-hr ASC PACU window; similar results compared to those for inpatient ACDF; can perform ACDF safely as outpatient ASC procedure; 90-day morbidity similar btwn cohorts for 1- & 2-level ACDF	Transfer from ASC to inpatient: 8 (0.8%), pain control: 3, chest pain & EEG changes: 2, intraop CSF leak: 1, postop hematoma: 1, profound postop weakness & surgical re-exploration: 1; mortality: 0%; 30-day hospital readmission: 2.2%

CONTINUED ON PAGE 8 »

» CONTINUED FROM PAGE 7

TABLE 3. Summary on the safety of and outcomes for outpatient anterior cervical spine surgeries

Authors & Year	Study Information	Type of Surgery	Observations/Conclusions	Outcomes
Arshi et al., 2017	Humana-insured patients, study dates 2011–2016, 1215 outpatients, 10,964 inpatient	1- to 2-level ACDF	Adjusting for age, sex, & comorbidities: outpatients more likely to undergo revision surgery for pst fusion at 6 mos & 1 yr, ant fusion at 1 yr; outpatient more likely to have postop acute renal failure	Outpatients: acute renal failure 15 (1.23%), respiratory failure 16 (1.32%), CVA 12 (0.99%); inpatients: acute renal failure 164 (1.50%), respiratory failure 313 (2.85%), CVA 132 (1.20)
Chin et al., 2017 ¹⁴	Single center, ASC	TDR: 55; 1-level ACDF: 55	1-level TDR safe in ASC w/ satisfactory clinical & patient-reported outcomes; comparable w/ ACDF in outpatient setting	Dysphagia most common postop complaint in both groups (6 total), no intergroup significant differences
Chin et al., 2017 ¹³	Single surgeon, ASC, study dates 2008–2014, 557 ASC, 210 inpatients	Inpatient: decompression 71, fusion 138; outpatient: decompression 150, fusion/disc replacement 197	Majority of spine surgery can be done as outpatient procedure after meeting certain eligibility criteria	Overall revision surgery 14%, overall complication rate 5%
Idowu et al., 2017	Truven Health Marketscan Research Databases, study dates 2003–2014, inpatient hospital, outpatient hospital, ASC	Lumbar fusion, lumbar decompression, ant cervical fusion, pst cervical decompression, pst cervical fusion	True ambulatory surgery (defined as at ASC) not increasing at same rate as outpatient procedures	
Fu et al., 2017	NSQIP database, study dates 2011–2014, 4759 outpatients, 17,211 inpatients	1- to 2-level ACDF: 2-level 6890 (20.7% outpatient)	Greater comorbidity burden (CCI), higher ASA class, chronic steroid use, HTN, & male sex independent risk factors for post-d/c complications; outpatient 2-level ACDF not associated w/ increased postop morbidity relative to inpatient procedure	2-level ACDF complications: 1.47% outpatient, 3.94% inpatient (p<0.001)
Khanna et al., 2018	NSQIP, study dates 2011–2013, 1778 (25.6%) outpatients, 5162 (74.4%) inpatients	1-level ACDF 6940	Complication rate higher in inpatient group (p=0.003); outpatient surgery for 1-level ACDF safe & favorable for select patients	Overall complication rate: 4.2%; outpatient: complication rate 1.2%, 30-day readmission 1.8%, mortality 0.1%; inpatient: complication rate 2.5%, 30-day readmission 2.2%, mortality 0.1%
Purger et al., 2017	CA, FL, NY SID & SASD, 3135 ambulatory, 46,966 inpatients	ACDF	Ambulatory younger (48.0 vs 53.1 yrs), more likely white; higher CCI, increased rate of ED visits, & readmission in both groups; overall charges lower for ambulatory \$33,362.51 vs inpatient \$74,667.04	Ambulatory: mortality 0%, ED w/in 30 days 168 (5.4%), readmitted 51 (1.6%), reoperation 200 (0.4%); infection, hematoma, disruption of surgical site or complication from implant: 20, neck pain or injury, radiculopathy, DD: 52, laryngeal/airway: 0, dysphagia/esophageal: 7, other: 172; inpatient: infection, hematoma, disruption of surgical site or complication from implant: 397, neck pain or injury, radiculopathy, DD: 630, laryngeal/airway: 7, dysphagia/esophageal: 118, other: 3792

ACDF+P = ACDF with plating; CVA = cerebrovascular accident; DD = degenerative disease; EEG = electroencephalography; HCUP = United States Healthcare and Cost Utilization Project; HTN = hypertension; LOS = length of stay; NASSQ = North American Spine Society Questionnaire; OR = operating room; PACU = post-anesthesia care unit; PEEK = polyetheretherketone; SID = State Inpatient Databases; SASD = State Ambulatory Surgery and Services Databases; TDR = total disc replacement.

including 12 articles and 1693 treated levels, which revealed an overall complication rate of 1.71% and a risk ratio of 0.99, suggesting no statistical difference between inpatient and outpatient groups.⁶

There may be a longer-term negative effect of outpatient ACDF. Arshi et al. examined more than 12,000 patients in a private insurance database and reported that outpatient ACDF was associated with higher odds of repeat anterior surgery at 1 year (OR 1.46) as well as a higher likelihood of undergoing posterior surgery at 6 months and 1 year (ORs 1.58 and 1.79, respectively).³ The authors speculate that pressures for high throughput in an ambulatory setting may force surgeons to be less rigorous in endplate preparation, discectomy, or proper instrumentation, leading to higher rates of pseudarthrosis. Another interesting theory posits that the bias against the treatment of more than 2 levels may increase the proportion of patients with untreated milder adjacent segment disease, which subsequently progresses. Their findings underline the importance of studying longer-term outcomes beyond 30 or 90 days to truly evaluate whether outpatient spine surgery has an unanticipated impact.

Cervical Disc Arthroplasty

Cervical disc arthroplasty is a logical companion to outpatient ACDF and may actually lend itself to superior outcomes as patients in these cases are often younger with fewer baseline comorbidities. Moreover, the surgical principles favor less bony and soft tissue disruption. For now, the data on outpatient surgery are limited. Wohns reported on a personal series of 26 consecutive cervical disc arthroplasties with a minimum 4-hour observation period in a cohort of patients with a mean age of 46 years and no comorbidities.⁴⁶ There were no transfers to inpatient status, nor any readmissions or reoperations within 30 days. Another group compared 55 outpatient disc arthroplasty cases to an outpatient ACDF control group (55 patients) and again found no readmissions or reoperations within 30 days.¹⁴

Cost

As described earlier, the difference between outpatient surgery performed at a hospital and that performed at an ambulatory center confounds direct comparison of the cost savings. However, in single-center studies, several authors have reported their own cost savings. For example, performing lumbar laminectomy in an ambulatory surgery center can produce a 30% facility fee reduction.²⁹ Similarly, Silvers et al. reported a cost savings of \$1800 per ACDF performed in 1996 and estimated a cost savings of \$140 million nationwide for that same year if every 1- or 2-level ACDF were performed in the outpatient setting.³⁸ Wohns found the cost of a single-level outpatient cervical disc arthroplasty to be 62% less than an outpatient ACDF and 84% less than an inpatient cervical disc arthroplasty.⁴⁶ This suggests that cost is a complex result of procedure, instrumentation, facility fee, and length of stay.³⁰ Purger et al. modeled costs and charges including all complications, readmissions, and reoperations within 90 days as a bundled charge and found significant savings in the outpatient ACDF cohort—nearly half the total for inpatient ACDF.³⁵

The 90-day bundled charge represents one of the proposed Medicare value-based reimbursement paradigms and is an ideal metric for future cost studies.

Patient Selection and Discharge Criteria

If the outcomes of ambulatory spine surgery are deemed acceptable, the next critical step will be to create protocols and standardize patient selection and postoperative care. As seen in the previously described outcome studies, there is an inherent selection bias toward younger and healthier patients undergoing outpatient spine surgery.⁴⁴ Age alone has been shown to be an independent risk factor for 30-day complications after ACDF.⁹ Chin et al. analyzed the overall eligibility of patients meeting predetermined outpatient criteria in their practice, including a body mass index less than 42, a low to moderate surgical risk, and the absence of medical comorbidities.¹³ Interestingly, they did not include patient age but added local caregiver and close to the hospital in their protocol. Overall, in their private practice group, 79% of patients met these criteria. Along the same lines, multiple groups have discussed the need for discharge criteria. Outpatient ACDF carries the feared complication of delayed neck hematoma, and there may be an optimal postoperative observation period to prevent any delayed complications. Lied et al. studied the timing in detecting a postoperative complication after ACDF.²⁷ Thirty-seven patients (9%) among 390 consecutive surgeries experienced any surgical complication. When stratified by the timing of presentation—immediate (within 6 hours), early (6–72 hours), and late (greater than 72 hours)—all 5 patients (1.2%) who developed a neck hematoma had been diagnosed and undergone evacuation within 6 hours.

Similarly, several groups have created protocols and discharge criteria for outpatient surgery.^{15,18,25,31} This includes the empowerment of anesthesia colleagues and nursing staff to improve efficiency and implement safety checkpoints.⁴¹ Furthermore, the utilization of a next-day clinic visit or follow-up telephone call can maintain patient satisfaction as well as preserve safety and outcomes.^{20,26,37}

Surgeon Preference

One additional consideration highlights the role of surgeon preference. In the United States medicolegal environment, the impact of a single death cannot be understated from the perspective of cost as well as surgeon willingness to send a patient home early.⁴⁵ For ACDF and cervical disc arthroplasty specifically, this may prevent the adoption of outpatient surgery at large regardless of the outcomes.

Conclusions

As the economic burden of United States health care continues to increase, we are obligated to produce novel solutions to rising costs. Here, we present evidence describing ambulatory spine surgery outcomes with related proposed cost savings. With proper patient selection and close follow-up, outpatient surgery may be an ideal model for innovation and significant cost reduction.

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Disclosures

The authors report no conflicts of interest concerning the materials or methods used in this study or the findings specified in this paper.

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Conception and design: Pendharkar, Ho, Sussman, Purger, Veeravagu, Ratliff, Desai. Acquisition of data: Pendharkar, Shahin, Ho, Sussman, Purger, Veeravagu, Desai. Analysis and interpretation of data: all authors. Drafting the article: Pendharkar, Shahin, Ho, Sussman, Purger, Veeravagu, Desai. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Pendharkar. Administrative/technical/material support: Pendharkar, Shahin, Ho.

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