Finding the Value in 'Value' Designation: Evidence and Opportunity in the United States

Sze-jung Wu, PhD[1]; Qinli Ma, PhD[1]; Patricia Martin, RN, BSN[2]; Andrea DeVries, PhD[1]

[1]HealthCore Inc., Wilmington, Del.; [2]Anthem Inc., Indianapolis, Ind.

ABSTRACT

Purpose: Centers of Excellence (COE) designations have been used to distinguish high-quality facilities. Originally based on quality metrics alone, published evidence failed to consistently show improvements in measurable quality markers. COE development has since shifted to a value-based framework incorporating cost of care, providing greater transparency. This study evaluated the patient outcomes of such value-designated facilities certified under one of the larger U.S. commercial provider networks.

Design: Retrospective, observational study using 2009–2013 commercial administrative claims data.

Methodology: Analysis included 33,827 adults (≥18 years) who received spine surgery at value-designated (n=6,141, 22%) vs. other facilities (n=27,686, 78%). Multivariate regression models were used to compare 90-day episodic costs and quality outcomes, adjusted for patient characteristics and comorbidities.

Results: Adjusted episodic cost per surgery was lower in value-designated facilities by $3,157 (16%) for lumbar discectomy/decompression, $6,784 (19%) for cervical simple fusion, and $11,134 (18%) for lumbar simple fusion (all $P<.05$). Adjusted complication rate was lower (1.5% vs. 2.0%; $P<.05$) at value-designated facilities, while other quality measures were similar. Value-designated facilities tended to be large, in metropolitan areas, affiliated with medical schools, and performed more surgical procedures and provided more nursing hours.

Conclusions: To our knowledge, this is the first large-scale study evaluating value-designated COE. Value-designated COE programs represent an advance over a cost- or quality-alone designation in the ability to identify facilities with lower costs and equal or better quality outcomes. Value designation offers patients transparency for selecting care providers. Future efforts should continue to refine quality criteria used in designations to distinguish patient outcomes.

Keywords: Delivery of healthcare; spinal fusion; discectomy; centers of excellence; healthcare value

INTRODUCTION

A medical facility or team designated as a Center of Excellence (COE) is recognized as providing the best practice for a specific area of health care. Unlike programs that rate top hospitals in terms of overall performance (American 2016, Catalyst 2016, Friese 2015, Leapfrog 2016, USNWR 2016), COE designations are typically made by professional organizations (such as the American College of Surgeons [Dimick 2013]) or payers, including the Centers for Medicare and Medicaid Services as well as commercial healthcare insurers (AIE 2016, Blue–Specialty 2016, Cigna 2016) or employer groups (General 2015). COE designations date back to 1991 and have been used to distinguish a variety of programs, including heart bypass projects (Hamilton 2006), bariatric surgery (Birkmeyer 2010, Dimick 2013, Livingston 2009, Nguyen 2012, Nguyen 2004), stroke (Kelly 2001), and pituitary and spine treatment centers (McLaughlin 2012, Mehrotra 2013a, Mehrotra 2015).

The COE designation is intended to raise patient and provider awareness about quality of care provided by the designated facilities and represents an effort to address transparency in pursuit of clinical excellence and enhanced efficiencies (Livingston 2009, Mehrotra 2013a,b). Measurable criteria, such as number of cases treated (Birkmeyer 2002, Pearce 1999), clinician training (Pearce 1999), electronic recording and management systems (Bates 1999), results for key quality measures (Peterson 2006), and staffing composition (Kane 2007), were meant to distinguish providers that deliver better quality of care. However, published evidence has been inconsistent, with some studies showing improvements in postoperative complication rates while others found insufficient evidence of improvement (AIE 2016, Dimick 2013, General 2015, Kane 2007, Kelly 2001, Mehrotra 2013a, Nguyen 2012, Nguyen 2004, Tu 2008). Such inconsistencies have had consequences; for example, study results prompted CMS in 2013 to drop the COE certification requirement that was enacted in 2006 for the coverage of bariatric surgeries (Dimick 2013).

Shifting to a value proposition

In recent years, attention to COE accreditations has gradually expanded its scope to the cost of care. While still in their infancy, efforts within the U.S. health care system are dedicated to educating patients on both quality and cost comparisons, such as value-

based designation or reference pricing reimbursement (Ginsburg 2007, Robinson 2012), in response to the price-transparency laws and regulations in many states (Catalyst 2016).

Health insurers are among the first private entities to integrate a cost component in the COE designation process. For instance, Cigna, along with its quality designation for COE programs, assigns cost-efficiency scores for common surgical procedures. This expanded scoring assigns hospitals in the 33% lowest average cost category the highest ranking (3-star), whereas those within the 33% highest cost group received a 1-star designation (Cigna 2016). Another major U.S. health plan, Aetna, seeks to improve value by directing patients to designated transplant and infertility clinics that satisfied quality (such as volume and success rate) and cost criteria (AIE 2016). These initiatives aim to bridge the information gap on the quality and cost of care for medical procedures that had otherwise not been available to patients.

Blue Distinction Centers+ value recognition

In keeping with this trend, the Blue Cross Blue Shield Association (BCBSA), which administers one of the nation's largest COE programs for private insurers, redesigned its Blue Distinction Specialty Care program, which includes more than 2,000 designated facilities across the top 50 metropolitan areas. The Blue Distinction Centers (BDCs) for spine surgery were among the first procedure categories to be modified by BCBSA, resulting in changes in the original quality selection criteria for the BDC designation. It included a revised scoring algorithm and assigned a new Blue Distinction Plus (BDC+) designation for centers that surpassed both quality and cost criteria (Hussey 2013).

The BDC+ program encompasses

TABLE 1
Characteristics of BDC+ value-designated facilities vs. all other facilities

Hospital characteristics	Value-designated facilities	All other facilities
Beds (%)		
<100	2.0*	15.8
100–400	58.8	60.6
>400	39.2	23.6
Region (%)		
West	41.2	25.8
Midwest	37.3	32.6
South	17.6	20.3
Northeast	3.9*	21.4
Metropolitan statistical area type (%)		
Metro	80.4	67.8
Division	19.6	20.3
Micro/rural	0.0	12.0
For profit (%)	7.8	12.3
Academic medical center affiliation (%)	68.6*	43.8
Teaching status, %	70.6*	47.3
Medicare insurance (avg % of patients)	42.7	45.7
Medicaid insurance (avg % of patients)	17.9	18.5
Medical/surgical ICU availability (% of hospitals)	100.0	96.3
All surgical operations-inpatient procedures per year (n)	5,511.8*	4,034.2
Nurse hours/patient day (n)	10.3*	8.9
Facility accreditation (%)		
Joint Commission	94.1	90.2
Healthcare Facilities Accreditation Program; American Osteopathic Association	5.9	5.7
DNV Healthcare accreditation	0.0	5.3
EMR (%)		
Fully implemented	61.2	53.2
Partially implemented	36.7	42.8
None	2.0	3.9
Advanced technology (%)		
Computer-assisted orthopedic surgery	64.7*	46.0
Transplant services – any	43.1	41.3
HCAHPS measures – patient experience (%)		
Patients given information about what to do after discharge	85.4	85.2
Doctors "always" communicated well	79.5	79.3
Nurses "always" communicated well	76.9	77.4
Definitely would recommend the hospital	74.8	73.0

table continues

TABLE 1 *(continued)*
Characteristics of BDC+ value-designated facilities vs. all other facilities

Hospital characteristics	Value-designated facilities	All other facilities
Rated hospital as 9 or 10 on a scale from 0 to 10 (highest)	71.1	70.4
Room and bathroom were "always" clean	70.0	71.0
Pain was "always" well controlled	69.8	69.8
Patients "always" received help as soon as they wanted it	62.1*	63.9
Staff "always" explained medicines before giving it to them	62.0	62.2
Area around their room was "always" quiet at night	55.5	56.1
SCIP measures (%)		
Patients were actively warmed in the operating room	99.8	99.8
Patients given appropriate antibiotic	99.2*	98.9
Patients given antibiotic within 1 hour before surgery	98.7	98.7
Patients received appropriate timing of DVT prophylaxis	98.3	97.9
Antibiotics stopped within 24 hours	98.1	97.8
Patients on beta blockers continued on beta blockers	97.7	97.3
Patients received appropriate urinary catheter removal	96.5	96.2
Patients received appropriate glucose control	95.8	96.4

BDC+=Blue Distinction Plus, DNV=Det Norske Veritas Healthcare, DVT=deep vein thrombosis, EMR=electronic medical record, HCAHPS=Hospital Consumer Assessment of Health Plans Survey, ICU=intensive care unit, SCIP=Surgical Care Improvement Project.
*$P<.05$

quality criteria on structure, process, and outcomes (Table 1 [Birkmeyer 2010]). Additionally, cost of care is calculated with the average total cost from claims data through the National Consumer Cost Tool (Blue Choice 2011). A cost threshold was set at 1.05 times the national average cost of surgery. Facilities that met predetermined clinical requirements and had spine surgery costs below the threshold received the value-designated BDC+ designation (Blue–Spine 2016).

The redesigned criteria resulted in fewer designated facilities. Using quality-only criteria, 310 facilities qualified as designated facilities. Using the BDC+ quality and value criteria, just 176 facilities qualified (Blue–Spine 2016).

This study aimed to evaluate whether the revamped designation criteria would result in improved patient outcomes. Additionally, previously cost criteria in the BDC+ designation had been calculated based on submitted registry reporting for the hospital stay.

Questions remained for the cost of surgery care at episode level due to concerns of cost of inpatient care being shifted to post-surgery costs (including all follow-up care, such as rehabilitation and readmissions). To address these questions, this study evaluated the medical cost and post-surgery quality outcomes at the episode level for patients who selected a value-designated hospital for spine surgery relative to other facilities.

To our knowledge, this is the first study that validated the outcomes of complete episodes of care at COE facilities that were designated under a value-based framework.

METHODS

Study design and population

This retrospective cross-sectional study used administrative claims data from 14 of the 36 commercial Blue Cross and Blue Shield health plans in the Northeast, Midwest, West, and Southeast regions of the United States. A total of 64 BDC+ facilities (value-designated facilities) and 771 comparison facilities (all other facilities) from these 14 plans were included in the study.

Patients were at least 18 years old and had a spinal surgery procedure between January 1, 2009 and May 31, 2013. The surgeries included in this study were cervical simple fusion (CSF; n=10,722), lumbar simple fusion (LSF, n=12,652), or lumbar discectomy/decompression (LDD, n=10,453) (Supplemental Table S1, page S-43).

All patients had medical eligibility in an Anthem BCBS health plan at least 6 months prior to and 3 months following the index surgery for measurement of baseline and post-surgery outcomes. Exclusion criteria, including previous refusion spine surgery or a history of spine fractures or vertebral dislocations, were based on BCBSA COE evaluation criteria (Birkmeyer 2010) and methodologies (Supplemental Table S1 [Blue Specialty 2016]).

Hospital-level outcomes from the claims were linked to 2012 American Hospital Association (AHA) hospital characteristics database, 2013 Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey data, and 2013 Surgical Care Improvement Project (SCIP) data (CMS 2016) to examine characteristics, patient experience, and surgical quality of care of value-designated facilities compared with the other facilities.

Outcome measures

Medical Costs

The primary outcome was total episode costs, consisting of total medical expenses for the procedure and inpatient stay plus all costs of care during the 90-day follow-up period, including readmissions and acute rehabilitation. Total episode costs were evaluated to capture potential cost shifting to other surgery-related services and expenses (such as acute rehabilitation care, physical therapy, or re-hospitalization). All costs included payments from both the health plan and patients and were adjusted with the Medicare Geographic Adjustment Factor to control for regional variations (Kullgren 2013). Surgical costs, including the medical costs for the spine surgery and inpatient stay, were also reported as a secondary outcome.

Quality

Quality metrics were based on the BCBSA criteria for spine surgery as part of the BDC+ designation process (Supplemental Table 2, page S-44). The overall complication measure was a composite metric of five individual complications (sepsis/septicemia, pneumonia, postsurgery wound complications within 30 days, pulmonary embolism within 30 days, and central nervous system complications within 7 days), plus death at hospital discharge. An occurrence of surgical site infections, osteomyelitis, arthritis-related infections, or surgical site bleeding was considered a postsurgery wound complication. The rates of the composite complication measure and each individual complication were estimated. Other quality measures included all-cause readmission rate within 30 days postdischarge of index stay and the average length of inpatient hospitalization for the index stay.

Statistical analysis

Hospital characteristics were summarized with descriptive analysis based on patients in each designation cohort. Quality metrics were aggregated regardless of types of spine surgery because no difference in quality outcomes was found among surgery types. All cost- and quality-outcome metrics were risk-adjusted for patient characteristics, including age, gender, health plan type, and comorbid conditions associated with spine surgery. Results were evaluated using the conventional alpha of .05.

RESULTS

Characteristics of value-designated facilities

Based on AHA hospital data, the facilities receiving BDC+ designations tended to be larger facilities, with only 2% having fewer than 100 beds, compared with 15.8% of the other facilities (Table 1). These facilities were more concentrated in the Western region than other facilities (41.2% vs. 25.8%, respectively) and less concentrated in the Northeast (3.9% vs. 21.4%, respectively). None of these facilities were located in the micropolitan or rural statistical area (0% high value vs. 12% other). A substantially larger proportion of the value-designated facilities than other facilities were affiliated with medical schools (68.6% high value vs. 43.8% other) and were teaching institutions (70.6% high value vs. 47.3% other).

Value-designated hospitals performed statistically significant more surgical and inpatient procedures annually than other facilities (5,512 procedures at value-designated vs. 4,034 procedures at other facilities, $P<.01$) with more nursing hours per patient day (10.3 hours value-designated vs. 8.9 hours other, $P<.01$). Compared with the other facilities, more value-designated facilities had the capability to perform computer-assisted orthopedic surgery (64.7% value-designated vs. 46.0% other, $P<.01$).

In terms of HCAHPS and SCIP measures of patient experience, value-designated facilities were similar to other facilities in most patient experience and surgical quality of care measures. The only exceptions were that a smaller proportion of patients at value-designated facilities than those at other facilities perceived they received assistance as soon as they wanted it (62.1% vs. 63.9%, respectively, $P=.02$), and a greater proportion of patients at value-designated facilities received an appropriate antibiotic compared with other facilities (99.2% vs. 98.9%, respectively, $P=.03$).

Demographic and clinical characteristics of study population

Based on claims data, patients who chose value-designated facilities were largely similar to those who chose other facilities in characteristics such as age and gender (Supplemental Table 3, page S-45). Across all types of spinal surgery, patients were more likely to have PPO than HMO health plans, although the difference was greater among patients who chose value-designated facilities than those choosing other facilities. There were no significant differences in baseline comorbidities between patients who chose value-designated facilities compared with those who chose the comparison facilities, with the exception of chronic atherosclerosis in patients undergoing LDD (4.0% value-designated vs. 5.3% other facilities, $P=.02$).

Cost and quality outcomes

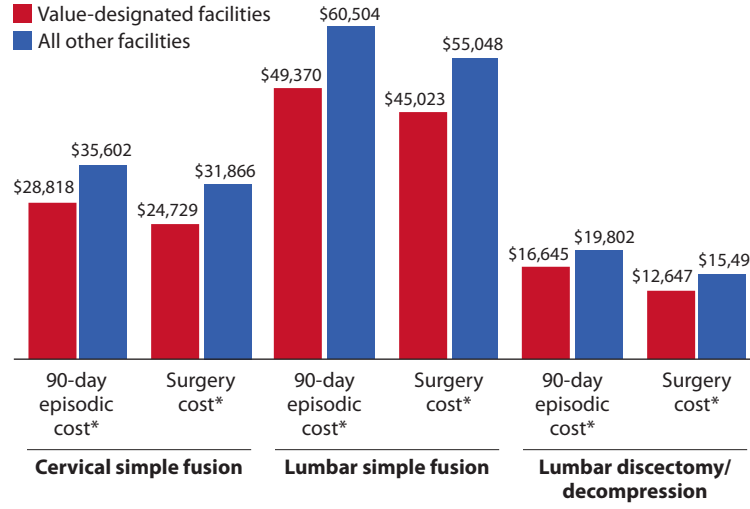
Based on claims data, the total episode costs were significantly lower at value-designated facilities than the comparison facilities for all types of spine surgery examined (Figure). Mean adjusted total episode costs were \$6,784 (19.1%) lower for CSF, \$11,134 (18.4%) for LSF, and \$3,157 (15.9%) lower for LDD at value-designated facilities than at the other facilities ($P<.05$ for all comparisons).

Similar results were found for total costs during the surgery stay. Mean adjusted surgical costs were $7,137 (22.4%) lower in value-designated facilities for CSF, $10,025 (18.2%) lower for LSF, and $2,847 (18.4%) lower for LDD compared with surgical costs in other facilities ($P<.05$ for all comparisons).

Quality in value-designated facilities, as measured by complication rates, was similar to or better than quality at the comparison facilities (Table 2). The risk-adjusted overall complication rate was significantly lower in value-designated than in the comparison facilities (1.5% vs. 2.0%, respectively, $P<.01$, odds ratio [OR] 0.73). Examining each component of the complication measure showed value-designated facilities had lower rates of postsurgical wound complications (0.4% value-designated vs. 0.7% other, $P=.03$, OR 0.66) and sepsis/septicemia (0.3% value-designated vs. 0.5% other, $P=.03$, OR 0.62) compared with other facilities. Rates of pneumonia, pulmonary embolism, and central nervous system complications were statistically similar between the two types of facilities. Although 30-day readmission rates were similar between the value-designated and other facilities (3.9% value-designated vs. 4.2% other, $P=.19$, OR 0.91), the length of stay was somewhat shorter at value-designated facilities than at other facilities (2.98 days value-designated vs. 3.08 days other, $P<.01$, OR 0.97).

FIGURE

Surgery and episode costs, value-designated vs. other facilities



Adjusted total surgery costs for the inpatient stay and adjusted total costs for the 90-day episode of care for Blue Distinction Plus–designated hospitals and all other hospitals for cervical simple fusion, lumbar simple fusion, and lumbar discectomy/ decompression. Total 90-day episode costs include surgery costs of the inpatient stay and all-cause 90-day follow-up costs, regardless of site of service. Adjusted for patient characteristics, including age, gender, health plan, Deyo-Charlson Comorbidities Index, and selected comorbidities.

*$P<.05$.

DISCUSSION

This analysis found value-designated facilities were larger teaching institutions located in urban areas where more surgical and inpatient procedures were performed with a higher

TABLE 2

Adjusted* complication rates of interest and readmissions at value-designated facilities vs. all other facilities

Complication rate	BDC+ designated facilities (%)	All other facilities (%)	Odds ratio	*P*-value
Overall complication (days postsurgery)	1.5	2.0	0.73	<.01
Wound complications (30)	0.4	0.7	0.66	.03
Sepsis/septicemia (7)	0.3	0.5	0.62	.03
Pneumonia (7)	0.5	0.5	0.98	.89
Pulmonary embolism (30)	0.3	0.3	0.96	.88
Central nervous system complication (7)	0.5	0.4	1.12	.57
Readmission rate (30)	3.9	4.2	0.91	.19
Length of stay (in days)	2.98	3.08	0.97	<.01

*Variables in the risk-adjustment regression included age, gender, surgery type, health plan, and selected comorbidities listed in Supplemental Table S3, page S-45.

proportion of nursing hours per patient. These hospital characteristics are largely consistent with previous studies on quality-designated COE facilities (Birkmeyer 2010, Livingston 2009, Mehrotra 2013b).

Earlier studies have reported inconsistent evidence in surgical outcomes between quality-designated and non-designated facilities. This study stands in contrast to that earlier research—including a study conducted by the RAND Corp.—because it found better clinical outcomes (lower overall complication as well as wound complication and sepsis) associated with the facilities that were designated for both quality and cost performance.

Additionally, this study found episode-level costs were significantly lower in the value-designated facilities. On average, the 90-day total episode cost of spine surgery was $11,134 lower for LSF, $6,784 lower for CSF, and $3,157 lower for LDD in value-designated facilities. That both cost and quality outcomes improved together shows that this COE program has evolved over the last decade and that facilities that outperform others in both quality and cost of care can be identified.

We conducted a sensitivity analysis to examine the 90-day total episode costs while controlling for presence of complications. In this analysis, value-designated facilities were found to be consistently associated with significantly lower total episodic cost, compared with other facilities ($P<.001$). This result demonstrates that while value-designated facilities were associated with lower complications, the total episodic costs were also lower than the other facilities regardless of presence of complications.

As health care transparency gains traction, cost and quality information on hospitals and providers have become more accessible to patients through the promotion of publicly available tools and information (Ginsburg 2007, Kullgren 2013, Kyle 2007, Tu 2009). Patients have traditionally relied on word-of-mouth information and referrals from physicians as the primary source of information on quality (Tu 2008). With the recent increase in the number of high-deductible health plans, this is starting to change. Patients are now more actively pursuing price and quality information for making health care decisions (Hardee 2005, Longo 2010).

What patients have faced in the search of health care transparency is the proliferating number of quality measures; by 2014, an estimated 350 metrics were in circulation (Taskler 2015). Many patients do not have the clinical literacy to interpret the difference of various quality metrics. Consumers have access to quality scores assigned by a number of different entities, each for a wide range of procedures (Hall 2004, Jensen 2014), and interpretation is problematic for consumers. A COE designation helps to overcome these challenges by combining multiple criteria and provides leaner decision support for patients (Whaley 2014).

The value-designated designation offers significant advantages over approaches that focus on cost or quality alone. While the efforts to better the COE quality criteria for enhanced patient outcomes remain a work in progress (Livingston 2009, Mehrotra 2013a,b), this value-designation framework offers consumers relevant information for selecting care providers. As the number and availability of price transparency tools increase, the need for science-based, consumer-friendly metrics may also increase. Our findings demonstrated that value-based designation as the next-generation COE programs can be used to identify good quality facilities at lower cost. To our knowledge, this study is the first in the process to start building evidence and validating such decision aids.

Limitations

This study evaluated value-designated COE facilities from Anthem's 14 health plans but not other BCBS plans that were not administrated by Anthem. This study was limited to the BCBSA's designation program and may not be generalized to other payers or insurers.

Evaluation beyond the 90-day follow-up period used here may better define the long-term impact of COE programs. Data were obtained from administrative claims, which may have contained undetected errors. Additionally, these results may have been influenced by factors not captured in the claims, such as differences in negotiated contract pricing or the possibility that larger hospital systems had resources available to provide a higher level of post-discharge care.

CONCLUSION

Facilities receiving a value designation were associated with 16% to 19% lower costs and equal or better quality outcomes, compared with all other facilities. While existing literature on COE programs has resulted in mixed results, these results highlight the potential benefits of COE programs that focus on a value framework. Future research is needed to continue identifying and improving quality criteria used in the designation process to

Corresponding author

Sze-jung Wu, PhD
HealthCore Inc.
123 Justison Street, Suite 200
Wilmington, DE 19801
Phone: (302) 230-2129
Fax: (302) 230-2020
Email: swu@healthcore.com

Disclosure: This study was internally funded by Anthem. Wu, Ma, and DeVries are employees of HealthCore, a wholly owned subsidiary of Anthem. Martin is an employee of Anthem.

further distinguish quality outcomes between COE designated and non-designated facilities and to further describe the elements that underpin the COE programs.

Acknowledgements

The authors gratefully acknowledge the contributions of Bernard B. Tulsi, MSc, and Cheryl Jones, BA, HealthCore, Inc, who provided writing and other editorial support for this manuscript.

REFERENCES

AIE (Aetna Institutes of Excellence). https://www.aetna.com/health-care-professionals/patient-care-programs/aetna-institutes.html. Accessed Oct. 7, 2016.

American Nurse Credentialing Center. Magnet recognition program designation criteria. http://www.nursecredentialing.org/Magnet/ResourceCenters/MagnetResearch/MagnetDesignation.html. Accessed Oct. 7, 2016.

Bates DW, Teich JM, Lee J, et al. The impact of computerized physician order entry on medication error prevention. *J Am Med Inform Assoc.* 1999;6(4):313–321.

Birkmeyer JD, Siewers AE, Finlayson EV, et al. Hospital volume and surgical mortality in the United States. *N Engl J Med.* 2002;346(15):1128–1137.

Birkmeyer NJ, Dimick JB, Share D, et al. Hospital complication rates with bariatric surgery in Michigan. *JAMA.* 2010;304(4):435–442.

Blue Choice Health Plan South Carolina. New national consumer cost tool. Feb. 25, 2011. http://www.bluechoicesc.com/UserFiles/bluechoice/Documents/Agents/Agent_Update_Treatment_Cost_Estimator.pdf. Accessed Oct. 7, 2016.

Blue–Specialty (Blue Distinction Specialty Care Program). 2011–2012 program selection criteria for Blue Distinction Centers for Spine Surgery. http://www.bcbs.com/healthcare-partners/blue-distinction-for-providers/BDC_SpineKneeHip_Selection_Criteria.pdf. Accessed Oct. 7, 2016.

Blue–Spine (Blue Distinction Centers for Spine Surgery). Directory of providers. http://www.bcbs.com/why-bcbs/blue-distinction/blue-distinction-centers-spine-surgery/bluedistinctionspinesurgery.pdf. Accessed Oct. 7, 2016.

Catalyst for Payment Reform. Report card on state price transparency laws. http://www.hci3.org/wp-content/uploads/files/files/Report_PriceTransLaws_2014.pdf. Accessed Oct. 7, 2016.

Cigna Centers of Excellence Hospital Value Tool 2016 Methodology. February 2016. http://www.cigna.com/pdf/CentersOfExcellence.pdf. Accessed Oct. 7, 2016.

CMS (Centers for Medicare & Medicare Services). Hospital Compare. https://www.cms.gov/medicare/quality-initiatives-patient-assessment-instruments/hospitalqualityinits/hospitalcompare.html. Accessed Oct. 7, 2016.

Dimick JB, Nicholas LH, Ryan AM, et al. Bariatric surgery complications before vs. after implementation of a national policy restricting coverage to centers of excellence. *JAMA.* 2013;309(8):792–799.

Friese CR, Xia R, Ghaferi A, et al. Hospitals in "magnet" program show better patient outcomes on mortality measures compared to non-"magnet" hospitals. *Health Aff* (Millwood). 2015;34(6):986–992.

General Electric contracts with four centers of excellence for employee joint replacements. http://www.advisory.com/daily-briefing/2014/11/25/ge-contracts-with-four-centers-of-excellence. Accessed Oct. 7, 2016.

Ginsburg PB. Shopping for price in medical care. *Health Aff* (Millwood). 2007;26(2):e208–e216.

Hall A, Walton G. Information overload within the health care system: a literature review. *Health Info Libr J.* 2004;21(2):102–108.

Hamilton JJ, Fisher SE. Centers of excellence: an evolving concept and controversy. *Bull AAOS.* 2006 Feb. http://www2.aaos.org/bulletin/feb06/fline8.asp. Accessed Oct. 7, 2016.

Hardee JT, Platt FW, Kasper IK. Discussing health care costs with patients: an opportunity for empathic communication. *J Gen Intern Med.* 2005;20(7):666–669.

Hussey PS, Wertheimer S, Mehrotra A. The association between health care quality and cost: a systematic review. *Ann Intern Med.* 2013;158(1):27–34.

Jensen JD, Carcioppolo N, King AJ, et al. The Cancer Information Overload (CIO) scale: establishing predictive and discriminant validity. *Patient Educ Couns.* 2014;94(1):90–96.

Kane RL, Shamliyan TA, Mueller C, et al. The association of registered nurse staffing levels and patient outcomes: systematic review and meta-analysis. *Med Care.* 2007;45(12):1195–1204.

Kelly DF, Becker DP. Advances in management of neurosurgical trauma: USA and Canada. *World Surg J.* 2001;25(9):1179–1185.

Kullgren JT, Duey KA, Werner RM. A census of state health care price transparency websites. *JAMA.* 2013;309(23):2437–2438.

Kyle MK, Ridley DB. Would greater transparency and uniformity of health care prices benefit poor patients? *Health Aff* (Millwood). 2007;26(5):1384–1391.

Leapfrog Group. Top hospitals. http://www.leapfroggroup.org/tophospitals. Accessed Oct. 7, 2016.

Livingston EH. Bariatric surgery outcomes at designated centers of excellence vs. nondesignated programs. *Arch Surg.* 2009;144(4):319–325.

Longo DR, Schubert SL, Wright BA, et al. Health information seeking, receipt, and use in diabetes self-management. *Ann Fam Med.* 2010;8(4):334–340.

McLaughlin N, Laws ER, Oyesiku NM, et al. Pituitary centers of excellence. *Neurosurgery.* 2012;71(5):916–924.

Mehrotra A, Sloss EM, Hussey PS, et al. Evaluation of centers of excellence program for knee and hip replacement. *Med Care.* 2013a;51(1):28–36.

Mehrotra A, Sloss EM, Hussey PS, et al. Evaluation of a center of excellence program for spine surgery. *Med Care.* 2013b;51(8):748–757.

Mehrotra A, Dimick JB. Ensuring excellence in centers of excellence programs. *Ann Surg.* 2015;261(2):237–239.

Nguyen NT, Nguyen B, Nguyen VQ, et al. Outcomes of bariatric surgery performed at accredited vs nonaccredited centers. *J Am Coll Surg.* 2012;215(4):467–474.

Nguyen NT, Paya M, Stevens CM, et al. The relationship between hospital volume and outcome in bariatric surgery at academic medical centers. *Ann Surg.* 2004;240(4):586–563.

Pearce WH, Parker MA, Feinglass J, et al. The importance of surgeon volume and training in outcomes for vascular surgical procedures. *J Vasc Surg.* 1999;29(5):768–776.

Peterson ED, Roe MT, Mulgund J, et al. Association between hospital process performance and outcomes among patients with acute coronary syndrome. *JAMA.* 2006;295(16):1912–1920.

Robinson JC, MacPherson K. Payers test reference pricing and centers of excellence to steer patients to low-price and high-quality providers. *Health Aff* (Millwood). 2012;31(9):2028–2036.

Taskler GB, Braithwaite RS. Developing a composite weighted quality metric to reflect the total benefit conferred by a health plan. *Am J Manag Care.* 2015;21(3):221–227.

Tu HT, Lauer JR. Word of mouth and physician referrals still drive health care provider choice. *Res Brief.* 2008 Dec;(9):1–8.

Tu HT, Lauer JR. Impact of health care price transparency on price variation: the New Hampshire experience. *Issue Brief Stud Health Syst Change.* 2009 Nov;(128):1–4.

USNWR (*US News & World Report*). Health: best hospitals [Internet series]. http://health.usnews.com/best-hospitals. Accessed Oct. 7, 2016.

Whaley C, Schneider CJ, Pinkard S, et al. Association between availability of health service prices and payments for these services. *JAMA.* 2014;312(16):1670–1676.

SUPPLEMENTAL TABLE S1
Patient attrition

	Cervical simple fusion			Lumbar simple fusion			Lumbar discectomy/ decompression		
Initial sample size	**Excluded (n)**	**Sample size after exclusion**	**% of initial sample size**	**Excluded (n)**	**Sample size after exclusion**	**% of initial sample size**	**Excluded (n)**	**Sample size after exclusion**	**% of initial sample size**
≥18 years with index spine surgery		27,768	100.0		37,982	100.0		30,925	100.0
Clinical exclusion criteria									
Surgery performed on multiple levels of the spine	890	26,878	96.8	404	37,578	98.9	1,166	29,759	96.2
Any refusion spine surgery during index stay	147	26,731	96.3	489	37,089	97.6	403	29,356	94.9
Another primary or refusion spine surgery in prior six months	298	26,433	95.2	258	36,831	97.0	586	28,770	93.0
Repeat procedure	11	26,422	95.2	1	36,830	97.0	16	28,754	93.0
With clinical conditions of interest*	1,595	24,827	89.4	3,665	33,165	87.3	388	28,366	91.7
Hospitalizations in which patient was admitted through the emergency department	170	24,657	88.8	143	33,022	86.9	587	27,779	89.8
Eligibility exclusion criteria									
Continuously enrolled from six months prior index date to 90 days after discharge from the index surgery	3,472	21,185	76.3	4,530	28,492	75.0	3,704	24,075	77.8
Have WLP BCBS plan as the sole insurer	4,107	17,078	61.5	8,902	19,590	51.6	8,278	15,797	51.1
Hospital-level criteria									
Incomplete information for designation identification	2,048	15,030	54.1	2,780	16,810	44.3	1,654	14,143	45.7
Out of WLP states	4,308	10,722	38.6	4,158	12,652	33.3	3,690	10,453	33.8
Final sample size		**10,722**	**38.6**		**12,652**	**33.3**		**10,453**	**33.8**

BCBS=Blue Cross Blue Shield, WLP=WellPoint.
*Includes spinal cord injuries, spine fractures, and vertebral dislocations, accidents, disk prosthesis, use of bone morphogenetic protein, pathologic fractures, malignant neoplasms, congenital spine disorders, inflammatory spondylopathies, abscess or osteomyelitis, or postlaminectomy syndrome.

SUPPLEMENTAL TABLE S2

Summary of program selection criteria for BDC+ for spine surgery after redesign

1. Required metrics

General safety and quality metrics

- Facility accreditation
- Use a comprehensive surgical safety checklist
- Comprehensive inpatient facility

Program-specific metrics

- ≥2 board-certified surgeons performing spine surgery
- ≥100 spine surgeries performed annually
- Report outcomes data for spine surgeries

2. Scored metrics

2.1 Structure metrics

General safety and quality metrics

- American Nurses Credentialing Center Magnet Recognition
- Health information technology
- Executive leadership by governance board
- Mandatory reporting of medication errors
- Active role in administration leadership of preoperative department/area leaders
- Association of American Medical Colleges principles for conduct and report of clinical trials
- Track and report ≥5 nursing-sensitive measures

Program-specific metrics

- Have a formal spine surgery program structure
- Have a dedicated floor/unit for providing care to ≥75% spine surgery patients
- Have a multidisciplinary care team
- Establish guidelines and/or protocols and monitor compliance and effectiveness for selected areas
- Use multidisciplinary clinical pathways for the care of spine surgery patients
- Establish a registry/database of outcomes data on all spine surgeries
- Have a continuous quality improvement program for spine surgery services
- Volume requirement for surgeon certification and training

2.2 Process metrics

General safety and quality metrics

- Patient safety training and education consistent with National Quality Forum Safe Practice #3
- Measure, monitor, and prevent infections/complications
- Improve or maintain high levels of sepsis management
- Conduct multidisciplinary rounds in the intensive care unit
- Governance board dedicates ≥25% of meeting time to quality and safety-improvement issues
- Pharmacy leaders have an active role in administration leadership
- Conflict of interest (COI) disclosure
- Report Surgical Care Improvement Project (SCIP) results
- Improve patient experience quality

Program-specific metrics

- Patient selection criteria
- Support communication processes to manage transition of care upon discharge
- Employ shared decision-making processes
- Provide preoperative patient education activities
- Have a protocol for patient follow-up in the first year postoperatively
- Routinely use a nationally recognized functional assessment tool to evaluate spine surgery patients pre- and postoperatively

2.3 Outcome metrics

General safety and quality metrics

- Report the number of central line-associated blood stream infections (CLABSI)
- Report Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey results

Program-specific metrics

- Track and report complications
- Self-reported complication rates less than thresholds

SUPPLEMENTAL TABLE S3

Patients' demographic characteristics and comorbidities: Value-designated facilities vs. all other facilities

	Value-designated facilities (n=6,141)	All other facilities (n=27,686)	*P*-value
Female (%)	50.4	49.8	.35
Plan region (%)			<.001
Northeast	9.1	24.5	
Midwest	39.0	28.0	
South	14.7	16.6	
West	37.2	30.9	
Health plan type (%)			<.001
HMO/POS	12.3	17.1	
PPO/FFS	79.2	74.3	
CDHP	8.4	8.5	
Average age (years)			.14
18–44 (%)	23.2	23.0	
45–64 (%)	71.6	71.1	
≥65 (%)	5.2	5.9	
Deyo-Charlson Comorbidity Score			.27
0 (%)	69.5	68.5	
1 (%)	19.4	20.2	
2 (%)	7.3	7.3	
≥3 (%)	3.8	4.0	
Comorbidities			
Diabetes mellitus	11.7	11.0	.10
Chronic atherosclerosis	4.3	5.0	.02
Hypertension	29.7	28.2	.02
Vascular or circulatory disease	3.8	3.6	.37
Major psychiatric disorders	4.3	4.7	.27
Congestive heart failure	0.6	0.7	.76
Rheumatoid arthritis	1.1	1.5	.02
Stroke	0.7	0.7	.49
COPD	0.5	0.5	.60

CDHP=consumer-directed health plan, COPD=chronic obstructive pulmonary disease, FFS=fee-for-service, HMO=health maintenance organization, POS=point-of-service, PPO=preferred provider organization.