Original Article

Geographic variations in orthopedic trauma billing and reimbursements for hip and pelvis fractures in the Medicare population

Ashley C. Dodd, Nikita Lakomkin, Catherine Bulka, Rachel Thakore,
Cory A. Collinge, Manish K. Sethi*

The Vanderbilt Orthopaedic Institute Center for Health Policy, 1215 21st Ave S, Suite 4200, Medical Center East-South Tower, Nashville, TN 37232, United States

ARTICLE INFO

Article history:

Received 14 April 2016

Accepted 21 June 2016

Available online 25 June 2016

Keywords:

Hip
Pelvis
Geographic variations
Medicare
Billing
Reimbursement

ABSTRACT

We investigated geographic variations in Medicare spending for DRG 536 (hip and pelvis fracture). We identified 22,728 patients. The median number of charges, discharges, and payments were recorded. Hospitals were aggregated into core based statistical (CBS) areas and the coefficient of variation (CV) was calculated for each area. On average, hospitals charged 3.75 times more than they were reimbursed. Medicare charges and reimbursements demonstrated variability within each area. Geographic variation in Medicare spending for hip fractures is currently unexplained. It is imperative for orthopedists to understand drivers behind such high variability in hospital charges for management of hip and pelvis fractures.

© 2016 Prof. PK Surendran Memorial Education Foundation. Published by Elsevier, a division of Reed Elsevier India, Pvt. Ltd. All rights reserved.

1. Introduction

Hip and pelvis fractures are among the most common and expensive fractures in the United States^{1–3} and occur at a higher rate within the Medicare population.⁴ In 2002, 1.6 million Medicare beneficiaries were treated for hip fractures costing Medicare around \$14 billion.³ With the GDP already committing 18% to healthcare,⁵ the Centers for Medicare & Medicaid Services (CMS) has begun to pilot a bundled payment model with the hopes of reducing overall Medicare costs while increasing quality of care⁶; however it is unknown if this reform will address geographic variance in hospital charges and reimbursements, a key issue in current Medicare spending.

There has been much discussion about geographic variations in hospital billing and Medicare reimbursement practices. A recent study by Rosenthal et al. highlighted the discrepancies among hospital billing across the country for a total hip replacement before medical insurance, sometimes even a 10-fold difference

across hospitals.⁷ Two studies by Fisher et al. found that regional variation within Medicare spending for hip fracture, colorectal cancer, or acute myocardial infarction had nothing to do with an increased quality of care or access to it, but instead was linked to an increase in the quantity of care. Fisher also noted that patients did not have better outcomes in areas of high-spending compared to low-spending areas, even though those patients received more care.^{8,9}

CMS currently uses the inpatient prospective payment system (IPPS), a fee-for-service model, with a base payment rate for hospital reimbursement. This rate is determined by the local wage index in the hospital area and is then multiplied by the diagnosis-related group (DRG) that is billed to Medicare from the hospital.¹⁰ Medicare payments are also influenced by outlier cases that require higher costs, teaching hospital status, and hospitals that take in more indigent patients than other hospitals in the area.¹¹

Hip and pelvis fractures are among the top 100 DRGs billed to Medicare. Because these fractures often require significant post-acute care and follow-up,¹² spending under the current payment model has varied greatly across the country. In this study, we aim to investigate the variations in Medicare charges and reimbursements surrounding these common orthopedic trauma injuries in the Medicare population. No study has yet to look at the geographic variation among hip and pelvis fractures under the

* Corresponding author. Tel.: +1 615 936 0112; fax: +1 615 936 2667.

E-mail addresses: ashley.c.dodd@vanderbilt.edu (A.C. Dodd), nikita.lakomkin@vanderbilt.edu (N. Lakomkin), cbulka2@uic.edu (C. Bulka), rachelvthakore@gmail.com (R. Thakore), cory.a.collinge@vanderbilt.edu (C.A. Collinge), manish.sethi@vanderbilt.edu (M.K. Sethi).

current Medicare IPPS. We then assess the importance of the up-and-coming bundled payment model to address the geographic variation found in the current fee-for-service model.

2. Methods

Hospital charge and Medicare reimbursement data were obtained for DRG 536 (hip and pelvis fractures without major complications or comorbidities) for the year 2011.¹³ Data were divided by geographic region according to the US Census¹⁴: northeast, south, midwest, and west. For each of these regions, the median number of charges, discharges, and payments was documented. In addition, a charge/payment ratio was calculated using data for each region. Hospitals were aggregated into core based statistical (CBS) areas, which are used by Medicare to assign a hospital wage index to all hospitals in the same area. These CBS areas control for variation in the cost of labor across the country. In order to evaluate the variations in both hospital billing and reimbursement within each area, we then calculated the coefficient of variation (CV) for each sector with regard to both the hospital charges and reimbursements. Reimbursements were defined as average total payments that included Medicare Payments but also co-payments and additional payments by third parties.¹⁵ CV-charge is calculated for each area as the ratio of the standard deviation (SD) of the hospital charges within the area to the mean hospital charge within the area multiplied by 100. CV-reimbursement was calculated in a similar manner.

In order to explore the relationship between cost variability and region, a one-way ANOVA test was employed to assess the difference in charges, number of discharges, payments, and charge/payment ratio between the four regions. The geographic region served as the categorical variable of four levels, while the aforementioned factors were considered as the continuous variables.

3. Results

One thousand one hundred forty-two hospitals accounted for 22,728 patients who had a hip and pelvis fracture without major complications or comorbidities (DRG 536). Table 1 shows the average discharges, charges, reimbursements, and charge to

reimbursement ratio for all DRG 536 billed to Medicare during the 2011 fiscal year. The average hospital charge and SD was \$17,482 (8759) with a wide range of charges (\$3,986–\$64,016). The average Medicare reimbursement and SD was \$4,791 (1072) with a range of reimbursements (\$3,144–\$11,923).

There was a significant difference in the average number of hospital discharges billed to Medicare based on geographic region ($p < 0.001$). Northeast had the highest average discharges (22.02, SD = 11.8) and the west had the lowest (17.61, SD = 6.8). The average hospital charges to Medicare and the average reimbursements were also significant based on geographic region ($p < 0.001$). The west region hospitals charged the highest (\$23,849, SD = 11,234) for DRG 536, followed by northeast (\$19,527, SD = 9889), south (\$15,844, SD = 6903), and midwest (\$13,644, SD = 4265). However, the northeast had the highest reimbursement average (\$5261, SD = 1220) compared to the lowest in the southern region (\$15,844, SD = 6903).

On average, hospitals charged 3.75 times more than they were reimbursed. The west region charged 4.57 times more than they were reimbursed compared to the midwest which only charged 3.02 times.

For our statistical mapping, 884 hospitals accounting for 18,361 patients were assigned into 169 CBS areas. As demonstrated in Fig. 1, there was a very wide variation in hospital charges for DRG 536 within each area; we identified 4 areas with very high CV-charges between 60% and 80% (Fig. 1, orange), and 15 with high CV-charges between 40% and 60% (Fig. 1, yellow). Table 2 shows a closer look at the CBS areas with higher than average coefficient of variation for hospital charges. Even though the average hospital charge across the country is \$17,482, the mean charges in these high CV CBS areas range from \$30,993 to \$7,127. The highest coefficient of variations was in Pittsburg, PA (67.6%) with the lowest being in Evansville, IN-KY (0.39%).

Medicare reimbursements also demonstrated variability within each area (Fig. 2), but on a lesser extent than hospital charges. Although the majority of areas (138) demonstrated a low CV (0–20%, Fig. 2, blue), 30 areas maintained a higher CV (20–40%, Fig. 2, green). Table 3 shows CBS areas with 20–40% coefficient of variation. Lexington-Fayette, KY had the highest coefficient of variations (40.7%) compared to the lowest in Springfield, IL (0.22%). Among the high CV areas, San Jose-Sunnyvale-Santa Clara, CA had

Table 1
Variations in hip and pelvis fractures w/o MCC (DRG 536) by geographic region.

Region	Discharges Mean (SD)	Charges Mean (SD)	Reimbursement Mean (SD)	Charge: reimbursement Mean (SD)
Northeast	22.02 (11.8)	\$19,527 (9889)	\$5261 (1220)	3.76 (1.89)
Midwest	18.93 (8.0)	\$13,664 (4265)	\$4567 (813)	3.02 (0.92)
South	20.28 (10.6)	\$15,844 (6903)	\$4484 (1011)	3.65 (1.66)
West	17.61 (6.8)	\$23,849 (11,234)	\$5205 (968)	4.57 (1.91)
Overall <i>P</i>	<0.001	<0.001	<0.001

Fig. 1. Variations in hospital charges within CBSAs for fracture of hip and pelvis without MCC (DRG 536).

Table 2

Areas with high variation in charges for hip and pelvis fractures w/o MCC (DRG 536).

CBS area	Mean	SD	CV
Boston-Cambridge-Newton, MA-NH	\$11,933	\$5496	46.1%
Daphne-Fairhope-Foley, AL	\$12,888	\$7589	58.9%
Flagstaff, AZ	\$17,916	\$11,987	66.9%
Lexington-Fayette, KY	\$18,065	\$11,107	61.5%
Peoria, IL	\$14,595	\$5907	40.5%
Pittsburgh, PA	\$15,431	\$10,428	67.6%
Port St. Lucie, FL	\$29,497	\$12,859	43.6%
Prescott, AZ	\$19,347	\$8148	42.1%
Providence-Warwick, RI-MA	\$14,767	\$6260	42.4%
Richmond, VA	\$18,229	\$7707	42.3%
Riverside-San Bernardino-Ontario, CA	\$30,993	\$13,726	44.3%
Salinas, CA	\$29,065	\$12,281	42.3%
Salisbury, MD-DE	\$7,127	\$3,114	43.7%
Santa Rosa, CA	\$29,690	\$12,883	43.4%
Sebastian-Vero Beach, FL	\$15,674	\$10,447	66.7%
Toledo, OH	\$15,792	\$7887	49.9%
Washington-Arlington-Alexandria, DC-VA-MD-WV	\$10,279	\$4353	42.4%
Winston-Salem, NC	\$14,968	\$7073	47.3%
Worcester, MA-CT	\$11,751	\$6248	53.2%

Table 3

Areas with high variation in reimbursements for hip and pelvis fractures w/o MCC (DRG 536).

CBS area	Mean	SD	CV
Ann Arbor, MI	\$6451	\$1316	20.4%
Augusta-Richmond County, GA-SC	\$5486	\$1574	28.7%
Baltimore-Columbia-Towson, MD	\$6589	\$1494	22.7%
Boston-Cambridge-Newton, MA-NH	\$5230	\$1124	21.5%
Buffalo-Cheektowaga-Niagara Falls, NY	\$4525	\$1070	23.7%
Cleveland-Elyria, OH	\$4414	\$1218	27.6%
Denver-Aurora-Lakewood, CO	\$4733	\$989	20.9%
Durham-Chapel Hill, NC	\$6762	\$1703	25.2%
Harrisburg-Carlisle, PA	\$4908	\$1604	32.7%
Houston-The Woodlands-Sugar Land, TX	\$5227	\$2022	38.7%
Iowa City, IA	\$5186	\$1787	34.5%
Jackson, MS	\$4532	\$1076	23.8%
Lexington-Fayette, KY	\$5162	\$2103	40.7%
Lubbock, TX	\$4972	\$1465	29.5%
Madison, WI	\$5924	\$1638	27.7%
Miami-Fort Lauderdale-West Palm Beach, FL	\$4860	\$1579	32.5%
Milwaukee-Waukesha-West Allis, WI	\$4932	\$1010	20.5%
Minneapolis-St. Paul-Bloomington, MN-WI	\$5378	\$1436	26.7%
New Haven-Milford, CT	\$6088	\$1502	24.7%
New York-Newark-Jersey City, NY-NJ-PA	\$5907	\$1396	23.7%
Omaha-Council Bluffs, NE-IA	\$4328	\$901	20.8%
Oneonta, NY	\$5301	\$1799	33.9%
Pittsburgh, PA	\$4679	\$1415	30.2%
Riverside-San Bernardino-Ontario, CA	\$5424	\$1203	22.2%
Rochester, NY	\$5020	\$1422	28.4%
San Jose-Sunnyvale-Santa Clara, CA	\$7093	\$1645	23.2%
Tucson, AZ	\$4924	\$1720	34.9%
Virginia Beach-Norfolk-Newport News, VA-NC	\$4200	\$851	20.3%
Wichita, KS	\$5205	\$1221	23.5%
Winston-Salem, NC	\$6740	\$2521	37.4%
Worcester, MA-CT	\$5570	\$1423	25.6%

the highest average reimbursement (\$7,093) compared to Virginia Beach-Norfolk-Newport News, VA-NC which had the lowest (\$4,200).

4. Discussion

This study is the first to evaluate geographic variability in hospital charges and Medicare reimbursement in patients with hip and pelvis fractures without major complication and comorbidities (DRG 536). We found that hospital charges demonstrated a high degree of variability even when using CBS areas to control for differences in hospital wages. We also found high variation in reimbursements in some areas that remain unexplained by Medicare's current method of calculating reimbursement.

The charge to reimbursement ratio also varied across regions, showing that hospital charges are not directly correlated with Medicare reimbursement. For example, midwest hospitals received 3 times less than what they charged, while hospitals in the northeast and the south received close to 4 times less than what they charged.

Historically, several studies have noted a geographic trend in rates of hip fracture being highest in the southern^{16–18} and northwest¹⁹ regions of the United States but lowest in the northern/northeast region.^{18,20} Studies have argued that socioeconomic status, which can affect access to care and preventative screenings¹⁶ as well as population demographics such as race, sex, and age¹⁷ can influence hip fracture rate. In our study, the northeast region had the highest average discharges for DRG 536 and the second highest charge to reimbursement ratio. On the other hand, the western region had the lowest average discharges

but also the highest hospital charges to Medicare as well as the highest charge to reimbursement ratio. Comparatively, the southern region had one of the lowest charge to reimbursement ratios, despite having the second highest discharge average.

With an evolving health care system, it is expected that unexplained geographic variation in federal spending will be addressed. A recent study by Auerbach et al. estimated the impact of three different payment systems including bundled payment on the effects of geographic variation in Medicare spending. Bundled payment models were based off of current pilot models by the CMS. Auerbach found that bundled payments moderately reduced the variation in Medicare spending, while the other two models had no effect.⁶

Our study had several limitations. Because we used Medicare Inpatient data for Part A Medicare beneficiaries, it may not be representative of the Medicare population in its entirety, as there are many Medicare beneficiaries that do not have Part A coverage.¹⁵ Medicare claims are also subject to error in data coding, with inconsistencies from hospital to hospital.⁴ There may also be regional variations in fracture type (due to typical age of

Fig. 2. Variations in hospital reimbursements within CBSAs for fractures of hip and pelvis without MCC (DRG 536).

population etc.) that make treatment necessarily more complex and potentially more expensive. In addition, when data was original collected for the 2011 fiscal year, a strictly Medicare payment column did not exist in the data set, only a total payments column which included third party and out-of-pocket payments. Therefore, our reimbursement rates are slightly higher than actual Medicare reimbursement. Lastly, we did not account for differences among CBS areas that may be influenced by the number of teaching hospitals, by hospitals that see more indigent populations, and by other unknown factors that may increase the variation in Medicare charges and reimbursements.

Geographic variations among hip fractures are well documented, however the geographic variation in Medicare spending for hip fractures is unexplained by the current fee-for-service model. As we move toward a bundled payment system, it is imperative for Orthopedic surgeons to understand the drivers behind such high variability in hospital charges for management of hip and pelvis fractures, especially as the Medicare population is expected to grow significantly in the coming decades.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institution and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required.

Conflicts of interest

The authors have none to declare.

References

- Hayes PJ, Carroll CM, Roberts CS, et al. Operative treatment of acetabular fractures in the Medicare population. *Orthopaedics*. 2013;36(8):e1065–e1070.
- Burge R, Dawson-Hughes B, Solomon DH, Wong JB, King A, Tosteson A. Incidence and economic burden of osteoporosis-related fractures in the United States, 2005–2025. *J Bone Miner Res*. 2007;22(3):465–475.
- Blume SW, Curtis JR. Medical costs of osteoporosis in the elderly Medicare population. *Osteoporos Int*. 2011;22(6):1835–1844.
- Sood N, Huckfeldt PJ, Escarce JJ, Grabowski DC, Newhouse JP. Medicare's bundled payment pilot for acute and postacute care: analysis and recommendations on where to begin. *Health Aff (Millwood)*. 2011;30(9):1708–1717.
- Rana AJ, Bozic KJ. Bundled payments in orthopaedics. *Clin Orthop Relat Res*. 2015;473(2):422–425.
- Auerbach D, Mehrotra A, Hussey P, et al. How will provider-focused payment reform impact geographic variation in Medicare spending? *Am J Manag Care*. 2015;21(6):e390–e398.
- Rosenthal JA, Lu X, Cram P. Availability of consumer prices from US hospitals for a common surgical procedure. *JAMA Intern Med*. 2013;173(6):427–432.
- Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder EL. The implications of regional variations in Medicare spending. Part 1: the content, quality, and accessibility of care. *Ann Intern Med*. 2003;138(4):273–287.
- Fisher ES, Wennberg DE, Stukel TA, Gottlieb DJ, Lucas FL, Pinder EL. The implications of regional variations in Medicare spending. Part 2: health outcomes and satisfaction with care. *Ann Intern Med*. 2003;138(4):288–298.
- Acute Inpatient PPS. Centers for Medicare and Medicaid Services. <https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/index.html?redirect=acuteinpatientpps/> [accessed 07.12.15].
- Belatti DA, Pugely AJ, Amendola A, Phisitkul P, Callaghan JJ. Medicare data transparency may confuse consumers comparing hospitals for total joint arthroplasty. *J Arthroplasty*. 2015;30(1):7–11.
- Birkmeyer JD, Gust C, Baser O, Dimick JB, Sutherland JM, Skinner JS. Medicare payments for common inpatient procedures: implications for episode-based payment bundling. *Health Serv Res*. 2010;45(6 Pt 1):1783–1795.
- Inpatient Medicare Provider Charge Data. Centers for Medicare and Medicaid Services. <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Medicare-Provider-Charge-Data/Inpatient2011.html> [accessed 07.12.15].
- Regions and Divisions. United States Census Bureau. http://www.census.gov/econ/census/help/geography/regions_and_divisions.html [accessed 10.12.15].
- Medicare Fee-For Service Provider Utilization and Payment Data Inpatient Public Use File: A Methodological Overview [PDF]. Centers for Medicare & Medicaid Services; 2015, June.
- Taylor AJ, Gary LC, Arora T, et al. Clinical and demographic factors associated with fractures among older Americans. *Osteoporos Int*. 2011;22(4):1263–1274.
- Stroup NE, Freni-Titulaer LW, Schwartz JJ. Unexpected geographic variation in rates of hospitalization for patients who have fracture of the hip. Medicare enrollees in the United States. *J Bone Joint Surg Am*. 1990;72(9):1294–1298.
- Lauderdale DS, Thisted RA, Goldberg J. Is geographic variation in hip fracture rates related to current or former region of residence? *Epidemiology*. 1998;9(5):574–577.
- Bacon WE, Smith GS, Baker SP. Geographic variation in the occurrence of hip fractures among the elderly white US population. *Am J Public Health*. 1989;79(11):1556–1558.
- Karagas MR, Baron JA, Barrett JA, Jacobsen SJ. Patterns of fracture among the United States elderly: geographic and fluoride effects. *Ann Epidemiol*. 1996;6(3):209–216.