



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Healthcare

The likely economic impact of fewer elective surgical procedures on US hospitals during the COVID-19 pandemic



Matthew J. Best, MD^a, Edward G. McFarland, MD^a, Gerard F. Anderson, PhD^b,
Uma Srikumaran, MD, MBA, MPH^{a,*}

^a Department of Orthopedic Surgery, Johns Hopkins University School of Medicine, Baltimore, MD

^b Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD

ARTICLE INFO

Article history:

Accepted 6 July 2020

Available online 29 July 2020

ABSTRACT

Background: To help control the coronavirus disease 2019 pandemic, elective procedures have been cancelled in most US hospitals by government order. The purpose of this study is to estimate national hospital reimbursement and net income losses owing to elective surgical procedure cancellation during the coronavirus disease 2019 pandemic.

Methods: The National Inpatient Sample and the Nationwide Ambulatory Surgery Sample were used to identify all elective surgical procedures performed in the inpatient setting and in hospital-owned outpatient surgery departments throughout the United States. Total cost, reimbursement, and net income was determined for all elective surgical procedures.

Results: The estimated total annual cost of elective inpatient and outpatient surgical procedures in the United States was \$147.2 billion, and estimated total hospital reimbursement was \$195.4 to \$212.2 billion. This resulted in a net income of \$48.0 to \$64.8 billion per year to the US hospital system. Cancellation of all elective procedures would result in estimated losses of \$16.3 to \$17.7 billion per month in revenue and \$4 to \$5.4 billion per month in net income to US hospitals.

Conclusion: Cancellation of elective procedures during the coronavirus disease 2019 pandemic has a substantial economic impact on the US hospital system.

© 2020 Elsevier Inc. All rights reserved.

Introduction

On March 13, 2020, a state of emergency was declared in the United States owing to coronavirus disease 2019 (COVID-19), and the Centers for Medicare and Medicaid Services (CMS) made recommendations to curtail elective procedures to help limit viral exposure, control the spread of the pandemic, and conserve hospital resources in order to preserve them for a projected increase in patients with COVID-19.^{1,2} As of May 2020, some hospitals have begun to slowly resume some elective procedures in accordance with CMS recommendations.³

Although cancellation of elective procedures leads to increased inpatient bed capacity and conservation of equipment, such as personal protective equipment and ventilators, it also results in substantial financial implications for the healthcare system.^{4,5} To help relieve financial strain on hospitals, Congress provided \$175

billion in relief funding to the healthcare system through the Coronavirus Aid, Relief, and Economic Security Act and the Paycheck Protection Program and Health Care Enhancement Act.^{6,7}

Several reports evaluating the financial implications on hospitals during the pandemic use data from the Healthcare Cost and Utilization Project (HCUP) for economic predictions.^{4,5,8} However, these estimates do not include information on hospital revenue or profit, but rather only provide estimates of aggregate cost of inpatient procedures and admissions and are based on data that are 6 to 9 years old.^{8,9} Therefore, it is difficult to make accurate financial predictions involving hospital revenue from elective procedures using these reports.

The purpose of this study is to estimate the total cost, reimbursement, and net income of elective inpatient and outpatient surgical procedures in the United States and to determine the likely economic impact of elective procedure cancellation on the US hospital system during the COVID-19 pandemic using a nationally representative sample of both inpatient and outpatient surgical procedures.

* Reprint requests: Uma Srikumaran, MD, Department of Orthopedic Surgery, Johns Hopkins Medicine—10700 Charter Drive, Suite 205, Columbia, MD 21044.

E-mail address: us@jhmi.edu (U. Srikumaran).

Methods

This study was exempt from institutional review board review because the data are de-identified and publicly available.

Data source

We used the National Inpatient Sample (NIS) and the Nationwide Ambulatory Surgery Sample (NASS), HCUP, data maintained by the Agency for Healthcare Research and Quality, for this study. The NIS, released from 1988 through 2017, is the largest all-payer database for inpatient hospital admissions in the United States. The database includes demographic and clinical information for each encounter such as diagnosis and procedure codes, length of hospital stay, source of payment, total hospital charges, and hospital characteristics such as teaching status.¹⁰ The NIS provides national estimates with data from over 35 million hospitalizations using a complex weighting method. Importantly, the NIS redesigned its hospital sampling method starting in 2012 to improve national estimates.¹⁰

The NASS is the only nationally representative ambulatory surgery database in existence today. It is the largest all-payer database yielding national estimates of major ambulatory surgery encounters performed in hospital-owned facilities.¹¹ The NASS contains clinical and resource-use related information including demographic information, diagnostic and procedure codes, total charges, source of payment, and facility characteristics. There are 2 years of data currently available for the NASS: 2016 and 2017. We utilized the most recent year available for both the NIS and the NASS.

Inpatient analysis

In order to estimate cost and reimbursement for inpatient elective surgical procedures, we selected all elective encounters in the NIS using the HCUP elective variable designation. Cases were then selected based on procedure class using the HCUP procedure classification system, which divides procedures into 4 categories: minor diagnostic or minor therapeutic (not requiring operating room) and major diagnostic or major therapeutic (operating room procedure).^{12,13} We analyzed elective operating room procedures as well as those procedures not requiring an operating room.

Cost variable

The HCUP provides cost-to-charge ratio files that are calculated based on information from hospital accounting reports collected from the CMS and are specific to each encounter in the NIS.¹⁴ These files provide a cost that reflects the actual expenses from hospital services, such as wages, supplies, and utility costs for each case.¹¹

Reimbursement variable

Reimbursement was calculated for each case based on the CMS system of payment for acute care hospital inpatient stays with adjustments for different rates of payment by different insurers. The Medicare payment system is referred to as the inpatient prospective payment system and assigns payment based on the diagnosis-related group for each encounter.¹⁵ The CMS assigns each diagnosis-related group a payment weight, which is available in the CMS Final Rule tables.¹⁶ This weight is multiplied by the sum of standardized labor-related share (adjusted by wage index supplied by the NIS) and nonlabor share plus the capital amount, all of which are available in the Final Rule tables.^{16,17} This provided a base reimbursement for each case.

The CMS provides additional payments for each case to teaching hospitals referred to as the indirect medical education (IME)

adjustment. The IME adjustment is calculated based on the number of residents and the number of beds in each hospital.¹⁸ The IME adjustment values of each teaching hospital are available in the CMS hospital cost report data.¹⁹ In order to estimate IME adjustments for cases in the NIS, we used the CMS hospital cost report data to calculate mean IME adjustment values stratified based on hospital census region, urban hospital setting, and hospital bed size. We then matched these adjustments to cases performed at teaching hospitals in the NIS based on the census region, urban hospital setting, and hospital bed size as listed in the NIS (Electronic Supplement 1). The CMS also adjusts the payment for each case based on whether the hospital treats patients with low income. This is referred to as the disproportionate share hospital (DSH) adjustment and is available in the CMS hospital cost report.²⁰ Using CMS data, we calculated mean DSH adjustments based on hospital census region and urban or rural hospital setting and matched these values to cases in the NIS based on hospital census region and hospital setting (Electronic Supplement 2).

Finally, the CMS provides an additional adjustment for exceptionally high cost cases, referred to as an outlier payment. Cases are eligible for outlier payments if the costs are greater than the sum of the adjusted payment plus a constant value set by CMS each year known as the fixed-loss cost threshold. The outlier payment is equal to 80% of the difference between the cost and the sum of the adjusted payment and the fixed-loss cost threshold.²¹

Not all insurers use the same payment methodology as Medicare and do not pay the same rates as Medicare. Typically, private insurance pays more, and Medicaid and self-pay have lower payment rates. In order to account for variations in reimbursement based on payer status, we utilized published reports comparing inpatient payments from Medicare, Medicaid, and private insurance to estimate payment rates by insurer type.^{22–28} Based on these published reports, we created 2 different sets of estimates for inpatient cases—a conservative and upper estimate: conservative estimate: 1.0 Medicare; 0.8 Medicaid; 1.8 private insurance; and 0.65 other, self-pay, missing, or no charge and upper estimate: 1.0 Medicare; 1.0 Medicaid; 2.0 private insurance; and 1.0 other, self-pay, missing, or no charge.

Outpatient analysis

Cost variable

We calculated cost for each outpatient case in the NASS using data from the hospital outpatient prospective payment system (HOPPS) designed by the CMS. The CMS determines mean cost values for each Current Procedural Terminology code, which is listed in the HOPPS Final Rule cost statistic tables. The CMS calculates these values to represent the average total cost for that type of case for all hospitals along with bundled services.²⁹ When more than 1 procedure is performed during a single surgery and more than 1 procedural code is listed, then the code with the highest cost is used to determine the total cost for the case. In the Medicare payment system, subsequent codes do not add to the total case cost.

Reimbursement variable

Reimbursement was calculated for each outpatient case using the CMS payment system. As with cost, the CMS determines total payment amounts and minimum copayment amounts for each procedural code, which is listed in the HOPPS Final Rule cost statistical and addenda tables for each year. The CMS calculates these amounts based on ambulatory procedure classifications, and procedure codes are also classified under a status indicator.³⁰ When more than 1 procedure is performed during a single surgery and more than 1 procedure code is listed, the status indicator is used to determine the method of payment. For example, if the status

Table 1

Aggregate hospital charges, reimbursement, cost, and net income for elective surgery and all elective procedures in the United States

Elective surgery	Annual	Monthly
	Billion, USD	Billion, USD
Total charges	546.4	45.5
Total reimbursement*	177.2–191.8	14.8–16.0
Total cost	129.9	10.8
Net income	47.1–61.6	3.9–5.1

All elective procedures†	Billion, USD	Billion, USD
Total charges	615.3	51.3
Total reimbursement*	195.4–212.2	16.3–17.7
Total cost	147.2	12.3
Net income	48.0–64.8	4.0–5.4

Net income = reimbursement – cost

* Ranges in hospital reimbursement are based on conservative (lower) to upper reimbursement estimates based on differences in payment rates based on payer type for each procedure.

† All elective procedures = includes surgeries requiring an operating room and minor procedures not requiring an operating room.

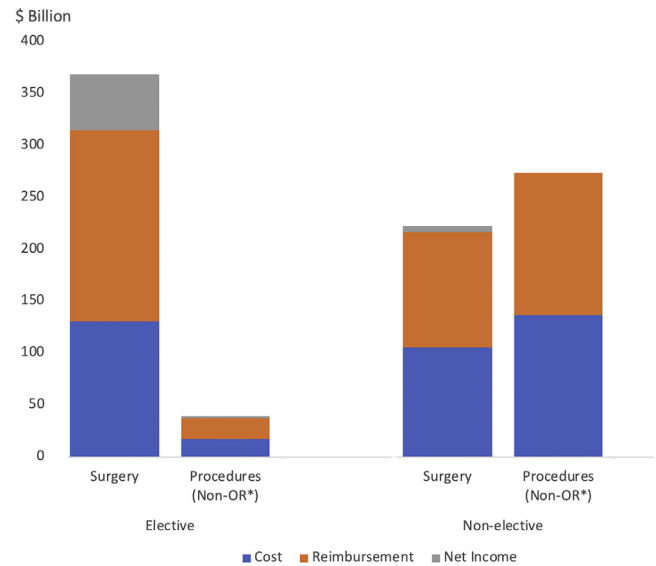


Fig 1. Aggregate cost, reimbursement, and net income from inpatient and outpatient surgery and minor procedures not requiring an operating room, comparing elective to nonelective cases. (Color version of the figure is available online.) *Non-OR = minor procedures not requiring an operating room. OR, operating room.

indicator of any code for the procedure is J1, then the case receives a bundled payment and additional procedure codes to do not affect payment. Payments for over 92% of cases in the NASS were bundled based on the CMS method. Nonbundled cases receive full payment for the primary procedural code, followed by 50% payment for subsequent codes in accordance with CMS rates.

In order to account for variations in reimbursement based on payer status, we utilized published reports comparing outpatient payments from Medicare, Medicaid, and private insurance to determine a conversion equation.^{22–28} Using a conservative and upper estimate, the final reimbursement adjustment values for outpatient cases were conservative estimate: 1.0 Medicare; 0.8 Medicaid; 2.5 private insurance; and 0.65 other, self-pay, missing, or no charge and upper estimate: 1.0 Medicare; 1.0 Medicaid; 2.65 private insurance; and 1.0 other, self-pay, missing, or no charge.

Statistical analysis

The total cost and adjusted reimbursement variables for all surgical services in all hospitals were calculated. Net income was calculated by subtracting total cost from adjusted reimbursement for each case, and an aggregate sum was calculated. The most commonly performed inpatient and outpatient operating room surgical procedures were identified using the HCUP clinical classification software.^{12,13} There were 1.7% (175, 119) of outpatient cases that had missing cost or reimbursement data so these were excluded from the analysis. We adhered to methodological standards for NIS use, including using discharge weights rather than hospital-level weights for analysis.^{31,32} Data were analyzed using SPSS, version 23, software (IBM Corporation, Armonk, NY).

Results

There were over 14.6 million elective inpatient and outpatient operating room surgical procedures in 2017, 4.6 million of which were inpatient and 10.0 million of which were outpatient. The total aggregate cost of elective inpatient and outpatient operating room surgical procedures was \$129.9 billion, while the total aggregate reimbursement was \$177.2 to \$191.8 billion, resulting in an annual net income of \$47.1 to \$61.6 billion or a monthly net income of \$3.9 to \$5.1 billion (Table 1). The total aggregate cost of all elective

procedures (including surgeries requiring an operating room and minor procedures not requiring an operating room) was \$147.2 billion, while total aggregate reimbursement was \$195.4 to \$212.2 billion, resulting in an annual net income of \$48.0 to \$64.8 billion or a monthly net income of \$4.0 to \$5.4 billion (Table 1). When comparing elective procedures to nonelective procedures, elective procedures had lower cost and higher net income than nonelective procedures (Fig 1).

The most common elective inpatient operating room procedures were knee arthroplasty ($n = 772,064$), elective cesarean section ($n = 673,394$), hip arthroplasty ($n = 434,195$), spinal fusion ($n = 379,575$), and laminectomy/discectomy ($n = 239,540$) (Table II). The most common outpatient surgeries were cataract/lens surgery ($n = 1,252,583$), cholecystectomy ($n = 580,424$), arthroscopy with or without meniscectomy ($n = 506,342$), inguinal/femoral hernia repair ($n = 452,353$), and other hernia repair including ventral and umbilical ($n = 423,480$) (Table III).

Discussion

This study demonstrates that elective inpatient and outpatient surgical procedures account for approximately \$195.4 to \$212.2 billion in hospital reimbursement and approximately \$48.0 to \$64.8 billion in hospital net income per year in the United States. Cancellation of elective surgical procedures during the COVID-19 pandemic results in estimated losses of \$16.3 to \$17.7 billion per month in reimbursement and \$4 to \$5.4 billion per month in net income to the US hospital system.

There are substantial financial implications from cancellation of elective procedures and other services, which have caused reductions in hospital revenue and net income.^{33,34} Publicly available national healthcare cost and expenditure data often provide aggregate hospital financial data but do not provide specific details on revenue and net income directly from elective procedures.³⁵ It is important to understand the reasons for the financial losses. This article shows the potential financial impact of stopping elective surgical procedures to the hospital, but it does not show the impact to surgeons.

Table II

Aggregate annual hospital charges, reimbursement, cost, and net income for elective surgery and all elective procedures comparing teaching hospitals to non-teaching hospitals in the United States

Elective surgery	Teaching hospitals (n = 10,034,858)	Nonteaching hospitals (n = 4,703,939)
	Billion, USD	
Total charges	400.8	145.5
Total reimbursement*	130.8–141.7	46.4–50.0
Total cost	94.8	35.0
Net income	35.7–46.7	11.3–15.0

All elective procedures†	(n = 11,343,748)	(n = 5,338,817)
	Billion, USD	
Total charges	452.6	162.7
Total reimbursement*	144.6–157.3	50.8–54.9
Total cost	107.6	39.5
Net income	36.8–49.4	11.2–15.4

Net income = reimbursement – cost

* Ranges in hospital reimbursement are based on conservative (lower) to upper reimbursement estimates based on differences in payment rates based on payer type for each procedure.

† All elective procedures = includes surgeries requiring an operating room and minor procedures not requiring an operating room.

Table III

Most common elective inpatient and outpatient operating room procedures performed in the United States based on surgery setting

Inpatient					
	Description	n (Thousand)	Cost (Billion, \$)	Reimbursement* (Billion, \$)	Net income (Billion, \$)
1	Knee arthroplasty	772.1	12.7	14.1–15.2	1.4–2.4
2	Cesarean section	673.4	4.5	5.7–6.6	1.1–2.0
3	Hip arthroplasty	434.2	7.3	8.2–8.8	0.9–1.5
4	Spinal fusion	379.6	11.7	14.4–15.8	2.6–4.1
5	Laminectomy/discectomy	239.5	6.7	8.4–9.2	1.7–2.6
6	Hysterectomy	148.4	1.9	2.0–2.2	0.1–0.3
7	Gastrectomy	145.3	2.1	2.7–3.0	0.6–0.9
8	Heart valve procedures	124.8	6.3	7.2–7.7	0.9–1.3
9	Arthroplasty other than hip/knee	123.0	2.3	2.4–2.5	0.002–0.2
10	Colorectal resection	120.3	2.6	2.8–3.1	0.2–0.5

Outpatient					
	Description	n (Thousand)	Cost (Billion, \$)	Reimbursement* (Billion, \$)	Net income (Billion, \$)
1	Cataract/lens surgery	1,252.6	2.3	3.5–3.7	1.2–1.4
2	Cholecystectomy/duct exploration	580.4	2.3	5.2–5.7	2.9–3.3
3	Arthroscopy/meniscectomy	506.3	1.7	3.5–3.8	1.8–2.1
4	Inguinal/femoral hernia repair	452.4	1.7	3.1–3.3	1.4–1.7
5	Other hernia repair-ventral/umbilical	423.5	1.7	3.5–3.7	1.7–2.0
6	Removal of tonsils and/or adenoids	417.9	1.5	2.7–2.9	1.2–1.5
7	Peripheral nerve decompression	354.5	0.7	1.2–1.3	0.5–0.6
8	Myringotomy/tympanostomy	319.7	0.6	1.0–1.1	0.4–0.5
9	Lumpectomy	315.8	0.9	1.7–1.8	0.8–1.0
10	Laminectomy/discectomy	234.3	1.4	3.1–3.3	1.7–1.9

Net income = reimbursement – cost

Outpatient = hospital-owned outpatient surgery centers.

Procedures identified with clinical classification software developed by the HCUP.

* Ranges in hospital reimbursement are based on conservative (lower) to upper reimbursement estimates based on differences in payment rates based on payer type for each procedure.

Several reviews estimating hospital losses during the COVID-19 pandemic reference a report from the HCUP released in 2017, which estimated aggregate costs for inpatient US operating room procedures using data from 2014.^{4,5,8} However, the HCUP does not collect information on hospital revenue, so their statistical brief did not include revenue or profit in the analysis. Furthermore, the report did not contain information on ambulatory services.⁸ Therefore, it is difficult to make financial predictions on the financial performance of hospitals from elective procedure cancellation using this report. In this study, we estimate hospital reimbursement specifically for elective inpatient and outpatient

surgical procedures, which can be used to aid in economic projections and decision-making. Aside from COVID-19 planning, it has information on the importance of elective surgeries and procedures for hospitals in the future.

On May 6, 2020, the CMS issued new recommendations on how hospitals may resume elective procedures at their own discretion.³ This decision places the responsibility to resume elective services on the leadership of specific hospitals and healthcare entities. Many hospitals may allow areas less affected by the virus, such as outside major metropolitan areas, to resume procedures before other areas with higher disease burden. The decision to allow resumption

based on hospital discretion may allow departments to slowly resume procedures in a tiered fashion, with the more time-sensitive elective surgeries being performed first. A concern about placing the decision under the responsibility of hospital leadership who may be experiencing firsthand the financial ramifications of the pandemic is that they may place financial concerns over safety concerns. It is important to remember that the federal funds were designed to help hospitals respond to the financial concerns of fewer elective surgeries. Hospital leaders must remember to keep the safety of patients as their top priority as they weigh the risks and benefits of resuming elective procedures while ensuring the safety of patients.

Although Congress has already allocated \$175 billion in relief funding to the healthcare system to help reduce net income losses, the exact impact this funding has on hospitals is not well elucidated because the funding has not been completely allocated. The findings of this study may be useful for federal and state agencies in further considerations to provide hospitals with additional measures to help offset these financial losses. Also, not all of the allocated dollars have been spent, and it is possible to change which hospitals receive the funding.

Some centers have needed to furlough employees and faculty, reduce salaries, decrease retirement funding, and limit benefits for workers, which may reduce financial losses.³⁶ Alternatively, hospitals may incur greater costs in the future (owing to increased COVID testing, greater use of personal protective equipment, and decreased operating room efficiency during tiered procedure resumption) in order to return to normal business operations and may have decreased efficiency in the next few years owing to distancing measures and limited personal protective equipment. Other long-term costs which may arise include enhanced testing measures to keep patients safe for elective visits, improved cleaning and sterilization processes, and enhanced infection control standards.

There are several limitations of this study. Most important, the study does not examine the impact on surgeons. Second, we do not know how many elective surgeries were actually cancelled, and how long the cancellations will continue. Third, the NASS only includes data for outpatient surgery that takes place in hospital-owned facilities (including those within the hospital, attached to the hospital, or in a different geographic location than the hospital) and represents a true national estimate of this but does not include physician-owned facilities. However, our objective was to study the economic impact on the US hospital system and not on private practice; a separate study would be needed to examine privately owned outpatient surgery centers. Additionally, some hospitals are exempt from the CMS inpatient prospective payment system, but these tend to be smaller, rural hospitals, and our payer adjustment would take this into account.³⁷ Using the NIS and NASS, we cannot determine losses incurred by hospitals owing to employees and infrastructure in the absence of surgery. Finally, this study estimates potential losses in the case that all elective procedures were cancelled, but the true number is likely lower than this.

The cost and revenue calculations are based on estimates. Cost estimates are reflective of the expenses for each case and represent hospital services such as wages, supplies, and utility costs. However, these costs do not include professional fees. Owing to variation across the United States based on physician-hospital contracts and other variables, we felt that estimates of professional fees would be difficult to assess and did not include these in the analysis. Our study utilizes CMS methodology for calculating reimbursement, but several estimations were necessary, including IME and DSH estimates. Mean IME and DSH estimates were stratified according to census region, hospital bed size, urban versus rural setting, and teaching status, because we cannot link data from CMS

to specific hospitals in the NIS. Larger teaching hospitals have the highest IME and DSH adjustments, so calculating stratified mean estimates will decrease the adjustments for these larger and busier hospitals; however, we calculated national estimates, not estimates for specific hospitals, so this would not affect the results. Although the HCUP provides cost estimates, we cannot determine exactly how the costs are allocated within the hospital. The hospitals may be allocating fixed and indirect costs to elective surgeries or away from elective surgeries depending on how payment rates are set. This is known as cost allocation by accountants. It is critical to note that the data presented in this study are a summary of financial implications to the entire hospital system in the United States and do not provide information on specific hospital losses. Different hospitals may have variable income losses based on volume and type of elective procedures performed, hospital staffing, hospital financial reserves, and other factors specific to each hospital. Finally, we made adjustments based on the source of payment; these were determined based on published literature estimating the differences in Medicare and private insurance payments.^{22–28}

In conclusion, the COVID-19 pandemic and the subsequent cancellation of elective surgical procedures has led to substantial strain on hospitals. Elective procedures account for approximately \$195.4 to \$212.2 billion in revenue and \$48.0 to \$64.8 billion in net income per year to hospitals in the United States. Cancellation of elective procedures results in deficits of \$16.3 to \$17.8 billion per month in revenue and \$4 to \$5.4 billion per month in net income to the US hospital system. These findings may aid state and federal agencies in financial planning during and after the COVID-19 pandemic, and officials should consider these results when deciding how to allocate funds and resources to sustain hospital operations.

Conflict of interest/Disclosure

The authors do not have any conflicts of interest related to authorship and/or publication of this article. Outside of the published work, Dr. McFarland reports receiving financial/educational/material support from Arthrex, Depuy, American Shoulder and Elbow Society, OMEGA, Smith & Nephew, Stryker, and Wright Medical; royalties from Innomed; and is on the editorial board of the American Journal of Sports Medicine. Dr. Srikumaran reports receiving financial/educational/material support from Arthrex, Depuy, Smith & Nephew, Stryker, Thieme; is a committee member for the American Academy of Orthopedic Surgeons; is a paid consultant for Conventus, Fx Shoulder, Orthofix; and receives stock options from Quantum OPS, ROM3, and Tigon Medical.

Funding/Support

The authors received no financial support for the research, authorship, and/or publication of this article. All authors fulfill the COPE requirements for authorship.

Acknowledgments

We thank Joseph K. Canner, MHS, of the Johns Hopkins Surgery Center for Outcomes Research (JSCOR), Department of Surgery, Johns Hopkins University School of Medicine for advisement on the design, methods, and guidance of statistical analysis for this study.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.surg.2020.07.014>.

References

- Trump DJ. Proclamation on declaring a national emergency concerning the novel coronavirus disease (COVID-19) outbreak; 2020. <https://www.whitehouse.gov/presidential-actions/proclamation-declaring-national-emergency-concerning-novel-coronavirus-disease-covid-19-outbreak/>. Accessed April 7, 2020.
- Center for Medicare & Medicaid Services. Non-emergent, elective medical services, and treatment recommendations; 2020. <https://www.cms.gov/files/document/cms-non-emergent-elective-medical-recommendations.pdf>. Accessed April 7, 2020.
- Center for Medicare & Medicaid Services. Opening up America again. Centers for Medicare & Medicaid Services (CMS) Recommendations. Re-opening Facilities to Provide Non-emergent Non-COVID-19 Healthcare: Phase I; 2020. <https://www.cms.gov/files/document/covid-flexibility-reopen-essential-non-covid-services.pdf>. Accessed May 8, 2020.
- Barnett ML, Mehrotra A, Landon BE. Covid-19 and the upcoming financial crisis in health care; 2020. <https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0153>. Accessed May 8, 2020.
- Khullar D, Bond AM, Schpero WL. COVID-19 and the financial health of US hospitals. *JAMA*; 2020. <https://jamanetwork.com/journals/jama/fullarticle/2765698>.
- Coronavirus Aid, Relief, and Economic Security (CARES) Act, HR 748, 116th Cong (2020). <https://www.congress.gov/116/bills/hr748/BILLS-116hr748enr.pdf>. Accessed May 8, 2020.
- Paycheck Protection Program and Health Care Enhancement Act, HR 266, 116th Cong (2020). <https://www.congress.gov/116/plaws/publ139/PLAW-116publ139.pdf>. Accessed May 8, 2020.
- McDermott KW, Freeman WJ, Elixhauser A. Statistical Brief #233: Overview of operating room procedures during inpatient stays in U.S. hospitals, 2014; 2017. <https://www.hcup-us.ahrq.gov/reports/statbriefs/sb233-Operating-Room-Procedures-United-States-2014.pdf>. Accessed April 1, 2020.
- Weiss AJ, Elixhauser A, Andrews RM. Statistical Brief #170: Characteristics of operating room procedures in U.S. hospitals, 2011; 2014. <https://www.hcup-us.ahrq.gov/reports/statbriefs/sb170-Operating-Room-Procedures-United-States-2011.jsp>. Accessed May 1, 2020.
- Healthcare Cost and Utilization Project (HCUP). Overview of the National (Nationwide) Inpatient Sample (NIS); 2017. www.hcup-us.ahrq.gov/nisoverview.jsp. Accessed April 3, 2020.
- Healthcare Cost and Utilization Project (HCUP). Overview of the Nationwide Ambulatory Surgery Sample (NASS); 2017. <https://hcup-us.ahrq.gov/nassoverview.jsp>. Accessed April 3, 2020.
- Healthcare Cost and Utilization Project (HCUP). Clinical Classifications Software (CCS) for ICD-10-PCS (beta version); 2017. <https://www.hcup-us.ahrq.gov/toolssoftware/ccs10/ccs10.jsp>. Accessed April 3, 2020.
- Healthcare Cost and Utilization Project (HCUP). Clinical Classifications Software for Services and Procedures; 2017. https://www.hcup-us.ahrq.gov/toolssoftware/ccs_svcsproc/ccssvcproc.jsp. Accessed April 3, 2020.
- Healthcare Cost and Utilization Project (HCUP). Cost-to-charge ratio files; 2017. www.hcup-us.ahrq.gov/db/state/costtocharge.jsp. Accessed April 3, 2020.
- Center for Medicare & Medicaid Services (CMS). Acute Inpatient PPS; 2017. <https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS>. Accessed April 10, 2020.
- Center for Medicare & Medicaid Services (CMS). FY 2017 IPPS Final Rule Homepage. <https://www.cms.gov/medicare/medicare-fee-service-payment/acuteinpatientpps/acuteinpatient-files-download/files-fy-2017-final-rule-and-correction-notice>. Accessed April 10, 2020.
- Krinsky S, Ryan AM, Mijanovich T, Blustein J. Variation in payment rates under Medicare's inpatient prospective payment system. *Health Serv Res*. 2017;52:676–696.
- Center for Medicare & Medicaid Services (CMS). Indirect Medical Education (IME); 2014. <https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Indirect-Medical-Education-IME>. Accessed April 10, 2020.
- Center for Medicare & Medicaid Services (CMS). Cost reports; 2020. <https://www.cms.gov/Research-Statistics-Data-and-Systems/Downloadable-Public-Use-Files/Cost-Reports>. Accessed April 10, 2020.
- Center for Medicare & Medicaid Services (CMS). Disproportionate share hospital (DSH); 2020. <https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/dsh>. Accessed April 10, 2020.
- Center for Medicare & Medicaid Services (CMS). Outlier payments; 2013. <https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/outlier>. Accessed April 10, 2020.
- Bai G, Anderson GF. Market power: price variation among commercial insurers for hospital services. *Health Aff (Millwood)*. 2018;37:1615–1622.
- Bai G, Anderson GF. Variation in the ratio of physician charges to Medicare payments by specialty and region. *JAMA*. 2017;317:315–318.
- Biener AI, Selden TM. Public and private payments for physician office visits. *Health Aff (Millwood)*. 2017;36:2160–2164.
- Cooper Z, Craig SV, Gaynor M, Van Reenen J. The price ain't right? Hospital prices and health spending on the privately insured; 2018. <http://www.nber.org/papers/w21815>. Accessed May 1, 2020.
- Ginsburg PB. Wide variation in hospital and physician payment rates evidence of provider market power; 2010. <http://www.hschange.org/CONTENT/1162/>. Accessed May 3, 2020.
- American Hospital Association. TrendWatch Chartbook 2018; 2018. <https://www.aha.org/guidesreports/2018-05-22-trendwatch-chartbook-2018>. Accessed March 31, 2020.
- White C, Whaley C. Prices paid to hospitals by private health plans are high relative to Medicare and vary widely: findings from an employer-led transparency initiative; 2019. https://www.rand.org/pubs/research_reports/RR3033.html. Accessed May 5, 2020.
- Center for Medicare & Medicaid Services (CMS). Hospital Outpatient PPS; 2017. <https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalOutpatientPPS>. Accessed April 10, 2020.
- Center for Medicare & Medicaid Services (CMS). Medicare CY 2019 outpatient prospective payment system (OPPS) final rule claims accounting; 2019. <https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/HospitalOutpatientPPS/Downloads/CMS-1695-FC-2019-OPPS-FR-Claims-Accounting.pdf>. Accessed April 10, 2020.
- Healthcare Cost and Utilization Project (HCUP). HCUP Nationwide Inpatient Sample Redesign Report; 2014. <https://www.hcup-us.ahrq.gov/db/nation/nis/reports/NISRedesignFinalReport040914.pdf>. Accessed September 25, 2017.
- Khera R, Angraal S, Couch T, et al. Adherence to methodological standards in research using the National Inpatient Sample. *JAMA*. 2017;318:2011–2018.
- Harris S, Sondel J, Schneider GS. Cash-starved hospitals and doctor groups cut staff amid pandemic. *The Washington Post*; April 9, 2020. https://www.washingtonpost.com/health/starved-for-cash-hospitals-and-doctor-groups-cut-staff-amid-pandemic/2020/04/09/d3593f54-79a7-11ea-a130-df573469f094_story.html. Accessed April 10, 2020.
- Health and Human Services Office of the Inspector General. Hospital experiences responding to the COVID-19 pandemic: results of a National Pulse Survey March 23–27, 2020; 2020. <https://oig.hhs.gov/oei/reports/oei-06-20-00300.asp>. Accessed May 1, 2020.
- Center for Medicare & Medicaid Services (CMS). National health expenditure data; 2019. <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData>. Accessed April 3, 2020.
- Mathews AW, Evans M. Hospitals, doctors feel financial squeeze as coronavirus sweeps U.S. *The Wall Street Journal*; April 1, 2020. <https://www.wsj.com/articles/hospitals-doctors-feel-financial-squeeze-as-coronavirus-sweeps-u-s-11585768706>. Accessed May 5, 2020.
- United States Government Accountability Office (GAO). 2013. Medicare: Legislative modifications have resulted in payment adjustments for most hospitals; 2013. <https://www.gao.gov/assets/660/653852.pdf>. Accessed May 1, 2020.