By Sara L. Schaefer, Shukri H. A. Dualeh, Nicholas Kunnath, John W. Scott, and Andrew M. Ibrahim

Higher Rates Of Emergency Surgery, Serious Complications, And Readmissions In Primary Care Shortage Areas, 2015–19

DOI: 10.1377/hlthaff.2023.00843
HEALTH AFFAIRS 43, NO. 3 (2024): 363–371

ABSTRACT **Primary care physicians are often the first to screen and identify patients with access-sensitive surgical conditions that should be treated electively. These conditions require surgery that is preferably planned (elective), but, when access is limited, treatment may be delayed and worsening symptoms lead to emergency surgery (for example, colectomy for cancer, abdominal aortic aneurysm repair, and incisional hernia repair). We evaluated the rates of elective versus emergency surgery for patients with three access-sensitive surgical conditions living in primary care Health Professional Shortage Areas during 2015–19. Medicare beneficiaries in more severe primary care shortage areas had higher rates of emergency surgery compared with rates in the least severe shortage areas (37.8 percent versus 29.9 percent). They were also more likely to have serious complications (14.9 percent versus 11.7 percent) and readmissions (15.7 percent versus 13.5 percent). When we accounted for areas with a shortage of surgeons, the findings were similar. Taken together, these findings suggest that residents of areas with greater primary care workforce shortages may also face challenges in accessing elective surgical care. As policy makers consider investing in Health Professional Shortage Areas, our findings underscore the importance of primary care access to a broader range of services.**

Sara L. Schaefer (schaesar@med.umich.edu), University of Michigan, Ann Arbor, Michigan.

Shukri H. A. Dualeh, University of Michigan.

Nicholas Kunnath, University of Michigan.

John W. Scott, University of Washington, Seattle, Washington.

Andrew M. Ibrahim, University of Michigan.

Seventy-four million Americans currently lack adequate access to primary care.[1] In response, primary care Health Professional Shortage Areas (HPSAs) were designated by the federal government to create incentives for primary care providers to practice in areas with the greatest need.[2] These areas are of particular importance, as areas with lower primary care physician density are associated with increased mortality.[3] Although primary care physicians are essential in treating common and chronic medical conditions, they also serve as front-line providers to identify surgical conditions that require initial screening and timely referral. This may be particularly true for access-sensitive surgical conditions—diagnoses requiring surgery that is ideally treated in the elective setting but, when access is limited, have a natural history that often results in emergency surgery if they are left untreated.[4,5] Examples include colectomies for cancer, abdominal aortic aneurysm repairs, and incisional hernia repairs.

Despite the importance of primary care physicians in facilitating access to surgical care, little is known about the relationship between primary care shortage areas and access-sensitive surgical care. On the one hand, the rate-limiting factor may be primary care physicians, who are often the first to identify these conditions and make a surgeon referral. On the other hand, the rate-limiting factor may be the availability of

nearby surgeons and hospitals. For example, surgical patients living in primary care HPSAs may need to seek care farther away to undergo common surgical procedures.[6] In addition, residents in primary care shortage areas have a higher burden of chronic disease and face greater economic challenges in accessing care.[7] When these factors are taken together, it remains unclear how primary care shortages may affect timely access to surgical care.

The primary objective of this study was to evaluate the association between primary care shortage severity and outcomes for access-sensitive surgical conditions. Specifically, we aimed to evaluate the rates of elective versus emergency surgery for Medicare beneficiaries undergoing access-sensitive surgical procedures, stratified by primary care HPSA severity score. We hypothesized that beneficiaries living in communities with more severe primary care shortages would have higher rates of emergency surgery and worse outcomes for surgical conditions that should be treated electively.

Study Data And Methods

DATA SOURCE AND STUDY POPULATION For this cross-sectional retrospective cohort study, we obtained Medicare beneficiary data from the 100 percent capture Medicare Provider Analysis and Review file for beneficiaries who underwent surgery during the period 2015–19. This database is maintained by the Centers for Medicare and Medicaid Services and captures claims submitted by hospitals where Medicare beneficiaries receive care. Hospital-level characteristics such as teaching status and nursing ratio were identified using the American Hospital Association Annual Survey, and hospital-level characteristics were linked to each beneficiary episode using unique hospital identifiers. This study was deemed exempt by the Institutional Review Board at the University of Michigan because of the use of secondary data.

Medicare beneficiaries ages sixty-five and older who underwent one of three access-sensitive surgical procedures were identified using the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Clinical Modification (ICD-10-CM), for colectomy for cancer, abdominal aortic aneurysm repair, and incisional hernia repair. These procedures were specifically selected, as they are ideally detected and treated in the elective setting; however, when access is limited, disease progression leads to an emergency operation. These conditions are also among the most common operations, including among older adults. This cohort has been used as a measure of access in several prior studies.[4,5,8]

The exposure was the degree of primary care shortage in the beneficiary's area of residence, which was identified using federally designated primary care HPSAs. Primary care HPSAs are assigned by the Health Resources and Services Administration to geographic areas with a shortage of primary care physicians.[1,2] A shortage of primary care physicians is defined as a population-to-full-time-equivalent (FTE) primary care physician ratio of at least 3,500:1, or a ratio of 3,000:1 in an area with "usually high needs for primary care services or insufficient capacity of existing primary care providers"[9] (details on primary care HPSA designation are in online appendix exhibit A1).[10] Each primary care HPSA is assigned a severity score from 0 to 25, with higher scores reflecting greater primary care need relative to the available primary care workforce. Beneficiaries were stratified by primary care HPSA severity score using the following score cutoffs: very mild shortage area (scores of 1–5), mild shortage area (6–10), moderate shortage area (11–15), severe shortage area (16–20), and very severe shortage area (21–25).

Because different primary care HPSAs are defined at multiple geographic levels (for example, full county, subcounty, and census tract), we identified beneficiaries residing in primary care HPSAs by geospatially merging all US census tracts with the primary care HPSA shapefile available from the Health Resources and Services Administration.[11] Census tracts were identified as being within primary care HPSAs if their geographic centroid was within a primary care HPSA. With each census tract merged to the HPSA shapefile, we used the census tract to link the HPSA status to each beneficiary. For each shortage area, the HPSA shapefile also contains the shortage area severity score; the number of FTE primary care physicians providing direct outpatient care; the total permanent resident population; and whether the shortage area is rural or partially rural, as defined by the Health Resources and Services Administration. Beneficiaries were not counted as living in a shortage area if the primary care HPSA was designated after the year of their operation.

OUTCOME VARIABLES The primary outcome was the rate of emergency surgery for access-sensitive surgical conditions in primary care shortage areas. The acuity of surgery was defined as coded in the Medicare inpatient file as elective, urgent, or emergent. Elective procedures were defined as those coded as elective, indicating that the procedure was planned in advance and scheduled. Emergency procedures were defined as those coded as either urgent or emergent. Urgent procedures require an operation

Our findings identify primary care shortage areas as a possible upstream determinant of patients' receipt of timely surgical care.

within hours, and emergency procedures require an operation immediately.

Our secondary outcome was risk-adjusted rates of four thirty-day surgical outcomes: mortality, development of a serious complication, development of any complication, and readmission. Mortality was determined in two ways. Vital status at the time of discharge was used to determine in-hospital mortality, and the Medicare beneficiary denominator file was used to identify patients who died within thirty days of discharge. Postoperative complications within thirty days were identified using ICD-10-CM codes and included pulmonary failure, pneumonia, myocardial infarction, deep venous thrombosis and pulmonary embolism, renal failure, surgical site infection, gastrointestinal bleeding, and hemorrhage. These complications represent a subset of ICD-10-CM codes with the highest sensitivity and specificity within claims data, as has been previously described.[12] Serious complications were defined as the incidence of a coded complication and a length-of-stay greater than the seventy-fifth percentile for each procedure, following prior precedent.[13,14] This length-of-stay criterion has been used to identify complications serious enough to have meaningful clinical impact. Readmission was identified as any claim for readmission to any hospital within thirty days after discharge.

To evaluate the distance that beneficiaries traveled to receive surgical care, we calculated the travel distance, defined as the driving distance from the geographic coordinates of the population-weighted centroid of the beneficiary's ZIP code to the geographic coordinates of the hospital provided from the American Hospital Association Annual Survey. Using the ArcGIS Pro route feature, we calculated the driving travel distance and travel time for each ZIP code and hospital pair. For 1,889 beneficiaries (less than 1 percent), we were unable to calculate driving distance and time because of geographic constraints—such as if there was no possible driving route around bodies of water or mountain ranges (for example, beneficiary ZIP code in Hawaii with operation in a hospital in the continental United States). In addition, this method did not capture other modes of transport, such as public transportation, and thus may have underestimated the actual travel burden for some beneficiaries.

ANALYSIS The purpose of this analysis was to compare the rates of elective versus emergency surgery and postoperative outcomes for beneficiaries living in areas with varying degrees of primary care shortage. To evaluate the association between primary care HPSA severity and the rate of emergency surgery, we calculated the unadjusted rate of emergency surgery at each level of primary care shortage. To evaluate whether postoperative outcomes were different in areas with more severe primary care shortages while accounting for patient and hospital factors, we used a multivariable logistical regression model with each outcome as the dependent variable. All models accounted for the following patient factors: beneficiary age, sex, Elixhauser comorbidities (as previously described by Anne Elixhauser and colleagues),[15] and procedure type (colectomy for cancer, abdominal aortic aneurysm repair, or incisional hernia repair). Our models also accounted for hospital factors, including teaching status and nurse-to-patient ratio. To account for secular trends, the year of surgery was included as a categorical variable. Risk-adjusted rates of each outcome were calculated by using predictions from our logistic regression. The rates of emergency surgery and outcomes at each primary care shortage level were also calculated for each procedure independently.

To confirm the robustness of our findings and further isolate the potential role of primary care physician shortages, we performed multiple sensitivity analyses. First, because patient characteristics such as age, sex, and comorbidities may influence the rate of emergency surgery, we accounted for these characteristics in our model. In addition, to better account for potential confounding, we risk-adjusted our model using the county-level poverty rate for people ages sixty-five and older as a continuous variable, as provided by the Area Health Resources File. Furthermore, to account for travel distance, we included beneficiary travel distance to the hospital as a continuous variable in our model. Second, because patients undergoing emergency surgery are more likely to have worse outcomes compared with patients undergoing elective surgery, we repeated the primary analysis and accounted for emergency surgery status as a binary variable.

Third, because race varied significantly across the different primary care HPSA severity groups, we repeated the primary analysis accounting for race in our model. We also stratified the analysis by race to better understand the effect that race may have on the rate of emergency surgery across primary care shortage areas. Fourth, to evaluate whether a shortage of surgeons affected outcomes, we included a binary variable in our model to indicate whether a beneficiary resided in an area with a shortage of surgeons. Using the Area Health Resources File, we counted a beneficiary as living in an area with a shortage of surgeons if their county of residence had fewer than seven general surgeons per 100,000 residents, as previously described.[16] Finally, because the primary care HPSA severity score is a composite measure intended to identify areas with the greatest primary care need relative to the available workforce, we repeated our primary analysis using primary care physician density alone as the exposure variable. Primary care physician density is calculated by the Health Resources and Services Administration using the number of FTE primary care physicians providing direct patient care in outpatient departments relative to the total permanent resident population for each shortage area.[9] Each primary care HPSA was classified in one of three groups: high density (more than 20 primary care physicians per 100,000 population), medium density (10–20 primary care physicians per 100,000), or low density (fewer than 10 primary care physicians per 100,000). Furthermore, we evaluated the rates of emergency surgery in areas bordering primary care HPSAs. A beneficiary was defined as bordering a shortage area if their ZIP code contained a designated primary care HPSA census tract but their census tract was not a designated shortage area. All statistical analyses were performed using Stata, version 18. Geospatial merging was performed using ArcGIS Pro, version 3.1.1. Statistical tests were two-tailed and used a 5 percent significance level for all hypothesis testing.

LIMITATIONS Our study should be interpreted in the context of important limitations. First, we used only one measure of primary care shortage, the primary care HPSA. In contrast to the number of primary care physicians, the HPSA measure considers multiple domains, making it a potentially more robust reflection of primary care need relative to the available workforce. Nonetheless, we performed a sensitivity analysis using primary care physician density within each shortage area, which demonstrated similar findings. Second, our study could not address all factors that influence access to surgical care. To mitigate and address these potential confounders, we applied a risk-adjustment model with known risk factors for poor surgical outcomes, carried out multiple sensitivity analyses, and used a universally insured cohort with 100 percent capture. Moreover, we stratified our exposure by severity of primary care shortage to better understand the association of primary care services and optimal surgical access. Third, the primary care HPSA measure may underestimate other sources of primary care services, such as those provided by advanced practice providers. At present, however, the current HPSA designation for primary care does not include these additional providers in the measure. Finally, our study specifically evaluated the nearby availability of primary care physicians, as designated by primary care HPSAs, and did not quantify actual beneficiaries' use of primary care within our surgical cohorts.

Our findings underscore the value of primary care physicians to a broad range of health conditions.

Study Results

A total of 228,204 Medicare beneficiaries underwent colectomy for cancer, abdominal aortic aneurysm repair, or hernia repair during the period 2015–19 (exhibit 1). Overall, the mean age of beneficiaries was 76.3 years (standard deviation: 7.6), 49.2 percent were male, 85.7 percent were White, and 10.5 percent were Black. Beneficiaries in areas with the most severe primary care shortages were more commonly Black compared with beneficiaries in areas with the least severe shortages (33.0 percent versus 3.2 percent; $p < 0.001$). Beneficiaries living in areas with the most and least severe primary care shortages traveled similar distances (median distance, 31.7 versus 28.2 miles; $p = 0.52$) and similar times (median time, 38.7 versus 38.4 minutes; $p = 0.99$).

Beneficiaries in areas with the most severe primary care shortages had higher rates of emergency surgery compared with beneficiaries in areas with the least severe shortages (37.8 per-

EXHIBIT 1

Patient, area, and hospital characteristics for Medicare patients undergoing surgery for 3 access-sensitive surgical conditions, overall and by primary care Health Professional Shortage Area (HPSA) severity score, 2015–19

		Primary care HPSA severity score[a]				
Characteristics	Total	Very mild (1–5)	Mild (6–10)	Moderate (11–15)	Severe (16–20)	Very severe (21–25)
PATIENT CHARACTERISTICS						
No. of patients	228,204	2,155	38,476	104,361	80,381	2,831
Demographics						
Age (mean years)	76.3	76.7	76.7	76.4	76.1	75.4
Male (%)	49.2	50.6	49.5	49.5	48.7	47.2
White (%)	85.7	91.8	89.8	87.0	82.5	65.5
Black (%)	10.5	3.2	7.6	9.0	13.3	33.0
Elixhauser comorbidities (%)						
0	6.0	5.3	6.3	6.1	5.7	4.6
1	14.5	15.2	14.8	14.8	14.1	13.7
2 or more	79.5	79.5	78.9	79.1	80.2	81.7
Procedure type (%)						
Colectomy	33.4	35.9	35.4	33.6	32.1	28.3
AAA repair	28.2	26.1	26.9	27.8	29.2	31.9
Incisional hernia repair	38.5	38.0	37.7	38.6	38.6	39.8
Travel distance[b] (median miles)	20.7	28.2	21.7	19.6	21.2	31.7
Travel time[b] (median minutes)	29.2	38.4	29.7	28.2	29.7	38.7
AREA CHARACTERISTICS						
PCP density[c] (mean)	14.1	29.5	23.5	15.4	7.8	6.2
Rural or partially rural[d] (%)	57.8	74.0	56.4	58.3	56.8	75.5
HOSPITAL CHARACTERISTICS						
No. of beds (mean)	479	430	445	478	499	445
Teaching hospital (%)	78.1	83.7	77.6	78.3	78.1	72.1
Nurse-to-patient ratio[e] (median)	8.7	9.1	9.1	8.7	8.5	8.0
Hospital in a HPSA (%)	52.5	32.0	45.9	52.6	56.2	52.4
Hospital geographic region (%)						
Midwest	22.3	62.8	29.2	20.0	21.3	11.3
Northeast	7.3	4.8	7.8	6.8	8.1	<1
South	53.8	15.8	37.7	54.4	60.5	87.5
West	16.6	16.6	25.4	18.8	10.2	1.2

SOURCE Authors' analysis of data from the Medicare Provider Analysis and Review file, 2015–19; American Hospital Association Annual Survey, 2015–19; and Health Resources and Services Administration (HRSA) HPSAs data, 2015–19. **NOTES** In this table, HPSAs are primary care HPSAs. The three access-sensitive surgical conditions are colectomy for colon cancer, abdominal aortic aneurysm (AAA) repair, and incisional hernia repair. $p < 0.001$ for all comparisons. [a]The HPSA severity score is calculated by HRSA; a higher score corresponds to a greater degree of primary care physician (PCP) shortage. HPSA severity score criteria are in appendix exhibit A1 (see note 10 in text). [b]Travel distance and time were missing for 1,889 beneficiaries (<1%) for whom no possible driving route was identified—for example, around bodies of water or mountain ranges. [c]HPSA PCP density is defined as the number of full-time-equivalent PCPs providing direct outpatient care per 100,000 total permanent residents within each HPSA. PCP full-time equivalents and total resident population are calculated by HRSA for each HPSA. [d]Rurality as defined by HRSA for each HPSA. [e]Defined as the ratio of the number of nurse full-time equivalents to the number of inpatient days times 1,000.

cent versus 29.9 percent; risk ratio: 1.26; 95% confidence interval: 1.17, 1.37; $p < 0.001$) (exhibit 2 and appendix exhibit A2).[10] In addition, outcomes were worse for beneficiaries in areas with the most severe primary care shortages (exhibit 3). Compared with patients living in areas with the least severe primary care shortages, beneficiaries in areas with the most severe shortages had higher adjusted rates of serious complications (14.9 percent versus 11.7 percent; adjusted RR: 1.27; 95% CI: 1.12, 1.44; $p < 0.001$) and readmissions (15.7 percent versus 13.5 percent; adjusted RR: 1.16; 95% CI: 1.01, 1.33; $p = 0.03$). Compared with areas with lower degrees of primary care shortage, beneficiaries in areas with the most severe shortages had similar rates of thirty-day mortality (5.6 percent versus 4.8 percent; adjusted RR: 1.17; 95% CI: 0.93, 1.47; $p = 0.17$) and any complications (25.9 percent versus 24.5 percent; adjusted RR: 1.05, 95% CI: 0.97, 1.15; $p = 0.21$). These trends were similar for each procedure independently (appendix exhibits A3 and A4).[10]

The additional sensitivity analyses demonstrated findings similar to those of the primary analysis. First, when patient characteristics were accounted for, the findings were similar to those of the primary analysis (appendix exhibit A5).[10] In addition, the findings were similar after county-level poverty rate and beneficiary travel

EXHIBIT 2

Unadjusted rate of and risk for emergency surgery for 3 access-sensitive surgical conditions, by primary care Health Professional Shortage Area (HPSA) severity score, 2015–19

Primary care HPSA severity scores[a]	Rate of emergency surgery		Risk for emergency surgery		
	Percent	95% CI	Risk ratio[b]	95% CI	*p* value[b]
Very mild (1–5)	29.9	28.0, 31.8	Ref	—[c]	—[c]
Mild (6–10)	32.1	31.7, 32.6	1.08	1.01, 1.15	0.03
Moderate (11–15)	34.2	33.9, 34.5	1.15	1.07, 1.22	<0.001
Severe (16–20)	35.3	35.0, 35.7	1.18	1.11, 1.26	<0.001
Very severe (21–25)	37.8	36.0, 39.5	1.26	1.17, 1.37	<0.001

SOURCE Authors' analysis of data from the Medicare Provider Analysis and Review file, 2015–19, and Health Resources and Services Administration (HRSA) HPSAs data, 2015–19. **NOTES** The 3 surgical conditions are listed in exhibit 1. Reference value is 1.00. [a]HPSA severity score calculated by HRSA; a higher score corresponds to a greater degree of primary care physician shortage. HPSA severity score criteria are in appendix exhibit A1 (see note 10 in text). [b]Risk ratios and *p* values compare each level of primary care shortage severity to the "very mild" severity group. [c]Not applicable.

EXHIBIT 3

Surgical outcomes for 3 access-sensitive surgical conditions, by primary care Health Professional Shortage Area (HPSA) severity score, risk-adjusted to account for patient and hospital characteristics, 2015–19

Outcomes and primary care HPSA severity scores[a]	Risk-adjusted rate of outcome[b]		Risk for outcome		
	Percent	95% CI	Adjusted risk ratio[c]	95% CI	*p* value[c]
Mortality, 30-day					
Very mild (1–5)	4.8	4.0, 5.7	Ref	—[d]	—[d]
Mild (6–10)	5.0	4.8, 5.2	1.04	0.86, 1.25	0.70
Moderate (11–15)	5.2	5.0, 5.3	1.07	0.89, 1.29	0.44
Severe (16–20)	5.4	5.3, 5.6	1.12	0.94, 1.35	0.21
Very severe (21–25)	5.6	4.9, 6.4	1.17	0.93, 1.47	0.17
Serious complications					
Very mild (1–5)	11.7	10.5, 12.9	Ref	—[d]	—[d]
Mild (6–10)	13.2	12.9, 13.5	1.12	1.01, 1.25	0.02
Moderate (11–15)	13.6	13.4, 13.8	1.16	1.05, 1.28	0.004
Severe (16–20)	13.8	13.6, 14.0	1.17	1.06, 1.30	0.002
Very severe (21–25)	14.9	13.8, 16.0	1.27	1.12, 1.44	<0.001
Any complications					
Very mild (1–5)	24.5	23.0, 26.1	Ref	—[d]	—[d]
Mild (6–10)	25.6	25.3, 26.0	1.05	0.98, 1.12	0.18
Moderate (11–15)	25.7	25.5, 25.9	1.05	0.98, 1.12	0.16
Severe (16–20)	25.7	25.4, 26.0	1.05	0.98, 1.12	0.15
Very severe (21–25)	25.9	24.5, 27.2	1.05	0.97, 1.15	0.21
Readmission					
Very mild (1–5)	13.5	12.0, 14.9	Ref	—[d]	—[d]
Mild (6–10)	14.3	14.0, 14.7	1.06	0.95, 1.18	0.29
Moderate (11–15)	14.5	14.3, 14.7	1.08	0.97, 1.20	0.18
Severe (16–20)	14.7	14.5, 15.0	1.09	0.98, 1.22	0.11
Very severe (21–25)	15.7	14.3, 17.0	1.16	1.01, 1.33	0.03

SOURCE Authors' analysis of data from the Medicare Provider Analysis and Review file, 2015–19, and Health Resources and Services Administration (HRSA) HPSAs data, 2015–19. **NOTES** The 3 surgical conditions are listed in exhibit 1. Reference value is 1.00. [a]HPSA risk score calculated by HRSA; a higher score corresponds to a greater degree of primary care physician shortage. HPSA severity score criteria are in appendix exhibit A1 (see note 10 in text). [b]Model adjusted for sex, age, year of procedure, procedure type, comorbidities, teaching status of hospital, and hospital nurse-to-patient ratio. [c]Adjusted risk ratios and *p* values compare each level of primary care shortage severity to the "very mild" severity group. [d]Not applicable.

Improving resources in primary care shortage areas may lead to better health outcomes in the Medicare population across the continuum of ambulatory and inpatient services.

distance to surgical care were accounted for (appendix exhibits A6 and A7).[10] Second, when the acuity of the operation coded as elective versus emergency was accounted for in the model, beneficiaries living in areas with the most severe primary care shortages also had a higher rate of serious complications (14.9 percent versus 12.2 percent; adjusted RR: 1.23; 95% CI: 1.08, 1.38; $p = 0.001$) and similar thirty-day mortality (5.7 percent versus 5.0 percent; adjusted RR: 1.14; 95% CI: 0.91, 1.43; $p = 0.25$) (appendix exhibit A8).[10] Third, the findings were similar after for race was accounted for in the model (appendix exhibit A9).[10] When we stratified by race, the rate of emergency surgery was higher for Black beneficiaries across all degrees of primary care shortage, relative to White beneficiaries (appendix exhibit A10).[10] In both groups, there was a trend toward increasing rates of emergency surgery in areas with more severe primary care shortages, although it did not reach statistical significance in Black beneficiaries. When surgeon density was accounted for in the model, the findings were also similar (appendix exhibit A11).[10]

To isolate the potential role of the primary care physician, we used primary care physician density within each primary care HPSA as the exposure variable. The rate of emergency surgery was higher in primary care HPSAs with a lower density of primary care physicians compared with primary care HPSAs with a higher density of primary care physicians (35.1 percent versus 33.4 percent; adjusted RR: 1.05; 95% CI: 1.04, 1.07; $p < 0.001$) (appendix exhibit A12).[10] Finally, for beneficiaries living in areas that bordered designated primary care shortage areas, the trend also demonstrated increasing rates of emergency surgery in areas neighboring areas with more severe primary care shortages (appendix exhibit A13).[10] Furthermore, mortality rates were lower for beneficiaries from non–primary care shortage areas, relative to designated primary care HPSAs (appendix exhibit A14).[10]

Discussion

Our study evaluating care for access-sensitive surgical conditions across primary care shortage areas had two principal findings. First, Medicare beneficiaries living in areas with greater primary care shortage severity had higher rates of emergency surgery for access-sensitive surgical conditions. Second, beneficiaries in primary care shortage areas also experienced worse outcomes after surgery, including higher rates of serious complications and readmissions. Collectively, our findings suggest that efforts to improve primary care access in shortage areas may also improve beneficiaries' access to safer, elective surgical care before their condition requires an emergency procedure.

Prior work evaluating access-sensitive surgical conditions has attempted to increase understanding of how residents of different communities receive surgery for these conditions. Using national Medicare claims data, Yuqi Zhang and coauthors found that emergency surgery rates for access-sensitive surgical conditions varied fourfold across hospital service areas.[4] A follow-up study using county-level analysis found that emergency surgery for these conditions was associated with the Social Vulnerability Index, a nationwide measure of resilience after an unforeseen emergency, such as a natural disaster.[5] Our findings using census tract–level data further extended prior work by identifying primary care shortage areas as a possible upstream determinant of patients' receipt of timely surgical care.

Understanding of the relationship between physician shortages and overall worse health outcomes continues to evolve across multiple domains of health.[3,17,18] For example, earlier studies focused on HPSAs and the effect on long-term disease management[19–22] and, more recently, on pediatric suicide rates.[17] Our study extends this work by also identifying worse outcomes for surgical conditions in areas with insufficient primary care physicians. Although this may be in part a result of underlying health differences among beneficiaries living within HPSAs, our results suggest that upstream evaluation and referral may also contribute.

Our findings have several important implications for improving health care delivery in primary care shortage areas. For policy makers de-

bating the future of HPSA policies, our findings underscore the value of primary care physicians to a broad range of health conditions. Specifically, our findings suggest that better primary care access may improve the likelihood that patients with access-sensitive surgical conditions undergo a lower-risk elective procedures versus a higher-risk emergency procedure.

For health systems facing difficult decisions about allocating resources across different service lines, these findings suggest an important overlap. Although surgical quality improvement has traditionally focused on inpatient providers and care, these findings underscore the opportunity to improve quality across the continuum of inpatient and outpatient care. By focusing on access-sensitive surgical conditions that are initially screened and identified in the primary care setting and then treated in the inpatient setting, health systems may have more opportunities to explicitly collaborate across care settings.

Finally, for payers and insurers, our findings suggest that access-sensitive surgical conditions may be potential opportunities for condition-based payment models.[23] Because improving primary care access for these conditions may lead to a lower-cost elective procedure instead of a higher-risk emergency procedure, these conditions have potential costs savings.[24,25] Thus, such a payment model would align with the priorities of policy makers who want to increase resources to primary care shortage areas while demonstrating potential cost savings.

Conclusion

Overall, our findings suggest both that primary care HPSAs may meaningfully identify areas that are in need of better access to surgical care and that addressing primary care access may have a meaningful impact on access to surgical care. Importantly, improving resources in primary care shortage areas may lead to better health outcomes in the Medicare population across the continuum of ambulatory and inpatient services. ■

An earlier version of this work was presented at the 2022 American College of Surgeons Clinical Congress in San Diego, California, October 17, 2022. The authors acknowledge grant support for this work from the following sources: Sara Schaefer receives funding from the National Cancer Institute, National Institutes of Health (NIH), as a postdoctoral fellow on Grant No. T32-CA-236621. Shukri Dualeh receives funding from the National Institute on Aging, NIH, as a postdoctoral fellow on Grant No. T32-AG062043. John Scott receives funding from the Agency for Healthcare Research and Quality (AHRQ) as principal investigator on Grant No. K08-HS028672 and as a coinvestigator on Grant No. R01-HS027788. Andrew Ibrahim and Scott receive funding from the National Institute of Diabetes and Digestive and Kidney Diseases, NIH, as co–principal investigators on Grant No. R01-DK137466. Ibrahim receives funding from AHRQ as principal investigator on Grant No. R01-HS028606-01A1 and as a coinvestigator on Grant No. R18-HS028963. The authors are solely responsible for the accuracy of the information presented in this article. Any views or opinions expressed in this article are solely those of the authors, and no endorsement of these views or opinions by the authors' institutions, the National Institutes of Health, or the Agency for Healthcare Research and Quality is expressed or implied. Scott was at the University of Michigan when this work was performed. To access the authors' disclosures, click on the Details tab of the article online.

NOTES

1 Health Resources and Services Administration. Health workforce shortage areas [Internet]. Rockville (MD): HRSA; [last updated 2024 Jan 31; cited 2024 Feb 1]. Available from: https://data.hrsa.gov/topics/health-workforce/shortage-areas

2 Health Resources and Services Administration. What is shortage designation? [Internet]. Rockville (MD): HRSA; [last reviewed 2023 Jun; cited 2024 Feb 1]. Available from: https://bhw.hrsa.gov/workforce-shortage-areas/shortage-designation

3 Basu S, Berkowitz SA, Phillips RL, Bitton A, Landon BE, Phillips RS. Association of primary care physician supply with population mortality in the United States, 2005–2015. JAMA Intern Med. 2019;179(4):506–14.

4 Zhang Y, Diaz A, Kunnath N, Dimick JB, Scott JW, Ibrahim AM. Emergency surgery rates among Medicare beneficiaries with access sensitive surgical conditions. J Surg Res. 2022;279:755–64.

5 Zhang Y, Kunnath N, Dimick JB, Scott JW, Diaz A, Ibrahim AM. Social vulnerability and outcomes for access-sensitive surgical conditions among Medicare beneficiaries. Health Aff (Millwood). 2022;41(5):671–9.

6 Lussiez A, Scott JW, Kunnath N, Dimick JB, Ibrahim AM. Surgical outcomes and travel burden among Medicare beneficiaries living in Health Professional Shortage Areas. Am J Surg. 2022;224(1 Pt B):470–4.

7 Streeter RA, Snyder JE, Kepley H, Stahl AL, Li T, Washko MM. The geographic alignment of primary care Health Professional Shortage Areas with markers for social determinants of health. PLoS One. 2020;15(4):e0231443.

8 Valbuena VSM, Dualeh SHA, Kunnath N, Dimick JB, Ibrahim AM. Disparities in unplanned surgery amongst Medicare beneficiaries. Am J Surg. 2023;225(4):602–7.

9 Designation of Health Professional(s) Shortage Areas, Title 42, Chapter I, Subchapter A, C.F.R. Part 5 (1980).

10 To access the appendix, click on the Details tab of the article online.

11 The authors constructed their data for comparison from several documents downloaded from the Health Resources and Services Administration website. Health Resources and Services Administration. Data downloads, Shortage areas [Internet]. Rockville (MD): HRSA; [cited 2024 Jan 4]. Available for download from: https://data.hrsa.gov/data/download

12 Iezzoni LI, Daley J, Heeren T, Foley SM, Fisher ES, Duncan C, et al. Identifying complications of care using administrative data. Med Care. 1994;32(7):700–15.

13 Scally CP, Thumma JR, Birkmeyer JD, Dimick JB. Impact of surgical quality improvement on payments in

Medicare patients. Ann Surg. 2015; 262(2):249–52.
14 Osborne NH, Nicholas LH, Ryan AM, Thumma JR, Dimick JB. Association of hospital participation in a quality reporting program with surgical outcomes and expenditures for Medicare beneficiaries. JAMA. 2015;313(5):496–504.
15 Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. Med Care. 1998;36(1):8–27.
16 Stewart RM, Liao LF, West M, Sirinek KR. The general surgery workforce shortage is worse when assessed at county level. Am J Surg. 2013; 206(6):1016–22, discussion 1022–3.
17 Hoffmann JA, Attridge MM, Carroll MS, Simon NE, Beck AF, Alpern ER. Association of youth suicides and county-level Mental Health Professional Shortage Areas in the US. JAMA Pediatr. 2023;177(1):71–80.
18 Shifman HP, Rasnick E, Huang CY, Beck AF, Bucuvalas J, Lai JC, et al. Association of primary care shortage areas with adverse outcomes after pediatric liver transplant. J Pediatr. 2022;246:103–109.e2.
19 Kohrs FP, Mainous AG 3rd. The relationship of health professional shortage areas to health status. Implications for health manpower policy. Arch Fam Med. 1995;4(8): 681–5.
20 Haskins CB, McDowell BD, Carnahan RM, Fiedorowicz JG, Wallace RB, Smith BJ, et al. Breast cancer endocrine therapy adherence in Health Professional Shortage Areas: unique effects on patients with mental illness. J Psychosom Res. 2021;140:110294.
21 Asch SM, Sloss EM, Hogan C, Brook RH, Kravitz RL. Measuring underuse of necessary care among elderly Medicare beneficiaries using inpatient and outpatient claims. JAMA. 2000;284(18):2325–33.
22 Hale NL, Bennett KJ, Probst JC. Diabetes care and outcomes: disparities across rural America. J Community Health. 2010;35(4): 365–74.
23 Jayakumar P, O'Donnell J, Manickas-Hill O, Japinga M, Mather C, McClellan MB, et al. Critical considerations for condition-based alternative payment models: a multi-stakeholder perspective. Health Affairs Blog [blog on the Internet]. 2020 Jul 17 [cited 2024 Jan 4]. Available from: https://www.healthaffairs.org/content/forefront/critical-considerations-condition-based-alternative-payment-models-multi-stakeholder
24 Smith M, Hussain A, Xiao J, Scheidler W, Reddy H, Olugbade K Jr, et al. The importance of improving the quality of emergency surgery for a regional quality collaborative. Ann Surg. 2013;257(4):596–602.
25 Haider AH, Obirieze A, Velopulos CG, Richard P, Latif A, Scott VK, et al. Incremental cost of emergency versus elective surgery. Ann Surg. 2015;262(2):260–6.