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Development and Assessment of a Systematic Approach for Detecting Disparities in Surgical Access

Jan H. Wong, MD; William D. Irish, PhD, MSc; Eric J. DeMaria, MD; Nasreen A. Vohra, MD; Walter J. Pories, MD; Michelle R. Brownstein, MD; Maria S. Altieri, MD; Warqaa Akram, MD; Carl E. Haisch, MD; David B. Leeser, MD; Janet E. Tuttle, MD

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IMPORTANCE Although optimal access is accepted as the key to quality care, an accepted methodology to ascertain potential disparities in surgical access has not been defined.

OBJECTIVE To develop a systematic approach to detect surgical access disparities.

DESIGN, SETTING, AND PARTICIPANTS This cross-sectional study used publicly available data from the Health Cost and Utilization Project State Inpatient Database from 2016. Using the surgical rate observed in the 5 highest-ranked counties (HRCs), the expected surgical rate in the 5 lowest-ranked counties (LRCs) in North Carolina were calculated. Patients 18 years and older who underwent an inpatient general surgery procedure and patients who underwent emergency inpatient cholecystectomy, herniorrhaphy, or bariatric surgery in 2016 were included. Data were collected from January to December 2016, and data were analyzed from March to July 2020.

EXPOSURES Health outcome county rank as defined by the Robert Wood Johnson Foundation.

MAIN OUTCOMES AND MEASURES The primary outcome was the proportional surgical ratio (PSR), which was the disparity in surgical access defined as the observed number of surgical procedures in the 5 LRCs relative to the expected number of procedures using the 5 HRCs as the standardized reference population.

RESULTS In 2016, approximately 1.9 million adults lived in the 5 HRCs, while approximately 246 854 lived in the 5 LRCs. A total of 28 924 inpatient general surgical procedures were performed, with 4521 being performed in those living in the 5 LRCs and 24 403 in those living in the 5 HRCs. The rate of general surgery in the 5 HRCs was 13.09 procedures per 1000 population. Using the 5 HRCs as the reference, the PSR for the 5 LRCs was 1.40 (95% CI, 1.35-1.44). For emergent/urgent cholecystectomy, the PSR for the 5 LRCs was 2.26 (95% CI, 2.02-2.51), and the PSR for emergent/urgent herniorrhaphy was 1.83 (95% CI, 1.33-2.45). Age-adjusted rate of obesity (body mass index [calculated as weight in kilograms divided by height in meters squared] greater than 30), on average, was 36.6% (SD, 3.4) in the 5 LRCs vs 25.4% (SD, 4.6) in the 5 HRCs (P = .002). The rate of bariatric surgery in the 5 HRCs was 33.07 per 10 000 population with obesity. For the 5 LRCs, the PSR was 0.60 (95% CI, 0.51-0.69).

CONCLUSIONS AND RELEVANCE The PSR is a systematic approach to define potential disparities in surgical access and should be useful for identifying, investigating, and monitoring interventions intended to mitigate disparities in surgical access that effects the health of vulnerable populations.

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Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Jan H. Wong, MD, Division of Surgical Oncology, Department of Surgery, Brody School of Medicine at East Carolina University, 600 Moye Blvd, Greenville, NC 27834 (wongj@ecu.edu).

Access, defined as "the timely use of personal health services to achieve the best possible health outcomes,"[1] continues to be a major challenge in the US and remains a priority of the Healthy People 2020 initiative.[2] Personal health services may include access to surgical services in a substantial proportion of the population. Surgical access is influenced by the complex interaction of numerous factors, including race/ethnicity, social economic status,[3-5] insurance,[6-8] and even the willingness to undergo surgery,[9,10] while outcomes and access may be influenced by disparities in disease burden and comorbid conditions,[11-13] surgeon volume,[14-16] and hospital volume,[17,18] all of which may result in surgical health care disparities.[19] However, limited access to health care is closely associated with surgical health care disparities.[19,20]

Kilbourne and colleagues[21] proposed a conceptual framework in which disparities research should be conducted in the context of the health care system. The first phase in this framework is detecting health disparities. Although indicators of access to health services can provide insight into the utilization of health services and are intended to sense where or when access problems occur,[1] it is important to recognize that access to health services broadly and surgical services specifically is not an end in and of itself. Access to surgical services is just one facet of health care services that contribute to the wellness of a population.

Determining the burden of surgical disease in a population is complex.[22] Most estimates of surgical disease burden are based solely on procedures performed and do not account for surgical conditions that affect health but never require a surgical procedure. To address this shortcoming, we defined an expected utilization of surgical services as that observed in a healthy population and used that as a reference to determine whether a difference in utilization observed in a vulnerable population could be broadly applied to detect potential disparities in surgical access using North Carolina as the modeling framework.

Key Points

Question Is there a reproducible method to detect and measure disparities in surgical access?

Findings In this cross-sectional study of more than 2 million residents residing in the 5 highest-ranked and lowest-ranked counties of North Carolina by health outcome rank as defined by the Robert Wood Johnson Foundation, the proportion of individuals receiving similar access to surgical care was significantly different than a reference healthy population.

Meaning A framework using a priori the healthiest populations at the county level as the reference provides a systematic approach to detect and measure disparities in surgical access.

Methods

Quantifying the Health of a Population

We used the county health rankings of the University of Wisconsin Population Health Institute Robert Wood Johnson Foundation (RWJF) to define the health rankings of the 100 counties in North Carolina.[23] The rankings are derived from models that use the domains of health behaviors, clinical care, social and economic factors, and physical environment where an individual lives to determine the impact on the length of life (ie, years of potential life lost before age 75 years) and quality of life. Health outcomes ranks demonstrated a cluster in the highest-ranked counties (HRCs) and the lowest-ranked counties (LRCs), with substantial overlap of the midquartiles of health outcome scores.[23] For this reason, we used the 5 HRCs as the reference for surgical access and compared surgical access with the 5 LRCs. The study used data that are publicly available on the internet from Healthcare Cost and Utilization Project (HCUP).[24] Based on guidance from the Office of Human Research Protection, this study was determined not to require institutional review board review under 45 CFR 46.

Data Sources

We used data from the 2016 North Carolina State Inpatient Database (SID) to determine the use of inpatient surgical services. The SID are part of the family of databases and software tools developed for the HCUP[24] and capture hospital inpatient stays in a given state. SID contains more than 100 clinical and nonclinical variables, such as the principal and secondary diagnoses, procedures, and patient demographic characteristics. Census data were obtained from the North Carolina Office of Budget and Management[25] to determine population size projections by county for 2016.

Procedures

Surgical procedures were identified using *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Procedure Coding System* (*ICD-10-PCS*) codes and diagnostic-related group (DRG) codes (DRG versions 33 and 34) where the primary reason for hospitalization was procedural. We excluded surgical procedures generally provided by subspecialty services, such as cardiac and peripheral vascular, surgery of the head and neck, transplant, and orthopedic procedures. Inpatient surgical procedures were categorized as emergent/urgent or elective according to the HCUP reporting structure. In addition, we studied cholecystectomy and hernia repairs as representative of commonly performed general (nonspecialized) surgical procedures that are performed on both an elective and emergent basis. We studied bariatric surgery as an example of an electively scheduled surgery. To identify cholecystectomy procedures, we used *ICD-10-PCS* codes FB40ZZ, 0FB44ZZ, 0FB43ZZ, 0FB48ZZ, 0FT40ZZ, and 0FT44ZZ. To identify herniorrhaphy (femoral repair, inguinal repair, and anterior wall repair), we used DRG codes 350 to 355. To identify bariatric procedures, we used DRG codes 619 to 621.

Assumptions, Definitions, and Hypothesis

Access to timely, safe, effective, equitable, evidence-based, and patient-centered[26] surgical care for those who require surgical care is a key contributor to the overall health of a population. We assumed that surgical care in the urgent or emergent setting should be minimized and surgical care, when needed, should be maximized in the elective setting. Furthermore, we assumed there is a disease burden defined as the number of individuals (N) with conditions of such duration and/or severity who meet accepted guidelines for surgical care as part of maintaining their health. In this paradigm, the observed surgical prevalence (R_1) is defined as $R_1 = m/N$, where m is the number of surgical procedures for a given disease or condition. For comparison, we assumed that there is a theoretical surgical prevalence, R_2, that reflects the true or ideal rate of surgery for population N. Since R_2 is unknown, we assumed the rate of surgery in the healthiest population[23] would best approximate R_2. The rationale for this is that individuals in the healthiest population are more likely to have access to health services, including surgical care, in a timely fashion. Furthermore, in the absence of prevalence data for a given disease or condition, ie, where there are insufficient data to estimate N, we assumed that a given population was at similar risk for developing conditions that require surgical intervention. Thus, we hypothesized that if R_1 is much less than R_2, then access to surgical care is insufficient for elective access to surgical care, and if R_1 is much greater than R_2, then there is either overutilization or emergency/urgent access to surgical care. In using the healthiest population to approximate R_2, it is important to recognize that this approximation may not define the ideal rate of surgical care for the population.

We defined disparity as a statistically significant difference in the observed number of individuals undergoing a surgical procedure in a less healthy population relative to the expected number of procedures based on the healthiest (reference) population. We termed this the proportional surgical ratio (PSR). Although unique to surgery, the PSR is similar in concept to the standardized mortality ratio used in epidemiologic research.[27]

Statistical Analysis

Using the county health rankings,[23] we estimated rates of inpatient surgical services in the 5 LRCs in North Carolina as well as in the 5 HRCs, which were defined a priori. These 5 HRCs served as the reference for R_2 and the PSR calculation. PSR was obtained by dividing the observed number of procedures in the 5 LRCs by the expected number of procedures. The expected number is the number of procedures that would occur in the 5 LRCs if the surgical rate in the HRC reference population (R_2) occurred in that cohort.

The expected number was calculated by multiplying the surgery rate of the 5 HRCs by the population size of each county in the 5 LRCs and then adding up the results. If the observed number of procedures equaled the expected number, the PSR is 1. If more procedures were observed than expected, the PSR is greater than 1. If fewer procedures were observed than expected, the PSR is less than 1. 95% CIs around the PSR were calculated using Byar approximation.[27] Calculations were performed for each type of surgical procedure. Characteristics of the 5 LRCs and HRCs were compared using the standard 2-sampled *t* test. All analyses were performed using SAS version 9.4 (SAS Institute). All tests were 2-tailed. *P* values less than .05 were considered statistically significant.

Results

Study Population

The adult population in the 5 HRCs in North Carolina in 2016, as defined by the RWJF, numbered approximately 1.86 million individuals, while 246 854 individuals resided in the 5 LRCs. In the 5 HRCs, on average, 32.5% of the residents lived in a rural setting compared with 60.1% of residents in the 5 LRCs. Residents in the 5 LRCs were typically older, had less education and lower income, were more likely to be uninsured, and had higher rates of preexisting health conditions compared with residents in the 5 HRCs (**Table 1**).

General Surgery

In 2016, a total of 28 924 inpatient general surgical procedures were performed in the 10 counties studied. Of these, 4521 procedures (373 emergent/urgent and 4148 elective procedures) were performed in the 5 LRCs (18.31 procedures per 1000 population) and 24 403 procedures (1213 emergent/urgent and 23190 elective procedures) were performed in the 5 HRCs (13.09 procedures per 1000 population). The observed and expected number of inpatient surgical procedures in the 5 LRCs are presented in **Table 2**. Residents in the 5 LRCs were 40% more likely to undergo an inpatient general surgical procedure than residents in the 5 HRCs (PSR, 1.40; 95% CI, 1.35-1.44). For emergent/urgent procedures, the PSR for the 5 LRCs was 2.72 (95% CI, 2.09-2.57).

Emergent/Urgent Cholecystectomy and Herniorrhaphy

The rate of emergent/urgent cholecystectomy ranged from 8.39 to 19.75 per 10 000 population, and the rate of emergent/urgent herniorrhaphies ranged from 7.30 to 29.18 per 100 000 population in the 5 LRCs. The observed and expected number of emergency/urgent cholecystectomy and herniorrhaphy performed in the 5 LRCs are presented in **Table 3**. Using HRCs as the reference, the PSR for the 5 LRCs was 2.26 (95% CI, 2.02-2.51) for cholecystectomy and 1.83 (95% CI, 1.33-2.45) for herniorrhaphy.

Elective Inpatient Cholecystectomy

The number of elective in-patient cholecystectomies performed was substantially less than the number of emergent/urgent cholecystectomies (1425 emergent/urgent vs 156 elective procedures). The rate of elective cholecystectomy ranged from 1.16 to 2.44 per 10 000 population in the 5 LRCs and from 0.34 to 0.83 per 10 000 population in the 5 HRCs. The expected number of inpatient cholecystectomies was 15.35 for the 5 LRCs. The PSR for the 5 LRCs was 2.60 (95% CI, 1.78-3.41) (**Table 4**).

Elective Bariatric Surgery

Obesity was defined as a body mass index (calculated as weight in kilograms divided by height in meters squared) of 30 or greater, and the percentage of adult obesity was obtained from the county health rankings of the RWJF.[23] On average, 36.6% (SD, 3.4) of individuals in the 5 LRCs had obesity compared with 25.4% (SD, 4.6) in the 5 HRCs (*P* = .002). Based on these estimates, 91 475 individuals in the 5 LRCs and 456 264 individuals in the 5 HRCs

Table 1. Summary of Characteristics of the Lowest-Ranked and Highest-Ranked Counties by Health Outcome in North Carolina

Variable	Mean (SD), % Lowest-ranked counties (n = 5)	Mean (SD), % Highest-ranked counties (n = 5)	*P* value
Population in 2016, No.	246 854	1 864 588	NA
African American individuals	39.1 (12.3)	17.4 (8.4)	.01
Median, %	38.8	12.3	NA
Living in rural area	60.1 (12.5)	32.5 (39.4)	.18
Median, %	54.7	27.3	NA
Age ≥65 y	16.3 (2.0)	11.5 (2.0)	.005
Median, %	16.4	11.2	NA
Household income, $	32 560 (1553)	62 483 (3188)	<.001
Median, %	32 782	61 730	NA
Income inequality[a]	5.4 (0.2)	4.4 (1.1)	.10
Median, %	5.4	4.3	NA
Uninsured adults[b]	25.2 (4.3)	19.6 (2.1)	.03
Median, %	23.5	18.7	NA
Adults with obesity[c]	36.6 (3.4)	25.4 (4.6)	.002
Median, %	36.9	24.9	NA
Adults with diabetes	15.1 (1.0)	8.7 (0.6)	<.001
Median, %	14.9	8.6	NA
Adults who are physically inactive[d]	31.2 (3.7)	19.3 (3.3)	.001
Median, %	32.6	18.7	NA
Primary care physician rate[e]	52.2 (13.6)	84.6 (62.9)	.29
Median, %	46.0	84.2	NA
Some college[f]	49.3 (5.1)	74.9 (5.4)	<.001
Median, %	46.6	77.2	NA

Abbreviation: NA, not applicable.

[a] Ratio of household income at the 80th percentile to income at the 20th percentile.

[b] Percentage of people younger than 65 years without insurance.

[c] Percentage of adults who report body mass index (calculated as weight in kilograms divided by height in meters squared) of 30 or greater.

[d] Percentage of adults who report no leisure-time physical activity.

[e] Number of primary care physicians per 100 000 population.

[f] Percentage of adults aged 25 to 44 years with some postsecondary education.

Table 2. Observed and Expected Number of General Surgery Procedures Performed for the 5 Lowest-Ranked Counties in North Carolina

Lowest-ranked counties[a]	Adult population in 2016, No.	No. of procedures Observed	No. of procedures Expected[b]
1	99 772	1688	1305.78
2	27 415	487	358.80
3	34 271	639	448.53
4	40 846	847	534.58
5	44 550	860	583.05
Total	NA	4521	3230.73
PSR (95% CI)[c,d]	NA	1.40 (1.35-1.44)	NA

Abbreviations: NA, not applicable; PSR, proportional surgical ratio.

[a] Counties are listed in no particular order.

[b] Expected number of general surgical procedures was derived using the general surgery rate in the 5 highest-ranked counties, calculated as R_2 = 24 403/1 864 588 = 0.01309, or 13.09 per 1000 population.

[c] PSR calculated as the total number of observed procedures divided by the total number of expected procedures.

[d] Calculated using Byar approximation.

would be classified as having obesity. For the 5 HRCs, the rate of bariatric surgery (R_2) was 33.07 per 10 000 population with obesity. The observed and expected number of bariatric surgery procedures in the 5 LRCs are presented in **Table 5**. Using the 5 HRCs as the reference, the PSR for the 5 LRCs was 0.60 (95% CI, 0.51-0.69).

Discussion

Mitigating surgical disparities is a priority of the American College of Surgeons and the National Institute of Health.[28] Optimizing access is considered the key to quality surgical care.[29] We hypothesized that surgical access disparities could be defined as the difference between the observed usage of surgical services in a vulnerable, less healthy population and that observed in a healthy reference population. In this report, we used routinely collected population-level information and focused on observed utilization of inpatient surgery as an indicator of healthiness. We observed that individuals residing in the 5 LRCs (less healthy) were significantly less likely to receive purely elective surgical care (eg, bariatric surgery) while being at a substantially greater likelihood to have emergency or urgent surgical interventions than those living in the 5 HRCs (more healthy). We designated this difference between individuals residing in LRCs and HRCs as the PSR and propose that it represents a useful in-

Table 3. Emergency/Urgent Cholecystectomies and Herniorrhaphies for the 5 Lowest-Ranked Counties in North Carolina

Lowest-ranked counties[a]	Adult population in 2016, No.	No. of procedures: Cholecystectomy, Observed	Cholecystectomy, Expected[b]	Herniorrhaphy, Observed	Herniorrhaphy, Expected[c]
1	99 772	121	58.43	14	9.74
2	27 415	23	16.06	2	2.68
3	34 271	46	20.07	4	3.35
4	40 846	55	23.92	11	3.99
5	44 550	88	26.09	13	4.35
Total	NA	333	144.57	44	24.10
PSR (95% CI)[d,e]	NA	2.26 (2.02-2.51)	NA	1.83 (1.33-2.45)	NA

Abbreviations: NA, not applicable; PSR, proportional surgical ratio.

[a] Counties are listed in no particular order.

[b] Expected number of emergent/urgent cholecystectomy procedures was derived using the cholecystectomy rate in the 5 highest-ranked counties, calculated as R_2 = 1092/1 864 588 = 0.00586, or 5.86 per 1000 population.

[c] Expected number of emergent/urgent herniorrhaphy procedures was derived using the herniorrhaphy rate in the 5 highest-ranked counties, calculated as R_2 = 182/1 864 588 = 0.0000966, or 9.66 per 100 000 population.

[d] PSR calculated as the total number of observed procedures divided by the total number of expected procedures.

[e] Calculated using Byar approximation.

Table 4. Elective Inpatient Cholecystectomies for the 5 Lowest-Ranked Counties in North Carolina

Lowest-ranked counties[a]	Adult population in 2016, No.	No. of procedures: Observed	Expected[b]
1	99 772	13	6.20
2	27 415	6	1.70
3	34 271	4	2.13
4	40 846	10	2.54
5	44 550	7	2.77
Total	NA	40	15.35
PSR (95% CI)[c,d]	NA	2.60 (1.78-3.41)	NA

Abbreviations: NA, not applicable; PSR, proportional surgical ratio.

[a] Counties are listed in no particular order.

[b] Expected number of elective cholecystectomy procedures was derived using the elective cholecystectomy rate in the 5 highest-ranked counties, calculated as R_2 = 116/1 864 588 = 0.00006, or 0.06 per 1000 population.

[c] PSR calculated as the total number of observed procedures divided by the total number of expected procedures.

[d] Calculated using Byar approximation.

Table 5. Obesity and Bariatric Surgery Procedures for the 5 Lowest-Ranked Counties in North Carolina

Lowest-ranked counties[a]	Adult population in 2016, No.	Age-adjusted adult population with obesity, %[b]	Adult population with obesity, No.	No. of procedures: Observed	Expected[c]
1	99 772	39	38 911	45	128.69
2	27 415	37	10 144	18	33.55
3	34 271	37	12 680	58	41.94
4	40 846	39	15 930	41	52.69
5	44 550	31	13 811	19	45.68
Total	NA	NA	NA	181	302.54
PSR (95% CI)[d,e]	NA	NA	NA	0.60 (0.51-0.69)	NA

Abbreviations: NA, not applicable; PSR, proportional surgical ratio.

[a] Counties are listed in no particular order.

[b] Percentage of adults who reported a body mass index (calculated as weight in kilograms divided by height in meters squared) of 30 or greater as reported in the Robert Wood Johnson Foundation Health Ranking report for 2016.

[c] Expected number of bariatric procedures was derived using the bariatric surgery rate in the 5 highest-ranked counties, calculated as R_2 = 1509/456 265 = 0.003307, or 33.07 per 10 000 population.

[d] PSR calculated as the total number of observed procedures divided by the total number of expected procedures.

[e] Calculated using Byar approximation.

dicator to identify potential surgical access disparity between populations.

A substantial volume of observational and cross-sectional data[19] demonstrate that certain segments of the population receive less than optimal surgical access as defined by certain processes of care and/or specified outcomes. These reports have used existing retrospective databases and are limited to the availability of the variables in the database and generally to patients who have undergone a surgical procedure.[19] For this reason, the disparity domains examined are largely confined to race/ethnicity and, to a lesser extent, insurance status and level of income.

To understand disparities in surgical access, it is incumbent to define the burden of surgical disease within a population. Estimating the population burden of surgical disease is extremely challenging. Although the number of inpatient and ambulatory surgery procedures performed can be obtained from large data repositories, such as the nationwide HCUP database,[24] defining the surgical disease burden solely on these data alone likely underestimates what constitutes surgical care. Certain types of surgical care would not be captured, such as preoperative assessments of whether it is appropriate to operate and intraoperative anesthetic management[30] that is critical to successfully treat a surgical condition or disease that never results in a surgical procedure but requires the expertise of surgeons, such as nonoperative management of blunt abdominal trauma. For these reasons, previous reports likely fail to account for the true burden of surgical disease and may not be truly representative of global disparities in access to surgical care.

Our approach to this fundamental question was a conceptual model in which access to surgical care was not characterized by disparity metrics[19] but instead was defined as an integral part of a health care system that contributes to the overall health and wellness of a population.[31] In this conceptual model, the healthiest populations were hypothesized to be most likely to have the best access to surgical care. Because a vulnerable subpopulation is not solely based on race/ethnicity but on a broad range of characteristics, such as socioeconomic status, age, sex, level of education, and place of residence,[32,33] incorporating these variables into the model is crucial to understand the determinants of the surgical access disparity.

To test this conceptual model, we examined whether the county health rankings model of the RWJF,[23] which incorporates multiple factors beyond race/ethnicity a priori, defines a population at the county level who have the fewest barriers to surgical care. The county health rankings model is a measure both of length of life (years of potential life lost before age 75 years) and quality of life. We opted to use the county of residence as the unit of analysis rather than the county of surgical care, as the RWJF ranking incorporates access to care. Our results demonstrate that the PSR is a dynamic platform that can identify differences in the use of surgical services relative to a reference healthy population. We suggest these differences can be used to globally define potential disparities in surgical access.

One of the strengths of this model is that it can account for both overuse and underuse of surgical services relative to a reference healthy population. Our results demonstrate that surgical conditions that ideally should be performed electively, such as cholecystectomy or herniorrhaphy, are significantly more likely to have emergent/urgent surgical care with the attended greater morbidity and mortality[34] in the 5 LRCs. In contrast, an elective surgical procedure with defined surgical indications, such as obesity, are less frequently performed in those living in LRCs. We observe that the populations in the 5 LRCs were significantly more likely to undergo inpatient elective cholecystectomy (PSR, 2.60; 95% CI, 1.78-3.41) than those living in the 5 HRCs. This is not unanticipated, as most cholecystectomies are now performed in an ambulatory setting[35] in which patients are generally healthy while inpatient procedures are reserved for those with significant comorbidities. Further research is needed to determine the reasons for the disparities, which may include more complex statistical modeling as an initial step.

Limitations

This study had limitations. This report did not account for care by surgeons that does not involve an inpatient surgical procedure or surgical procedures performed in the outpatient setting. We recognize that in our evolving health care system, increasingly, many surgical procedures are now conducted in the outpatient setting, and for this reason, SID data alone may not account for the actual prevalence of clinical conditions within populations. In this report, we assumed that our populations of comparison were at similar risk of developing conditions of surgical importance, which may not be accurate. Combining both inpatient and outpatient data will give a more comprehensive perspective of disparities in surgical access as well as the prevalence of disease. However, it is important to note that the PSR methodology proposed in this report will remain useful to detect potential disparities in surgical access that warrant further investigation.

In the 3 phases of health disparities research described by Kilbourne and colleagues,[21] detecting and defining vulnerable populations predicates understanding and subsequently intervening and reducing health disparities. This report describes a systematic method to define and detect potential disparities in surgical access. Because we used the county health rankings in the model, the PSR incorporates differences in health outcomes or health status and minimizes the effects of selection bias and other potential confounding factors. Although the calculation of the PSR presented in this report is simple, more complex statistical models can be performed considering not only the variability in access across counties but variability within a county as well. In this report, we used the county of residence as the unit of measure; however, there is no discernable reason not to use other units, such as the county in which surgical care is delivered, the Census tract, or the area deprivation index,[36] as long as data are available, to ascertain the population size and the number of operative procedures.

Conclusions

The PSR is a methodologic framework in which populations can be determined to have potential surgical access disparity for very specific surgical conditions. Future investigations will use increasingly granular, publicly available Census data on health, behavioral, and social determinants down to the level of the zip code, which will allow us to develop more robust statistical models that will allow more precise estimates of the PSR. This will allow us to better understand variables at the patient, physician, clinical encounter, and health care system level that contribute to these disparities and can help unravel how these variables are intertwined. We anticipate this will allow a systematic development of interventions to address and reduce surgical access disparities.

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Author Affiliations: Division of Surgical Oncology, Department of Surgery, Brody School of Medicine at East Carolina University, Greenville, North Carolina (Wong, Vohra, Akram); Division of Surgical Research, Department of Surgery, Brody School of Medicine at East Carolina University, Greenville, North Carolina (Irish, Pories); Department of Public Health, East Carolina University, Greenville, North Carolina (Irish); Division of General Minimal Invasive and Bariatric Surgery, Department of Surgery, Brody School of Medicine at East Carolina University, Greenville, North Carolina (DeMaria, Altieri); Division of Trauma and Critical Care, Department of Surgery, Brody School of Medicine at East Carolina University, Greenville, North Carolina (Brownstein); Division of Surgical Immunology and Transplantation, Department of Surgery, Brody School of Medicine at East Carolina University, Greenville, North Carolina (Haisch, Leeser, Tuttle).

Author Contributions: Drs Wong and Irish had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: All authors.
Acquisition, analysis, or interpretation of data: Wong, Irish, DeMaria, Vohra, Pories, Brownstein.
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