Racial and ethnic disparities in abdominal aortic aneurysm evaluation and treatment rates in Texas

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ABSTRACT

Background: Screening identifies intact abdominal aortic aneurysms (iAAAs) before progression to ruptured AAAs (rAAAs). However, screening efforts have been limited by the low overall diagnostic yield and unequal screening among minority populations. The goal of the present study was to identify equitable AAA screening strategies for both majority and minority populations.

Methods: We performed epidemiologic and geospatial analyses of inpatient and outpatient procedures for iAAAs and rAAAs at Texas hospitals from 2006 through 2014 at all nonfederal hospitals and clinics in Texas. The data were aggregated by area (metropolitan statistical area vs rural region) and then supplemented by six additional data sources to estimate the AAA repair incidence rates, rates of AAA-related clinic and ultrasound visits, travel distance to providers, and the location and number of unrecognized AAAs.

Results: Most AAA repairs had occurred among men aged 65 to 84 years and categorized as White in large metropolitan areas. The area procedure rates for rAAAs and iAAAs were strongly correlated ($R^2 = 0.47$). Two other variables—the proportions of persons categorized as White and those aged ≥65 years in a region—identified subgroups within the majority population with a high risk of iAAAs ($R^2 = 0.46$). Lower rates of clinic visits and AAA ultrasound scans were seen among persons categorized as Black. Several areas with disproportionately higher rAAA/iAAA repair ratios were found, mainly affecting persons categorized as Black.

Conclusions: Multiple focused AAA screening strategies could be required to address the disproportionately lower AAA identification among persons categorized as Black. (J Vasc Surg 2022;76:141-8.)

Keywords: Abdominal aortic aneurysm; Ultrasound; Disparities; Screening; Ruptured aneurysm

In contrast to the unfavorable natural history of large, untreated abdominal aortic aneurysms (AAAs), contemporary surgery for AAAs has resulted in low mortality.[1,2] Ultrasound can identify AAAs with low cost and excellent diagnostic accuracy, as summarized by the U.S. Preventive Services Task Force.[3] These observations have led national health care services in the United States,[4] the United Kingdom,[5] and Canada[6] to recommend or provide one-time ultrasound screening to detect AAAs, typically for men aged 65 to 80 years with a history of tobacco use and persons with a family history of AAAs. The U.S. Preventive Services Task Force concluded with "moderate certainty" that supporting studies have demonstrated a "moderate net benefit" for screening in these populations.[3] Numerous additional professional societies, including the American Heart Association, have also supported the use of AAA ultrasound screening. In the United States, the Screening Abdominal Aortic Aneurysms Very Efficiently (SAAAVE) Act has legislated that one-time AAA screening for selected groups should be reimbursed by Medicare.

Nonetheless, AAA screening efforts have had two important shortcomings. First, the diagnostic yield of screening has been low: 305 men must be screened to prevent one AAA-related death, and 1000 men must be screened to avoid two emergency AAA procedures.[7] Second, racial inequalities could exist in the identification and treatment outcomes of AAAs in the United States. The proportion of patients who present with a ruptured AAA (rAAA) rather than an intact AAA (iAAA) has been higher for persons categorized as Black than for persons categorized as White.[8] In the United Kingdom, the highest AAA prevalence has been seen among persons with the greatest degree of social

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deprivation; however, these were the persons least likely to receive AAA screening.[9] These findings suggest that organizations seeking to increase AAA screening must focus their efforts on specific persons in specific areas to reduce inequalities.

Thus, we sought to use publicly available data to identify community-level factors associated with the incidence of AAAs in Texas that could prove useful in focusing AAA screening efforts among both the majority population (persons categorized as White) and minority populations (persons categorized as Black or Hispanic) in Texas. We focused especially on Black persons because of the significant and longstanding health disparities that have been reported in this population (eg, a risk-adjusted rate of nontraumatic leg amputations that has persistently been twofold greater than that for persons categorized as White for the past 20 years[10,11]).

ARTICLE HIGHLIGHTS

- **Type of Research:** A multicenter, retrospective, nonrandomized cohort
- **Key Findings:** Persons categorized as Black had a higher overall ratio of ruptured abdominal aortic aneurysm (AAA) repairs to intact AAA repairs compared with other Texans. This elevated ratio appeared to result from a lower frequency of clinic visits and screening ultrasound scans for persons categorized as Black.
- **Take Home Message:** Focused ultrasound screening for AAAs among persons categorized as Black could help reduce the disparate number of persons categorized as Black who undergo urgent repair for a ruptured AAA vs elective repair of an intact AAA.

METHODS

Data on all admissions to nonfederal Texas hospitals for the 8-year period from 2006 to 2014 were obtained through the Texas Department of State Health Services (DSHS). The study population of interest was adults living in Texas who had undergone surgery for iAAAs and rAAAs. The study sample was obtained by identifying all adult Texas residents with both (1) diagnosis codes denoting either iAAAs or rAAAs and (2) procedural codes denoting open surgical or endovascular AAA repair. Patients with an aortic aneurysm at an unspecified location were included only if the procedural codes had specified treatment of an aneurysm of the abdominal aorta. Data on all outpatient clinic visits and ultrasound scans for which the primary diagnosis code denoted an AAA were also obtained through the Texas DSHS. The categorizations of race and ethnicity were included in these state data. We used the descriptor "people categorized as [group]" as people-first language and also to recognize that this categorization might not have always been used by the patients themselves.

The patient location from both of these data sets was categorized into areas according to the county of residence: either a metropolitan statistical area (MSA) as defined by the U.S. Office of Management and Budget[12] for urban patients or one of eight regions designated by the state[13] for rural patients. The annual population estimates and demographics for each county for each of the 9 years of the study period were also obtained from the Texas DSHS. Estimates on the proportion of each county's population aged ≥65 years were obtained from the Texas Demographics Center.[14]

Data from the Robert Wood Johnson County Health Rankings and Roadmaps website provided county-level estimates for 2011 and 2012 on the proportion of the population with diabetes or obesity, the proportion uninsured, their education and physical activity levels, the median income, and the number of primary care providers per population.[15] The addresses of licensed tobacco vendors were obtained from the Texas Comptroller's office and used to calculate the tobacco retailer density. From the Centers for Medicare and Medicaid Services, we obtained data on the number and location of ultrasound scans performed from 2012 to 2013 under the SAAAVE Act using the Health Care Procedure Coding System code G0389 or Common Procedural Terminology code 76706.

Finally, we created a probabilistic Markov model to estimate the relative risk ratio for AAAs in Black persons and the number of unrecognized AAAs in various regions of Texas. We first searched using "abdominal aortic aneurysm AND race" in the PubMed database to identify relevant studies reported from October 1985 to May 2020. Additional, extensive searches were performed using permutations of the following MeSH (medical subject heading) terms: "abdominal aortic aneurysm," "prevalence," "incidence rate," "odds ratio," "Black," "White," and "Hispanic." The references of each of the identified studies were also reviewed for any additional reports not already encountered in the PubMed search. We included only reports that had compared the incidence rates or odds ratios for AAAs between Black and White persons. Studies describing the relative incidence rates without original patient data and studies reporting the earlier results of a particular study were excluded. The frequencies from these studies were used to inform a beta distribution. A probabilistic Markov model was then used to create 1000 simulations in which the relative risk ratio was computed from this beta distribution. The results were validated by comparing them to the number of deaths attributed to AAAs and aortic dissection (grouped together in reporting) listed in the 2014 data from the state.

Generalized linear regression models were then used to develop area-level models of rAAA and iAAA repair rates. Statistical analyses were performed using Intercooled

Table I. Selected patient demographic and clinical characteristics

Variable	Estimate, No. (%)
Sex	
Male	17,077 (76.1)
Female	4787 (21.3)
Unknown	591 (2.6)
Age, years	
45-64	3848 (17.1)
65-74	9005 (40.1)
75-84	7773 (34.6)
≥85	1827 (8.1)
Missing	2 (<0.01)
Race and ethnicity	
White	16,935 (75.4)
Hispanic, White or other	1985 (8.8)
Black, non-Hispanic	1078 (4.8)
Native American	259 (1.1)
Asian	146 (0.7)
Hispanic, Black	18 (0.1)
Categorized as other	1177 (5.2)
Categorized as unknown	21 (0.1)
Missing	837 (3.7)
Area of residence	
Metropolitan	16,912 (75.3)
Rural	5543 (24.7)
Diabetes	
Type 1	32 (0.1)
Type 2	3982 (17.7)
Heart disease	
Coronary artery disease	6554 (29.2)
Congestive heart failure	2433 (10.8)
Atrial fibrillation	3037 (13.5)
Valvular heart disease	542 (2.4)
Kidney disease	
CKD (stage 1-5)	2410 (10.7)
ESRD (stage 6)	538 (2.4)
COPD	641 (2.9)
Anemia	2552 (11.4)

CKD, Chronic kidney disease; *COPD,* chronic obstructive pulmonary disease; *ESRD,* end-stage renal disease.

Stata, version 8.2 (StataCorp LP, College Station, Tex), RStudio, version 1.2.5033 (Rstudio Inc, Boston, Mass), and Microsoft Excel, version 16 (Microsoft Corp, Redmond, Wash). A *P* value <.05 was considered statistically significant. Descriptive statistics are presented as the median, range, and 25% to 75% interquartile range, unless otherwise stated. No institutional review board approval was required, because all data sets used were de-identified and publicly available.

RESULTS

Epidemiology of AAA procedures in Texas. During the study period, 63.9% of the population of Texas were categorized as non-Hispanic White, 29.3% as Hispanic, and 6.4% as Black. Diversity was notable throughout the state, with Hispanic persons ranging from 6.5% of the population (Texarkana MSA) to 95.5% (Laredo MSA), and Black persons ranging from 0.1% of the population (Laredo MSA) to 25.4% (Beaumont-Port Arthur MSA).

A total of 22,455 patients (Table I) had undergone AAA procedures during the study period. Most (17,077; 76.1%) of the patients were men, and nearly three fourths (16,778; 74.7%) were aged 65 to 84 years. The patients were most frequently categorized as White (16,935; 75.4%), followed by Hispanic (1985; 8.8%) and non-Hispanic Black (1078; 4.8%).

Of all AAA procedures, 20,674 (92.1%) were for iAAAs and 1781 (7.9%) for rAAAs. Compared with the 8.0% rate of rAAAs (n = 1259) among White persons, the proportion of rAAAs was significantly higher for Black persons (10.6% [n = 103]; $P < .0001$) and Hispanic persons (11.7% [n = 208]; $P < .0001$). The procedures for AAA repair consisted of open surgical repair in 32.6% of cases (n = 7317) and endovascular aneurysm repair in 67.4% (n = 15,138). Of the endovascular repairs, 478 (3.2%) involved placing fenestrated or branched stent grafts.

The location of residence was available for 21,203 patients (94.4%). Most patients (n = 16,916; 75.3%) resided in a metropolitan area. Patients living in the Dallas-Fort Worth-Arlington, Houston-Galveston, and San Antonio MSAs comprised nearly one half (n = 10,331; 48.7%) of the total patient population. The AAA patient population of the largest rural region (public health region 9/10 outside of El Paso) exceeded the population of the fifth largest metropolitan area (Corpus Christi; Table II).

Region- and county-level incidence rates of AAA treatment. Based on the hospital admission and state demographic data, we calculated that the median annual incidence of iAAA repairs in Texas was 144/1 million population (range, 33-237/1 million among the various areas; Table II). The median annual incidence of rAAA repairs in Texas was 10.9/1 million (range, 3-21/1 million) among the areas. The median incidence of iAAA repairs per 1 million population varied significantly by race and ethnicity: 190 for White persons, 38 for Black persons, and 24 for Hispanic persons.

We found that the rate of rAAA procedures within an area correlated strongly with the rate of iAAA procedures in that region. This single parameter was associated with one half the variance in the rAAA procedure rates among the MSAs ($R^2 = 0.47$; $P < .001$; Fig 1). Regarding the ratio of annual rAAA to iAAA procedures, the most extreme outliers were all notably in populations of Black persons (McAllen-Edinburg-Mission MSA, Sherman-Dennison MSA, San Angelo MSA, and rural public health region 8

Table II. Demographic characteristics and abdominal aortic aneurysm (AAA) cases and rates in Texas metropolitan statistical areas (MSAs) and rural regions, 2006 to 2014

Region	Total population	White, %	Black, %	Aged ≥65 years, %	iAAAs, No.	rAAAs, No.	Incidence, % iAAA	Incidence, % rAAA
Abilene	162,388	69.0	7.6	14.1	217	19	167.0	14.6
Amarillo	250,851	65.9	5.7	12.3	295	22	147.0	11.0
Austin-Round Rock	1,687,436	55.2	7.7	8.8	1015	77	75.2	5.7
Beaumont-Port Arthur	398,275	58.8	25.5	13.5	492	35	154.4	11.0
Brownsville-Harlingen	396,901	11.5	0.3	11.8	220	15	69.3	4.7
College Station-Bryan	214,188	61.3	12.5	9.6	147	14	85.8	8.2
Corpus Christi	417,552	35.2	3.7	13.7	511	34	153.0	10.2
Dallas-Fort Worth-Arlington	6,462,828	51.6	13.5	9.3	4579	390	88.6	7.5
El Paso	758,526	11.6	2.6	11.4	366	38	60.3	6.3
Houston-Galveston	5,823,869	39.4	16.7	9.2	3678	335	78.9	7.2
Killeen-Temple	381,741	52.6	22.1	9.7	334	27	109.4	8.8
Laredo	240,749	3.9	0.1	8.6	63	7	32.7	3.6
Longview	206,137	66.6	18.1	15.0	307	31	186.2	18.8
Lubbock	282,729	56.0	7.8	11.8	283	18	125.1	8.0
McAllen-Edinburgh-Mission	740,014	7.3	0.3	10.3	348	31	58.8	5.2
Midland	138,040	53.0	6.9	11.7	116	8	105.0	7.2
Odessa	133,754	40.8	4.7	10.7	123	10	114.9	9.3
San Angelo	107,383	56.3	4.3	14.8	130	18	151.3	21.0
San Antonio-New Braunfels	2,070,001	36.7	6.7	11.9	1236	113	74.6	6.8
Sherman-Denison	119,618	80.2	6.2	16.2	227	17	237.2	17.8
Texarkana	94,160	66.4	25.6	14.3	87	9	115.5	11.9
Tyler	204,097	61.0	18.6	15.0	293	27	179.4	16.5
Victoria	95,108	46.5	6.1	14.2	98	15	128.8	19.7
Waco	247,832	56.1	16.3	13.2	220	13	111.0	6.6
Wichita Falls	154,152	71.3	9.8	13.5	193	11	156.5	8.9
Rural HSR 1 (outside Lubbock)	506,544	62.7	9.8	16.0	653	55	161.1	13.6
Rural HSR 11 (outside Harlingen)	223,291	49.9	5.5	15.6	278	23	155.6	12.9
Rural HSR 2/3 (outside Dallas-Fort Worth-Arlington)	454,910	67.3	8.6	18.1	681	44	187.1	12.1
Rural HSR 4/5N (outside Tyler)	447,895	53.0	10.4	14.9	534	47	149.0	13.1
Rural HSR 6/5S (outside Houston-Galveston)	110,822	76.3	4.7	19.6	194	15	218.8	16.9
Rural HSR 7 (outside Temple)	422,362	50.4	5.4	15.8	487	41	144.1	12.1
Rural HSR 8 (outside San Antonio)	372,980	63.5	9.4	17.9	514	45	172.3	15.1
Rural HSR 9/10 (outside El Paso)	455,169	63.3	10.3	15.9	615	65	168.9	17.9

HSR, Health service region; *iAAAs,* intact abdominal aortic aneurysms; *rAAAs,* ruptured abdominal aortic aneurysms.

outside of San Antonio). The populations identified as outliers had ratios of >15 rAAAs per 100 iAAA repairs per year, >20 rAAAs per 200 iAAA repairs per year, or >25 rAAAs per 300 iAAA repairs per year, or absolute incidence rates of >2 rAAAs per 100,000 population per year.

Using the admission data and outpatient clinic visit data, we found that the rates of iAAA procedures within the various regions also correlated significantly with the rates of outpatient clinic visits for AAAs ($P < .0001$), the proportion of persons aged ≥65 years ($P < .0001$), the proportion categorized as White ($P < .0001$), and the per capita number of tobacco retailers ($P = .05$; overall model $R^2 = 0.57$). A simplified two-factor model that included only the proportions of White persons and persons aged ≥65 years achieved a model R^2 of 0.46, suggesting that these two factors alone had good predictive ability.

No significant correlation was observed between the rate of iAAA repairs and any of the following variables: proportions of male, Black, and Hispanic persons; rates

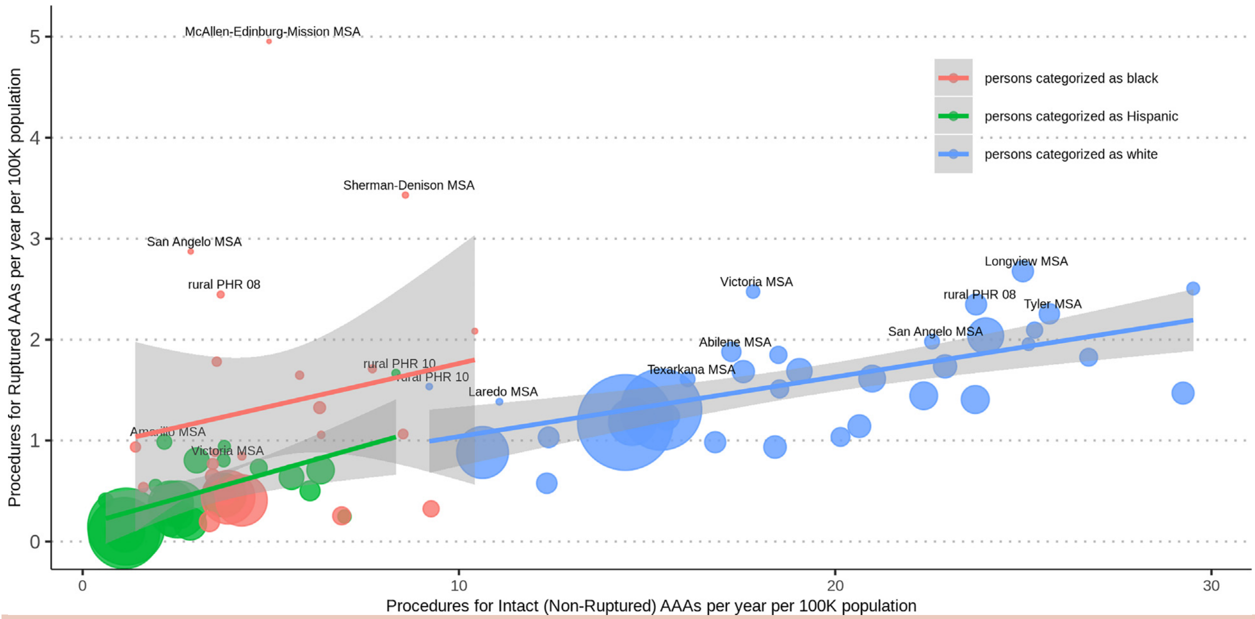

Fig 1. Scatterplot showing the close association between the rate of procedures for intact (nonruptured) abdominal aortic aneurysm (AAA) and the rate of procedures for ruptured AAAs for persons categorized as White (*blue circles/line*), Hispanic (*green circles/line*), and Black (*red circles/line*).

of diabetes, obesity, being uninsured, having a high school diploma or equivalent, illiteracy, and physical inactivity; median zip code-level area deprivation indexes; per capita prevalence of primary care providers and SAAAVE Act screening ultrasound facilities; and county characteristics (rural vs metropolitan; Texas—Mexico border vs nonborder).

Estimating number and location of potentially missed AAAs. The literature review identified a total of nine unique studies that had reported the race- or ethnicity-specific AAA incidence among a total of 5.8 million individuals screened with ultrasound (Supplementary Table, online only). In these studies, screening identified an AAA in 0.56% of White persons and 0.39% of Black persons, yielding a relative risk ratio of 0.703 (1000 simulations; 25%-75% interquartile range, 0.687-0.719).

We used this estimated relative risk ratio, along with the known population sizes and the recorded numbers of iAAA and rAAA repairs, in 1000 simulations of a probabilistic model to estimate the number of unrecognized AAAs among Black persons in each area. Specifically, we attempted to identify the gap between the number of iAAA repairs actually reported and the number of iAAA repairs that would have been expected within a given region, assuming a relative risk ratio for AAA incidence centered at 0.703 but a rate of AAA identification that was equal between Black and White persons. The results suggested that the Dallas-Fort Worth-Arlington and Houston-Galveston MSAs had the largest total number of unrecognized AAAs per year among Black persons (n = 151 and n = 129, respectively), followed by rural Texas public health region 4/5 in East Texas (n = 76) and the Beaumont-Port Arthur MSA (n = 32).

We validated these estimates of unrecognized AAAs by comparing them with 2014 Texas DSHS data on deaths from AAAs or aortic dissection. The estimates were closely correlated, with an R^2 of 0.90 in a bivariate regression model. In addition to the relative rates, the absolute number of unrecognized AAAs in each region closely matched the number of AAA- and dissection-related deaths in that region. The 25 missed AAAs per year predicted for the Dallas-Fort Worth-Arlington MSA matched the 25 AAA-related deaths reported for that area in 2014.

Relative rates of clinic visits and AAA ultrasound scans. We calculated the relative rates of outpatient AAA encounters (clinic visits and diagnostic ultrasound scans for which the primary diagnosis code denoted an AAA) for White vs Black persons within a given region. First, we calculated the ratio of outpatient encounters (outpatient clinic visits or ultrasound scans) per actual iAAA repairs (using hospital admission data) for White persons and per expected total iAAA repairs for Black persons (ie, known AAA repairs and previous estimate of unrecognized AAAs). We then calculated the ratio of these ratios (eg, rate of clinic visits by Black vs White persons), anticipating that equal rates of clinic and ultrasound visits within a region would be reflected by a ratio of 1. Few of the regions had rates near or >1 for either clinic visits or

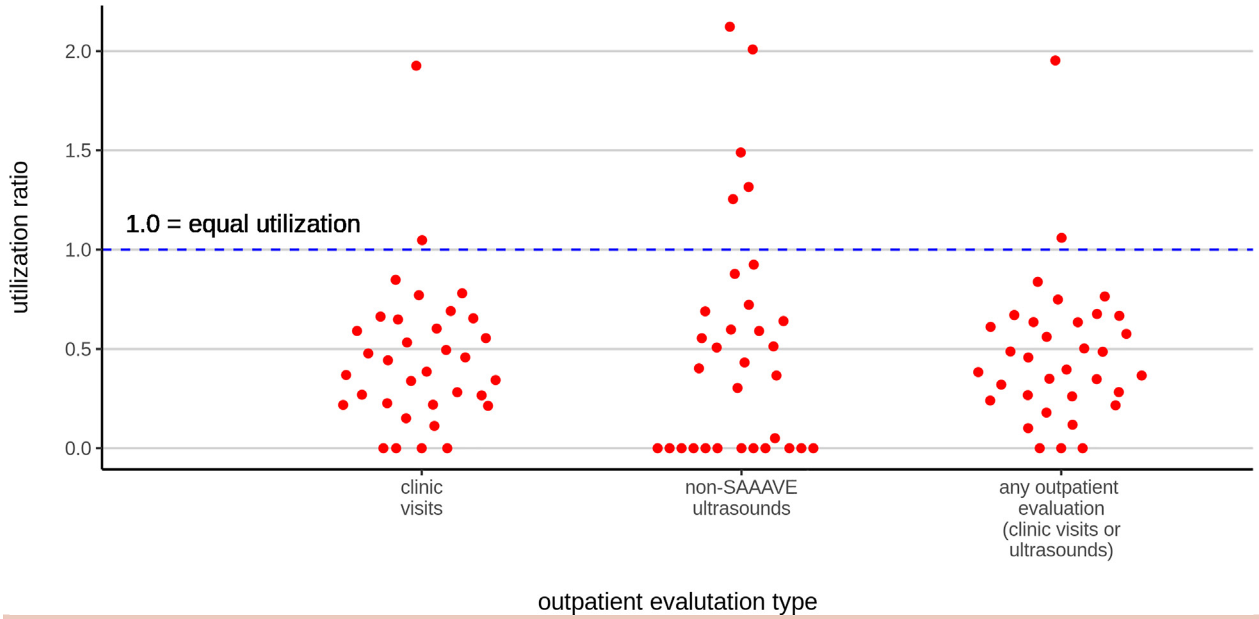

Fig 2. Dot plot comparing the ratio of abdominal aortic aneurysm (AAA)-related clinic visits (*left*), non- Screening Abdominal Aortic Aneurysms Very Efficiently (SAAAVE) ultrasound scans for AAAs (*center*), and either clinic visits or AAA ultrasound scans (*right*) to the anticipated total AAAs for Black persons relative to the ratio for White persons. The *dotted blue line* at 1.0 represents the level expected if the rates of clinic and ultrasound visits for AAAs were equal for Black and White persons.

ultrasound visits (Fig 2). Especially notable were the 12 regions that reported zero AAA-specific ultrasound visits for Black persons during the 8-year study period.

Travel distance to providers. Finally, we estimated the travel distances from the zip code of each patient's residence to the location of the nearest SAAAVE Act ultrasound screening provider. We estimated the travel distances to determine whether the location of, or distance to, these providers might represent a barrier to ultrasound screening reimbursed through the SAAAVE Act. Our analysis showed that, compared with persons categorized as White or Hispanic, those categorized as Black more frequently lived within 50 miles of a SAAAVE Act provider (81.0% vs 69.9%; $P < .0001$) and had a shorter median distance to the nearest provider (11.9 vs 16.7 miles; $P < .0001$). We found no significant differences for these parameters between White and Hispanic persons. Unlike the non-SAAAVE AAA ultrasound scans, we did not have data on the volume of SAAAVE ultrasound scans performed by these various providers.

DISCUSSION

The goal of the present study was to use publicly available Texas data to identify strategies to improve AAA screening in both majority (White) and minority (Black and Hispanic) populations. The proportion of White persons and persons aged ≥65 years accounted for 46% of the variation in AAA procedure rates among MSAs. Thus, just these two variables alone—easily obtained for all U.S. states through the U.S. Census Bureau data portal or the Robert Wood Johnson County Health Rankings & Roadmaps websites—could be used to more precisely direct ultrasound screening efforts in the majority White population.

In the Hispanic population, we noted elevated rates of an rAAA presentation but no outliers in the rAAA/iAAA ratio or distance to SAAAVE providers. Although other important disparities might exist in this population, we focused much of our analysis on Black persons because of the amplitude and consistency of the disparities previously described for the latter population.

However, many of our findings suggest that Black Texans receive less AAA-related screening and treatment than persons categorized as White or Hispanic. A significantly higher proportion had undergone repair for a rAAA than for an iAAA. We found that the four most extreme outliers in the race/ethnicity-specific rAAA/iAAA treatment rates within a region were from Black populations (Fig 1). Per AAA, Black persons had received fewer AAA-related clinic visits and ultrasound scans compared with White persons (Fig 2), and many regions reported no AAA ultrasound scans performed for Black persons during the study period.

The SAAAVE Act could be helpful in increasing AAA screening among Black persons. Initiated by a "coalition of medical and surgical specialty societies, foundations, and corporate partners,"[16] the SAAAVE Act is unusual in legislating federal payments to screen for a disease that disproportionally affects White men aged ≥65 years. In the United Kingdom, the persons most likely to undergo AAA screenings are those with the lowest levels of socioeconomic deprivation, yet these persons also had the lowest AAA incidence.[9] Without processes to foster equitable screening, therefore, the reimbursement provided by the SAAAVE Act has the potential to exacerbate the baseline racial disparities in clinic and ultrasound visits. However, although seemingly underused at present, providers or professional societies could use the federal resources provided by the SAAAVE Act to direct screening efforts to minority populations identified by studies such as ours and thereby reduce or eliminate the disparities now present.

The close direct relationship between the rAAA and iAAA rates within regions is a novel finding with practical implications. Although one might expect an inverse correlation (ie, that more iAAA repairs would result in fewer rAAA repairs), our findings suggest that the population characteristics have a much stronger influence on rAAA rates than do the iAAA rates. However, the ratio of rAAA repairs to iAAA repairs could serve as a yet-more accessible parameter to identify populations that would benefit from more intensive AAA screening.

That our study focused on procedures for treating AAAs resulted in limitations. First, because of the greater proportion of Black persons who had undergone treatment for rAAAs rather than iAAAs, we suspected that the number of unidentified AAAs was larger among Black persons than among White persons. Therefore, we adjusted the denominator used in the clinic and ultrasound visit ratios according to the best available estimates of the relative incidence rates, which came from studies of generalized ultrasound screening. Although we would argue that no estimates more accurate than these are available, they are estimates nonetheless.

We intend to use these findings to direct AAA ultrasound screenings in specific areas of Texas. We hope to also partner with local vascular surgeons, cardiologists, and primary care physicians in the areas with high rAAA/iAAA procedure ratios (McAllen-Edinburgh, Sherman-Dennison, and San Angelo) and in areas with the largest estimated number of missed AAAs (Dallas-Fort Worth, Houston, Beaumont, and east Texas) to increase AAA screening among at-risk people.

CONCLUSIONS

Health care providers should use publicly available demographic data to focus AAA screening on particular geographic areas and to better identify the segments of the White population with the highest incidence of AAAs. Knowledge of the ratio of rAAA/iAAA procedures within a region could help reduce the apparent disparity in identifying AAAs among persons categorized as Black, and areas with high rAAA/iAAA ratios should develop strategies to increase AAA screening and AAA-related clinic evaluations.

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AUTHOR CONTRIBUTIONS

Conception and design: NB, DB
Analysis and interpretation: NB, DB, PK, JM, SL
Data collection: NB, DB
Writing the article: NB, DB
Critical revision of the article: NB, DB, PK, JM, SL
Final approval of the article: NB, DB, PK, JM, SL
Statistical analysis: NB, DB
Obtained funding: Not applicable
Overall responsibility: NB

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Supplementary Table (online only). Abdominal aortic aneurysm (AAA) screening studies reporting race-specific rates

	Persons categorized as white		Persons categorized as black		
Investigator	No.	Incidence rate	No.	Incidence rate	Incidence rate calculation method
Johnson et al[17]	1530	0.029	680	0.015	Given
Lederle et al[18]	63,133	0.049	5843	0.028	Given
Tang et al[19,a]	10,204	0.050	3593	0.023	Calculated using given number of AAA cases per 1000 person-years
Tang et al[19,a]	4504	0.015	1296	0.007	Calculated using given number of AAA cases of total number of subjects screened
Benson et al[20]	19,865	0.014	769	0.007	Given
Jahangir et al[21]	7417	0.021	11,084	0.011	Calculated using given number of AAA cases among total number of subjects screened
Kent et al[22]	2,653,317	0.008	89,214	0.004	Calculated using given proportions of Black and White among subjects with and without AAAs
Jacomelli et al[9]	352,257	0.013	3651	0.006	Given
DeRubertis et al[23]	8404	0.006	540	0.011	Given
Greco et al[24]	2,709,301	0.001	90,583	0.000	Calculated using given proportions of Black and White among subjects with and without AAAs

[a] Different cohorts of patients within the same study.