Demographic, social and geographic factors associated with glycaemic control among US Veterans with new onset type 2 diabetes: a retrospective cohort study

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ABSTRACT

Objectives This study evaluated whether a range of demographic, social and geographic factors had an influence on glycaemic control longitudinally after an initial diagnosis of diabetes.

Design, setting and participants We used the US Veterans Administration Diabetes Risk national cohort to track glycaemic control among patients 20–79-year-old with a new diagnosis of type 2 diabetes.

Primary outcome and methods We modelled associations between glycaemic control at follow-up clinical assessments and geographic factors including neighbourhood race/ethnicity, socioeconomic, land use and food environment measures. We also adjusted for individual demographics, comorbidities, haemoglobin A1c (HbA1c) at diagnosis and duration of follow-up. These factors were analysed within strata of community type: high-density urban, low-density urban, suburban/small town and rural areas.

Results We analysed 246,079 Veterans who developed a new type 2 diabetes diagnosis in 2009–2018 and had at least 2 years of follow-up data available. Across all community types, we found that lower baseline HbA1c and female sex were strongly associated with a higher likelihood of within-range HbA1c at follow-up. Surprisingly, patients who were older or had more documented comorbidities were more likely to have within-range follow-up HbA1c results. While there was variation by community type, none of the geographic measures analysed consistently demonstrated significant associations with glycaemic control across all community types.

INTRODUCTION

Maintaining appropriate glycaemic control is critically important in mitigating the impact of the devastating complications of diabetes. A clinically-feasible reduction in haemoglobin A1c (HbA1c) of 1% is associated with a reduced likelihood of macrovascular complications such as heart attack and stroke by approximately 14% and a reduced likelihood of microvascular complications by approximately 37%. Without appropriate glycaemic control, many patients with diabetes experience these adverse health effects and are at risk for premature death. While appropriate clinical care is of paramount importance, a wide array of demographic, social and geographic factors play a strong role in health outcomes, but data are limited on their influences on glycaemic control among patients with diagnosed diabetes. Understanding the exact influence of these determinants is critical in addressing the enormous impact that diabetes has on health outcomes.

To investigate the demographic, social and geographic factors that influence the burden
of diabetes, the Location, Environmental Attributes and Disparities (LEAD) Network was funded by the Centers for Disease Control and Prevention to identify these key influences. In addition to strengthening the existing literature by linking neighbourhood disadvantage to prevalent diabetes, the LEAD Network has also leveraged data from three distinct patient cohorts across the country to find that rates of incident diabetes are also driven by socio-economic deprivation, an adverse food environment and neighbourhood walkability as measured by land use.7–10 The network has also found that such determinants may vary by community type, and that suburban or small town, and rural areas of the country may experience higher rates of diabetes, in addition to distinct geographic risk factors.11–13 A question left unanswered about these influences is whether they pose an adverse health impact after a diagnosis of diabetes has been made, and whether there are demographic, social or geographic factors that influence glycaemic control after a new diagnosis of diabetes.

The goal of this study was to identify key risk factors associated with adequate glycaemic control among US Veterans with new diagnosis of type 2 diabetes (T2D). We used the US Veterans Administration Diabetes Risk (VADR) cohort, which has been validated to identify patients with a new T2D diagnosis through the electronic health record (EHR) and has been a national cohort used by the LEAD Network to describe key risk factors associated with diabetes.14 We selected candidate demographic, social, and geographic factors based on our prior studies in the LEAD Network, which demonstrated the importance of considering varied geographies in analyses of diabetes and factors such as the food environment.15 In addition, the longitudinal data allowed us to use a specific analytic approach that took advantage of repeated HbA1c measures. We hypothesised that the drivers of diabetes prevalence and incidence (eg, worse neighbourhood-level socioeconomic environment and an adverse food environment) would also be associated with lower likelihood of glycaemic control among patients with newly diagnosed diabetes, which would indicate the vulnerability of specific subpopulations of patients.12

METHODS
Study population
We analysed newly diagnosed cases of T2D from the VADR cohort. This national, longitudinal cohort was established using EHR to identify all patients in the Veterans Administration (VA) enrolled in primary care from 2008 to 2018.14 To be a part of the diabetes-free cohort, patients had to have at least two or more primary care visits at least 30 days apart from 2003 to 2016 without evidence of diabetes. A diagnosis of diabetes was established by either: (1) two or more separate VA healthcare encounters with T2D-specific ICD-9/10 codes, or (2) one or more VA encounters with T2D-specific ICD-9/10 codes and two or more elevated HbA1c measures≥6.5%, or (3) one or more prescriptions for T2D medication other than metformin or acarbose alone. Patients were followed from the date they entered the cohort free of diabetes to when they developed diabetes and up to 10 years afterwards unless they were lost to follow-up (no healthcare encounters for 2 years), deceased, or reached the end of the study period on December 31, 2021.

Primary outcome
Our primary outcome was glycaemic control as measured by the proportion of within-range HbA1c values during the follow-up of each individual patient. A within-range HbA1c was defined as a HbA1c less than 7.0% based on the VA clinical guidelines for maintaining glycaemic control. In this study, we excluded patients aged 80 years or older for whom HbA1c less than 8.5% is considered within-range per VA clinical guidelines. We coded glycaemic control at each time it was measured as a binary variable (0 for HbA1c 7.0% or above and one for HbA1c less than 7.0%). Baseline HbA1c was defined based on the HbA1c result at diagnosis or within the 30 days before or after the diagnosis date. To explore geographic variation in our glycaemic control nationally, we mapped our primary outcome by county across the United States, excluding counties with less than 10 patients in order to limit error due to small cell counts.

Sociodemographic and clinical measures
All models also controlled for individual-level and prespecified neighbourhood-level factors. These adjustments were made based on consensus analytic recommendations made by the LEAD Collaborative Network.12 For each patient, we included the following predictors: (1) age at time of diagnosis, (2) sex (male or female), (3) race and ethnicity as categorised by non-Hispanic (NH) White, NH Black, NH Asian, NH Native Hawaiian or Other Pacific Islander, NH American Indian or Alaskan Native, or Hispanic, (4) low-income or disability status at cohort entry (based on the patient’s eligibility for VA-based benefits), and (5) marital status at cohort entry (married vs living with a partner or single). We also included the following clinical variables given their expected impact of glycaemic control: duration of follow-up after T2D diagnosis (in years), baseline HbA1c at the time of diagnosis, and medical comorbidities as summarised using the Elixhauser Comorbidity Index at cohort entry, where a higher score out of -13 to +34 indicate a higher number and severity of comorbidities.16–18

Geographic exposures
To control for neighbourhood-level potential confounders based on consensus recommendations of the LEAD Network, we also adjusted for the following variables at the Census tract level based on address at cohort entry: (1) percent NH Black, (2) percent Hispanic, (3) neighbourhood socioeconomic status (NSEE), a metric created based on a continuous z-score sum of the percent of adults with less than a high school education, percent unemployed, percent of households with less than $30,000
annual income, in poverty, on public assistance, or without a car, (4) neighbourhood land use environment (LUE), a metric created based on average block length, average block size, household density, intersection density, street connectivity, retail establishment density, and percent of developed land, (5) the retail food environment, which was measured by the prior 5-year mean counts of supermarkets relative to other retail food outlets before the time of diagnosis, and (6) the restaurant food environment, which was measured by the prior 5-year mean counts of fast-food restaurants relative to other restaurant food outlets before the time of diagnosis.8-19 These last four measures were created from Retail Environment and Cardiovascular Disease (RECVD), a national geographic database of neighbourhood measures developed and validated for use for studies of the built environment.20

Stratification and effect modification
Given our prior studies in the LEAD Collaborative Network, we have been aware that the built environment may have varying influence on diabetes burden based on what region or area of the country is being studied (ie, urban vs rural).12 15 Therefore, we stratified our results by community type as defined by the classification system developed by the LEAD Network.21 Each participant was geolocated to a Census tract based on residential address at cohort entry and all study results were analysed by high-density urban, low-density urban, suburban / small town, and rural community types.

Statistical analysis
To demonstrate associations between potential demographic, social and geographic risk factors and HbA1c tests within-range among Veterans with new-onset T2D, we used generalised estimating equations (GEE) with a Logit link function for repeated-binary measures of the primary outcome.22-25 We specified an exchangeable working correlation matrix and applied a GEE (marginal model) to maximum likelihood estimation in order to interpret parameter estimates in terms of population-averaged change in HbA1c due to differential, time-invariant risk factors across a large number of neighbourhoods.26-28 We included a time-varying covariate of years since T2D diagnosis to account for the timing of each test in relation to diabetes progression. Using the Python 3 GENMOD GEE package, we examined the statistical models stratified by community type and exponentiated regression coefficients prior to interpretation. To map hotspots of adequate and inadequate glycaemic control, we performed a spatial analysis to map local clusters where neighbouring counties had a high and low proportion of within-range HbA1c values averaged across patients. Using the Getis-Ord Gi* statistic, statistically significant clusters were mapped at 95% and 99% confidence levels.

Patient and public involvement
Given the retrospective nature of this study, there was no direct patient involved in the design of this study.

RESULTS

Study population
We analysed data on 2 46079 patients enrolled in the Veterans Health Administration who developed newly diagnosed diabetes between 2008 and 2018 and had at least 2 years of follow-up. When compared with veterans living in more rural areas, we found that Veterans in urban areas had higher proportions of women and minorities, a slightly younger age at diagnosis and slightly higher rates of low-income status. In comparison, Veterans in rural areas had higher proportions of male and non-Hispanic White patients, a slightly older age at diagnosis and slightly lower rates of low-income status (see table 1). At the time of initial diagnosis, the average baseline HbA1c of our study population was 7.3%. The average was slightly higher in high-density urban areas at 7.5% and slightly lower in rural areas at 7.2%. Notably, the SD for HbA1c were large (eg, 1.8% overall for the cohort). However, this result was due to a number of patients having very high baseline HbA1c values, causing a rightward skew in the distribution of baseline HbA1c results.

Primary outcome
During the study period, there were 2 494524 HbA1c tests conducted during routine follow-up visits, for an average of 10 tests per patient. Comparing levels of glycaemic control by community type, we found the mean proportion of within-range tests averaged by patient was two-thirds (67%). While the geographic variation for this outcome did not show any obvious pattern, there was a sizeable SD of 35% in glycaemic control when compared across counties. To illustrate national geographic variation in our primary outcome, we mapped the mean proportion of HbA1c tests within-range averaged by patient across counties in the USA (figure 1). Our clustering analysis also mapped areas where neighbouring counties had relatively high and low proportions of within-range HbA1c after an initial diagnosis of T2D (figure 2).

Sociodemographic and clinical measures
Across all the community types, our fully specified models found that lower baseline HbA1c and female sex were associated with a higher likelihood of within-range HbA1c over time. A 1.0% higher baseline HbA1c correlated with a 0.72 to 0.76 times lower likelihood of within-range HbA1c across community types. In addition, women had a 1.13 to 1.18 times higher likelihood of within-range HbA1c than men across community types. Only in rural regions, we found that patients identified as an American Indian or Alaskan Native also had a lower likelihood of within-range HbA1c after an initial diagnosis of diabetes. In low-density urban and rural community types, having low income or being married predicted a lower likelihood of within-range HbA1c. Surprisingly, we found that across all community types, patients who were older or had more documented comorbidities were more likely to have within-range HbA1c. For each year, older a patient was at initial diagnosis, they were 1.04 times more likely
Table 1  Population characteristics of US Veterans aged less than 80 years with a new type 2 diabetes diagnosis by community type

<table>
<thead>
<tr>
<th>Population characteristics</th>
<th>All community types</th>
<th>High-density urban</th>
<th>Low-density urban</th>
<th>Suburban and small town</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of veterans</td>
<td>246079</td>
<td>29824</td>
<td>87814</td>
<td>53359</td>
<td>75082</td>
</tr>
<tr>
<td>Median age at diagnosis</td>
<td>63.4</td>
<td>62.0</td>
<td>63.0</td>
<td>63.6</td>
<td>64.5</td>
</tr>
<tr>
<td>Mean (SD) age at diagnosis</td>
<td>62.0 (10.1)</td>
<td>60.7 (10.1)</td>
<td>61.4 (10.3)</td>
<td>62.0 (10.3)</td>
<td>63.1 (9.7)</td>
</tr>
<tr>
<td>Sex, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>5.5%</td>
<td>6.4%</td>
<td>6.3%</td>
<td>5.5%</td>
<td>4.2%</td>
</tr>
<tr>
<td>Race/ethnicity, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>65.0%</td>
<td>41.0%</td>
<td>58.1%</td>
<td>69.8%</td>
<td>79.4%</td>
</tr>
<tr>
<td>Black</td>
<td>21.0%</td>
<td>39.2%</td>
<td>26.4%</td>
<td>17.2%</td>
<td>10.1%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>4.9%</td>
<td>9.4%</td>
<td>6.2%</td>
<td>4.2%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Asian</td>
<td>0.9%</td>
<td>2.3%</td>
<td>1.2%</td>
<td>0.8%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Hawaiian or Pacific Islander</td>
<td>0.8%</td>
<td>1.1%</td>
<td>1.0%</td>
<td>0.8%</td>
<td>0.6%</td>
</tr>
<tr>
<td>American Indian or Alaskan Native</td>
<td>0.8%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.8%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Income status, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disability</td>
<td>37.1%</td>
<td>32.6%</td>
<td>38.3%</td>
<td>39.5%</td>
<td>35.7%</td>
</tr>
<tr>
<td>Low income</td>
<td>37.9%</td>
<td>48.8%</td>
<td>38.4%</td>
<td>34.0%</td>
<td>35.7%</td>
</tr>
<tr>
<td>Marital status, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>36.7%</td>
<td>50.4%</td>
<td>39.1%</td>
<td>33.0%</td>
<td>30.9%</td>
</tr>
<tr>
<td>Mean (SD) Elixhauser Comorbidity Index</td>
<td>1.0 (10.4)</td>
<td>0.9 (11.3)</td>
<td>1.6 (10.5)</td>
<td>1.2 (10.0)</td>
<td>0.8 (10.0)</td>
</tr>
<tr>
<td>Mean (SD) baseline HbA1c</td>
<td>7.3 (1.8)</td>
<td>7.5 (2.1)</td>
<td>7.3 (1.9)</td>
<td>7.2 (1.7)</td>
<td>7.2 (1.7)</td>
</tr>
<tr>
<td>Total tests</td>
<td>2494524</td>
<td>309299</td>
<td>885447</td>
<td>534866</td>
<td>764912</td>
</tr>
<tr>
<td>Mean (SD) tests per patient</td>
<td>10.1 (6.8)</td>
<td>10.4 (7.0)</td>
<td>10.1 (6.8)</td>
<td>10.0 (6.7)</td>
<td>10.2 (6.7)</td>
</tr>
<tr>
<td>Mean (SD) proportion of patient’s within-range tests</td>
<td>67% (35%)</td>
<td>66% (35%)</td>
<td>66% (35%)</td>
<td>67% (35%)</td>
<td>67% (35%)</td>
</tr>
</tbody>
</table>

HbA1c, haemoglobin A1c.

Figure 1  Average proportion of within-range haemoglobin A1c (HbA1c) tests by County among US Veterans followed after an initial diagnosis of diabetes. VADR, US Veterans Administration Diabetes Risk.
to have a within-range HbA1c across community types. In addition, for each point on the Elixhauser Comorbidity Index, patients were 1.01 times more likely to have a within-range HbA1c across community types. Notably, black patients also had a higher probability of being within-range across all community types (table 2).

Geographic exposures and analyses by community type
We also analysed the contribution of the neighbourhood level factors measured at the Census tract level in our fully specified models, including neighbourhood level proportion of Black and Hispanic residents as well as measures of the socioeconomic environment, land use, the proportion of fast-food restaurants and supermarket availability. None of these measured factors demonstrated any statistically significant associations with within-range HbA1c, except the unexpected finding that a higher proportion of black residents by neighbourhood in suburban or small town and rural community types predicted a higher likelihood of within-range HbA1c. In addition, we found that a higher socioeconomic environment (ie, better NSEE score) in suburban or small town areas predicted a higher likelihood of within-range HbA1c. However, none of these findings was consistent across all community types.

DISCUSSION
Our study sought to identify demographic, social and geographic risk factors associated with glycaemic control among US Veterans with a new diagnosis of diabetes. Our findings provide evidence that some of the strongest predictors of poor glycaemic control after initial diagnosis are younger age at diagnosis and high baseline HbA1c. Key factors linked to a higher proportion of HbA1c tests within-range included being woman, older or having more documented comorbidities. Notably, though there were some findings in specific community types, none of the geographic factors studied in our analysis demonstrated any consistent statistically significant association with glycaemic control across all the community types analysed, even though strong geographic associations have been demonstrated in prior studies between several of these factors and a higher prevalence and incidence of diabetes.

Notably, a key predictor of inadequate glycaemic control among patients with newly diagnosed diabetes was a high baseline HbA1c at initial diagnosis. While this finding in particular may not be surprising, it should highlight that a very high HbA1c at the time of diagnosis may indicate that a patient is likely to do poorly and should have more attention, so that they receive the proper diabetes care to promote optimal glycaemic control.

Our study also found that black race was associated with a higher odds of having a within-range HbA1c across all community types. In other studies performed by the LEAD Network, black race has generally been associated with poorer health outcomes, which is consistent with known racial health disparities in the USA. There are several possible reasons for this unexpected finding. First, our study adjusts for baseline HbA1c and other clinical characteristics that are not accounted for in other LEAD Network studies. Therefore, after accounting for disease severity (eg, baseline glycaemic control), age at diagnosis and other factors, black patients were more likely than non-Hispanic white patients to have within-range HbA1c. In addition, prior studies among Veterans have demonstrated that health disparities by race (eg, for mortality) among patients with diabetes may not be as severe among Veterans as among non-Veterans. Therefore, predictors of glycaemic control studied among Veterans with diabetes may not be generalisable to non-Veterans with diabetes. Finally, there is also the possibility of some important unmeasured confounder that is the reason for this unexplained result.

While one might expect that patients who are older and have more comorbidities are generally more vulnerable to poor health outcomes, we found the opposite,
In regard to our finding that more comorbidities were associated with better glycaemic control, a comorbidity index score is an indicator of documented health conditions. Therefore, documentation of comorbidities may be higher among those patients who have more regular interactions with the healthcare system, which may be generally protective among those who have conditions like diabetes. However, our study may also be suggestive that younger patients without any significant medical comorbidities are a high-risk group who are likely to have poor glycaemic control after an initial diagnosis of diabetes.

For instance, one geographic study of glycaemic control in New York City demonstrated that among patients with diabetes, the highest proportion of patients with poor glycaemic control (HbA1c ≥ 9.0%) resided in neighbourhoods where the average age of patients with diabetes was the lowest. This study also suggested that minority
patients were more likely to live in these neighbourhoods and that based on the range of ages among these patients with diabetes, they died younger than non-minority patients. Our own study findings taken together with the literature might suggest that more attention must be directed towards these at-risk populations, who are likely more susceptible to poorly controlled diabetes, which leads to earlier diabetic complications and early diabetes-related death. Specific interventions might include screening practices that focus on younger individuals who may have infrequent contact with the healthcare system or behavioural interventions tailored specifically to reach younger individuals before they develop diabetes in the first place.  

In terms of other predictors, we found that some factors such as being identified as rural American Indian or Alaskan Native, or having certain income limitations only predicted a lower likelihood of within-range HbA1c in low-density urban and rural community types. In addition, we found that the neighbourhood-level variables of proportion of Black residents and environment with lower socioeconomic disadvantage (eg, better NSEE score) predicted a higher likelihood of within-range HbA1c among certain community types in our study. Given that these findings were not consistent in all community types, they may be artefactual. A standardised measurement approach of geographic predictors may not be appropriate in all regions given significant differences in geographic scale. Some of these unexpected associations may be confounded by other unmeasured factors that drives inadequate glycaemic control in specific areas of the country. However, if these findings by specific community type are correct, then they might speak to vulnerability of certain areas of the country, which has been highlighted by other LEAD Network studies, especially among rural communities.  

Another finding in our study was that there was only slightly higher average baseline HbA1c among urban residents in our study, along with a proportion of within-range HbA1c tests that was stable across the community types analysed in our study. However, our maps also demonstrated significant variation in glycaemic control nationally when analysed by county. Our findings may suggest that even if particular geographic predictors are not universally associated with inadequate glycaemic control after an initial diagnosis of diabetes, the geographic distribution of suboptimal glycaemic control may be located in small clusters or even specific counties in the USA. By identifying these geographic areas, this geospatial analysis highlights high-risk areas of the country that may need targeted health interventions to improve glycaemic control after a new diagnosis of diabetes.  

Overall, we thought that one of the most salient findings of our study was that younger patients with fewer comorbidities were considerably less likely to maintain adequate glycaemic control after an initial diagnosis of type 2 diabetes when compared with older patients with more comorbidities. In translating our study findings to clinical practice, more attention may be needed to help these high-risk younger patients to prioritise maintaining better glycaemic control whether it be through better adherence to medications or specific behavioural modifications. As younger patients with diabetes may be more technologically engaged than older patients, strategies to improve engagement and treatment may need to include digital health solutions or other specifically designed tools that can be tailored for those individuals with development of type 2 diabetes at a relatively young age. However, a critical first step is to understand why these younger patients are less likely than older patients to maintain adequate glycaemic control after their initial diagnosis. By identifying the main barriers, these younger patients face the solutions for these problems may become more apparent.

**Strengths and Limitations**

Our study uses the VADR Cohort to characterise glycaemic control among US Veterans across the USA. While the advantage of using such a cohort is the national scale and large numbers of patients can be analysed in the Veterans Administration healthcare system, the generalisability of our results may be limited when considering non-Veteran patients, especially given the male predominance of our study population and our unexpected findings related to race. These results may not apply to other countries or non-Veteran patient populations given that this study focuses specifically on the Veterans in the USA. In addition, though we use a validated cohort to identify newly diagnosed cases of diabetes, it may be that any individual case of diabetes may be wrongly attributed as incident when the diagnosis may have happened prior to the indicated date. In clinical practice, the use of diagnosis codes alone would not be sufficient to identify cases of diabetes; therefore, the study might have included patients who did not actually have diabetes or have missed patients who did have diabetes. However, we developed our study cohort based on the best practices of identifying diabetes cases using EHRs. Also, we did not account for the types of diabetes medications that patients had been prescribed or adherence to these medications as these clinical factors have a significant impact on glycaemic control. Furthermore, there is some measurement error in our primary outcome of HbA1c that could not be accounted for, though we believe that this error is randomly distributed both in a positive and negative directions and should not have affected our overall study results. Finally, there may have been other unmeasured factors that contribute to suboptimal glycaemic control in our study population or the approach in measuring the analysed variables may have not been measured appropriately for specific patients or geographic regions. However, even with these limitations, we believe that our study provides an indication of at least the most salient factors associated with inadequate glycaemic control after an initial diagnosis of type 2 diabetes.
Conclusions

Overall, our study demonstrates the need to focus on highly vulnerable subpopulations of patients who develop type 2 diabetes by identifying key factors associated with inadequate glycemic control after an initial diagnosis of diabetes. Increased attention, screening, support and tailored treatment plans may be needed especially for patients who are at high-risk for developing diabetes at an early age, have extremely poor glycemic control at the time of diagnosis and among minorities who are at high risk for poor diabetes control and diabetic complications. If the risk of suboptimal glycemic control is located in certain areas or even specific counties of the USA, our geographic findings might suggest that effective interventions can be geographically targeted to those communities that are at highest risk of these poor health outcomes, which may ultimately reduce the substantial variation in outcomes that we see among patients diagnosed with diabetes.

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Contributors

DCL, SLO, BE, LET and MDS contributed to the study concept and design. SLO, RK, SA, PER, ART and JOA contributed to data acquisition, analysis or interpretation. DCL, SLO, and RK drafted the manuscript. SA, PER, ART, JOA, BE, LET and MDS critically revised the manuscript for important intellectual content. SLO, RK and DCL conducted the statistical analyses. BE and LET obtained funding. DCL is the guarantor of this work and, as such, 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.

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Map disclaimer

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Competing interests

None declared.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication

Not applicable.

Ethics approval

Our study was approved by the Veterans Administration Institutional Review Board (study number 1667) and the NYU School of Medicine Institutional Review Board (study number S17-01428).

Provenance and peer review

Not commissioned; externally peer reviewed.

Data availability statement

Data are available upon reasonable request. Deidentified study data will be shared with researchers who provide a methodologically sound proposal upon reasonable request and agree to the requirements of a data use agreement with NYU Langone Health. Requests may be directed to: David.Lee@nyulangone.org.

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