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Geographic Variation in Racial Disparities in Receipt of High-Dose Influenza Vaccine Among US Older Adults

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Abstract

Background Racial disparities in receipt of high-dose influenza vaccine (HDV) have been documented nationally, but whether small-area geographic variation in such disparities exists remains unknown. We assessed the distribution of disparities in HDV receipt between Black and White traditional Medicare beneficiaries vaccinated against influenza within states and hospital referral regions (HRRs).

Methods We conducted a nationally representative retrospective cohort study of 11,768,724 community-dwelling traditional Medicare beneficiaries vaccinated against influenza during the 2015–2016 influenza season (94.3% White and 5.7% Black). Our comparison was marginalized versus privileged racial group measured as Black versus White race. Vaccination and type of vaccine were obtained from Medicare Carrier and Outpatient files. Differences in the proportions of individuals who received HDV between Black and White beneficiaries within states and HRRs were used to measure age- and sex-standardized disparities in HDV receipt. We restricted to states and HRRs with ≥ 100 beneficiaries per age-sex strata per racial group.

Results We detected a national disparity in HDV receipt of 12.8 percentage points (pps). At the state level, the median standardized HDV receipt disparity was 10.7 pps (minimum, maximum: 2.9, 25.6; $n = 30$ states). The median standardized HDV receipt disparity among HRRs was 11.6 pps (minimum, maximum: 0.4, 24.7; $n = 54$ HRRs).

Conclusion Black beneficiaries were less likely to receive HDV compared to White beneficiaries in almost every state and HRR in our analysis. The magnitudes of disparities varied substantially across states and HRRs. Local interventions and policies are needed to target geographic areas with the largest disparities to address these inequities.

Keywords Nursing homes · Vaccination · Systemic racism · Healthcare disparities · Geographic mapping · Long-term care

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Introduction

In the United States (US) older adults, aged 65 years or older, are among those at highest risk for severe illness or complications due to influenza infection and account for the most influenza-related hospitalizations and deaths [1]. High-dose influenza vaccine (HDV; Fluzone High-Dose, Sanofi), is an alternative to other seasonally recommended standard-dose vaccines (SDVs), and was recently preferentially recommended for this age group by the Advisory Committee on Immunization Practices for the 2022–2023 influenza season [2]. Although HDV has been demonstrated to be superior to SDV in clinical efficacy trials, only 47% of older adults immunized against influenza receive HDV [2–4]. An unaddressed driver of stagnation in HDV uptake may be racial disparities in vaccination between socially marginalized Black and more privileged White older adults [5].

Health disparities are defined as differences in health outcomes and the provision of health services that adversely affect systematically marginalized groups [6, 7]. For example, socially privileged groups, including White populations, experience greater access to and uptake of innovations in medical technology including vaccines [8, 9]. Many health disparities arise from the long-standing effects of structural racism, that is, the various systemic societal practices and policies that result in discrimination towards socially-defined marginalized groups [10–12]. Historical discrimination and medical mistreatment of these groups, particularly Black populations, have contributed to well-documented contemporary medical mistrust and vaccine hesitancy [13–15].

Disparities in HDV receipt between Black and White traditional Medicare beneficiaries have been documented in excess of 15 percentage points (pps), but these studies have reported disparities at either national or regional levels [4, 16]. The distribution of these disparities across smaller geographic units including states and hospital referral regions (HRRs), which represent regional hospital catchment areas with a minimum population of 120,000 [17], remains unknown. Such disparities likely also vary in magnitude across geographic areas as a consequence of localized structural racism, which has contributed to residential segregation and the ability to access high-quality health care [18, 19]. It is therefore necessary to characterize disparities in HDV receipt at smaller geographic units (e.g., states and HRRs) such that local interventions and policies can be targeted to areas with the greatest disparities. Such local interventions are likely to have just as much, if not larger, effects on improving equity in access to HDV as any national efforts [20].

In this study, we aimed to examine crude disparities in high-dose influenza vaccine receipt between community-dwelling non-Hispanic White and non-Hispanic Black traditional Medicare beneficiaries vaccinated against influenza across the US. We also used direct standardization to estimate age- and sex-standardized racial disparities in HDV receipt among this same group of beneficiaries within states and HRRs [21]. We hypothesized that substantial geographic variation in disparities in HDV receipt across states and HRRs would exist and that there would be substantial heterogeneity of disparities in HDV receipt among HRRs located within the same state.

Methods

Study Design and Data Sources

This nationally representative retrospective cohort study of community-dwelling US Medicare beneficiaries included adults aged 65 years and older enrolled in traditional Medicare between July 1, 2015 and June 30, 2016, prior to when HDV was preferentially recommended for older adults. We linked the Medicare Beneficiary Summary File (MBSF), which includes beneficiary demographic, residential, and enrolment information [22], to a 100% sample of Medicare Part B Carrier and Outpatient files, which provide information on the date and nature of all claims submitted for physician and nursing services provided in hospital outpatient settings [23]. The study was approved by the Brown University Institutional Review Board and the need for informed consent was waived due to the use of deidentified data.

Study Population

Eligible participants included all non-Hispanic White and non-Hispanic Black US traditional Medicare beneficiaries aged 65 years and older during the study period. We excluded beneficiaries enrolled in Medicare Advantage as information on influenza vaccination from these beneficiaries is missing in Carrier and Outpatient files. Nursing home residents were also excluded as vaccination decisions for these beneficiaries may be driven by facility and other characteristics unmeasured in our data [24, 25]. Participants either entered the cohort on the study start date (July 1, 2015), on their 65th birthday, or on the date of coverage initiation. To ensure sufficient time for vaccinations to be documented and observed, we required beneficiaries to have at least 3 months of continuous coverage during the study period. Because Medicare claims are less reliable for documenting influenza vaccination among non-White beneficiaries [26], and because we were interested in disparities in the type of vaccine received (HDV versus SDV), we restricted the study population to only participants who

were documented to have received any vaccination. Doing so reduces uncertainty about the accuracy of influenza vaccination documentation in administrative claims, as individuals who may have received an influenza vaccination through sources such as work or free clinics may not be represented in claims data [26].

Conceptual Framework

Informed by the literature, we constructed a causal directed acyclic graph (DAG) to help guide our analytic decisions (Fig. 1) [10, 11, 16, 18, 27–32]. Based on this DAG, factors such as comorbidities, health behaviors, and provider characteristics are considered to be mediators of the relationship between marginalized racial group and HDV receipt instead of confounders [29]. A bracket is used to signify that our outcome "vaccinated with HDV" and selection criteria "received any vaccination," which occur simultaneously, share common determinants. Because our study population was restricted to vaccinated traditional Medicare beneficiaries in specific geographic units who were alive and enrolled in 2015–2016, part of the relationship between racial group and vaccine type may occur through non-random selection, e.g., through collider stratification via pathways involving age and sex [29, 33]. To minimize the impact of this collider stratification, which may serve to mask or underestimate a disparity, we standardized our analyses by age and sex [21]. Additional details concerning the DAG can be found in the Supplement (Online Resource 1).

Comparison: Membership in a Marginalized versus Privileged Racial Group

Race is a social construct, rather than a biological one, and is a product of structural racism [34]. In our study, Black race was considered to be a marginalized racial group while White race was considered to be a privileged racial group. Information on beneficiaries' race was obtained from the MBSF using information that is derived from applications to Social Security [35]. Our primary interest was investigating disparities between non-Hispanic White and non-Hispanic Black Medicare beneficiaries, between whom the difference in social privilege is historically distinct and among the largest [36]. We therefore excluded beneficiaries who identified as Hispanic, Asian/Pacific Islander, American Indian/Alaska Native, and Other.

Outcome: High-Dose Influenza Vaccination

Receipt of an influenza vaccination and type of vaccine received during the study period were identified using Current Procedural Terminology codes obtained from the

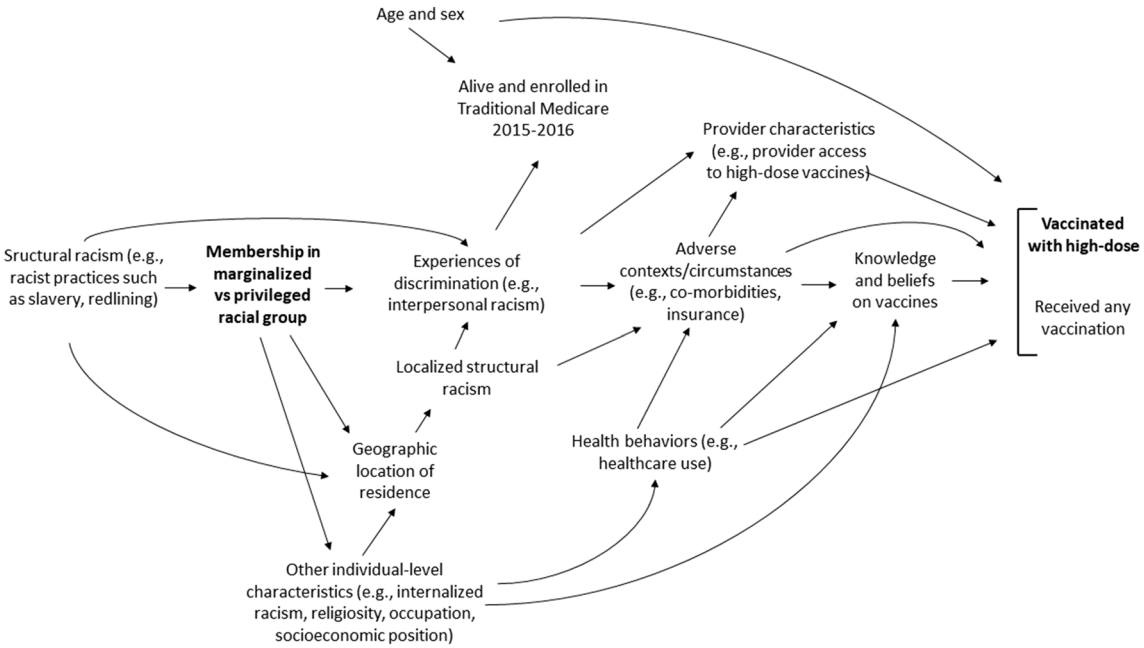

Fig. 1 Causal directed acyclic graph encoding subject matter knowledge regarding the relationship between racial group and high-dose influenza vaccination. Figure 1 represents an encoding of our assumptions about variables (nodes) and the relationships between them that are reflected by the included single direction arrows. The figure is read from left to right, encoding temporality, wherein each node that is an antecedent (a node with an arrow emanating from it) of another also precedes it time. Our comparison of interest is represented by the node "Membership in a marginalized versus privileged racial group," which is operationalized as being Black versus White race in our analyses. Additional information on how to read this figure and descriptions of each node can be found in the Supplement.

Centers for Medicare and Medicaid Services Carrier and Outpatient files. Vaccines were categorized into HDV (Fluzone High-Dose vaccine) and SDV (all other vaccines) (Online Resource 2). Only the first vaccine identified during the study period was included.

Covariates

We obtained beneficiaries' age, sex, and location of residence from the MBSF. Beneficiaries were categorized into the following age groups according to their age at their index date of inclusion into the study cohort: 65–69 years, 70–74 years, 75–79 years, 80–84 years, and 85 years or older.

Statistical Analysis

Measurement of HDV Receipt Disparities

We calculated the crude and age- and sex-standardized proportion of non-Hispanic White and non-Hispanic Black beneficiaries vaccinated with HDV in each racial group (e.g., proportion of Black beneficiaries vaccinated with HDV among Black beneficiaries vaccinated) at the national, state, and HRR level. Smaller than states, HRRs may serve as a more practical geographic unit to target interventions to reduce disparities. Differences in HDV receipt were measured as the pp difference in the proportion of individuals vaccinated with HDV between Black and White beneficiaries. Positive differences in HDV receipt favoring White beneficiaries were indicative of disparities, which by definition arise as differences that favor socially privileged groups [6].

To avoid issues of small cell-size and obtain stable estimates of differences in HDV receipt, we restricted our analyses to geographic units with at least 100 beneficiaries per covariate strata per racial group. As we standardized over sex and age (which consisted of 5 age categories), states and HRRs that have standardized estimates had a minimum population of 1000 Black and 1000 White beneficiaries. The use of US county as a geographic unit of analysis was considered; however, sample sizes in the majority of counties were too small to support sufficiently precise, valid estimates of differences in HDV receipt.

Direct Standardization

In order to calculate age- and sex-standardized estimates of differences in HDV receipt between White and Black beneficiaries across different geographic units, we employed direct standardization [37]. Our estimates were standardized to a reference population represented by all community-dwelling beneficiaries in all geographic units included in the standardization. We calculated 95% confidence limits (CLs) for standardized differences using standard methods [38].

Stability Analyses

To assess the impact of standardizing by age and sex and stratifying our results by geographic units, we compared the median standardized difference in HDV receipt across states and HRRs from our primary analysis to the crude national difference among beneficiaries included in our analyses and a standardized national difference; estimated by standardizing the national White and Black populations to the overall population distribution of age and sex. Separately, we also standardized our estimates to the covariate distribution in the population of Black beneficiaries. Standardization to an overall population may produce estimates that differ substantially from those obtained from using a reference population representing a socially marginalized population [39].

Software

Data were analyzed using SAS version 9.4 (SAS Institute, Inc., Cary, NC) and ArcMap 10.8 (ESRI, Redlands, California).

Results

National Study Cohort and Influenza Vaccination

The final study cohort consisted of 11,768,724 vaccinated non-Hispanic White and non-Hispanic Black Medicare beneficiaries during the during the 2015–2016 influenza season (Online Resource 3). The cohort was predominantly White (11,099,096 White beneficiaries [94.3%] and 669,628 Black beneficiaries [5.7%]). The distribution of age and sex were similar across Black and White beneficiaries. Among Black beneficiaries, 427,294 (63.8%) were female compared to 6,488,380 (58.5%) White beneficiaries. Black beneficiaries were also slightly younger, with a median age of 74.5 years compared to 75.5 years among White beneficiaries (Table 1). Across the whole cohort, 41.2% of Black beneficiaries were vaccinated with HDV in contrast to 54.0% of White beneficiaries, for a national disparity of 12.8 pps.

Geospatial Analyses

We included 30 states and 54 HRRs after restricting to geographic units with sufficient sample sizes. Of the initial study cohort, 9,461,880 beneficiaries were included in the state analysis, and 4,700,522 were used in the HRR analysis. Compared to beneficiaries who were excluded from these analyses, the distributions of age and sex were similar (Online Resource 4).

Table 1 Characteristics of community-dwelling non-Hispanic White and non-Hispanic Black traditional Medicare beneficiaries vaccinated against influenza, 2015–2016 influenza season

Beneficiary characteristic	White beneficiaries $N = 11{,}099{,}096$		Black beneficiaries $N = 669{,}628$	
	N or median	% or Q1, Q3	*N* or median	% or Q1, Q3
Age[a], median (Q1, Q3), years	74.0	69.0, 81.0	73.0	68.0, 79.0
Age group, *n* (%)				
65–69 years	2,943,033	26.5	212,692	31.8
70–74 years	2,748,316	24.8	167,063	24.9
75–79 years	2,171,790	19.6	126,929	19.0
80–84 years	1,592,483	14.3	84,866	12.7
85+ years	1,643,474	14.8	78,078	11.7
Sex, *n* (%)				
Male	4,610,715	41.5	242,334	36.2
Female	6,488,380	58.5	427,294	63.8

Q1 quartile 1, *Q3* quartile 3, % percentage

Note: the 2015–2016 influenza season was defined as July 1, 2015 to June 30, 2016. Vaccination status leveraged data through June 30 to allow for sufficient time for vaccination status to be documented in administrative claims data

[a]Age was assigned when participants first became eligible to participate in the study cohort, either at the study start date, their 65th birthday, or when initiating coverage

State Geographic Variation

The median crude disparity in HDV receipt between White and Black beneficiaries at the state level was 10.5 pps. After employing direct standardization for age and sex, the median disparity was 10.7 pps (Quartile 1, Quartile 3 (Q1, Q3), 8.7, 13.5) (Table 2). States with either the largest or smallest differences were not concentrated in any specific region; however, lower overall HDV receipt among both White and Black beneficiaries was observed in more Southern states (Fig. 2 Online Resource 5). The District of Columbia had the largest standardized disparity (largest positive difference) measured at 25.6 pps (95% CLs, 24.1, 27.1). The state with the lowest standardized disparity (smallest positive difference) in HDV receipt was Kentucky at 2.9 pps (95% CLs, 1.6, 4.1) (Online Resource 6).

Hospital Referral Region Geographic Variation

Among HRRs, the median crude disparity in HDV receipt between White and Black Medicare beneficiaries was 11.3 pps. The median disparity after standardizing by age and sex was 11.6 pps (Q1, Q3, 8.0, 14.8) (Table 2). Wide geographic variation in disparities in HDV receipt was observed across HRRs, but differences did not appear to cluster in specific regional areas (Fig. 2). The largest disparity among HRRs was the HRR associated with Chicago, Illinois which had a disparity of 24.7 pps (95% CLs, 23.9, 25.6). The HRR associated with Greenville, North Carolina had the smallest difference at 0.4 pps (95% CLs, −0.6, 1.3) (Online Resource 7).

Stability Analyses

We found that the median standardized disparities at the state and HRR levels were slightly smaller in magnitude compared to a national estimate (Online Resource 8). The use of an alternate reference population representing the distribution of age and sex only among Black beneficiaries did not meaningfully change inferences about which states or HRRs had the largest disparities in HDV receipt (Online Resource 9).

Discussion

In this nationally representative cohort study of community-dwelling Medicare beneficiaries during the 2015–2016 influenza season, we revealed substantial geographic variation in HDV receipt among vaccinated beneficiaries across both states and HRRs. Among vaccinated beneficiaries, Black beneficiaries were typically less likely than White beneficiaries to receive HDV versus SDV in every state and HRR included in our study (one 95% CL included a negative difference, not indicative of a disparity). However, the magnitudes of these differences ranged from no difference to differences in excess of 25 pps. These findings are highly relevant due to the recent preferential recommendation of HDV for older adults during the 2022–2023 influenza season and highlight the need for localized policies and interventions, which may have the largest impact on the elimination of such disparities in vaccination. Future policies and interventions

Table 2 Crude and standardized incidence of and differences in high-dose influenza vaccine receipt between community-dwelling non-Hispanic White and non-Hispanic Black traditional Medicare beneficiaries vaccinated against influenza, by state and hospital referral region, 2015–16 influenza season

	Crude			Age/sex-standardized		
	White vaccination (%)	Black vaccination (%)	Percentage point difference	White vaccination (%)	Black vaccination (%)	Percentage point difference
State ($N = 30$)						
Mean	53.42	41.97	11.44	53.41	41.94	11.47
SD	6.68	6.84	4.50	6.67	6.79	4.42
Median	54.22	41.62	10.50	54.24	41.68	10.71
Q1, Q3	49.21, 57.91	35.02, 45.87	8.51, 13.38	49.12, 58.11	35.17, 45.80	8.67, 13.45
Min, max	39.35, 65.02	31.05, 56.41	2.82, 26.08	39.25, 64.86	31.07, 56.23	2.86, 25.61
HRR ($N = 54$)						
Mean	52.64	41.26	11.38	52.67	41.22	11.45
SD	8.69	8.47	5.44	8.66	8.44	5.40
Median	54.22	40.73	11.33	54.22	40.70	11.57
Q1, Q3	45.99, 59.19	34.95, 47.48	7.85, 14.97	46.42, 59.66	34.89, 47.49	7.96, 14.75
Min, max	24.97, 65.66	24.58, 57.81	0.39, 24.54	24.89, 65.78	24.54, 57.50	0.35, 24.73

SD standard deviation, *Q1* Quartile 1, *Q3* Quartile 3, *HRR* hospital referral region, *Min* minimum, *Max* maximum

Note: the 2015–2016 influenza season was defined as July 1, 2015 to June 30, 2016. Vaccination status leveraged data through June 30 to allow for sufficient time for vaccination status to be documented in administrative claims data. Analyses were restricted to states and Hospital Referral Regions with at least 100 beneficiaries per covariate strata per racial group. Standardized estimates were calculated via direct standardization using a reference population represented by all community-dwelling Medicare beneficiaries in all geographic units included in standardization. Percentage point differences were calculated as the proportion in age- and sex-standardized White beneficiaries vaccinated with high-dose vaccine (HDV) minus the proportion in age- and sex-standardized Black beneficiaries vaccinated with HDV, with positive differences indicative of a disparity in HDV receipt

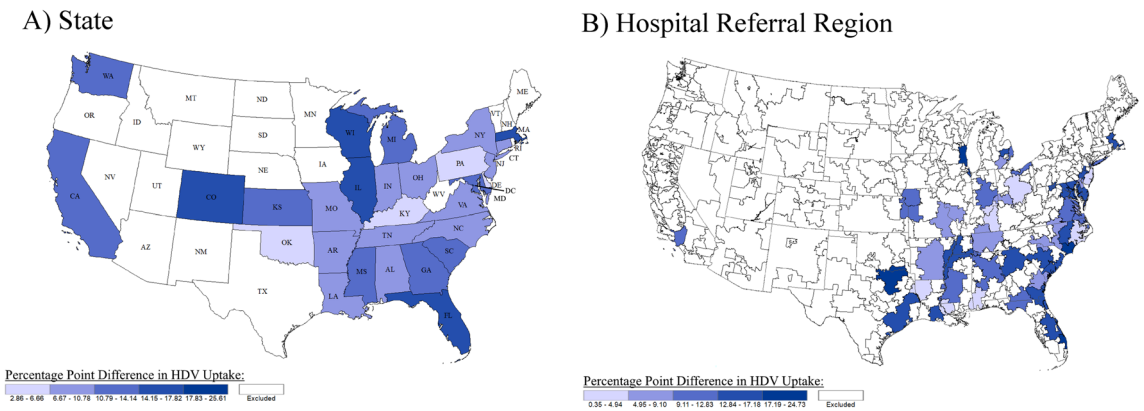

Fig. 2 Standardized disparities in high-dose influenza vaccine receipt between community-dwelling non-Hispanic White and non-Hispanic Black traditional Medicare beneficiaries vaccinated against influenza, by state and hospital referral region, 2015–2016 influenza season. Note: Panel **B** includes Hospital referral region boundaries in black and state boundaries in gray. Alaska, Hawaii, and Puerto Rico are not pictured as none met the minimum number of observations set by the eligibility criteria in any of the analyses. The 2015–2016 influenza season was defined as July 1, 2015 to June 30, 2016. Vaccination status leveraged data through June 30 to allow for sufficient time for vaccination status to be documented in administrative claims data. Analyses were restricted to states and hospital referral regions with at least 100 beneficiaries per covariate strata per racial group. Standardized estimates were calculated via direct standardization using a reference population represented by all community-dwelling Medicare beneficiaries in all geographic units included in standardization. Percentage point differences were calculated as the proportion in age- and sex-standardized White beneficiaries vaccinated with high-dose vaccine (HDV) minus the proportion in age- and sex-standardized Black beneficiaries vaccinated with HDV, with positive differences indicative of a disparity in HDV receipt

should focus on reducing racial disparities in HDV receipt in geographic areas with the greatest inequities.

These findings extend knowledge about racial disparities in important ways. First, we leveraged the entire community-dwelling traditional Medicare population to measure vaccine receipt using a large population-based database. Second, we constructed a causal DAG to help guide our analytic decisions. Third, unlike prior work estimating racial disparities [40], we avoided adjusting for factors that could mask or underestimate disparities in HDV receipt. Finally, prior studies on racial disparities in HDV receipt exist; however, these estimates have only been presented at either national or regional levels [4, 16]. While our findings are generally consistent with published literature that reported greater disparities in more urban areas (some of the greatest disparities were observed in small HRRs around dense urban centers including Chicago and the District of Columbia) we also reveal novel small-area geographic variation in these disparities that are targetable by interventions [4, 5]. These findings coincide with our prior work estimating racial disparities in influenza vaccination among nursing home residents, which also found the HRR associated with Chicago to have one of the largest disparities between Black and White residents [41]. Additionally, we found that the distribution of disparities was similar at the level of state and HRR; however, due to similarities in cartographic boundaries between states and HRRs, included beneficiaries could have contributed to both state- and HRR-level estimates of disparities which may have contributed to the observed concordant results. Furthermore, our findings reveal that state level estimates may mask more dramatic differences among smaller geographic units within states. An example of this phenomenon is North Carolina, which had a standardized difference in HDV receipt of 10.0 pps (95% CLs, 9.6, 10.4), but among HRRs within North Carolina, differences in HDV receipt ranged from the smallest difference observed in the study (0.4 pps) to one of the largest (18.6 pps) (Online Resources 6–7).

Disparities in the receipt of influenza vaccines have been well documented among older adults in the US [42–45]. Our study contributes to a growing knowledge base that reveals, even among older adults who do elect to get vaccinated, significant disparities exist in who receives a more effective vaccine (HDV) and where these disparities seem to be exacerbated the most. Future research should be directed at elucidating drivers of disparities in HDV receipt in geographic areas where disparities are greatest to inform future local interventions and policies. Drivers of geographic variation in HDV receipt disparities may range from individual characteristics such as comorbidities and health literacy to structural-level barriers such as access to providers [4, 31]. Further understanding how racial disparities in HDV receipt intersect with overall uptake is important, as interventions targeted to geographic areas with large disparities but low HDV uptake may serve to be particularly effective. In our study, for example, the HRR with the third largest disparity (Dallas, Texas; 20.7 pps) ranked 29th for HDV receipt among Black beneficiaries (41.2%), whereas the HRR with the second largest disparity (Milwaukee, Wisconsin, 24.0 pps) had the fourth lowest receipt among Black beneficiaries (24.5%) (Online Resource 7). Because all beneficiaries included in the study were vaccinated against influenza, factors such as vaccine hesitancy likely do not considerably explain the observed disparities. Also, the Fluzone High-Dose vaccine, having been approved by the Food and Drug Administration in 2009 [46], was widely available during the study period and, like other SDV, covered by the Medicare Part B Supplemental Medical Insurance Benefit and thus available at no cost to beneficiaries. However, as Fluzone High-Dose was more expensive than other SDV offered during the 2015–2016 influenza season [47], it is possible that individual providers in more disadvantaged areas may have been less likely to acquire and therefore administer HDV. This hypothesis is in part supported by a recent analysis that found greater disparities in HDV receipt among Medicare Advantage beneficiaries residing in counties with larger socially marginalized populations, and among beneficiaries who received their vaccinations at physician offices compared to a pharmacy or medical facility [48]. The authors also noted that disparities were relatively greater among physicians who had administered HDV in the prior season, suggesting that provider characteristics may be an important driver of observed disparities.

Limitations

There are several limitations to our study. First, our analyses were restricted to traditional Medicare beneficiaries aged ≥ 65 years, meaning our results may not be generalizable to beneficiaries who enrolled in Medicare through entitlements other than age or those enrolled in Medicare Advantage. However, a recent analysis of vaccination with HDV among beneficiaries enrolled in Medicare Advantage and commercial health plans from 2014 to 2018 also found comparable disparities at the national level between Black and White older adults [48]. This indicates that existing financial incentives for Medicare Advantage plans that may drive higher overall influenza vaccination among enrolled beneficiaries, particularly marginalized beneficiaries who also enroll in Medicare Advantage at higher rates compared to White beneficiaries, may not have the same impact on what type of vaccine beneficiaries receive [49–51].

Second, because we restricted to geographic units that met specific sample size thresholds and included only vaccinated beneficiaries, we were unable to conduct our analyses at a smaller geographic unit (e.g., counties) that could potentially reveal more granular small-area geographic variation.

Additionally, because of this restriction our results may not generalize to all states or HRRs; however, the geographic units included in our analyses are largely reflective of the geographic distribution of where Black Americans reside in the US [52].

Third, because our study was limited to one influenza season, we cannot determine how disparities in HDV receipt have changed over time, or how observed patterns of geographic variation in inequities may have shifted (particularly during the COVID-19 pandemic which has disproportionately affected socially marginalized racial groups [53]). Other studies have revealed how disparities in influenza vaccination have continued to persist over time without significant variation by season [5], and it plausible that HDV receipt disparities have persisted in a similar manner.

Finally, though we minimized the earlier mentioned selection effect potentially operating through pathways that included age and sex, we were not able to minimize the selection effect potentially operating through other pathways (i.e., vaccinated individuals and geographic units) given that the data necessary to do so was not completely available (e.g., we had no measure of other individual-level characteristics) [54, 55]. Furthermore, it is difficult to know whether such selection disadvantages the Black population with respect to vaccination type for the populations we studied, and whether our inability to minimize such selection resulted in a conservative estimate of the true disparity in HDV receipt. However, despite these limitations, this study is among the first to provide granular information on small-area geographic variation in disparities in HDV receipt between non-Hispanic White and non-Hispanic Black Medicare beneficiaries.

Conclusions and Implications

Our study reveals considerable small-area geographic variation in racial disparities in HDV receipt between non-Hispanic White and non-Hispanic Black US Medicare beneficiaries across both states and HRRs during the 2015–2016 influenza season. These results should be leveraged by local policymakers and other stakeholders to address localized disparities in HDV receipt via the use of local interventions and policies targeted to high-disparity geographic areas. The use of such localized interventions may have equal if not larger effects than national policies, and advance progress towards achieving health equity in influenza vaccination.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s40615-023-01628-z.

Author Contribution J.B.B.S. participated in conceiving the study, data collection, data analysis, interpretation of the data, writing and critical revision of the manuscript for important intellectual content, and final approval of the manuscript submitted. A.R.Z., C.J.H., M.M.L, R.v.A, and G.P., participated in conceiving the study, interpretation of the data, critical revision of the manuscript for important intellectual content, and final approval of the manuscript submitted. All authors, participated in interpreting results, providing critical revisions, and final approval of the manuscript submitted.

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Data Availability The data that support the findings of this study are available from the Centers for Medicare and Medicaid Services but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are, however, available from the authors upon reasonable request and with permission of the Centers for Medicare and Medicaid Services.

Declarations

Ethics Approval The study was approved by the Brown University Institutional Review Board and the need for informed consent was waived due to the use of deidentified data.

Competing Interests R.v.A. and M.M.L. are employed by Sanofi and may hold shares and/or stock options in the company. No other authors report potential conflicts of interest.

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