Racial and Ethnic Disparities in Seasonal Influenza Vaccination among Dialysis Facilities in the United States

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ABSTRACT

Background Racial and ethnic disparities in vaccination rates for seasonal influenza exist. Whether such disparities extend to patients with ESKD, who simultaneously are at risk for complications of infection and have extensive contact with health care providers, has not been investigated.

Methods To determine whether the proportion of patients vaccinated at a dialysis facility differs according to the facility's racial and ethnic composition, we examined dialysis facility data reported to the Centers for Medicare and Medicaid Services. The main outcome was the proportion of facility patients vaccinated for influenza among 6735 Medicare-certified facilities operating between 2014 and 2017.

Results Among dialysis facilities, the mean percentage of patients vaccinated during the influenza season was 72.1%. Facilities with higher proportions of Black and Hispanic patients had significantly lower vaccination percentages than less diverse facilities. The average proportion of patients vaccinated at each facility decreased significantly from 2014 to 2017 (a decrease of 1.05% vaccinated per year) and decreased significantly more so among facilities with higher minority proportions. The share of vaccinated patients in facilities in the quartile with the highest proportion of Black patients decreased 1.21% per year compared with a decrease of 0.88% per year in facilities in the quartile with the lowest proportion of Black patients. We found similar trends for Hispanic patients.

Conclusions Rates of seasonal influenza vaccination are modestly but significantly lower among dialysis facilities with larger proportions of minority patients, and the gap seems to be widening over time. As wide-scale vaccination efforts grow more urgent amid the current COVID-19 pandemic, these disparities must be addressed to protect patients and communities equitably.

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Despite heightened susceptibility to infectious complications, widespread Medicare coverage, and regular interface with health care providers, patients with ESKD are not uniformly vaccinated for influenza. Because influenza vaccination has been associated with lower risks of hospitalization, morbidity, and mortality,[1,2] any gaps in universal coverage can have sizable public health consequences.

Accordingly, as clinicians and public health professionals collectively respond to the current coronavirus disease 2019 pandemic and consider the potential for future vaccination campaigns, understanding current barriers to universal vaccination of patients with ESKD is of heightened importance.[3] Recent attention has highlighted the importance of race and ethnicity, with significantly lower minority vaccination rates against many illnesses[4–6]

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and across many populations.[7–11] Given the increased susceptibility to kidney disease in some minority populations, understanding whether similar ethnic and racial disparities affect vaccination rates among patients with ESKD is an urgent priority.

To address this issue, we used facility-level data from Medicare-certified dialysis facilities operating between 2014 and 2017 across the United States. We examined associations of proportions of Black and Hispanic patients within each facility with facility-level seasonal influenza vaccination and how such trends have changed over time.

Significance Statement

The current COVID-19 pandemic heightens the urgency of understanding current barriers to universal vaccination among patients with ESKD. Although studies have reported racial and ethnic disparities in vaccination, these disparities have not been investigated among patients with ESKD. In a study of how the proportion of Black and Hispanic patients in dialysis facilities affects those facilities' rates of seasonal influenza vaccination, the authors found important racial and ethnic disparities, which seem to be worsening over time. Understanding and addressing these disparities will be important in preparing for any future widespread vaccination programs, as might be expected in response to COVID-19.

METHODS

Study Populations and Data Sources

Dialysis facilities report patient and facility data directly to the Centers for Medicare and Medicaid Services, which contracts with the University of Michigan Kidney Epidemiology and Cost Center to produce and manage dialysis facility reports (DFRs) annually.[12] The most recently available DFR reflects Medicare-certified facilities operating in 2017 and provides comprehensive data between 2014 and 2017 for Medicare patients on a wide range of clinical, demographic, and structural factors. The primary analysis included 5619 facilities reporting seasonal vaccination percentages throughout the entire study period as well as 1116 facilities without complete reporting (405 and 300 facilities with three and two measurements, respectively). Forty-eight facilities did not report influenza vaccination rates and were excluded. Complete case analysis of the 5619 facilities with complete participation was secondarily examined.

Sociodemographic data corresponding to the zip code of each dialysis facility were obtained from the American Community Survey (5-year estimates, 2017 release), providing annual population estimates across the United States.

Primary Outcomes

The proportion of patients vaccinated for influenza during peak season (from August 1st to December 31st) was ascertained for each dialysis facility. The DFR measure includes in its denominator only patients who were alive on December 31st with Medicare as the primary payer; all vaccinations billed to Medicare, regardless of if administered at the dialysis facility, are included in the numerator. In addition, we also examined how facility seasonal influenza vaccination percentages changed between 2014 and 2017.

Primary Exposure

Each facility reported the proportion of patients who were Black or Hispanic examined as continuous variables and in quartiles. The quartile thresholds were $<$6.8%, $\geq$6.8%–25.6%, $\geq$25.6%–55.6%, and $\geq$55.6% for Black patients and 1.2%, 1.2%$\geq$ to 5.4%, $\geq$5.4%–20%, and $\geq$20% for Hispanic patients.

Additional Variables

Characteristics reported by each facility included the number of patients, commercial or nonprofit affiliation, average patient age, average patient years of prior ESKD therapy, average number of patient comorbidities, average percent of patients with serum phosphorus $>$7 mg/dl, and average fistula rate. Neighborhood characteristics identified from the zip code of each facility included median household income, unemployment rate, and percent college or higher educated.

Analyses

Baseline characteristics are presented as percentages for categorical variables and mean and SD for continuous variables stratified by the median racial/ethnic composition of dialysis facilities. We describe the unadjusted facility seasonal influenza vaccination percentages across increasing racial and ethnic quartiles. To examine the adjusted effect of higher facility percentages of Black and Hispanic patients, defined continuously and by quartiles, we used a linear mixed model with a random effect for each dialysis facility so as to account for repeat measurements per facility. We used indicator variables for higher ethnic quartiles, considering those facilities in the lowest quartile of Black and Hispanic patients as reference. Because individual facilities followed different numbers of patients, we repeated our analyses using clustered linear regression with analytic weights on the basis of the number of Medicare patients seen at each facility each year. Results from these analyses yielded similar inferences to unweighted mixed models.

We assessed the association of calendar year with seasonal influenza vaccination percentages and determined whether this association differed by facility racial/ethnic composition. We re-examined our primary findings among dialysis facilities reporting seasonal vaccination rates across the entire study period. We also examined whether our primary findings were similarly associated with annual vaccination percentages (August through March), which are available from 2014 to 2016. In addition, we explored whether the racial composition of the dialysis zip code similarly associated with facility percent seasonally vaccinated by examining zip-code Black proportions defined continuously.

Table 1. Dialysis facility characteristics stratified by median facility Black and Hispanic composition

Variable	Black <25.6%	Black ≥25.6%	Hispanic <5.4%	Hispanic ≥5.4%
No. of facilities	3591	3621	3810	3863
Facility characteristics				
No. of patients	85.9 (51.6)	98.2 (52.9)	80.1 (44.8)	103.9 (57.0)
For profit (%)	13.8	9.4	12.7	10.6
Facility patient characteristics				
Patient age, yr	63.9 (3.7)	61.4 (3.5)	62.8 (3.7)	62.6 (3.8)
Duration of ESKD therapy, yr	4.6 (1.0)	5.2 (1.1)	4.9 (1.1)	5.0 (1.1)
Comorbidities, *n*	5.1 (0.7)	5.0 (0.7)	5.1 (0.7)	5.0 (0.7)
Serum phosphorus >7 mg/dl, %	11.5 (4.4)	12.0 (4.3)	11.9 (4.5)	11.6 (44.3)
Fistula use, %	64.2 (11.0)	58.1 (11.0)	59.9 (11.4)	62.4 (11.3)
Facility zip-code characteristics				
Median household income, $	58,410 (21,496)	52,209 (21,949)	51,240 (19,407)	59,342 (23,516)
College or higher education, %	28.3 (14.0)	29.0 (16.5)	27.3 (14.1)	29.9 (16.2)
Unemployment, %	6.4 (3.2)	8.3 (4.1)	7.6 (4.0)	7.2 (3.4)

Mean (SD) provided for continuous variables and percentages for categorical variables.

RESULTS

Among 6735 Medicare-certified dialysis facilities operating between 2014 and 2017 (Table 1), those with larger proportions of Black and Hispanic patients tended to be larger, be not for profit, and have older patients.

The mean facility percentage of patients vaccinated between August and December was 72.1% (±16.1). Facilities with higher proportions of Black and Hispanic patients had lower seasonal vaccination percentages (Figure 1). In adjusted analysis using patient racial/ethnic composition as a continuous variable, a 10% increment in proportion of patients who were Black was associated with a 0.60% (95% confidence interval [95% CI], −0.74 to −0.50; $P<0.001$) lower percent vaccinated; the corresponding estimate for Hispanic patients was 0.79% (95% CI, −0.95 to −0.63; $P<0.001$) (Figure 2).

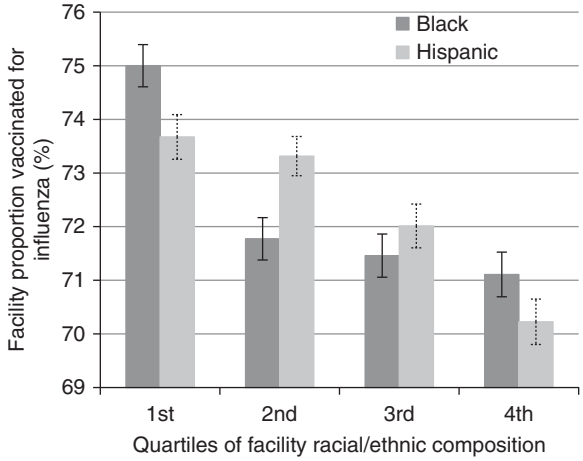

Figure 1. Proportions (95% CIs) of patients in dialysis facilities who received a seasonal (August through December) influenza vaccination between 2014 and 2017 according to quartiles of higher facility percent Black and Hispanic composition. The quartile thresholds were <6.8%, ≥6.8%–25.6%, ≥25.6%–55.6%, and ≥55.6% for Black patients and 1.2%, ≥1.2%–5.4%, ≥5.4%–20%, and ≥20% for Hispanic patients.

From 2014 to 2017, seasonal influenza vaccination decreased in reported prevalence (1.05% lower adjusted vaccination percentage per year; 95% CI, −1.19 to −0.92; $P<0.001$). This adverse trend was most apparent among facilities with higher proportions of Black and Hispanic patients (interactions between calendar year and facility percentages of Black and Hispanic patients: P values =0.005 and =0.007, respectively) (Figure 3). Facilities in the lowest quartile of Black patients noted a 0.82% (95% CI, −1.10 to −0.53; $P<0.001$) lower percent vaccinated per year, compared with 1.21% (95% CI, −1.5 to −0.93; $P<0.001$) lower percent vaccinated per year among facilities in the highest quartile. We observed a similar trend across higher quartiles of Hispanic patient representation.

When restricted to 5619 dialysis facilities reporting seasonal vaccination rates across the entire study period, facilities with large proportions of Black and Hispanic patients showed similarly less improvement in seasonal influenza vaccination (interactions between calendar year and facility percentages of Black and Hispanic patients: P values =0.02 and =0.04, respectively). Facilities in the lowest quartile of Black patient composition noted a 0.88% (95% CI, −1.16 to −0.58; $P<0.001$) lower percent vaccinated per year, compared with 1.17% (95% CI, −1.45 to −0.88; $P<0.001$) lower percent per year among facilities in the highest quartile. Facilities in the lowest quartile of Hispanic patient composition noted a 0.84% (95% CI, −1.15 to −0.53; $P<0.001$) lower percent vaccinated per year, compared with 1.22% (95% CI, −1.51 to −0.92; $P<0.001$) lower percent per year among facilities in the highest quartile.

The mean (SD) facility percent vaccinated between August 1st and March 31st (annual vaccination) was 75.0% (±15.8). Annual vaccination was 0.46% (95% CI, −0.60 to −021; $P<0.001$) lower per 10% higher Black facility composition. Similar results were observed among facilities with higher Hispanic proportions. When examining facility zip-code (rather than facility) racial/ethnic proportions, a 10%-higher proportion of Blacks residing in the dialysis facility zip code was

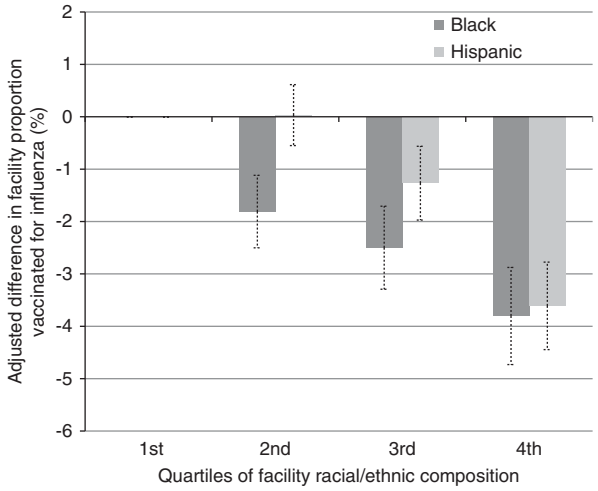

Figure 2. Adjusted difference (95% CIs) in proportion of patients seasonally vaccinated for influenza at the facility level between 2014 and 2017 according to proportion of patients at the facility level who were Black or Hispanic. It was adjusted for facility size, for-profit or nonprofit affiliation, percent Black, percent Hispanic, average patient age, average patient-years of prior ESKD therapy, average number of patient comorbidities, average percent of patients with serum phosphorus >7 mg/dl, and average fistula rate as well as characteristics of the dialysis facility zip code, including median household income, unemployment rate, and percent college or higher educated. The reference category is the 589 facilities with the lowest quartiles of black and Hispanic patients.

associated with a 0.53% (95% CI, −0.70 to −0.36; $P<0.001$) lower percent vaccinated.

DISCUSSION

Despite the medical vulnerability of patients with ESKD and their heighted opportunity for care, seasonal influenza vaccination is not universal and varies widely across United States dialysis facilities. Facilities did not vaccinate an average of approximately 25% of patients, more so in those with larger proportions of Black and Hispanic patients. Furthermore, these disparities in vaccination seem to be worsening.

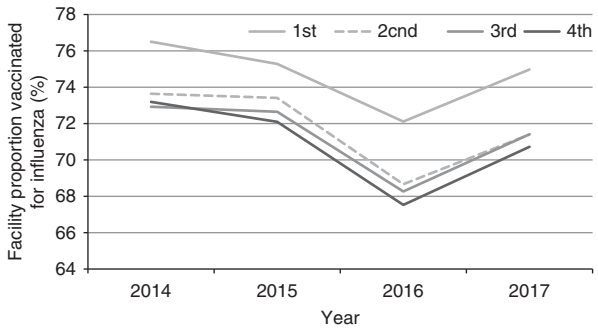

Figure 3. Proportions of patients in dialysis facilities seasonally vaccinated for influenza from 2014 to 2017 according to quartiles of higher facility percent Black composition. The quartile thresholds were <6.8%, ≥6.8%–25.6%, ≥25.6%–55.6%, and ≥55.6% for Black patients, and 1.2%, ≥1.2%–5.4%, ≥5.4%–20%, and ≥20% for Hispanic patients.

Whether the racial and ethnic differences in facility-level vaccination are due to individual, facility, or community determinants will require further analysis. Important cultural, philosophical, and socioeconomic factors influence vaccination rates, including education,[13] financial security,[14] health literacy, and access to care,[15,16] and given well described inequities facing minorities,[17–19] they might account for lower vaccination among minority-serving facilities. Similarly, facilities with more comprehensive vaccination efforts, including coordinated team approaches and patient education programs, may have higher vaccination percentages, and staffing, payer mix, and physician input are potential influences.[20] Furthermore, because vaccinations administered outside of the dialysis facility contribute to the proportion vaccinated within a facility, the effect of neighborhood health care practices might influence our findings.[21]

Regardless of the underlying explanations, however, the potential consequences to both individual patients and public health are important. Universal and widespread vaccination is essential to conferring community protection; that dialysis facilities with higher proportions of minority patients or those located in areas with higher proportions of Black residents had lower vaccination percentages highlights the heightened risks for minority communities. These disparities, which show no signs of improvement in recent years, are particularly poignant amid the current coronavirus disease 2019 pandemic, which has disproportionately affected minorities. As it becomes apparent that a coronavirus vaccine will be necessary for long-term pandemic control, the dialysis facility is likely to have an increasingly important role in any national vaccination effort, particularly given the disproportionate amount of kidney disease among minorities. Accordingly, achieving uniform vaccination will be instrumental to protecting Americans equitably.

Further analyses with individual-level data are needed to better understand the determinants of these facility differences. For example, it would enable analysis of out of facility vaccination, of racial and ethnic concordance of patients and physicians, and of other socioeconomic factors that may be driving the observed differences by race and ethnicity. Although we used socioeconomic status measured at the zip-code level, it may be poorly matched with the socioeconomic status of individual patients at a given facility. In addition, DFR data only includes Medicare-certified facilities with >30 patients, and whether these observations extend into smaller facilities is not known.

Influenza vaccination among dialysis facilities is neither universal nor homogenous. Better understanding of the racial/ethnic disparities in vaccination, which seem to be

growing over time, could protect communities who are most at risk for the complications of influenza and other viral pathogens.

DISCLOSURES

E. Weinhandl is a consultant epidemiologist to Fresenius Medical Care North America. All remaining authors have nothing to disclose.

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