



Vaccination among Medicare-fee-for service beneficiaries: Characteristics and predictors of vaccine receipt, 2014–2017



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ABSTRACT

Background: Vaccination coverage rates for older adults are low. To better understand utilization of Medicare vaccination benefits we examined a retrospective cohort of more than 26 million Medicare fee-for-service beneficiaries age 65 years and older from 2014 to 2017.

Methods: Multivariate logistic regression was used to obtain marginal effects (ME) describing the association between patient-level characteristics and the likelihood of vaccination. Vaccines routinely recommended by the Advisory Committee on Immunization Practices—seasonal influenza, 23-valent pneumococcal polysaccharide, 13-valent pneumococcal conjugate, and herpes zoster vaccines—were examined. Variables considered include demographics (e.g., age, sex, race), use of preventive services, frailty indicators, and co-morbidities.

Results: The mean beneficiary age (SD) for each vaccine examined—seasonal influenza (2016–2017), pneumococcal, and herpes zoster—was 75.0 (7.9) years, 74.5 (7.5) years, 74.5 (7.4) years respectively; and 43.7%, 43.2%, and 39.5% were males respectively. Adjusted marginal effects showed that Black beneficiaries were less likely to receive any of the three vaccines compared to White beneficiaries, while North American Native beneficiaries were most likely to receive a pneumococcal vaccine. Trends by race and sex were similar across all ages. Beneficiaries utilizing preventive services, particularly cardiovascular disease screening (ME of 13.8%, 15.6% and 1.5% for influenza, pneumococcal and herpes zoster vaccine respectively), other vaccinations, and the Medicare Annual Wellness Visit (ME of 9.8%, 15.3% and 0.4% respectively) were predictors of vaccination for all three vaccines. For herpes zoster vaccines, beneficiaries in rural settings (ME of 1.0%) and those who are dual-eligible for Medicare and Medicaid insurance (ME of 1.7%) were more likely to receive herpes zoster vaccine than beneficiaries in urban settings and those not dual-eligible, respectively.

Conclusion: Medicare beneficiaries of certain demographic with selected comorbid conditions are less likely to receive routinely-recommended vaccines. Strategies and interventions can target such sub-populations of Medicare beneficiaries by optimizing the utilization of preventive services.

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1. Introduction

Medicare is the U.S. federal health insurance program for individuals age 65 and over and those under age 65 with permanent disabilities and end-stage renal disease. Administered by the Centers for Medicare & Medicaid Services (CMS), Medicare covers certain preventive services with the goal of supporting healthy aging

and minimizing costs. Beneficiaries with comorbid conditions are among the highest users of Medicare-funded healthcare. Thus, provision of primary and secondary prevention in the Medicare population is important for reducing morbidity and mortality and containing costs [1,2].

Older adults are at increased risk for vaccine-preventable diseases due to age, waning immunity, and the increased prevalence of chronic disease, yet vaccination remains underutilized [3–5]. Annually, an estimated 30,000 Americans die of vaccine-preventable diseases, mostly influenza, and more than 95% of these deaths occur among older adults [3,4]. The economic burden of vaccine-preventable disease in adults is estimated at \$9 billion a

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year, including \$5.9 billion of inpatient costs [6] which does not include the emerging research on the link between influenza and cardiovascular disease and stroke [7,8]. The Advisory Committee on Immunization Practices (ACIP) routinely recommends vaccines for older adults and updates these recommendations annually [9]. However, adult vaccination coverage remains below national goals despite expanded sites for vaccination services (including pharmacy venues, provider offices, and long-term care settings) and Medicare insurance coverage for these vaccines [3–5,10,11].

By statute under Medicare Part B, the portion of the Medicare program which covers physician, outpatient, and some preventive services, influenza and pneumococcal vaccines are routinely covered and Hepatitis B vaccine is covered for individuals at high or medium risk [10]. All Part B vaccines are a covered benefit at no cost to the beneficiary. All other commercially available vaccines (i.e., herpes zoster and tetanus-containing vaccines) are not statutorily covered by Part B, but are required on all Part D formularies, Medicare's outpatient prescription drug benefit program [10,11]. Not all fee-for-service (FFS) beneficiaries choose to enroll in Medicare Part D. All Medicare beneficiaries do have the benefit of a Welcome to Medicare and subsequent Annual Wellness Visits (AWV), which are opportunities to review screening and preventive services customized for the beneficiary. Beneficiaries who utilize the AWV tend to have higher vaccination coverage [12]. In this paper, we examine national utilization of routinely recommended vaccines and quantify the association between individual beneficiary level characteristics and vaccination status of each vaccine examined, including utilization of other preventive services. Our goal is to better understand the utilization of Medicare vaccination benefits in order to target subgroups with low vaccination coverage for interventions.

2. Methods

This retrospective population based cohort study utilized Medicare's Enrollment Database to establish the beneficiary cohorts and FFS Medicare Parts A (hospitalization), B (office-based care), and D (prescription drug coverage) claims data to evaluate beneficiary vaccination status and underlying characteristics and comorbidities from 2014 to 2017. ACIP-recommended vaccines included in this analysis were seasonal influenza, 23-valent pneumococcal polysaccharide, 13-valent pneumococcal conjugate, and herpes zoster vaccines [9]. A new two-dose herpes zoster vaccine was recently ACIP-recommended in October 2017; this vaccine was not included in this analysis as the vaccine was available outside the study window [13]. Tetanus-containing vaccines were also not included in this analysis as these claims comprised less than 1% of claims observed.

To evaluate associations with influenza vaccines, three yearly cohorts of beneficiaries were created, from 2014 to 2017. For each influenza season (spanning July 1 through the following June 30), the cohorts were comprised of all Medicare beneficiaries continuously-enrolled in Parts A and B through the entire season. Requiring this continuous enrollment ensured that all of a beneficiary's claims were available through the entire observation period; otherwise, gaps in enrollment could lead to the misclassification of a vaccinated beneficiary as unvaccinated. Since pneumococcal and herpes zoster vaccines are not administered on an annual basis, the study defined one cohort for each vaccine: the pneumococcal cohort and herpes zoster cohort were comprised of all Medicare beneficiaries continuously-enrolled in Parts A and B from January 2015 to December 2017. In addition, beneficiaries in the herpes zoster cohort were required to have continuous Part D enrollment because the vaccines are covered under Part D. For all cohorts, beneficiaries that died during the observation period were considered fully enrolled if they had continuous enrollment for the

months they were alive. For all cohorts, beneficiaries were excluded if they were younger than 65 years old at the start of each vaccine observation period. These excluded beneficiaries who entered Medicare due to disability or end stage renal disease [14] and were expected to have different characteristics from the overall Medicare population. For each beneficiary, vaccine receipt was defined as the observation of a vaccination claim in the institutional outpatient setting or physician's office within the cohort time window.

Beneficiary characteristics, including age, sex, race, geographic region, and dual eligibility status, were derived from Medicare's Enrollment Database. Medicare claims data was used to identify Charlson and Elixhauser comorbidities [15], frailty indicators [16] and utilization of selected preventive services covered by CMS [17] (Supplementary Material S1).

For each vaccine cohort, a single multivariate logistic regression was used to obtain marginal effects (ME) describing the association between these variables and the likelihood of receiving a given vaccine. Marginal effects represent the effect on probability of vaccine receipt per unit change in the independent variable. As beneficiary age had a nonlinear association with the likelihood of vaccine receipt (Fig. 1), age was treated as a continuous variable and modeled using cubic splines with 4 knots. Interaction terms between age and sex, and age and race were also included in the regression models due to the observed differences in age trends between the sexes and races (Fig. 1).

All analyses were performed using R 3.4.3 (R Foundation for Statistical Computing, Vienna, Austria) and SAS v 9.4 (SAS Institute Inc., Cary, NC).

3. Results

More than 25 million beneficiaries continuously enrolled in Medicare Parts A and B were included in each influenza cohort and more than 21 million were included in the pneumococcal cohort (Table 1). The herpes zoster cohort included more than 13 million beneficiaries. As findings across each influenza seasons were similar, only results from the latest influenza season were presented (See Supplementary Material S2 for additional influenza cohorts).

Within each influenza, pneumococcal, and herpes zoster cohort, the mean (SD) age was 75.0 (7.9) years, 74.5 (7.5) years, 74.5 (7.4) years respectively; and 43.7%, 43.2%, and 39.5% were men in each cohort, respectively (Table 2). For influenza vaccine, vaccination rates increased from 44.2% for 65–69 year olds to 57.9% for 85–89 year olds, before decreasing to 49.9% for 95–99 year olds. For pneumococcal and herpes zoster vaccines, vaccination rates declined with age during the study period, likely due to older beneficiaries receiving vaccination before the study period. Fig. 1 displays vaccination rates across age by sex and race for each vaccination cohort. Black and Hispanic beneficiaries had consistently lower influenza vaccination rates than Asian and White beneficiaries across all ages (27–42% versus 40–61%). For pneumococcal vaccine, White beneficiaries had the highest vaccination rates followed by North American Native, Asian, Black and Hispanic beneficiaries. For herpes zoster vaccine, Asian beneficiaries had the highest vaccination rates.

After adjustment for other comorbidities and selected preventive services in the multivariable logistic regression models, the trends observed across age were mostly similar to the unadjusted rates except for the influenza and pneumococcal vaccines with respect to race (Fig. 2). Compared to White beneficiaries, Asian beneficiaries had higher probability of receiving influenza vaccines (ME, 3.9%; 95% CI, 3.7% 4.2% at age 75), while North American Native beneficiaries had higher probability of receiving pneumococcal vaccines (ME, 4.8%; 95% CI, 4.5% 5.0% at age 75) across all ages.

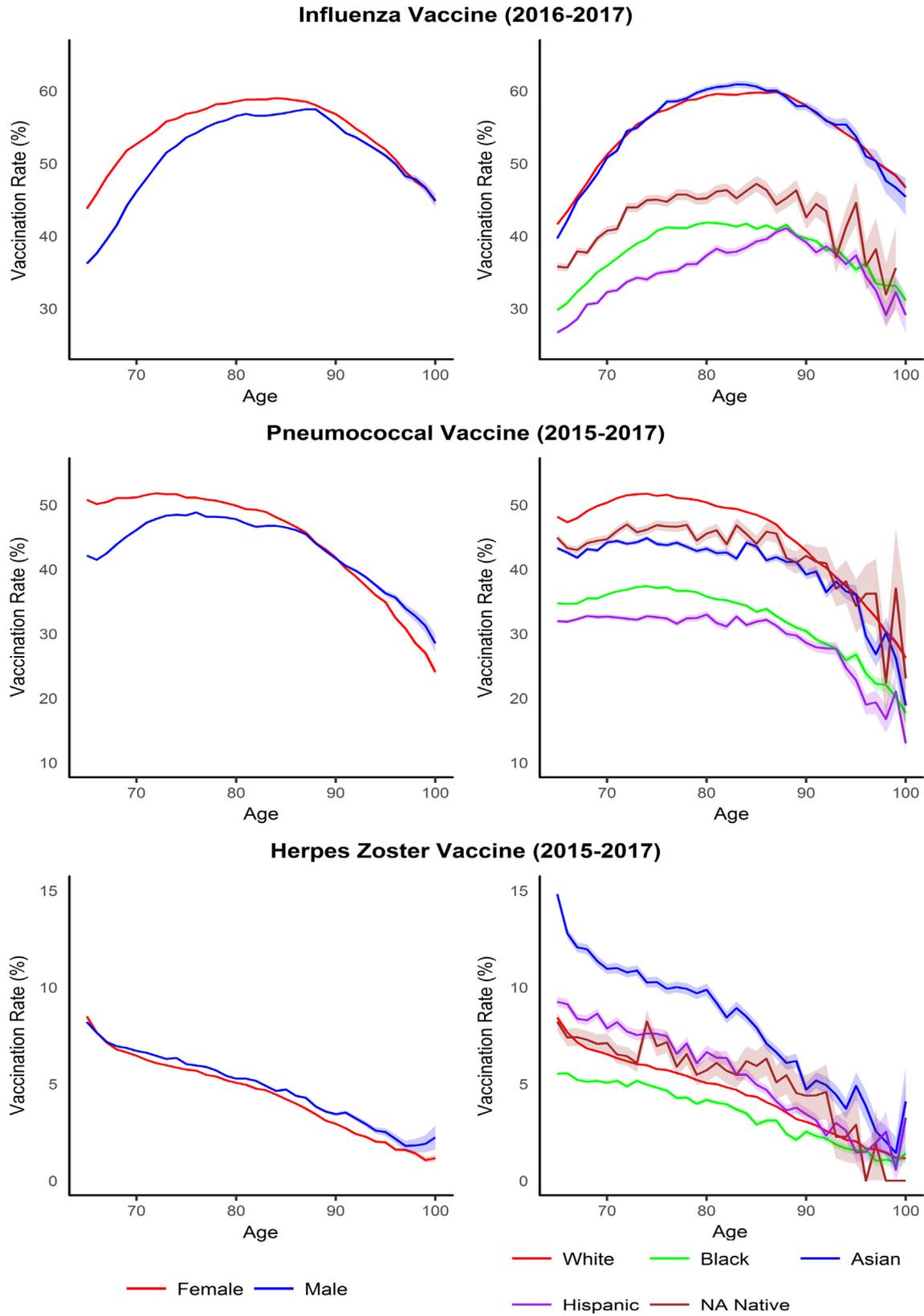


Fig. 1. Vaccination rates by age and sex, and age and race. Notes: 95% Confidence intervals shown as shaded region around each trend line. NA = North American.

Associations between selected preventive services and receipt of vaccine were mostly similar for influenza and pneumococcal vaccines (Table 3). For the influenza vaccine, beneficiaries utilizing preventive services, particularly cardiovascular disease screening

(ME, 13.8%; 95% CI, 13.8% 13.9%), receipt of a pneumococcal vaccine (ME, 28.6%; 95% CI, 28.6% 28.7%), receipt of a Hepatitis B vaccine (ME, 18.0%; 95% CI, 17.7% 18.4%), or receipt of an AWV (ME, 9.8%; 95% CI, 9.7% 9.8%) were more likely to be vaccinated (Table 3).

Table 1
Beneficiary cohort inclusion criteria.

Vaccine	Influenza			Pneumococcal 2015–2017	Herpes Zoster 2015–2017
	2014–15	2015–16	2016–17		
Observation period					
<i>Criteria</i>					
Alive and enrolled in Medicare FFS	31,252,028	31,603,826	31,671,150	26,593,249	26,593,249
Enrolled in Part D					17,092,769
Age ≥ 65 (Final population)	25,646,154	26,055,076	26,285,612	21,970,796	13,806,270

Notes: Influenza seasons span from July 1 to the next June 30 for the corresponding years. Pneumococcal and herpes zoster cohorts span from January 1, 2015 to December 31, 2017.

Table 2
Demographic characteristics of beneficiaries by vaccine cohorts.

Demographic variables	Influenza season July 2016–June 2017		Pneumococcal calendar years 2015–2017		Herpes zoster calendar years 2015–2017	
	Bene %	Vax Rate	Bene %	Vax Rate	Bene %	Vax Rate
Beneficiaries	26,285,612		21,970,796		13,806,270	
Beneficiaries receiving the vaccine	13,582,486		10,520,970		827,301	
Vaccination rate	51.7%		47.9%		6.0%	
	Bene %	Vax Rate	Bene %	Vax Rate	Bene %	Vax Rate
Age						
65–69	31.6%	44.2%	32.0%	47.1%	31.1%	7.4%
70–74	23.7%	52.2%	25.0%	49.7%	25.9%	6.3%
75–79	17.7%	56.3%	18.2%	49.7%	18.5%	5.6%
80–84	12.7%	57.9%	12.7%	48.3%	12.6%	4.9%
85–89	8.7%	57.9%	7.9%	45.5%	7.9%	3.9%
90–94	4.3%	54.8%	3.3%	39.7%	3.2%	2.7%
95–99	1.2%	49.9%	0.7%	32.8%	0.7%	1.8%
100+	0.2%	35.8%	0.1%	15.1%	0.1%	1.0%
Sex						
Male	43.7%	48.8%	43.2%	45.7%	39.5%	6.3%
Female	56.3%	53.9%	56.8%	49.6%	60.5%	5.8%
Race						
White	85.5%	53.4%	86.7%	49.3%	86.8%	5.9%
Black	7.4%	37.0%	6.9%	35.4%	6.5%	4.6%
Asian	1.9%	53.2%	1.8%	43.0%	2.1%	10.1%
Hispanic	1.6%	33.6%	1.4%	31.8%	1.5%	7.0%
NA native	0.5%	41.8%	0.5%	45.0%	0.4%	6.7%
Dual status						
Not dual	87.8%	52.8%	88.0%	49.4%	82.3%	6.0%
Dual	12.2%	43.6%	12.0%	36.5%	17.7%	6.1%

Notes: Derived from continuously enrolled Medicare FFS, age 65+ beneficiaries. Additional Part D enrollment required for herpes zoster cohort. Bene % refers to the percentage of beneficiaries in the vaccine cohort in the demographic category. Vax Rate refers to the percentage of beneficiaries in a demographic category that was vaccinated by the corresponding vaccine. NA = North American.

Substantially higher vaccination rates were also associated with comorbidities such as hypertension (ME, 9.4%; 95% CI, 9.4%–9.5%) and AIDS/HIV (ME, 14.0%; 95% CI, 13.4%–14.5%). Within the pneumococcal cohort the strongest associations with preventive services were for screenings for cardiovascular disease (ME, 15.6%; 95% CI, 15.6%–15.7%), Hepatitis C (ME, 11.1%; 95% CI, 11.0%–11.2%), and Lung Cancer (ME, 12.6%; 95% CI, 12.3%–12.9%). The receipt of an influenza vaccination (ME, 43.3%; 95% CI, 43.2%–43.3%), Hepatitis B vaccination (ME, 15.3%; 95% CI, 15.0%–15.6%) and an AWWV (ME, 15.3%; 95% CI, 15.3%–15.4%) were strongly associated with increased pneumococcal vaccination rates.

In the herpes zoster cohort, some important differences could be seen in contrast to the influenza and pneumococcal cohorts. Dual Medicare and Medicaid-eligible insurance beneficiaries had higher probability than non-dual eligible beneficiaries (ME, 1.7%; 95% CI, 1.6%–1.7%), and those in rural settings had higher probability than those in urban settings (ME, 1.0%; 95% CI, 0.9%–1.0%) of getting vaccinated. Associations with preventive service screenings were also observed [(e.g., screenings for cardiovascular disease (ME, 1.5%; 95% CI 1.5%–1.5%) and use of pneumococcal vaccine (ME, 0.9%; 95% CI, 0.9%–1.0%)] (Table 3).

4. Discussion

Vaccination coverage rates are sub-optimal despite insurance coverage benefits and wide accessibility to vaccination services [3–5,10,18]. This study specifically characterized beneficiary characteristics and vaccination coverage rates across ACIP-routinely recommended Part B and Part D vaccines in the Medicare FFS beneficiary population. Our study found that beneficiaries utilizing preventive services, particularly cardiovascular disease screening, other vaccinations, and the Medicare Annual Wellness Visit, were strong predictors of vaccination for all three vaccines [12,19–21].

Influenza vaccination, recommended annually, peaked at age 80–90, declining thereafter. As older beneficiaries are often residents of long term care facilities, the exclusion of claims from such facilities may explain lower observed vaccination rates, despite vaccination coverage being higher in such facilities [22]. More research can be done to explore declining vaccination rates in older beneficiaries. For pneumococcal and herpes zoster vaccinations which are not recommended annually, most of the vaccinations in our study were observed in younger beneficiaries, perhaps upon the initial window of the ACIP-recommendation. The Food and

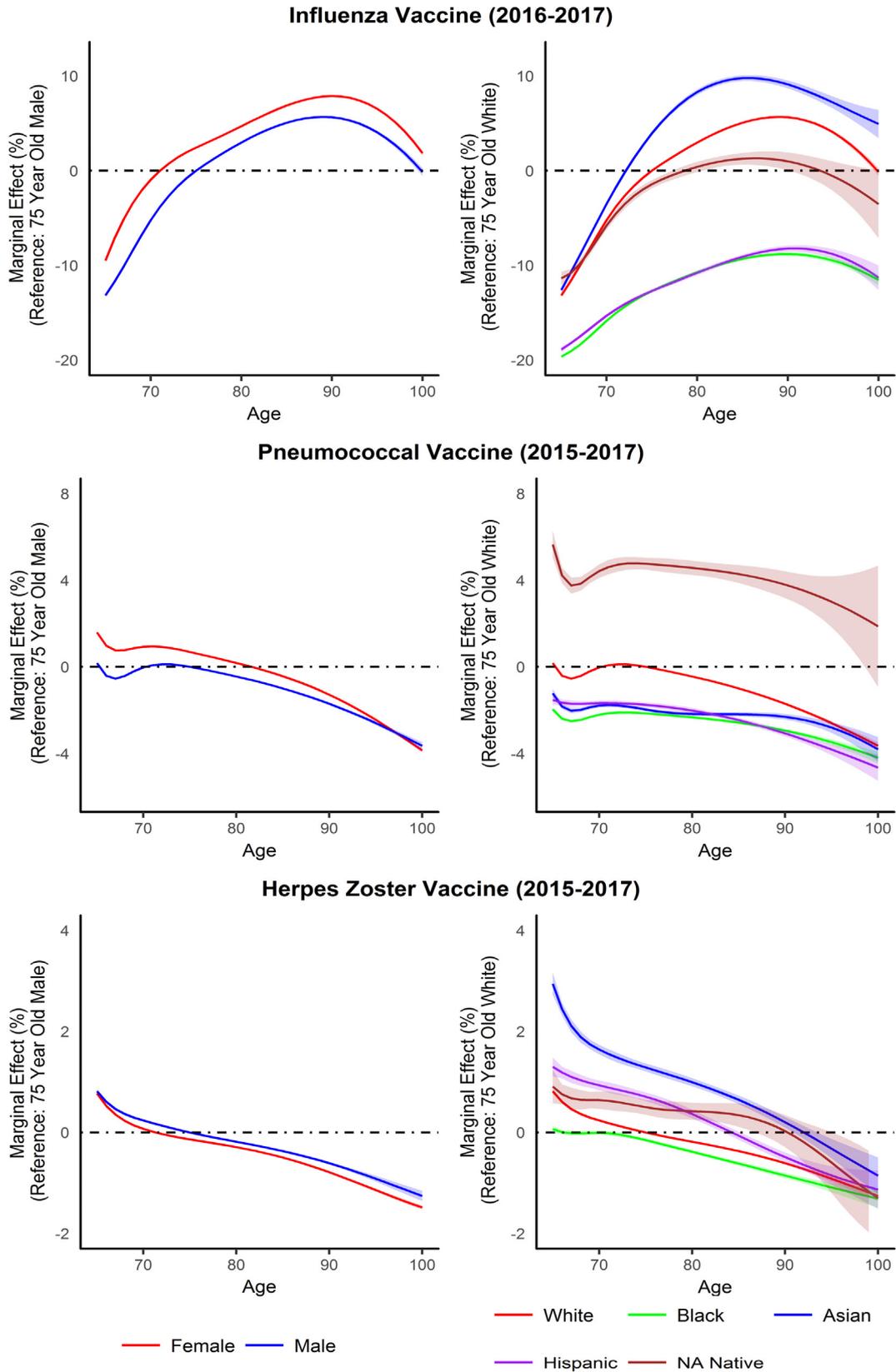


Fig. 2. Marginal effects of age by sex and race on the probability of vaccine receipt. Notes: 95% confidence interval shown as shaded region around each trend line. NA = North American.

Drug Administration (FDA) licensed age indication for herpes zoster is adults age 50 and older and the ACIP recommends adults age 60 and older [23]. Our study does not capture vaccinations that

occurred prior to entrance into Medicare (i.e., individuals vaccinated prior to age 65) and vaccinations that occurred outside the limited study period 2015–2017.

Table 3
Marginal Effects of other beneficiary demographics, preventive services and comorbidities on probability of vaccine receipt.

Demographic variables	Influenza season July 2016–June 2017				Pneumococcal calendar years 2015–2017				Herpes zoster calendar years 2015–2017			
	Bene %	Vax Rate	Marginal Effect	95% CI	Bene %	Vax Rate	Marginal Effect	95% CI	Bene %	Vax Rate	Marginal Effect	95% CI
	<i>Urban</i>											
Urban (Reference)	76.3%	53.2%	–	–	75.7%	49.6%	–	–	75.1%	5.9%	–	–
Rural	23.3%	47.2%	–4.7%*	(–4.8% –4.7%)	24.3%	42.7%	–4.2%*	(–4.3% –4.1%)	24.9%	6.3%	1.0%*	(0.9% 1.0%)
<i>Dual</i>												
Not dual (Reference)	87.8%	52.8%	–	–	88.0%	49.4%	–	–	82.3%	6.0%	–	–
Dual	12.2%	43.6%	–7.9%*	(–8.0% –7.8%)	12.0%	36.5%	–6.8%*	(–6.9% –6.7%)	17.7%	6.1%	1.7%*	(1.6% 1.7%)
<i>Preventive services</i>												
Screening – Cardiovascular Disease	61.6%	60.2%	13.8%*	(13.8% 13.9%)	82.2%	53.2%	15.6%*	(15.6% 15.7%)	87.1%	6.4%	1.5%*	(1.5% 1.5%)
Screening – Hepatitis C	3.4%	61.0%	2.9%*	(2.7% 3.0%)	7.2%	63.2%	11.1%*	(11.0% 11.2%)	7.8%	8.0%	0.3%*	(0.2% 0.3%)
Screening – Lung Cancer	0.4%	62.1%	4.9%*	(4.6% 5.2%)	0.6%	67.9%	12.6%*	(12.3% 12.9%)	0.7%	8.4%	0.4%*	(0.2% 0.5%)
Vaccine – Hepatitis B	0.4%	75.3%	18.0%*	(17.7% 18.4%)	0.8%	69.8%	15.3%*	(15.0% 15.6%)	0.9%	6.6%	–0.8%*	(–0.9% –0.7%)
Vaccine – Influenza	51.7%	100.0%	–	–	67.6%	62.9%	43.3%*	(43.2% 43.3%)	73.2%	7.1%	0.4%*	(0.4% 0.5%)
Vaccine – Pneumococcal	16.4%	77.3%	28.6%*	(28.6% 28.7%)	47.9%	100.0%	–	–	52.4%	8.1%	0.9%*	(0.9% 1.0%)
Visit – Annual Wellness Visit	25.8%	65.3%	9.8%*	(9.7% 9.8%)	43.3%	61.2%	15.3%*	(15.3% 15.4%)	45.9%	7.0%	0.4%*	(0.4% 0.5%)
<i>Elixhauser comorbidities</i>												
AIDS/HIV	0.1%	59.1%	14.0%*	(13.4% 14.5%)	0.1%	46.0%	–3.2%*	(–3.8% –2.5%)	0.2%	5.2%	–1.1%*	(–1.3% –0.8%)
Chronic pulmonary disease	21.4%	58.3%	4.6%*	(4.6% 4.7%)	33.0%	52.0%	2.5%*	(2.5% 2.6%)	35.1%	6.0%	0.0%*	(0.0% 0.1%)
Hypertension, uncomplicated	69.3%	57.3%	9.4%*	(9.4% 9.5%)	80.2%	50.4%	2.5%*	(2.4% 2.5%)	83.6%	6.1%	0.4%*	(0.4% 0.4%)
Diabetes, uncomplicated	26.2%	57.2%	0.8%*	(0.7% 0.8%)	33.6%	48.9%	–4.3%*	(–4.3% –4.2%)	35.9%	6.3%	0.2%*	(0.1% 0.2%)

Notes: Derived from continuously enrolled Medicare FFS, age 65+ beneficiaries. Additional Part D enrollment required for herpes zoster cohort. Additional variables were included in the model but not presented in this table, including Medicare eligibility status (e.g., aged, End Stage Renal Disease), additional Charlson and Elixhauser comorbidities, additional frailty indicators (e.g., falls, fractures, wheelchair use), and additional preventive services (e.g., therapies). See supplemental materials for full results. Bene % refers to the percentage of beneficiaries in the vaccine cohort flagged for the corresponding category. Vax Rate refers to the percentage of beneficiaries in a corresponding category that was vaccinated by the corresponding vaccine. Marginal effect refers to the percent change in probability of vaccination due to presence of the corresponding category.

* The effect for this variable is statistically significant at the 0.05 level. Because the data set is large, the confidence intervals are narrow.

Among those who received vaccinations, beneficiary characteristics associated with herpes zoster vaccination appear to differ from what we observed with influenza and pneumococcal vaccinations. Those who receive herpes zoster vaccinations were enrolled in Medicare Part D [10,11]. Because Part D is a pharmacy benefit program, it is relatively simple for a beneficiary to receive Part D vaccines in a pharmacy when allowed by state laws. Administration of Part D vaccines by a physician requires additional administrative effort. This study’s findings showed that beneficiaries in rural areas were marginally more likely to receive herpes zoster vaccine relative to those in urban settings. Pharmacists and pharmacies as well as mid-level providers such as medical assistants play an important role in immunizations expanding providers and access points and extending hours for vaccination and preventive screenings to adults who value convenience in seeking services. Additionally, pharmacies may be a central source of health care services in rural environments where there is a critical shortage of primary care providers, serving as a natural partner in supporting increased uptake of preventive services [4,24,25].

In our study we also found that dual Medicare- and Medicaid-eligible beneficiaries had a lower probability of influenza and pneumococcal vaccination. However, these beneficiaries had a marginally higher probability of receiving herpes zoster vaccine. While all beneficiaries do not experience any cost-sharing (i.e., co-payment, co-insurance, deductible) for the receipt of Medicare Part B covered influenza and pneumococcal vaccines [10], cost-sharing does occur with Part D vaccines (e.g., herpes zoster vaccine). The dual eligible population experiences minimal cost-sharing for the receipt of any Part D vaccines while other beneficiaries may experience significant cost-sharing (between \$14 and \$102) depending on the Part D plan [26,27]. This demand sensitivity to cost-sharing for the beneficiary for Part D vaccines may be a barrier to vaccination [26,27]. However, this demand sensitivity does not explain lower vaccination coverage to other vaccines.

Perceptions on the value of adult vaccines are specific to each individual vaccine. Beneficiaries may have specific concerns to one vaccine such as influenza vaccine and not express a similar concern with another vaccine [22,28].

For beneficiaries who received any of the ACIP-recommended vaccines—influenza, pneumococcal, and herpes zoster—receipt of other preventive services, including receipt of other vaccines were strong predictors of vaccination, though less so for herpes zoster vaccine. This is most evident with influenza and pneumococcal vaccines. Beneficiaries who seek or receive other preventive services, such as the AWV, may be more inclined to also value and seek vaccinations, whether in provider-based office settings, pharmacy settings, or long-term care facilities. The AWV specifically reviews and customizes a preventive action plan for each beneficiary. While use of the AWV is increasing and has demonstrated to increase use of preventive services, utilization is relatively low and even lower for racial minority beneficiaries [29,30]. It is unclear if providers have the time to actively engage in discussions around prevention and screening, as the treatment of chronic conditions may be a higher priority. For those providers who do, they may be assessing and recommending vaccinations during other preventive screenings and visits, which is a critical role in increasing vaccination coverage rates. Efforts to increase immunization coverage in specialty settings in addition to primary care settings, particularly with beneficiaries who have comorbid conditions (e.g., chronic pulmonary disease) may be contributing to increased awareness about vaccination as a norm. Further research can be performed to study the impact and effectiveness of tailored and culturally appropriate interventions to increase uptake. Research on barriers specific to provider types (e.g., specialists) caring for these patients may be important to expand the network of providers that identify beneficiaries who need to be vaccinated. Providers are critical in patient care and the coordination of care for this population. Evidence-based strategies

(e.g. standing orders, provider reminders) in combination with a provider recommendation should be undertaken to improve vaccination uptake [31,32].

This study found higher vaccination rates across select comorbid conditions (e.g., hypertension) and increased vaccination rates with some preventive service screenings (e.g., cardiovascular disease). This highlights the importance of active engagement across the spectrum of primary care (e.g., pharmacists, medical assistants) and specialty providers (e.g., cardiologists), which can increase rates by identifying beneficiaries that need to be vaccinated and targeting subpopulations (e.g., diabetic individuals) to address gaps coverage (e.g., racial disparities). Beneficiaries who have more chronic comorbidities (e.g., chronic pulmonary disease, diabetes) are more at risk for vaccine-preventable diseases [3–8]. These beneficiaries should be targeted for vaccination as targeted efforts can increase coverage. In our study we found a high marginal effect for North American Native beneficiaries (Fig. 2). This population is twice as likely as Whites to have diabetes [33] and is more likely to die from pneumonia and influenza [34,35]. Recent and concerted efforts by the Indian Health Service (IHS) to focus on this population through team-based care and population approaches have been effective in addressing prevention (i.e., immunization) for those with chronic diseases (e.g., diabetes) resulting in increased immunization coverage, particularly for pneumococcal vaccines. IHS developed and implemented quality measures to facilitate vaccination [36,37] which may in part reflect the higher coverage observed in our study (Fig. 2).

There are several limitations with this study. Firstly, claims data may not capture all vaccinations administered to Medicare beneficiaries as vaccination sites that may not submit a claim will not be observed. For example, a patient who receives an influenza vaccine through at a worksite wellness clinic that did not submit a claim would not be captured in this dataset. These beneficiaries may likely be younger and healthier. Furthermore, some patients may have been indicated for the pneumococcal or herpes zoster vaccines before age 65 and received these vaccine(s) prior to entry into Medicare and not be observable in this study [9]. These findings are however, generalizable to FFS beneficiaries, age 65 years and older which comprises of approximately 70% of all Medicare beneficiaries. Secondly, the study design did not capture a beneficiary's Medicare history, rather only vaccinations observed during the study period. Therefore aside from influenza, which is recommended annually, vaccinations for pneumococcal and herpes zoster that were administered outside the study window were not captured. The study however did capture the comorbid conditions of the beneficiary and utilization of other preventive services (e.g., cardiovascular screening) around the time of vaccination. Lastly, it is not possible to separate Hispanic ethnicity from the race designation because race and ethnicity reside in a single variable in Medicare data. Hence, some beneficiaries identified as Hispanic may also identify themselves as White, Black etc.

5. Conclusion

As the nation seeks models of care that improve outcomes and reduce costs, particularly for patients with complex needs, optimizing utilization of preventive services becomes even more critically important. As health care costs continue to increase focused engagement of providers and patients, who are likely to benefit from low-cost preventive and evidence-based interventions, such as vaccinations, will become increasingly important [38]. A common and strategic platform like the AWV can address the spectrum of needs customized to each beneficiary toward optimizing the essential preventive services covered by Medicare at no cost to the beneficiary [10–12,18]. Leveraging the “spillover” effect some

preventive services have on other services can be a strategic means to keep this population of retired older adults healthy in an environment of rising healthcare costs.

Disclosures

The authors have no conflicts of interest or financial disclosures to declare.

Disclaimer

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Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2019.01.010>.

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