ORIGINAL RESEARCH

Impact of Medical and/or Pharmacy Reimbursement on Adult Vaccination Rates

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ABSTRACT

OBJECTIVES: To evaluate whether adults enrolled in commercial health insurance plans that provide reimbursement for herpes zoster vaccine (HZV) and pneumococcal vaccine (PV) through the medical and pharmacy benefits have higher vaccination rates compared with those whose health plans cover vaccines under the medical benefit alone.

STUDY DESIGN: Retrospective claims analysis using medical and pharmacy claims data from January 1, 2012, through December 31, 2014. Separate but parallel analyses were conducted for HZV and PV.

METHODS: Previously unvaccinated patients were divided into exposed (those in employer groups with both medical and pharmacy benefits for vaccinations) and unexposed (those in employer groups that covered vaccination under the medical benefit only) cohorts.

RESULTS: For HZV, 32,506 and 1299 patients received vaccinations in the exposed and unexposed cohorts, respectively. The vaccination rate was significantly higher in the exposed (42 vaccinations per 1000 eligible person-years) than the unexposed cohort (15 vaccinations per 1000 eligible person-years; *P* <.001). For PV, 16,409 and 1386 received vaccinations in the exposed and unexposed cohorts, respectively. The vaccination rate was significantly higher in the exposed (22 vaccinations per 1000 eligible person-years) than the unexposed cohort (17 vaccinations per 1000 eligible person-years; *P* <.001).

CONCLUSIONS: Among members with commercial health insurance, HZV and PV rates were significantly higher among those whose insurance covered vaccinations under both medical and pharmacy benefits, compared with members whose insurance covered vaccines under the medical benefit only. Pharmacy-based vaccination coverage from commercial health insurance plans may help improve adult vaccination rates.

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Pneumococcal pneumonia and herpes zoster are vaccine-preventable diseases, but they continue to cause considerable burden among older adults.[1-3] The herpes zoster vaccine (HZV) and 2 pneumococcal vaccines (PVs), the 13-valent pneumococcal conjugate vaccine (PCV13) and the 23-valent pneumococcal polysaccharide vaccine (PPV23),[1] effectively reduce the incidence of these diseases. However, despite clinical recommendations for their use, adult vaccination rates are persistently low, especially in at-risk populations, such as those with compromised immune systems.[4-6]

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Barriers to adult vaccination are numerous and vary according to an individual's age, health status, life situation, and ethnicity,[7-9] but they generally fall into 3 categories: lack of healthcare provider recommendation[7,9-13]; lack of knowledge about vaccine effectiveness or seriousness of the disease[7,9,11-14]; and vaccine costs, not only the cost to the patient but also the providers' costs for purchasing and administering vaccines.[9-12] Patient mistrust of vaccines, of the healthcare system in general, or of recommendations backed by government entities present barriers for some individuals.[7,13] Additionally, adult healthcare largely focuses on acute or chronic rather than preventive care, with patients seeing both generalists and specialists, making coordination of adult vaccination difficult.[12,15] The CDC's Healthy People 2020 goals include increasing the rates of PV receipt among adults 65 years or older to 90% and of HZV receipt among adults 60 years or older to 30%.[16] Proposed interventions to help meet these vaccination goals include increasing provider awareness, to consequently improve communications to patients about necessary vaccines and understand patient barriers to vaccination; establishing national leadership to coordinate adult vaccination efforts; and improving appropriate financial and infrastructure resources.[12,17]

Infrastructure improvement includes increasing the use of pharmacies to provide adult vaccinations,[18] which can circumvent office-based barriers to vaccination. For example, whereas physician offices most often require appointments, pharmacies offer walk-up service, multiple locations, and extended business hours, allowing

for vaccinations during evenings or weekends.[19-21] Additionally, outreach by pharmacists, including advertising vaccination services, draws in customers who may have otherwise not considered vaccination.[22] Vaccination costs have been shown to be up to 25% lower in some pharmacies than in physician offices.[21] The advantages of pharmacy-administered vaccination can be an important factor in achieving the Healthy People 2020 vaccination goals of 90% for PV and 30% for HZV.[16]

TAKEAWAY POINTS

- Covering herpes zoster and pneumococcal vaccinations under both the medical and pharmacy health insurance benefit results in significantly higher vaccination rates among those with commercial health insurance, compared with health plans covering the vaccines under the medical benefit only.
- Covering vaccines under the medical benefit limits vaccine administration to physician offices, whereas allowing coverage under the pharmacy benefit expands administration to pharmacies.
- Pharmacy-based vaccination may help improve adult vaccination rates, which remain below Healthy People 2020 targets.

Vaccines traditionally have been administered in physician offices and billed under the medical health insurance benefit, but covering vaccines under the pharmacy benefit may improve adult vaccination rates because pharmacies already are reimbursed through the pharmacy benefit.[21] The increased availability of vaccination in nontraditional settings offers an opportunity to evaluate whether the coverage of vaccination through both medical and pharmacy benefits can help increase rates of HZV and PV receipt among adults. Therefore, the objective of this study was to evaluate whether adults enrolled in commercial health insurance plans that provide reimbursement for PV and HZV through the medical and pharmacy benefits have higher vaccination rates compared with those whose health plans cover vaccines under the medical benefit alone.

METHODS

Study Design

This retrospective cohort study used medical and pharmacy claims data from January 1, 2012, to December 31, 2014 (the study period). Data were obtained from the HealthCore Integrated Research Database, which contains longitudinal claims data for 48.9 million members across 14 health plans geographically dispersed across the United States. Researchers accessed only a limited dataset in full compliance with relevant provisions of the Health Insurance Portability and Accountability Act of 1996.

Separate but parallel analyses were conducted for HZV and PV receipt rates. The analysis included health plan members enrolled in employer groups (ie, a group of beneficiaries who had a set of common medical and pharmacy benefits) that fell into 1 of 2 categories. The first category was employer groups with pharmacy benefit coverage for vaccination, encompassing those employer groups that covered HZV and PV under both medical and pharmacy benefits during the study period (the exposed cohort). The second category included employer groups with no pharmacy benefit coverage for vaccination—that is, those that covered vaccination under only the medical benefit during the study period (the unexposed cohort). In both categories, HZV and PV were offered at no out-of-pocket cost to enrollees.

The 2012 calendar year was used to establish baseline vaccine use and comorbidity profiles. Vaccination rates were measured during the 2013 and 2014 calendar years.

Employer Group Selection

Commercially insured employer groups were selected based on exposure status determined by the presence of paid pharmacy claims for HZV, PV, or influenza vaccination during 2013 and 2014. Presence of paid claims indicated reimbursement. Pharmacy claims for influenza vaccination were used in addition to HZV and PV to identify employer groups with vaccine coverage in the pharmacy benefit because of the large proportion of enrolled members eligible for and receiving influenza vaccination (approximately 50% of members). Health plans that offered pharmacy benefit reimbursement for 1 of the vaccines (HZV, PV, or influenza) did so for all 3. To minimize the misclassification of exposed groups as unexposed due to missing pharmacy claims, only employer groups with at least 100 members in each year of the measurement period were included.

Patient Selection

Members of selected employer groups eligible to be vaccinated with HZV or PV were identified. To be considered eligible, patients had to have continuous health plan eligibility during the baseline period (2012) and at least 1 day of health plan eligibility between January 1, 2013, and December 31, 2014. Patients were considered HZV-eligible if they were 50 years or older[23] on January 1, 2013, and had no claims for HZV during the baseline period. Patients were considered PV-eligible if they were 19 years or older on January 1, 2013, and had no claims for PV during the baseline period. Additionally, per Advisory Committee on Immunization Practices (ACIP) recommendations and because the study population included patients 19 years or older, PV-eligible patients were required to have at least 1 claim with a diagnosis or procedure code for 1 of the conditions warranting PV during the baseline period (list in **eAppendix** [available at **ajmc.com**]).

Vaccination Eligibility and Follow-Up

Patients with no claims for HZV in 2012 and who met the patient selection criteria during the study period were considered to be

HZV-eligible. ACIP recommends 2 doses of PPV23 vaccine for all adults 65 years or older, with the second dose administered at least 5 years after the first dose. The PCV13 vaccine is indicated for all adults 50 years or older; however, ACIP also recommends use of this vaccine for adults (19 years or older) with immunocompromising conditions, followed by a dose of the PPV23 vaccine at least 8 weeks later.[24] Patients were determined to be PV-eligible until they had a claim for both types of PV or the end of follow-up, whichever was earlier. Once patients reached the vaccination end point (ie, receipt of 1 dose of HZV or receipt of both PCV13 and PPV23), they were no longer considered vaccine-eligible for the remainder of the study. For example, if a patient received PCV13 and PPV23 in 2013, he or she would not be included in the 2014 vaccination rate calculation. Patients who did not reach the vaccination end point remained vaccine-eligible until the end of the continuous health plan eligibility or the end of the study period, whichever occurred earlier.

Study Group Assignment

An employer group was assigned to the "exposed" study cohort if 1 or more members had at least 1 paid pharmacy claim for HZV, PV, or influenza vaccine between January 1, 2013, and December 31, 2014. An employer group was included in the "unexposed" study cohort if no member had any paid pharmacy claims for HZV, PV, or influenza vaccine between January 1, 2013, and December 31, 2014, and if at least 1 member had a paid medical claim for 1 of the other vaccines in that same period. Employer groups that had no pharmacy or medical claims for HZV, PV, or influenza between January 1, 2013, and December 31, 2014, were excluded because vaccine coverage status could not be determined. HZV- and PV-eligible and -vaccinated patients fell under the exposed and unexposed employer group category as per the employer group under which they were enrolled.

Outcome Measures

Two sets of outcomes were assessed in parallel analyses for HZV and PV. First, the vaccination rates for exposed and unexposed cohorts were compared during 4 measurement periods to capture the vaccination rate across all meaningful combinations of follow-up time and continuous member eligibility criteria. Analysis of the subgroups of patients with 1 year or more of continuous eligibility allowed for uninterrupted follow-up at the cost of lower generalizability of results, whereas analysis of patients with at least 1 day of eligibility allowed for the evaluation of all patients qualifying for the study, but with uneven continuous follow-up. Comparisons within 2 annual cohorts for 2013 and 2014 controlled for year-specific factors impacting the outcome. Vaccination rates were measured among patients with at least 1 day of eligibility between January 1, 2013, and December 31, 2014 (Period A); and among patients continuously eligible between January 1, 2013, and December 31, 2013 (Period B); continuously eligible between January 1, 2014, and December 31, 2014 (Period C); and continuously eligible throughout the entire study period, between January 1, 2013, and December 31, 2014 (Period D).

The vaccination rate was computed as the number of vaccinated patients per 1000 vaccine-eligible person-years within the measurement period. Unvaccinated patients contributed person-years equal to their follow-up time within each measurement period. Vaccinated patients contributed person-years until the date on which they reached the vaccination end point. Person-years contributed by the vaccinated and unvaccinated patients were included in the vaccine-eligible person-years used in the calculation of vaccination rate.

Statistical Analysis

Descriptive statistics were presented as means (SDs) and relative frequencies for continuous and categorical data, respectively, for baseline patient characteristics. Baseline characteristics were compared between exposed and unexposed cohorts using *t* tests for continuous variables and χ^2 tests for categorical variables. Differences in vaccination rates between exposed and unexposed cohorts were evaluated using the Pearson's χ^2 test of independent proportions.

RESULTS

A total of 7404 commercially insured employer groups with 2.83 million members had at least 100 enrollees each in 2013 or 2014. Patients belonging to 44 employer groups were excluded because of a lack of claims for HZV, PV, or influenza vaccine during 2013. The median number of members enrolled per employer group in the exposed cohort was 192 in 2013 and 194 in 2014; in the unexposed cohort, the median number of members was 196 in 2013 and 177 in 2014.

After applying all inclusion and exclusion criteria, 457,631 HZV-eligible patients and 442,972 PV-eligible patients had at least 1 day of health plan eligibility in 2013 or 2014 (period A). Of 457,631 HZV-eligible patients, 34,623 (7.6%) had a claim for HZV; of 442,792 PV-eligible patients, 18,406 (4.2%) had a claim for PV.

The populations for the 3 additional measurement periods were derived from this total study population. Period B contained 6742 employer groups with 2.20 million members. Of the 457,550 HZV-eligible members, 17,562 (3.8%) had a claim for HZV; 442,442 members were PV-eligible, of whom 8644 (2.0%) were vaccinated. Period C consisted of 6863 employer groups with 2.38 million members. Of the 405,038 HZV-eligible members, 16,018 (4.0%) were vaccinated; 389,460 were PV-eligible, of whom 9184 (2.5%) were vaccinated. Period D consisted of 6250 employer groups with 1.90 million members. Of the 405,038 HZV-eligible members, 31,320 (7.7%) were vaccinated; 389,460 were PV-eligible, of whom 16,647 (4.3%) were vaccinated.

Characteristics of Vaccinated Patients

Among the 34,623 HZ-vaccinated patients with at least 1 day of health plan eligibility during the study period (period A), 32,903 (95.0%)

TABLE 1. Demographics and Clinical Characteristics of Patients Vaccinated With HZV and PV

	HZV[a]			PV[b]		
	Exposed[c] (n = 32,903)	Unexposed[d] (ref) (n = 1720)	*P*[e]	Exposed[f] (n = 16,612)	Unexposed[g] (ref) (n = 1794)	*P*[e]
Age, years[h] (mean, SD)	61.7 (5.4)	60.6 (4.8)	<.001	57.7 (10.8)	57.3 (11.8)	.1995
Age category, years						
18-49, n (%)	0 (0.0)	0 (0.0)	<.001	3191 (19.2)	380 (21.2)	<.001
50-59, n (%)	8412 (25.6)	513 (29.8)		5288 (31.8)	636 (35.5)	
≥60, n (%)	24,491 (74.4)	1207 (70.2)		8133 (49.0)	778 (43.4)	
Gender						
Female, n (%)	17,954 (54.6)	881 (51.2)	.0066	8015 (48.2)	869 (48.4)	.8778
Geographic region of residence, n (%)						
Northeast	7694 (23.4)	129 (7.5)	<.001	3999 (24.1)	195 (10.9)	<.001
Midwest	11,783 (35.8)	687 (39.9)		5541(33.4)	705 (39.3)	
South	8251 (25.1)	437 (25.4)		4576 (27.5)	468 (26.1)	
West	4705 (14.3)	314 (18.3)		2182 (13.1)	233 (13.0)	
Other	470 (1.4)	153 (8.9)		314 (1.9)	193 (10.8)	
Health plan type, n (%)						
HMO	4619 (14.0)	628 (36.5)	<.001	2730 (16.4)	826 (46.0)	<.001
PPO	23,696 (72.0)	518 (30.1)		12,120 (73.0)	447 (24.9)	
CDHP	4588 (13.9)	574 (33.4)		1762 (10.6)	521 (29.0)	
DCI score, mean (SD)	0.9 (1.5)	0.9 (1.4)	.2623	2.2 (2.1)	2.3 (2.1)	.0069
DCI score category, n (%)						
0	18,340 (55.7)	945 (54.9)	.3354	2135 (12.9)	168 (9.4)	<.001
1	7092 (21.6)	394 (22.9)		6140 (37.0)	650 (36.2)	
2	4084 (12.4)	221 (12.8)		3593 (21.6)	409 (22.8)	
≥3	3387 (10.3)	160 (9.3)		4744 (28.6)	567 (31.6)	
Receipt of other vaccines, n (%)						
Varicella	16 (0.0)	1 (0.1)	.5795	18 (0.1)	1 (0.1)	.8577
Td	344 (1.0)	20 (1.2)	.6267	235 (1.4)	25 (1.4)	.9426
Tdap	5468 (16.6)	318 (18.5)	.0427	3063 (18.4)	343 (19.1)	.4815

CDHP indicates consumer-driven health plan; DCI, Deyo-Charlson Comorbidity Index; HMO, health maintenance organization; HZV, herpes zoster vaccine; PPO, preferred provider organization; PV, pneumococcal vaccine; ref, reference group; Td, tetanus and diphtheria toxoid, adsorbed; Tdap, tetanus, (reduced) diphtheria, (reduced) pertussis.

[a]All members with at least 1 day of eligibility between January 1, 2013, and December 31, 2014, who were vaccinated with HZV in the calendar years 2013-2014.

[b]All members with at least 1 day of eligibility between January 1, 2013, and December 31, 2014, who were vaccinated with PV in the calendar years 2013-2014.

[c]Exposure was defined as coverage for HZV in the pharmacy benefit, operationalized as presence of at least 1 claim for HZV in the pharmacy benefit between January 1, 2013, and December 31, 2014, for members in selected health plans.

[d]Unexposed group was defined as no coverage for HZV in the pharmacy benefit, operationalized as no claims for HZV in the pharmacy benefit between January 1, 2013, and December 31, 2014, for members in selected health plans.

[e]*P* value is based on comparison between the exposed and the unexposed cohorts (reference group); χ^2 tests for categorical and *t* tests for continuous variables were used.

[f]Exposure was defined as coverage for PV in the pharmacy benefit, operationalized as presence of at least 1 claim for PV in the pharmacy benefit between January 1, 2013, and December 31, 2014, for members in selected health plans.

[g]Unexposed group was defined as no coverage for PV in the pharmacy benefit, operationalized as no claims for PV in the pharmacy benefit between January 1, 2013, and December 31, 2014, for members in selected health plans.

[h]Age on January 1, 2013.

were in the exposed cohort and 1720 (5.0%) were in the unexposed cohort (**Table 1**). The mean age was slightly older in the exposed than the unexposed cohort (61.7 vs 60.6 years, respectively; *P* <.001), although 25.6% in the exposed cohort were aged between 50 and 59 years. The exposed cohort had a slightly higher proportion of women than the unexposed cohort (54.6% vs 51.2%, respectively; *P* <.007).

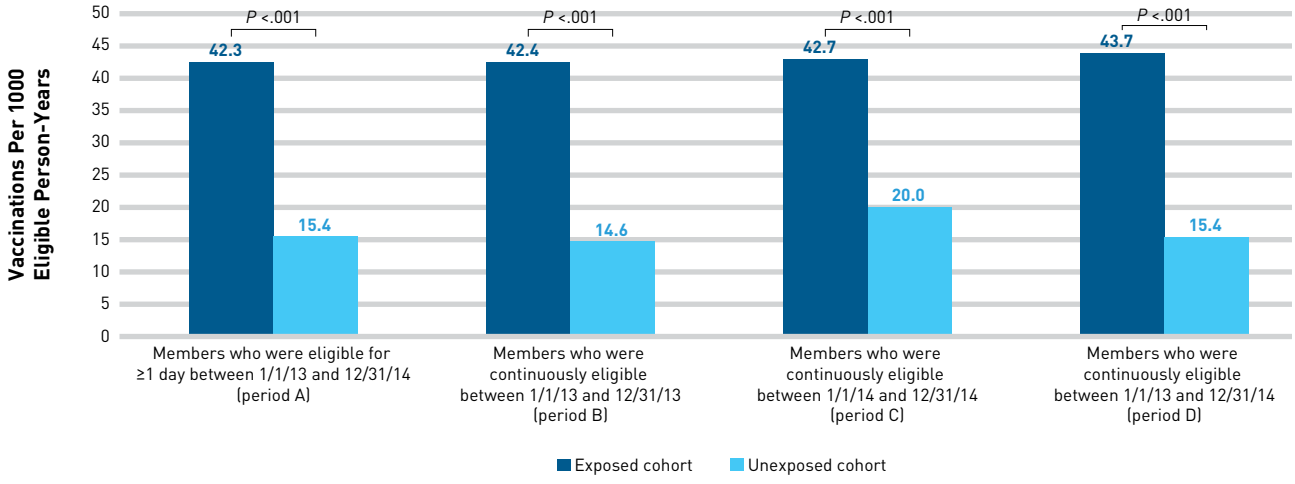
Among the 18,406 PV-vaccinated patients, 16,612 (94.6%) were in the exposed cohort and 1794 (10.2%) were in the unexposed cohort, with similar mean age (57.7 vs 57.3 years, respectively; *P* = .20) and proportion of women (48.2% vs 48.4%, respectively; *P* = .88).

TABLE 2. Vaccine Eligibility and Vaccination Rates for HZV

	Period A[a]			Period B[a]			Period C[a]			Period D[a]		
	Exposed[b]	Unexposed[c] (ref)	*P*[d]	Exposed[b]	Unexposed[c] (ref)	*P*[d]	Exposed[b]	Unexposed[c] (ref)	*P*[d]	Exposed[b]	Unexposed[c] (ref)	*P*[d]
Vaccinated members, n (A)	32,506	1299		16,776	786		15,129	889		29,421	1194	
Vaccine-eligible members,[e] n	395,842	43,141		403,448	54,102		360,206	44,832		350,074	39,394	
Sum of p-y for vaccinated and vaccine-eligible members (B)[e]	767,854	84,305		395,788	53,744		353,901	44,483		672,862	77,675	
Vaccination coverage (A/B)	0.042	0.015	<.001	0.042	0.015	<.001	0.043	0.020	<.001	0.044	0.015	<.001

HZV indicates herpes zoster vaccine; PV, pneumococcal vaccine; p-y, person-years; ref, reference group.
[a]The measurement periods were: period A (1/1/13-12/31/14) included patients with at least 1 day of health plan eligibility in that period; period B (1/1/13-12/31/13) included patients with continuous health plan eligibility in 2013; period C (1/1/14-12/31/14) included patients with continuous health plan eligibility in 2014; and period D (1/1/13-12/31/14) included patients with continuous eligibility for that entire period.
[b]Exposed cohort is defined as health plan coverage for PV and HZV in the pharmacy benefit, operationalized as presence of at least 1 claim for PV or HZV in the pharmacy benefit between the period of interest for members in selected health plans.
[c]Unexposed cohort is defined as no health plan coverage for PV and HZV in the pharmacy benefit, operationalized as no claims for PV or HZV in the pharmacy benefit between the period of interest for members in selected health plans.
[d]*P* value is based on comparison of vaccination coverage between the exposed and the unexposed cohorts (ref).
[e]Postvaccination follow-up for members vaccinated during period of interest does not count toward p-y total.

FIGURE 1. Vaccination Rates for HZV[a]



HZV indicates herpes zoster vaccine.
[a]*P* value is based on comparison of vaccination coverage between the exposed and the unexposed cohorts.

HZ Vaccination Rates

In period A, 32,506 in the exposed and 1299 in the unexposed cohort received HZV (**Table 2**). In the exposed cohort, 395,842 HZV-eligible members contributed to 767,854 person-years; in the unexposed cohort, 43,141 HZV-eligible members contributed to 84,305 person-years. The vaccination rate was significantly higher among patients in the exposed group (0.042 vaccinations per eligible person-year, or 42 vaccinations per 1000 eligible person-years) compared with the unexposed group (0.015 vaccinations per eligible person-year, or 15 vaccinations per 1000 eligible person-years; $P < .001$) (**Figure 1**).

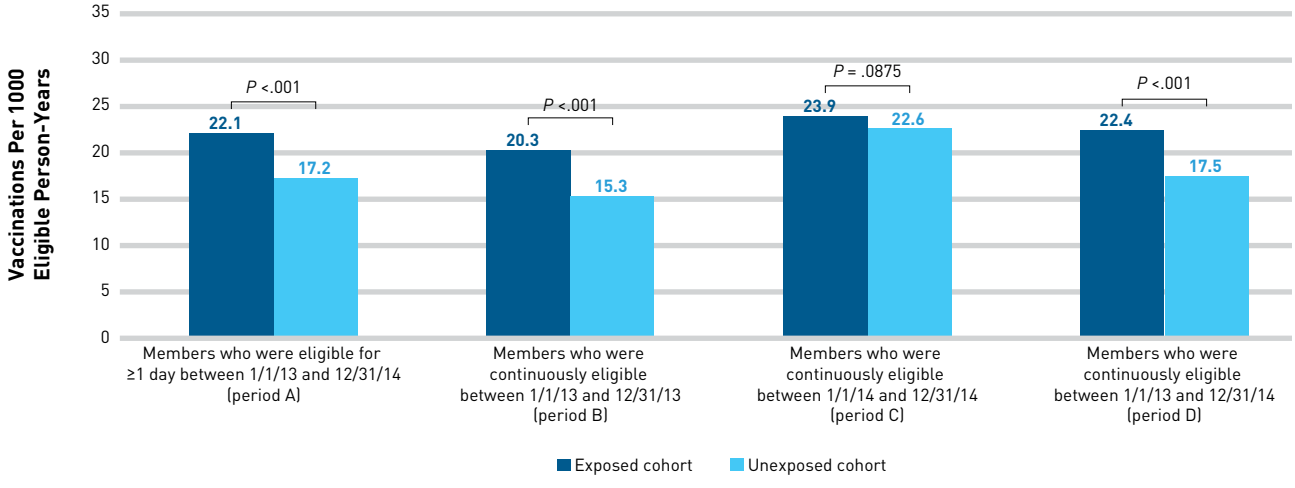
Similar patterns were observed in the remaining 3 measurement periods (Table 2). In all measurement periods, vaccination rates were higher for patients in the exposed than unexposed cohorts (Figure 1).

TABLE 3. Vaccine Eligibility and Vaccination Rates for PV

	Period A[a]			Period B[a]			Period C[a]			Period D[a]		
	Exposed[b]	Unexposed[c] (ref)	*P*[d]	Exposed[b]	Unexposed[c] (ref)	*P*[d]	Exposed[b]	Unexposed[c] (ref)	*P*[d]	Exposed[b]	Unexposed[c] (ref)	*P*[d]
Vaccinated members, n (A)	16,409	1386		7837	807		8248	936		14,838	1277	
Vaccine-eligible members,[e] n	382,767	41,332		389,419	53,023		347,637	41,823		336,904	37,077	
Sum of p-y for vaccinated and vaccine-eligible members (B)[e]	742,476	80,481		386,145	52,682		344,533	41,443		661,261	73,070	
Vaccination coverage (A/B)	0.022	0.017	<.001	0.020	0.015	<.001	0.024	0.023	.0875	0.022	0.017	<.001

HZV indicates herpes zoster vaccine; PV, pneumococcal vaccine; p-y, person-years; ref, reference group.
[a]The measurement periods were: period A (1/1/13-12/31/14) included patients with at least 1 day of health plan eligibility in that period; period B (1/1/13-12/31/13) included patients with continuous health plan eligibility in 2013; period C (1/1/14-12/31/14) included patients with continuous health plan eligibility in 2014; and period D (1/1/13-12/31/14) included patients with continuous eligibility for that entire period.
[b]Exposed cohort is defined as health plan coverage for PV and HZV in the pharmacy benefit, operationalized as presence of at least 1 claim for PV or HZV in the pharmacy benefit between the period of interest for members in selected health plans.
[c]Unexposed cohort is defined as no health plan coverage for PV and HZV in the pharmacy benefit, operationalized as no claims for PV or HZV in the pharmacy benefit between the period of interest for members in selected health plans.
[d]*P* value is based on comparison of vaccination coverage between the exposed and the unexposed group (ref).
[e]Postvaccination follow-up for members vaccinated during period of interest does not count toward p-y total.

FIGURE 2. Vaccination Rates for PV[a]



PV indicates pneumococcal vaccine.
[a]*P* value is based on comparison of vaccination coverage between the exposed and the unexposed cohorts.

Pneumococcal Vaccination Rates

In period A, 16,409 in the exposed and 1386 in the unexposed cohort received PV (Table 3). In the exposed cohort, 382,767 PV-eligible members contributed to 742,476 person-years; in the unexposed cohort, 41,332 PV-eligible members contributed to 80,481 person-years. The vaccination rate was significantly higher among patients in the exposed (0.022 vaccinations per eligible person-year, or 22 vaccinations per 1000 eligible person-years) compared with the unexposed cohort (0.017 vaccinations per eligible person-year, or 17 vaccinations per 1000 eligible person-years; *P* <.001) (Figure 2).

Periods B and D followed a similar pattern, with vaccination rates higher among patients in the exposed compared with the unexposed cohorts. Vaccination rates in the exposed and unexposed cohorts were not statistically significantly different in period C (Table 3 and Figure 2).

DISCUSSION

The results of this real-world analysis demonstrated that vaccination rates for HZV and PV were significantly higher among those whose commercial insurance plans covered vaccinations under both the medical and pharmacy benefit, compared with members whose insurance covered vaccines under the medical benefit only. With the exception of PV uptake in 2014, these results were consistent across 2013 and 2014 and for patients who had continuous as well as noncontinuous health plan enrollment.

While the exposed groups for both HZV and PV had higher vaccination rates than the unexposed groups, the differential was greater in the HZV group. A potential explanation is the requirement that HZV must be stored between −50°C and −15°C to maintain potency, requiring the use of a freezer. Unlike pharmacies, most physicians lack access to freezers and are therefore unable to store and administer HZV. Consequently, patients are likely to be recommended to receive HZV from a pharmacy instead.[14] In contrast, PV can be stored at standard refrigerator temperatures; refrigerators, compared with freezers, are more likely to be found in physician offices. Therefore, the differences in vaccination rates for PV between exposed and unexposed cohorts were not as pronounced.

Strengths and Limitations

This study fills a gap in the literature by using a large, diverse population in a real-world setting. Although the patients included had a variety of health plan types, all had confirmed coverage for vaccines under medical and/or pharmacy benefits or under medical benefits alone. There were no between-group differences in co-pays for vaccines, as all study patients were commercially insured and did not have out-of-pocket co-pays for HZV and PV under the Affordable Care Act's preventive care benefits. Thus, the difference in distribution of health plan benefits was unlikely to influence the observed different vaccination rates between the exposed and unexposed groups due to economic factors. All patients had equal follow-up periods and included those with continuous as well as intermittent health plan enrollment.

However, this study was subject to several limitations. The vaccination rates presented in this study are limited to a 3-year follow-up based on limited retrospective review of data. The proportion of vaccine-eligible patients was not adjusted for vaccinations given prior to January 1, 2012, potentially overestimating the number of vaccine-eligible patients in the exposed and unexposed cohorts. Lifetime follow-up of patients, although ideal, is challenging for patients who are likely to change their insurer with changes in employment or retirement. A single data source, such as a claims database or electronic health record, may be censored once a patient changes their physician, place of healthcare service, or insurer. Similarly, self-reported receipt of vaccination over longer time frames is also prone to limited or incorrect recall of the vaccine administered. A multivariable analysis was not conducted to control for other factors that may have affected vaccination rates. Coverage of HZV and PV under the pharmacy benefit was determined by the presence of pharmacy claims for these 2 vaccines, which may have resulted in false negatives due to an absence of observed pharmacy claims despite the employer group having provided coverage for the vaccines in the pharmacy benefit. This was mitigated to some extent by selecting groups with at least 100 members for each study year, thus diminishing the probability of false-negative assignment of unexposed status. Furthermore, the study also used the presence of claims for influenza vaccinations, which are highly prevalent in most commercial populations, as a proxy for pharmacy benefit–based coverage of PV and HZV to minimize chances of false negatives. It is possible that patients may have been vaccinated prior to the study period. Because vaccination prior to the study period was not captured and may have been substantially different for HZV and PV, vaccination rates between the 2 vaccines could not be compared.

This study was based upon data provided by major managed care health plans across the United States. The majority of patients were members of employer-sponsored managed care programs, and the results may not be generalizable to the uninsured or to those with other types of insurance. Medical coding errors may have occurred, but there is no evidence to show that such a coding error would be systematically different between the exposed and unexposed groups. Some patients may have received medical care through alternate insurance programs or may have paid for their care with cash, either of which would not have been captured in the claims contained in the study database. However, the patients included in this study were fully covered by the health plans, so the chances of these members seeking care outside of the health plan were low. Information related to access to healthcare and other socioeconomic status information (eg, education and income level) was unavailable in administrative claims. The CDC reported that 24% of adults 60 years and older reported ever receiving HZV in 2013 based on the National Health Interview Survey (NHIS), a cross-sectional survey of the US population.[25] Although the vaccination rate reported in this study was lower than the self-reported vaccination rate in the NHIS survey, the rates are not comparable. The NHIS used self-reported vaccination data, whereas the current study used a claims database. Also, the NHIS results represent a more diverse US population, including persons with noncommercial insurance, whereas the current study only included commercially insured members. It may take some time for pharmacy benefit changes to be communicated or understood by patients and/or providers, which could have affected how soon patients visited a pharmacy to receive a vaccination.

CONCLUSIONS

Although pharmacy-based vaccination may help improve adult vaccination rates, these rates still remain below Healthy People 2020

targets. Future research is needed to investigate other methods to improve vaccine coverage and access among eligible populations. ■

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eAppendix

Comorbidities Indicated for Pneumococcal Vaccination for Adults Aged 19-64 Years

Chronic Medical Conditions	*ICD-9-CM* Diagnosis Codes	*ICD-9-CM* Procedure Codes	CPT-4 Procedure Codes	HCPCS Codes
Asthma	493.xx			
Asplenia	759.0x		38100, 38102, 38120	
Sickle cell disease and other hemoglobinopathies	282.6x			
Cerebrospinal fluid leak	349.81, 388.61			
Cigarette smoking	305.1x, V15.82			
Cochlear implant			69930, L8615, L8621, L8622, L8623, L8624	
Congenital or acquired immunodeficiencies				
Hodgkin disease	201.xx			
Lymphoma	200.xx, 202.xx			
Leukemia	203.xx-208.xx			
Kidney failure	584.xx, 585.9x, 586.xx, 958.5x			
Multiple myeloma	203.0x			
Nephrotic syndrome	581.xx			
HIV infection or AIDS	042.xx, V08.xx, 795.71, 079.53			
Damaged spleen or no spleen	759.0x, 289.5x, 197.8x, 200.x7, 201.x7, 202.x7			
Organ transplant	V42.0x, V42.1x, V42.6x, V42.7x, V42.83, V42.84	00.91, 00.92, 00.93, 07.94, 37.51, 46.97, 55.53, 55.69, 11.6x, 33.5x, 33.6x, 41.0x, 50.4x, 50.5x, 52.8x	00144, 00580, 00796, 00868, 29868, 32851, 32852, 32853, 32854, 32855, 32856, 33933, 33935, 33944, 33945, 38240, 38241, 38242, 44135, 44136, 44137, 44715, 44720, 44721, 47135, 47136, 47143, 47144, 47145, 47146, 47147, 48551, 48552, 48554, 48556, 50323, 50325, 50327, 50328, 50329, 50340, 50360, 50365, 50370, 65710, 65730, 65750, 65755, 65756, 65757, 65780, 65781, 76776, 76778, 81267, 81268	
Immunosuppressive therapy				

Chronic Medical Conditions	*ICD-9-CM* Diagnosis Codes	*ICD-9-CM* Procedure Codes	CPT-4 Procedure Codes	HCPCS Codes
Long-term steroids	V58.65			
Certain cancer drugs			96379, 96401, 96402, 96409, 96411, 96413, 96415, 96416, 96417, 96420, 96422, 96423, 96425, 96440, 96446, 96450, 96521, 96522, 96542	Q0083, Q0084, Q0085
Radiation therapy			77261-77525	
Generalized malignancy	141.xx-172.xx, 174.xx-209.xx, 230.xx-234.xx			
Chronic heart disease	393.xx-398.xx, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 413.xx, 414.xx, 416.xx, 425.xx, 428.xx-429.xx, 746.xx			
Chronic lung disease	490.xx-492.xx, 494.xx-496.xx, 500.xx-505.xx, 515.xx, 516.xx, 518.83, 518.89			
Diabetes	250.xx			
Alcoholism	303.9x, V11.3x	94.46, 94.53		
Cirrhosis	571.2x, 571.5x, 571.6x			

CPT-4 indicates Current Procedural Terminology, 4th Edition; HCPCS, Healthcare Common Procedure Coding System; *ICD-9-CM*, *International Classification of Diseases, Ninth Revision, Clinical Modification*.