

# Office Manager and Nurse Perspectives on Facilitators of Adult Immunization

Mary Patricia Nowalk, PhD, RD; Melissa Tabbarah, PhD, MPH; Jonathan A. Hart, MS; Dwight E. Fox, DMD; Mahlon Raymund, PhD; Stephen A. Wilson, MD, MPH; and Richard K. Zimmerman, MD, MPH; for the FM-PittNet Practice Based Research Network

Immunizations are an important quality measure for primary care, yet rates of adult immunizations are below ideal levels and disparities in rates by race have been widely observed.<sup>1-3</sup> Differential uptake due to mistrust, lack of access, lack of awareness,<sup>4</sup> or lack of perceived recommendation<sup>5</sup> by healthcare providers may be addressed through interventions at the patient level (reminders) or provider level (recommendations).<sup>6,7</sup> Differences among the primary care practices where vaccines are received also may account for racial disparities and low rates. For example, patients seen in inner-city practices have significantly lower overall vaccination rates compared with patients seen in Veterans Affairs practices, and racial disparities exist among the former, but not the latter.<sup>4,8</sup> Research has shown that blacks and whites receive care from providers who differ both in their training and in the level and types of resources available to them.<sup>9</sup> Furthermore, the number of immunization-promoting activities in a practice is related to adult pneumococcal polysaccharide vaccine (PPV) vaccination rate,<sup>10</sup> and increasing office systems to promote immunizations increases overall practice rates and reduces racial disparities.<sup>11</sup> In this study, we intentionally sampled practices with predominantly minority patients and practices with predominantly white patients, loosely matched by neighborhood income, and used hierarchical linear modeling (HLM) to account for clustering of patients within practices to explore additional office factors that may affect adult vaccination rates.

## METHODS

Detailed methodology including site selection, recruitment, survey development, patient selection, power calculations, and medical record review has been published.<sup>12</sup> Methods specific to this analysis will be described herein.

### Site Selection and Recruitment

In general, we selected diverse practices that served a large percentage of elderly patients and had white and/or minority providers. We attempted to match a practice serving primarily minority patients with a similar practice serving primarily white patients in socioeconomically

**Objective:** To assess which characteristics of primary care practices serving low- to middle-income white and minority patients relate to pneumococcal polysaccharide vaccine (PPV) and influenza vaccination rates.

**Methods:** In an intentional sample of 18 primary care practices, PPV and influenza vaccination rates were determined for a sample of 2289 patients  $\geq 65$  years old using medical record review. Office managers and lead nurses were surveyed about their office systems for providing adult immunizations, beliefs about PPV and influenza vaccines, and their own vaccination status. Hierarchical linear modeling (HLM) analyses were used to account for the clustered nature of the data.

**Results:** Sampled patients were most frequently female (61%) and white (83%), and averaged 76 years of age. Weighted vaccination rates were 61.1% for PPV and 52.5% for influenza; rates varied by practice. Using HLM, with patient age and race entered as level 1 variables and office factors entered as level 2 variables, time allotted for an annual well visit was associated with a higher likelihood of influenza vaccination (odds ratio [OR] = 1.04; 95% confidence interval [CI] = 1.02, 1.07;  $P = .003$ ). Nurse influenza vaccination status was associated with a higher likelihood of PPV vaccination (OR = 3.81; 95% CI = 1.49, 9.78;  $P = .009$ ).

**Conclusions:** In addition to race and age, visit length and the nurses' vaccination status were associated with adult vaccination rates. Quality improvement initiatives for adult vaccination might include strengthening social influence of providers and/or ensuring that adequate time is scheduled for preventive care.

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### Take-Away Points

Pneumococcal polysaccharide vaccine and influenza vaccination rates varied widely across 18 primary care practices.

- Influenza vaccination status of the lead nurse was associated with pneumococcal vaccination of patients.
- Longer scheduled well-visit times were associated with a higher influenza vaccination rate.
- A greater emphasis on adult well visits, with sufficient time allotted for preventive services such as immunizations, may help to increase vaccination rates.

### Medical Record Review

Because of Health Insurance Portability and Accountability Act regulations, manual medical record review was performed by a certified honest broker.<sup>16</sup> In 2006, the honest broker used the randomized list to confirm eligibility, then collected data from 150 to 175 patient charts

comparable neighborhoods, based on US Census data. Of 23 practices selected, 18 agreed to participate. Five practices failed to respond to requests or refused to participate, for a refusal rate of 22% (5/23).

### Survey Development

The questionnaires were designed to describe current medical practices and determine barriers to and facilitators of organizational change that could lead to quality improvement strategies to increase adult immunization. Constructs from the PRECEDE-PROCEED framework (predisposing, enabling, and environmental factors) were included in the office manager and nurse questionnaires. For instance, office managers were asked about time allotted for visits, continuing education opportunities for staff, and staff retention and satisfaction. Nurses were asked about policies to support adult immunization such as standing orders, vaccine screening responsibility, and so forth. Some of the factors of the Competing Values Framework<sup>13,14</sup> were used to assess teamwork, innovation, bureaucracy, and efficiency that affect the ability of a practice to implement quality improvements.

The surveys were developed and revised through an iterative process by a multidisciplinary team that examined them for face and content validity.<sup>15</sup> They were pilot-tested before use and revised accordingly. Office manager and nurse respondents were offered \$50 payment in the form of a check or gift certificate. To reduce keystroke entry error, survey data were entered twice into an electronic database, results were compared electronically, and discrepancies were reconciled.

### Patient Sampling

The first stage of a 2-stage stratified sampling created an intentional sample of diverse practices, stratified by race of the patients. In the second stage, random sampling of patient records within the practices was conducted, leading to a clustered, random sample. From electronic billing lists or medical records, patients were selected who (1) were born before January 1, 1940 (age  $\geq 65$  years in 2005); (2) were living; and (3) had an office visit in the last 12 months, indicating that they were active patients of the practice.

in large practices or all eligible charts in smaller practices (with <150 eligible patients).

### Data Reduction

Because of the complexity of hierarchical analyses, 21 priority variables from the surveys (12 from the office manager survey and 9 from the lead nurse survey) were selected for HLM analyses. Priority variables (Table 1) were chosen based on a priori importance, a sufficient number of responses, or reasonable variable distribution. Some variables such as different systems to increase vaccination rates were combined.

### Statistical Methods

The deidentified medical record data file was merged with the questionnaire data files for the office manager and nurse. Based on sampling fractions, weights were calculated so that the reviewed records reflected the patient panels within practices. SAS software (SAS Institute Inc, Research Triangle Park, NC) was used to calculate descriptive statistics. Summary vaccination rates were weighted and stratified; the Cochran-Mantel-Haenszel test was used to compare vaccination rates by race. Influenza vaccination status as a dichotomous variable was based on the combined status for an individual patient for the majority (>60%) of years (2001-2005).

HLM version 6 (Scientific Software International, Inc, Lincolnwood, IL) was used to determine the effect of office manager-level and nurse-level variables on vaccination status, while controlling for patient race and age. The reliability estimates for the weighted models without any independent variables were .95 for PPV and .93 for influenza, which showed high reliability. We used full maximum likelihood estimation with the Laplace approximation algorithm.

Following the strategy recommended by Raudenbush and Bryk,<sup>17</sup> the multilevel analyses for a Bernoulli distribution were conducted in an incremental fashion, starting with an empty or null model, then adding group-mean centered level 1 variable age and uncentered level 1 variable race, and subsequently adding level 2 variables from the office manager and nurse surveys (grand-mean centered if continuous, uncentered if not). Among level 1 variables, patient race ( $P = .01$ ) and age ( $P < .001$ ) were found to be associated with PPV vaccination

■ **Table 1.** Variables Selected for Hierarchical Linear Modeling Analyses From Office Manager and Nurse Surveys

Office Manager Variables
Time allotted for chronic care visit, minutes
Time allotted for annual well visit, minutes
Wait time for return visit, days
Distance from adult exam room to vaccine refrigerator, feet
Practice has "very good" to "excellent" ability to retain staff (reference is "good" to "poor")
Practice supports outside education and training for staff
Practice has "high" to "very high" overall staff satisfaction (reference is "average" to "very low")
Level of group culture
Level of hierarchical culture
Practice has all white physicians (reference is mixed or all nonwhite)
Practice has all white clinical staff (reference is mixed or all nonwhite)
Practice has all white clerical staff (reference is mixed or all nonwhite)
Nurse Variables
Practice has standing orders for nurses/medical assistants to give adult immunizations, holds "clinics" for walk-in adult vaccination, screens adults for immunization (combination score)
Clinical staff recommends influenza vaccine for high-risk individuals age 18-49 years and all age $\geq 50$ years
Clinical staff recommends PPV for high-risk individuals age 18-64 years and all age $\geq 65$ years
Proportion of patients age $\geq 65$ years who know that they should receive the PPV
Proportion of patients age $\geq 65$ years who accept the PPV when recommended
Nurse vaccinated against influenza in 2003-2004
Nurse's age, years
Length of time individual has served as head nurse, months
Individual is a registered nurse
PPV indicates pneumococcal polysaccharide vaccine.

status and also with influenza vaccination status (race  $P < .001$  and age  $P = .002$ ). These variables were retained for further HLM analyses.

For level 2 variables with coefficients that were significant at the  $P < .15$  level, correlations were calculated and 1 member of pairs that were significantly correlated was excluded from further analyses. Remaining level 2 variables were entered pairwise into multivariable analyses and the most significant pair selected.

The full mathematical model is shown in the [eAppendix](#) (available at [www.ajmc.com](http://www.ajmc.com)).

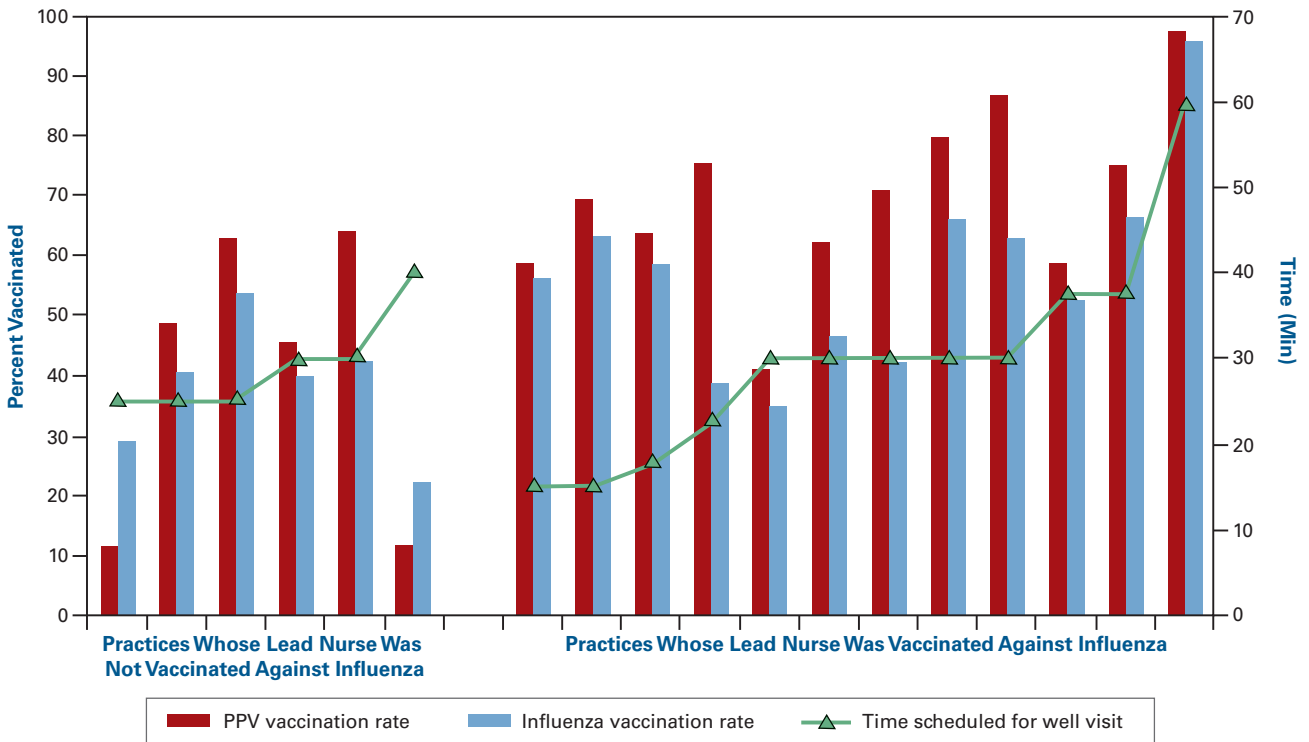
## RESULTS

From the 18 practices, 2289 sampled patient records had sufficient and usable data. The patients were largely female (61.1%) and white (82.5%), averaged  $76.0 \pm 7.0$  years of age, and lived in neighborhoods with a median per capita income of  $\$18,831 \pm \$5745$  (2000 census data). Overall, the weighted PPV vaccination rate was 61.1%; the weighted influenza vac-

ination rate was 52.5%. Average wait time for a return appointment was  $6.2 \pm 4.8$  days; average time allotted for chronic care visits was  $20.4 \pm 6.7$  minutes, and for annual well visits it was  $29.4 \pm 10.4$  minutes; 67% of practices supported outside training/education for staff, but only 39% reported high staff satisfaction. Most practices frequently offered PPV (61%) and influenza vaccine (75%) to eligible adults. In 67% of practices, nurses reported that most patients accept the PPV when it is recommended.

Without accounting for patient race and age, the [Figure](#) plots the vaccination rates for practices (shown in columns), stratified by nurse influenza vaccination status (unvaccinated on left, vaccinated on right) and organized by increasing time allotted for annual well visits (using a line to show minutes). Higher PPV and influenza vaccination rates were observed in practices in which the nurse was vaccinated against influenza compared with practices in which the nurse was not vaccinated against influenza. The 2 practices with the lowest PPV and influenza vaccination rates were those in which the nurse did not receive influenza vaccine.

■ **Figure.** PPV and Influenza Vaccination Rates by Nurses' Vaccination Status and Time Scheduled for Well Visits



PPV indicates pneumococcal polysaccharide vaccine.

### Hierarchical Linear Modeling

In HLM, the overall variance, also called the residual error ( $u_0$ ), was statistically significant at  $P < .001$  for PPV and for influenza, showing significant between-panel variance in immunization rates and supporting the use of HLM instead of traditional logistic regression. There was no apparent relationship with vaccination rate for many of the variables. However, when entered into the model singly, items associated with PPV at  $P < .15$  included time allotted for an annual well exam, percentage of practices in which most patients accept the PPV when recommended, percentage of practices that frequently recommend influenza vaccine for all eligible adults, and percentage of practices in which nurse respondent received influenza vaccine in the previous season, in addition to patient age.

In HLM, uncorrelated level 2 variables associated with PPV vaccination at  $P < .15$  were entered into multivariable models pairwise. For PPV, the best pair was time allotted for an annual well exam ( $P = .089$ ) and percentage of practices in which the lead nurse received influenza vaccine in the previous season ( $P = .009$ ). Patient age and race and 1 practice-level variable, time allotted for an annual well exam, were significantly related to influenza vaccination. Final HLM models with odds ratios and interpretations are presented in

Table 2, with identical likelihood of receiving PPV and influenza vaccine associated with time allotted for well visits.

## DISCUSSION

Immunizations are an important quality-of-care measure. Previous research has shown that vaccination rates vary by race and age,<sup>1-3</sup> and our level 1 analyses confirmed those findings. Office systems to promote adult vaccination are significantly related to increased adult vaccination rates.<sup>6,7,10</sup> In this analysis, the only office system factor that was related to increased influenza vaccination was time allotted for adult well visits; in fact, the highest immunization rate was in the practice with the longest well visits. We cannot differentiate whether longer scheduled visit length reflects more time allowed for prevention, greater attention given to prevention, or both. Other studies have reported that increased visit length was associated with increased provision of preventive services<sup>18</sup> and procedures and screening tests.<sup>19</sup> Furthermore, low frequency of well or preventive visits has been associated with lower adult immunization rates.<sup>20</sup> Therefore, a greater emphasis on adult well visits, with sufficient time allotted for preventive services such as immunizations, may help to increase vaccination rates.

**Table 2.** Correlates of Vaccination Status in Multivariate Hierarchical Linear Modeling and Model-Based Impact

Variable, Fixed Effect	Odds Ratio	95% Confidence Interval	P	Model-Based Incremental Impact of Variable on Vaccination Probability <sup>a</sup> Percentage Points
<b>PPV</b>				
Intercept ( $\gamma_{00}$ )	0.17	0.03, 1.12	.063	—
Time allotted for annual well visit, minutes ( $\gamma_{01}$ )	1.04	0.99, 1.09	.089	0.4-0.5 per additional minute
Nurse received influenza vaccine last season ( $\gamma_{02}$ )	3.81	1.49, 9.78	.009	20-22 if nurse were vaccinated
Older patient age ( $\gamma_{10}$ )	1.04	1.02, 1.05	.000	0.6-0.7 per age increment
Patient white race (reference is minority) ( $\gamma_{20}$ )	1.44	0.95, 2.18	.086	7-8 for whites over minorities
<b>Influenza</b>				
Intercept ( $\gamma_{00}$ )	0.24	0.09, 0.67	.010	—
Time allotted for annual well visit, minutes ( $\gamma_{01}$ )	1.04	1.02, 1.07	.003	0.25-0.26 per additional minute
Older patient age ( $\gamma_{10}$ )	1.04	1.02, 1.05	<.001	0.17 per age increment
Patient white race (reference is minority) ( $\gamma_{20}$ )	1.66	1.21, 2.26	<.002	4 for whites over minorities

PPV indicates pneumococcal polysaccharide vaccine.

<sup>a</sup>The logits were calculated for various scenarios from the coefficients from the hierarchical linear modeling equations in the Appendix. Then, estimated vaccination rates were calculated using the formula: Probability =  $1/(1 + \text{exponent}(-\text{logit}))$ .

Lead nurse influenza vaccination increased the likelihood of PPV vaccination threefold. Given that multiple studies reveal the importance of habit and social support in understanding adult vaccination behavior,<sup>4,21</sup> this association may indicate that support for vaccination (receiving the influenza vaccine) is translated into encouragement of patients to be vaccinated. Role modeling is an accepted component of behavior change methodology, as is social influence (ie, the nurse's behavior may be influencing the patients, with or without other practice factors that may exert influence). We previously reported that practice factors, including the number of immunization promotion activities and the time allotted for acute care visits, were related to increased PPV vaccination rates.<sup>10</sup>

Quality improvement efforts are a critical element of optimizing healthcare and managing its associated costs. Two potential quality improvement initiatives regarding adult immunization are increasing social influence by encouraging staff to receive annual influenza vaccine as a means of strengthening the immunization message and increasing the time allotted for well visits or prevention.

### Strengths and Limitations

Among the strengths of this study is the fact that we selected a diverse sample of practices, some with large minority patient populations that we generally matched with similar-sized practices with largely white patient populations. Our questionnaires and observations are second generation, building on our previous work and using a variety of underlying theoretical models to understand office culture and

practices from the office manager and nurse perspective. Using HLM, we examined vaccination of patients within the environment of the practice, thus accounting for the clustered nature of the data and properly accounting for variance partitioning.

Although the study is limited by having been conducted in 1 region, this region has the advantage of having the second oldest population of any metropolitan area in the country, with a high proportion of elderly blacks. The low number of elderly Hispanic patients precludes the examination of factors related to their historically low rates of PPV receipt. The degree to which this intentional, modest-sized sample is representative of where nonwhites and whites obtain care is unknown. Although vaccines can be given elsewhere (eg, specialist offices, hospitals), thus resulting in underestimation of vaccination rates, we believe that in this sample, the majority of such vaccinations were captured using a confirmatory check of the network's electronic databases (most, but not all, practices were in a network).

### CONCLUSION

Time allotted for well visits and the lead nurse's own vaccination status were associated with higher patient immunization rates, after adjusting for race and age. Quality improvement initiatives for adult immunization might include strengthening the social influence of providers and/or ensuring that adequate time is scheduled for preventive care.

**Author Affiliations:** From the Department of Family Medicine and Clinical Epidemiology (MPN, MT, DEF, MR, RKZ) and the Department of

Behavioral and Community Health Sciences (RKZ), University of Pittsburgh, PA; and University of Pittsburgh Medical Center (JAH, SAW), PA.

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**Address correspondence to:** Mary Patricia Nowalk, PhD, RD, Department of Family Medicine and Clinical Epidemiology, 3518 5th Ave, Pittsburgh, PA 15261. E-mail: tnowalk@pitt.edu.

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