Raising Adult Vaccination Rates over 4 Years Among Racially Diverse Patients at Inner-City Health Centers

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OBJECTIVES: To increase adult immunizations at inner-city health centers serving primarily minority patients.

DESIGN: A before–after trial with a concurrent control.

SETTING: Five inner-city health centers.

PARTICIPANTS: All adult patients at the health centers eligible for influenza and pneumococcal vaccines.

INTERVENTION: Four intervention sites chose from a menu of culturally appropriate interventions based on the unique features of their respective health centers.

MEASUREMENTS: Immunization and demographic data from medical records of a random sample of 568 patients aged 50 and older who had been patients at their health centers since 2000.

RESULTS: The preintervention influenza vaccination rate of 27.1% increased to 48.9% ($P<.001$) in intervention sites in Year 4, whereas the concurrent control rate remained low (19.7%). The pneumococcal polysaccharide vaccine (PPV) rate in subjects aged 65 and older increased from 48.3% to 81.3% ($P<.001$) in intervention sites in Year 4. Increase in PPV in the concurrent control was not significant. In logistic regression analysis, the likelihood of influenza vaccination was significantly associated with the intervention (odds ratio (OR) = 2.07, 95% confidence interval (CI) = 1.77–2.41) and with age of 65 and older (OR = 2.0, 95% CI = 1.62–2.48) but not with race. Likelihood of receiving the pneumococcal vaccination was also associated with older age and, to a lesser degree, with intervention.

CONCLUSION: Culturally appropriate, evidence-based interventions selected by intervention sites resulted in increased adult vaccinations in disadvantaged, racially diverse, inner-city populations over 2 to 4 years. **J Am Geriatr Soc 56:1177–1182, 2008.**

Key words: influenza vaccine; pneumococcal polysaccharide vaccine; immunization; utilization; health disparities

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Racial disparities in the incidence and mortality rates of disease, access to care, treatments available and received, and preventive services offered and received have been widely documented. As a result, elimination of health disparities has become a public health priority and is one of two cardinal goals of Healthy People 2010.[1] Specific to influenza vaccination, Healthy People 2010 has set an annual goal of 90% for individuals aged 65 and older,[1] but national influenza vaccination rates in adults aged 65 and older in the most recent National Health Interview Survey were only 69% for non-Hispanic whites, 48% for non-Hispanic blacks, and 45% for Hispanics, with an overall rate for all races of 65.5%.[2] Nationally, 56% of all adults aged 65 and older have ever received a pneumococcal polysaccharide vaccine (PPV), with 61% of non-Hispanic whites, of non-Hispanic blacks, and 28% of Hispanics reporting vaccination.[3]

Based on previous work,[4,5] the investigators believed that the best way to eliminate racial disparities was to increase immunizations in practices that served high numbers of racial minorities. Since 2001, the investigators have worked with inner-city health centers that serve patient populations that consist largely of the groups least likely to be vaccinated (i.e., low-education, low-income, minority

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racial groups).[2] Using a individualized approach to select and implement interventions and overcome identified barriers to immunization, health centers shaped their immunization practices based on interventions that had been tested in other settings.[6,7] The purpose of this study was to determine the success of culturally appropriate, evidence-based interventions to improve adult vaccination rates in four health centers serving disadvantaged, racially diverse, inner-city populations by examining medical records of a sample of patients over five influenza vaccination seasons.

METHODS

Inner-City Health Centers

A before–after trial was conducted in four inner-city health centers, with the fifth center serving as a concurrent control. Two of the intervention sites were faith based, one was a federally qualified health center (FQHC), and one was a FQHC look-alike; two intervention sites were University of Pittsburgh family medicine residency practices. The non-intervention site was an FQHC. All sites served populations that were largely minority and economically disadvantaged.

Individualized, Culturally Appropriate Interventions

At each intervention site, the investigators conducted provider education on immunization, including discussions about types of interventions proven to be effective according to systematic evidence reviews.[6,7] Each site implemented patient-, provider-, and system-oriented interventions that the administration and staff believed would be most effective and feasible given the unique characteristics of each center's operational systems, staffing patterns, and patient population.

Sequence of Intervention and Environmental Issues

The enrollment was staggered over three influenza seasons; during 2001/02, two health centers (A and B) were enrolled in the study, and during each of the two subsequent seasons, one new health center was added such that, in 2002/03 there were three intervention sites, and in 2003/04, there were four intervention sites (Table 1). In 2001 but not in subsequent years, the local health department provided free vaccines to Health Centers A and B. During the study period, influenza vaccine delays or shortages occurred in 2000/01 and 2004/05. The investigators did not specifically encourage interventions in the 2004/05 season, because of the influenza vaccine shortage, or in 2005/06, because the intervention phase of the study was then over.

Table 1. Intervention Design

	Intervention Sites		Nonintervention Sites	
Year	Health Center	Patients n	Health Center	Patients n
2000/01 (preintervention)	—	0	A+B+C+D+E	568
2001/02 (Year 1)	A+B	255	C+D+E	313
2002/03 (Year 2)	A+B+C	401	D+E	167
2003/04 (Year 3)	A+B+C+D	507	E	61
2005/06 (Year 4)	A+B+C+D	507	E	61

In 2001, Health Center A implemented standing orders for nursing staff to screen adults and vaccinate, held educational sessions for all clinical staff, hung immunization posters in each examination room, played immunization videos in the waiting room, mailed reminders with a "free flu shot coupon" to all eligible adults, and set hours for walk-in influenza vaccine clinics. In 2002 and 2003, Health Center A mailed reminders to eligible patients, established walk-in influenza vaccine hours, and created a provider prompt for immunizations in its electronic medical record.

In 2001, Health Center B held an educational session for staff, established standing orders for vaccination, reviewed each patient chart, placed a vaccination reminder on the front cover of the charts of vaccine-eligible patients, held four influenza vaccination clinics in the surrounding neighborhood, hung immunization posters in all examination rooms and in the community, and established walk-in anytime vaccination during influenza season. In 2002 and 2003, Health Center B gave patient vaccination reminders to patients seen during the late summer as they left the office; established influenza vaccine clinic dates and walk-in hours and advertised them in the community.

In 2002 and 2003, Health Center C held an immunization educational session for clinical staff, sent a letter to its eligible patients, used an electronic chart prompt, scheduled nursing visits for patients to receive influenza vaccine, and hung posters in all examination rooms.

In 2003, Health Center D held an educational session including an immunization quiz for clinical and clerical staff, mailed fliers to age-eligible patients and telephoned high-risk patients, scheduled influenza vaccine clinics, established standing orders, held a vaccination poster competition in which all who entered the health center were eligible to vote, and sponsored a contest for the most prolific vaccinator. Additionally, vaccinators and vaccinees received a small treat at the time of vaccination, and posters encouraging vaccination were hung throughout the health center, including patient posters in Vietnamese and Spanish.

Health Center E served as the control group, because there was no contact between the investigators and the health center until data were being collected through medical record review.

Sample

Inclusion criteria were aged 50 and older and being a patient in the practice (having at least one visit) in 2000 and 2005. Because the nature of these practices is such that patients frequently leave and return to the practice or are not necessarily seen annually, a visit during each of the study years was not required for inclusion. From billing lists, each site developed a list of patients who were aged 50 and older (range 51–95) and had been patients at their health centers since 2000. This list was randomized, and the first 150 patients with confirmed office visits in 2000 and 2005 were selected for medical record review. In smaller sites, all eligible patients were selected, because there were fewer than 150 who met the criteria. Sample sizes were determined to be adequate, because they were estimated using an intraclass correlation coefficient (ICC)[8] to account for repeated measurement of vaccination status (a binary outcome: vaccinated vs not vaccinated) over time. Patients who receive the influenza vaccine in any given year may be more likely to receive it again. With repeated-measures analysis, the ICC adjusts for the strength of the likelihood of each patient receiving the vaccine again. Based on calculations previously developed,[9] for a statistical power of 0.80 with a two-tailed alpha-level of 0.05, a 30% preintervention vaccination rate and an ICC of 0.3, the per-group sample sizes needed with five repeated binary observations were 34 for a hypothesized postintervention rate of 50% and 129 for a hypothesized postintervention rate of 40%.

Medical Record Review

A certified honest broker,[10] that is, an individual who is trained to collect health information and provide deidentified, aggregate data to investigators, performed medical record review using an electronic spreadsheet to enter the data directly. Electronic and paper charts were reviewed to determine influenza vaccination for 2000/01 through 2005/06 and pneumococcal vaccination for all years available. An individual was considered to be vaccinated against influenza if he or she received the influenza vaccine between September 1 and February 28 each year. Basic demographic data, including age, race, and sex, were also collected.

Statistical Analysis

The primary outcome variables in this study were annual influenza vaccination status and cumulative PPV status. Preintervention PPV status was determined from receipt of PPV as noted in the medical record anytime before September 1, 2001, using as the denominator individuals who were aged 65 and older in 2000. Pneumococcal vaccination rates for subsequent years included all those vaccinated at preintervention, as well as those who were vaccinated during each year beginning September 1 and ending August 31. The denominator for subsequent (intervention) years added all individuals who turned 65 during that calendar year to the previous year's denominator. Although other subjects younger than 65 may have been eligible to receive PPV because of high-risk conditions, it was not possible to determine eligibility based on these criteria.

Descriptive statistics of demographic variables at baseline and the vaccination rates for influenza and PPV at each health center for each year were calculated. Because patient populations from specific health centers and not from the general population were used, they may have shared one or more common traits; thus, they were analyzed adjusting for this fact. Chi-square tests were used to compare the differences in vaccination rates between intervention and nonintervention sites in each year overall and according to race. The changes in vaccination rates over time were examined.

The main objective of the study was to determine whether the intervention had a significant effect on the odds of receiving influenza vaccine or PPV over the years of the study while controlling for race, age, sex, and health center. Because the data were collected for the same subjects in five health centers (clusters) for 5 years (repeated measures), the outcomes would be expected to be correlated.[11,12] Thus, PROC GENMOD in SAS 9.1 (SAS Institute Inc., Cary, NC) was used for logistic regression analysis with maximum likelihood estimation. Statistical significance was set at $P<.05$ for all tests. The University of Pittsburgh institutional review board approved this project.

RESULTS

Medical records of 568 patients with immunization and demographic information and who were seen in each of their respective health centers in 2000 and in 2005 were included in the analyses (Table 2). The mean age was 62.2 ± 8.9, with 35.7% aged 65 and older. Most participants were non-white (61.4%) and female (58.5%). Tables 3 and 4 indicate influenza and pneumococcal vaccination rates for all participants and according to racial groups for each year of the study. Influenza vaccination rates differed significantly between intervention and nonintervention sites overall in Year 1 (2001/02), Year 3 (2003/04), and Year 4 (2005/06), with no significant difference between intervention and nonintervention sites in Year 2 (2002/03). The same pattern of change was true for non-whites; although for whites, a significant difference between intervention and nonintervention sites occurred only in Year 1. When comparing intervention and nonintervention sites, rates of PPV vaccination did not increase significantly for any year of the study for the overall group of patients aged 65 and older or for either racial group.

The effectiveness of the interventions in increasing adult vaccination rates in whites and non-whites are shown in Figure 1, which includes mean data for the four intervention sites only. Rates for influenza and pneumococcal vaccination were significantly higher at Year 4 than at preintervention ($P<.001$ for overall and according to race comparisons). In the influenza graph, a second nonintervention bar has been included, because it could be argued that the influenza vaccination rate was spuriously lower in 2000/01 because of the delay in delivery of influenza

Table 2. Demographic Descriptions of Patients at Health Centers

Demographic Characteristic	Health Center A n = 151	Health Center B n = 104	Health Center C n = 146	Health Center D n = 106	Health Center E n = 61	*P*-Value
Age, mean ± standard deviation	62.4 ± 9.4	63.4 ± 8.3	61.3 ± 8.5	61.0 ± 8.8	63.5 ± 9.2	.14
Age group, %						.08
50–64	62.3	57.7	71.9	67.9	55.7	
≥65	37.7	42.3	28.1	32.1	44.3	
Female, %	68.9	33.7	54.1	58.5	85.2	<.001
Non-white, %	62.9	38.5	56.1	70.6	96.3	<.001

Table 3. Comparison of Influenza Vaccination Rates Overall and According to Race in Intervention and Nonintervention Sites According to Year

	Total (N = 568)			Whites (n = 219)			Non-Whites (n = 349)		
	Nonintervention	Intervention		Nonintervention	Intervention		Nonintervention	Intervention	
Year	n (%)		P-Value*	n (%)		P-Value*	n (%)		P-Value*
2000/01	154 (27.1)†	—	—	58 (26.5)†	—	—	96 (27.5)†	—	—
2001/02	89 (28.4)	126 (49.4)	<.001	28 (28.3)	59 (49.2)	.002	61 (28.5)	67 (49.6)	<.001
2002/03	62 (37.1)	170 (42.4)	.25	17 (48.6)	76 (41.3)	.43	45 (34.1)	94 (43.3)	.09
2003/04	13 (21.3)	226 (44.6)	.001	1 (33.3)	90 (41.7)	.63	12 (20.7)	136 (46.7)	<.001
2005/06	12 (19.7)	248 (48.9)†	<.001	0 (0.0)	105 (48.6)†‡	.14	12 (20.7)	143 (49.1)†‡	<.001

Denominators (not shown by year) vary by year, because four of the five sites transitioned over time from nonintervention to intervention sites (Table 1).
* According to chi-square tests; for cells less than 5, Fisher exact test was used.
† Difference between preintervention (2000/01) and Year 4 (2005/06), $P<.001$.
‡ Difference between whites and non-whites at Year 4, $P=.91$.

vaccine supplies. However, the influenza vaccination rate in the nonintervention sites in 2001/02 was virtually the same as the rate during the previous year, when delivery of the influenza vaccine was delayed 2 months ($P=.18$ overall, $P=.11$ for whites, and $P=.07$ for non-whites). This comparison was not necessary for PPV, because there was no shortage of vaccine. Logistic regression analyses that controlled for age, race, and sex indicated that the likelihood of influenza vaccination was two times as high for older individuals ($\geq$65) and for those in intervention sites. For PPV, likelihood of vaccination was significantly higher for older individuals and marginally higher ($P=.06$) for those in intervention sites (Table 5), with no different likelihood of vaccination between racial groups.

DISCUSSION

Medical record data indicated that individualized, culturally appropriate, evidence-based interventions increased rates of adult vaccinations in disadvantaged, racially diverse, inner-city populations over 2 to 4 years. The magnitude of change from baseline across time (33 percentage points for PPV and 21 percentage points for influenza) is clinically meaningful. Furthermore, no racial disparities were observed. In a previous report from this study, self-reported vaccination rates increased significantly in health centers implementing individualized, culturally appropriate interventions.[13]

Racial disparities in influenza vaccination and PPV rates have been found in national, cross-sectional surveys of Medicare beneficiaries, even when controlling for factors such as insurance coverage, access to a usual physician,[14] provider recommendation and awareness of recommendation to be vaccinated,[15] and positive attitudes toward vaccination.[16] Disparities may be due in part to economic limitations, differences in providers, and belief differences.[16] Although the interventions were culturally sensitive in choice of language and images and were implemented by multiracial health center staffs, they were not race based. Instead, the interventions raised immunization rates in the participating centers in both non-whites and whites.

It is likely that several factors contribute to this rise in rates. First, most sites included team input and planning in their implementation decisions so that multiple perspectives, including those of minority staff, were included.

Table 4. Comparison of Pneumococcal Vaccination Rates Overall and According to Race in Intervention and Nonintervention Sites According to Year for Subjects Aged 65 and Older at Baseline

	Total (N = 203)			Whites (n = 72)			Non-Whites (n = 131)		
	Nonintervention	Intervention		Nonintervention	Intervention		Nonintervention	Intervention	
Year	n (%)		P-Value*	n (%)		P-Value*	n (%)		P-Value*
2000/01	98 (48.3)†	—	—	35 (48.6)†	—	—	63 (48.1)†	—	—
2001/02	51 (50.0)	62 (61.4)	.10	15 (51.7)	27 (62.8)	.35	36 (49.3)	35 (60.3)	.21
2002/03	39 (63.9)	90 (63.4)	.94	8 (72.7)	40 (65.6)	.74	31 (62.0)	50 (61.7)	.98
2003/04	17 (63.0)	122 (69.3)	.51	0 (0.0)	50 (70.4)	.31	17 (65.4)	72 (68.6)	.76
2005/06	18 (66.7)	143 (81.3)†	.08	0 (0.0)	57 (80.3)†‡	.21	18 (69.2)	86 (81.9)†‡	.15

Denominators (not shown by year) vary by year, because four of the five sites transitioned over time from nonintervention to intervention sites (Table 1).
* According to chi-square tests; for cells less than 5, Fisher exact test was used.
† Difference between preintervention (2000/01) and Year 4 (2005/06), $P<.001$.
‡ Difference between whites and non-whites at Year 4, $P=.24$.

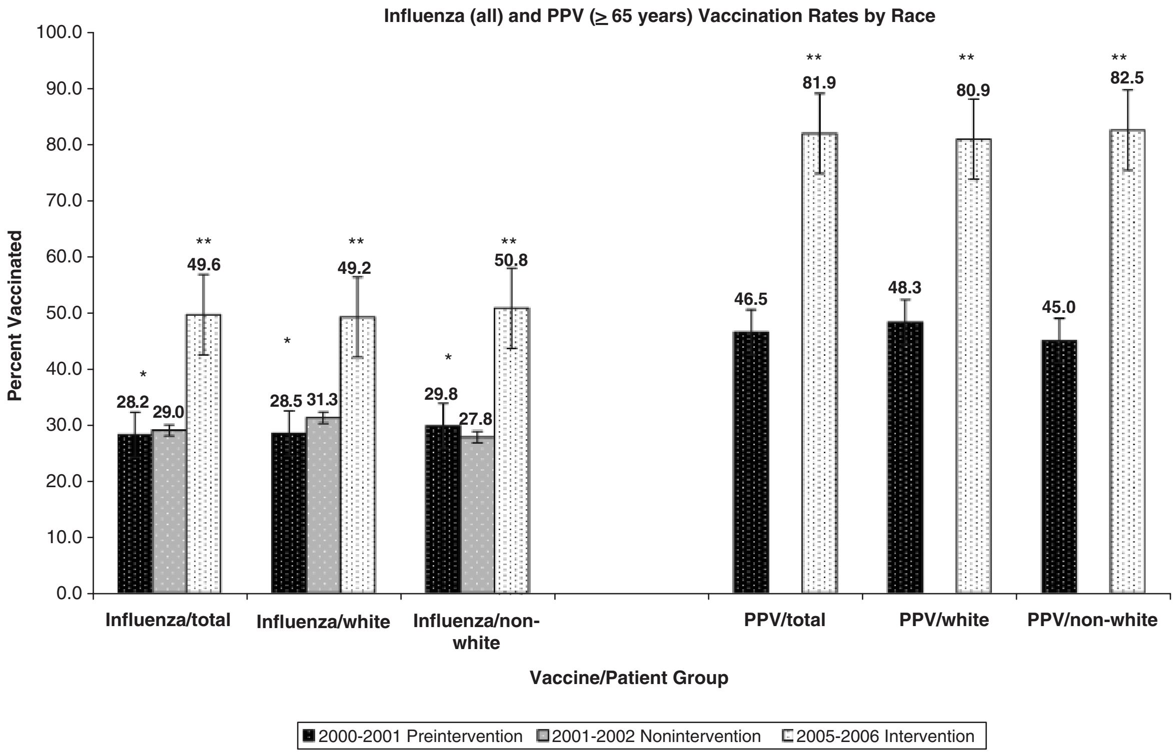

Figure 1. Influenza (all) and pneumococcal polysaccharide vaccine (PPV) (aged ≥65) vaccination rates according to race. *Difference between 2000/01 and 2001/02, $P > .05$; **Difference between 2000/01 and 2005/06, $P < .001$.

Second, these teams mostly chose evidence-based interventions,[7,17] including system-, provider-, and patient-oriented strategies, such as standing orders, provider and patient education, walk-in influenza vaccine clinics, electronic prompts, and patient reminders. The findings herein are consistent with previous findings from an intervention that consisted of a single change to office practice in which medical assistants screened for influenza vaccination and offered the vaccine under a standing order policy.[18] In that study, similar proportions of African-American (62.1%) and white (68.9%) patients accepted influenza vaccine. Third, the interventions were individualized to the culture, operational systems, staffing patterns, and patient populations of the health centers.[13,19–21] For instance, one practice with an electronic medical record had previous adult immunizations automatically loaded into the office note. The process of care was changed to include checking immunization status as part of nursing duties and as part of the electronic vital sign recording. Fourth, through their outreach work in their neighborhoods, the sites had developed a level of trust among community members; subsequently, they developed culturally sensitive applications to adult immunizations. For instance, promotional materials reflected the racial background of the patient population served. Fifth, many of the sites made concerted efforts (e.g., held staff meetings to discuss strategies, involved all staff) to have the project succeed and their dedication undoubtedly influenced the project's success.

Table 5. Results of Logistic Regression, Controlling for Repeated Measures

Independent Variable	Influenza Vaccination (N = 568)	Pneumococcal Polysaccharide Vaccination (N = 203, aged ≥65)
	Odds Ratio (95% Confidence Interval)	
Intercept	0.31 (0.24–0.40)*	0.00 (0.00–0.05)*
Intervention (reference = nonintervention)	2.07 (1.77–2.41)*	1.21 (0.99–1.47)
Non-white race (reference = white)	1.06 (0.83–1.34)	1.15 (0.66–1.98)
Aged ≥65 (reference = aged 50–64)	2.00 (1.62–2.48)*	—
Aged ≥65 (continuous)	—	1.10 (1.05–1.15)*
Female (reference = male)	0.87 (0.69–1.10)	0.98 (0.57–1.68)

* $P < .001$.

Strengths and Limitations

This project, conducted in economically disadvantaged communities resulted in clinically sizable increases in immunization rates over several years in whites and minorities. Because of the team approach to the interventions, it is likely that most interventions will be sustainable. The most common minority group among the patients in this study was African American; therefore, the results cannot be generalized to other racial groups.

The immunization data were based on actual medical record review. Because of budget constraints, a random sample of almost 600 patients was chosen to represent a patient population in the thousands. Sample size calculations indicate that this is an appropriate approach. Because record review does not capture vaccines given in community settings such as work places, grocery stores, and pharmacies, a complete inventory of all vaccines received was not available, but a previous report from the first year of this study found that, when vaccines reported in an interview to have been received in community settings were added to those documented in the medical record, the numbers were almost identical to the overall vaccination reports from the survey.[13] To study the effects of interventions over time, the study included only patients who were enrolled in the clinics over the entire study period; those who left the clinic and those recently coming to the clinic were not included. Thus, results can only be generalized to stable patient populations (even though these clinics serve many transient patients). Before this intervention, one center had instituted quality improvement efforts that included automatic chart prompts and mailed reminders; the effects of this would be to mitigate the effects of the intervention, thus strengthening these findings. A concurrent control group allowed comparison that accounts for secular trends in immunization rates.

CONCLUSION

Culturally appropriate, evidence-based interventions selected by intervention sites resulted in higher adult vaccination rates in disadvantaged, racially diverse, inner-city populations over 2 to 4 years, with no evidence of racial disparities in postintervention vaccination rates.

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Author Contributions: Mary Patricia Nowalk: project coordinator, writing of manuscript. Richard K. Zimmerman: study design, principal investigator, writing of manuscript. Chyongchiou Lin, Dwight E. Fox, and Melissa Tabbarah: data analysis, editing of manuscript. Stephen A. Wilson, Ann McGaffey, J. Todd Wahrenberger, Bruce Block, and David G. Hall: Development and implementation of interventions, editing of manuscript. Edmund M. Ricci: PI on parent disparities grant, edit manuscript.

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