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Research Paper

Delivering Pneumococcal Vaccine to a High Risk Population

The Navajo Experience

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ABSTRACT

High rates of preventable diseases such as pneumococcal disease occur among the Navajo despite their universal health insurance through the Indian Health Service. The objective of this study was to determine the proportion of Navajo adults vaccinated with pneumococcal polysaccharide vaccine and to examine key features of vaccination programs of the Navajo Indian Health Service. For this cross-sectional study, medical charts of Navajo patients with vaccine indications were randomly selected and reviewed to determine who had been vaccinated as of January 1, 1999. Among 480 Navajo ≥65 years old, 73% were vaccinated (95% confidence interval [CI]: 69%–77%). Among 111 Navajo 18–64 years old with vaccine indications, 54% were vaccinated (95% CI: 45%–63%). Vaccination programs utilized extensive public health nursing, home visits, standing orders, and "express lane" clinics. In spite of excellent delivery systems and universal healthcare, the proportion of Navajo persons vaccinated was still below the goals for Healthy People 2010 of having 90% of persons ≥65 years old vaccinated and 60% of high-risk persons 18–64 years old vaccinated.

INTRODUCTION

High rates of vaccine-preventable diseases, such as pneumococcal disease, occur among Native American populations despite having access to care that is based on universal health insurance through the Indian Health Service (IHS). The Navajo have nearly 4 times the rate of pneumococcal disease as the general U.S. population:[1-3] in 1997–1998, the annual incidence of invasive pneumococcal disease among Navajo adults was 56/100,000 for Navajo 18–64 years and 190/100,000 for those ≥65 years.[1] At present, vaccination with the 23-valent polysaccharide pneumococcal vaccine (PPV23) is the primary strategy for preventing pneumococcal disease in these adults. PPV23 is recommended for persons at high risk for pneumococcal disease or complications of the disease,[4] including individuals ≥65 years old, individuals with cetain underlying medical conditions, and certain Native American persons <65 years old who live in settings in which high rates of pneumococcal disease have been documented.[4] To examine vaccination of adults in the setting of universal healthcare (IHS), we assessed the proportion of Navajo adults who had received PPV23 and determined key features of the vaccination programs of the Navajo IHS.

METHODS

Study site. The study was conducted on the Navajo Nation, an area of >25,000 square miles of northern Arizona, western New Mexico, and southern Utah. There are ~235,000 tribal members and health care is administered by the IHS, an agency of the federal Department of Health and Human Services.

Proportion vaccinated. We randomly selected and reviewed medical charts of patients with vaccine indications and determined if patients had been vaccinated as of January 1, 1999. Participants were drawn from Navajo adults who received medical care at one of eight participating medical facilities of the IHS Navajo Area (defined as ≥ two encounters, at least one after January 1, 1994), had an indication for the vaccine, and were alive as of January 1, 1999. Participants were chosen in two groups.

1. Navajo patients who were ≥65 years old. Participants were chosen from each of the 8 service units that make up the Navajo Indian Health Service System.
2. Navajo patients who were18–64 years old with underlying conditions that qualified as vaccine indications.[4] Participants were chosen from the 2 largest service units.

We used the computer registration system of the IHS, the Resource and Patient Management System (RPMS), to identify all Navajo persons ≥65 years old or 18–64 years old with an

Table 1 **Proportion of Navajo persons age 65 and older who were vaccinated, by underlying disease (n = 480)**

Underlying Disease	Number With Disease	Number Vaccinated	Percent Vaccinated, Unadjusted	Percent Vaccinated, Weighted %[1](95% CI)
Diabetes	149	122	82%	80% (73–87%)
Cardiac disease	94	77	82%	81% (73–89%)
Lung disease	62	56	90%	91% (84–98%)
Alcoholism	53	41	77%	76% (66–87%)
Renal disease	33	21	64%	52% (34–70%)
Cancers	20	14	70%	62% (51–73%)
Rheumatologic disease	10	8	80%	74% (64–85%)
Cirrhosis or liver disease	4	4	100%	NA
Other chronic illness	3	3	100%	NA
No illness	197	119	60%	63% (56–70%)

[1]Weighted by size of the service unit. CI, confidence interval; NA, not applicable because of small numbers.

International Classification of Disease (ICD-9) code for a vaccine indication. Persons are listed in the RPMS system if they have had any encounter with the IHS in the past 5 years, including administrative encounters such as a change of address. From the lists of persons identified, we selected a random sample of their medical records to review: each patient on the lists of persons identified was assigned a random number using a random number generator, we ordered the patients by their random numbers, and we selected medical records according to that random order. Patients were only included if, when we reviewed their medical chart, we were able to confirm that they had an age-based or a medical indication for receiving the vaccine.

For both groups, we extracted information from medical records about underlying diseases and vaccination. For persons 18–64 years, we also determined the year of onset of their indication for vaccination. To ensure that we had completely ascertained vaccinations status with PPV23, for each subject chosen, we reviewed their vaccination records at all area facilities where they had received medical care until we found evidence of vaccination with PPV23 or until we had reviewed their charts at all locations. For some patients this meant that we reviewed their charts at 10 different clinical sites. Patients were considered vaccinated if they had received PPV23 at any point after 1983, the year the 23-valent vaccine became available through the IHS.

Sample size calculations. To calculate the proportion of persons ≥65 years old who were vaccinated, we selected a target sample size of 400 assuming a simple random sample and assuming that 50% of persons would be vaccinated (50% was used to maximize the sample size), with a desired precision of 5 percentage points and 95% confidence (power of 50%). This sample was broken down equally among the 8 service units (50 charts per site). To account for charts that could not be located, patients who had died, or patients who had insufficient medical encounters, we sampled a total of 560 charts.

To assess the proportion of persons aged 18–64 years old who were vaccinated, we chose a sample size of 100 and included 50 from each of the 2 largest service units. These 2 service units make up more than 40% of the population of the Navajo Nation. This sample size was chosen to provide precision within 15 percentage points. To account for charts that could not be located, patients who had died, patients who had insufficient medical encounters, or patients who did not have an indication for the vaccine on review of their medical records, we sampled a total of 200 charts.

Survey of vaccination programs. We administered a structured interview to the persons responsible for the vaccine program at the main hospitals of five of the eight service units. Questions inquired about their use of techniques for improving vaccination coverage such as home visits, standing orders, tracking methods, reminder/recall, "express lane" vaccination appointments, local clinics, and other techniques that might be used in the vaccination process.[5,6]

Analysis. To calculate the overall proportion vaccinated as of January 1, 1999, we weighted the individual service unit estimates by size of the populations served by that service unit using Excel software (Microsoft, Redmond, WA). Statistical analyses were conducted using SAS software (SAS institute, Cary, NC). Two-tailed *P*-values <.05 were considered statistically significant.

To determine which characteristics of participants affected vaccination, we used conditional logistic regression to calculate odds ratios (PROC PHREG) and used the participant's main service unit of care as a stratification variable. Age was included in all models; other variables were included in the final model if the significance level was <.05. Variables that we examined were the number of underlying diseases, the presence of diabetes, cancer, alcoholism, liver disease, cardiac disease, lung disease, rheumatologic disease, renal disease, or other chronic disease. As part of this analysis, we examined the interaction between diabetes and renal disease. For persons 18–64 years old, we also included the duration of their first underlying disease and did not include cancer, renal disease, or rheumatologic disease because of the small proportion of participants with these diseases. An odds ratio (OR) >1 indicated a condition associated with an increased probability of vaccination compared to all subjects without that condition, while an OR <1 indicated a condition associated with a decreased probability of vaccination compared to all subjects without that condition.

RESULTS

Of the 560 randomly selected persons aged ≥65 years old, 480 met the inclusion criteria and were included in the analysis (those not included had charts that could not be located, had died, or had insufficient medical encounters). Persons in this group had a median age of 73 years (interquartile range [IQR]: 69–80) and a median of one underlying illness (IQR: 0–1, range 0–5). Diabetes was the underlying illness most often found (149/480, 31%) (Table 1) and 41% (197/480) had no underlying disease. Smokers comprised only 0.8% (4/480).

Of the 200 randomly selected persons aged 18–64 years old with underlying diseases, 111 met inclusion criteria and were included in the analysis (those not included had charts that could not be located, had died, had insufficient medical encounters, or did not have an actual indication for the vaccine on review of their medical records). The median age in this group was 45 years (IQR: 31–54 years). Alcoholism was the most common underlying disease (64%, 71/111) and diabetes was the second most common (37%, 41/111) (Table 2). Smokers comprised 3% (3/111).

Proportion vaccinated. The proportion of persons ≥65 years old who were vaccinated was 73% (349/480; 95% confidence interval [CI]: 69%–77%). For individual health service units, the proportion vaccinated ranged from 67% (37/55; 95% CI: 55%–80%) to 83% (48/58; 95% CI: 73%–92%). Among persons 18–64 years old with vaccine indications, 54%

Table 2 **Proportion of Navajo persons age 18–64 years who were vaccinated, by underlying disease (n = 111)**

Underlying disease	Number with condition	Number vaccinated	Percent vaccinated (95% CI)
Alcoholism	71	30	42% (31–54%)
Diabetes	41	33	80% (68–93%)
Lung disease	12	11	92% (52–76%)
Cardiac disease	8	7	88% (65–100%)
Cirrhosis or liver disease	8	4	50% (15–85%)
Cancers	6	3	50%[2]
Renal disease	4	4	100%[2]
Rheumatologic disease	2	0	0%[2]
Other chronic illness[1]	5	4	80%[2]

[1]Human immunodeficiency virus infection, intravenous drug use, Down syndrome, Graves' disease. [2]Confidence intervals not shown for denominators < 8. CI, confidence interval.

were vaccinated (60/111; 95% CI: 45%–63%). The proportions vaccinated at each service unit were 64% (39/61; 95% CI: 52%–76%) and 42% (21/50; 95% CI: 28%–56%).

Among participants ≥65 years old, persons with lung disease had the highest rates of vaccination. Vaccination was also high among persons with diabetes and cardiac disease; fewer persons with alcoholism were vaccinated (Table 1). Among participants 18–64 years old, persons with diabetes, lung disease, and cardiac disease had the highest proportions who were vaccinated whereas persons with alcoholism had the lowest (Table 2).

Factors that affected vaccination. For participants ≥65 years old, controlling for age and stratified by service unit, diabetes (OR 2.5 [1.5–4.3]), cardiac disease (OR 2.0 [1.1–3.6]), lung disease (OR 4.0 [95% CI: 1.6–9.7]) and renal disease (OR 0.3 [95% CI: 0.13–0.7]) influenced the likelihood of being vaccinated. Persons with diabetes, cardiac disease, and lung disease were thus more likely to be vaccinated than persons without those conditions, while persons with renal disease were less likely to be vaccinated than were persons without renal disease. The interaction term examining the interaction between renal disease and diabetes was not significant and therefore was not used in the model.

For participants who were 18–64 years old, controlling for age and stratified by service unit, factors that significantly affected vaccination were diabetes (OR 12 [95% CI: 3.0–50]) and the duration of their first underlying disease (1–2 years: reference/ 3–4 years: OR 17 [95% CI: 2.1–132] / 5–6 years, OR: 14 [95% CI: 1.6 –121] / ≥7 years, OR: 20 [95% CI: 3–128]).

Description of vaccination programs. All eight sites used a blue form in the medical chart to track immunizations; this form is the only item in the chart that is colored blue. Since the same chart held outpatient and inpatient records, the blue form is always present when a clinician has the chart. In addition, all of the sites used a computerized system (the IHS' RPMS) to track immunizations; although in some sites it is used more reliably than in others. While the Navajo Nation is a large, rural area, access to medical care is facilitated by the availability of clinics dispersed throughout the area, so that clinics are available locally. As Native Americans, all Navajo persons are eligible to receive health care free-of-charge at IHS facilities. Because the Navajo Nation is geographically contiguous and distinct, persons who live on the reservation or the surrounding areas consistently obtain care at IHS facilities.

Five of eight service units were included in the survey of vaccination programs. Each of the five had extensive public health nursing programs for high-risk patients; three reported having outreach programs that included going to patient homes. All five sites reported having standing orders for vaccination of outpatients, and two sites had standing orders for inpatients. Three of the sites used a formal patient reminder/recall system; four had "express lane" clinics for vaccination. All five reported a strong emphasis on vaccination and on reviewing a patient's immunization record at every visit.

DISCUSION

With 73% of Navajo ≥65 and 54% of Navajo 18–64 years old being vaccinated, the proportion of persons vaccinated with pneumococcal vaccine was high among adult Navajo and was much higher than in the general population. For the general United States' population in 1999 (the year of this study), only 50%–61% of ≥65 years old were vaccinated; in 1997, 11%–25% of high-risk 18–64 year olds were vaccinated.[7-9] Although high, vaccination among Navajo adults still did not reach Healthy People 2010 goals of having 90% of persons ≥65 years old and 60% of high-risk persons 18–64 years old vaccinated.[10]

Persons with certain underlying illnesses were more likely to be vaccinated; these persons may have more frequent office visits and therefore more opportunities to be vaccinated. Alternatively, they may be more likely to receive the vaccine because their disease is a well-recognized indication and so they are targets of programs for vaccination. A smaller proportion of persons 18–64 years old were vaccinated than of those ≥65 years old; this discrepancy also occurs in the general population.[8] Higher rates of vaccination among Navajo ≥65 years old suggest that recommendations for vaccination that are based on age may be easier to implement than those based on the presence of specific diseases.

Although the study did not have adequate power to compare the proportions of patients vaccinated among sites, the rates of vaccination did appear to vary from site to site. Future studies may more completely elucidate the most successful features of vaccination programs at the different sites and could evaluate individual-level factors associated with failure to receive vaccine. A more detailed study is currently underway to evaluate the impact of other factors that could influence vaccination coverage such as public awareness of the vaccine and attitudes held by providers.

Because the study participants only included those persons registered at one of the IHS health clinics, it is possible that we have overestimated vaccination in this population. This may be particularly true since there are large discrepancies in health care among American Indians who qualify for and who utilize the health care offered by the IHS and those who do not.[11,12] However, data from another study we are performing suggests that vaccination is indeed high throughout the Navajo population. In that study, 86% of Navajo ≥65 years old and living in the community were vaccinated (authors' data).

Because the Navajo population has universal access to health care through the IHS and is serviced by extensive public health nursing, outreach programs, and vaccination programs, it may represent a "best case scenario" for a system of delivery of vaccines to adults. Yet, the proportion of persons vaccinated remains less than Healthy People 2010 goals. Additional research to identify the cultural, systems-related or resource-related barriers may be necessary to create innovative, culturally based programs to vaccinate higher proportions of the population.

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