

ORIGINAL RESEARCH & CONTRIBUTIONS

# Napa Immunization Study: Immunization Rates for Children with Publicly Funded Insurance Compared with those with Private Health Insurance in a Suburban Medical Office

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## Abstract

**Introduction:** Healthy People 2020 set a goal to increase the proportion of children who receive the recommended doses of Diphtheria Tetanus and Pertussis, polio, measles mumps and rubella, Haemophilus influenzae type b, hepatitis B, varicella and pneumococcal conjugate vaccines to 80% from the 2009 baseline rate of 69%. The purpose of this study is to compare the recommended immunization rates for low-income children insured through publicly funded health insurance (PFI) to the rates for children with private health insurance (PHI) in a suburban medical office.

**Methods:** The immunization rates and health access measures of 109 children ages 24 to 48 months who had PFI were compared with 300 children of the same age with PHI in the same medical practice.

**Results:** Overall immunization rates for the study population were very high and exceeded the Healthy People 2020 goals for full immunization. Children with PFI had lower rates of immunization and fluoride prescriptions; however the differences were only significant in the cohort of children age two years. By three years of age, the immunization rates and the fluoride prescription rates were similar. There were no significant differences in health outcomes for Spanish-speaking compared with English-speaking children.

**Discussion:** Barriers to successful immunization practices and strategies to overcome those barriers are discussed.

**Conclusion:** The successful immunization practices and secondary outcomes in this study are a reflection of the integrated care model in this practice that facilitates comprehensive, coordinated, and accessible care for patients and allows physicians and support staff to practice culturally sensitive and compassionate care—the definition of a medical home.

## Introduction

Healthy People 2020 set a goal to: “Increase the proportion of children aged 19 to 35 months who receive the recommended doses of DTaP, polio, MMR, Hib, hepatitis B, varicella and PCV vaccines.”<sup>1</sup> The target for full immunization with the recommended doses of each vaccine was set at 90% and for the complete series of all of these immunizations at 80%. The most recent data from 2009 as reported by the National Immunization Survey showed that only 69% of US children received the full set of recommended immunizations—well below the Healthy People 2020 target.<sup>2</sup>

The primary goals of the Children’s Health Initiative (CHI)-Napa County are that every child in Napa County has health insurance and that every child in Napa County has access to comprehensive health care and a primary care home. CHI-Napa County has enrolled virtually every low-income child in Napa County up to age 18 with health insurance (Mark Diel, MPH, personal communication; 2011 Jan 18).<sup>3</sup> However, insuring a child and providing access to health care may not be sufficient to assure comprehensive health care for children. Childhood immunization is a good proxy for access to health care.<sup>3</sup> This study examines the immunization rates and preventive care of low-income children compared with those with employer-based and/or private health insurance (PHI) in a suburban group medical practice. The benefits of a medical home to facilitate childhood immunization are discussed.

## The Uninsured Child

Children without health insurance have poor access to health care. The National Health Interview Survey in 2002 reported “Fifteen percent of uninsured children had not had contact with a doctor or other health professional in more than 2 years (including those who never had a contact) compared with 3% for

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children with private insurance coverage or children with Medicaid.<sup>4p5</sup> Children who are uninsured are significantly more likely to have unaddressed health care needs and to have delays in needed care.<sup>5</sup> The same study showed uninsured children to be far less likely to have a usual place of care and much less likely to have well-child care visits.

The 2003 report on Health Insurance Coverage in America reported that 64% of the uninsured are in low-income families.<sup>6</sup> The report showed that in 2002, 21% of children younger than age 19 years were uninsured and the numbers of the uninsured were rising 10% per year from 2000 to 2003. Significant ethnic disparities were seen in the uninsured; for example, although Hispanics made up 15% of the population, they accounted for 29% of the uninsured. The numbers of uninsured dropped over the next 3 years, nonetheless, by 2006, nearly 12% of US children younger than age 18 years still lacked health insurance. There were also significant disparities in the uninsured child. In 2006, 19.3% of poor children were uninsured and 22.1% of Hispanic children were uninsured.<sup>7</sup>

### State Children's Health Insurance Program and Children's Health Initiatives

In 1997, in response to rising numbers of uninsured children, the US Congress passed the State Children's Health Insurance Program (S-CHIP) to extend health insurance coverage to children beyond the limits of the federal Medicaid program. In response to this new funding source, California developed the Healthy Families program to provide medical coverage to children up to 250% of the federal poverty level (FPL). Through additional funding from the California Endowment, pilot projects were created to extend health insurance coverage to undocumented children, resulting in the formation of the first CHI in Santa Clara County in 2000.<sup>8</sup> As of 2008, there were over 30 county CHI programs throughout California coordinating health coverage to children who lack health insurance.

CHIs in California enroll low-income children in publicly funded health insurance (PFI) and dental insurance through a number of programs on the basis of income and legal status. Medi-Cal, the California version of the federal Medicaid program, provides care to children up to 133% of the FPL. Healthy Families is a program that is funded through the S-CHIP program and is designed for legal residents up to 250% of the FPL. Healthy Kids and the Kaiser Permanente (KP) Child Health Plan are privately funded programs that extend health and dental insurance to children up to 250% of the Federal

Poverty Level and who do not qualify for Medi-Cal or the Healthy Families programs.

Provision of stable health insurance coverage has been shown to benefit children. Children are more likely to receive proper preventive services and to be up to date for their immunizations when they have stable health coverage.<sup>9</sup> Children with stable health insurance have been shown to be more likely to have a regular clinician and to have a marked decrease in unmet needs and delayed care.<sup>10</sup>

Publicly funded health insurance programs often have cumbersome enrollment processes and retention of coverage may be difficult, particularly for those who are socioeconomically challenged. Disruptions in health insurance for children have been shown to result in lower immunization status, postponed care, and a decrease in medication prescriptions.<sup>11</sup> County-based CHIs have been formed to assist in outreach, enrollment and retention of health insurance status for low-income children in California.

### Napa County Children's Health Initiative

The CHI-Napa County was established in 2005. Initial funding was provided by the Blue Shield of California Foundation, First Five Napa County, First Five California, KP, Napa Valley Vintners, Queen of the Valley Hospital, St Joseph's Health System Foundation, the California Endowment, the County of Napa, and the United Way of the Bay Area. Initial estimates provided by the 2005 California Health Interview Survey indicated between 736 to 3616 children ages 0 to 18 years were uninsured. CHI-Napa County was launched "to secure affordable health insurance for lower income children and to connect them with the healthcare services they need."<sup>12</sup> In 2010, CHI-Napa County was case managing over 8500 low-income children in PFI products (Mark Diel, MPH, personal communication; 2011 Jan 18).<sup>a</sup>

The PFI programs available to Napa County children are Medi-Cal, Healthy Families, Healthy Kids, and the KP Child Health Program. Funding for the Healthy Kids program in Napa County was discontinued in 2008 and the 1300 children who had Healthy Kids coverage were subsequently enrolled in the KP Child Health Plan.

Although CHI-Napa County has been very effective in enrolling children and helping them retain health insurance, CHI-Napa County does not have the capability of assessing outcomes, such as preventive care visits or immunization rates of its case managed clients.

**... tens of thousands of children and adults in the US continue to develop vaccine-preventable diseases."**

### Immunizations and Child Health

Deaths from infectious diseases in the US rose 58% from 1980 to 1992 and remain a significant cause of illness and disability.<sup>1</sup> Vaccines can prevent many of these diseases and childhood vaccination has helped to nearly eliminate diseases such as polio, measles, and rubella. Healthy People 2020 noted: “Consideration of indirect savings—prevention of work loss by parents to care for ill children and prevention of death and therefore lost earnings from disability—shows that vaccines routinely recommended for children are highly cost saving.”<sup>1</sup> Burns reported that: “Rates of pertussis, measles, and other previously common childhood illnesses have plummeted thanks to the wide administration of effective vaccines to the pediatric population. However, tens of thousands of children and adults in the US continue to develop vaccine-preventable diseases.”<sup>12</sup> Guerra et al reported that in 2005, “... only 17% of 24- to 35-month-old children were vaccinated with 6 recommended vaccines on time, and 37% experienced a delay of >6 months for at least 1 vaccine.”<sup>13</sup>

### Healthy People 2020

On December 2, 2010, Healthy People 2020 launched its 10-year health agenda for the US. Goal (IID-8) of Healthy People 2020 is to “Increase the proportion of children aged 19 to 35 months who receive the recommended doses of DTaP, polio, MMR, Hib, hepatitis B, varicella and PCV vaccines.”<sup>1</sup> Healthy People 2020 reports that for each birth cohort immunized at the recommended level, the US would save 33,000 lives, prevent 14 million cases of disease, and reduce health costs by almost \$10 billion. Despite this recommendation, approximately 42,000 adults and 300 children die each year in the US from vaccine-preventable illness.<sup>1</sup>

The Centers for Disease Control and Prevention (CDC) has been monitoring immunization coverage in the US since 1994 through the National Immunization Survey, which is conducted by the National Center for Immunization and Respiratory Diseases and the National Center for Health Statistics. The most recent immunization level for children receiving the full set of immunizations was 69% as reported by the National Immunization Survey on the 2009 survey. This was higher than the rate of 68% on the 2008 survey.<sup>1</sup> Targets, goals, and 2009 baselines for individual vaccines are listed in Table 1.

### Goals of this Study

The primary outcome of this study is to compare the recommended immunization rates for low-income children insured through PFI with immunization rates for children with PHI in the same medical office. Secondary outcomes will compare children with PFI with those with PHI for linkage to a personal primary care physician (PCP), presence of preventive well-child visits, and prescription of fluoride as recommended for children in Napa County.

### Methods

#### Study Design

This study is a cross-sectional survey of the immunization status and selected markers of health care access for children ages 2 years to 3 years receiving health care at the KP medical offices in Napa, California. All study procedures were approved by the Touro University, California Investigational Review Board.

#### Study Setting

All children in this study are covered by the Kaiser Foundation Health Plan, Inc (Health Plan) and are assigned to receive their medical care at the KP medi-

**Table 1. Baseline immunization status 2009 and targets for Healthy People 2020.<sup>1</sup>**

| Immunization    | Number of doses | No. (%)    | Target (%) | US baseline | CA baseline |
|-----------------|-----------------|------------|------------|-------------|-------------|
| DTaP            | 4               | 370 (90.5) | 90         | 83.9        | 83.4        |
| Polio           | 3               | 380 (92.9) | 90         | 92.8        | 92.4        |
| MMR             | 1               | 383 (93.6) | 90         | 90.0        | 90.1        |
| Hib             | 3               | 383 (93.6) | 90         | 83.6        | 85.5        |
| Hepatitis B     | 3               | 378 (92.4) | 90         | 92.4        | 89.9        |
| Varicella       | 1               | 382 (92.4) | 90         | 89.6        | 89.9        |
| PCV             | 4               | 360 (88.0) | 90         | 80.4        | 79.9        |
| Fully immunized | 19              | 345(84.4)  | 80         | 69.0        | 70.8        |

<sup>1</sup> Center for Disease Control and Prevention. Statistics and surveillance: 2009 table data [table on the Internet]. US Department of Health and Human Services: Centers for Disease Control and Prevention; late updated 2010 Nov 16 [cited 2011 Nov 23]. Available from: [www.cdc.gov/vaccines/stats-surv/nis/data/tables\\_2009.htm](http://www.cdc.gov/vaccines/stats-surv/nis/data/tables_2009.htm), click on Coverage with Individual Vaccines and Vaccination Series: by State and Local area (includes birth dose of HepB and 2+ doses Hep A) Excel file.

DTaP = diphtheria, tetanus, and pertussis; Hib = Haemophilus influenzae type B; MMR = measles, mumps, and rubella; PCV = pneumococcal conjugate vaccine.

cal offices at 3285 Claremont Way, Napa, CA, 94558. Pediatricians and family medicine physicians of The Permanente Medical Group provided medical care.

### Study Sampling Procedure

A list of children younger than age 4 years with active Health Plan insurance who reside in zip codes within Napa County was obtained from the Medical Office Controller in January 2011. The list comprised 2356 names.

**Inclusion Criteria.** Children ages 24 through 48 months who reside in zip codes 94558 and 94559 with active Health Plan insurance for at least 6 months before December 31, 2010 were eligible to participate in this study. There were 312 children born between January 1, 2007 and December 31, 2007 and 269 children born between January 1, 2008 and December 31, 2008 who met the inclusion criteria. These 581 children were the eligible study population. Table 2 describes sampling details.

**Exclusions.** Children who reside outside of the city of Napa were excluded. Children in the northern and southern areas of Napa County often receive their health care at facilities other than the Napa medical office building. There were 2118 children with Health Plan insurance less than age 48 months who resided in zip codes 94558 and 94559.

Children with health insurance for <6 months were excluded. Six months of active health insurance should be sufficient to allow catch up immunizations for children new to Health Plan. Healthcare Effectiveness Data and Information Set (HEDIS) requires 12 months of active health insurance with no more than a 45-day gap in coverage for its audits of immunization status. The author considered the 12-month requirement to be too long a time period given the need for children at this age to be up to date on their immunizations as soon as possible. There were 1613 children younger than age 48 months in zip codes 94558 and 94559 who had active Health Plan insurance before July 1, 2010.

Children younger than age 24 months were excluded and children older than age 48 months were excluded. All primary immunizations in this study are due by age 18 months. The 24- to 48-months age groups are consistent with other studies assessing immunization status in children.<sup>14</sup>

One three-year-old child with De George syndrome was excluded from the study because immunization with live virus vaccine is contraindicated because of this child's immune deficiency.

### Study Procedure

Data extraction was done by the author in the author's office in the KP medical office building in Napa.

**Table 2. Population sample description**

| Sampling Step                                    | Sample |
|--|--------|
| Children under age 48 months                     | 2356   |
| Children in zip codes 94558 and 94559            | 2118   |
| Kaiser Foundation Health Plan in effect 7/1/2010 | 1613   |
| Born between 1/1/2007 and 12/31/2008             | 581    |
| No medical contraindications to immunization     | 580    |

The electronic medical record (EMR) was reviewed and the following data was extracted: presence of personal PCP, documentation of office visits and well-child visits, the primary language used in the home, evidence of fluoride prescription in the pharmacy record, type of active health insurance, and the immunization history as documented in the immunization section of the EMR. If there were no immunizations noted, the problem list was opened to see if a reason for lack of immunizations was noted. Details of office visits, laboratory studies or personal communications between the patient, parents, or physician were not reviewed.

Each child in the study was given a unique identification number. This unique number was used to identify the study participant in the active data file. The active study file did not contain any personally identifiable information.

Health care visits and immunizations given through December 31, 2010 were included in the study. An immunization was recorded as given if that specific immunization and date of administration was documented in the EMR.

### Identification of Type of Health Insurance

Several children had more than one type of health insurance during the study period. The most common variations were children switching between Medicaid, Healthy Families, or employer-supplied Health Plan insurance. The most recent active health insurance (ie, the type of insurance in effect for December 2010) was used in assigning the insurance type. Commercial insurance was listed as PHI. Medicaid, Healthy Families and the KP Child Health Plan were considered PFI.

### Sample Size Calculations: Selection of Participants from the Eligible Study Population

**Publicly funded group.** All children between ages 24 and 48 months with PFI were included in the study. There were 55 children in Cohort A (children age 2 years) and 54 children in Cohort B (children age 3 years) who had PFI. The EMRs of 100% (109 children) of this PFI study group population were reviewed.

**Private health insurance group.** The PHI comparison

| Insurance Type                      | Children age 2 years | Children age 3 years | Total |
|-------------------------------------|----------------------|----------------------|-------|
| Private insurance                   | 150                  | 150                  | 300   |
| Kaiser Permanente Child Health Plan | 26                   | 22                   | 48    |
| Medi-Cal                            | 25                   | 18                   | 43    |
| Healthy Families                    | 4                    | 14                   | 18    |

group was selected from the remaining 471 eligible children. With an estimated immunization rate of 85%, a sample of 300 PHI children was considered adequate to assure with 99% confidence that the sample would not differ by more than 3.2% from the true population proportion. One hundred fifty children age 2 years and 150 children age 3 years were selected by sorting the birthdays of the children by birth date so that the first 150 children with PHI in both Cohort A and Cohort B were selected. The study participants by insurance type are listed in Table 3.

#### Outcomes and Statistical Analysis

*Primary Outcome Measure.* Children ages 24 through 48 months who had 4 diphtheria, pertussis and tetanus (DTaP), 3 polio, 1 measles mumps and rubella (MMR), 3 Haemophilus influenzae type b (Hib), 3 hepatitis B, 1 varicella, and 4 pneumococcal conjugate vaccine (PCV) immunizations (listed on the

National Immunization Survey as 4:3:1:3:3:1:4) were counted as fully immunized. A child lacking even one immunization was considered not fully immunized. This is consistent with the goals of Healthy People 2020 and the state of California requirements for entering primary school.

The HEDIS immunization goals were changed in 2009 to include hepatitis A, rotavirus, and influenza vaccines. Because these changes to immunization recommendations occurred during the study period, the three additional vaccines were not included.

*Secondary Outcome Measures.* Linkage of a child to a personal PCP was recorded. Documentation of medical office visits and well-child preventive care visits was noted. There is no fluoride in the water in Napa County and fluoride prescription is recommended for all children in Napa County. Documentation of having a fluoride prescription filled in the KP pharmacy was noted.

*Design and Statistical Analysis.* The primary outcome variables (fully immunized or not fully immunized) were tested against the exposure variables (PFI compared with PHI). The secondary outcome of presence or absence of a fluoride prescription was also compared by insurance status. Results were stratified by age. These outcomes were also compared by language. Chi-square analysis was used to assess statistical significance for the dichotomous primary

| Cohort           | Cohort of children age 2 years<br>January 1, 2008 to<br>December 31, 2008 |     | Cohort of children age 3 years<br>January 1, 2007 to<br>December 31, 2007 |     | Total |
|------------------|---|-----|---|-----|-------|
|                  | PFI   | PHI | PFI   | PHI |       |
| Insurance type   |   |     |   |     |       |
| Number           | 55  | 150 | 54  | 150 | 409   |
| Spanish speaking | 13  | 26  | 31  | 25  | 95    |

PFI = publicly funded health insurance; PHI = private health insurance.

| Immunization               | Publicly funded health insurance<br>No. (%) | Private health insurance<br>No. (%) | Odds Ratio | Confidence Interval | p value |
|----------------------------|---|-------------------------------------|------------|---------------------|---------|
| 4 DTaP <sup>a</sup>        | 92 (84.4)                                   | 278 (92.7)                          | 0.428      | 0.218, 0.842        | 0.012   |
| 3 IPV <sup>a</sup>         | 94 (86.2)                                   | 286 (95.3)                          | 0.307      | 0.143, 0.659        | 0.002   |
| 1 MMR                      | 99 (90.8)                                   | 284 (94.7)                          | 0.558      | 0.245, 1.270        | 0.159   |
| 3 Hib <sup>a</sup>         | 94 (86.2)                                   | 289 (96.3)                          | 0.239      | 0.106, 0.537        | < 0.001 |
| 3 Hepatitis B <sup>a</sup> | 95 (87.2)                                   | 283 (94.3)                          | 0.408      | 0.194, 0.858        | 0.015   |
| 1 VAR                      | 99 (90.8)                                   | 283 (94.3)                          | 0.595      | 0.264, 1.342        | 0.207   |
| 4 PCV <sup>a</sup>         | 49 (45.0)                                   | 271 (90.3)                          | 0.087      | 0.051, 0.150        | < 0.001 |
| Fully Immunized            | 85 (78.0)                                   | 261 (87.0)                          | 0.529      | 0.301, 0.931        | 0.025   |

<sup>a</sup> Statistically significant difference in immunization rates between PHI and PFI groups

DTaP = diphtheria, tetanus, and pertussis; Hib = Haemophilus influenzae type B; IPV = inactivated polio vaccine; MMR = measles, mumps, and rubella; PCV = pneumococcal conjugate vaccine; PFI = publicly funded health insurance; PHI = private health insurance; VAR = varicella.

outcome of immunization status and the secondary outcome of fluoride prescription. When the number of patients in the 2x2 table was 6 or less, the Fisher Exact Probability Test was used to calculate p values. P values <0.05 were considered significant. Odds ratios (OR) with 95% confidence intervals (CI) were used to compare immunization status and fluoride prescription status between the study groups.

## Results

A total of 409 children, who were age 2 and 3 years as of December 31, 2010 and who were assigned to the KP clinic in Napa were included in this study. Three hundred children had PHI and 109 children had PFI. An overview of the study participants is seen in Table 4.

There were 55 children age 2 years and 54 age 3 years in the PFI group. There were 150 children age 2 years and 150 age 3 years in the PHI group. Ninety-five (23.2%) of the participants identified their primary language as Spanish.

Overall, the participants in this study achieved high levels of immunization. The immunizations rates exceeded the Healthy People 2020 goals for each immunization in this study, except for PCV, for which they achieved an 88.0% immunization rate. Overall immunization rates by vaccine are listed in Table 1.

There were, however, significant differences in immunization rates between the PHI and PFI groups. The prevalence of being fully immunized with all 19 required vaccines was significantly lower for the PFI group at 78.0% compared with 87.0% for the PHI group (OR 0.529, CI 0.301 - 0.931,  $p = 0.025$ ). The immunization rate for pneumococcal vaccine showed the largest difference between the 2 groups and was only 45% for the PFI group compared to 90.3% for the PHI group (OR 0.087, CI 0.051 - 0.150,  $p < 0.001$ ). Only with vaccines requiring one injection (MMR and varicella) were rates of immunization not significantly

| Cohort                  | All Children | PHI         | PFI        |
|-------------------------|--------------|-------------|------------|
| A: Children age 2 years | n = 205 (%)  | n = 150 (%) | n = 55 (%) |
| Fully immunized         | 173 (84.4)   | 132 (88.0)  | 41 (74.5)  |
| - lack 1                | 9 (4.4)      | 7 (4.7)     | 2 (3.6)    |
| - lack 2 or more        | 23 (11.3)    | 11 (7.3)    | 12 (21.8)  |
| Refused immunization    | 2 (1.0)      | 1 (0.7)     | 1 (1.8)    |
| B: Children age 3 years | n = 204      | n = 150     | n = 54     |
| Fully immunized         | 172 (84.3)   | 128 (85.3)  | 44 (81.5)  |
| - lack 1                | 11 (5.4)     | 8 (5.3)     | 3 (5.6)    |
| - lack 2 or more        | 21 (10.3)    | 14 (9.3)    | 7 (13.0)   |
| Refused immunization    | 5 (2.5)      | 4 (2.7)     | 1 (1.9)    |

PFI = publicly funded health insurance; PHI = private health insurance.

different between the PFI and PHI groups. Table 5 demonstrates the immunization rates between the PFI and PHI groups by vaccine.

There were also differences in immunization rates between Cohort A and Cohort B. Table 6 shows the number and extent of children lacking immunizations by age and insurance type. The parents of 7 children (2 children age 2 years and 5 children age 3 years) in this study (1.7%) refused to have their children immunized. The parents of years refused immunizations. Of those 7 refusals, 5 were in the PHI group and 2 were in the PFI group. The reasons for refusal of immunization were not documented in the medical records.

The difference in rates of full immunization status between the PFI and PHI groups as a whole was primarily because of the lower immunization rates for PFI children in Cohort A (OR 0.399, CI 0.182 - 0.872,  $p = 0.019$ ). Table 7 shows the compliance rates for the individual immunizations by insurance type for Cohort A. Table 8 shows the compliance rates for the individual immunizations by insurance type for Cohort B. By age 3 years, the rate of full immunization status for PFI children was still lower than for PHI children, but the

|                          | All<br>n = 204 (%) | PHI<br>n = 150 (%) | PFI<br>n = 54 (%) | Odds<br>ratio | Confidence<br>interval (low) | Confidence<br>interval (high) | p value |
|--------------------------|--------------------|--------------------|-------------------|---------------|------------------------------|-------------------------------|---------|
| DTaP                     | 180 (87.8)         | 137 (91.3)         | 43 (78.2)         | 0.371         | 0.155                        | 0.888                         | 0.022   |
| Polio <sup>a</sup>       | 189 (92.2)         | 144 (96.0)         | 45 (81.8)         | 0.208         | 0.07                         | 0.617                         | 0.004   |
| MMR <sup>a</sup>         | 192 (93.7)         | 144 (96.0)         | 48 (87.3)         | 0.286         | 0.092                        | 0.892                         | 0.031   |
| Hib <sup>a</sup>         | 192 (93.7)         | 147 (98.0)         | 45 (81.8)         | 0.102         | 0.027                        | 0.393                         | <.001   |
| Hepatitis B <sup>a</sup> | 190 (92.7)         | 144 (96.0)         | 46 (83.6)         | 0.24          | 0.079                        | 0.727                         | 0.012   |
| Varicella <sup>a</sup>   | 190 (92.7)         | 142 (94.7)         | 48 (87.3)         | 0.451         | 0.149                        | 1.365                         | 0.131   |
| PCV                      | 180 (87.8)         | 136 (90.7)         | 44 (80.0)         | 0.453         | 0.188                        | 1.092                         | 0.072   |

<sup>a</sup> Fisher Exact Probability Test used for these p values. Other p values by  $\chi^2$  analysis

DTaP = diphtheria tetanus and pertussis; Hib = Haemophilus influenzae type B; MMR = measles mumps and rubella; PCV = pneumococcal conjugate vaccine; PFI = publicly funded health insurance; PHI = private health insurance.

**Table 8. Immunizations for Cohort B (age 3 years)**

|                          | All<br>n = 205 (%) | PHI<br>n = 150 (%) | PFI<br>n = 55 (%) | Odds<br>ratio | Confidence<br>interval (low) | Confidence<br>interval (high) | p value |
|--------------------------|--------------------|--------------------|-------------------|---------------|------------------------------|-------------------------------|---------|
| DTaP <sup>a</sup>        | 190 (93.1)         | 141 (94.0)         | 49 (90.7)         | 0.521         | 0.177                        | 1.54                          | 0.183   |
| Polio <sup>a</sup>       | 191 (93.6)         | 142 (94.7)         | 49 (90.7)         | 0.46          | 0.152                        | 1.392                         | 0.139   |
| MMR <sup>a</sup>         | 191 (93.6)         | 140 (93.3)         | 51 (94.4)         | 0.911         | 0.274                        | 3.033                         | 0.546   |
| Hib <sup>a</sup>         | 191 (93.6)         | 142 (94.7)         | 49 (90.7)         | 0.46          | 0.152                        | 1.392                         | 0.138   |
| Hepatitis B <sup>a</sup> | 188 (92.2)         | 139 (92.7)         | 49 (90.7)         | 0.646         | 0.227                        | 1.841                         | 0.287   |
| Varicella                | 192 (94.1)         | 141 (94.0)         | 51 (94.4)         | 0.814         | 0.24                         | 2.758                         | 0.479   |
| PCV                      | 180 (88.2)         | 135 (90.0)         | 45 (83.3)         | 0.5           | 0.21                         | 1.192                         | 0.112   |

<sup>a</sup> Fisher Exact Probability Test used for these p values. Other p values by  $\chi^2$  analysis  
 DTaP = diphtheria tetanus and pertussis; Hib = Haemophilus influenzae type B; MMR = measles mumps and rubella; PCV = pneumococcal conjugate vaccine; PFI = publicly funded health insurance; PHI = private health insurance.

difference was not statistically significant (OR 0.756, CI 0.332 - 0.172, p = 0.502). Immunization status by cohort is summarized in Table 9.

Spanish-speaking children had similar rates of full immunization between the PFI and PHI groups. As a group, Spanish-speaking children had a slightly higher, although not significant, rate of full immunization compared with English-speaking children (OR 1.55, CI 0.774 - 3.11, p = 0.213) as seen in Table 10.

Table 11 shows the primary and secondary outcomes by age and type of insurance. The secondary outcomes were used as surrogates to assess health care access and quality of care for the children in this study.

Every child in this study was linked to a personal PCP. Nearly 100% had a medical office visit documented in the EMR. There was a very high rate of well-child preventive care visits at 98.3% overall: 99.7% of patients with PHI and 94.5% for children with PFI had a well-child visit documented in the EMR.

Fluoride was prescribed to 84.8% of the children in both cohorts. The rate was significantly lower for children in the PFI group at 78.0% compared with 87.3% for children in the PHI group (OR 0.514, CI 0.292 - 0.905, p = 0.019). The low number for the PFI group was almost entirely because of the 65.5% level for Cohort A. The Cohort A PFI group was significantly less likely to have fluoride prescribed than

the Cohort B PFI group (OR 0.193, CI 0.066 - 0.566, p = 0.001). Provision of fluoride was nearly identical between the Spanish-speaking and English-speaking patients in this study. Table 12 shows fluoride prescriptions by insurance type and by language.

**Discussion**

**Primary Outcome**

The major finding of this study is that children ages 2 and 3 years in the KP medical offices in Napa, CA achieved very high rates of immunization and exceeded the Healthy People 2020 goals for each immunization except PCV, which missed the target by 2.0%. The rate of full immunization with all 19 recommended doses of vaccine was 84.4%, exceeding the Healthy People 2020 target of 80% and markedly exceeding the 2009 National Immunization Survey baseline of 69%. Although there were significant differences in vaccination rate between children with PFI and children with PHI, these differences were almost entirely because of low vaccination rates in Cohort A with PFI. By age 3, the differences in immunization rates between children with PFI and children with PHI were not significant and both groups achieved nearly the same rates for each vaccine and for full immunization status.

**Secondary Outcomes**

All of the children in this study had a personal PCP. Ninety-nine percent of children in this study had an office visit and over 98% had a preventive well-child visit. There was also a significant difference in rates of fluoride prescriptions between the PFI and PHI groups, however this difference was again because of low rates in the Cohort A PFI group. Fluoride prescription rates between the PFI and PHI children were equivalent in Cohort B.

**Table 9. Fully immunized status by cohort and insurance type**

| Fully immunized  | PFI<br>No. (%) | PHI<br>No. (%) | Odds<br>ratio | Confidence<br>interval | p value |
|------------------|----------------|----------------|---------------|------------------------|---------|
| Cohort A         | 41 (74.5)      | 132 (88.0)     | 0.399         | 0.182, 0.872           | 0.019   |
| Cohort B         | 44 (81.5)      | 128 (85.3)     | 0.756         | 0.332, 1.72            | 0.502   |
| Spanish speaking | 38 (86.4)      | 46 (90.2)      | 0.688         | 0.195, 2.43            | 0.559   |

PFI = publicly funded health insurance; PHI = private health insurance.

### The Medical Home

The remarkable levels of success in achieving high immunization rates and very high rates of health access for the population in this study are a reflection of systems of care designed to assist all patients, regardless of insurance type or language, in meeting their health care goals. The systems and the people working in these systems have lately been labeled the “medical home.” In 2002, the American Academy of Pediatrics defined the medical home as:

“... the medical care of infants, children, and adolescents ideally should be accessible, continuous, comprehensive, and family centered, coordinated, compassionate, and culturally effective. It should be delivered or directed by well-trained physicians who provide primary care and help to manage and facilitate essentially all aspects of pediatric care. The physician should be known to the child and family and should be able to develop a partnership of mutual responsibility and trust with them”<sup>15</sup>

A medical home is supported by an EMR that reminds physicians and staff at every patient contact of immunization status and health care needs regardless of the type of patient contact. It requires culturally sensitive care with sufficient language support in the office. A medical home must have excellent access for well-patient and acute care so that the patients' needs are handled quickly. It requires outreach to children who are behind on immunization. It requires that each child have a personal PCP or nurse practitioner so that a trusting relationship can develop between patient and clinician.

| Language | Total population No. (%) | Fully immunized No. (%) | Odds ratio | Confidence interval | p value |
|----------|--------------------------|-------------------------|------------|---------------------|---------|
| Spanish  | 95 (23.2)                | 84 (88.4)               | 1.55       | 0.774 – 3.11        | 0.213   |
| English  | 314 (76.8)               | 261 (83.1)              |            |                     |         |

### Confronting the Barriers to Immunization

There are many barriers to effective immunization practices. There are many studies that have shown disparities in immunization rates for low-income children with PFI.<sup>3,7,16</sup> However, barriers even exist in affluent communities. Barbara Yahn, et al, showed that 47% of families in an affluent community reported barriers to childhood immunization including inconvenience, fears of adverse vaccine reactions, having a sick child and not knowing when the next series was due.<sup>17</sup> Many studies have shown lower immunization rates for African-American and Hispanic children.<sup>3,6</sup> Despite these barriers, there are effective strategies to ensure adequate childhood immunization that are in place in the KP Napa office that may explain the high rate of immunization in this practice.

*Access.* Having health insurance and access to health care is one of the most important factors in getting children immunized. In their telephone outreach, CHI-Napa County reported that 96.8% of clients have a medical home other than the emergency room and 99.1% reported no barriers to health access. This study showed that 100% of children were linked to a personal PCP and that 99% of the children had had a medical

|                        | Cohort A    |             | Cohort B    |             | Total No. (%) |
|------------------------|-------------|-------------|-------------|-------------|---------------|
|                        | PFI No. (%) | PHI No. (%) | PFI No. (%) | PHI No. (%) |               |
| Primary outcome        |             |             |             |             |               |
| Fully immunized        | 41 (74.5)   | 132 (88.0)  | 44 (81.5)   | 128 (85.3)  | 345 (84.4)    |
| Secondary outcomes     |             |             |             |             |               |
| Primary care physician | 55 (100)    | 150 (100)   | 150 (100)   | 54 (100)    | 409 (100)     |
| Office visit           | 53 (98.1)   | 150 (100)   | 150 (100)   | 53 (98.1)   | 405 (99.0)    |
| Well-child visit       | 52 (96.3)   | 149 (99.3)  | 52 (96.3)   | 149 (99.3)  | 402 (98.3)    |
| Fluoride prescription  | 36 (65.5)   | 130 (86.7)  | 49 (90.7)   | 132 (88.0)  | 347 (84.8)    |

PFI = publicly funded health insurance; PHI = private health insurance.

|         | No. (%)    | Odds ratio | Confidence interval | p value |
|---------|------------|------------|---------------------|---------|
| PFI     | 85 (78.0)  | 0.514      | 0.292 – 0.905       | 0.019   |
| PHI     | 262 (87.3) |            |                     |         |
| Spanish | 84 (87.4)  | 1.31       | 0.666 – 2.577       | 0.435   |
| English | 264 (88.0) |            |                     |         |

PFI = publicly funded health insurance; PHI = private health insurance.

**Language is often cited as a barrier to receiving immunizations. There were no significant health outcome differences for Spanish-speaking children in this study.**

office visit. The overall high immunization rates in this study are a reflection of the excellent access to care for the children in this study.

Although not markedly different, the rates of well-child preventive care visits were lower for the PFI group (OR 0.140, CI 0.027 – 0.731,  $p = 0.016$ ). KP staff actively work to improve the rate of well-child visits by telephone outreach. The PFI group receives additional support to improve their access to care: children who are case managed by CHI-Napa County receive outreach contact twice a year reminding families to seek preventive care and inquiring about barriers to health care access. The number of PFI children with a well-child visit was consistent with the CHI-Napa County telephone surveys, although it is not clear why some PFI children did not come in for well-child care. More studies are needed to understand the barriers to access for the children with PFI who did not obtain well-child preventive care visits.

*Insurance Type.* More than 18% of children age 24 to 48 months in this practice receive PFI. Forty-eight children in the PFI group would currently be uninsured if the KP Child Health Program had not been offered to them when the Napa Healthy Kids program lost its funding in 2008. This study showed that care outcomes were equivalent by age 3 years regardless of type of insurance.

*Language.* Language is often cited as a barrier to receiving immunizations.<sup>7</sup> There were no significant health outcome differences for Spanish-speaking children in this study. Immunization rates were slightly lower in the PFI group of Spanish speakers, but not significantly so. Spanish speakers actually had higher, although not significantly higher, rates of full immunization in the combined Cohorts A and B (OR 1.55; CI 0.774 - 3.11;  $p = 0.213$ ). This is likely a reflection of slightly higher PHI coverage in the Spanish-speaking group. Prescription of fluoride was not significantly different between Spanish-speaking and English-speaking patients.

Cultural competency and language skills are necessary to meet the needs of Spanish-speaking patients. The KP Napa practice offers bilingual physicians and staff to meet this need. All patient education materials are available in Spanish and English. Additionally, the CHI-Napa County provides bilingual case managers in their enrollment and outreach programs. These programs reduce the barriers of language in a county that was 38% Hispanic on the recent 2010 census.

*Family fears.* Parents may have many concerns about vaccine safety. In 2000, Gellin et al noted that 25% of parents believe receiving so many vaccines may weaken immune systems and 19% of parents do not

believe vaccines have been adequately tested before licensing for use.<sup>18</sup> KP Napa offers vaccine information statements in most languages to help educate patients on the need for comprehensive vaccination. Patient information about vaccine need and vaccine safety is readily available in KP Napa offices and on the physicians' Web sites. Additionally, physicians and staff must be knowledgeable and comfortable with the discussion of vaccine safety to allay patient and family fears.

*Physician concerns.* There are many missed opportunities when a child who is eligible to receive a vaccine does not receive it. The most common reasons are that a child has a mild illness and that the visit is for acute and not preventive care.<sup>19</sup> KP Napa physicians are not immune to these concerns and it takes constant attention to immunization needs to achieve high rates. Although some health care systems offer monetary awards to improve immunization rates,<sup>20</sup> KP Napa physicians do not receive financial rewards for care. They do receive nonblinded quarterly reports on their quality indicators so that members of the department can see how they and the department compare with the quality goals.

*Complex immunization schedules.* Immunization practice has changed markedly from the 3:3:1 (DPT, polio, MMR) schedules in place since 1971. It is even more complicated by combination vaccines that vary in their components. For example, Pediarix and Pentacel both have DTaP and polio, but one has Hib and the other has hepatitis B. When children transfer into a practice, they may have had one or several combination vaccines and yet be lacking on individual vaccines. The EMR at KP Napa offices is able to indicate at each visit which vaccines are deficient and which are up to date. This is particularly important for vaccines such as PCV, which is new in the last decade and requires 4 injections by age 18 months to be effective.

*Cost.* Cost can be a major factor in vaccine administration. Surveys of pediatricians and family physicians have found 49% of physicians delayed purchase of vaccines because of cost and 38% felt reimbursement for the time and counseling for vaccine administration was not sufficient.<sup>21</sup> Nearly 11% of these physicians considered not offering immunizations in their practice. Referring patients to county public health departments for immunizations will only lower the chances of a child being fully immunized. The KP Napa practice supplies immunizations at no cost to children. There are no financial disincentives to impair fully immunizing the children in this practice.

### Limitations in This Study

*Assessment of bias.* Restricting the study to children in zip codes 94558 and 04559 (city of Napa) removed 238 children (10.1%) from the study. The demographics of this population are not known. Since these children reside outside the city of Napa, they often receive care in other medical centers and were excluded for that reason. Requiring 6 months of active health insurance removed an additional 505 children (21.4%). The choice of how long a patient should have active health insurance is arbitrary, but 6 months of active coverage was felt sufficient by the author. Restricting the study population to children ages 24 to 48 months is also arbitrary but consistent with other studies, as noted previously. Ages 2 and 3 years are appropriate for assessing voluntary primary immunization rates, before the mandatory immunization documentation is required at ages 4 to 6 years when children enter preschool and kindergarten.

Selecting PHI children by birth date resulted in a slightly older cohort because no children born in November or December were included in the study group. Choosing older children may select for higher rates of immunization in the PHI groups, but this was not demonstrated in this study. The number of children with full immunization in each chronological quintile of cohort A with PHI group was 23, 27, 29, 28, and 25 (Average = 26.4, standard deviation [SD] 2.41). The number of children with full immunization in each chronological quintile of Cohort B with PHI group was 25, 25, 27, 23, and 27 (Average = 25.6, SD 1.95). It does not appear the selection process biased Cohort B with PHI towards higher levels of full immunization in the older quintiles of either cohort. Since all primary immunizations should be completed by age 18 months, this selection process was not felt to bias the PHI group.

*The administrative record.* This study was done without direct patient contact. Patients were considered low-income if they had PFI. However, demographics and family incomes are not known. Insurance types in the PFI group indicate family income less than 250% FPL, but the group is not homogenous. The last active insurance type was known and was documented as the insurance type, but previous insurance status (uninsured, PFI subtypes, or private insurance) is not known. The record of immunizations given before care at KP Napa could be incomplete. Both the PHI and PFI groups may have under-reported immunization records. Barriers to immunization are not known. Although the study was restricted to Napa city zip codes, Napa is not homogenous in income or other demographics. Although CHI-Napa County asks about barriers to ac-

cess in their outreach efforts, this information is not currently retrievable from their data systems. Further studies are needed to answer these concerns.

### Conclusion

The children in this study achieved high rates of immunization that exceeded the Healthy People 2020 target and markedly exceeded the National Immunization Survey 2009 benchmark for full immunization status for the 19 recommended vaccines in this study. Cohort A with PFI was deficient in immunizations and fluoride prescription compared with Cohort A with PHI, but this difference was eliminated by age 3 years. There were no differences in care based on language.

The successful immunization practices and achievement of the secondary outcomes in this study are a reflection of the integrated care model in this practice. The EMR and support systems facilitate comprehensive, coordinated, and accessible care for patients and allow physicians and support staff to practice culturally sensitive and compassionate care—the definition of a medical home. ❖

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*The author(s) have no conflicts of interest to disclose.*

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## To Do the Possible

Our goal is not to completely eradicate the infection—that would be very difficult—but to produce a vaccine that will prevent not infection but disease.

I think this is more possible.

— *Luc Montagnier, b 1932, French virologist, 2008 Nobel Laureate in Physiology or Medicine for his discovery of the human immunodeficiency virus*