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Are Patient-Held Vaccination Records Associated With Improved Vaccination Coverage Rates?

James T. McElligott and Paul M. Darden

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AUTHORS: James T. McElligott, MD, MSCR and Paul M. Darden, MD

Department of Pediatrics, Medical University of South Carolina, Charleston, South Carolina

KEY WORDS
vaccination, primary prevention, minority health

ABBREVIATIONS
NIS—National Immunization Survey
UTD—up-to-date
CI—confidence interval
OR—odds ratio

Dr Darden's current affiliation is Department of Pediatrics, University of Oklahoma Health Sciences Center, Oklahoma City, OK.

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Address correspondence to James McElligott, MD, Medical University of South Carolina, Department of Pediatrics, 135 Rutledge Ave, PO Box 250561, Charleston, SC 29425. E-mail: mcellig@musc.edu

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WHAT'S KNOWN ON THIS SUBJECT: Patient-held vaccination records are sparsely studied, particularly in pediatrics. Information from adult patient reminder studies and some studies with pediatric patients suggest a possible benefit for immunization rates, although results are variable. The use of these vaccination records varies widely.

WHAT THIS STUDY ADDS: This study provides evidence of a positive association of vaccination record use with immunization rates. The results indicate that this simple intervention has a meaningful impact on vaccination rates, with the potential to affect clinical practice and public health planning.

abstract

FREE

OBJECTIVE: The goal was to determine whether patient-held vaccination records improve vaccination rates.

METHODS: The public-use files of the 2004–2006 National Immunization Survey, a national, validated survey of households with children 19 to 35 months of age, were used. The main outcome was up-to-date (UTD) vaccination status (4 diphtheria-tetanus-acellular pertussis/diphtheria-tetanus vaccine, 3 poliovirus vaccine, 1 measles vaccine, 3 *Haemophilus influenza* type B vaccine, and 3 hepatitis B vaccine doses), and the main predictor was the use of a vaccination record. Control variables were race/ethnicity, maternal education, poverty status, language, number of children in the home, state of residence, and number of health care providers.

RESULTS: Overall, 80.8% of children were UTD, and 40.8% of children had vaccination records. Children with vaccination records were more likely to be UTD (83.9% vs 78.6%; $P < .0001$). The largest effects associated with vaccination records were seen for children with multiple providers, comparing with and without a vaccination record (82.8% vs 71.9%; $P < .0001$), those with low maternal education, (81.6% vs 72.9%; $P < .0001$), and those with ≥4 children in the household, (76% vs 69.6%; $P < .004$). Logistic regression predicting UTD status and controlling for race/ethnicity, maternal education, poverty level, language, number of children in the home, and number of vaccine providers revealed the vaccination record to be associated with a 62% increase in the odds of UTD status (odds ratio: 1.62 [95% confidence interval: 1.49–1.77]).

CONCLUSIONS: Use of patient-held vaccination records is an easily implemented strategy that is associated with increased immunization rates. A greater effect was seen in groups at risk for underimmunization. Methods to incorporate and to ensure effective use of these records should be implemented. *Pediatrics* 2010;125:e467–e472

Little has advanced the medical care of children more than vaccines. Immunization rates for children are improving but still fall short of national guidelines.[1] Increasing diligence in preventative care programs and policies will be required to reach unimmunized children and to achieve national goals. Moreover, the situation is becoming increasingly complicated with the addition of new vaccines for both young children and adolescents. Successful use of immunizations relies on high degrees of compliance within the population and organization within medical practices, but there is still uncertainty regarding which interventions aimed at increasing vaccination rates are successful.

The patient-held vaccination record is an often-used but not well-studied intervention. In addition, there are varying opinions regarding its importance and inconsistent emphasis on its usefulness as a tool.[2–4] Vaccination records might have effects in 3 prominent ways. First, use of the vaccination record has the potential to increase knowledge regarding vaccines and demand by parents and patients for vaccines. Second, the record may act through communication within and between practices. Third, the record may reduce missed opportunities to immunize children by acting as a prompt to parents and providers.

Despite widespread use of vaccination records, there is little objective information on their effectiveness. A 1999 literature review found the evidence on the subject to be inconclusive,[5] particularly with respect to children. Since then, a possible association of vaccination records with improved immunization rates was noted,[6] although other authors questioned whether such records are cost-effective, despite their proven popularity.[2–4,7,8] The use of this simple tool deserves to be explored further, because a true association with increased vaccination rates might induce changes in epidemiological and clinic-related policies that could be implemented quickly.

It is quite possible that the vaccination record plays a larger role in certain situations. Situations in which communication is increasingly important may benefit the most. Of particular interest are cases in which multiple health care providers are used and in which there are multiple children in 1 household, because such children are at risk for underimmunization.[1] The objective of this study was to determine whether the use of vaccination records was associated with increased vaccination rates, with particular attention to children who were at risk because of an increased need for good communication.

METHODS

An analysis was performed on the public-use files of the National Immunization Survey (NIS) from 2004 to 2006. The National Immunization Program of the Centers for Disease Control and Prevention sponsors these surveys, and the National Center for Health Statistics conducts them. The methods of the surveys were published elsewhere.[9] In brief, these are national, validated, stratified, random-digit-dialing telephone surveys of households with children 19 to 35 months of age. Demographic and immunization information regarding all age-eligible children is gathered from the parents in this interview. Vaccination data are gathered directly from the identified vaccine provider for surveyed children.[10] For the purposes of this study, it is important to note that the NIS does not use data from the vaccination record as part of the assessment of up-to-date (UTD) status. Adjustments are made for biases resulting from nonresponding and non–telephone-containing households. Children without adequate provider data were not included in this analysis. Over the time period examined, the recommended vaccines for a child 2 years of age were diphtheria-tetanus-acellular pertussis/diphtheria-tetanus vaccine, poliovirus vaccine, measles-containing vaccine, *Haemophilus influenzae* type b vaccine, hepatitis B vaccine, pneumococcal conjugate vaccine, influenza vaccine, and varicella zoster vaccine.

The main outcome was a provider record of the child being UTD. For these analyses, UTD was defined as 4 diphtheria-tetanus-acellular pertussis/diphtheria-tetanus vaccine, 3 poliovirus vaccine, 1 measles-containing vaccine, 3 *Haemophilus influenzae* type b vaccine, and 3 hepatitis B vaccine doses. This outcome was defined within the public-use files of the NIS. Pneumococcal conjugate vaccine, influenza vaccine, and varicella zoster vaccine were not examined because the uptake of these vaccines might not have been stable over the period studied.

The primary predictor was parental report of the presence of a patient-held vaccination record. During the interview, the respondent was asked whether a written record of the child's vaccination history was available. If the record was available, then the respondent was asked to read information directly from the record.[10] This record was not used by the NIS in the assessment of UTD status.

Variables were chosen to explore the relationships of demographic features with both vaccination record use and UTD status, with emphasis on known risk factors for underimmunization, and to explore issues of communication and prompting.[10] For race and ethnicity, we used a composite race variable defined by the NIS as Hispanic, white (non-Hispanic), black (non-Hispanic), and all others (non-Hispanic). The surveys allowed respondents to indicate multiple races. Respondents who indicated multiple

races were included in the category of all others if they did not indicate Hispanic ethnicity.

Maternal education was recorded in 4 categories in the data. This variable was dichotomized as <12 years versus ≥12 years. Depending on the data collection year, poverty was recorded in either 2 or 3 categories within the data. We dichotomized poverty status as above or below the poverty line. The language in which the interview was conducted was categorized as English, Spanish, or other. The number of children in the home was reported in 3 categories, that is, 1, 2 or 3, and ≥4. Analyses were performed at each of these variable levels. The number of health care providers giving and reporting vaccines was recorded in the data and was dichotomized as 1 versus >1 for the purpose of our analyses.

The associations between each variable level and the proportion UTD were assessed with corresponding 95% confidence intervals (CIs). Bivariate analyses compared the possession of a vaccination record with UTD status at each variable level. The significance of differences in the mean proportions of UTD was determined with *t* tests. Parameters were considered significant if the *P* value was <.05 or the CI did not include 1.

We modeled the independent effect of a parent-held vaccination record on UTD by using logistic regression. The model included the dependent variable of being UTD and the independent variables of vaccination record possession, race/ethnicity, maternal education, poverty level, language, number of children in the home, state of residence, and number of vaccine providers.

To account for the complex survey design, the appropriate strata, clusters, and weights were applied by following NIS recommendations, for evaluation of children with adequate provider data. Each year's NIS data set included weights appropriate for inferences to the population of children 19 to 35 months of age in that year in the United States. For analysis of our 3-year data set without overweighting of observations, the weight for each observation was divided by 3. This had the effect of making the weighted data set the average for the target population of children over the time period studied. The 3 years of data were merged and weights were adjusted by following NIS recommendations. A weighted population of 5 940 204 children, which represented the average US population of children 19 to 35 months of age over the 3-year period studied, was used in this cross-sectional analysis.

The NIS data are publicly available and deidentified. This secondary analysis qualified for exemption from institutional review board approval. We performed our data extraction and recoding by using SAS 9.1 (SAS Institute, Cary, NC) and conducted analyses appropriate for this multistage, complex survey by using Stata 8.0 (Stata, College Station, TX). The Stata software permits the inclusion of the survey design variables in the analysis and thus addresses the complex sampling appropriately, to achieve the best approximate variances for population estimates. Unless stated otherwise, all rates reported are weighted to reflect population-based estimates.

RESULTS

The immunization rate for children 19 to 35 months of age over 2004–2006 was 80.8%. Similar to previously reported national data,[1] there was variation in the vaccination rates among the levels of the variables studied. Table 1 presents the proportions of UTD children according to each variable individually. There were significant differences for each variable level with the exception of language. Black, Hispanic,

TABLE 1 UTD Status and Use of Records

Variable	Proportion, Estimate (95% CI), %	
	UTD	With Vaccination Record
All	80.8 (80.2–81.3)	40.8 (40.1–41.5)
Vaccination record		
Yes	83.9 (83.1–84.7)	
No	78.6 (77.8–79.4)	
Race/ethnicity		
White	82.5 (81.9–83.2)	38.5 (37.6–39.3)
Black	76.8 (75.2–78.5)	28.7 (26.8–30.5)
Hispanic	79.6 (78.3–80.8)	51.3 (49.7–52.8)
Other	79.8 (77.8–81.8)	38.6 (36.3–40.9)
No. of children in household		
1	85.9 (84.9–86.8)	42.0 (40.6–43.3)
2 or 3	80.8 (80.0–81.5)	41.0 (40.1–41.8)
≥4	72.0 (70.3–73.8)	38.0 (36.1–40.0)
Maternal education		
≥12 y	81.7 (81.1–82.3)	39.5 (38.8–40.2)
<12 y	76.9 (75.3–78.5)	46.0 (44.1–47.9)
Poverty status		
Above poverty level	82.5 (81.9–83.1)	44.7 (43.1–46.3)
Below poverty level	76.9 (75.6–78.2)	38.9 (38.1–39.6)
No. of providers		
1	82.5 (81.8–83.2)	36.8 (35.9–37.6)
Multiple	77.3 (76.3–78.4)	49.6 (48.4–50.9)
Language		
English	80.9 (80.3–91.5)	37.6 (36.9–38.3)
Spanish	80.1 (78.3–82.0)	57.9 (55.7–60.1)
Other	81.4 (76.1–86.6)	46.2 (39.9–52.6)

or other race/ethnicity was associated with lower immunization rates, compared with white race. Other respondent characteristics that were associated with lower immunization rates are having multiple children in the home, low maternal education, income below the poverty level, and having multiple providers.

There were differences among variable levels in the use of the vaccination record (Table 1). The majority of respondents did not have the child's vaccination record in their possession (59.2% [95% CI: 58.5%–59.9%]). There were statistically significant differences between ethnicities, with Hispanic subjects using vaccination records most and black subjects least. Families with multiple children were less likely to have vaccination records in their possession than were those with 1 child. This relationship reached statistical significance only when 1 child was compared with ≥4 children, although a trend of sequential decreases with increasing numbers of children was seen. Maternal education of <12 years, income below the poverty level, having multiple providers, and having the interview conducted in Spanish all demonstrated the largest proportions of children with vaccination records available, with statistically significant differences.

For each variable category, a comparison of the proportions of those UTD was made between children with vaccination records and those without (Table 2). For all variables, having a vaccination record was associated with higher immunization rates. This was significant at the $P < .05$ level for all variable levels with the exception of Spanish and other languages. For the whole population, subjects with vaccination records had higher vaccination rates (83.9% vs 78.6%; $P < .0001$). Among ethnicities, the largest effect was seen in the other category (84.8% vs 76.6%; $P < .0001$), followed by white (86.2% vs 80.3%; $P < .0001$), black (80.4% vs 75.4%; $P < .008$), and Hispanic (81.4% vs 77.6%; $P < .003$). A larger increase in UTD proportions was noted for variables associated with high risks for underimmunization that likely would benefit from improved communication, such as multiple children in the home (2 or 3 children: 83.9% vs 78.6%; $P < .0001$; ≥4 children: 76.0% vs 69.6%; $P < .0005$), low maternal education (81.6% vs 72.9%; $P < .0001$), and multiple providers (82.8% vs 72.9%; $P < .0001$).

TABLE 2 Proportion UTD When Vaccination Record Is Used

Variable	Proportion, Estimate (95% CI), %			*P*
	UTD With Vaccination Record	UTD Without Vaccination Record	Difference[a]	
All	83.9 (83.1–84.7)	78.6 (77.8–79.4)	5.4	<.001
Race/ethnicity				
White	86.2 (85.2–87.2)	80.3 (79.4–81.2)	5.9	<.001
Black	80.4 (77.5–83.3)	75.4 (73.3–77.5)	5.0	
Hispanic	81.4 (79.7–83.2)	77.6 (75.7–79.5)	3.8	
Other	84.8 (82.3–87.3)	76.6 (73.8–79.5)	8.2	
No. of children in household				
1	88.2 (86.9–89.5)	84.2 (82.9–85.5)	4.0	<.001
2 or 3	83.9 (82.8–85.0)	78.6 (77.6–79.6)	5.3	
≥4	76.0 (73.3–78.7)	69.6 (67.4–71.9)	6.4	
Maternal education				
≥12 y	84.5 (83.6–85.5)	79.8 (79.0–80.6)	4.7	<.001
<12 y	81.6 (79.6–83.7)	72.9 (70.5–75.2)	8.7	
Poverty status				
Above poverty level	86.6 (85.8–87.4)	79.9 (79.0–80.8)	6.7	<.001
Below poverty level	80.1 (78.2–82.0)	74.3 (72.6–76.2)	5.8	<.001
No. of providers				
1	84.6 (83.5–85.6)	81.3 (80.4–82.1)	3.3	<.001
Multiple	82.8 (81.4–84.2)	71.9 (70.3–73.5)	10.9	<.001
Language				
English	84.7 (83.8–85.6)	78.6 (77.8–79.3)	6.1	<.58
Spanish	81.1 (78.8–83.4)	78.8 (75.8–81.8)	2.3	
Other	84.1 (78.4–89.7)	79.0 (70.7–87.3)	5.1	

[a] Difference is the calculated value of the proportion UTD with a vaccination record minus the proportion UTD without a vaccination record.

Table 3 presents the multivariate model. Controlling for all variables, having a vaccination record was associated with a 62% increase in the odds of being UTD, compared with not having a vaccination record (odds ratio [OR]: 1.62 [95% CI: 1.49–1.77]). For races/ethnicities other than white, there was a significant reduction in the proportion UTD for black race only in this analysis. The odds of being UTD were inversely related to the number of children in the household (2 or 3 children:

TABLE 3 Multivariate Analysis Results

Variable	OR (95% CI)
Vaccination record	
Yes	1.62 (1.49–1.77)[a]
No	Reference
Race/ethnicity	
White	Reference
Black	0.83 (0.73–0.93)[a]
Hispanic	0.94 (0.82–1.06)[a]
Other	0.89 (0.77–1.03)[a]
No. of children in household	
1	Reference
2 or 3	0.70 (0.63–0.77)[a]
≥4	0.46 (0.40–0.52)[a]
Maternal education	
≥12 y	Reference
<12 y	0.77 (0.68–0.87)[a]
Poverty status	
Above poverty level	Reference
Below poverty level	0.86 (0.77–0.95)[a]
No. of providers	
1	Reference
Multiple	0.70 (0.65–0.76)[a]
Language	
English	Reference
Spanish	1.29 (1.07–1.54)[a]
Other	0.93 (0.63–1.39)

[a] Significantly different from the reference group. State of residence is not shown.

OR: 0.70 [95% CI: 0.63–0.77]; ≥4 children: OR: 0.46 [95% CI: 0.40–0.52]). Maternal education <12 years (OR: 0.77 [95% CI: 0.68–0.87]), income below poverty level (OR: 0.86 [95% CI: 0.77–0.95]), and multiple providers (OR: 0.70 [95% CI: 0.65–0.76]) all decreased the odds of being UTD. The interview being conducted in Spanish, compared with English, increased the odds of being UTD, with controlling for the other variables (OR: 1.29 [95% CI: 1.07–1.54]).

Vaccination record use was variable according to state, ranging from 19% in Indiana to 57% in Kansas. Inclusion of state of residence as an independent variable in the regression model is reflected in the results in Table 3.

Figure 1 is a graphical display of the multivariate analysis results. State was included in the regression model, although it is not included in Fig 1. The possession of a vaccination record was a strong predictor of being UTD, relative to the other variables.

DISCUSSION

The NIS data set is a powerful aid in the effort to understand the immunization gaps among young children in the United States. A consistent, positive association of vaccination rates and vaccination record use was seen in both bivariate and multivariate analyses. Improved odds of being UTD with the use of patient-held vaccination records were seen across diverse populations. Moreover, several of the groups with factors that identify children who are epidemiologically at high risk for underimmunization, such as those with low income and multiple children in the home, seem to benefit the most.

The improved immunization rates associated with use of vaccination records support the hypothesis that the records improve communication between caregivers and providers. This is consistent with the relatively large improvements seen with families with multiple children, low maternal education, and multiple providers. The sequentially larger improvements in vaccination rates seen with increasing numbers of children in the home suggest that vaccination records may have increasing importance in busy households.

Vaccination records have the potential to increase the likelihood of children receiving vaccinations by acting at both the provider and caregiver levels. For providers, the record may act as a prompt to check on the vaccination status of the child more often, such as during sick visits. From the caregivers' perspective, having a sense of ownership over the child's health maintenance may be beneficial or simply having the card as a reminder in the home may contribute to the effect. Keeping track of the record also may give parents insight into their child's health maintenance process. This may lead to reductions in excess immunizations and associated excess costs. Whether the vaccination record serves as a reminder or an organizational tool, it seems to have a significant role in improving vaccination rates when communication is increasingly important.

There was a large improvement in UTD proportion for children with multiple providers. This suggests that the vaccination record may act as a tool for communication between practices. Therefore, these data also may inform the discussion on electronic registry use, because it is worth considering that a registry may have similar success with vaccination improvements.

The cross-sectional data provided by the NIS limit the ability to infer causality. The vaccination record may act as a surrogate marker for caregiver traits such as organizational ability or may represent a difference in provider structures or performance. The significant, persistent effects seen across all variables studied suggest that the vaccination record is more than just a marker, particularly with the larger associations seen in the categories of intuitive interest, as noted above. Another potential limitation is that only

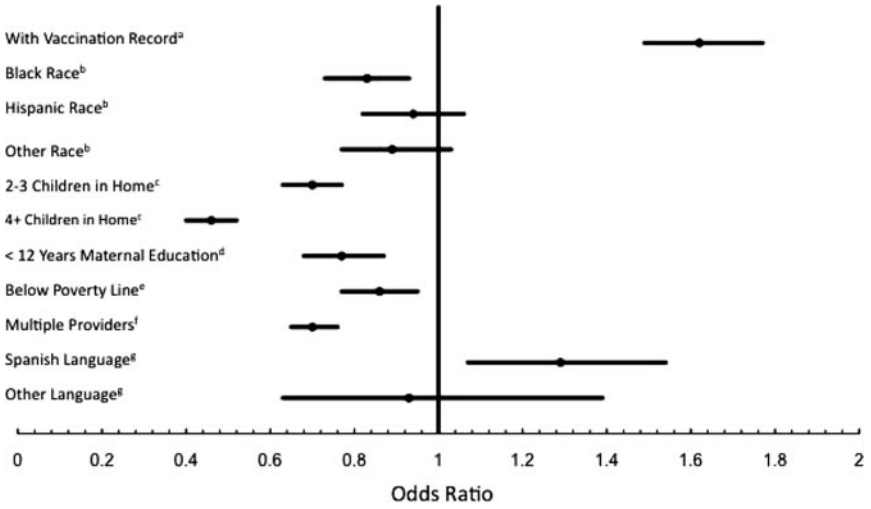

FIGURE 1

Odds of being UTD according to variable (graphical display of the multivariate model). The points represent ORs relative to the reference group, and the bars represent the corresponding 95% CIs. State of residence was included in the model. [a] Reference: without a vaccination record. [b] Reference: white race. [c] Reference: 1 child in the home. [d] Reference: ≥12 years of maternal education. [e] Reference: above the poverty line. [f] Reference: 1 provider. [g] Reference: English language.

children with adequate provider data could be used, although the weights applied in the analyses do account for this. Also, there likely is variability across states and regions in policies regarding the use of the vaccination record, which is not addressed with this study.

The fact that the use of the vaccination record varies across populations suggests that the vaccination record's usefulness as a tool is inconsistently emphasized. Clinics differ in how much they use or ask for the vaccination record, and families likely have different views on its importance. Perhaps the first step in taking advantage of the vaccination record's association with improved vaccination rates should be to place more emphasis on the importance of the vaccination record for both providers and parents, adding a level of communication that otherwise would be absent.

CONCLUSIONS

The patient-held vaccination record is a simple tool that significantly prevents underimmunization. The association is broadly seen across all family and provider variables measured, with a larger impact for children at higher risk of underimmunization. Use of this easily implemented tool provides an additional level of communication between families and providers, as well as between providers. The immunization record should be incorporated as a routine part of the preventative care that is delivered by individual practices.

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