Improving The Immunization Coverage Of Children Less Than 7 Years Old In A Family Practice Residency

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Background: **This prospective cohort study was designed to evaluate the effectiveness of mail and telephone contact with parents as a means to improve the immunization coverage of children less than 7 years old in a family practice residency clinic.**

Methods: **Immunization records for 519 children enrolled in an outpatient clinic were reviewed and updated. Children whose immunizations were current (55) were excluded, which left 464 children whose immunizations were more than 1 month behind for their age groups. A random sample of one-half of these children (231) were mailed a postcard listing the immunizations that they required to be up to date. The mailing was followed up with telephone contact, when necessary, to prompt compliance. The other one-half of the children were not contacted and served as the control group. Immunizations provided to the two groups were compared 6 months after the initial mailing.**

Results: **Before the initiation of the study, only 10.6 percent of the infants and children in the practice had their immunizations completed or were up to date. There were 124 immunizations given to 49 children in the intervention group compared with 84 immunizations to 33 children in the control ($P<0.047$). Thirty-four children were brought up to date in the control group compared with 17 in the intervention cohort ($P<0.011$).**

Conclusions: **Direct mail reminders and telephone contact with parents of children who were behind in their immunizations were effective methods to encourage compliance. The increased number of immunizations received by the children in the intervention group was overshadowed by the poor coverage of the entire practice, a highly mobile and predominately indigent group. Additional interventions are urgently needed to improve immunization levels in infants and children. (J Am Board Fam Pract 1994; 7:472-7.)**

One of the most important public health successes in the last 50 years has been reduction of childhood morbidity and mortality caused by vaccine-preventable diseases. Smallpox has been eradicated, and efforts are well underway to halt the transmission of poliomyelitis. These successes, however, provide no justification for complacency. The number of cases of pertussis is again increasing,[1] and improved immunization coverage remains a national goal targeted in *Healthy People 2000*.[2]

The incidence of vaccine-preventable diseases is often cited as an indicator for monitoring immunization performance, but a more appropriate benchmark is the percentage of children less than a predetermined age who are up to date with their immunization schedule. The ages of 1 year, 2 years, or entry into elementary school are often used in reporting vaccine coverage. Coverage assessment provides an indicator of access to and utilization of child health services. Throughout the world vaccine coverage is considered to be directly proportional to the quality of maternal-child health services. A low coverage level suggests the presence of barriers to immunization and is reflected in outbreaks of vaccine-preventable disease.

Coverage information is seldom available in the private practice setting, and little emphasis is placed on finding the infant or child who has dropped out of the immunization sequence. If such a child is detected, it is uncertain what is the most effective method of encouraging catch-up immunization and bringing the child up to date.

Reminder letters and telephone contacts have been shown to improve influenza vaccination rates in the elderly[3-6]; however, neither method

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was judged effective in terms of the expense of the programs. There are several studies that have evaluated the effect of parental education on infant immunization rate. In one study no significant improvement in coverage was reported for the intervention group, whose mothers received a health education talk, a handout, and a reminder letter, when compared with a control cohort.[7] A postcard reminder was successful in improving measles coverage in an Australian practice,[8] but there was no control group in this study, and the mailing was linked with a media campaign. Immunization coverage improved after mail contact with parents of children attending public health clinics in Washington State[9] and in Ohio,[10] but only diphtheria-pertussis-tetanus (DPT) and DPT and polio coverage rates were reported, and only high-risk children were targeted in the Ohio study. There have been no studies reporting a comprehensive audit of a child's immunization status for all vaccines followed by a mail and telephone intervention.

Our study was undertaken to determine the immunization coverage of the children enrolled in a family practice residency and to develop and implement a simple means of improving the percentage of children with up-to-date immunizations.

Methods

Study Site

Our study was conducted in a family practice residency clinic between 1 January and 30 June 1991. Immunization records of the county health department were reviewed. The residency clinic maintains active charts on approximately 12,000 persons who make 23,000 visits per year and are seen by 12 residents, 8 physician-faculty, and 1 physician's assistant. The county health department offered immunizations at five clinic sites and provided 2275 infant and child immunizations in the first 6 months of 1991.

Randomization

The charts of all infants older than 2 months of age as of 1 January 1991 and children less than 7 years of age as of 30 June 1991 who were actively enrolled in the practice were reviewed for immunizations received. This information was supplemented with immunizations recorded in the health department registry, as a number of patients enrolled at the family practice residency received low-cost immunizations at the nearby county health department Well-Child Clinic.

The immunization records of the 519 children were entered into a minicomputer. Seven children who were fully immunized and 48 children whose immunizations were up to date were then excluded. Up-to-date immunizations indicated that the child was within 1 month of being compliant with the standards set by the American Academy of Pediatrics[11] and the American Academy of Family Physicians[12] (Table 1).

The 464 children eligible for the study were randomized into experimental and control cohorts of 231 and 233 children, respectively. No attempt was made to group children of one family into the same cohort.

Interventions

In the intervention group attempts were made to increase immunization coverage by mail and telephone contact. The control group had no special contact. After randomization it was learned that 1 child assigned to the intervention group had died. This child's immunization history was included in the analysis under the intention-to-treat rule.

Children in the intervention group were sent a postcard reminder listing the types of immunizations required for that child and urging that an appointment be made. The postcards were in English, because less than 1 percent of the practice are Spanish speaking only. Of the 231 postcards sent, 29 (13 percent) were returned as undeliverable. Twenty-five parents called the office in response to the postcard. Their child's immu-

Table 1. Immunization Recommendations (1 January 1991 to 30 June 1991).

Age	Dose Number			
	DPT	TOPV*	MMR	HIB†
Less than 3 months	1	1		1
Less than 5 months	2	2		1
Less than 7 months	3	2		1
Less than 16 months	3	2		1
Less than 19 months	4	3	1	1
Less than 7 years	5	4	2	1

*No child received inactivated polio vaccine.
†Three different types of *Haemophilus influenzae* b vaccines were used: Hib Titer, ProHibit, and PedvaxHIB. DPT=diphtheria-pertussis-tetanus; TOPV=trivalent oral poliovirus vaccine; MMR=measles-mumps-rubella; HIB=*Haemophilus influenzae* b.

nization records were reviewed and recommendations were given by one of the authors (1 faculty and 2 resident physicians). After a 6-week period attempts were made to telephone the parents or guardians of the remaining 177 children. Contact was made in 136 (77 percent) families, and the telephone had been disconnected in 41 instances; attempts were abandoned after three unsuccessful tries. During the telephone interviews, we learned that 11 children had been brought in for their immunizations in response to the postcard prompt. The telephone calls were made by physicians during an 8-week period between 8 AM and 10 PM on weekdays. All were conducted in English.

Table 2. Base-line Comparison of Intervention and Control Groups.

	Control	Intervention	*P* Value
Number	233	231	
Age (months)	41.2±21.7	39.1±21.3	NS
Male	126	110	NS
Hispanic surname	36	42	NS
Immunizations received only at residency	124	122	NS
Number of immunizations on entry	5.4±2.4	4.9±3.9	NS
Have telephone	206	195	NS
Age at entry into study (months)			
2–6	7	2	NS
7–12	10	19	NS
13–24	52	35	<0.048
25–36	48	47	NS
37–48	44	45	NS
49–60	30	35	NS
61–72	21	24	NS
73–78	21	24	NS

NS=not significant.

Analysis

The study period was from 1 January 1990 to 30 June 1990. Six months after the initial mailing and 2 months after the attempts at telephone contact were abandoned, the immunization coverage of the two groups was compared. Confirmation of immunizations received during the study period was ascertained by a review of the practice billing codes and charts along with the county health department's records. Immunizations received at other sites could not be confirmed and were not recorded. There were no outbreaks of vaccine-preventable illness or other campaigns to improve immunization coverage during the study period.

Data entry and analysis were carried out using Epi Info 5.1 software.[13] Statistical analysis was by the chi-square and two-tailed t tests as appropriate with $P<0.05$ considered significant.

The study was approved by the Residency Research Review Committee. After the study was completed, immunization recall letters were introduced into the practice to improve coverage.

Results

The study groups were comparable on the basis of a number of variables (Table 2). The majority of the children seen at the Family Practice Clinic and the county health clinics are covered by Medicaid. A surrogate for socioeconomic status was ascertained by the percentage of families with telephones and by their ZIP codes. The number of families with Hispanic surnames was similar, and children were equally distributed by ZIP code. An equal percentage of children in each group received their immunizations at one site. The number of immunizations per child on entry into the study was 5.4±2.4 in the control and 4.9±3.9 in the intervention group. There were significantly more children aged 13 to 24 months in the control group ($P<0.048$).

Only 10.6 percent of the 509 study children were fully immunized or up to date for age. There were 84 immunizations given to the children in the control group compared with 124 in the intervention group (Table 3). When each type of immunization was examined separately, there were more DPT, trivalent oral poliovirus vaccine (TOPV), measles-mumps-rubella (MMR), and *Haemophilus influenzae* b (HIB) immunizations given in the intervention cohort. Only the difference in the number of MMR vaccinations was statistically significant ($P<0.0049$). Thirty-four infants and children in the intervention group were brought up to date or completed their immunizations, whereas 17 reached this goal in the control group ($P<0.011$). There were 57 clinic visits for immunizations by 49 children from the interven-

Table 3. Number of Immunizations Received by Group.

	Control	Intervention	*P* Value
DPT	31	34	NS
TOPV	23	33	NS
MMR	8	23	<0.0049
HIB	22	34	NS
Total immunizations	84	124	
Fully immunized or up to date for age (percent)	17 (7.3)	34 (14.7)	<0.011
Number of children immunized	33	49	<0.047
Number of clinic visits per child	1.2±.41	1.2±.56	NS
Number of immunizations received per child	2.54±1.33	2.53±1.0	NS

DPT=diphtheria-pertussis-tetanus; TOPV=trivalent oral poliovirus vaccine; MMR=measles-mumps-rubella; HIB=*Haemophilus influenzae* b.

tion group. Forty-two of these contacts occurred at the residency clinic. Thirty-three children from the control group made 40 visits. Thirty-five of these encounters were at the residency clinic. In comparing the two groups, there were nearly one and one-half times the number of children immunized in the intervention cohort ($P<0.047$), and twice as many intervention group children were brought up to date in their immunizations ($P<0.011$). There was little difference in these results when the groups were standardized for race or age. The residency billing codes missed 19 percent of the immunizations administered when compared with the chart records.

Discussion

The immunization coverage in this residency practice is extremely low, considerably less than that reported for the county or state and lower than that of many developing nations. Up-to-date coverage for the entire practice was 10.6 percent at the start of the study and increased to 19.1 percent after the 6-month intervention ($P < 0.0002$). This small but significant increase can probably be attributed to the intervention and the increased attention given to a child's immunization status by the physicians. Most of the 55 children whose immunizations were up to date at the beginning of the study maintained their current immunization status: 7 received additional immunizations and remained up to date while 41 remained up to date without additional contact. Seven children fell behind.

More children were immunized in the intervention group than in the control group, and there was a significant difference between the two groups in the number of children who were up to date. Sixty-nine percent of the children in the intervention group who visited the clinics during the 6-month study were brought up to date. In contrast only 51 percent of the children in the control group who came into one of the clinics reached that goal. There was no increase in the number of clinic visits per child for immunizations or the number of immunizations received per child in the intervention cohort despite the postcard and physician's telephone contact. The intervention appeared to increase the number of children that contacted the clinics but had no effect on the promotion of subsequent visits. Many of the children were only one or two clinic visits away from being up to date.

There are several reasons why the coverage in the residency practice appears so low when compared with that of the county as a whole. The study criteria specified that a child could be no more than 1 month late for his or her next scheduled immunization to be up to date for age. We also required a second MMR between the 4th and 6th birthdays. Up-to-date immunization coverage in the United States is frequently defined as four DPTs, three OPVs, and one MMR by age 2 years, or five DPTs, four OPVs, and a MMR prior to school entry. Achieving these goals still offers inadequate protection for many children if they are late in receiving the vaccines. Immunizations need to be provided as soon as possible to offer maximal protection during early infancy and childhood. Many children remain vulnerable to vaccine-preventable diseases until they catch up on their immunizations before entering child care or school.

Many physicians were unfamiliar with newly licensed vaccines and recent changes in the immunization requirements.[14] A new HIB immunization recommendation had been introduced just before the study, which could explain why most infants were behind in their HIB vaccinations. The intervention did increase the number of HIB vaccines given. The

increase was proportional to the increase seen in all vaccines.

Eighty-four percent of the children immunized at the residency clinic were insured through Medicaid, and 7 percent had no health insurance. Only 9 percent had private insurance. There were no out-of-pocket expenses for immunization for the majority of children. Most uninsured children were immunized at the less expensive public health clinic. Financial constraints were probably not a factor in delayed receipt of immunizations.

There are several potential sources of bias in this study. There might have been some contamination of our control group. Children with different surnames and assigned to different groups could have resided in the same household. If one child received a postcard reminder, the parent might have brought all the children in for immunizations, including those in the control group. A similar situation could occur between neighbors. A single postcard could have influenced several families. If this contamination did take place, it would have decreased any differences between the cohorts.

Some postcards might not have been received by the intended target parents or not understood in a Spanish-speaking household. If so, the response rate in the intervention group would have been lowered.

The clinic population is highly mobile. Thirteen percent of the intervention group had moved and had no forwarding address. Despite three attempts to reach them by telephone, 41 of 177 families were never contacted. The immunization coverage in the intervention group might have been higher had the 40 percent of children who were not contacted been excluded. Medicaid-insured children had an 18 percent no-show rate for appointments, which decreased the opportunities for immunization. Sixty-five percent of the children immunized during the study period were making their first visit to the practice, indicating the rapid in-and-out movement of patients. The frequent turnover of patients and resident physicians makes it difficult to maintain continuity of care long enough to ensure completion of the primary immunization series.

As the elementary school registration deadline drew near, it was hypothesized that the number of immunizations would increase. Children requiring the mandatory immunizations for school entry would visit to catch up. There was no difference, however, (909 versus 906) in total immunizations given between the January-June 6-month study period and the next 6 months.

Immunization coverage appears to decline with age. All of the infants less than 3 months of age in the study (n=9) had made their first immunization visit. Only 1 of the 9 was properly immunized; the HIB was omitted in the others. After the first visit, immunizations were often delayed or forgotten. Nineteen percent of children less than 5 months old were up to date. Twenty-three percent of children less than 7 months old were current in their immunizations, while 9 percent of children less than 19 months old were up to date. This decline in immunization coverage with age is similar to that reported elsewhere.[9] Coverage never improved until requirements for day care or school entry provided the impetus for catching up. There was no significant difference between control and intervention groups in the number of children provided with DPT, TOPV, and the HIB immunizations; however, there was a significant increase in the MMR immunizations given in the intervention group. This observation lends strength to the argument that the parents usually remembered (or considered more important) the primary set of immunizations (DPT, TOPV, HIB). As the time between immunizations lengthened, the later immunizations were forgotten or ignored. In the parent's view an older infant might be less susceptible to immunization-preventable diseases.[15] These parents responded to the reminder. This increase occurred despite the inability of the county health department to provide a second MMR.

The initial postcard mailing to parents of children whose immunizations were not up to date prompted 25 telephone inquiries. Most parents were surprised to learn that their children required further immunizations. Twenty-four percent (6 of 25) of the children attended the clinic to catch up on their immunizations during the study period. It is unclear why the other parents did not bring their children to the clinics. Postcard reminders resulted in only 11 patient visits from the 201 cards that were presumed delivered, a response rate of 5.5 percent. The overall response rate for the 231 children reminded by mailers was 4.8 percent. This response rate was similar to the 4 percent response rate for infants whose mothers received a postpartum immunization-related health education talk and a 2-month postcard

reminder[7] but considerably lower than the 11 percent reported from Australia, where birthday cards were used to remind parents of the need for children's measles immunizations,[8] and the 22 percent[9] and 16 percent[10] response rates reported by county health departments. The 135 telephone contacts resulted in another 39 visits (29 percent response). This rate was similar to the 25.4 percent[15] and 28.9 percent[6] reported in adult influenza immunization studies but was better than others that reported 12 percent[3] and 17.8 percent[6] response rates. As reported from other studies, telephone contacts were more successful in eliciting a subsequent clinic visit for immunizations.

Mailing reminders to children and contacting their parents by telephone were effective in improving coverage in the residency practice. A larger response might have resulted by using a health-belief-modeled postcard detailing the child's susceptibility to and the seriousness of immunization-preventable diseases. At the completion of the study, reminder letters were initiated in the practice to encourage attendance at well-child visits for immunizations. Additional interventions are necessary to improve coverage to an acceptable level.

Public health surveys confirm that immunization coverage is unacceptably low in children younger than 7 years old. Coverage is seldom calculated in private practices, however, and most physicians are unaware of how unsuccessful their practice is in immunizing children.[16] Tickler files and reminder letters to increase compliance with annual Papanicolaou smears are utilized in many practices. A similar tracking system coupled with such proactive interventions as postcard reminders, telephone follow-up, and a strategy to immunize at every opportunity can be successfully used to improve immunization coverage. Physicians are encouraged to determine and audit the coverage level of their practices and to institute a program to reach the goals set by UNICEF of 90 percent of children less than 1 year old to be fully immunized by the year 2000.[17]

Conclusion

An audit of immunization coverage in a family practice residency practice demonstrated that the majority of infants and children were not up to date. Postcards and telephone reminders were effective in increasing coverage but further efforts are necessary to improve immunization practices.

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