Registry-Driven, Community-Based Immunization Outreach: A Randomized Controlled Trial

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Objectives. This study evaluated the effectiveness of registry-driven, community-based outreach directed toward children with immunization delays.

Methods. A sample of 1856 children aged 6 to 10 months was randomly assigned to receive either outreach or no intervention.

Results. Children in the outreach group were more likely to receive an immunization during the observation period than children in the control group (61% vs 43%). Outreach was most effective for children with multiple risks, as measured by their immunization record; it was not effective for children whose mothers had received inadequate prenatal care.

Conclusions. Registry-driven outreach can effectively identify high-risk children and bring them to care. (*Am J Public Health.* 2001;91:1507–1511)

Provider-based recall and reminder systems and case management outreach programs have been found to raise immunization rates.[1–6] Because provider-based systems may miss children without a regular provider, many states and cities have created immunization registries. Registries pool data from multiple sources and can be used to target children most at risk and most likely to benefit from outreach. Previous research has identified key predictors of underimmunization: socioeconomic status, use of prenatal care, birth order, number of well-child visits, and whether the immunization schedule was started on time.[7–11] This study addressed whether community-based, registry-driven outreach is effective and whether predictors of underimmunization can be used to target at-risk children.

METHODS

Study Design

In 1997, 2 random samples of children aged 6 to 10 months were drawn from the Philadelphia Department of Public Health KIDS Immunization Database/Tracking System. Those in the original sample of 1696 were randomly assigned to receive outreach, a mailed reminder letter, or no intervention. As a means of increasing the number of outreach cases handled by 1 of the 2 participating outreach organizations, the study was extended after completion of the initial research. A second random sample of 160 children aged 6 to 10 months was drawn from the area served by that outreach organization and assigned to receive outreach. The outcome measure used was receipt of any immunization during the study observation period.

The KIDS registry contains birth records, medical records, and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) records. Because the registry included immunization histories for only 7% of the sampled cases when the study was conducted, immunization records were obtained primarily from parents and providers during outreach. The immunization histories of children in the reminder letter and control groups were obtained through outreach after completion of the observation period of the study.

Outreach

Two community-based organizations were contracted by the Department of Public Health to provide outreach to specific neighborhoods. Two thirds of the sample received outreach from a bilingual social services agency and one third from a university nursing center. The social services agency cases were evenly split among outreach, reminder letter, and no intervention. Because of the additional sample of outreach cases handled by the nursing center, 50% of the nursing group received outreach, 25% received a letter, and 25% received no intervention. Outreach workers used KIDS registry information to locate the family, obtain the immunization history, and assess whether the child was up to date. If the child was not up to date, the outreach worker helped the family obtain care and updated the registry. In the case of children who were not up to date, outreach workers made an average of 4 attempts to contact the family or the provider.

The 2 community-based organizations followed similar outreach procedures, except that the nursing center placed higher priority on the cases of older children and relied more heavily on home visits. The social services agency was more likely to contact providers directly to obtain immunization histories. In comparison with the nursing center, the social services agency had a larger and more experienced staff and had less personnel turnover during the study. Neither facility required outreach workers to hold advanced degrees, but the nursing center looked for outreach workers with previous experience in health care. Additional information about the outreach is available elsewhere.[12,13]

Sample

The median household income of the area served by the university nursing center was $23 365, and the median income of the area served by the social services agency was $15 291 (we calculated these income figures using the 1990 census).[14] In comparison with maternal data for Philadelphia as a whole, mothers in the outreach areas were more likely to have received inadequate prenatal care, to be teenagers, to be unmarried, and to be African American or Latina and less likely to have graduated from high school (data not shown). A 1992 population-based home survey conducted in this area revealed that approximately 40% of children were fully immunized at 24 months.[14]

Of the 1856 children initially sampled, 104 were removed from the study because they did not meet participation criteria. Complete immunization histories were collected for 57% of the 1752 eligible cases. Immunization histories were not obtained in 23% of cases because the client had moved out of the outreach areas or the street address could not be found. In another 4% of cases, histories were not obtained owing to refusal, a missing or late chart, or a medical exemption. Finally, in 16% of cases, the outreach worker's attempts to contact the family were unsuccessful.

As shown in Table 1, cases involving children whose immunization histories were not obtained were more likely to have been handled by the nursing center; also, these children were more likely to have mothers who had received inadequate prenatal care, to be aged 6 to 8 months, and to be African American and were less likely to be the first child born to their mother. Once site was controlled for, age was significant only in the case of the university nursing center, owing to its policy of prioritizing older cases; race was significant only for the social services agency.

The outreach group was more likely to have been worked by the nursing center, to have mothers who were high school graduates, and to be African American. When site was controlled for, there were no significant differences between the outreach and control groups.

Statistical Analysis

Children who were up to date at 7 months (3 diphtheria–tetanus–pertussis [DTP], 2 oral polio vaccine, 2 *Haemophilus influenzae* type b, and 2 hepatitis B) did not require outreach and were removed from the analysis. We constructed 2 measures of risk based on immunization history: (1) began immunizations after 3 months (start time) and (2) missing more than the third DTP (degree of delay). The prenatal care variable was based on the Kotelchuck index, wherein inadequate prenatal care is defined as care begun after the fourth month of pregnancy or completion of less than 50% of the recommended number of visits.[15] Bivariate and multivariate relationships were assessed via odds ratios (ORs) from cross tabulations and logistic regression analyses; SPSS for Windows (version 8.0; SPSS, Inc, Chicago, Ill) was used in these analyses.

RESULTS

As can be seen in Table 1, children in the outreach group were more likely to receive an immunization during the study observation period than children in the control group (61% vs 43%; $P<.001$). Table 2 presents the results of the bivariate and multivariate logistic regression analyses. In addition to outreach, variables that significantly increased the odds of receiving a vaccination were having a case handled by the social services agency, having a mother who received adequate prenatal care, having a teenaged mother, needing only the third DTP, being in the 6- to 8-month age group, and starting the immunization schedule on time. When these 6 variables were entered into the multivariate regression analysis, maternal age was insignificant and was dropped from the model. Start time and degree of delay had almost identical predictive power, and a model including both variables was not more predictive than a model including only 1 of the 2.

Here we describe a model involving start time, because that variable can be constructed with a less complete immunization record. In a model including intervention group, site, prenatal care, and start time, children receiving outreach were 2.5 times more likely to have received a vaccination than children in the control group (95% confidence interval [CI]=1.5, 3.9). Children whose cases were handled by the social services agency (OR=2.3, 95% CI=1.4, 3.7), whose mothers had received adequate prenatal care (OR=1.7, 95% CI=1.1, 2.7), and who had started the immunization schedule on time (OR=1.6, 95% CI=1.0, 2.5) were also more likely to receive a vaccination.

Interaction terms between intervention groups and identified risk factors were tested but did not improve the fit of the model. However, cross-tabulation of these interactions produced potentially useful results. Outreach was ineffective among children who needed only the third DTP, but it increased the percentage of children receiving vaccinations from 34% to 58% ($P=.001$) among those missing one of the first or second series. Outreach was more successful among children who had started the immunization schedule late (increasing the percentage of children receiving vaccinations from 35% to 58%; $P=.006$), than among children who had started the immunization schedule on time (increase of 49% to 63%; $P=.026$).

The opposite was true for prenatal care. Outreach was ineffective among children whose mothers had received inadequate prenatal care; however, among children whose mothers had received adequate prenatal care, it increased the percentage receiving vaccinations from 45% to 68% ($P<.001$; Table 3).

DISCUSSION

In this report, we have described 2 predictors from immunization records, start time and degree of delay, and 1 predictor from the birth record, prenatal care, that could be used separately or in tandem to target outreach. Using measures based on immunization records, we found that outreach was most effective with children at high risk. Similar results have been found for children at risk owing to a low number of well-child visits.[3] In contrast, outreach was not effective among families with inadequate prenatal care. Previous research has shown that mailed letters can be an effective feature of provider-based reminder and recall systems, but letters were not effective in this study.

One of the community-based organizations was more effective than the other in terms of obtaining immunization histories and bringing families to care, even when demographic differences between the populations served were controlled. We can offer 2 possible explanations. First, contacting providers directly for immunization records was an effective method of outreach and one that was pursued to a greater degree by the more successful organization. Second, the less successful organization had less experienced staff and more personnel turnover.

A limitation of this study and the intervention described was that immunization histories were collected from only 57% of the sample. Some children had moved out of the outreach area, and we were unable to contact families of other children. Part of the reason

TABLE 1—Sample Characteristics and Differences Between Groups, by Whether an Immunization History Was Obtained and by Intervention Group: Philadelphia, 1997

		Immunization History		Intervention Groups (Immunization History Obtained)	
	Total Sample (n = 1752), %	Obtained (n = 991), %	Not Obtained (n = 761), %	Control (n = 612), %	Outreach (n = 379), %
Site					
Social services agency	65.6	70.9	58.7**	80.4	55.7**
Nursing center	34.4	29.1	41.3	19.6	44.3
Maternal age, y					
≤19	22.3	23.9	20.3	23.8	24.1
≥20	77.7	76.1	79.7	76.2	75.9
Prenatal care					
Adequate	74.0	78.2	68.7**	78.1	78.3
Inadequate	26.0	21.8	31.3	21.9	21.7
Mother's education					
High school	62.5	60.6	64.9	57.5	65.5*
Less than high school	37.5	39.4	35.1	42.5	34.5
Birth order					
First child	36.4	40.0	31.7**	39.4	40.9
Second child or later	63.6	60.0	68.3	60.6	59.1
Mother's marital status					
Unmarried	74.6	74.6	74.5	74.5	74.8
Married	25.4	25.4	25.5	25.5	25.2
Mother's race					
White	19.3	22.8	14.9**	26.2	17.4*
African American	54.9	48.9	62.5	40.0	63.1
Hispanic	25.8	28.3	22.6	33.9	19.4
Child's age, mo					
6–8	66.5	63.4	70.5**	64.2	62.0
≥9	33.5	36.6	29.5	35.8	38.0
Start time[a]					
Late	…	…	…	20.1	17.4
On schedule	…	…	…	79.9	82.6
Up to date[a]					
No	…	…	…	39.9	39.1
Yes	…	…	…	60.1	60.9
Degree of delay[b]					
Only 3rd DTP needed	…	…	…	45.9	44.6
Need 1st or 2nd shot	…	…	…	54.1	55.4
Immunization receipt[b]					
At least 1 vaccination	…	…	…	43.3	60.8
No vaccinations	…	…	…	56.7	39.2

[a]Includes only the 991 cases with an immunization history.
[b]Includes only the 393 cases not up to date as of the study observation period.
*$P < .05$, insignificant after site was controlled for.
**$P < .01$, insignificant after site was controlled for.

for the low response rate may have been that the contact information from birth records was more than 6 months old. Other researchers using birth records to locate older children have reported similar response rates.[10,11]

Children whose immunization histories were not obtained were more likely to have mothers who received inadequate prenatal

TABLE 2—Bivariate and Multivariate Analysis Predicting Vaccination During Observation Period for Children Not Up to Date at Beginning of Observation Period: Philadelphia, 1997

	Bivariate Analysis, Odds Ratio (95% Confidence Interval)	Multivariate Analysis, Odds Ratio (95% Confidence Interval)
Intervention group		
Outreach	2.0 (1.3, 3.1)**	2.5 (1.5, 3.9)**
Control[a]		
Site		
Social services agency	1.6 (1.0, 2.4)*	2.3 (1.4, 3.7)**
Nursing center[a]		
Maternal age, y		
≤18	1.6 (1.0, 2.6)*	. . .
>18[a]		
Prenatal care		
Adequate	1.7 (1.1, 2.6)*	1.7 (1.1, 2.7)*
Inadequate[a]		
Degree of delay		
Only 3rd DTP needed	1.6 (1.1, 2.4)**	. . .
Need 1st or 2nd shot[a]		
Child's age, mo		
6–8	1.7 (1.1, 2.7)*	. . .
≥9[a]		
Start time		
On time	1.7 (1.2, 2.6)*	1.6 (1.0, 2.5)*
Late[a]		
Mother's education		
High school	1.2 (.8, 1.8)	. . .
Less than high school[a]		
Birth order		
First child	1.3 (.8, 2.0)	. . .
Second child or later[a]		
Mother's marital status		
Unmarried	1.4 (.9, 2.4)	. . .
Married[a]		
Mother's race		
White	1.0 (.5, 1.8)	. . .
African American	0.7 (.4, 1.2)	. . .
Hispanic[a]		

[a]Reference category.
*P < .05; **P < .01.

TABLE 3—Percentage of Children Who Received Vaccination, by Outreach Status and Immunization Predictors: Philadelphia, 1997

	Received Immunization, % (No.)
Degree of delay	
Only 3rd DTP needed	
Outreach	64 (82)
Control	52 (132)
Need 1st or 2nd shot	
Outreach	58 (66)**
Control	34 (113)
Start time	
On time	
Outreach	63 (60)*
Control	49 (72)
Late	
Outreach	58 (52)**
Control	35 (98)
Prenatal care	
Adequate	
Outreach	68 (100)**
Control	45 (158)
Inadequate	
Outreach	42 (41)
Control	41 (75)

*P < .05; **P < .01 (Pearson χ^2).

care and to have been second or higher in terms of birth order. Beginning outreach earlier for children whose mothers have received inadequate prenatal care may improve tracking as well as response to outreach. This is also a limitation of the program model, as data collection was integral to program delivery. Furthermore, the variables associated with the program's inability to collect immunization histories are often associated with populations at risk for lower rates of immunization.

Registry-driven, community-based outreach increased the number of children receiving vaccinations during the study observation period. Registries make possible a multi-tiered approach to outreach, with resources targeted where they will have the greatest effect. Further research is needed to identify immunization outreach programs that will be effective in reaching families with a history of inadequate prenatal care and to determine why registry-generated reminder letters appear to be less effective than provider-generated reminder letters. ■

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Contributors

S.A. Wilcox managed the study, analyzed the data, and wrote the paper. C.P. Koepke designed the study, directed study management and analysis, and cowrote the paper. R. Levenson assisted in designing the study and in writing the paper. J.C. Thalheimer assisted in designing and managing the study and contributed to the interpretation of the data.

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