

Barriers to Immunization in a Relatively Affluent Community

Barbara P. Yawn, MD, MSc, Zhisen Xia, PhD, Larry Edmonson, MPH,
Robert M. Jacobson, MD, and Steven J. Jacobsen, MD, PhD

Background: Although *Healthy People 2000* calls for the complete immunization of at least 90% of children by age 20 months, few communities can claim such success. We wanted to determine the parent-reported barriers associated with underimmunization of infants in a relatively affluent midwestern population.

Methods: We undertook a case-control study of a population-based sample of parents and guardians of children who were either fully immunized or underimmunized at 20 months of age in Olmsted County, Minn.

Results: In this study, 596 of 1,216 parents (46%) of both immunized and underimmunized children participated. Of these participants, 281 (47%) reported barriers to immunizations, but only 15 (3%) reported major barriers. Whereas the most commonly reported barriers were barriers of inconvenience (waiting too long, inconvenient office hours), only delays caused by a sick child, fear of reactions, trouble remembering an appointment, not knowing when the next shot was due, and transportation problems were significantly associated with underimmunization when controlling for demographic factors. Fear of reactions, sick child delays, and not knowing when the next shot was due had the highest attributable risk for underimmunization. Taken together, parent-reported barriers and demographic factors explained less than 30% of the underimmunization status of children. Parents' most common recommendations for improving immunization status were the use of a recall or reminder system and a single unified schedule for immunizations.

Conclusions: In this relatively affluent community, barriers to immunization were commonly reported but few (fear of reactions, sick child delays, and not knowing when the next shot was due) were associated with underimmunization. The types of barriers reported were similar to those reported in other communities, but unlike many populations studied, cost was not reported as an important barrier. (*J Am Board Fam Pract* 2000;13:325-32.)

Healthy People 2000 calls for the complete immunization of at least 90% of children by age 20 months.¹ Although some managed care populations have attained this goal,² few communities can claim such success.³⁻⁵

The reasons for this shortfall in infant immunizations have been studied, evaluated, and discussed for decades.⁶⁻¹³ In 1991 the common community barriers to immunization of infants were listed as missed opportunities, organizational failures in the health care delivery system, inadequate access to care, and incomplete public awareness of the importance of immunizations and the morbidity of vaccine preventable diseases.¹⁴ The following family characteristics are associated with lower likelihood of completed immunizations by the age of 2 years: completing less formal education, large family size, lower socioeconomic status, being non-white, receiving services through a public health department, living in a single-parent family, getting a late start on immunizations, and inadequate insurance.^{15,16} Practice barriers have been reported by private and public health clinicians as high cost

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From the Olmsted Medical Center, Department of Research (BPY), Rochester; the Section of Clinical Epidemiology, Department of Health Sciences Research (ZX, SJJ), Mayo Clinic, Rochester; the Olmsted County Public Health Services, Division of Disease Prevention and Control (LE), Rochester; and the Department of Pediatric and Adolescent Medicine (RMJ), Mayo Clinic, Rochester, Minn. Address reprint requests to Barbara P. Yawn, MD, MSc, Department of Research, Olmsted Medical Center, 210 Ninth St. SE, Rochester, MN 55904.

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of vaccine to providers,^{10,11,17-20} inadequate insurance coverage of families,^{6,10-12,21-24} inadequate use of immunization opportunities,^{10,25-29} and lack of community-based registries or tracking systems across communities.³⁰

Parent-perceived barriers have also been studied, primarily in inner-city parents, parents receiving medical assistance, and rural parents.^{7,11,25-27,31-36} Most studies have focused on the delivery of immunizations by the public health system. The most common parent-reported barriers were cost, safety concerns, lack of health care access, and inconvenience.³¹⁻³⁵ Four published studies included parents that were not economically stressed^{25,37-39} but only one³⁷ examined the association between parent-reported barriers and the actual immunization status of the child. A second compared the health beliefs of parents in an affluent community with their child's immunization status.³⁸ Although all barriers deserve attention, the most important barriers to recognize and address are those associated with incomplete immunizations by age 2 years.

Previous reports of parent-perceived barriers have encouraged the development of immunization registries and recall and reminder systems that have been shown to be associated with increased immunization in a clinic population.^{40,41}

Middle-class communities, as well as economically stressed communities, also fall short of the *Healthy People 2000* goal of 90% immunization by age 24 months.^{25,29,38} Barriers reported in the studies of more distressed communities and public health systems might not predict barriers experienced by parents in more affluent or less underserved areas. We report and compare the parent-perceived barriers for fully immunized and underimmunized children found in a population-based birth cohort of children in a relatively affluent community. We also report the solutions suggested by parents.

Methods

Sample

Children eligible for this study were 2 and 3 years old from a birth cohort of children born in Olmsted County, Minn, between 1 July 1992 and 30 June 1993 and still residing in Olmsted County on 1 March 1996. Olmsted County is a metropolitan statistical area located 90 miles southeast of Minneapolis. According to 1990 census data, 96% of its

residents were white and mostly middle class, with approximately 82% of adults having completed a high-school education.⁴² In 1994, the rate of completed immunization for 20-month-old children in Olmsted County was 69% and for 2-year-old children, 74%.³⁰ At the time of the survey, only 8% of the population was uninsured, 18% had Medicaid insurance, 20% was covered by managed care contracts, and the rest had fee-for-service private insurance (personal communication, Troy Stafford, CFO, Olmsted Medical Center).

Using a population-based case-control design, a sample of parents and guardians was selected for this study. Cases were defined as underimmunized children who received two or fewer polio vaccines (oral polio vaccine [OPV] or injectable polio vaccine [IPV]) or three or fewer diphtheria, pertussis, tetanus (DPT) immunizations or no measles, mumps, and rubella (MMR) immunizations by the age of 20 months. Hepatitis B immunizations were not included in the definition, because not all community providers were routinely recommending them for children during the study period. Controls were children who were fully immunized (4 DPT, 3 OPV or IPV, and 1 MMR) by age 20 months. The children for the cases (n = 332) and controls (n = 1,053) were selected from a previously reported study²⁷ that assessed immunization status of each child in the birth cohort based on data from the medical records of all three Olmsted County private and the one public health providers. Survey questionnaires were sent to parents or guardians of all case children as well as to a 50% random sample of all eligible control children.

The survey questionnaire was mailed to the last known address of each parent or guardian. A second questionnaire was mailed to those with a forwarding address and those not returning the initial questionnaire within 3 weeks. If no response was received in an additional 3 weeks, the family was telephoned (if a telephone number could be found) and asked to return the questionnaire.

For each case and control child, the survey requested information on such family demographics as family structure, household income, maternal and paternal education, and source of insurance. A checklist of potential barriers was developed using information from the published literature and from a similar study completed by the Anoka County, Minn, Department of Health.³⁸ Parents were asked to check all barriers they experienced as well as the

two biggest barriers. For each barrier checked, parents were asked to indicate whether it was a major or minor barrier. Several blank lines were provided to list additional barriers. The survey instrument also provided several blank lines for the parents to suggest what they thought would facilitate children receiving all immunizations. The survey was to be completed by the adult designated as most responsible for the child's care.

Data Analysis

Categorical demographic and family characteristic variables were compared for case and control children using the chi-square statistic. Because previous studies suggested immunization status is associated with demographic factors, multivariable logistic regression models were used to examine the association between parent-perceived barriers and case-control status, with and without adjustment for demographic factors. Case status was the dependent variable. The main effects examined were the most commonly reported barriers to immunization. The model selection was based on the hierarchical principle. Odds ratio and attributable risk estimates^{43,44} were calculated for the variables in the final logistic regression model.

Results

Of the 1,216 survey questionnaires that were distributed, 1,089 could be delivered. A total of 596 questionnaires were returned completed, representing a response rate of 49% of all questionnaires. The response rate was 57% and 26% of mailed (66% and 48% of deliverable) questionnaires for the mothers of the control children and case children, respectively. Family characteristics for the case and control children were similar with respect to maternal age, race, birth order, the number of adults and children in the house, and number of infant health care encounters (Table 1). There were, however, differences in maternal education and household income (Table 1). Underimmunized (case) children were more likely than immunized (control) children to have mothers with lower education (54.9% vs 67.6% of college or higher, $P = .034$) and lower household income (19.4% vs 7.9% of less than \$20,000, $P = .002$).

Underimmunized children were more likely than immunized children to receive social or public health services, such as Women, Infants and Chil-

Table 1. Proportions of Characteristics of Case and Control Children.

Characteristics	Percent Case (n = 70)	Percent Control (n = 526)	P Value
Adults in household			.828
1	5.6	6.3	
2 or more	94.4	93.7	
Children in household			.093
1	11.3	13.7	
2	42.3	53.0	
3 or more	46.5	33.3	
Birth order of child			.999
First	39.4	39.4	
Second or higher	60.6	60.6	
Race of child			.960
White	94.4	94.2	
Other	5.6	5.8	
Race of mother			.935
White	95.8	96.0	
Other	4.2	4.0	
Maternal age			.568
<33 years	47.8	44.2	
≥33 years	52.2	55.8	
Maternal education			.034
College or higher	54.9	67.6	
Less than college, or unknown	45.1	32.4	
Health care visits before 24 months old, No.			.243
<3	14.1	8.4	
3 to 6	26.8	32.2	
>6	59.2	29.4	
Household income in 1995			.002
<\$20,000	19.4	7.9	
\$20,000 to \$39,000	26.9	19.7	
≥\$40,000	53.7	72.5	

dren (WIC) and Public Health services, for both the first and the second year of their life. Case children also were more likely than control children to have medical assistance or Children's Health Plan insurance in the second year of their life (odds ratio [OR], 3.0, 95% confidence interval [CI], 1.5–5.8). This association was not as strong in the first year (OR, 1.7, 95% CI, 0.8 to 3.3). During both the first and second year of life, using WIC was the family characteristic with the highest attributable risk for underimmunization (data not shown).

Barriers to immunizations were reported by the parents of completely immunized and the parents of underimmunized infants. Overall, 281 of 596

Table 2. Perceived Barriers to Immunization Among Survey Respondents (n = 596).

Barrier	Major No. (%)	Minor No. (%)	Biggest Problem* No. (%)
Concern about safety	17 (3)	74 (12)	22 (4)
Cost	17 (3)	32 (5)	11 (2)
Office wait too long	10 (2)	90 (15)	24 (4)
Did not want to put child through pain	8 (1)	57 (9)	14 (2)
Did not know when shot was needed	7 (1)	56 (9)	16 (3)
Parent could not leave work	6 (1)	36 (6)	11 (2)
Lack of parental time	5 (1)	52 (9)	16 (3)
Could not get records transferred from another facility	5 (1)	9 (2)	3 (1)
Did not want child to get more than one shot at a time	4 (1)	30 (5)	7 (2)
Delayed because of illness	4 (1)	27 (5)	8 (2)
Location of clinic inconvenient	3 (1)	17 (3)	5 (1)
Did not like doctors or nurses	3 (1)	11 (2)	4 (1)
Inconvenient hours	2 (0.5)	45 (8)	16 (3)
No child care for other children	2 (0.5)	26 (5)	8 (2)
Doctor said child should not have shots right now	2 (0.5)	12 (2)	2 (0.5)
Forgot appointment	0 (0)	24 (4)	2 (0.5)

Note: Case and control children were combined.

*Respondents were asked to circle two biggest problems from a list of potential barriers.

parents (47%) reported they experienced one or more barriers. Most barriers (more than 94%) were considered minor barriers by the parents. Table 2 lists all the barriers reported by parents as major and minor barriers as well as the two biggest problems reported by the parents. Waiting too long in the waiting room and fear of a reaction to the shot were each listed as either major or minor barriers by more than 15% of respondents (n = 98 and n = 91, respectively). Not knowing when the next shot was needed, time concerns, worrying about pain from the shot, and inconvenient clinic hours were listed by about 50 (8%) respondents each. Cost was infrequently reported as a major barrier (2% of all parents).

Although each of these stated barriers deserves attention, the barriers reported by families with underimmunized children might be the most important to address. Five barriers were significantly more likely to be reported by parents of underimmunized children than parents of fully immunized children (Table 3). Transportation had the highest odds ratio but was listed by only 8 parents as a major or minor barrier. Conversely, not knowing or having trouble remembering the timing for the next shot had a lower odds ratio but was reported by 63 parents overall as a major or minor barrier. Delaying shots because of illness and fear of reaction were the other barriers associated with under-

immunization and were reported by 45 and 91 respondents, respectively. Fear of reactions to the shots was most commonly listed as the biggest problem by all parents.

The barriers reported and those associated with underimmunization did vary by some maternal characteristics. Trouble remembering appointments was most highly associated with underimmunization in mothers 33 years of age or older (OR, 7.1; 95% CI, 1.8–27.6), whereas transportation problems were most likely to be associated with underimmunization in women with multiple children. Fear of reactions was associated with underimmunization in children of those mothers who had a college education and in those who had multiple children. Interestingly, only first-time mothers did not delay immunizations because of the child's illness.

In multivariable analysis, there were only two significant family demographics associated with underimmunization by age 20 months: household income and self-payment. After adjusting for household income and self-payment, the odds ratios for parent-perceived barriers associated with underimmunization changed only slightly from the bivariate analyses (Table 3). The largest change in odds ratio in the multivariable analysis occurred with transportation problems. In bivariate and multivariable analyses controlling for income and self-pay-

Table 3. Association Between Perceived Barriers and Underimmunization.

Problem	Univariate Analysis Overall		Adjusted* Analysis	
	Odds Ratio (95% CI)	Attributable Risk (95% CI)	Odds Ratio (95% CI)	Attributable Risk (95% CI)
I had problems getting transportation	7.8 (1.9, 31.8)	4.9 (-0.7, 10.4)	4.7 (1.1, 20.8)	5.2 (0.1, 13.7)
My child had been sick and I didn't take my child for shots	5.2 (2.3, 11.5)	12.5 (3.4, 21.4)	4.0 (1.7, 9.3)	12.1 (2.4, 21.8)
I didn't know when the next shot was needed	2.8 (1.5, 5.3)	13.6 (2.9, 21.2)	2.8 (1.4, 5.4)	14.1 (2.4, 25.8)
It was hard to remember the appointment	2.6 (1.0, 6.8)	5.2 (-1.6, 12.0)	2.7 (1.0, 7.4)	5.5 (-1.9, 13.0)
I was afraid my child would have a reaction to the shot	2.3 (1.3, 4.2)	14.4 (2.5, 26.4)	2.5 (1.3, 4.6)	16.4 (3.6, 29.2)
I didn't like the doctors or nurses at the clinic	3.1 (0.9, 10.1)	3. (-1.7, 9.3)	2.4 (0.7, 8.1)	3.5 (-3.0, 10.0)
My doctor advised that my child not have shots at this time	3.1 (0.9, 10.1)	3.8 (-1.7, 9.3)	2.5 (0.7, 8.5)	3.6 (-2.1, 9.3)
I found the clinic location was not convenient	2.6 (0.9, 7.3)	4.3 (-1.9, 10.5)	2.7 (0.9, 8.0)	4.6 (-2.0, 11.3)
I had to pay too much for the shots	2.0 (0.9, 4.4)	6.4 (-2.0, 18.0)	1.1 (0.5, 2.7)	0.5 (-10.6, 11.6)
I didn't want to put my child through the pain of shots	1.4 (0.7, 2.9)	4.0 (-5.1, 13.3)	1.1 (0.5, 2.5)	1.6 (-9.2, 12.3)
I didn't want my child to get more than one shot at a time	1.6 (0.7, 4.1)	3.3 (-3.4, 10.0)	1.7 (0.7, 4.5)	4.1 (-3.9, 12.1)
Any barriers listed above	2.5 (9.0, 49.4)	33.0 (15.2, 50.7)	2.1 (1.2, 3.6)	29.2 (9.0, 49.4)

Note: Barriers are combined reported major and minor barriers.
 *Associations after adjusting for income and self-payment.

ment, fear of a reaction to the immunization had the highest attributable risk 14.4% (95% CI, 2.5, 26.4) followed closely by not knowing when the next shot was needed 13.6% (95% CI, 2.9, 24.2) and delaying immunizations because of a sick child 12.5% (95% CI, 3.4, 21.4) (Table 3). In combination, all the reported barriers account for only 29.2% of the underimmunization of these children.

The solutions proposed by parents to increase immunization rates did not differ based on the child's immunization status. By far, the most commonly suggested solution was a system of reminders (96/596, 16%). Parents suggested that reminders be mailed or parents telephoned before an immunization was due as well as when a child missed an immunization. The second most common suggestion (58/596, 10%) was having a single immunization schedule for all clinics and all clinicians. Thirty-two parents specifically commented that they did not like schedules with broad ranges of possible immunization age (ie, the second DPT should be administered between 2 and 4 months of age). More convenient hours was next (32/596, 5%) with lower cost the fourth most common suggestion (18/596, 3%). Twelve parents were concerned that immunization status was not checked at each appointment. Fewer than 10 parents each suggested immunization clinics with or without appointment, childcare for siblings, and better aware-

ness of immunization safety and benefits. Free or low-cost immunization clinics were suggested by only 3% of the parents and were reported to be used by only 20% of those reporting cost as a barrier.

Discussion

In this relatively affluent Midwestern community, almost one half of all parents stated they had at least minor barriers to immunizations. Less than 3% of the parents, however, reported major barriers to immunization series completion. Although inconvenience (inconvenient location, inconvenient time, or too long waiting time) was reported most commonly by all parents as a barrier to immunizations, it was not associated with underimmunization, suggesting that parents found ways to compensate for the inconvenience or were willing to accept the inconvenience to immunize their child.

The comparison of perceived barriers with immunization status at 20 months provides useful information on barriers parents might be unable to overcome without additional resources. While odds ratios provide some information, the attributable risk estimates show the barriers that have the greatest impact on underimmunization rate. This information can help the community tailor solutions for the greatest potential impact. For example, the

Table 4. Comparison of Frequency of Reported Immunization Barriers in Four States.

Barrier	Olmsted County (n = 596) % (Rank)*	Anoka County, Minn ³⁷ (n = 574) % (Rank)*	Ohio City ²⁵ (n = 203) % (Rank)*	North Carolina Rural Poor ²⁶ (n = 109) % (Rank)*
Office wait too long	17 (1)	17 (3)	28 (3)	39 (1)
Concern about safety	15 (2)	20 (1)	11 (7)	25 (2)
Didn't know when shot was due	11 (3)	11 (6)	11 (8)	5 (9)
Concerns about pain	11 (4)	15 (4)	NA	NA
Lack of parental time	10 (5)	9 (7)	20 (5)	14 (7)
Delayed because of illness	8 (6)	19 (2)	27 (4)	15 (6)
Inconvenient hours	8 (7)	7 (8)	18 (6)	23 (3)
Forgot appointment	4 (8)	NA	8 (10)	NA
Insurance doesn't cover	1 (9)	NA	35 (2)	22 (4)
Transportation	1 (10)	3 (9)	10 (9)	14 (8)
Disease not a danger	NA	NA	5 (11)	1 (10)

NA - not asked.

*Rank order of frequency of parent-reported barriers.

odds ratios suggest that transportation problems have the strongest relation with underimmunization. Only 8 parents reported this problem, however. Conversely, problems with fear of reactions, not knowing when to get the next immunization, and delays caused by sick children have a much larger attributable risk despite lower odds ratios. Educating parents about the relative safety and risks and benefits of immunizations, considering the use of a reminder or recall system,^{40,41} and educating parents and physicians about inappropriate immunization delays for illnesses⁴¹ have the potential, therefore, for a much greater impact than developing a transportation system.

Overall, the barriers perceived by our parents are similar to those reported in studies of other socioeconomic and geographic groups. The Olmsted County parents, however, reported all barriers less frequently and with a different order of frequency than reported in other studies in the medical literature (Table 4). Even so, for all parents too long an office wait and concerns about safety were high on the list. Unfortunately, we can do little to compare the impact of these differences on immunization rates, because only the Anoka, Minn (unpublished), study compared reported barriers with documented immunization rates.

As in studies of inner-city or rural residents and public health clinic clients, we found socioeconomic and demographic characteristics to be associated with incomplete immunization status at 20 months. Although in our community the use of low-cost immunization clinics was associated with

higher rates of completed immunizations by age 20 months, less than 20% of people who listed cost as a concern used the low-cost clinics. Further exploration of why low-cost clinics are not used might reveal factors that could be modified to enhance the use or function of those clinics. Previous studies of public health and low-cost clinics have noted similar issues.¹⁰

Parental solutions listed in our survey are also similar to those suggested in other studies.^{25,26,37} Unlike respondents in less affluent communities, however, our respondents mention reducing cost less often. Other solutions, such as free transportation, were also listed less often.

Parents in our study wanted a reminder system and a unified schedule of immunizations that would allow them to know exactly - not within weeks or months, as listed on the harmonized ACIP-AAFP-AAP schedule - when the next immunization was due. Parents suggested a system that allows reminders to be mailed to parents or parents telephoned whose children have missed an immunization or who are approaching the need for a next one. Immunization registry and tracking systems, which have these abilities, are commercially available. Only the Olmsted County Health Department had such a system at the time of this survey. In addition, this community had at least three different immunization schedules given to parents. The broad bands of flexibility of the harmonized immunization schedule allow this variation. For providers, this variability and personal preference

might be helpful. For parents, it appears to be confusing and frustrating.

Although findings from this study provide important information about barriers to childhood immunization, several potential limitations must be recognized. The response rate was less than we would desire. Most studies report response based on delivered survey instruments or answered telephone calls, which would also increase our reported response rate. Other clinical studies that include families who are noncompliant with medical care have reported similar problems in obtaining responses except through home visits. This low response rate might affect the reported barriers as well as our determination of the barriers most closely associated with incomplete immunizations. In addition, the information on barriers is self-reported and can include a recall or selection bias. Parents appear to be the best source of this information, however. The child's immunization status was based on medical record documentation and did not rely on parent reporting. Finally, to provide a balance or counterpoint for the data from low-income parents reported in previous studies, the known higher-than-average income and educational levels of the parents in this community were a primary reason to select Olmsted County. Despite inclusion of all family demographics and barriers previously associated with incomplete infant immunization, we could account for less than 30% of the attributable risk for underimmunization of these children. Other studies have found similar gaps in the ability to explain the reasons for underimmunization based on parent-perceived and reported barriers.^{40,41}

Conclusion

This study illustrates the potential importance of tailoring community solutions to locally reported barriers to immunization rather than merely extrapolating from data collected from different geographic, social, or ethnic groups.

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