

An Evaluation of Immunization Status of White Children in a Kentucky County

DAN A. MARTIN, M.D., SALLY J. FLEMING, M.D., TIMOTHY G. FLEMING, M.D., and DEANNA C. SCOTT

THE DIFFICULTIES in achieving measles immunization in 12- to 15-month-old children in Hopkins County, Ky., have been described in a previous retrospective study (1), in which we also assessed the effect of mailed notices to the parents urging protection against measles. A rather small number of children—only about one-half—were found to be protected against measles either by natural disease or by immunization. Moreover, no effect of the mailed notices could be detected.

In the belief that these disappointing results might have been due to the relative newness of the campaign for measles immunization, we undertook a study of immunization against poliomyelitis and DPT (diphtheria-pertussis-tetanus) which we expected might yield different and better results.

A prospective study was designed to (a) assess the effectiveness of notices urging polio-

myelitis and DPT immunization, (b) reveal the total number of children for whom such immunizations had been started by 4 and 12 months of age, (c) determine the factors preventing 100 percent poliomyelitis and DPT immunization of all children born in a particular period, as well as the effort that would be necessary to produce 100 percent immunization, and (d) disclose the characteristics of families that had and had not begun immunization of their children by an acceptable time after birth.

Materials and Methods

Beginning May 1, 1966, and continuing through April 30, 1967, the names of all children born in Hopkins County were listed serially along with other information pertinent to our study, including sex of the child, address of the parents, number of other children in the family, legitimacy of the birth, education of the mother, income of the family, and name of the child's physician. Scott elicited these data at the time of the mother's confinement.

To the parents of every other baby born during the period May 1, 1966–April 30, 1967, notices were sent when the baby was 3 weeks old urging poliomyelitis and DPT immunization (see box); no known selection factors were involved in this system. Since all the children's records that were available for study at 4 and 12 months after birth were reviewed in physicians' offices and at the Hopkins County Health Department, we did not need to rely solely upon

Dr. Martin is clinical professor of community medicine, University of Kentucky School of Medicine, Lexington, and acting health officer for Hopkins County. Dr. Sally J. Fleming and Dr. Timothy G. Fleming, who at the time of the study were senior students in the school's department of community medicine, are interns at the University of Wisconsin Hospitals in Madison. Mrs. Scott is a clerk in the vaccine assistance program, department of epidemiology, Kentucky State Department of Health, Frankfort. This program provided financial support for the study.

the parents' memory. The physicians' records could have been incorrect, of course, but we do not believe that they were an important source of error.

To fulfill the four aims of the study, we decided to keep separate records on (a) births to residents which occurred outside Hopkins County when these residents were considered to belong rightfully to the county's population and (b) births of nonwhite infants both within and outside the county. As the following distribution of babies born to county residents in the period May 1, 1966–April 30, 1967, shows, the total births to nonwhite residents and to white residents outside the county were so small in number that further subdivision of the groups would have precluded profitable statistical examination:

<i>Births</i>	<i>Number</i>
To white residents:	
In the county.....	487
Outside the county.....	42
To nonwhite residents:	
In the county.....	62
Outside the county.....	1
Total.....	592

Results

Because the groups of nonwhite children and of white children born outside the county were too small to subdivide profitably for further study, our results are limited to the 487 infants born to white residents within Hopkins County in the period May 1, 1966–April 30, 1967.

Effectiveness of notices. There was no statistically significant difference between the results of immunization among families receiving notices urging immunizations and families receiving no notices, as the following table shows:

<i>Item</i>	<i>Sent notice</i>	<i>No notice</i>
Total selected ¹	243	240
Available for study.....	229	224
Started immunization by 4 months:		
DPT.....	189	179
Poliomyelitis.....	177	178
Unavailable for study.....	14	16
Letters unclaimed.....	6	-----
Moved from county.....	8	16

¹ 4 of the 487 white babies born in Hopkins County in the period May 1, 1966–April 30, 1967, were excluded from the study because they were adopted.

These data suggest that nothing is gained by mailed notices urging immunization. The reason may be that most parents take their children to physicians often enough so that preventive measures are initiated irrespective of the parents' desire for this service. But not all parents fall into this group. Approximately one-fifth of the total group of 453 babies available for study had not been started on preventive immunization (85 for DPT and 98 for poliomyelitis) by the expected and desirable time of 4 months after birth. We expected, however, that a restudy of the babies at 12 months of age would show an improvement.

Immunizations by 4 and 12 months. By October 31, 1967, that is, 18 months after the study began, we were able to determine how many of the 254 babies born in the county to white residents in the 6-month period May 1, 1966–October 31, 1966, had been started on poliomyelitis and DPT immunizations by 4 and by 12 months of age. Records of the babies at the health department and in physicians' offices were reviewed when the children were 4 months of age and again when they were 12 months of age to determine what had happened between these two points with respect to immunization. The results for the 254 babies born in the 6-month period, excluding 23 who were adopted or had moved, were as follows:

<i>Initiation of immunization</i>	<i>DPT</i>	<i>Poliomye- litis</i>
By 4 months.....	186	183
By 12 months ¹	11	12
Not started.....	² 34	36
Total.....	231	231

¹ But after 4 months.

² Also had not been started on poliomyelitis.

To find that only an additional 5 percent of the study children had been immunized by the 12th month of age was disappointing. It had been postulated originally that the passage of time would bring a large number of children to physicians and that immunizations would be started on these visits. Our results indicate, however, that if a child has not been started on his initial immunizations by 4 months of age, he is unlikely to have been started on them by 1 year of age. Of the 231 babies available for study at both 4 and 12 months of age, 34 (ap-

proximately 15 percent) had not been started on either DPT or poliomyelitis immunizations by 1 year of age.

Study of children not immunized by 1 year. Thirty-four children had not received any immunizations by 1 year of age. It therefore became necessary to visit or to attempt to visit these children in their homes. A public health nurse and Scott, who had established the initial contact with the hospitalized mother following the child's birth, obtained the following information on their first home visit, or attempted visit:

<i>Immunization status</i>	<i>Number of children</i>
None obtained in county.....	13
Family moved from county or State.....	10
Incorrect address or family not known to neighbors or post office.....	3
Obtained in county.....	11
DPT and poliomyelitis, "spontaneously" before visit.....	2
DPT and poliomyelitis at home as result of visit.....	7
DPT and poliomyelitis at health department after refusing at home.....	1
Measles only at health department after refusing DPT and poliomyelitis at home ¹	1
Potential immunizations through second visit...	10
Family moved within county and must be relocated.....	5
Family not at home ²	3
Baby ill at time of visit ³	2
Total.....	34

¹ Baby later developed clinical whooping cough; no organism was cultured.

² Later one of these babies also developed clinical whooping cough.

³ One family asked nurse and clerk not to return.

If we exclude the families of the 13 infants that could not be located because they had moved or initially had given unlocatable addresses, as well as the two families that had obtained immunizations for their babies spontaneously, 19 of the 34 "problem group" infants remained who needed immunizations and were available for intensive followup. One home visit resulted in approximately 25 percent of the 34, or eight babies, receiving immunizations. This result was accomplished by two people spending 9½ days each and traveling 329 miles. A second visit was to be directed at the 10 children presumed still to be in the county and still "at risk."

Were there any unusual personal or family characteristics by which the parents of these 34

Dear Parent,

From the minute a baby is born, he begins counting on you to keep him safe . . . warm . . . happy. He's also counting on you to protect him from the serious diseases most children can still get—diseases such as diphtheria, whooping cough, lockjaw, polio, smallpox, and measles. Your first act of defense against such serious diseases is the "Baby-Shots" available from your family doctor or health department.

These diseases are especially dangerous to children under five and may lead to permanent damage or death if untreated. Aftereffects or complications can be severe and may include heart failure, paralysis of muscles, nerve damage or destruction, blindness, pneumonia, and skin diseases.

Doctors recommend that protection be started as early as two months of age. A three-in-one shot keeps an infant or child safe from diphtheria, whooping cough, and lockjaw. Polio protection is available by shot or by letting a sugar cube containing protective vaccine dissolve in the mouth. Smallpox requires a separate vaccination later in the baby's first year.

Don't let your baby down . . . See that he gets the protection he needs. *Take him to a doctor as early as two months of age.* You'll be glad you did. Good intentions won't keep your child safe!

Hopkins County Health Department

babies might have been detected early and tagged as being at high risk of not obtaining immunizations? If such identification had been possible in our study, the two unfortunate cases of clinical whooping cough might have been avoided. In this study, families were not contacted as soon after a missed immunization as they might otherwise have been because of the design of waiting a year to determine what families do "spontaneously" about immunization. Followup closer to the time of a missed immunization would probably produce better results.

Immunized and nonimmunized babies. When 317 of the 453 children under study had reached 8 months of age, S. J. and T. G. Fleming compared the characteristics of the 38 families that had not obtained initial poliomyelitis and DPT immunizations for their children with the characteristics of the 279 families that had. The significant data are summarized in table 1.

As a group, the families which had not immunized their babies showed statistically significant differences from the group that had.

These differences included a lower income, greater parity and less education of the mother, and more rural residences. These attributes then are some of the characteristics of families of babies who have a high risk of not being immunized by an acceptable time after birth.

Of course not all rural families of low income in which the mother has three (or more) babies and is poorly educated fail to obtain immunizations; nor do all families not exhibiting these characteristics immunize their babies.

We next paired 33 of the nonimmunized babies with the same number of immunized babies matched for family residence and income level and for parity and education of the mother. To try to determine the reasons for the differences in the matched groups, we analyzed (a) the babies' birth weights, (b) length of mothers' postpartum hospital stays, (c) number of prenatal visits by mothers, (d) evidence of bacteriuria—by number of white blood cells in the mothers' hospital urine specimens, (e) hematocrit levels of the mothers, and (f) number of well-baby and "sick" baby visits in an 8-month period. A sick visit was defined from the child's chart, which was reviewed in the physician's office. Since all physicians provided

access to their records, we were able to determine which physician the children had visited and what had been done for them.

This comparison did not prove as useful as was originally expected. Not surprisingly, the immunized children accounted for significantly more total visits to physicians, including both sick and well visits, than the nonimmunized. The most significant difference was in the greater number of well-baby visits for immunized children between 2 and 8 months of age. Families of the nonimmunized children simply did not bring their children to physicians in this critical period when immunizations should be started. Mothers whose babies were not immunized tended not to come for prenatal care as often or as early as those mothers who had their babies immunized. The only other statistically significant difference in the two groups, however, was with respect to hematocrit levels (table 2).

The significance of the lower hematocrit levels in the mothers of the nonimmunized babies is not clear. Taken along with their tendencies to make fewer visits to physicians, the lower levels may indicate only that these mothers do not value health care for them-

Table 1. Characteristics of families in which babies were and were not immunized against poliomyelitis and DPT by age 8 months, Hopkins County, Ky., 1967

Characteristic	Immunized (N=279)		Not immunized (N=38)		Difference	
	Observed	Expected	Observed	Expected	Chi-square	Significance
Residence:						
Urban ¹	152	141.7	9	19.3}	12.69	P<0.01
Rural.....	127	137.3	29	18.7}		
Family income:						
More than \$3,000.....	193	184.0	16	25.0}	10.91	P<0.01
Less than \$3,000.....	86	95.0	22	13.0}		
Parity of mother (including present index child):						
1 child.....	113	103.9	5	14.1}	14.48	P<0.01
2 children.....	78	79.2	12	10.8}		
3 or more children.....	88	95.9	21	13.1}		
Age of mother (years):						
15-24.....	171	169.9	22	23.1}	.19	² P<0.05
25-34.....	83	83.6	12	11.4}		
35-45.....	25	25.5	4	3.5}		
Education of mother (years):						
0-9.....	³ 63	74.3	23	11.7}	18.04	P<0.01
10 or more.....	³ 177	165.7	15	26.3}		

¹ Urban=town of more than 2,000.

² Not significant.

³ Number of years of education is not known for 39 mothers who immunized their babies.

Table 2. Hematocrit levels in 33 pairs of mothers, matched for residence, income level, parity, and education, who had and had not had their babies immunized

Level	Immu- nized ¹	Not immu- nized	Total
35 and over-----	25	14	39
34 and under-----	8	19	27
Total-----	33	33	66

¹ Had received initial DPT and poliomyelitis immunizations by 8 months of age.

NOTE: Chi square=7.584; $P < 0.01$.

selves or their children in the way that their matched counterparts do. Even if this interpretation is correct, however, our study did not reveal the basic reason for this attitude.

Conclusion

Mailed notices to parents urging immunizations for DPT and poliomyelitis did not result in an improved immunization status in their children as compared with the children of a control group. This result suggests that knowledge about childhood immunizations and the activity of physicians in performing these preventive measures are already about as extensive as can be expected. Therefore few additional immunizations are likely to be induced by mailed notices. By the time children in Hopkins County are 4 months old, DPT and poliomyelitis immunizations have been started for about 80 percent. Yet such a small proportion of children are started on immunizations between 4 and 12 months of age—5 percent—that for practical purposes it can be stated that if a child is to receive these immunizations in the first year of life, they will have been initiated by 4 months of age.

Home followup of the "hard core" 15 percent of children who have received no immunizations by the end of their first year, by a public health nurse or clerk, or both, is practical even though some of the children will have moved by the time of the visit. On the basis of our results, we estimate that if two attempts at home visits are made as soon after the baby is 4 months of age as possible, fully one-half to two-

thirds of the hard core group could be located and immunized at home.

The staff of most health departments will have difficulty learning which children have not had their immunizations by 4 months of age. One method is to ask physicians to notify a central agency (the State health department, for example) when they begin children's immunizations. Another method is to ask the parents by mail what immunizations have been given. Both methods have obvious drawbacks. A third method might incorporate two approaches. A clerk could obtain an exact address, telephone number, and other data while the mother was still in the hospital after the child's birth. Then the State health department could request information from the mother when the baby was about 4 months old. All parents not responding or giving inadequate information would be telephoned, if possible, and visited, if necessary, to obtain the information or to provide the needed immunizations.

A partial approach to reaching the hard core group would be to initiate immunizations in the still hospitalized newborn baby if his parents belonged to the group which shows a high risk of not returning for immunizations. In our study such parents tended to be poor, to live in rural areas, have three or more children, and the mother was likely to be poorly educated. If early immunization can be accepted as being of benefit (2-4) or at least as doing no harm, some partial protection might be obtained in this way. In addition to immunizing many children of the hard core group, it might also catch some children like the 5 percent of the total selected for our study who had moved or otherwise could not be located by age 4 months.

Still another approach to the nonimmunized 15 percent would be to seize any opportunity to immunize the baby. Most physicians do not consider immunization advisable if a baby is ill. If, however, the child is believed to be at high risk of not being immunized, this step may be justified, especially if the child has a relatively minor illness. Two children in our study who had not received any immunizations by 1 year of age and in whom clinical whooping cough developed had been taken to a physician's office for earlier illnesses and might have been immunized

if this approach had been taken. These are judgments that only the physician can make in the light of all facts and risks.

Summary

The 453 infants that could be located among the 487 born to white residents in Hopkins County, Ky., in a recent 1-year period were divided into two groups. Parents of one group received mailed notices urging DPT (diphtheria-pertussis-tetanus) and poliomyelitis immunizations; parents of the other group did not. When the babies were 4 months old, the two groups did not differ significantly in the percent of immunizations started. For approximately 20 percent of the 453 infants, neither DPT nor poliomyelitis immunizations had been initiated.

Study of a subgroup of 231 babies at 12 months of age showed that only 5 percent more received immunizations between 4 and 12 months of age than had received them by 4 months. Thirty-four infants of this subgroup had received no immunizations of any kind. A home visit by a public health nurse and a clerk resulted in completion of immunizations in eight of the 34; one mother refused to have her child immunized. The parents of two children

had already voluntarily had them immunized before the visit. Families of 13 infants could not be located. A second home visit was planned to try to persuade the parents of the remaining 10 infants to provide the protection their children needed.

Families unlikely to have babies immunized by an acceptable time were characterized by poverty, rural residence, a mother with an education of 9th grade or less, and three or more children.

REFERENCES

- (1) Martin, D. A., Scott, D. C., Underwood, W. F., and Thurber, D. C.: Measles vaccination study in Hopkins County, Kentucky—1966. *J Kentucky Med Assoc* 65: 675-677, July 1967.
- (2) Adams, J. M., Kimball, A. C., and Adams, F. H.: Early immunization against pertussis. *Amer J Dis Child* 74: 10-18, July 1947.
- (3) Osborn, J. J., Dancis, J., and Julia, J. F.: Studies of the immunology of the newborn infant. 1. Age and antibody production. *Pediatrics* 9: 736-744, June 1952.
- (4) Osborn, J. J., Dancis, J., and Julia, J. F.: Studies of the immunology of the newborn infant. 2. Interference with active immunization by passive transplacental circulating antibody. *Pediatrics* 10: 328-334, September 1952.

Two New Regional Medical Libraries

The National Library of Medicine has awarded two \$150,000 grants to establish two more regional medical libraries under the authority of the Medical Library Assistance Act of 1965. The grants were awarded to the New York Academy of Medicine in New York City, and to the University of California at Los Angeles (UCLA) Biomedical Library Center for Health Sciences.

The awards will initiate regional library services for health professionals in New York State, the 11 northern counties of New Jersey, and the Pacific Southwest Region, which includes California, Nevada, Arizona, and Hawaii.

The UCLA Biomedical Library, under the direction of librarian Louise Darling, will be assisted by a 19-man advisory committee. The library also will have a subcontract for inter-

library loan assistance to northern California and Nevada with the University of California Medical Center Library in San Francisco.

The New York Academy of Medicine, under the direction of Dr. James E. McCormack, director of the academy, will serve as the administrative unit for the New York Regional Medical Library.

The Regional Medical Library operation will improve flow of biomedical information through local medical libraries to medical practitioners, researchers, and educators throughout the New York and Pacific Southwest Regions. The main goal of the new library service is to provide the most effective delivery of health science information to members of the health professions of the region. Operation of the service in the two new regions is scheduled to begin this year.