EFFECTIVENESS OF PEDIATRIC PRACTICE CONSULTATION ON MISSED OPPORTUNITIES FOR IMMUNIZATION

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ABSTRACT

Objective. To evaluate the effectiveness of pediatric practice consultation in reducing missed-opportunity rates at eight pediatric sites in Baltimore, Maryland. The overarching goal was to decrease the occurrence of missed opportunities from 33% to 15% for the first, second, and third diphtheria and tetanus toxoids and pertussis vaccines during visits at which children were eligible for the vaccines.

Design. The effect of an in-office educational program alone at four sites is compared with the educational program and a consultation on office vaccination practices at four matched sites. All eight sites received a small grant (\$2,000) to fund practice changes. The medical records of children making visits before and after the interventions were audited to determine missed-opportunity rates. The policies and operations and the knowledge, attitudes, and practices of physicians and nurse practitioners at each site were also assessed.

Results. The four education-consultation sites experienced a statistically significant 14% net reduction in the missed-opportunity rate relative to the education-only sites. This positive effect, however, was largely due to an increase in missed opportunities at one education-only site. There was a 10% increase in the missed-opportunity rate among the education-only sites and a 4% decrease among the education-consultation sites; neither change was statistically significant. Two of the three sites that reduced missed opportunities were matched health maintenance organizations (HMOs). Shortly after the interventions, both HMOs implemented tracking and follow-up information systems, which were planned before the interventions.

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Conclusions. There is no evidence that either the educational program alone or the educational program and consultation combination reduced missed opportunities. The findings suggest that improved tracking and follow-up data systems and vaccination of children at sick visits may reduce missed opportunities.

KEY WORDS Vaccination, Immunization, Missed opportunities, Children, Primary care, Tracking system.

INTRODUCTION

Missed opportunities for vaccination contribute to underimmunization and are a major focus of efforts to improve vaccination coverage among US children.¹ In the Baltimore Immunization Study (BIS), among a community-based sample of poor children born during the period August 1988 through March 1989, only 55% were up-to-date for 4 doses of diphtheria and tetanus toxoids and pertussis (DTP) vaccine, 3 doses of oral polio vaccine (OPV), and 1 dose of measles-mumps-rubella (MMR) vaccine by 2 years.² This rate was similar to those of other urban populations at the time.³ Missed opportunities occurred at one-third of vaccine-eligible visits. Had there been no missed opportunities, the up-to-date rate would have been 73% instead of 55%.⁴

Previous research has suggested multiple reasons for missed opportunities, including failure to assess a child's eligibility for vaccination, lack of information about prior vaccinations, cautious interpretation of vaccine contraindications, failure to provide all antigens due the child at the visit, and administrative barriers, including the cost of vaccines.⁴⁻¹⁶ In Baltimore, a survey of inner-city pediatric providers found marked variation in their interpretation of the American Academy of Pediatrics and Advisory Committee on Immunization Practices recommendations.^{17,18} Nonsimultaneous administration of vaccines, inability of the parent to pay, and switching providers were not major causes of missed opportunities.⁴

This paper describes an intervention study designed to reduce missed-opportunity rates at eight pediatric sites in Baltimore. We compared the effect of an in-office educational program alone at four sites to the in-office educational program and a consultation on office immunization practices at four matched sites. All eight sites received a small grant (\$2,000) to encourage and fund practice changes. We hypothesized that the educational program would increase physician knowledge of the immunization guidelines and risk factors for delayed vaccination, and that the consultation would stimulate changes in vaccination policies and practices. These changes would decrease the occurrence of missed opportunities from 33% to 15% at DTP1-DTP3 vaccine-eligible visits. Before and after the interventions, we measured missed-opportunity rates for DTP1, DTP2, and DTP3 and assessed provider knowledge, attitudes, and practices (KAP) and site policies and operations regarding immunization. The study was approved

by the Committee on Human Research of the Johns Hopkins University School of Public Health.

METHODS

STUDY DESIGN

Eight pediatric sites in Baltimore participated in the pretest, post-test non-equivalent comparison group study. These sites were selected from the practice sites surveyed in the 1991–1992 Baltimore Provider-Based Immunization Study (BPIS).¹⁷ The BPIS included 40 of the 41 sites that provided primary health care to children and were located in or contiguous to 57 of Baltimore's poorest census tracts. The BIS community-based sample of children was drawn from these census tracts.²

Each of the 40 sites was characterized by practice type: health center (9); hospital clinic (9); staff-model health maintenance organization (HMO) (9); or private practice (13). Within each practice type, the two sites with the closest match on source of vaccine (public or private), size of practice (number of children aged 2.5 to 3 years with medical records at the site), and vaccination coverage measured in the BPIS were invited to participate. All eight sites agreed to participate. One site in each pair was then randomly selected to receive both the education program and the consultation (the education-consultation site); the other site received only the education program (education-only site). Table I

TABLE I Characteristics of the 8 Study Sites and the 40 Baltimore Provider-Based Immunization Study Sites (Based on Baltimore Immunization Study Data, 1991–1992)*

	Education-Only Sites, n = 4	Education-Consultation Sites, n = 4	BPIS sites, n = 40
Number of public sites†	1	1	13
Mean number of children aged 2.5 to 3 years with medical records at site	206	160	159§
Percentage of children up to date by 24 months for 4:3:1‡	68.1%	61.4%	58.1%
Percentage of children <2 years receiving medical assistance	73.5%	87.8%	63.3%
Percentage of children African-American	75.5%	87.8%	78.9%

*Data are based on medical records data obtained from practice sites surveyed in the 1991–1992 Baltimore Provider-based Immunization Study (BPIS).

†Public = sites that received government grants ("330" or children and youth funds) and/or government-subsidized vaccine.

‡4 DTP, 3 OPV, 1 MMR; children born August 1988 through March 1989.

§Based on 37 sites with available data.

summarizes the characteristics of the education-only and education-consultation sites, as well as the 40 BPIS sites.

EDUCATION PROGRAM

Physicians with expertise in vaccine science designed and conducted a 1-hour program at each of the eight sites (see Fig. 1). The seminar, attended by the site's physicians and nurses, consisted of a review of immunization guidelines, recommendations, contraindications, schedule, and risk factors for delayed vaccination. Each site received a report, based on the BPIS data, that documented vaccination levels for the site and aggregate levels for the 40 sites.

Consultation. The three-member consultation team, consisting of a practice management consultant, a practicing pediatrician, and the project director, visited the four sites 1 to 4 weeks after the educational program. At the 1- to 2-hour visit, the team met with the medical director or solo physician and staff. Using a structured visit guide, the team reviewed appointment-making, assessment and administration procedures, provider decision-making issues, and possible incentives or disincentives for children to return for subsequent visits.

Within 1 month of the visit, each consultation site received a written summary of the team's observations and recommendations for changes. These recommendations included, but were not limited to, methods to reduce missed opportunities. In general, the recommendations reinforced the *Standards for Pediatric Immunization Practice* guidelines.¹⁹ The team encouraged the sites to screen children for vaccination status, to immunize eligible children at all visits, to follow the "General Recommendations on Immunization"¹⁸ when interpreting contraindications, and to inform parents at each visit of the next well-child visit and vaccination due. The team also recommended that each site have an information system to track and monitor appointments, to identify children due and overdue for

FIG. 1 Sequencing of interventions and research activities.

vaccination, and to generate periodic reports of the site's vaccination levels. Later, the management consultant telephoned the site's medical director or solo physician to verify receipt of the report and answer questions. The team provided no other assistance.

Grant. One to two months after the consultation at each education-consultation site, that site and its matched site received a \$2,000 grant to improve vaccination delivery. Seven of the eight sites used the grant to strengthen their information systems: for example, to support data-entry costs or purchase computer hardware or software. The eighth site, already funded to upgrade its information system, used the grant to develop an educational booklet for parents of newborns. Coincidentally, prior to the consultation both HMOs planned information system improvements that became functional during the 4 months before the postintervention period.

DATA COLLECTION

Between the preintervention period and the educational program, the physicians and nurse practitioners at each site completed a self-administered KAP questionnaire, and the medical director or solo physician completed a self-administered questionnaire on site policies and operations. After the postintervention period, the questionnaires were repeated (Fig. 1). The KAP questionnaires included questions about sources used to make vaccination decisions, liability concerns, deferral frequency, vaccine contraindications, and likelihood of vaccinating in various clinical circumstances. The responses of only those providers who completed questionnaires before and after intervention were analyzed. The policy questionnaire covered hours of operation, staffing, appointment policies, immunization schedule, vaccine sources, type of visits when vaccinations are administered, and patient tracking, monitoring, and notification of upcoming and missed appointments and vaccinations.

Record audits were conducted at each site for a random sample of children aged 42 days to 9 months during 2 to 3 months of the preintervention period and another random sample of children aged 42 days to 9 months during 2 to 3 months of the postintervention period. The 3-month preintervention period spanned October 1993 to January 1994, ending 3 months before the educational program (Fig. 1). For each pair of sites, the postintervention period, spanning October 1994 to January 1995, began 4 months after the consultation site received the team's report. Thus, all sites had a 4-month period to make changes before the postintervention period.

Abstracted data for a child included the child's birth date, the dates and reasons for vaccine deferrals, and the date of each vaccine received. For each visit falling within the 3-month preintervention or postintervention period, we

abstracted the date, type of visit, temperature, and diagnoses, and noted the child's vaccination status. All audits were conducted after the postintervention period.

DEFINITIONS

We defined a DTP-eligible visit as one that occurred when a child was of eligible age for DTP1, DTP2, or DTP3 vaccine and had no contraindications.⁴ A missed-opportunity occurred when a provider failed to administer the DTP vaccine at an eligible visit. The definitions for eligible visits, DTP contraindications, and missed opportunities were those used in the BIS.⁴ The missed-opportunity definition applied to preventive and sick visits. Preventive visits were visits for health supervision, follow-up, or vaccination.

SAMPLE SIZE

We reviewed 25 records preintervention and postintervention at the private practice sites and 50 records preintervention and postintervention at each of the other sites. The sample size was adequate to demonstrate a statistically significant reduction ($\alpha = .05$) from 33% to 15% in the aggregate missed-opportunity rate at visits eligible for DTP1-DTP3 for three comparisons: between the education-only sites preintervention and postintervention; between the education-consultation sites preintervention and postintervention; and between the education-only and education-consultation sites postintervention.

DATA ANALYSIS

Analyses of the KAP and policy questionnaires are descriptive. At each site with more than one KAP questionnaire respondent, we calculated the mean score for each question. Within each of the eight sites, we determined if a change occurred from preintervention to postintervention and the magnitude and direction thereof. We observed the sites for patterns of consistent change.

We assessed the impact of the educational program by comparing the change in preintervention and postintervention missed-opportunity rates for preventive, sick, and all visits at each of the four education-only sites. For each pair of sites, we calculated the effect of the consultation at preventive, sick, and all visits by subtracting the change in preintervention to postintervention missed-opportunity rates at the education-only site from the change in preintervention to postintervention rates at the education-consultation site. A similar calculation was made by subtracting the aggregate missed-opportunity rate change for the education-only sites from the change at the education-consultation sites. The four missed-opportunity rates (education-only preintervention and postintervention and education-consultation preintervention and postintervention) are assumed to be statistically independent. A standard error for the effect of the consultation is the square root of the sum of the variances of the four rates. A preintervention

and postintervention difference in the missed-opportunity rate between the consultation-education and education-only site that exceeds twice the standard error for the effect is considered statistically significant ($\alpha = .05$).

In addition, at each site before and after intervention, we assessed the number and percentage of (1) preventive and sick visits, (2) all visits when a vaccination assessment was recorded, (3) visits when a missed opportunity for DTP vaccination and receipt of at least one other vaccination occurred simultaneously, and (4) children with multiple eligible visits. We also calculated the mean age at which children made their first DTP1-eligible visit.

RESULTS

Overall, 62% of 60 resident physicians and 85% of 39 nonresident physicians and nurse practitioners responded to the preintervention KAP survey; 71% of 62 residents and 98% of 41 nonresident physicians and nurse practitioners completed the postintervention KAP questionnaires. These percentages were similar across the education-only and the education-consultation sites. Of the 31 residents and the 36 nonresidents eligible for both the preintervention and postintervention questionnaire, 48% and 81%, respectively, completed both.

The KAP scores and reported policies and operations (Table II) varied across

TABLE II Selected Site Policies and Operations at Education-Only and Consultation-Education Sites

Site Type	Education Only, n = 4		Education- Consultation, n = 4	
	Pre	Post	Pre	Post
Requires appointment for vaccination				
Health center	Yes	Yes	Yes	No
Hospital	Yes	Yes	Yes	Yes
Health maintenance organization (HMO)	No	No	Yes	Yes
Solo private practice	No	No	Yes	No
Immunizes at acute visits				
Health center	No	No	No	Yes
Hospital	Yes	Yes	No	Yes
HMO	Yes	Yes	No	Yes
Solo private practice	Yes	Yes	Yes	Yes
Hours per week open for vaccination				
Health center	42	27	40	48
Hospital	38	39	33	34
HMO	45	40	44	34
Solo private practice	32	31	21	26
Full-time-equivalent physicians and nurse practitioners				
Health center	2	2	2	2
Hospital	6	5	16	14
HMO	2	2	3	3
Solo private practice	1	1	1	1

sites before and after intervention and showed no consistent pattern of changes after intervention.²⁰ There were a few exceptions. All sites scheduled subsequent well-child appointments at the current visit preintervention and postintervention, and all required consent for vaccination before intervention. Only the education-consultation solo private practice site did not require consent after intervention. The matched pairs had similar DTP immunization schedules.

In the aggregate, preintervention missed-opportunity rates were comparable at the education-only and education-consultation sites (Table III) and similar to DTP and OPV missed-opportunity rates in the BIS. The total rate for missed opportunities increased at education-only sites, from 33% preintervention to 43% postintervention, and decreased at consultation-education sites, from 36% to 32%

TABLE III Proportion of DTP1-DTP3 Eligible Visits With a Missed Opportunity* During Preintervention and Postintervention Periods

Practice Type	Visit Type	Education Only			Education-Consultation			Effect
		Pre	Post	Difference	Pre	Post	Difference	
Health center	Sick	1.0 (9)	1.0 (11)	.00	1.0 (16)	.80 (15)	-.20	-.20
	Preventive	.17 (54)	.52 (69)	.35	.25 (71)	.14 (56)	-.11	-.46†
	Total	.29 (63)	.59 (80)	.30	.39 (87)	.28 (71)	-.11	-.41†
Hospital	Sick	.89 (9)	1.0 (17)	.11	.83 (12)	.75 (20)	-.08	-.19
	Preventive	.11 (45)	.10 (67)	-.01	.07 (54)	.10 (51)	.03	.04
	Total	.24 (54)	.29 (84)	.05	.21 (66)	.28 (71)	.07	.02
HMO	Sick	.79 (14)	.50 (8)	-.29	.85 (20)	.55 (20)	-.30	-.01
	Preventive	.17 (30)	.03 (32)	-.14	.21 (48)	.15 (52)	-.06	.08
	Total	.36 (44)	.12 (40)	-.24	.40 (68)	.26 (72)	-.14	.10
Solo private practice	Sick	1.0 (16)	1.0 (30)	.00	1.0 (7)	1.0 (14)	.00	.00
	Preventive	.17 (24)	.19 (21)	.02	.41 (17)	.25 (16)	-.16	-.14
	Total	.50 (40)	.67 (51)	.17	.58 (24)	.60 (30)	.02	-.15
All sites	Sick	.92 (48)	.94 (66)	.02	.91 (55)	.75 (69)	-.16	-.18†
	Preventive	.15 (153)	.25 (189)	.10	.21 (190)	.14 (175)	-.07	-.17†
	Total	.33 (201)	.43 (255)	.10	.36 (245)	.32 (244)	-.04	-.14†

*Total number of visits in parentheses.

†Effect of consultation exceeds twice its standard error.

preintervention and postintervention, respectively. The direction of change at sites within each of the two groups varied. Only three sites, both HMO sites and the health center education-consultation site, experienced decreases in missed opportunities. One practice, the HMO education-only site, achieved a missed-opportunity rate of less than 15%. Because of the lack of uniformity, we compared the matched pairs of sites. The only statistically significant difference in preintervention to postintervention missed-opportunity rates occurred between the two health centers, largely because of an increase in missed opportunities at the education-only site.

We examined differences in missed-opportunity rates at sick and preventive visits (Table III). The percentage of sick visits with a missed opportunity was high: five of the eight sites had missed opportunities at all sick visits before and/or after intervention. Missed opportunities at preventive visits ranged from 7% to 41% preintervention and 3% to 52% postintervention. The three sites with substantial decreases in missed opportunities reduced missed opportunities more at sick visits than at preventive visits. Preintervention and postintervention changes in the percentage of sick or preventive visits did not explain the changes in missed-opportunity rates. Preventive visits accounted for 77% (343/446) of all eligible visits before intervention and 73% (364/499) after intervention. Changes in missed-opportunity rates did not correspond consistently to changes in the percentage of sick visits or the percentage of children with multiple visits to the sites.

Of the three sites that reduced missed-opportunity rates, only the two HMOs experienced improvements in the timeliness of health care visits as measured by a decrease in the mean age at the first DTP1-eligible visit (Table IV). The two sites with the largest increase in missed-opportunity rates had the greatest increase in mean age at this visit. No consistent pattern between missed opportunities and age at visit was evident for the other sites. The HMO that experienced the largest decrease in missed opportunities and lowest missed-opportunity rate

TABLE IV Mean Age in Days of First DTP1-Eligible Visit Made in Preintervention and Postintervention Periods by Children Aged 6 Weeks Through 7 Months

Site Type	Education Only			Education-Consultation		
	Pre	Post	Difference	Pre	Post	Difference
Health center	74	91	17	83	90	7
Hospital	68	76	8	89	71	-18
HMO	111	98	-13	120	87	-33
Solo private practice	79	118	39	105	99	-6
Total	82	93	11	98	87	11

following the intervention also experienced a large increase in vaccination assessments (Table V). There was, however, no consistent association between assessment and missed-opportunity rates at the other sites.

DISCUSSION

We observed a statistically significant consultation effect for all sites combined; however, this positive effect was largely due to an unexpected and unexplained increase in missed opportunities at the education-only health center. There is no evidence that the educational program alone reduced missed opportunities; at only one education-only site was there a reduction in the missed-opportunity rate. In addition, we observed no consistent change in knowledge, attitudes, and practices or site policies and operations preintervention and postintervention.

The duration and intensity of the interventions may have been inadequate to expect an improvement in practices. We gave the providers only one educational session and the education-consultation sites only one consultation visit. Even if the advice directly addressed the factors that might have been essential to reduce missed opportunities, the sites had only 4 months and \$2,000 to implement the new practices. The preintervention and postintervention periods were too short to measure the effect of the interventions on overall vaccination coverage rates.

Sites that decreased missed-opportunity rates did so at sick visits more than at preventive visits, even though the majority of visits made by children were preventive. The ability of sites to reduce missed opportunities at sick visits offers encouragement to other sites to take advantage of these visits to vaccinate eligible children. Changes in simultaneous vaccination did not explain reductions in missed opportunities. Only 12 children had a missed-opportunity visit for DTP1, DPT2, or DPT3 and received another vaccination at the visit; this finding is similar to the BIS results.

TABLE V Proportion of All Visits with Documented Vaccination Assessments Made in Preintervention and Postintervention Period by Children Aged 6 Weeks Through 7 Months*

Site Type	Education Only			Education-Consultation		
	Pre	Post	Difference	Pre	Post	Difference
Health center	.53 (101)	.46 (123)	-.07	.69 (108)	.59 (103)	-.10
Hospital	.68 (88)	.58 (116)	-.10	.65 (92)	.61 (103)	-.04
HMO	.57 (60)	.73 (62)	.16	.51 (108)	.54 (118)	.03
Solo private practice	.43 (53)	.28 (80)	-.15	.39 (28)	.40 (35)	.01
Total	.57 (302)	.50 (381)	-.07	.60 (336)	.56 (359)	-.04

*Total number of visits in parentheses.

The HMO findings were incidental to the interventions. Both HMOs planned information system improvements prior to the study; these took effect between the preintervention and postintervention periods. This time was insufficient to implement such systems fully at the sites, which had no prior planning. Although not directly related to the interventions, the HMOs' success suggests strongly that improved patient tracking and follow-up data systems may help reduce missed opportunities.

At the HMOs, the changes associated with the tracking and follow-up systems were multifaceted. Both HMOs began to actively identify children needing vaccination, remind providers at encounters of vaccinations due, ensure that children were appropriately vaccinated at visits, and follow up children who did not keep appointments. Medical directors at the HMOs reported an increased awareness of immunization issues among all staff, not just the physicians. The education-only HMO site improved the frequency of vaccination assessments. Both sites increased the timeliness of visits for the first DTP1-eligible visit. Although other sites experienced one or more of these changes, none did so to the same degree as the two HMOs. These findings are consistent with other research that supports the effectiveness of multiple interventions over single interventions in changing provider practices.²¹

State policy initiatives to monitor and improve vaccination rates of Medical Assistance-insured children in HMOs may have provided an added incentive to reduce missed opportunities. If HMOs are responding to market or public policy incentives that translate into financial consequences (for example, performance report cards), it may be possible to identify mechanisms, applicable to other types of practices, that lead to demonstrably improved performance.

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