Knowledge And Attitudes Of Minnesota Primary Care Physicians About Barriers To Measles And Pertussis Immunization

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Background: **Understanding the causes of low levels of childhood immunization is critical to preventing outbreaks of vaccine-preventable diseases. Hence, we examined physicians' knowledge and attitudes about measles and pertussis vaccines and barriers to immunization.**

Methods: **We developed a telephone questionnaire, subjected it to a pilot test, and subsequently interviewed Minnesota pediatricians, general practitioners, rural family physicians, and urban family physicians. The physicians were selected by a random process.**

Results: **The response rate was 76.4 percent (411 of 538 eligible physicians). Almost all physicians thought that vaccine efficacy was high and that the likelihood of serious side effects was low. Respondents were divided, however, about the likelihood of serious complications from pertussis disease and the role of adults as a pertussis reservoir. Many physicians inappropriately believed certain conditions were contraindications to vaccination; for instance, 33 percent of physicians would not administer measles, mumps, and rubella vaccine to a child whose mother was pregnant. Many physicians (31 percent) would not administer four vaccines simultaneously because of concerns that included parental acceptance and vaccine efficacy. Physicians were more likely to refer children without insurance ($P<0.001$) or with Medicaid ($P<0.001$) than children with insurance to health department vaccine clinics for immunization.**

Conclusions: **For immunization rates to reach high levels, changes are needed in health care system issues, such as vaccine reimbursement, and in provider practices, such as interpretation of vaccine contraindications. (J Am Board Fam Pract 1995; 8:270-7.)**

A measles epidemic of 55,622 reported cases occurred in the United States between 1989 and 1991[1] despite the nation's wealth and advanced technology. According to the National Vaccine Advisory Committee, the primary cause of the epidemic was failure to immunize.[2] Many (58 to 90 percent) children are not up-to-date at 2 years of age according to recent surveys in selected US cities.[3]

The major causes of low immunization coverage include vaccine cost, lack of insurance, number of injections, lack of access to care, fear of litigation, safety concerns, immunization barriers within the health care system, missed opportunities by providers to administer vaccines, and inadequate public awareness. It is important to understand those obstacles that can be affected by changes in provider practices and public policy, because improvement in these areas can be effected more quickly than such systemwide issues as access to care.

Understanding the perspective of primary care physicians is crucial, because they play a major role in providing immunizations. For instance, 84 percent of Minnesota 2-year-olds are immunized by physicians in private practice (written communication, Diane Peterson, Minnesota Department of Health, 1990). The immunization rate was 62

Submitted, revised, 28 February 1995.

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This work was funded by the Department of Family Practice and Community Health, University of Minnesota, and the Department of Family Medicine and Clinical Epidemiology, University of Pittsburgh.

This work was presented in part at the 25th annual spring conference of the Society of Teachers of Family Medicine, 25-29 April, 1992, St. Louis, and as a poster at the 27th National Immunization Conference, June 1993, Washington, DC.

percent in 1988 for 2-year-old children vaccinated exclusively in Minnesota private practices. Three immunization barriers for which private physicians are accountable are (1) appropriate awareness of contraindications to vaccine administration; (2) simultaneous vaccine administration; and (3) knowledge about vaccine safety, efficacy, and disease risk.

Many providers are inappropriately cautious when interpreting contraindications to vaccinations. For instance, a British study found that many health professionals would not give pertussis vaccine to infants with a family history of mental retardation, febrile convulsions, or neurological disorders.[4]

Lack of simultaneous vaccine administration is another barrier to adequate immunization. In a recent measles outbreak, 38 percent of cases were in children who were given oral polio vaccine and diphtheria and tetanus toxoids and pertussis vaccine (DTP) at a time when the measles-mumps-rubella vaccine (MMR) could also have been given but was not.[5]

Physicians caring for children need to be knowledgeable about vaccine safety, efficacy, and disease risk. An inadequate understanding of the issues is a barrier to immunization. A theoretical model that has been used to understand compliance is the Health Belief Model,[6,7] which proposes that immunization compliance is based on perceptions of disease severity, disease risk, vaccine efficacy, vaccine safety, and barriers to immunization.

Public policies concerning vaccine reimbursement make up another area where improvements might be realized quickly. Surveys of Dallas County, Texas,[8] and Washington State[9] physicians found that 73 and 76 percent, respectively, made referrals to public clinics when patients were unable to afford immunizations.

To understand immunization issues confronting primary care physicians, we conducted a survey about the issues that affect practice and public policy. We previously reported a validity study in which the responses of 25 physicians to the questionnaire were compared with the ages at immunization of children in the practice.[10] It showed that physician training and likelihood of referring children to public vaccine clinics based on insurance status were associated with age at immunization. The questionnaire was further tested and found to be reliable.[11] The purpose of the current study was to survey a representative sample of Minnesota primary care physicians using the above questionnaire.

Methods

The target population comprised physicians who administer the majority of childhood vaccines in Minnesota; hence, we focused on general practitioners, board-certified family physicians,[12] and pediatricians. To interview a sufficient number of rural physicians so their views could be accurately understood, rural family physicians were surveyed as a separate group. Urban versus rural location was determined by extending the urban areas defined by Rand McNally[13] by 25 miles so we could account for physicians who had offices just outside a city but had urban referral patterns. The Rand McNally classification was used instead of standard metropolitan statistical areas (SMSAs) because SMSAs do not follow population density well in some areas of Minnesota.

To select the physicians, we used the Minnesota Medical Association (MMA) master list. The list includes nonmembers and incorporates the American Medical Association list of physicians, data from the Minnesota Board of Medical Examiners, and inquiries from the MMA to clinics. In examining the accuracy of the MMA list, we found that 97.2 percent of those on the list from the American Board of Family Practice[12] were also on the MMA list (11 others had moved out of Minnesota). In order to ensure geographic representation, the 2225 names in the MMA master list were sorted by ZIP code. For the survey, we selected a systematic random sample of the MMA list.

The questionnaire was designed using the Health Belief Model,[6,7] common misunderstandings of immunization,[4,14] and input from physicians in pediatric infectious disease, family practice, maternal and child health, and public health. For most questions, respondents rated on a scale from 0 (unlikely) to 10 (very likely) how likely they were to recommend immunization for a child in a particular clinical situation. The questionnaire was pretested on 16 subjects to evaluate wording and variance of the responses; then it was pilot tested on 31 subjects.[15,16] Interviews were conducted by telephone from November 1990 to August 1991 to determine eligibility and to administer the questionnaire.

Frequency distributions and means of responses were calculated as a weighted average of the specialty-specific estimates, where the weights were equal to the fraction of eligible physicians in each specialty in the target population.[17] For categorization of the contraindication and economic questions with response values of 0 to 10, the values 0 to 3, 4 to 6, and 7 to 10, respectively, were categorized as do not immunize, intermediate, and immunize.

The influence of economics on immunization practices was of particular interest; therefore, comparisons were made between insurance types using matched-pair *t*-tests and between rural and urban family physicians using *t*-tests for unequal variances.

To determine characteristics of respondents who might benefit from educational intervention, we used multiple linear regression (based on the all possible regressions procedure) with DTP and MMR contraindication summary scores as the dependent variable.[18] Contraindications were selected because correct answers could be positioned at one end of the scale. Each summary score was the sum of three questions about contraindications in a clinical scenario; the range of possible values was 0 to 30, with higher values indicating better knowledge. The following factors were considered as independent variables: (1) demographic, medical training, and practice characteristic; and (2) responses about litigation, reimbursement, vaccine timing, disease severity, disease communicability, vaccine failure, and side effects. Analyses were done using the Statistical Analysis System package.[19]

Results

Of the 1220 names provided to the authors by MMA, 67 were selected to take part in the pretest and pilot testing of the survey instrument and were not eligible for the final survey. Based on lists of current residents and telephone contacts, 390 physicians were excluded because they were in residency training, saw fewer than 5 preschool-aged children or fewer than 15 patients per week, or had less than 50 percent of their practice dedicated to primary care (Table 1). The remaining 538 eligible physicians made up the study sample. Of these, 127 could not be reached or refused to participate, and 441 study participants completed the telephone interview for a response rate of 76.4 percent. The 82 physicians who refused graduated from medical school earlier ($P=0.04$) and were significantly more likely to be rural ($P<0.001$), male ($P<0.001$), and a general practitioner ($P<0.001$).

Most respondents were board-certified (88 percent, not weighted), residency-trained (77 percent), male (75 percent), participants in a group practice (92 percent), and located in urban or suburban areas (63 percent). Mean year of graduation from medical school was 1974; the 10th and 90th percentiles were 1959 and 1984, respectively. About one-half (49 percent) participated in a capitated health maintenance organization (HMO); only 11 percent were salaried with an HMO. Respondents treated an average (weighted) of 113 patients per week, of whom an average of 94.7 percent were primary care patients and a mean of 31.2 percent were preschool-aged (range 5 percent to 90 percent).

Health Belief Model Results

Respondents generally disagreed with each other and with data from the literature about disease severity, communicability, and transmission but not about vaccine failure rates or side effects (Table 2).[20-33] Most respondents (≥89 percent) indicated that serious side-effects from DTP and MMR were unlikely. Most recommended routine immunization even if a parent seemed litigious or had concerns about vaccine safety (92 percent and 98 percent, respectively). Responses from pediatricians and rural family physicians were closest to values cited in the literature.

Contraindications, Simultaneous Administration, Timing, and Information Source

Respondents disagreed widely on interpretations of certain contraindications (Table 3). For instance, many (29 percent) would not administer MMR to a child with a minor illness, such as an upper respiratory tract infection and a temperature of 37.5°C. Some (10 percent) reported they would administer split doses of DTP instead of the recommended full doses for a premature infant. Responses differed by specialty (Table 3). Few respondents (1 percent) would immunize a child with DTP who had a seizure 1 day after the last DTP immunization. A seizure temporally related to DTP administration was an absolute contraindication to subsequent administration of

Table 1. Numbers of Minnesota Primary Care Physicians by Physician Enrollment Characteristics.

Characteristics	Urban Family Physicians	Rural Family Physicians	General Practitioners	Pediatricians	Total
Physicians listed in MMA directory	752	469	465	539	2225
Number of physicians provided to authors by MMA	300	312	309	299	1220
Physicians in study population	210	195	292	298	995
Number of physicians ineligible*	46	0	21	0	67
Number of physicians excluded†	27	29	179	155	390
Physicians eligible for study	137	166	92	143	538
Physicians refusing or not located	16	44	48	19	127
Physicians with completed interviews	121	122	44	124	411
Response rate (%) (interviewees/physicians eligible)	88.3	73.4	47.8	86.7	76.4

MMA=Minnesota Medical Association.

*Physicians who were involved with the pretesting and pilot testing of the study questionnaire.
†Physicians who treated <5 school-aged children per week, saw <15 patients per week, had <50% of practice in primary care, or were residents.

pertussis vaccine when our questionnaire was administered.[14] It was changed to a precaution in 1991, however, by the Advisory Committee on Immunization Practices (ACIP) and the American Academy of Pediatrics (AAP).[34,35] Some physicians (19 percent) would administer trivalent oral poliovirus vaccine (TOPV) to a child whose mother was on chemotherapy for leukemia, which is an accepted contraindication.[14]

Many respondents (31 percent) were unlikely to administer four vaccines simultaneously. Some (16 percent) were concerned that simultaneous immunizations might result in decreased vaccine efficacy. Some volunteered concerns about patients accepting multiple injections (22 percent) and difficulty in determining the causal vaccine if a side effect occurred (17 percent).

Most respondents were familiar with the timing of childhood vaccines. Most (80 percent) were willing to administer DTP to a 7-month-old who had the first DTP 6 weeks previously. For DTP, intervals of 4 weeks are adequate between each of the first 3 doses, especially if a child is behind schedule.[34,35]

Respondents stated that the most important source for their immunization information was the health department (57 percent), journals (18 percent), residency training (11 percent), colleagues (9 percent), or continuing education conferences (5 percent).

Vaccine Reimbursement

The percentage of physicians likely to refer children to public health clinics for immunization decreased markedly with increasing insurance coverage (Figure 1). Physicians were much more likely, on a scale of 0 to 10, to refer children with no insurance than they were to refer children with either Medicaid coverage (difference = 4.6, 95 percent CI 4.4–4.8, $P<0.001$) or private insurance (difference=5.2, 95 percent CI 5.0–5.4, $P<0.001$). Physicians were more likely to refer children with Medicaid coverage than those with private insurance (difference=0.57, 95 percent CI 0.43–0.71, $P<0.001$). Rural physicians were more likely to refer children with Medicaid or private insurance to public vaccine clinics than were their urban counterparts ($P<0.001$).

Characteristics of Respondents with Better Knowledge of Contraindications

Characteristics of respondents who were better informed about vaccine contraindications were identified using regression analysis. More accurate knowledge of DTP contraindications was associated with board certification, specialty (pediatrics), respondent sex (female), and lower likelihood of referring patients with Medicaid coverage to the local health department for immunization (overall $P<0.001$, adjusted $R^2=0.177$). More accurate knowledge of MMR contraindications was associated with a higher rating of measles communicability, a lower rating of vaccine efficacy, specialty (pediatrics), board certification, receipt of free vaccine supplies from the health department, sex (female), and

Table 2. Knowledge of Minnesota Primary Care Physicians about Pertussis, Measles, and Vaccines Based on the Health Belief Model.

Questionnaire Item	Best Answer According to the Medical Literature	Percent with Correct Answer*
Likelihood 9-month-old needs hospitalization for:		
Pertussis	53% hospitalized[20]	28
Measles	35%[21] to 44%[22] hospitalized	48
Likelihood 9-month-old will have serious complications from:		
Pertussis	42% have apnea; 19% have pneumonia[20]	47
Measles	33% total complications[5]	48
Disease communicability for immunized siblings, aged 2 and 3 years, who sleep in same room:		
Pertussis	84%[23] to 100%[24]	63
Measles	90%[25]	77
Likelihood of vaccine failure in fully immunized 3-year-old:		
Pertussis vaccine	5% to 36%[26]	98
Measles vaccine	≤5%[27]	90
Likelihood of serious side effects following:		
Pertussis vaccine	0.0011% for hypotonic-hyporesponsive episodes and convulsions combined[28]	89
Measles vaccine	0.7% for MMR (arthropathy)[29]†	92
Likelihood of fever of 39.3°C (101°F) from:		
Pertussis vaccine	45%[28]	47
Measles vaccine	30–33%[29]	46
Likelihood that an unimmunized 2- to 3-year-old child who develops pertusis was exposed to it by an adult	55%‡[30]	35
Likelihood that an unimmunized 2- to 3-year-old child who develops measles was exposed in an emergency department or clinic	1%–81%[31-33]	97§

Note: Number or responses per item ranged from 394 to 411.

*Generally, correct answers are published values rounded off, plus or minus 1 point on the 0–10 scale. For pertussis vaccine failure and measles transmission in medical facilities, expanded ranges of 0–4 and 0–8, respectively, were used because of the large range reported in the medical literature. For measles vaccine failure and side effects to pertussis and measles vaccines, a narrow range (0 to 1) was considered correct according to published values.

†Arthropathy is attributed to the rubella component of MMR; it was selected because it was more common than other serious adverse events due to MMR. Serious adverse events associated with the measles component include anaphylaxis and, in immunocompromised individuals, death caused by measles virus infection.

‡This reference is for infants < 12 weeks old.

§The percentage of physicians responding 0–3, 4–6, and 7–10 was 61%, 28%, and 11%, respectively.

residency training (overall $P<0.001$, adjusted $R^2=0.158$). For the summary scores, each factor was individually significant ($P\leq0.05$).

Discussion

According to a 1994 MEDLINE search, our study is the first published report that emphasizes the Health Belief Model to understand better physician perspectives about immunization. Response rates were high for both board-certified family physicians and pediatricians. Our immunization survey might also be the first to sample rural family physicians as a separate group of sufficient size to describe their beliefs.

Administering immunizations according to schedule is important because delayed immunizations leave windows of inadequate protection, giving rise to community outbreaks of vaccine-preventable disease. For instance, during a pertussis outbreak, the attack rate was markedly higher in unimmunized than in immunized individuals (82 percent versus 30 percent).[24]

Unfortunately, many Minnesota physicians lack adequate knowledge of vaccine-preventable disease severity, communicability, and transmission. Misunderstanding about disease severity might be due both to the spectrum of clinical outcomes and to the number of physicians who have not seen these diseases. The importance of disease communicability is illustrated by a case of airborne measles transmission from 1 infected child to another who was in a

Table 3. Percentage of Physicians by Specialty Unlikely* to Immunize Child in the Following Scenarios in Which No Condition Contraindicates Immunization.

Scenario	Urban Family Practice	General Practitioners	Rural Family Practice	Pediatricians	Total
Diphtheria and Tetanus Toxoids and Pertussis Vaccine (DTP)					
An 18-month-old with 3 DTP doses has allergic rhinitis caused by hay fever	12	28	11	3	11
A 10-month-old with 1 previous DTP is receiving an antibiotic for asymptomatic middle ear fluid	6	26	7	1	7
Healthy 2-month-old who was born at 32 weeks gestational age	9	19	8	2	8
Child not acutely ill but on long-term antibiotic for recurrent otitis media	1	0	2	0	1
Otherwise healthy child has a parent with a grand mal seizure disorder	8	12	2	7	8
Child has a fever of 39.4°C after last DTP	45	49	47	13	36
Measles, Mumps, and Rubella Vaccine (MMR)					
Healthy 15-month-old with no MMR was exposed to strep throat yesterday	8	16	10	3	8
Healthy 17-month-old with no MMR whose brother had a seizure following MMR	7	10	3	0	4
A 20-month-old is brought in by parents for watery diarrhea. He is afebrile and well hydrated and has not had MMR	37	51	34	20	33
Child has a mild upper respiratory tract infection with a temperature of 37.5°C (99.5°F)	35	58	30	11	29
Mother is 2 months' pregnant and brings her son for his MMR immunization	35	33	41	16	30
A 2-year-old needs DTP, TOPV, MMR, and HbCV. Would you recommend them all today?	29	53	31	30	33

TOPV=trivalent oral poliovirus vaccine, HbCV=*Hemophilus* b conjugate vaccine.

*Responses of 0 through 3 on the 0 to 10 scale were categorized as unlikely.

different room and who came to the clinic at least 1 hour after the infected child left the premises.[36]

Many respondents were more cautious than warranted, according to ACIP[14] and AAP[35] guidelines, and inappropriately assumed certain conditions to be contraindications. For instance, many would not administer MMR vaccine to a child if the child had minor illnesses or if the child's mother were pregnant. MMR is a live viral vaccine, but it is not transmitted casually from person-to-person; hence, MMR can safely be given to a child whose mother is pregnant. Because of the theoretical risk of congenital infection, MMR vaccination is contraindicated for a pregnant woman. TOPV contains a live virus that is shed in feces; therefore, children in close contact with an immunocompromised person should receive enhanced-potency inactivated poliovirus vaccine, not TOPV. Screening checklists and vaccine standards are available to facilitate appropriate immunization.[37,38]

Litigation and media attention about vaccine safety might have led to overly cautious interpretations of contraindications. Nevertheless, most physicians recommended vaccines even if the parent seemed litigious. Vaccine litigation has centered on adverse events but has also occurred for failure to immunize.

Respondents were more likely to refer children who were either uninsured or on Medicaid to public health departments for vaccines than those with insurance. We hypothesize that physicians considered the amount of Medicaid reimbursement for vaccines to be inadequate. If properly implemented, the Vaccines for Children Program, which gives providers free vaccine for uninsured, Native American, and Medicaid-insured children, could redress this problem.

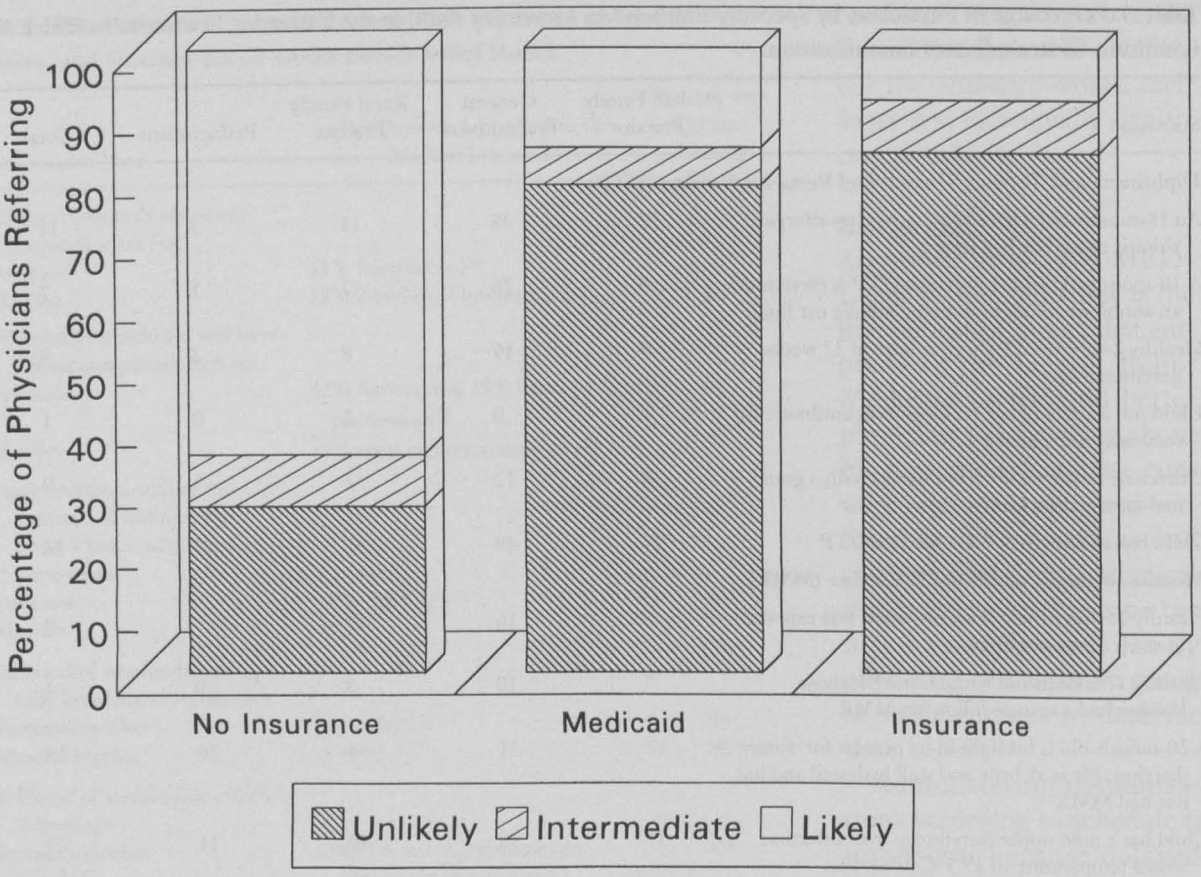

Figure 1. Physicians' referral patterns to health department vaccination clinics for immunization based on recipients' insurance status. Respondents were asked: (1) How likely are you to refer a child without any insurance whose parents are poor? (2) How likely are you to refer a child with Medicaid coverage? (3) How likely are you to refer a child with insurance?

Study results represent self-report of Minnesota physicians who see moderate to large numbers of preschool-aged children for primary care; the results cannot be generalized to all primary care physicians in the United States or to physicians who see fewer than 5 preschool-aged children per week or whose practices are less than 50 percent primary care. The number of general practitioners who were eligible for inclusion and responded was not sufficient to characterize their views accurately, but the exclusion rate suggests that the majority of Minnesota general practitioners administer few childhood vaccines. Although self-report does not always correspond to actual practices, we have previously reported that aspects of the questionnaire were correlated with the timing of immunizations in physicians' practices.[10]

Conclusion

To increase immunization coverage in this country, changes are needed (1) in physician knowledge about disease severity and transmission, interpretation of contraindications, and simultaneous vaccine administration, via medical education; and (2) in vaccine reimbursement.

Gail A. Lefkowitz was responsible for production of graphics and Steve Dombrosk assisted with sampling and the sampling frame.

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