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Abstract
Background and Objectives: National standards and goals for childhood immunization rates are well established. Yet, despite clear standards and goals, physicians do not achieve the desired rate (90%) for immunization coverage. This study examined factors related to immunization status for 2-year-old children in pediatric and family practice settings.

Methods: Specially trained personnel used computer software to audit 2,552 records from 42 practices in Northeast Florida throughout 1997–1999. Immunization records were judged as either complete or incomplete, and factors related to immunization status were studied. Clinic type and 18 immunization practice standards were reviewed for effect on immunization status.

Results: The probability of complete immunization status for children in pediatric clinics was greater than for those in family practice clinics. Multivariate logistic regression revealed that use of semiannual audits (odds ratio [OR]=2.00, confidence interval [CI]=1.65–2.42) was the most important factor for immunization completion. This was followed by availability of discounted immunizations (OR=.44, CI=.27–.73) and the use of an immunization tracking system (OR=1.48, CI=1.18–1.70). Factors that were not found to contribute included clinic type and the remaining 15 practice standards.

Conclusions: Considering the significant factors, immunization status was not affected by the type of clinic providing immunizations. Based on this analysis, family physicians should implement tracking systems and should perform semiannual audits to match the success of pediatricians in immunizing children. Neither group met nationally established goals for administration of immunizations for 2-year-old children.

Disciplines
Community Health | Medical Immunology | Other Medicine and Health Sciences | Pediatrics | Public Health

Factors Influencing Immunization Status in Primary Care Clinics

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Background and Objectives: *National standards and goals for childhood immunization rates are well established. Yet, despite clear standards and goals, physicians do not achieve the desired rate (90%) for immunization coverage. This study examined factors related to immunization status for 2-year-old children in pediatric and family practice settings.* Methods: *Specially trained personnel used computer software to audit 2,552 records from 42 practices in Northeast Florida throughout 1997–1999. Immunization records were judged as either complete or incomplete, and factors related to immunization status were studied. Clinic type and 18 immunization practice standards were reviewed for effect on immunization status.* Results: *The probability of complete immunization status for children in pediatric clinics was greater than for those in family practice clinics. Multivariate logistic regression revealed that use of semiannual audits (odds ratio [OR]=2.00, confidence interval [CI]=1.65–2.42) was the most important factor for immunization completion. This was followed by availability of discounted immunizations (OR=.44, CI=.27–.73) and the use of an immunization tracking system (OR=1.48, CI=1.18–1.70). Factors that were not found to contribute included clinic type and the remaining 15 practice standards.* Conclusions: *Considering the significant factors, immunization status was not affected by the type of clinic providing immunizations. Based on this analysis, family physicians should implement tracking systems and should perform semiannual audits to match the success of pediatricians in immunizing children. Neither group met nationally established goals for administration of immunizations for 2-year-old children.*

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The timely administration of infant and childhood immunizations is among the most effective and efficient interventions in medicine. Since the universal acceptance of childhood immunizations, there have been dramatic reductions in mortality and morbidity from vaccine-preventable disease.[1] Through the use of infant and childhood immunizations, smallpox has been eradicated worldwide, while measles and polio have been nearly eradicated in the United States. Cases of invasive hemophilus influenza, pertussis, tetanus, congenital rubella, and diphtheria have been reduced to fractions of former levels. The infection rates for hepatitis B and chickenpox can be expected to decline as effective vaccination programs are implemented nationwide.[2]

In contrast to many other health interventions, there are clear standards for the use of childhood immunizations. The US Public Health Service, the National Vaccine Advisory Committee, the American Academy of Pediatrics, and the American Academy of Family Physicians have reached consensus regarding the infant and childhood immunization schedule, and this schedule is readily available to physicians in this country.[3]

The US government, through the National Institutes for Health and the Centers for Disease Control (CDC), has developed and published Healthy People 2000 and 2010 goals for having 90% of 2-year-old children up to date on immunizations.[4,5] Yet, despite clear standards and explicit goals, to date most populations have failed to meet the recommended 90% coverage level.[6] Further, most primary care physicians have not attained

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90% coverage levels for immunization for 2-year-old children receiving care in their practices.[7]

The majority of clinic-based family physicians and pediatricians provide immunization services for their patients. National statistics on infant and childhood immunization status indicate that pediatricians typically achieve higher immunization rates for 2-year-old children than those rates usually achieved by family physicians.[8] Previous studies have suggested that there are many factors that influence immunization status for children. These factors include the cost of immunizations, the availability of immunization services, avoiding missed opportunities for immunizations, medical record routines, the immunization knowledge base of physicians, the use of immunization tracking systems, performing semiannual immunization audits, and the use of performance improvement strategies, among other things.[9,10] Experts in the field of immunization hypothesize that immunization rates are influenced by physician adherence to the accepted standards for immunization practice. In theory, physicians adhering to the *Standards for Immunization Practice*[11] would achieve better immunization rates for 2-year-old children than physicians who do not adhere to the accepted standards. However, the underlying reason for the observed difference in immunization status (adherence to the standards and immunization rates) between the pediatric and family physician clinic settings has not been completely elucidated.

This study investigated differences in immunization status in pediatric and family practice clinics to determine whether or not adherence to the *Standards for Pediatric Immunization Practices* affects the immunization status of 2-year-old children within the two clinic settings.

Methods

After approval from an ethics board, we undertook a retrospective review of 2,552 immunization records from 42 clinics (10 family practice and 32 pediatric), representing 75% of the primary care clinics delivering immunization services in Northeast Florida. Primary care clinics were included if they participated in the Vaccine for Children Program (a federally funded, state-administered program for uninsured or underinsured children), delivered a high volume of immunizations to children, and were enrolled in area managed care plans (Blue Cross/Blue Shield, Humana, AV Med, and Aetna). Primary care clinics were excluded if they declined to participate or if they provided immunization services for a small number of 2-year-old children (<10 per year). The study was undertaken during 1997 through 1999.

Prior to data collection, two research assistants and one supervisor from the Department of Health, Duval County, Fla, were educated about the process of extracting immunization data from primary care clinic records and entering data into the Clinical Assessment Software Application (CASA), an immunization assessment application of the CDC.[12] Immunization status was determined by CASA, based on an internal algorithm. Staff were also familiarized with the Standards for Pediatric Immunization Practices (Table 1) and instructed on administering a state-developed survey on adherence to the standards.

Data Collection

Audits to assess immunization status were scheduled during regular, weekday business hours for each clinic meeting criteria for the study. During the first portion of the audit, research assistants randomly selected a representative sample of 2-year-old children who received at least one immunization in the clinic within the last year. If the clinic provided a list of 1–150 clients, every record was reviewed. If the list contained more than 150 clients, every other record was selected. If the list was more than 300 clients, every third record was selected. In 13 of the clinics (31%), the small numbers of 2-year-old children receiving immunizations allowed for 100% assessment of the eligible children.

After the sample in each clinic was determined, each record was audited for documentation of eight immunizations (a series of four DTP vaccinations, three polio vaccinations, and one MMR vaccination). Data regarding immunization completeness were immediately entered into the CASA program using laptop computers. The total number of children in the sample who were up to date on their immunizations (completed the series by second birth date) and those who were not up to date (had not completed the series by second birth date) was determined. CASA generated a printout that included the number of records entered and the number complete. These numbers were used to create a spreadsheet of 2,552 records with "complete" as the outcome variable.

Each clinic was also assessed for adherence with the *Standards for Pediatric Immunization Practices* developed by the National Vaccine Advisory Committee (CDC, 1993). Whether or not each primary care practice adhered to the practice standards was determined by a survey. The survey instrument was developed by the Florida Department of Health and was completed by clinic personnel (medical director, nurse in charge of immunizations, and clinic administrator) at the time of the audit (Table 1). Those clinic personnel were asked to answer either yes or no to all survey items. An answer of yes signified adherence to that particular standard, and an answer of no indicated nonadherence with the various standards. Responses to one question were eliminated because of inconsistencies of subjects'

Table 1

Family and Pediatric Clinics Reporting Adherence
With US Department of Health Standards for Pediatric Immunization

		FAMILY PRACTICE		*PEDIATRICS*	
		Records	*Clinics*	*Records*	*Clinics*
Standard	*Measure*	*Yes/No*	*Yes/No*	*Yes/No*	*Yes/No*
1	Are immunization services readily available?	576/0	10/0	1,976/0	32/0
2	Are there barriers or unnecessary prerequisites to receive vaccines?	576/0	10/0	1,976/0	32/0
3	Are immunization services available free of charge or for a minimal fee?	576/0	10/0	1,812/163	28/4
4	Do providers use all clinical encounters to screen and immunize when needed?	576/0	10/0	1,976/0	32/0
5	Do providers educate parents and guardians about immunizations?	576/0	10/0	1,976/0	32/0
6	Prior to immunizing, do providers question parents or guardians about the contraindications for immunizations and inform them of the risks and benefits of immunizations?	576/0	10/0	1,976/0	32/0
7	Do providers follow only true contraindications for immunizations?	576/0	10/0	1,976/0	32/0
8	During the office visit, do providers simultaneously administer all vaccine doses for which a child is eligible?	576/0	10/0	1,880/96	31/1
9	Do providers use accurate and complete recording procedures?	576/0	10/0	1,880/96	31/1
10	Do providers schedule immunization appointments along with other appointments for child health services?	576/0	10/0	1,976/0	32/0
11	Do providers adequately and completely report adverse events following immunizations?	576/0	10/0	1,976/0	32/0
12	Do providers operate an immunization tracking system?	74/502	2/8	1,160/816	19/13
13	Do providers adhere to appropriate vaccine management procedures?	576/0	10/0	1,976/0	32/0
14	Do providers conduct semiannual audits to assess immunization coverage levels and to review patient records?	277/299	4/6	1,595/381	27/5
15	Do providers maintain up-to-date, readily available medical protocols at all locations where vaccinations are administered?	576/0	10/0	1,665/311	29/3
16	Do providers operate using patient-oriented and community-based approaches?	433/143	8/2	1,976/0	32/0
17	Are vaccinations administered by properly trained individuals?	576/0	10/0	1,976/0	32/0
18	Do providers receive ongoing education and training related to current immunization recommendations?	576/0	10/0	1,976/0	32/0

Family practice clinic immunizations—n=576
Pediatric clinic immunizations—n=1976

These standards are recommended by the American Academy of Pediatrics, National Vaccine Advisory Committee of the Centers for Disease Control, and the US Public Health Service, 1992.

Standard 16 was not considered in this study (see text).

responses. Adherence with each standard was added to the database, attached to each child's record according to where the child's record was reviewed.

The determination of clinic type (meaning whether or not the clinic was staffed predominantly by pediatricians or family physicians) was determined by the principal investigator. Generally, this was a simple process since almost all of the clinics were staffed exclusively by pediatricians or exclusively by family physicians. In one clinic, a group of family physicians practiced with a pediatrician. In that case, the clinic was predominantly staffed by family physicians and was categorized as a family practice clinic. Data abstractors were not blinded as to clinic type but were not aware that this was a variable under study.

Data Analysis

Multivariate logistic regression, using Statistical Packages for the Social Sciences (SPSS),® was performed to determine the association of immunization rates with each standard and with clinic type. The final regression model was chosen by forward stepwise methods with the likelihood-ratio test as the criterion for determining the variables to remain in the model. The final model included completed immunizations as the dependent variable and standards 14, 3, and 12 as the independent variables. Epi Info version 6.0® was used to determine if there was a relationship between immunization status and clinic type, to compare immunization status by clinic type within selected standards and to calculate odds ratios and *P* values.

Results

We reviewed the records of 2,552 2-year-old children. A total of 1,976 patient records were reviewed from pediatric clinics and 576 from family practice clinics. The range of records reviewed was 11 to 166 records per clinic.

Within this sample, the probability of complete immunizations was .74. The probability for patients seen in pediatric clinics was .76 and for those seen in family practice clinics was .64 (OR=1.75, CI=1.44–2.10) (Table 2). We observed 2,807 instances of non-adherence to the *Standards of Pediatric Immunization Practices* in a total of 2,552 records (944 family practice records and 1,863 pediatric records) and in seven standards (3, 8, 9, 12, 14, 15, and16) (Table 1). Standards 8 and 9 were excluded from analysis because these deficiencies occurred in only one clinic and only together, and it was impossible to determine whether other, more important factors accounted for their influence. As noted earlier, data on standard 16 was excluded because of inconsistency in data collection.

Analysis using multivariate logistic regression revealed that use of semiannual audits (standard 14) was the factor most highly associated with immunization completion (OR=2.00, CI=1.65–2.42). This was followed by providing discounted immunizations (OR=.45, CI=.27–.73), and use of an immunization tracking system (OR=1.48, CI=1.18–1.70) (standards 3 and 12 respectively). Clinic type and the remaining 15 practice standards were not associated with immunization completion.

An important distinction between pediatricians and family physicians was discovered when we analyzed the clinics' adherence to standards 12 and 14. When both pediatric and family practice clinics performed semiannual immunization audits, the probabilities of complete immunization status were comparable: .776 and .755 respectively (OR=1.12, CI=.83–1.53). Similarly, when family practice clinics operated an immunization tracking system, the probability of complete immunization status was equal to that of pediatric clinics operating an immunization tracking system (pediatric: .77 and family: .772 respectively, OR=1.01, CI=.56–1.82). However, when comparing between clinic types for those not using immunization tracking systems, likelihood of complete immunizations was higher for pediatric clinics than for family practice clinics (.74 and .62 respectively, OR=1.72, CI=1.35–2.20). Pediatric clinics also performed significantly better than family practice clinics when neither used semiannual audits (.69 and .54 respectively, OR=1.91, CI=1.38–2.65) (Table 2).

Discussion

The findings from this study support the use of semiannual audits and immunization tracking systems. Use of these systems was associated with an increased probability of complete immunization status for 2-year-old children receiving care in family practice clinics in Northeast Florida.

Further, the findings indicated that the probability of complete immunization status for 2-year-old children was greater for pediatric-based clinics than for family physician-based clinics. This finding was primarily related to the fact that family practice clinics were less likely than pediatric clinics to adhere to immunization tracking systems (standard 12), less likely to perform semiannual audits (standard 14), and more likely to see children who required free or discounted immunizations (standard 3). Although pediatricians achieved a higher overall rate of 2-year-old immunization than did family physicians, neither group achieved the Healthy People 2000/2010 goal of 90% coverage level for 2-year-old children.

Overall, the findings indicated that the benefit of using semiannual audits and tracking systems on immunization status seemed much greater for family physicians than for pediatricians. Additionally, children seen by family physicians using immunization track-

Table 2

Comparison of Immunization Rates in Pediatric and Family Practice Clinics by Office Routines

Clinic Type	*#*	*Complete*	*Proportion*	*Odds Ratio*	*95% CI*
A. Rates for those complying with Semiannual Audit Standard					
Pediatric	1,595	1237	.78	1.12	.83–1.53
Family practice	277	209	.75		
B. Rates for those NOT complying with Semiannual Audit Standard					
Pediatric	381	263	.69	1.91	1.38–2.65
Family practice	299	161	.54		
C. Rates for practices operating an Immunization Tracking System					
Pediatric	1,160	896	.77	1.01	.56–1.82
Family practice	74	57	.77		
D. Rates for practices NOT operating an Immunization Tracking System					
Pediatric	816	604	.74	1.72	1.35–2.20
Family practice	502	313	.62		

n=2,552

CI—confidence interval

ing systems and semiannual audits received complete immunizations as often as those seen by pediatricians who used these systems. These findings point to the fact that the difference in immunization status between family physicians and pediatricians is based almost entirely on these two office interventions.

It is interesting to postulate reasons why the lack of semiannual audits and tracking systems did not appear to influence rates in pediatric clinics when compared to family practice clinics. One possible explanation is that pediatric clinics were more likely than family practice clinics to conduct immunization histories in their daily routine (ie, ask to see the patient's immunization record). Another possible explanation is that children in Northeast Florida are more likely to be seen early for care by pediatricians, compared with family physicians. This early entry may give pediatricians more continuity and more opportunities to follow immunization schedules without a formal tracking system.

Limitations

There were limitations to this study that should be noted. The first limitation is related to the sample size. Although the findings from this study were determined after analyzing 2,552 immunizations, and the sample represented 75% of the primary care physicians offering immunizations in Northeast Florida, the number of clinics participating in the study was small. Only 42 primary care clinics were included in the study, the majority of which were staffed by pediatricians. Because of the small number of family practice clinics involved, other factors within the clinic setting could have influenced immunization status within those clinics, and that influence may have been attributed to the practice standards. A larger number of practices would have allowed the unit of analysis to be the clinic and the outcome variable to be the immunization rate of the clinic. Further, because this study was undertaken in Northeast Florida, the data and results may not necessarily be generalized to other areas of the state or country even though the overall immunization rates we found are consistent with those observed in other parts of the country.

There also may be other factors, not measured in this study, in attaining a high immunization status other than the clinic's adherence to practice standards. Such factors might include the clinic's location (ie, rural clinics versus urban); the age, gender, and year of medical school graduation of the physician; or size of the practice. Physicians' levels of training related to immunizations, interest in immunizations, and volume of immunizations as a percentage of total service volume may also affect immunization status. We were unable to examine these factors in our study.

Another point of caution is that the survey instrument we used may not be the best method to identify deficiencies in the standards studied. Although the survey had face validity, there have been no studies documenting its reliability.

Conclusions

The implication of our findings for managed care organizations, primary care providers, patients, health care payors, health educators, and health policy advocates are that to reach the Healthy People 2000/2010 goal of 90% rate for childhood immunizations, emphasis should be placed on encouraging standardized office routines that include semiannual immunization audits and immunization tracking systems. Encouraging open participation with the community immunization programs of immunization process assessment, evaluation, and improvement should also be accomplished. Although significant in this study, it would be difficult to recommend avoiding children who require financial assistance as a method of improving immunizations.

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