Open Access

Private Pediatric Clinic Characteristics Associated with Influenza Immunization Efforts in the State of Georgia: A Pilot Evaluation

Karen Pazol[*,1], Julie A. Gazmararian[2], Mila M. Prill[3,4], Emily M. O'Malley[5], Deborah Jelks[6], Margaret S. Coleman[4], Alan R. Hinman[7] and Walter A. Orenstein[1]

[1]*Division of Infectious Diseases, School of Medicine, Emory University, Atlanta, GA, USA*

[2]*Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, GA, USA*

[3]*P[3]S Corporation, San Antonio, TX, USA*

[4]*National Center for Immunization and Respiratory Diseases, Centers for Disease Control and Prevention, Atlanta, GA, USA*

[5]*UCB, Inc., Smyrna, Georgia, USA*

[6]*Immunization Program, Division of Public Health, Georgia Department of Human Resources, Atlanta, GA, USA*

[7]*The Task Force for Child Survival and Development, Decatu, GA, USA*

Abstract: The Advisory Committee on Immunization Practices (ACIP) recently recommended that all children 6 months to 18 years be vaccinated annually against influenza. Because pediatricians will be critical for implementing this recommendation, we assessed the characteristics of immunization providers associated with the greatest efforts to vaccinate children against influenza. Using a cross-sectional survey of 35 private pediatric clinics in Georgia, we found that adding extra hours for immunization during the influenza vaccination season and having a policy of allowing six or more vaccines to be delivered at one appointment were characteristics associated with a greater intent to vaccinate children in the 2004-2005 influenza vaccination season. Most respondents indicated that for their clinic to implement a universal childhood vaccination policy it would be important to have a formal recommendation from the ACIP and American Academy of Pediatrics, and to be assured that they could receive credits or refunds for unused vaccine.

Keywords: Universal vaccination, influenza, childhood vaccinations.

INTRODUCTION

Influenza is a significant source of morbidity and mortality in the United States, accounting for an annual average of 36,000 deaths and over 200,000 hospitalizations [1, 2]. Because most morbidity occurs among persons ≥ 65 years [2], vaccination efforts traditionally have focused on the elderly [3]. However, increasing evidence indicates that children experience substantial influenza related morbidity [4, 5], and a number of studies have produced suggestive findings that vaccination of children indirectly protects other community members by reducing the spread of influenza [6-12]. In light of this information, the Advisory Committee on Immunization Practices (ACIP) has been expanding the categories of children for whom vaccination is recommended, and recently it advised that all children 6 months to 18 years be vaccinated annually [13]. Because pediatric immunization providers will be essential for increasing the number of children who are immunized, it is important to evaluate practices and perceptions among these providers that are associated with the greatest likelihood that they will reach their patient population for annual vaccination. With this information public health officials then can focus their efforts where they are most needed to support a universal childhood influenza vaccination recommendation.

While the ACIP recently has recommended that all children be vaccinated against influenza, prior to 2002 it advised vaccination only for children with underlying medical conditions, and for children who were household contacts of persons at increased risk for influenza complications [14]. In 2002, the ACIP first recommended annual influenza vaccination of all children 6-23 months, and in 2006 it expanded this recommendation to include all children 6-59 months [15, 16]. Experience with other vaccines clearly illustrates that healthcare provider endorsement will be critical for implementing these expanded recommendations – with the introduction of new vaccines and vaccine policies for hepatitis B, varicella, and pneumococcal conjugate vaccine, physician concurrence with recommendations greatly improved adherence to guidelines and compliance with immunization standards related to improved vaccine delivery (e.g., providing multiple injections at one appointment) [17-21]. Moreover, influenza research consistently has shown that parental recall of a physician recommendation is one of the strongest predictors of immunization status among children [22-25].

Given the importance of healthcare providers, successful implementation of a universal childhood influenza vaccina-

*Address correspondence to this author at the Emory Vaccine Center, Room 446, Dental Bldg, 1462 Clifton Rd NE, Atlanta, GA 30322, USA; Tel: (404) 712-2466; Fax: (404) 712-2557; E-mail: kpazol@emory.edu

1874-9240/08

tion recommendation will require knowledge of the barriers that practitioners face in immunizing children against influenza and which clinic practices lead to greater success in delivering vaccine. To determine these factors, we conducted a cross-sectional survey of private pediatric clinics in the state of Georgia. We sought to identify clinic characteristics and practices associated with greater intent to deliver influenza vaccine in the immunization season preceding our survey (2004-2005) and the types of support that healthcare providers felt necessary to increase influenza vaccine delivery to their entire patient population.

MATERIALS AND METHODS

Data Sources

This study supplemented information obtained by the Georgia Immunization Program (GIP) from medical practices participating in its Vaccines for Children (VFC) program. Similar to all VFC programs, the GIP distributes free vaccine for private healthcare providers to administer to Medicaid enrolled, uninsured, and American Indian or Alaska Native children. In addition, the GIP uses supplemental funding so that private providers may obtain free vaccine for underinsured children and children participating in Georgia's State Children's Health Insurance Program (SCHIP), PeachCare for Kids. The GIP also allows private providers to charge VFC eligible children for an office visit and a nominal administration fee [26].

Using a list of all private clinics participating in Georgia's VFC program (N = 948), we initially drew a random sample of 132 medical practices distributed across Georgia. Because this was an exploratory study, our sample size was based on logistical considerations. Of the 132 clinics selected, 69 were excluded because they had a practice specialty other than pediatrics. Hence, our final sample contained 63 medical practices from an estimated 450 pediatric clinics in Georgia.

For those clinics we selected, our data sources included a self-administered survey and GIP vaccine shipment records from its VFC program. In addition, we abstracted 2000 US Census data describing the demographic characteristics of the counties in which the clinics were located. Inclusion criteria for our analysis were: (1) a clinic specialty of pediatrics; (2) the availability of records for the number of influenza doses shipped in the 2004-2005 vaccination season; and (3) the availability of records for the number of measles, mumps and rubella (MMR) doses shipped in the 2004 calendar year. Because the aim of this study was to identify characteristics of immunization providers that might allow them to reach their entire patient population for influenza immunization on an annual basis, clinics which were shipped $\leq$40 doses of MMR vaccine were excluded, as they were presumed not to be significant providers of any childhood immunizations.

Survey Instrument

This study was based on a self-administered, cross-sectional survey that was initially distributed by mail in November 2005. Clinics that did not return the survey were contacted by telephone to encourage them to respond. Those that still did not respond were telephoned a second time between June 2006 and August 2006 and invited to complete an abbreviated survey with a trained interviewer. Questions asked in this abbreviated survey were similar to those in the full survey except that there were fewer items about general as opposed to influenza-specific immunization practices. As a final option, clinics that indicated they could not complete the abbreviated survey over the telephone were given a link to a website where they could complete the survey electronically. Participants were asked to provide written consent before completing the survey instrument. Verbal consent was obtained from participants who completed the survey over the telephone. Each clinic completing a survey received a $25 gift card. All procedures were approved by the Institutional Review Board of Emory University.

All participants were asked to respond in relation to their clinic practices during the 2004-2005 influenza vaccination season. Hence, the survey took place after a recommendation for infants 6-23 months had been implemented [15, 27], but before a recommendation had been made for 24-59 month old children [16], or for all children 6 months to 18 years [13]. For clinics that returned surveys, respondents were asked to indicate if they were a physician, a nurse, an office manager, or another type of personnel.

The survey addressed the following topics: (1) knowledge of ACIP/AAP (American Academy of Pediatrics) recommendations for influenza vaccination; (2) support for universal childhood influenza vaccination; (3) clinic size and capacity for delivering vaccine; (4) general and influenza specific immunization policies; and (5) measures clinics considered necessary for adhering to a universal vaccination recommendation. To assess knowledge of current recommendations, respondents were asked whether various categories of patients should or should not receive influenza vaccine. The categories included persons for whom the ACIP recommended vaccine at the time (e.g., 6-23 month olds), as well as persons for whom vaccine was not routinely recommended (e.g., college students in dormitories). To assess support for universal childhood vaccination, respondents were asked to indicate whether they generally agreed, generally disagreed, or had no opinion about universal vaccination. To assess clinic size, capacity and immunization practices, respondents were asked to fill in information such as number of clinic employees and exam rooms, hours of operation, and the maximum number of vaccines administered at a single appointment. In addition, respondents were asked whether or not they adhered to certain practices (e.g., whether they used particular reminder strategies, whether they used thimerosal containing vaccine, whether they vaccinated parents/guardians at the same time as their children). To assess the types of support providers felt were important for their clinic to adhere to a universal vaccination recommendation, respondents were asked to rank a number of potential measures on a 5-point Likert scale (1 = not at all important, to 5 = extremely important).

A copy of the full-length survey is available at: http://www.medicine.emory.edu/id/ecirve/Full_Survey.pdf. The abbreviated survey is available at: http://www.medicine.emory.edu/id/ecirve/Abbreviated_Survey.pdf

Vaccine Shipment Data

Because we were not able to measure the actual number of influenza vaccine doses administered, we used the number of VFC doses of influenza vaccine that the GIP shipped to individual clinics as our primary measure representing intent to deliver influenza vaccine in the 2004-2005 season. To adjust for differences in clinic size and number of VFC participants among practices, we used the ratio of influenza vaccine doses ordered through the VFC program during the 2004-2005 influenza season, relative to the number of MMR doses ordered through the VFC program in the 2004 calendar year. For both influenza and MMR vaccine, a minimum order of 10 doses was required. We chose the MMR vaccine for our comparison because this vaccine has been included in the VFC program for many years and high coverage levels among preschool children have been achieved (>90% since 1999) [28]. Moreover, among older children, a second dose is required for entry into kindergarten (coverage rate of 93.7% for the 2006-2007 school year) [29]. Because our outcome measure was calculated by dividing influenza vaccine doses by MMR vaccine doses, larger values were taken to represent greater intent to immunize children against influenza in the 2004-2005 vaccination season.

Demographic Data

Information on the demographic characteristics of the counties where participating clinics were located was obtained from the 2000 US Census. Variables considered were: percent population non-Hispanic white, non-Hispanic black, and Hispanic; percent population with a high school diploma and a college degree; mean household income and percent families living below the federal poverty line; median population age and percent population < 5 years; total county population; and the extent to which communities were considered urban *vs* rural on the basis of the United States Department of Agriculture rural-urban continuum codes [30].

Data Analysis

Descriptive statistics were calculated for provider knowledge of current influenza recommendations, support for universal vaccination, and considerations clinics reported as important for them to adopt a universal vaccination policy. Bivariate tests were conducted to assess whether our outcome measure (influenza:MMR VFC doses shipped) was associated with: support for universal vaccination; clinic size and capacity for delivering vaccines; influenza-specific practices; and general immunization practices (see Table **1** for list of independent variables).

Variables associated with our outcome measure at a level of $p \leq 0.10$ through bivariate analysis were entered into a multivariable model to assess their independent effects. A value of $p \leq 0.05$ was the criterion for accepting statistical significance.

While responses from all individuals were used to assess clinic characteristics and practices associated with intent to vaccinate children, only surveys completed by a physician or

Table 1. Independent Variables Assessed for Association with the Dependent Measure, Influenza to MMR Shipment Ratios

Category	Independent Variables
Clinic Size and Capacity	Number of physicians†
	Number of nurses (LPNs and RNs)†
	Total number of employees
	Number of exam rooms
	Number of hours open for operation on a weekly basis
	Number of children served
	Ratio of exam rooms to physicians
	Ratio of nurses to physicians
	Ratio of children to nurses
	Ratio of children to physicians
	Ratio of children to exam rooms
	Ratio of children to hours open for operation on a weekly basis
	Clinic has a records keeper
	Clinic has a front-line supervisor
Influenza-Specific Practices	Number of hours/week influenza vaccine administered
	Number of additional hours for influenza vaccination added last season
	Number of distinct reminder/recall strategies implemented
	Uses specific types of reminders (phone, mail and written/verbal at last appointment)
	Clinic has a policy that clinic staff must be vaccinated against influenza
	Clinic reports achievement of a staff vaccination rate ≥ 60%
General Immunization Practices	Clinic uses safety syringes
	Clinic has a policy to vaccinate parent/guardian at same time as the child
	Clinic has a policy to deliver ≥ 6 vaccines at one appointment
	Clinic has a policy of attempting to use only thimerosal free vaccine for children ≤ 2 years
	Clinic has a policy of attempting to use only thimerosal free vaccine for all children
Attitudes about Universal Vaccination	Expressed degree of support for universal vaccination (agree, no opinion, disagree)

† Each full-time employee was considered 1 full time equivalent (FTE); each part-time employee was considered 0.5 FTE.

a nurse (N = 21 of 35 surveys) were included in analyses of adherence to ACIP/AAP recommendations and attitudes about universal vaccination. Consequently, variables related to clinic characteristics and practices were considered separately from variables related to attitudes and beliefs for inclusion in multivariable regression models.

In our analysis, we considered using a finite population correction. This adjustment was potentially appropriate because we drew our sample from a defined population of some 450 private pediatric clinics in Georgia's VFC program, and we included nearly 8% of all potential participants in our final sample. However, we decided not to use the finite population correction because practically speaking with a sample under 5-10% of a population, the correction is very small [31].

RESULTS

Response Rates and Participant Characteristics

Of the 63 pediatric clinics contacted, 44 (70%) completed a survey. There were no differences between the population demographics of counties in which responder and non-responder clinics were located (data not shown). Of the responding clinics, five were excluded from our final analysis because no data were available to indicate the number of influenza doses (N = 1), the number of MMR doses (N = 3), or the number of both vaccine types (N = 1) shipped through Georgia's VFC program. In addition, four clinics were excluded because they were shipped ≤ 40 doses of MMR vaccine. Thus of the responding clinics, 35 of 44 (80%) met our study inclusion criteria. Of the pediatric clinics that did not respond, eight would have met our study inclusion criteria, while the remaining practices either were shipped ≤ 40 doses of MMR vaccine (N = 8), or had no record of the number of influenza (N = 2) or the number of MMR (N = 1) doses shipped. Among the clinics that met our study inclusion criteria, the calculated influenza to MMR ratios were similar between responders and non-responders (p = 0.813; $\text{ratio}_{\text{responders}} = 1.89 \pm 0.32$, N = 35; $\text{ratio}_{\text{non-responders}} = 2.08 \pm 0.83$, N = 8). Of the 35 surveys included in our final analysis, a physician or nurse completed 21 (60%; N = 6 physicians and 15 nurses); an office manager completed 5 (14%); and a medical assistant completed 5 (14%). Other/unknown categories of individuals (e.g., clinical supervisors, front desk clerks) completed the remaining 4 (11.4%).

Distribution of Outcome Measure Scores

The mean ratio of influenza to MMR doses shipped to each clinic was 1.89±0.32 (range 0-7.82), with one medical practice receiving no influenza vaccine. Among clinics with a nurse or a physician respondent, the mean ratio was 2.42±0.49 (range 0.38-7.82).

Knowledge of ACIP/AAP Recommendations and Support for Universal Vaccination

When asked to identify individuals they would vaccinate, most nurses and physicians correctly identified categories of children included in ACIP/AAP recommendations at the time. All respondents indicated they would vaccinate healthy children 6-23 months, children ≥ 6 months with high-risk medical conditions, and healthy household contacts of children with high-risk medical conditions. Twenty of 21 respondents indicated they would vaccinate healthy household contacts of children 0-23 months (one physician indicated he/she would not), and 18 of 21 respondents indicated they would vaccinate healthy household contacts of high-risk adults (a second physician and two nurses indicated that they would not).

Most physicians and nurses supported or were neutral in their opinion about universal childhood vaccination: 10 (48%; 2 of 6 physicians and 8 of 15 nurses) agreed with a universal vaccination recommendation, 8 (38%; 3 of 6 physicians and 5 of 15 nurses) had no opinion, and 3 (14%; 1 of 6 physicians and 2 of 15 nurses) disagreed. Reasons given for disagreeing with a universal immunization recommendation were that it was not necessary to vaccinate all children, and that there were better uses of health care resources. There was no significant difference in the ratio of influenza to MMR vaccine doses shipped across categories of support for universal vaccination (p = 0.458; $\text{ratio}_{\text{support}} = 2.96 \pm 0.73$; $\text{ratio}_{\text{no.opinion}} = 2.23 \pm 0.87$; $\text{ratio}_{\text{disagree}} = 1.13 \pm 0.36$).

Clinic Characteristics and Practices Associated with Intent to Deliver Influenza Vaccine

Bivariate analyses revealed no significant association between any clinic size or capacity variable and our outcome measure (data not shown). However, significantly higher ratios of influenza to MMR vaccine doses were associated with: the number of clinic hours added for vaccination during the influenza immunization season (r = 0.460; N = 26; p = 0.018); having a policy of delivering ≥ 6 vaccines at one appointment (p = 0.012; $\text{ratio}_{\text{delivers} \geq 6\text{ vaccines}} = 4.17 \pm 1.24$, N = 4; $\text{ratio}_{\text{does not deliver} \geq 6\text{ vaccines}} = 1.43 \pm 0.39$, N = 14); and self-reported achievement of a staff vaccination rate ≥ 60% (p = 0.010; $\text{ratio}_{\text{achieved} \geq 60\%} = 2.17 \pm 0.39$, N = 27; $\text{ratio}_{\text{did not achieve} \geq 60\%} = 0.85 \pm 0.26$, N = 5).

Measures considered Important for Clinics to Support Universal Vaccination

The percent of nurse and physician respondents considering a given measure very to extremely important (4-5 on a 5 point Likert scale) for their clinic to adopt a universal vaccination policy ranged from 57% to 100% (Table **2**). All respondents (100%) indicated that knowing influenza vaccines are effective for protecting individual children was very to extremely important. Having a formal AAP/ACIP recommendation and the availability of credits or refunds for unused vaccines were the two considerations deemed very to extremely important by the next highest percent (86%) of respondents. The availability of alternative locations to support vaccination efforts – such as the local health departments, pharmacists, or visiting nurse associations – was considered very to extremely important by the lowest percentage (57%) of respondents.

Multivariable Analyses of Clinic Policies/Practices

Because multiple clinic policies and practices were associated with our outcome measure at a level of $p \leq 0.1$ (number of exam rooms; number of hours added for influenza vaccination during the 2004-2005 vaccination season; reported achievement of a staff vaccination rate ≥ 60%; having a policy of delivering ≥ 6 vaccines at one appointment), we assessed the independent effects of these variables. Overall, this model explained significant variation in the ratio of in-

Table 2. Relative Importance of Issues that would Need to be Addressed for Clinics to Implement a Universal Influenza Vaccination Policy

Variable	% Considering Measure:		
	Extremely to Very Important^	Important	Not Very to Not at All Important
Vaccine effectiveness	*N*=21 of 21 (**100%**)	*N*=0 of 21 (**0%**)	*N*=0 of 21 (**0%**)
Formal AAP/ACIP recommendation	*N*=18 of 21 (**86%**)	*N*=3 of 21 (**14%**)	*N*=0 of 21 (**0%**)
Credit or refunds for unused vaccine	*N*=18 of 21 (**86%**)	*N*=3 of 21 (**14%**)	*N*=0 of 21 (**0%**)
Protects adult contacts of vaccinated children	*N*=17 of 20 (**85%**)	*N*=1 of 20 (**5%**)	*N*=2 of 20 (**10%**)
Greater availability of thimerosal free vaccine	*N*=15 of 21 (**71%**)	*N*=3 of 21 (**14%**)	*N*=3 of 21 (**14%**)
Private insurance reimbursement	*N*=14 of 21 (**67%**)	*N*=3 of 21 (**14%**)	*N*=4 of 21 (**19%**)
Educational campaigns	*N*=14 of 21 (**66%**)	*N*=6 of 21 (**29%**)	*N*=1 of 21 (**5%**)
Alternative locations to support efforts	*N*=12 of 21 (**57%**)	*N*=2 of 21 (**10%**)	*N*=7 of 21 (**33%**)

^ Mean importance scores based on a Likert scale where 5 = extremely important, 4 = very important, 3 = important, 2 = not very important, and 1 = not at all important.

fluenza to MMR vaccine doses shipped to clinics (r^2 = 0.594; p = 0.006). Both the number of hours added for vaccination during the 2004-2005 influenza season, and having a policy of delivering ≥ 6 vaccines at one appointment were positively related to our outcome measure (Table **3**).

DISCUSSION

The results of this study indicate that the great majority of the pediatric providers participating in our study were well informed about current recommendations for childhood vaccination against influenza. In addition, very few respondents expressed disagreement with a universal vaccination policy. Our findings suggest that those clinics which added extra hours for vaccinating children during the influenza vaccination season, and those which had a policy of delivering ≥ 6 vaccinations at one appointment, had the highest influenza to MMR vaccine shipment ratios. The three considerations that nurse and physician respondents deemed most important for their clinics to adopt a universal childhood influenza vaccination policy were: knowing that immunization protected individual children, having a formal AAP/ACIP recommendation, and having credits or refunds available for unused vaccine.

Table 3. Clinic Practices and Policies: Multivariable Linear Regression Results for the Association with Influenza to MMR Shipment Ratios*

Variable	Parameter Estimate	Standard Error	t-Value	p-Value
Intercept	0.552	1.42	t = 0.39	p = 0.706
Reported staff vaccination rate ≥ 60%	0.649	1.39	t = 0.47	p = 0.650
Delivers ≥ 6 vaccines at one appointment	2.896	0.97	t = 3.00	**p = 0.012**
Hours for influenza vaccination added in 2004-2005	0.319	0.10	t = 3.23	**p = 0.008**
Number of examination rooms	-0.034	0.11	t = -0.30	p = 0.766

*Significant values in bold.

Higher influenza to MMR shipment ratios among clinics with a policy of delivering ≥ 6 vaccines at one appointment suggests that clinics adhering to the standard of simultaneously administering all vaccinations for which a child is eligible [32] will be in the forefront of those implementing universal vaccination recommendations. Provider unwillingness to deliver multiple vaccinations has been shown to lower immunization rates [33, 34] and slow the introduction of new vaccines and vaccine policies [17, 18, 20, 35-37]. Overcoming resistance to delivering multiple vaccines at one appointment indeed appears to be important for improving influenza immunization rates – Szilagyi *et al.* [38] have reported that just adding 6-23 month old children to the recommendations would require clinics to schedule extra appointments, and we found that clinics adding extra hours during the influenza vaccination season had higher influenza to MMR shipment ratios. However, in spite of the potential for insufficient capacity during the influenza season, only 57% of respondents considered the availability of alternative locations to support vaccination efforts important for them to implement universal vaccination. Hence, at this time many clinicians may not have considered seriously the logistical implications of implementing a universal vaccination policy.

One of the major strengths of this study is that we used an objective measure to quantify intent to deliver influenza vaccine relative to other childhood immunizations. While studies comparing immunization rates obtained through self-report versus chart review suggest that providers tend to overstate their success in delivering vaccines [39], the information we used was provided by the GIP as an objective outside source. This measure likely provided a reasonable measure of intent to vaccinate based on a clinic's best estimate of the number of influenza doses it could deliver. While it did not represent the percentage of children a clinic actually immunized, it did control for differences in the number of children in a medical practice, as well as the proportion eligible for participation in the VFC program, by measuring the number of influenza doses relative to the number of doses of MMR – a vaccine for which coverage rates routinely have exceeded 90% in Georgia [28, 29].

Despite the strength of our outcome measure, it also had some shortcomings. One weakness of this measure is that it only allowed us to assess vaccine ordered through Georgia's VFC program, and it is possible that providers treat VFC-eligible and non-VFC-eligible children differently. However, Georgia's VFC program allows providers to charge eligible children for an office visit and a nominal administration fee [26], when these costs are not covered by Medicaid and parents have the ability to pay out of pocket. This ability to recoup many of their costs may minimize differences in the way that providers treat recipients of VFC and non-VFC vaccine. Another shortcoming of our measure is that it does not provide information on the age of children being vaccinated. One of our findings was that many providers felt having an official AAP/ACIP recommendation was extremely important for them to support universal vaccination. At the time our study was conducted, the ACIP recommended vaccination for healthy children from 6-23 months, but also had a permissive policy which allowed for vaccination of all persons who wished to decrease their risk of influenza and its complications [27]. Because our measure does not reflect the age of children vaccinated, we cannot use it to differentiate between implementation of the existing recommendation at the time (i.e., vaccination of 6-23 month old children), versus implementation of the permissive policy.

In addition to the weaknesses identified in our outcome measure, this study has a number of limitations. First, as a cross-sectional study, this analysis allows only for hypothesis development rather than causal inferences. In addition, because this was a descriptive, exploratory study, our sample size was based on logistical considerations and we therefore had limited power to detect differences between groups. This shortcoming was particularly pronounced for our assessment of attitudes and beliefs, which was restricted to nurses and physicians and included only 21 respondents. For example, although we did not find a significant association between expressed support for universal vaccination and our outcome measure, we did find a distinct trend, with those expressing support for universal vaccination having higher influenza to MMR shipment ratios. With a larger sample size, we may have been able to detect an effect. Similarly, although we found no relationship between our outcome measure and the use of patient reminders for influenza, or any size and capacity variable, given a larger sample size we may have been able to detect an effect of these variables. Future research, in which a power analysis is conducted during the study design to ensure a sufficient sample size, will be needed to address these issues.

In addition to power constraints, our sampling frame, which included only private pediatric immunization providers in the state of Georgia, limits the degree to which our findings can be generalized to other populations and types of providers. Because numerous studies have shown that the immunization practices and beliefs of pediatricians and family practitioners differ [17, 20, 21, 33, 40, 41], providers serving adults as well as children may have different concerns and constraints to face with respect to implementing a universal vaccination policy. Similarly, private medical practices may differ substantially from public clinics in ways that impact their ability to deliver influenza vaccine. For instance, public clinics in Georgia are less likely than private medical practices to use patient reminders, although healthcare workers at public clinics are more likely to express support for universal vaccination (manuscript in preparation). In addition, we looked only at immunization providers, excluding those clinics that were shipped a very small number of MMR doses on the assumption that they rarely provided any vaccines. While it would have been interesting to understand the characteristics of clinics that do not administer vaccines, there were only four medical practices in this category. We thus felt we could not conduct a meaningful analysis and chose to focus on the factors that influence the ability of current immunization providers to reach their patient population on an annual basis. Finally, because there is variation across states in childhood influenza vaccination rates [28, 29], and presumably attitudes toward vaccination, our findings from Georgia cannot necessarily be extrapolated to other regions of the country. Future studies will be needed to assess general and immunization specific practices that are associated with influenza vaccine delivery efforts in the wide range of clinics that will be needed to support the implementation of universal childhood recommendation.

CONCLUSION

This study suggests that clinics adding additional hours for vaccination during the influenza season, and clinics that have adopted a policy of providing ≥6 vaccines at a single visit, when indicated, showed the greatest intent to vaccinate their patients during the 2004-2005 influenza vaccination season. Having a formal AAP/ACIP recommendation is critical for implementation of a universal vaccination policy. A substantial proportion of clinics also want to be assured they can receive credits or refunds for unused vaccine. Future research – including a much larger sample size and medical practices representing additional specialties and states – is needed to determine which clinic characteristics correlate best with implementation of current influenza recommendations. By developing measures that can be used to identify clinics most and least supportive of universal immunization, public health officials can focus their promotion efforts where they are needed most.

ABBREVIATIONS

AAP	=	American Academy of Pediatrics
ACIP	=	Advisory Committee on Immunization Practices
GIP	=	Georgia Immunization Program
MMR	=	Measles, Mumps, Rubella
SCHIP	=	State Children's Health Insurance Program
VFC	=	Vaccines for Children

CONFLICT OF INTEREST

Dr. Orenstein has received grant support for clinical trials and research from Merck, Sanofi Pasteur, and Novartis. He is on data safety monitoring boards for vaccine clinical trials for Encorium and GlaxoSmithKline.

ACKNOWLEDGEMENTS

This project was supported by Grant 1P20RR020735 from the National Center for Research Resources (NCRR), a component of the National Institutes of Health (NIH). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of NCRR or NIH.

REFERENCES

[1] Thompson WW, Shay DK, Weintraub E, *et al*. Influenza-associated hospitalizations in the United States. JAMA 2004; 292(11): 1333-40.

[2] Thompson WW, Shay DK, Weintraub E, *et al*. Mortality associated with influenza and respiratory syncytial virus in the United States. JAMA 2003; 289(2): 179-86.

[3] Centers for Disease Control and Prevention. Update: Influenza vaccine supply and recommendations for prioritization during the 2005-06 influenza season. MMWR Morb Mortal Wkly Rep 2005; 54(34): 850.

[4] Neuzil KM, Mellen BG, Wright PF, Mitchel EF Jr, Griffin MR. The effect of influenza on hospitalizations, outpatient visits, and courses of antibiotics in children. N Engl J Med 2000; 342(4): 225-31.

[5] Neuzil KM, Hohlbein C, Zhu Y. Illness among schoolchildren during influenza season: Effect on school absenteeism, parental absenteeism from work, and secondary illness in families. Arch Pediatr Adolesc Med 2002; 156(10): 986-91.

[6] Ghendon YZ, Kaira AN, Elshina GA. The effect of mass influenza immunization in children on the morbidity of the unvaccinated elderly. Epidemiol Infect 2006: 134(1): 71-8.

[7] King JC Jr, Cummings GE, Stoddard J, *et al*. A pilot study of the effectiveness of a school-based influenza vaccination program. Pediatrics 2005; 116(6): e868-73.

[8] King JC Jr, Stoddard JJ, Gaglani MJ, *et al*. Effectiveness of school-based influenza vaccination. N Engl J Med 2006; 355(24): 2523-32.

[9] Monto AS, Davenport FM, Napier JA, Francis T Jr. Modification of an outbreak of influenza in Tecumseh, Michigan by vaccination of schoolchildren. J Infect Dis 1970; 122(1): 16-25.

[10] Piedra PA, Gaglani MJ, Kozinetz CA, *et al*. Herd immunity in adults against influenza-related illnesses with use of the trivalent-live attenuated influenza vaccine (CAIV-T) in children. Vaccine 2005; 23(13): 1540-8.

[11] Reichert TA, Sugaya N, Fedson DS, Glezen WP, Simonsen L, Tashiro M. The Japanese experience with vaccinating schoolchildren against influenza. N Engl J Med 2001; 344(12): 889-96.

[12] Rudenko LG, Slepushkin AN, Monto AS, *et al*. Efficacy of live attenuated and inactivated influenza vaccines in schoolchildren and their unvaccinated contacts in Novgorod, Russia. J Infect Dis 1993; 168(4): 881-7.

[13] Centers for Disease Control and Prevention. Prevention and control of influenza: Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Morb Mortal Wkly Rep 2008; 57: 1-60.

[14] Centers for Disease Control and Prevention. Prevention and control of influenza: Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Morb Mortal Wkly Rep 2001; 50(RR-4): 1-31.

[15] Centers for Disease Control and Prevention. Prevention and control of influenza: Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Morb Mortal Wkly Rep 2002; 51(RR-3): 1-31.

[16] Centers for Disease Control and Prevention. Prevention and control of influenza: Recommendations of the Advisory Committee on Immunization Practices (ACIP). Morb Mortal Wkly Rep 2006; 55(RR-10): 1-42.

[17] Loewenson PR, White KE, Osterholm MT, MacDonald KL. Physician attitudes and practices regarding universal infant vaccination against hepatitis B infection in Minnesota: Implications for public health policy. Pediatr Infect Dis J 1994; 13(5): 373-8.

[18] Davis MM, Ndiaye SM, Freed GL, Clark SJ. One-year uptake of pneumococcal conjugate vaccine: A national survey of family physicians and pediatricians. J Am Board Fam Pract 2003; 16(5): 363-71.

[19] Wood DL, Rosenthal P, Scarlata D. California pediatricians' knowledge of and response to recommendations for universal infant hepatitis B immunization. Arch Pediatr Adolesc Med 1995; 149(7): 769-73.

[20] Freed GL, Freeman VA, Clark SJ, Konrad TR, Pathman DE. Pediatrician and family physician agreement with and adoption of universal hepatitis B immunization. J Fam Pract 1996; 42(6): 587-92.

[21] Schaffer SJ, Bruno S. Varicella immunization practices and the factors that influence them. Arch Pediatr Adolesc Med 1999; 153(4): 357-62.

[22] Daley MF, Beaty BL, Barrow J, *et al*. Missed opportunities for influenza vaccination in children with chronic medical conditions. Arch Pediatr Adolesc Med 2005; 159(10): 986-91.

[23] Grant VJ, Le Saux N, Plint AC, *et al*. Factors influencing childhood influenza immunization. Can Med Assoc J 2003; 168(1): 39.

[24] Hemingway CO, Poehling KA. Change in recommendation affects influenza vaccinations among children 6 to 59 months of age. Pediatrics 2004; 114(4): 948-52.

[25] Poehling KA, Speroff T, Dittus RS, Griffin MR, Hickson GB, Edwards KM. Predictors of influenza virus vaccination status in hospitalized children. Pediatrics 2001; 108(6): e99.

[26] Georgia Department of Human Resources, Division of public health, vaccines for children. [accessed April 15, 2008]. Available from: http://health.state.ga.us/programs/immunization/vfc/index.asp

[27] Centers for Disease Control and Prevention. Prevention and control of influenza: Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Morb Mortal Wkly Rep 2004; 53(RR-6): 1-40.

[28] National Immunization Survey. 2007 [updated 2008 March 28]; [accessed April 10, 2008]. Available from: http://www.cdc.gov/vaccines/stats-surv/imz-coverage.htm#nis

[29] Centers for Disease Control and Prevention. Vaccination coverage among children in kindergarten--United States, 2006-07 school year. MMWR Morb Mortal Wkly Rep 2007; 56(32): 819-21.

[30] United States Department of Agriculture. Data sets: Rural-urban continuum codes. [updated 2004 Nov 3]; [accessed April 10, 2008]. Available from: http://www.ers.usda.gov/Data/RuralUrbanContinuumCodes/

[31] Dorofeev S, Grant P. Statistics for Real-Life sample surveys: Non-simple-random samples and weighted data. New York: Cambridge University Press 2006.

[32] National Vaccine Advisory Committee. Standards for child and adolescent immunization practices. Pediatrics 2003; 112(4): 958-63.

[33] Koepke CP, Vogel CA, Kohrt AE. Provider characteristics and behaviors as predictors of immunization coverage. Am J Prev Med 2001; 21(4): 250-5.

[34] Lieu TA, Davis RL, Capra AM, *et al*. Variation in clinician recommendations for multiple injections during adoption of inactivated polio vaccine. Pediatrics 2001; 107(4): e49.

[35] Kraus DM, Campbell MM, Marcinak JF. Evaluation of universal hepatitis B immunization practices of Illinois pediatricians. Arch Pediatr Adolesc Med 1994; 148(9): 936-42.

[36] Wood D, Donald-Sherbourne C, Halfon N, *et al*. Factors related to immunization status among inner-city Latino and African-American preschoolers. Pediatrics 1995; 96(2 Pt 1): 295-301.

[37] Freed GL, Bordley WC, Clark SJ, Konrad TR. Universal hepatitis B immunization of infants: Reactions of pediatricians and family physicians over time. Pediatrics 1994; 93(5): 747-51.

[38] Szilagyi PG, Iwane MK, Schaffer S, *et al*. Potential burden of universal influenza vaccination of young children on visits to primary care practices. Pediatrics 2003; 112(4): 821-8.

[39] Santoli JM, Szilagyi PG, Rodewald LE. Barriers to immunization and missed opportunities. Pediatr Ann 1998; 27(6): 366-74.

[40] Szilagyi PG, Hager J, Roghmann KJ, *et al*. Immunization practices of pediatricians and family physicians in the United States. Pediatrics 1994; 94(4): 517-23.

[41] Takayama JI, Iser JP, Gandelman A. Regional differences in infant immunization against hepatitis B: Did intervention work? Prev Med 1999; 28(2): 160-6.

Received: April 28, 2008 Revised: July 28, 2008 Accepted: July 31, 2008