

Knowledge, Attitudes, and Beliefs of School Nurses and Personnel and Associations With Nonmedical Immunization Exemptions

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ABSTRACT. *Objectives.* We studied school personnel involved in the review of student's immunization status to determine whether personnel training, immunization-related knowledge, attitudes, and beliefs, use of alternative medicine, and sources of vaccine information were associated with the vaccination status of school children.

Methods. Surveys were mailed to a stratified and random sample of 1000 schools in Colorado, Massachusetts, Missouri, and Washington. School personnel reported their training and perceptions of disease susceptibility/severity, vaccine efficacy/safety, key immunization beliefs, use of alternative medicine, confidence in organizations, sources, and credibility of vaccine information, and the rates of vaccine exemptors in their schools. Logistic regression analysis was used to explore associations between personnel factors and beliefs (independent variables) with the likelihood of a child having an exemption (dependent variable). Regression models were adjusted for clustering of children in schools, type of school (public versus private), and state.

Results. Surveys were returned by 69.6% of eligible participants. A child attending a school with a respondent who was a nurse was significantly less likely to have an exemption than a child attending a school with a respondent who was not a nurse (odds ratio [OR]: 0.39; 95% confidence interval [CI]: 0.28–0.56). The majority of respondents believed that children (95.6%) and the community (96.1%) benefit when children are vaccinated. Nurses were more likely than nonnurses to hold beliefs supporting the utility and safety of vaccination. Greater perceived disease susceptibility and severity and vaccine efficacy and safety were associated with a decreased likelihood of a child in the school having an exemption. Vaccine misconceptions were relatively common. For example, 19.0% of respondents were concerned that children's immune systems could be weakened by too many immunizations, and this belief was associated with an increased likelihood of a child in the school having an exemption (OR: 1.51; 95% CI: 1.00–2.28).

Most respondents had a moderate amount or great deal of confidence in state health departments (91.4%), the Centers for Disease Control and Prevention (CDC) (93.9%), local health departments (88.8%), health care

providers (88.5%), the Food and Drug Administration (73.6%), and the health care system (65.2%). Fewer respondents had a moderate amount or great deal of confidence in the media (17.4%). A child attending a school with a respondent who had a moderate amount or great deal of confidence in local and state health departments was less likely to have an exemption (OR: 0.47 and 0.44; 95% CI: 0.27–0.80 and 0.25–0.80, respectively) than a child attending a school with a respondent who did not have a moderate amount or great deal of confidence in local and state health departments. Confidence in other groups was not associated with the likelihood of a child in the school having an exemption.

Nearly half (45.5%) of the respondents or their immediate family members had used some form of alternative medicine in the last 5 years. A child attending a school with a respondent who had (or had a family member[s] who) used an alternative medicine practitioner was more likely to have an exemption than a child attending a school with a respondent who had not used an alternative medicine practitioner.

There were significant associations between sources used and perception of reliability for vaccine information with the likelihood of a child in the school having an exemption. Use of professional organizations, government resources, vaccine companies, and pharmacists for vaccine information were associated with a decreased likelihood of a child in the school having an exemption. Perceiving health departments and the CDC as a good or excellent source for vaccine information was associated with a decreased likelihood of a child in the school having an exemption.

Conclusions. The training, knowledge, attitudes, and beliefs of school personnel who work with parents on immunization issues were associated with the likelihood of a child in the school having an exemption. Although respondents generally believed in vaccinations, misconceptions were common. Many school personnel seem to be unaware of the seriousness of some vaccine-preventable diseases and that unimmunized children are highly susceptible to diseases. These misperceptions were associated with an increased likelihood of a child having an exemption.

This study of associations cannot determine causal associations. Nonetheless, the frequency of vaccine misconceptions among school personnel warrants vaccine communication programs for school employees who work with parents on immunization issues. An intervention study could determine whether such programs have an impact on parental decisions to claim exemptions for their children.

Personnel without formal health care training who advise parents on immunization issues could be passing on misinformation to parents. Nurses or properly trained

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health personnel should be the primary school contacts for parents on immunization issues.

Health departments and health care providers were used most often by school personnel for vaccine information. Providers, professional organizations, health departments, and the CDC were considered most credible. The CDC may be an underutilized source, given its high credibility; only 58.1% of respondents reported using the CDC for vaccine information. Greater visibility of CDC on vaccine information statements and communication efforts from the CDC directly to school personnel will likely be well received. Respondents who do not consider health departments and the CDC as credible sources were associated with a greater likelihood of a child in their school having an exemption. The CDC may need to consider working with other reliable sources to communicate with these personnel.

Studies are needed to understand why some parents choose to forgo vaccination for children who do not have true medical contraindications to vaccines. School personnel trained in vaccine safety may serve as a valuable source of vaccine information for parents. Parents who have misconceptions about vaccines would likely benefit from discussions with health care providers. Additional public-information campaigns regarding misconceptions and the value of vaccination may be needed. *Pediatrics* 2004;113:e552–e559. URL: <http://www.pediatrics.org/cgi/content/full/113/6/e552>; immunization, vaccination, public health, nurse, law.

ABBREVIATIONS. VPD, vaccine-preventable disease; KABs, knowledge attitudes and beliefs; CDC, Centers for Disease Control and Prevention; FDA, Food and Drug Administration; OR, odds ratio; CI, confidence interval.

The development and use of vaccines has been one of the greatest achievements in medicine and public health during the past century. Smallpox has been eradicated, wild-type poliomyelitis viruses soon will follow, and the incidence of most other vaccine-preventable diseases (VPDs) in the United States has been reduced by 98% to 99%.^{1,2} These achievements are a result of a strong manufacturing base (including research and development, clinical trials, and large-scale production of vaccines), national guidelines for the use of vaccines, a strong federal program for supporting state and local immunization programs, support from health care providers, reduction of many barriers (including financial) to vaccination, requirements for vaccination before school attendance, and high public confidence in the benefits of immunizations.^{3–7}

Most parents support vaccination and fully vaccinate their children before school entry. In a recent study, 78% of parents believed that immunizations are one of the safest forms of medicine ever developed; 89% believed that immunizations are getting better and safer as a result of medical research; and 71% believed that vaccines strengthen the immune system.⁸ However, parents still have concerns about vaccines: 23% of respondents believed that children get more immunizations than are good for them; 39% believed that children should only be immunized against serious diseases; and 25% were concerned that their child's immune system could be weakened by too many vaccines. Although most parents vac-

nate their children before school entry, the rate of parents claiming exemptions from school immunization requirements for their children (exemptors) has been increasing in many states,⁹ and in the 2002–2003 school year, the average state exemption rate was 1.4% (<http://www2a.cdc.gov/nip/schoolsurv/rptall.asp>).

Exemptors are at increased individual risk of contracting VPDs and transmitting these infections to other school children who are not vaccinated for medical reasons, are too young to be vaccinated, or who have not developed protective immune responses to vaccines.^{10,11} All states permit medical exemptions; 48 states permit religious exemptions (all but Mississippi and West Virginia); and 19 states permit philosophical exemptions.

Health care providers' practices and beliefs are associated with immunization coverage in the populations they serve.^{12–15} However, the role of school nurses and other personnel who ensure that school immunization requirements are met has not been studied. Increases in the number of vaccines recommended for routine use and required for school attendance have contributed to parental concerns about vaccines.¹⁶ This study was designed to 1) characterize the knowledge, attitudes, and beliefs (KABs) of school personnel who work with parents on immunization issues, 2) determine whether the KABs of school personnel are associated with the decision of parents to claim an exemption, and 3) identify the sources used by school personnel to obtain information about vaccines and the sources they consider credible for vaccine information.

METHODS

We surveyed school personnel who work directly with parents on immunization issues in 1000 public and private elementary schools in Colorado, Massachusetts, Missouri, and Washington. These states were selected because the frequency of exemptions was medium to high, as compared with other states, and there was variation among these states in the procedures for claiming exemptions.¹³ In each state, we sampled 150 schools with the highest rate of exemptions, 50 schools with the lowest rate of exemptions, and 50 other randomly selected schools. Exemption rates were based on annual school reports to the state health departments. To avoid oversampling small schools with unstable exemption rates, we stabilized each school's rate by taking a weighted average of the overall exemption rate of all schools in the state and the school's observed rate, for which the weights depended on the variability (variance) of the observed rates. Institutional review-board approval was obtained from the Committee on Human Research, Johns Hopkins Bloomberg School of Public Health.

Survey Procedures

Surveys were mailed to each school, addressed to the person who had completed the state immunization report; the cover letter requested that the survey be completed by the person who works most directly with parents on immunization issues. Respondents were requested to mail a preaddressed postcard indicating their willingness to participate to an independent party at a separate institution so that the investigators would not know who had completed a survey. Completed anonymous surveys were mailed back to the investigators by the respondent. Follow-up letters and telephone calls to encourage participation were conducted by the independent party. Surveys were mailed in May 2001 in Massachusetts and in October 2001 in the remaining states. Letter and telephone follow-up to encourage participation continued in all states until June 2002.

Survey Content

Respondents were asked to report the numbers of fully vaccinated children and exemptors (for ≥ 1 vaccines) in kindergarten through grade 4 in the current school year. They were asked also to use a 5-point Likert scale to estimate the probability that an unimmunized child would contract selected VPDs during a 10-year period ("impossible" to "very likely"); how serious it would be for an 8-year-old child to develop one of these diseases ("not at all serious" to "very serious"); how effective the vaccines are in preventing children from getting these childhood diseases ("not at all protective" to "very protective"); and how safe the vaccine is ("dangerous" to "very safe"). Respondents were asked also to use a 5-point Likert scale ("strongly disagree" to "strongly agree") to indicate their agreement/disagreement to a series of 11 questions relating to "key immunization beliefs"⁸: who benefits from vaccination (child, community, doctors, government, and companies that make vaccines: "not at all" to "a great deal"); whether they or their immediate family members had used specific types of alternative medicine in the last 5 years; level of confidence in local health departments, state health departments, the Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA), health care providers, the health care system, and the media ("none" to "a great deal"); where they received information about vaccines and how good a variety of sources are for vaccine information ("extremely poor source" to "excellent source"); and questions regarding the type of school and their training. Surveys took ~30 minutes to complete and can be accessed online.¹⁴

Data Entry and Management

Surveys were designed in Teleform 6.2 and programmed with validation and logical checks to ensure accuracy. All variables were verified manually in 14% of the first 140 forms received (20 forms, 22 480 image units), and key variables were verified in 35% of the first 140 forms received (50 forms, 350 image units). Manual verification of Teleform revealed that our system of data entry was 99.88% accurate for all variables and 100% accurate for key variables.

Data Analysis

General constructs for respondents' assessments of disease susceptibility and severity and vaccine efficacy and safety were created by using the individual respondent's mean score for all 10 antigens/diseases. Key-belief questions were dichotomized into "strongly agree or agree" versus all other responses. Perception of benefit from vaccination was dichotomized into "a moderate amount or a great deal of benefit" versus all other responses. Confidence in organizations was dichotomized into "a moderate amount or a great deal of confidence" versus all other responses. Each source for vaccine information was dichotomized into "a good or excellent source" versus all lower levels.

Logistic regression models were fit by using the number of exemptors in each school divided by the total number of students in the school as the dependent variable; within-school correlation was adjusted for via generalized estimating equations (blogit procedure, Stata 7, Stata Corporation, College Station, TX). Logistic regression with generalized estimating equations is the optimal model when the outcome variable (child having an exemption) is the sum of dichotomous variables (exempt or vaccinated) at a single point in time (school entry). We used the following independent variables (separate models): 1) whether the respondent was trained as a nurse; 2) vaccine/disease-specific and general constructs for disease susceptibility, disease severity, and vaccine safety and efficacy; 3) key-belief questions; 4) the perceived person/group benefiting from vaccination; 5) confidence in organizations; 6) whether the respondent had used alternative medicine practitioners; 7) whether the respondent had used each source for vaccine information; and 8) whether the respondent considered the source as good or excellent. For comparisons between nurses and nonnurses, ordinary logistic models were used. All models were adjusted for type of school (public versus private) and state. *P* values < .05 are considered to be statistically significant.

Assessment of Nonresponse Bias

Selection bias caused by refusal to participate or loss to follow-up was assessed by examining the differences among 3

groups of schools: those that participated, were lost to follow-up, or refused to participate. Size of school and exemption rate were compared among these 3 groups. In addition, we compared community-level characteristics by linking the zip code of each school to Census Bureau demographic data including racial make-up, average household income, education level, and population density. Potential bias caused by leaving questions blank was assessed by comparing the KABs of respondents who completed questions asking the number of exemptors and total number of students to the KABs of those who left these questions blank. All comparisons between groups were made by using the Student's *t* test with Satterthwaite's approximation.

RESULTS

Ninety-two selected schools were ineligible because they were duplicate schools/respondents, the school had closed, or the selected school was not an elementary school. An additional 54 schools/respondents did not receive the survey mailed to them because the selected respondent was a volunteer who came into the school only to review the students' records and complete the school report to the state regarding the number of students and exemptions. These volunteers could not be reached by telephone or mail despite many attempts. Of the remaining 854 schools, surveys were completed by 594 (69.6%).

Schools that returned surveys had a higher mean number of students than schools that refused to participate. None of the other school or population characteristics explored were different between schools that completed a survey and those that refused. Compared with schools that were lost to follow-up, schools that completed surveys were located in zip code areas in which a higher percentage of residents did not have greater than a high school education. No other school or population characteristics were different between schools that completed a survey and those that were lost to follow-up. Respondents who did not report the number of students in the school ($n = 59$) rated varicella susceptibility higher (4.59 vs 4.34, $P = .01$), pertussis more serious (4.08 vs 3.67, $P = .01$), mumps more serious (3.79 vs 3.31, $P < .01$), and tetanus vaccine safer (4.44 vs 4.08, $P < .01$); were less likely to believe that children get more immunizations than are good for them (5.1% vs 14.6%, $P = .02$); and were more likely to believe that immunizations are one of the safest forms of medicine ever developed (82.1% vs 67.9%, $P = .04$) than schools that did report the number of students in the school. Respondents who did not report the number of exemptors were not different from responders who did report the number of exemptors in any of these KABs.

In all states, the study-exemption rate was higher than the reported overall exemption rate for each state (Table 1) because of the planned oversampling of schools with high exemption rates.

The majority of respondents ($n = 413$, 69.5%) were trained as nurses, and 389 respondents (65.5%) indicated that "nurse" was their position in the school. An additional 75 respondents (12.7%) held positions in the school as health care paraprofessionals or assistants, 77 (13.0%) were clerks or administrators, 24 (4.1%) were principals, and 89 (14.9%) had a broad range of other positions, including a bus driver. Re-

TABLE 1. Study Population by State and Exemption Rate

State	Respondents <i>n</i> (%)	Mean School Exemption Rate	Median School Exemption Rate	State Exemption Rate*
Colorado	137 (23.0)	7.1	4.5	2.05
Massachusetts	161 (27.0)	4.6	0.9	0.6
Missouri	153 (25.8)	1.5	0.6	0.4
Washington	135 (22.8)	10.5	6.6	2.55
Not identified	8 (1.4)	10.1	3.0	NA
Total	594 (100.0)	5.8	1.7	1.4

* Source: school reports to state health department.

porting of these positions was not mutually exclusive. All respondents reported talking directly with parents regarding fulfillment of the school immunization requirements. The proportion of parents that a respondent spoke with regarding vaccines was not associated with the likelihood of a child having an exemption in that school. A child attending a school with a respondent who was a nurse was significantly less likely to be have an exemption than a child attending a school with a respondent who was not a nurse (odds ratio [OR]: 0.39; 95% confidence interval [CI]: 0.28–0.56), adjusting for clustering of children in schools, type of school, and state.

The majority of respondents believed that children (95.6%) and the community (96.1%) benefit when children are vaccinated. Among the VPDs, respondents

perceived that children were most susceptible to varicella and least susceptible to diphtheria and polio (Fig 1). Respondents reported that diphtheria, tetanus, polio, and hepatitis B were the most serious and that varicella was the least serious. *Haemophilus influenzae* type b, pertussis, measles, mumps, and rubella were considered moderately severe (means between 3.0 and 4.0). All vaccines, with the exception of varicella, were perceived to be protective (mean: >4.0), and all vaccines were perceived to be safe (mean: >4.0). There was significant variation in disease- and vaccine-specific beliefs about susceptibility, severity, efficacy, and safety among both nurses and nonnurses. For example, with regard to pertussis, the majority of respondents (69.0%) perceived that unimmunized children were susceptible, the disease was serious (79.3%), and the vaccine

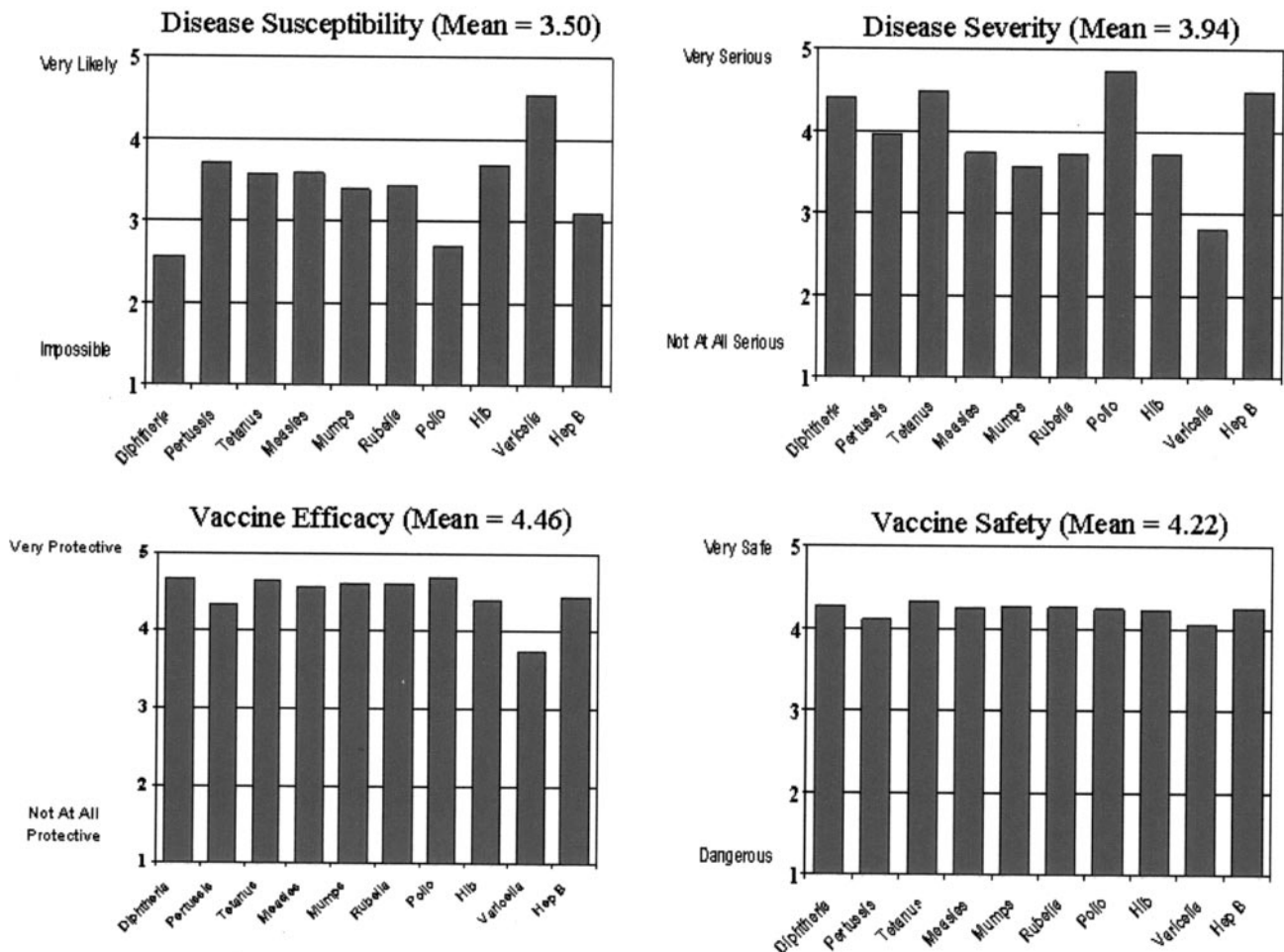


Fig 1. Perceived disease susceptibility and severity and vaccine efficacy and safety.

TABLE 2. Adjusted OR of Child Having an Exemption Associated With School Personnel Perceptions of Susceptibility and Severity of Diseases and Efficacy and Safety of Vaccines

Disease/Antigen	Disease Susceptibility*		Disease Severity†		Vaccine Efficacy‡		Vaccine Safety§	
	Adjusted OR of Child Having an Exemption	95% CI	Adjusted OR of Child Having an Exemption	95% CI	Adjusted OR of Child Having an Exemption	95% CI	Adjusted OR of Child Having an Exemption	95% CI
Mean¶	0.98	0.76–1.29	0.79	0.60–1.05	0.72	0.48–1.08	0.71#	0.51–0.99
Diphtheria	0.90	0.77–1.05	0.87	0.81–0.94	0.83	0.75–0.93	0.82	0.72–0.92
Pertussis	0.88	0.78–0.99	0.88	0.76–1.02	0.82	0.72–0.94	0.91	0.79–1.05
Tetanus	0.95	0.84–1.08	0.82	0.74–0.90	0.78	0.67–0.92	0.87	0.74–1.02
Measles	0.89	0.79–0.99	0.77	0.68–0.88	0.80	0.69–0.92	0.91	0.78–1.06
Mumps	0.87	0.77–0.99	0.85	0.74–0.98	0.83	0.73–0.96	0.84	0.74–0.96
Rubella	0.90	0.80–1.02	0.90	0.78–1.03	0.83	0.72–0.95	0.86	0.74–0.99
Polio	0.92	0.81–1.05	0.96	0.82–1.12	0.90	0.76–1.07	0.82	0.70–0.95
Haemophilus influenzae type b	0.93	0.83–1.03	0.92	0.82–1.02	0.91	0.84–0.99	0.93	0.83–1.03
Varicella	0.86	0.75–0.98	0.90	0.75–1.09	0.85	0.77–0.94	0.93	0.82–1.05
Hepatitis B	0.89	0.78–1.03	0.94	0.82–1.08	0.87	0.78–0.96	0.88	0.78–0.99

ORs shown in bold type indicate a *P* value < .05.

* How likely an unimmunized child will be to get the following diseases during a 10-year period, measured on a 5-point Likert scale.

† How serious it would be if an 8-year-old child got one of these diseases, measured on 5-point Likert scale.

‡ How protective vaccines are to prevent a child from getting childhood diseases, measured on 5-point Likert scale.

§ How safe these vaccine are, measured on a 5-point Likert scale.

|| Adjusting for clustering of children in school, type of school (public versus private), and state.

¶ Mean of 5-point Likert scale ranging from 1.0 to 5.0 for 10 diseases/antigens among those that were nonmissing for each form.

Interpretation of OR: a child who attends a school with key personnel who believe vaccine safety to be higher (for each 1-point increase) is ~29% less likely to be exempt, adjusting for clustering of children in school, type of school (public versus private), and state.

was protective (90.7%) and safe (84.2%); some nurses and nonnurses (13.0% and 15.3%, respectively) believed that a child who had not received pertussis vaccine was unlikely to contract the disease, that per-

tussis was not very serious (8.1% and 5.2%, respectively), that the vaccine was not protective (4.3% and 1.0%, respectively), and that the vaccine was unsafe or dangerous (2.0% and 3.5%, respectively).

TABLE 3. Percent of Nurses and Nonnurses Agreeing With Vaccine-Related Beliefs

Statement	Percent Nurses Agreed or Strongly Agreed	Percent Nonnurses Agreed or Strongly Agreed	<i>P</i> Value
Children should only be immunized against serious diseases.	60.2	69.5	.04
Children get more immunizations than are good for them.	11.8	17.8	.06
I am concerned that children's immune systems could be weakened by too many immunizations.	15.3	26.1	<.01
I am more likely to trust immunizations that have been around a while.	68.8	71.8	.46
Immunizations are one of the safest forms of medicine ever developed.	63.9	50.0	<.01
Immunizations are getting better and safer all of the time as a result of medical research.	73.0	59.5	<.01
Vaccines strengthen the immune system.	63.7	37.0	<.01
Parents should be allowed to send their children to school even if not vaccinated.	26.1	38.1	<.01
I am opposed to immunization requirements, because they go against freedom of choice.	3.8	8.6	.02
I am opposed to immunization requirements, because parents know what is best for their children.	1.0	3.4	.04
Immunization requirements protect children from getting diseases from unimmunized children.	89.6	75.9	<.01

Percentages that differ at a *P* value < .05 are shown in bold type.

TABLE 4. Frequency of Respondent Agreeing With Vaccine-Related Beliefs and ORs of Children Having an Exemption in Respondent's School

Statement	Percent Agreed or Strongly Agreed	Unadjusted OR of Child Having an Exemption	95% CI	Adjusted OR of Child Having an Exemption*	95% CI
Children should only be immunized against serious diseases.	62.7	1.21	0.83–1.78	1.03	0.69–1.53
Children get more immunizations than are good for them.	14.0	1.88†	1.18–2.98	1.56	0.94–2.58
I am concerned that children's immune systems could be weakened by too many immunizations.	19.0	1.67	1.11–2.52	1.51	1.00–2.28
I am more likely to trust immunizations that have been around a while.	69.5	1.29	0.88–1.90	1.17	0.77–1.78
Immunizations are one of the safest forms of medicine ever developed.	59.0	0.81	0.55–1.18	0.91	0.62–1.34
Immunizations are getting better and safer all of the time as a result of medical research.	68.9	0.91	0.61–1.37	0.94	0.62–1.42
Vaccines strengthen the immune system.	55.3	0.59	0.41–0.84	0.66	0.46–0.94
Parents should be allowed to send their children to school even if not vaccinated.	29.6	2.70	1.93–3.78	1.75	1.22–2.52
I am opposed to immunization requirements, because they go against freedom of choice.	5.5	2.07	0.92–4.70	1.80	0.61–5.31
I am opposed to immunization requirements, because parents know what is best for their children.	2.1	1.47	0.34–6.35	0.50	0.12–2.11
Immunization requirements protect children from getting diseases from unimmunized children.	85.2	0.67	0.38–1.17	0.53	0.37–0.77

ORs shown in bold type indicate a *P* value < .05.

* Logistic regression adjusting for the clustering of children in schools, type of school (public versus private), and state.

† Interpretation of OR: a child who attends a school with key personnel who agree or strongly agree with this statement are ~88% more likely to be exempt, adjusting for the clustering of children in schools, type of school, and state.

Greater perceived disease susceptibility and severity and vaccine efficacy and safety were associated with a decreased likelihood of a child having an exemption, adjusting for confounders (Table 2). Children who attended schools in which the respondent had a higher general construct score for vaccine safety were less likely to have an exemption than children who attended schools in which the respondent had a lower general construct score for vaccine safety, adjusting for confounders. Other mean constructs were not statistically significant.

The majority of respondents reported that children should be immunized against serious diseases only (62.7%), but only 24.9% of respondents perceived varicella as serious. Key vaccine beliefs varied between nurses and nonnurses (Table 3). Nurses were more likely than nonnurses to hold beliefs that recognize the utility and safety of vaccination. The frequency of respondents who agreed or strongly agreed with these beliefs and associations with a child having an exemption are summarized in Table 4.

Most respondents had confidence in state health departments (91.4%), the CDC (93.9%), local health departments (88.8%), health care providers (88.5%), the FDA (73.6%), and the health care system (65.2%). Fewer respondents had confidence in the media (17.4%). A child attending a school with a respondent who had a great deal of confidence in local and state health departments was less likely to have an exemption (OR: 0.47 and 0.44; 95% CI: 0.27–0.80 and 0.25–0.80, respectively) than a child attending a school

with a respondent who did not have a great deal of confidence in local and state health departments, adjusting for confounders. Confidence in other groups was not associated with the likelihood of a child having an exemption.

Nearly half (45.5%) of the respondents had used, or their immediate family members (spouse/partner or children) had used, alternative medicine in the last 5 years. A child attending a school with a respondent who had used the following types of alternative medicine was more likely to have an exemption than a child attending a school with a respondent who had not used this type of alternative medicine practitioner: any alternative medicine practitioner (OR: 1.58; 95% CI: 1.11–2.23), chiropractor (OR: 1.44; 95% CI: 1.01–2.04), imagery or energy healing (OR: 2.44; 95% CI: 1.21–4.90), spiritual healing (OR: 2.73; 95% CI: 1.16–6.47), high-dose megavitamins (OR: 2.31; 95% CI: 1.39–3.85), or other alternative medicine practitioners (OR: 2.47; 95% CI: 1.75–3.48), adjusting for confounders.

There were significant associations between sources used and perception of reliability for vaccine information with the likelihood of a child having an exemption (Table 5). Use of professional organizations, government resources, vaccine companies, and pharmacists for vaccine information were associated with a decreased likelihood of a child having an exemption. Perceiving health departments and the CDC as good or excellent sources for vaccine information was also associated with a decreased likelihood of a child having an exemption.

TABLE 5. Adjusted OR of a Child Having an Exemption by Respondent Utilization and Credibility of Sources for Vaccine Information

Source	Percent	Used in Past OR of Child Having an Exemption*	95% CI	Percent	Rated Good or Excellent Source OR of Child Having an Exemption*	95% CI
Health care providers' advice	76.5	0.99	0.58–1.68	100.0		
Printed materials from health care providers (vaccine information statements)	81.6	0.84	0.46–1.52	91.0	0.65	0.30–1.41
Professional organizations such as doctors/nurses' associations	47.6	0.57†	0.41–0.81	77.5	0.82	0.50–1.37
Alternative health care providers such as chiropractors or acupuncturists	7.9	1.72	1.00–2.95	14.3	1.65	0.98–2.78
Parents/friends	30.1	1.36	0.95–1.96	14.2	1.90	1.13–3.20
Religious leaders and organizations	1.5	1.38	0.67–2.83	2.2	0.69	0.35–1.33
Media (television, radio, newspapers, books, magazines, etc)	44.9	0.99	0.68–1.47	27.9	0.97	0.61–1.52
Local or state health department	86.7	0.56	0.34–0.93	96.2	0.34	0.19–0.60
CDC and the National Immunization Program	58.1	0.59	0.42–0.83	94.1	0.50	0.25–1.00
FDA	14.5	0.92	0.64–1.31	59.5	1.12	0.76–1.64
Vaccine companies	22.7	0.52	0.35–0.77	43.1	1.03	0.71–1.49
Pharmacists	16.7	0.52	0.35–0.77	63.0	0.94	0.63–1.40
Internet	23.8	1.12	0.76–1.66	35.5	1.03	0.68–1.59
Institute of Medicine	1.7	2.22	1.07–4.63	41.9	1.10	0.73–1.64
National Vaccine Information Center	9.1	1.02	0.62–1.70	65.8	0.79	0.53–1.18

ORs shown in bold type indicate a *P* value < .05.

* Adjusting for clustering of child in schools, type of school (public versus private), and state.

† Interpretation of OR: a child who attends a school with key personnel who have used professional organizations as a source for information about vaccines is ~43% less likely to be exempt, adjusting for the clustering of children in schools, type of school, and state.

DISCUSSION

The KABs of school personnel who work with parents on immunization issues were associated with the likelihood of a child having an exemption. Although respondents generally supported vaccination, misconceptions were common, consistent with findings of Gellin et al,⁸ who used the same questions in the general population. For example, 14.0% of the respondents were concerned that children get more immunizations than are good for them, and 19.0% of respondents were concerned that the immune system could be weakened by too many vaccines, a belief that was associated with an increased likelihood of a child having an exemption. Additionally, many school personnel seem to be unaware of the seriousness of some VPDs and that unimmunized children are highly susceptible to diseases. These misperceptions also were associated with the likelihood of a child having an exemption but were less common among nurses than nonnurses.

The KABs of school personnel could influence parents to choose exemptions for their children or a high proportion of parents requesting exemptions, and sharing their concerns about vaccines could affect school personnel KABs. Also, school personnel with negative KABs about immunizations could selectively live in communities in which the parents have such beliefs; school personnel tend to be representative of the communities in which they live. These personnel characteristics and the likelihood of a child

having an exemption could be associated because of some other factor (confounder). There is also the potential for selection bias in the survey, because ~30% of eligible respondents did not respond. We did not identify any characteristics of schools without a respondent to suggest such a bias. The inability to get the survey to some volunteers responsible for immunization compliance also may have introduced bias, because volunteers (or their schools) may differ from employees who could be surveyed.

This study of associations cannot determine causal associations. Nonetheless, the frequency of vaccine misconceptions among school personnel warrants vaccine communication programs for school employees who work with parents on immunization issues. An intervention study could determine whether such programs have an impact on parental decisions to claim exemptions for their children.

The use of personnel without formal health care training to work with parents on immunization issues is concerning because of the many misconceptions that could be transmitted to parents. What sort of vaccine discussions is a bus driver having with parents? We found nurses to have stronger beliefs in the utility and safety of vaccines and that such beliefs correlated with lower exemption rates. Thus, it may be preferable for nurses or properly trained health personnel to be the main people at schools to advise parents on immunization issues, although this may become increasingly difficult as states face budget deficits.

Health departments and health care providers are used most often by school personnel for vaccine information. Providers, professional organizations, health departments, and the CDC were considered most credible. The CDC may be an underutilized source, given its high credibility and the fact that >40% of respondents had not used the CDC for vaccine information. Respondents may not have been aware that the CDC writes the vaccine information statements that are provided to parents at the time of immunization. Greater visibility of the CDC on vaccine information statements and communication efforts from the CDC directly to school personnel will likely be well received. Respondents who do not consider health departments and the CDC as credible sources were associated with a greater likelihood of a child in their school having an exemption. The CDC may need to consider working with other reliable sources to communicate with these personnel. Our findings that the use of vaccine information from the Institute of Medicine was associated with the highest exemption OR among all information sources should be interpreted with caution. It may be that school personnel in high-exemption-rate schools had more doubts about vaccine safety and hence were more likely to dig deeper into literature that focuses on possible causal association between vaccines and adverse events and thereby came across IOM reports.

Studies are needed to understand why some parents choose to forgo vaccination for children who do not have true contraindications to vaccines. School personnel trained in vaccine safety may serve as a valuable source of vaccine information for parents. Parents who have misconceptions about vaccines would likely benefit from discussion with health care providers. Additional public-information campaigns regarding misconceptions and the value of vaccination may be needed.¹⁷

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