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Vaccine knowledge and practices of primary care providers of exempt vs. vaccinated children

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Abstract

Objectives: Compare vaccine knowledge, attitudes and practices of primary care providers for fully vaccinated children and children who are exempt from school immunization requirements.

Methods: We conducted a mailed survey of parent-identified primary care providers from four states to measure perceived risks and benefits of vaccination and other key immunization beliefs. Frequencies of responses were stratified by type of provider, identified by exempt versus vaccinated children. Logistic regression was used to calculate odds ratios for responses by provider type.

Results: 551 surveys were completed (84.3% response rate). Providers for exempt children had similar attitudes to providers for non-exempt children. However, there were statistically significant increased concerns among providers for exempt children regarding vaccine safety and lack of perceived individual and community benefits for vaccines compared to other providers.

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Conclusions: The great majority of providers for exempt children had similar attitudes about vaccine safety, effectiveness and benefits as providers of non-exempt children. Although providers for exempt children were more likely to believe that multiple vaccines weaken a child’s immune system and were concerned about vaccine safety and less likely to consider vaccines were beneficial, a substantial proportion of providers of both exempt and vaccinated children have concerns about vaccine safety and believe that CDC underestimates the frequency of vaccine side effects. Effective continuing education of providers about the risks and benefits of immunization and including in vaccine recommendations more information on pre and post licensing vaccine safety evaluations may help address these concerns.

Keywords
vaccines; primary care providers; parents; exemptions; school immunizations

Introduction
Immunizations have been remarkably successful in preventing disease.\textsuperscript{1,2} Yet the success of immunization programs has created a paradox. When diseases are prevalent, the public has a fear of disease and seeks prevention through immunization. When high levels of immunization coverage are sustained, disease is reduced and public attention shifts to concerns about vaccine safety rather than fear of the diseases. When concerns about vaccine safety become widespread, a loss in public confidence in vaccines\textsuperscript{3} can result in a resurgence of disease.\textsuperscript{4}

Most parents follow the advice of their primary health care providers (PHCP) and comply with state school immunization requirements by fully vaccinating their children before school entrance.\textsuperscript{5,6} State laws requiring vaccination for school entry have contributed to the success of the U.S. childhood immunization programs.\textsuperscript{7} Most states offer non-medical exemptions to school immunization requirements. The rates of parents refusing vaccines by claiming non-medical exemptions have been increasing in states that make exemptions easily available to parents.\textsuperscript{8} Vaccine safety concerns were identified as the primary reason for vaccine refusal in a recent Indiana measles outbreak.\textsuperscript{9}

We conducted a case-control study to determine why some parents refused vaccines by claiming non-medical exemptions. We surveyed parents of exempt (case) and vaccinated (control) elementary school children recruited from 112 private and public schools in Colorado, Massachusetts, Missouri and Washington.\textsuperscript{10} The primary reason parents did not vaccinate their children was concern that vaccines might cause harm (68.6%) or overload the immune system (49.1%). Compared with parents of vaccinated children, parents of exempt children were more likely to report low perceived vaccine safety and efficacy, disease susceptibility and severity, and trust in health care providers and government. Parents of vaccinated children were more likely to report that their child’s PHCP were physicians (93.9% vs. 75.8%, respectively); parents of exempt children were more likely to report that their child’s PHCP were nurse practitioners (7.4% vs. 2.7%, respectively) or complementary or alternative medicine (CAM) providers (11.5% vs. 0.3% respectively).
PHCPs greatly influence parents’ immunization decisions. PHCP perceptions of vaccine efficacy and safety, missed opportunities to vaccinate, recognition of professional organization recommendations, and clinic characteristics have been associated with parental decisions to vaccinate. In our study of exempt and vaccinated children, more than 90% of parents reported receiving vaccine information from their child’s PHCP. The majority of vaccinated (89.5%) and exempt (63.9%) parents reported their child’s PHCP was a good or excellent source for vaccine information. Yet, the role of PHCP in impacting parents who refuse vaccines has not been explored.

The aim of our study was to compare vaccine knowledge, attitudes and practices of PHCP for children who are exempt from school immunization requirements with PHCP for fully vaccinated children.

Results

Of the 712 surveys mailed, 44 were returned without reaching the provider (26 practices closed, five deceased providers, 13 providers retired). Of the remaining 668 providers, 14 were not PHCPs. Of the remaining 654 providers, 103 declined to complete a survey or were lost to follow-up. Overall, 551 surveys were completed for an 84.3% response rate among eligible providers who received a survey. Surveys were completed by 55 providers of exempt children (provider identified by parent of one or more exempt child and no vaccinated children), 64 mixed providers (provider identified by parent of one or more exempt child and one or more vaccinated child), and 432 providers of vaccinated children (provider identified by parent of one or more vaccinated child and no exempt children). Of the 551 providers who completed surveys, 389 providers were identified by one parent, 88 providers were identified by two parents, and 74 providers were identified by three or more parents.

Providers for vaccinated children were more likely to have an MD (87.9% vs. 74.1%, p = 0.01) and less likely to be DOs (13.0% vs. 5.3%, p < 0.01) than providers of exempt children. There was no significant difference in the proportion of providers of exempt and vaccinated children who were nurse practitioners (5.6% vs. 2.1%) or naturopathic doctors (5.6% vs. 1.6%); however, the low number of providers holding these degrees limited the power to detect a difference. The majority of providers of exempt and vaccinated children were pediatricians (53.7% and 62.8%, p = 0.03), followed by family medicine (44.4% and 33.3%, p = 0.01), and internal medicine (7.4% and 1.9%, p = 0.07). The majority of providers of exempt (50.0%) and vaccinated (58.8%) children were in a group practice (p-value = 0.44). Other office settings (not mutually exclusive) among providers of exempt and vaccinated children included private practices (33.3% and 32.6%, p = 0.44), two-physician practices (9.3% and 6.3%, p = 0.04), HMOs (3.7% and 7.0%, p = 0.28) and other (community health clinic, medical school clinic, etc.).

Providers of exempt children estimated that a lower proportion of their patients aged 5–12 years were fully vaccinated based on ACIP/AAP guidelines: 87% of providers of vaccinated children reported at least 75% of their patients were fully vaccinated compared to 73% of providers of exempt children. The vast majority (98.1%) of providers of exempt and vaccinated children reported having a parent refuse a vaccine. Providers of exempt and vaccinated children estimated that a lower proportion of their patients aged 5–12 years were fully vaccinated based on ACIP/AAP guidelines: 87% of providers of vaccinated children reported at least 75% of their patients were fully vaccinated compared to 73% of providers of exempt children. The vast majority (98.1%) of providers of exempt and vaccinated children reported having a parent refuse a vaccine. Providers of exempt and
vaccinated children reported that 22.8% and 18.4%, respectively, of parents initiated questions about risks of adverse events following vaccination (p = 0.18). Providers of exempt and vaccinated children took the following actions when a parent refused a vaccine (not mutually exclusive): noted refusal (71.2% and 78.3%, p = 0.68), provided additional information about the vaccine (73.1% and 78.1%, p = 0.07), required signature/informed refusal document (28.8% and 38.5%, p = 0.12), offered waiver for school laws (9.6% and 5.4% p = 0.25) and refused to care for the child (7.7% and 9.2%, p = 0.12). The majority of providers of exempt and vaccinated children reported giving parents VIS prior to any immunization (64.0% and 71.4%, p = 0.07).

Concerns about the safety of vaccines was the most common reason providers of exempt and vaccinated children reported as to why some of their patients’ parents had refused vaccines (86.3% and 75.7%, p = 0.27). Other reasons that providers of exempt and vaccinated children reported included not believing in vaccines (17.6% and 21.4%, p = 0.21), alternative belief systems (13.7% and 22.4%, p = 0.11), religious reasons (11.8% and 9.3%, p = 0.93), and lack of concern about the diseases (7.8% and 7.6%, p = 0.28). A notable proportion of providers of exempt and vaccinated children reported that they would write a medical exemption so that a child could enter school if the parent did not want to vaccinate his/her child even if the child did not have a valid medical contraindication as defined by ACIP, AAP or AAFP (24.5% and 14.6%, p = 0.40).

Providers of exempt children were slightly less likely to begin to administer the vaccine series when it is recommended by ACIP (47.1% vs. 53.3%, p = 0.01) or by AAP/AAFP (78.4% vs. 81.7%, p = 0.01) and were slightly more likely than providers of vaccinated children to wait until the vaccine has been in universal use for one year (17.6% vs. 14.3%, p = 0.03). A noticeable proportion of providers of exempt and vaccinated children reported that they would wait until the vaccine becomes a day care or school entry requirement (13.7% and 15.6%, p = 0.24).

The majority of providers of exempt and vaccinated children reported that the child and community benefit a moderate amount when a child is fully vaccinated (Table 1). Providers of exempt children were less likely than providers of vaccinated children to report that the child, community, PHCPs, health insurance companies, and state and federal government benefit a moderate amount or great deal when a child is fully vaccinated (Table 1).

Providers of exempt children were less likely than providers of vaccinated children to report high confidence in vaccine safety (Table 2). Providers of exempt children tended to have more concerns about vaccine safety and vaccine benefits (Table 3). For example, 6.2% of providers for vaccinated children believed children get more immunizations than are good for them compared to 13.0% of providers of exempt children. Many of the beliefs that differed among providers of exempt and vaccinated children related to perceptions or beliefs regarding vaccine safety (Table 3).

Some concerns about vaccine safety were prevalent among both groups of providers. For example, 19.2% of providers of exempt children and 9.2% of providers of vaccinated children reported concern that the CDC/ACIP underestimates the frequency of vaccine side
effects. Similarly, 13.0% of providers of exempt children and 5.6% of providers of vaccinated children reported that they cared for a child that had autism that they believe may have been caused by vaccines (p = 0.04). When asked if they would vaccinate a 15-month-old child who was due the following vaccines according to the immunization schedule at that visit (MMR, DTaP, Hib, PCV, varicella, hepatitis B and influenza), a substantial proportion of providers of both exempt and vaccinated children reported that they would not administer all of these vaccines at that visit because: there is an increased risk of adverse events with higher numbers of vaccines (20.0% exempt and 12.8% vaccinated; p < 0.01) or they would not want to overload the child’s immune system (16.0% exempt and 10.0% vaccinated; p = 0.12).

PHCPs with DO degrees perceived vaccine-preventable diseases to be more serious than PHCPs with MD degrees (36.8% vs. 20.7% serious or very serious; p = 0.02). PHCPs with DO degrees showed significantly less confidence in vaccine safety compared to PHCPs with MD degrees in all other constructs that were statistically significant. For example, DOs were less likely than MDs to have a high confidence in vaccine safety (76.3% vs. 88.4%; p = 0.03). PHCPs with DO degrees were more likely than PHCPs with MD degrees to agree or strongly agree with the following statements: children get more immunizations than are good for them (13.9% vs. 5.6%; p = 0.05); immunizations do more harm than good (8.1% vs. 1.7%; p = 0.02); many of the reports of serious side effects from vaccines are accurate (24.3% vs. 8.0%; p < 0.01); and the CDC/ACIP underestimate the frequency of vaccine side effects (23.5% vs. 7.4%; p < 0.01). PHCPs with DO degrees were less likely than PHCPs with MD degrees to agree or strongly agree with the following statements: immunizations are one of the safest forms of medicine ever developed (67.6% vs. 85.2%; p < 0.01) and immunizations are getting better and safer all of the time as a result of medical research (75.8% vs. 92.3%; p < 0.01).

Discussion

The results of our study indicate that most PHCPs identified by exempt children have similar attitudes concerning vaccines as PHCPs of non-exempt children. However, there were significant differences in opinion for a minority of PHCPs in both groups. Overall, safety as shown in Table 2 was very similar between the two groups, 88.9% versus 93.9% reporting high vaccine safety. The most striking difference between PHCPs of exempt and vaccinated children related to key safety immunization beliefs (Table 3). These findings suggest that the knowledge, attitudes and practices of PHCPs may have an important contributing effect on parental decisions to accept or forgo vaccination.

Due to the cross-sectional nature of this study we could not assess a temporal relationship and therefore we are not able to establish causal relationships. While PHCPs may be directly influencing parental decision making, parents could be selecting PHCPs who share their vaccine attitudes and beliefs. Some parents who have vaccine concerns and had poor experiences with their child’s PHCPs may have sought an alternative provider who was more open to their concerns. Similarly, 9.2% of PHCPs of exempt children reported that they would refuse to care for a child whose parents did not plan on vaccinating that child. In such situations, these PHCPs may have been responsible for the care of the child until the time of
parental vaccine refusal and then the parent found a different PHCP. Previous studies have found that 39% of pediatricians would dismiss a family who refused all vaccines and 28% of pediatricians would dismiss a family for refusing some vaccines.\textsuperscript{36}

While many of the differences in attitudes, beliefs and practices were statistically different between PHCPs of exempt and vaccinated children, the absolute difference was often relatively modest. For example, 92.6% of PHCPs of exempt children reported a moderate or great deal of benefit from vaccines compared to 98.4% of PHCPs of vaccinated children. In regression analysis, a highly significant odds ratio was 0.30. Nonetheless, the vast majority of PHCPs in both groups believed there was at least a moderate benefit from vaccines. Similarly, 16.7% of PHCPs of exempt children and 4.2% of PHCPs of vaccinated children reported concern that a child’s immune system could be weakened by too many immunizations. The importance of the prevalence of these beliefs goes beyond the odds ratio and interpretation of our results must consider absolute risk as well as risk ratios.\textsuperscript{35}

There was the potential for selection bias if responders differed from non-responders in terms of immunization knowledge, attitudes and practices and the type of child (exempt vs. vaccinated) they cared for. Our high response rate should have minimized potential selection bias.

Differences in provider knowledge, attitudes and practices were observed between DOs and MDs. Our study was not designed to analyze the difference by provider training. Nevertheless, the statistically significant differences found in our study deserve further exploration through study designs intended to assess differences in provider training and vaccine attitudes and practices. We were not able to explore differences between MDs and CAM providers because of a lack of adequate number of the latter group. Vaccine knowledge, attitudes and practices among CAM providers deserve further study.

Even among providers identified by vaccinated children, many concerns about vaccine safety, concerns about the scientific credibility of CDC, and misconceptions about the capacity of the immune system were prevalent. For example, 10% of providers of vaccinated children reported that they believed that CDC/ACIP underestimate the risks of vaccines, and nearly 6% believed that they have cared for a child with autism as a result of vaccination. These findings strongly suggest there is an urgent need for studies to explore the origin of these concerns and find effective ways to address them. Consideration needs to be given to such options as expanding the information on pre and post licensing vaccine safety evaluations in ACIP and AAP recommendations; having investigators not funded by pharmaceutical companies conduct vaccine safety studies; having vaccine safety issues reviewed by independent groups and/or agencies; improving provider education about immunization and vaccine safety during professional schooling, clinical training, and continuing professional education; training for clinicians on risk communication, ongoing assessment of both the public’s and provider’s vaccine safety concerns coupled with risk communication messages targeting both these groups from sources each perceives as credible; and additional studies and review articles that address the vaccine safety concerns of health care providers.

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Methods

In a previous case-control study to determine the reasons behind vaccine refusal, we asked parents to provide the names and addresses of up to 3 PHCP for their child at 2 and 5–6 years of age. In 2005, we mailed a survey to these PHCP. Children were considered fully vaccinated if they had received all vaccines required for school entry. Children were considered exempt if they had claimed an exemption for one or more vaccines. Parents of 391 exempt children and 976 vaccinated children supplied some contact information for PHCPs. Parents named 806 different providers. Some “mixed” providers were identified by parents of vaccinated and exempt children. Provider contact information was verified using online sources including the AMA Physician Directory. Contact information for 94 (8%) providers was unverifiable. A survey was mailed to 712 PHCPs via Federal Express including a cover letter, the survey instrument, a postage-paid return envelope, and a $20 cash incentive. Follow-up included two letters, re-mailing the survey, and a phone call. This study was approved by the Committees on Human Research at Johns Hopkins University.

Survey instrument

Respondents were asked their most advanced clinical degrees, their type of clinical practice and setting, and payment method by estimated proportion of patients. Respondents were asked to estimate the proportion of their patients aged 5–12 years who were fully vaccinated by ACIP/AAP guidelines. Respondents were asked if they have had a parent refuse vaccines; what proportion of parents initiate questions about the risks of adverse events following vaccination; if they give parents Vaccine Information Statements (VIS) prior to any immunization; and what action(s) they take when a parent refuses a vaccine. Respondents were asked what they consider the most important reason parents have refused some vaccines; and whether they would write a medical exemption for a parent who did not want to vaccinate his/her child but did not have a valid medical contraindication as defined by ACIP, AAP or AAFP.

Respondents were asked when they would be likely to regularly use a new vaccine recommended for universal use in infancy, assuming adequate supply and coverage by insurance or the Vaccines for Children program. Respondents were asked if they would vaccinate a 15 month old child in one visit who was due for the following recommended vaccines: MMR, DTaP, Hib, PCV, varicella, hepatitis B, influenza.

PHCPs were asked to use a five point Likert scale to identify who benefits from vaccination (“not at all” to “a great deal”); to estimate the probability that an unimmunized preschooler would contract an associated vaccine-preventable disease during a ten year period (“impossible” to “very likely”); how serious it would be for an 8-year-old to develop one of these diseases (“not at all serious” to “very serious”); how effective 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 to indicate their agreement/disagreement to a series of questions relating to “key immunization beliefs” on a five point Likert scale (“strongly disagree” to “strongly agree”).
Data analysis

Frequencies for specific responses were calculated, stratified by type of provider (exempt, mixed and vaccinated). To explore differences between providers of exempt and vaccinated children, we estimated logistic regression models using a Generalized Estimating Equations framework (GEE-logistic).\textsuperscript{34} Odds ratios are the odds of a positive answer by a provider identified by an exempt child compared with a positive answer identified by a provider of a vaccinated child. A binomial framework allows for mixed providers to contribute to the odds ratio calculation, weighted by the probability that the provider was identified by an exempt child.

General constructs for respondents’ assessments of disease susceptibility and severity, and vaccine efficacy and safety were created using the respondent’s mean Likert scores for all antigens/diseases with a final score ranging from 1.0–5.0. Construct scores were then dichotomized by 1.0–3.99 versus 4.0–5.0. Responses to “key immunization beliefs” were dichotomized by 1–3 (strongly disagree, disagree, and neither agree nor disagree) vs. 4 and 5 (agree and strongly agree) on the 5 point Likert scale.

Differences in attitudes and beliefs between PHCP with DO degrees versus MD degrees were explored by running frequencies of specific responses stratified by type of provider. Differences were considered statistically significant based on the p-value obtained using logistic regression with the attitude or belief variable as the outcome variable and whether the provider had a MD or DO degree as the independent variable. Differences between other types of providers (i.e., MD vs. naturopathic physician or doctor of chiropractic) were not explored as there were insufficient numbers of participants with other degrees for meaningful analysis. Throughout all analyses, p values ≤0.05 were considered statistically significant.

Acknowledgements

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Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHCP</td>
<td>primary health care provider</td>
</tr>
<tr>
<td>CAM</td>
<td>complementary or alternative medicine</td>
</tr>
<tr>
<td>VIS</td>
<td>vaccine information statement</td>
</tr>
</tbody>
</table>

References


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### Table 1

Proportion of health care providers reporting moderate amount or great deal of benefit when a child is fully vaccinated, by provider type and associations between provider and parental responses

<table>
<thead>
<tr>
<th>Who benefits when children receive all of the recommended vaccines</th>
<th>Healthcare providers reporting moderate amount or great deal of benefit</th>
<th>% Exempt&lt;sup&gt;a&lt;/sup&gt;&lt;br&gt;n = 55</th>
<th>% Mixed&lt;sup&gt;b&lt;/sup&gt;&lt;br&gt;n = 64</th>
<th>% Vaccinated&lt;sup&gt;c&lt;/sup&gt;&lt;br&gt;n = 432</th>
<th>Odds ratio&lt;sup&gt;d&lt;/sup&gt;</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child</td>
<td></td>
<td>92.6</td>
<td>98.4</td>
<td>98.4</td>
<td>0.30&lt;sup&gt;e&lt;/sup&gt;</td>
<td>0.10–0.85</td>
</tr>
<tr>
<td>Community</td>
<td></td>
<td>94.4</td>
<td>98.4</td>
<td>98.8</td>
<td>0.28</td>
<td>0.09–0.88</td>
</tr>
<tr>
<td>Primary care practitioner</td>
<td></td>
<td>64.2</td>
<td>51.6</td>
<td>68.2</td>
<td>0.59</td>
<td>0.39–0.90</td>
</tr>
<tr>
<td>Health insurance company</td>
<td></td>
<td>82.4</td>
<td>79.0</td>
<td>87.5</td>
<td>0.56</td>
<td>0.32–0.99</td>
</tr>
<tr>
<td>State and federal government</td>
<td></td>
<td>73.5</td>
<td>79.3</td>
<td>85.3</td>
<td>0.55</td>
<td>0.32–0.96</td>
</tr>
<tr>
<td>Vaccine companies</td>
<td></td>
<td>89.4</td>
<td>79.3</td>
<td>89.7</td>
<td>0.57</td>
<td>0.30–1.10</td>
</tr>
</tbody>
</table>

95% CI: 95% Confidence interval; Odds ratios in bold have p values <0.05;  
<sup>a</sup>Provider identified only by parents of exempt (unimmunized) children  
<sup>b</sup>Providers identified by parents of exempt (unimmunized) and vaccinated children  
<sup>c</sup>Provider identified only by parents of vaccinated children  
<sup>d</sup>Model results are based on binomial regression analysis accounting for within practice clustering of parents in a GEE framework. Odds ratios include providers identified by both exempt and vaccinated parents in addition to providers only identified by either group  
<sup>e</sup>Interpretation of Odds ratio = Health care providers identified by exempt children had 0.30 lower odds of reporting a child benefits a moderate amount or great deal when fully vaccinated compared with health care providers identified by vaccinated children.
Table 2
Proportion of health care providers with High perceived susceptibility and severity of disease and efficacy and safety of vaccines, by provider type, and associations between provider and parental responses

<table>
<thead>
<tr>
<th>Constructs</th>
<th>% Exempt&lt;sup&gt;a&lt;/sup&gt;</th>
<th>% Mixed&lt;sup&gt;b&lt;/sup&gt;</th>
<th>% Vaccinated&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Odds ratio&lt;sup&gt;d&lt;/sup&gt;</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease susceptibility&lt;sup&gt;e&lt;/sup&gt;</td>
<td>11.3</td>
<td>4.7</td>
<td>5.7</td>
<td>1.39</td>
<td>0.68–2.85</td>
</tr>
<tr>
<td>Disease severity&lt;sup&gt;e&lt;/sup&gt;</td>
<td>30.2</td>
<td>23.8</td>
<td>29.4</td>
<td>0.90</td>
<td>0.59–1.38</td>
</tr>
<tr>
<td>Vaccine efficacy&lt;sup&gt;f&lt;/sup&gt;</td>
<td>87.0</td>
<td>96.8</td>
<td>88.8</td>
<td>1.37</td>
<td>0.65–2.86</td>
</tr>
<tr>
<td>Vaccine safety&lt;sup&gt;f&lt;/sup&gt;</td>
<td>88.9</td>
<td>85.9</td>
<td>93.9</td>
<td>0.37</td>
<td>0.19–0.72&lt;sup&gt;g&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

95% CI: 95% Confidence interval; Odds ratios in bold have p values ≤0.05

<sup>a</sup>Provider identified only by parents of exempt (unimmunized) children

<sup>b</sup>Providers identified by parents of exempt (unimmunized) and vaccinated children

<sup>c</sup>Provider identified only by parents of vaccinated children

<sup>d</sup>Model results are based on binomial regression analysis accounting for within practice clustering of parents in a GEE framework. Odds ratios include providers identified by both exempt and vaccinated parents in addition to providers only identified by either group

<sup>e</sup>Mean of 12 diseases ranging from 1.0–5.0, dichotomized by 1 to <4 and ≥4

<sup>f</sup>Mean of 9 vaccines for 12 diseases ranging from 1.0–5.0, dichotomized by 1 to <4 and ≥4

<sup>g</sup>Interpretation of odds ratio = health care providers identified by exempt children had 0.37 lower odds of reporting high perceived vaccine safety compared with health care providers identified by vaccinated children.
Table 3
Proportion of health care providers agreeing or strongly agreeing to key immunization beliefs, by provider type and associations between provider and parental responses

<table>
<thead>
<tr>
<th>Health care providers agreeing or strongly agreeing with statement</th>
<th>% Exempt&lt;sup&gt;a&lt;/sup&gt; n = 55</th>
<th>% Mixed&lt;sup&gt;b&lt;/sup&gt; n = 64</th>
<th>% Vaccinated&lt;sup&gt;c&lt;/sup&gt; n = 432</th>
<th>Odds ratio&lt;sup&gt;d&lt;/sup&gt;</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children should only be immunized against serious diseases</td>
<td>39.6</td>
<td>57.8</td>
<td>43.2</td>
<td>1.25</td>
<td>0.91–2.01</td>
</tr>
<tr>
<td>Children get more immunizations than are good for them</td>
<td>13.0</td>
<td>15.9</td>
<td>6.2</td>
<td><strong>2.28</strong>&lt;sup&gt;e&lt;/sup&gt;</td>
<td>1.56–5.10</td>
</tr>
<tr>
<td>A good diet is more important than immunization in preventing infectious diseases</td>
<td>11.1</td>
<td>4.7</td>
<td>3.8</td>
<td><strong>3.68</strong></td>
<td>1.61–8.38</td>
</tr>
<tr>
<td>I am concerned a child’s immune system could be weakened by too many immunizations</td>
<td>16.7</td>
<td>7.8</td>
<td>4.2</td>
<td><strong>4.03</strong></td>
<td>2.06–7.86</td>
</tr>
<tr>
<td>I am more likely to trust immunizations that have been around for a while</td>
<td>74.1</td>
<td>78.1</td>
<td>67.4</td>
<td>1.42</td>
<td>0.92–2.19</td>
</tr>
<tr>
<td>Immunizations are one of the safest forms of medicine ever developed</td>
<td>76.9</td>
<td>76.2</td>
<td>82.2</td>
<td>0.75</td>
<td>0.48–1.18</td>
</tr>
<tr>
<td>Immunizations are getting better and safer all of the time as a result of medical research</td>
<td>76.9</td>
<td>90.3</td>
<td>90.3</td>
<td><strong>0.47</strong></td>
<td>0.27–0.82</td>
</tr>
<tr>
<td>Vaccines strengthen the immune system</td>
<td>64.7</td>
<td>58.7</td>
<td>69.4</td>
<td><strong>0.55</strong></td>
<td>0.36–0.85</td>
</tr>
<tr>
<td>For the overall health of a child, it is better for them to develop immunity by getting sick than to get a vaccine</td>
<td>15.1</td>
<td>4.8</td>
<td>4.0</td>
<td><strong>4.08</strong></td>
<td>1.90–8.76</td>
</tr>
<tr>
<td>Healthy children do not need immunization</td>
<td>1.9</td>
<td>3.2</td>
<td>3.5</td>
<td>0.66</td>
<td>0.24–1.76</td>
</tr>
<tr>
<td>Immunizations do more harm than good</td>
<td>3.8</td>
<td>0.0</td>
<td>4.2</td>
<td>0.47</td>
<td>0.11–2.08</td>
</tr>
<tr>
<td>I am opposed to school immunization requirements because they go against freedom of choice</td>
<td>9.4</td>
<td>9.5</td>
<td>5.2</td>
<td>1.88</td>
<td>0.83–4.23</td>
</tr>
<tr>
<td>I am opposed to school immunization requirements because parents know what is best for their children</td>
<td>0.0</td>
<td>4.8</td>
<td>2.4</td>
<td>1.60</td>
<td>0.46–5.62</td>
</tr>
<tr>
<td>School immunization requirements protect children against getting diseases from unimmunized children</td>
<td>84.9</td>
<td>85.7</td>
<td>88.7</td>
<td>0.73</td>
<td>0.43–1.22</td>
</tr>
<tr>
<td>Parents should be allowed to send their children to school even if their child is not vaccinated</td>
<td>50.9</td>
<td>39.3</td>
<td>35.5</td>
<td><strong>1.72</strong></td>
<td>1.13–2.60</td>
</tr>
<tr>
<td>Breastfeeding protects children against vaccine preventable diseases, such as polo, better than vaccination</td>
<td>7.8</td>
<td>0.0</td>
<td>1.9</td>
<td>2.14</td>
<td>0.60–7.65</td>
</tr>
<tr>
<td>I worry that many of the reports of serious side effects from vaccines are accurate</td>
<td>15.4</td>
<td>14.3</td>
<td>11.1</td>
<td><strong>2.03</strong></td>
<td>1.05–3.91</td>
</tr>
<tr>
<td>I am concerned the CDC/ACIP underestimates the frequency of vaccine side effects</td>
<td>19.2</td>
<td>19.7</td>
<td>9.2</td>
<td><strong>2.86</strong></td>
<td>1.65–4.97</td>
</tr>
</tbody>
</table>

95% CI: 95% Confidence interval; Odds ratios in bold have p values ≤0.05

<sup>a</sup> Provider identified only by parents of exempt (unimmunized) children

<sup>b</sup> Providers identified by parents of exempt (unimmunized) and vaccinated children

<sup>c</sup> Provider identified only by parents of vaccinated children

<sup>d</sup> Model results are based on binomial regression analysis accounting for within practice clustering of parents in a GEE framework. Odds ratios include providers identified by both exempt and vaccinated parents in addition to providers only identified by either group

<sup>e</sup> Interpretation of Odds ratio = health care providers identified by exempt children had 2.28 higher odds of agreeing or strongly agreeing that children get more immunizations than are good for them compared with health care providers identified by vaccinated children.