

SHORT REPORT



## School-level perceptions and enforcement of the elimination of nonmedical exemptions to vaccination in California

Taylor A. Holroyd<sup>a,b</sup>, Amanda C. Howa<sup>c</sup>, Tina M. Proveaux<sup>a,d</sup>, Paul L. Delamater<sup>e</sup>, Nicola P. Klein<sup>f</sup>, Alison M. Buttenheim<sup>g</sup>, Rupali J. Limaye<sup>a,b,d,h,i</sup>, Saad B. Omer<sup>j,k,l</sup>, and Daniel A. Salmon<sup>a,d,i</sup>

<sup>a</sup>Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA; <sup>b</sup>International Vaccine Access Center, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA; <sup>c</sup>Hubert Department of Global Health, Rollins School of Public Health, Emory University, Atlanta, GA, USA; <sup>d</sup>Institute for Vaccine Safety, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA; <sup>e</sup>Department of Geography and Carolina Population Center, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA; <sup>f</sup>Kaiser Permanente Vaccine Study Center, Kaiser Permanente Northern California Division of Research, Oakland, CA, USA; <sup>g</sup>Department of Family and Community Health, University of Pennsylvania School of Nursing, Philadelphia, PA, USA; <sup>h</sup>Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA; <sup>i</sup>Department of Health, Behavior & Society, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA; <sup>j</sup>Yale Institute for Global Health, Yale University, New Haven, CT, USA; <sup>k</sup>Department of Internal Medicine, Yale School of Medicine, New Haven, CT, USA; <sup>l</sup>Department of Epidemiology of Microbial Diseases, Yale School of Public Health, New Haven, CT, USA

### ABSTRACT

In 2015, California passed Senate Bill 277 eliminating all nonmedical exemptions to school vaccinations. We aimed to explore school-level modes of SB277 enforcement, characterize vaccination knowledge, attitudes, and beliefs of school officials, and identify whether school vaccination policies are associated with medical exemptions being granted. Surveys were mailed to a stratified random sample of 1,450 schools in California. School personnel ( $n = 752$ ) reported their medical training, vaccination beliefs, enforcement of vaccination policies, and school rates of medical exemptions. Multiple logistic regression was used to assess whether school policies are associated with the likelihood of medical exemption requests being granted. Nurses were more likely than non-nurses to hold beliefs recognizing the importance of vaccination. A school where the survey respondent was a nurse was more likely to have granted a medical exemption request compared to a school where the respondent was not a nurse (OR 2.11, 95% CI 1.34–3.36). The training of school officials and school-level practices may impact the enforcement of medical exemptions. Equipping school officials as competent sources of vaccine information for concerned parents will be valuable in improving parental vaccine uptake.

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Vaccines are a critical component of disease prevention and control strategies, but many parents have expressed concerns about vaccine safety and efficacy.<sup>1,2</sup> Increasing vaccine hesitancy and refusal have contributed to suboptimal vaccine coverage<sup>3–6</sup> and outbreaks of varicella,<sup>4</sup> measles,<sup>5</sup> and pertussis<sup>6,7</sup> in the United States. Vaccine-preventable disease outbreaks in the United States underscore a need to improve public understanding of vaccination in order to improve vaccine coverage.<sup>8</sup>

Contributing to outbreaks are clusters of unvaccinated children whose parents obtain exemptions to school vaccination requirements.<sup>5–7,9</sup> School vaccination requirements in the United States are legislated and implemented at the state level, not the federal level.<sup>10</sup> There is wide variability in the implementation and enforcement of school vaccination requirements, the required vaccines, and the applicable populations.<sup>11</sup> All states allow for medical exemptions to school vaccination requirements, and 45 states allow for nonmedical religious or personal belief exemptions.<sup>10</sup> The availability and ease of obtaining personal belief exemptions have been associated with higher rates of exemptions and pertussis incidence.<sup>12,13</sup> Vaccination policy in the United States differs widely from that in other high-income

settings; in Canada, for instance, mandatory vaccine policies are not applied in every province, and those that do require vaccines also permit non-medical exemptions.<sup>14,15</sup> In other countries such as France, Germany, and Australia, mandatory vaccination laws are much stricter in response to infectious disease outbreaks.<sup>15–17</sup>

In 2015, the California legislature passed Senate Bill 277 (SB277) eliminating all nonmedical exemptions to school vaccinations and requiring all students either to provide evidence of vaccination or to obtain a medical exemption.<sup>18,19</sup> In response to widespread measles outbreaks in 2019, both New York<sup>20,21</sup> and Maine<sup>22,23</sup> passed legislation to eliminate nonmedical exemptions, and Washington eliminated philosophical exemptions for measles, mumps, rubella vaccine (MMR).<sup>24,25</sup>

SB277 states that all children in public or private elementary or secondary schools, childcare centers, and nursery schools must be fully immunized unless they obtain a medical exemption from a physician due to family medical history or a valid medical reason, such as immunosuppression or vaccine ingredient allergy.<sup>19</sup> The overall rate of children not up-to-date on school vaccination requirements has decreased post-SB277; however, the impact of this legislation has been mitigated by

an increase in medical exemptions among kindergartners from 0.17% in 2015 to 0.73% in 2017.<sup>18,26,27</sup>

In California, the administrative burden is on schools to check the vaccination records for all students, notify parents of required vaccines, compare each child's received doses to school-entry requirements, and determine whether each child can be admitted.<sup>19,28</sup> Medical training of school personnel and their vaccine knowledge, attitudes, and beliefs have been associated with exemption rates.<sup>29</sup>

The implementation and enforcement of SB277 may vary considerably statewide depending on individual school policies as well as the vaccine knowledge, attitudes, and beliefs of each school official. School officials are responsible for consistently and correctly enforcing the vaccination requirements, regardless of their knowledge or opinion of the rationale listed for a medical exemption. In this study, we aimed to explore school-level modes of enforcement of SB277, to characterize vaccine knowledge, attitudes, and beliefs of school officials in California responsible for student vaccination records, and to identify whether school vaccination policies and practices are associated with the likelihood of a medical exemption request being granted.

A cross-sectional survey (Appendix 1) was administered to school officials in California from October 2018 to July 2019. Given this analysis was completed under a much larger parent study, the sample size was initially calculated to detect longitudinal changes over time before and after the implementation of SB277. The aims of the study later changed, but the sample size remained the same; as such, as part of the larger parent study, we aimed to survey up to 1,450 school officials at different California schools. We used a publicly available list from the California Department of Education to identify 6,023 eligible schools and randomly selected 1,450 schools. We only sampled California schools that were not independent study or homeschooling programs. We stratified schools exhibiting either "high" (top 20% of schools) or "low" (not high) exemption rates based on health department data for the 2013–14 school year, the last full academic year before the legislation was passed. We purposefully over-sampled schools with high exemption rates so that the overall sample contained equal numbers of schools in the high and low exemption rate categories. Schools were contacted by phone to identify the school official responsible for student vaccination records. In the 2018–19 academic year, packets were mailed containing a disclosure letter, postcard, survey, 5 USD gift card incentive, and return envelope. The postcard indicating survey participation and the completed survey was mailed back separately to researchers, allowing us to follow up with non-responders while maintaining survey anonymity. Two additional follow-up letters and two phone calls were conducted by members of the study team over several weeks if no response was received. School officials could complete the survey either by mail or online through the web-based software Qualtrics (Provo, UT). We assessed face validity of the survey questions both by expert review by our study team, and by careful close reading and pre-testing with three school officials in California, in order to be sure that each question was interpreted as intended, to clarify any confusing wording, and to remove redundant questions or response options. This ensured that the survey instruments have high content validity because they include all applicable

domains, concisely ask relevant questions, and provide appropriate and comprehensive response options. The survey took approximately 20–30 minutes to complete. School officials who were interested and willing to participate were consented via a disclosure letter before taking the survey. This study was approved by the Institutional Review board at Emory University.

The survey asked school administrators whether and how parents were notified about SB277 (i.e. through in-person meetings, e-mail, or online or written communication), what categories of students are considered eligible for conditional admission (i.e. those with temporary medical exemptions or those missing vaccine doses), who had the authority to write medical exemptions (i.e. physician, nurse, or other healthcare providers), whether school personnel had the authority to deny medical exemption requests, what were acceptable reasons for denying said requests (i.e. if the request form was not signed, incomplete, or did not specify exemption information), and how long exemptions remained valid. Respondents were asked to indicate how many exemptions were both *requested* and *granted* for kindergarten students in the current school year by exemption type. Respondents were asked how much time they spent verifying vaccination records, how they handled under-immunized students (i.e. whether or not they were permitted to attend school), whether they had any formal medical training (such as RN, LPN, Doctor of Nursing, or PA), and how long they had worked on vaccination requirements at the school.

To assess vaccine knowledge, attitudes, and beliefs, the survey included separate 5-point Likert scales (strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree) to report perceptions of a child's susceptibility to vaccine-preventable disease by age 12 (measles, mumps, influenza, pertussis, and varicella), how serious it would be for an eight-year-old to develop one of these diseases, and how safe the vaccines are. Respondents used a 5-point Likert scale to indicate their opinion on key vaccination beliefs; these responses were dichotomized into "strongly agree" or "agree" versus all other response categories. Additional 5-point Likert scales asked participants about the quality of sources for vaccine information and their opinion on how much different entities benefit when a child is fully vaccinated. These questions were based on questions previously used and validated by members of the study team in previous surveys.<sup>30–51</sup>

We examined the enforcement of vaccine-related administrative procedures at each school, including whether (1) parents have to provide signature from physician, (2) form must state that medical exemption is either temporary or permanent, (3) form must state medical condition that contraindicates vaccination, (4) only children with temporary medical exemptions are eligible for conditional admission, and not students missing doses, (5) only physicians have authority to write medical exemptions, and (6) the reason provided for the medical exemption is not a valid medical contraindication as defined by the Advisory Committee on Immunization Practices.<sup>18,52,53</sup>

Descriptive statistics were used to explore the school-level modes of enforcement of SB277 and to describe vaccine knowledge, attitudes, and beliefs of school officials responsible for

student vaccination records. Bivariate and multivariate logistic regression analyses via generalized linear models using the Stata *glm* procedure (Stata version 14, College Station, TX) were used to assess whether school official medical training was associated with the likelihood of agreeing with key vaccination-related beliefs and whether school-level vaccination policies were associated with the likelihood of medical exemption requests being granted. School- and individual-level characteristics that were associated with these outcomes with a  $p$ -value  $<0.1$  in bivariate regression models were included in preliminary multivariate models, and backwards stepwise regression was then conducted to identify those characteristics with  $p \leq 0.05$ . We ultimately adjusted for whether the school official had completed medical training and how long they had been in that position in multivariate models. All statistical analyses were based on two-sided  $p$ -values.

Among the 1,450 schools contacted, 752 (52%) completed and returned the school official surveys. Three hundred and fifty-nine schools refused to participate and the remainder did not respond. The sample was representative of California overall: 78% of participating schools were public schools, representing 385 of the 977 school districts in California. There were no significant differences geographically or in public vs. private status between the schools where school officials did or did not respond. Respondents identified as the school nurse (28%), health clerk (16%), school registrar (13%), district nurse (9%), school principal (7%), and other administrative roles (13%) Table 1. Approximately 68% of respondents reported some level of formal medical training, with most of these (85%) reporting training as a registered nurse. Respondents had been in their position for a median of 3 years (range 0 to

**Table 1.** Characteristics of school officials in study population.

School characteristics	N (%)
Mode of response	
Paper	463 (58.9)
Online	323 (41.1)
Respondent role in school	
School nurse	223 (28.7)
Health clerk	123 (15.9)
Other administrative role	104 (13.4)
Registrar	102 (13.2)
District nurse	71 (9.1)
School principal or director	52 (6.7)
Not reported	101 (13.0)
Respondent trained as nurse	
Yes	532 (67.7)
No	119 (15.1)
Not reported	135 (17.2)
Parents notified about SB277	
Yes	578 (77.5)
No	37 (5.0)
Don't know	131 (17.5)
How parents were notified about SB277	
Included information in kindergarten registration materials	420 (55.9)
Sent written communication home	371 (49.3)
Posted information on school website	269 (35.8)
Posted written information at school	204 (26)
Sent e-mail communication home	200 (27.1)
Other form of communication	66 (8.8)
Held meeting at school for parents	42 (5.6)
Years respondent has been in position, median (IQR)	3 (6.4)
Hours spent verifying vaccination records this year, median (IQR)	10 (31)

Note: Not all participants responded to every question, so the number of respondents is not the same for all variables; due to these missing values, the reported N does not add up to the total number in the study population. SB277, Senate Bill 277. IQR, interquartile range.

41 years, interquartile range [IQR] 6.42 years). Participants spent a median of 10 hours this year (range 0 to 901 hours, IQR 31 hours) verifying vaccination records.

Most schools (74%) notified parents about SB277 via at least one mechanism: 47% sent written communication home, 26% sent e-mail communication home, 34% posted information on the school website, and 53% included information in kindergarten registration materials Table 1. Regarding the enforcement of school vaccination policies Table 2, 80% of respondents reported that only physicians have the authority to write medical exemptions, 51% reported that the form must have a physician's signature, 38% reported that the form must state whether the medical exemption is permanent or temporary, and 38% reported that the form must state there is a medical condition that contraindicates vaccination. Notably, 15% of school officials reported that people other than physicians had the authority to write medical exemptions, and 21% reported that an invalid medical contraindication was an acceptable reason to deny a medical exemption; both are inconsistent with SB277 law. Only 137 school officials (17%) reported implementing correct interpretations of all aspects of SB277 law. School officials reporting enforcement of school-level policies inconsistent with SB277 were significantly more likely to report the belief that parents should be allowed to send

**Table 2.** School enforcement of SB277 provisions among California schools in study.

School policy	N (%)
Form must have signature from physician	
Yes	401 (51.0)
No	157 (20.0)
Not reported	228 (29.0)
Form must state whether medical exemption is permanent or temporary	301 (38.3)
Yes	257 (32.7)
No	228 (29.0)
Not reported	
Form must state medical condition that contraindicates vaccination	301 (38.3)
Yes	257 (32.7)
No	228 (29.0)
Not reported	
Only children with temporary medical exemptions eligible for conditional enrollment	46 (5.8)
Yes	708 (88.8)
No	43 (5.4)
Not reported	
Only physicians (MD or DO) have authority to write medical exemptions	625 (79.5)
Yes	118 (15.0)
No	43 (5.5)
Not reported	
Reason provided for the medical exemption is not a valid medical contraindication	393 (50.0)
Yes	165 (21.1)
No	228 (29.0)
Not reported	
Number of SB277 provisions enforced by school	
0 policies	20 (2.5)
1–2 policies	194 (24.7)
3–4 policies	225 (28.6)
5–6 policies	118 (15.0)
Not reported	229 (29.1)

Note: Not all participants responded to every question, so the number of respondents is not the same for all variables; due to these missing values, the reported N does not add up to the total number in the study population. MD, Doctor of Medicine. DO, Doctor of Osteopathic Medicine.

their unvaccinated children to school (odds ratio [OR] 2.71, 95% confidence interval [CI] 1.33–5.48). Although nurse respondents largely acknowledged the benefits of vaccines, 87% of nurses also reported that parents should be allowed to send unvaccinated children to school.

Among the five vaccine-preventable diseases included in the survey, school officials perceived that children in their school were most susceptible to influenza and varicella, and less susceptible to pertussis, mumps, and measles. Respondents perceived pertussis, mumps, and measles as more severe diseases and influenza and varicella as less severe. All vaccines included in the survey were perceived to be safe. Key vaccination beliefs varied substantially between school officials who were and were not trained as nurses Table 3. Nurses were more likely than non-nurses to hold beliefs recognizing the importance of vaccination. For example, over 80% of nurse respondents reported that vaccines strengthen the immune system, while only 62% of non-nurse respondents reported the same. Almost 7% of nurse respondents and 11% of non-nurses reported that vaccinations do more harm than good. Both nurses (98%) and non-nurses (96%) reported that parents should be allowed to send their unvaccinated children to school. Respondents trained as nurses were significantly more likely to agree that vaccines strengthen the immune system (OR 2.20, 95% CI 1.40–3.48), and significantly less likely to report that they were opposed to vaccination requirements because they go against freedom of choice (OR 0.30, 95% CI 0.13–0.63) or because parents know what is best for their children (OR 0.28, 95% CI 0.10–0.80).

Among the 752 responding school officials, 277 reported that one or more medical exemptions had been requested at their school in the current academic year. The number of requests per school ranged from 1 to 37, with a total of 820 medical exemptions requested and 768 accepted. The proportion of requests accepted per school ranged from 0% to 100% with a mean of 46% of requests accepted per school. The vast

majority of these school officials (93%) reported that *all* medical exemption requests were accepted at their school in the current academic year.

Nurses were *more* likely to have accepted a medical exemption request than non-nurses (OR 2.12, 95% CI 1.34–3.36). The length of time the school official had been in that position was not significantly associated with the likelihood of a medical exemption request being accepted (OR 1.03, 95% CI 0.99–1.07). After adjustment for confounders, enforcement of SB277 provisions was not significantly associated with an increased likelihood of a medical exemption request being accepted Table 4.

We characterized vaccine knowledge, attitudes, and beliefs of school officials and our results suggest these may be associated with school-level medical exemption rates. School officials were generally supportive of vaccination, but some held concerns and misconceptions about vaccination. Vaccination concerns were less prevalent among nurses compared to non-nurses, consistent with previous research on this topic.<sup>29</sup> The increase in medical exemptions throughout California may suggest that vaccine-hesitant parents who previously would have utilized nonmedical exemptions have successfully obtained medical exemptions from agreeable providers.<sup>54</sup> An alternative explanation is that parents of children with valid reasons for medical exemption had previously obtained less rigorous personal belief exemptions and then shifted to medical exemptions upon SB277 implementation;<sup>18,55</sup> however, this is unlikely given the national median rate of medical exemptions is only 0.2%.<sup>56</sup>

We found that, in this population, school-level vaccination policies are not associated with the likelihood of medical exemptions being accepted. This may be indicative of the level of awareness of state-level and school-level policies by those who completed the survey, given the wide range in reported roles. Additionally, we noted several important inconsistencies between reported school policies and the actual SB277

**Table 3.** Likelihood of respondents agreeing with key vaccination-related beliefs associated with medical training.

Key vaccination belief	Respondents agreed or strongly agreed (%)		Unadjusted OR (95% CI)	Adjusted OR (95% CI)
	Nurses (n = 273)	Non-nurses (n = 259)		
I am concerned that children's immune systems could be weakened by too many immunizations	17 (6.7)	29 (11.2)	0.48 (0.26–0.90)*	0.52 (0.27–1.01)
Vaccines strengthen the immune system	222 (81.3)	160 (61.8)	2.14 (1.40–3.30)*	2.20 (1.40–3.48)*
Immunizations do more harm than good	18 (6.6)	18 (6.9)	0.88 (0.45–1.74)	0.81 (0.41–1.62)
I am opposed to immunization requirements because they go against freedom of choice	11 (4.0)	31 (12.0)	0.29 (0.14–0.60)*	0.30 (0.13–0.63)*
I am opposed to immunization requirements because parents know what is best for their children	5 (1.8)	16 (6.2)	0.27 (0.10–0.75)*	0.28 (0.10–0.80)*
Immunization requirements protect children from getting diseases from unimmunized children	238 (87.2)	213 (82.2)	1.33 (0.80–2.20)	1.32 (0.78–2.22)
Parents should be allowed to send their children to school even if not vaccinated	268 (98.1)	249 (96.1)	0.61 (0.34–1.08)	0.59 (0.33–1.08)

**Table 4.** Likelihood of medical exemption request being accepted associated with enforcement of school vaccination and exemption policies.

Respondent report of enforcement of school policy	N (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Parent must provide signature from physician	401 (51)	2.09 (0.68–6.40)	1.35 (0.40–4.54)
Form must state whether medical exemption is permanent or temporary	301 (38)	1.34 (0.40–4.52)	1.64 (0.38–7.14)
Form must state medical condition that contraindicates vaccination	301 (38)	2.13 (0.66–6.85)	2.12 (0.59–7.71)
Only children with temporary medical exemptions eligible for conditional enrollment	46 (6)	2.38 (0.78–7.22)	1.96 (0.59–6.47)
Only physicians (MD or DO) have authority to write medical exemptions	625 (80)	1.94 (0.62–6.01)	2.08 (0.60–7.24)
Reason provided for the medical exemption is not a valid medical contraindication	393 (50)	15.40 (1.47–16.37)*	8.99 (0.86–9.58)

OR, odds ratio. CI, confidence interval. MD, Doctor of Medicine. DO, Doctor of Osteopathic Medicine. Odds ratios adjusted for whether or not the school official was trained as a nurse and how long the school official has been in that position.

\*  $p < 0.05$ .

legislation. About 15% of school officials reported that people other than physicians, such as physician's assistants or nurses, had the authority to write medical exemptions; however, *only* physicians have the authority to write medical exemptions in California. About 21% of school officials reported that an invalid medical contraindication as defined by the Advisory Committee on Immunization Practices<sup>52</sup> was an acceptable reason to deny a medical exemption. This too is beyond their authority, since under SB277 schools can only deny medical exemptions for administrative reasons such as the form not being signed by a physician. This suggests that misunderstanding and inconsistent enforcement of SB277 by misinformed or underinformed school administrators may result in medical exemptions being inappropriately accepted or denied.

It is already understood that the medical training of school personnel and their vaccine knowledge, attitudes, and beliefs are associated with exemption rates.<sup>29</sup> In California under the new legislation, the administrative burden is on schools to check student vaccination records and to determine whether each child can be admitted. While other literature has been published on school personnel and vaccine exemptions, and literature has been published on SB277, we are not aware of other studies that have examined the recent legislation change in California within the context of school personnel and whether their vaccine knowledge, attitudes, and beliefs are associated with exemption rates. Our study adds to our understanding of SB277 to confirm that the training of school officials, their vaccine knowledge and beliefs, and school-level vaccination practices may impact school-level enforcement of medical exemptions in this California population; this has important implications not only in California but also in other states considering similar policies.

It has previously been reported that California has a shortage of school nurses;<sup>57</sup> as such, nurses likely need to prioritize school issues such as student medication and special needs, and as a result they may be insulated from vaccination and exemption decisions that might be happening on an administrative level. Our findings may be predicated on whether school districts can afford to embed nurses at local schools who would then be responsible for vaccination records.

The present study suggests that the knowledge, attitudes, and beliefs of school officials may impact the up-to-date vaccination status of children in California. While SB277 was intended to be applied consistently statewide, implementation in terms of tracking vaccination records and accepting medical exemption requests may vary widely depending on the individual school administrator.<sup>58,59</sup> Robust school policies that ensure careful recordkeeping of vaccination requirements and missed doses are crucial for ensuring children are up to date on their vaccinations. Oversight of each school's procedures by the California Department of Public Health may also be necessary for ensuring consistent enforcement.

School officials who work with parents on vaccination are in a unique position to influence parental vaccine decision-making, and as such they need to be sufficiently equipped to answer parent questions and discourage unnecessary exemptions.<sup>29</sup> Our results suggest that some school officials may need additional education on vaccination law and vaccine science. The prevalence of concerns and misconceptions about vaccination

among respondents suggests that a communication intervention might be beneficial for school officials to address their misconceptions and improve their capacity to effectively talk to parents about vaccines. Almost 7% of nurses reported the belief that vaccinations do more harm than good; this suggests that school officials, even those with medical training, may be transmitting incorrect information to parents. Schools with sufficient resources and personnel should prioritize properly trained health-care employees to handle student vaccination records.

Another strategy for reducing medical exemptions entails the required verification and approval of all medical exemption requests by a state or local health department.<sup>58,59</sup> Additional vaccine legislation was passed in California in late 2019 to increase oversight of medical exemptions going forward: SB276 will require the California Department of Public Health to review medical exemptions from schools having less than 95% students up-to-date, from schools that fail to report vaccination rates to the California Department of Public Health, and from physicians who wrote more than five medical exemptions in a calendar year,<sup>60</sup> and SB714 will permit a child with a medical exemption accepted before 2020 to remain conditionally enrolled until they enter the next grade span.<sup>61</sup> A similar but more stringent strategy has long been in place in West Virginia, where a physician employed by the State Bureau for Public Health reviews evidence from the child's physician to determine whether medical exemptions should be accepted,<sup>62</sup> rather than placing that burden on schools. Shifting some of the responsibility for verifying and accepting medical exemptions from the school to the California Department of Public Health should address many of the implementation and enforcement issues identified in our study, but a significant burden remains at the school level.

This study has several limitations. There is the possibility of response bias, since only the most interested or opinionated school officials may have taken the time to respond and their responses may differ from those who chose not to complete the survey or who did not respond. The vast majority of non-responders did not return the postcard to indicate they were declining to participate, so we were unable to assess whether there were differences between those that did agree to participate, did not agree to participate, or simply did not respond. We ultimately followed up with school officials who had not returned the postcard, but again were unable to confirm whether postcards were not returned because of refusal or because of non-response.

Additionally, we asked questions about legislation that was implemented two years before the survey was conducted, which may have contributed to recall bias in the responses. There were also several limitations with the study design and method of sampling; given the way the surveys were confidentially administered, we were unable to stratify analyses by school type or previous exemption rate. Some school officials needed to obtain permission from higher-level administrators to complete the survey or may have been prevented from participating based on school policies. Smaller schools may have been less likely to respond due to limited resources. Some schools may not have had complete or accurate records of the frequency of exemption requests, or the respondent may not have been sufficiently familiar with school-level vaccination policies. We did not ask the

total number of kindergarten students in each school, preventing us from assessing the likelihood of a child having a medical exemption or extrapolating to the likelihood of a child being up-to-date on all vaccines. Instead, we assessed the likelihood of a medical exemption request being accepted as a binary variable, but the relative rarity of some or no requests being accepted may have limited the statistical significance of our findings. While the anonymous survey format likely limited social desirability bias, some school officials may have been less likely to report especially vaccine-hesitant beliefs. Our study population was representative of school officials in public schools in California, but this sample did not reflect school administrators at private schools without information listed online, independent study programs, or homeschooling private school programs; as such, we may have under-estimated vaccine hesitancy among school officials in the state. As such, our findings are likely generalizable to school officials at schools in California, but not to the greater United States, as SB277 is specific to California. Lastly, the cross-sectional study design precludes us from making conclusions about causality in this study.

The present study discussed the school-level modes of SB277 enforcement and characterized vaccine knowledge, attitudes, and beliefs of school officials. We found that many school officials are knowledgeable about and supportive of vaccines, and identified addressable gaps in the vaccine knowledge of school officials, particularly those not trained as nurses. Equipping school officials as competent sources of vaccine information for concerned parents will be valuable in improving parental vaccine uptake. As more states eliminate non-medical exemptions, further research should be conducted to explore how other states are implementing and enforcing similar legislation. Further research is also needed to assess how SB277 can be more consistently and efficiently implemented, and whether additional legislation like SB276 is necessary to refine school vaccination law in California. In addition, existing studies regarding immunization law in other countries focus primarily on health-care worker vaccination mandates as opposed to school vaccination mandates, reflecting an additional gap in the literature that may be worth exploring further.

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## ORCID

Taylor A. Holroyd  <http://orcid.org/0000-0003-1907-2218>  
 Paul L. Delamater  <http://orcid.org/0000-0003-3627-9739>

Nicola P. Klein  <http://orcid.org/0000-0003-1777-4814>

Rupali J. Limaye  <http://orcid.org/0000-0002-3883-9720>

## References

- Edwards KM, Hackell JM. Countering vaccine hesitancy. *Pediatrics*. 2016;138(3):e20162146–e20162146. doi:10.1542/peds.2016-2146.
- Jacobson RM, St Sauver JL, Finney Rutten LJ. Vaccine hesitancy. *Mayo Clin Proc*. 2015;90(11):1562–68. doi:10.1016/j.mayocp.2015.09.006.
- Salmon DA, Dudley MZ, Glanz JM, Omer SB. Vaccine hesitancy: causes, consequences, and a call to action. *Vaccine*. 2015;33 Suppl 4:D66–71. doi:10.1016/j.vaccine.2015.09.035.
- Glanz JM, McClure DL, Magid DJ, Daley MF, France EK, Hambidge SJ. Parental refusal of varicella vaccination and the associated risk of varicella infection in children. *Arch Pediatr Adolesc Med*. 2010;164(1):66–70. doi:10.1001/archpediatrics.2009.244.
- Salmon DA, Haber M, Gangarosa EJ, Phillips L, Smith NJ, Chen RT. Health consequences of religious and philosophical exemptions from immunization laws: individual and societal risk of measles. *Jama*. 1999;282(1):47–53. doi:10.1001/jama.282.1.47.
- Atwell JE, Van Otterloo J, Zipprich J, Winter K, Harriman K, Salmon DA, Halsey NA, Omer SB. Nonmedical vaccine exemptions and pertussis in California, 2010. *Pediatrics*. 2013;132(4):624–30. doi:10.1542/peds.2013-0878.
- Glanz JM, McClure DL, Magid DJ, Daley MF, France EK, Salmon DA, Hambidge SJ. Parental refusal of pertussis vaccination is associated with an increased risk of pertussis infection in children. *Pediatrics*. 2009;123(6):1446–51. doi:10.1542/peds.2008-2150.
- Siddiqui M, Salmon DA, Omer SB. Epidemiology of vaccine hesitancy in the United States. *Hum Vaccin Immunother*. 2013;9(12):2643–48. doi:10.4161/hv.27243.
- Omer SB, Enger KS, Moulton LH, Halsey NA, Stokley S, Salmon DA. Geographic clustering of nonmedical exemptions to school immunization requirements and associations with geographic clustering of pertussis. *Am J Epidemiol*. 2008;168(12):1389–96. doi:10.1093/aje/kwn263.
- Centers for Disease Control and Prevention. State Vaccination Requirements. Published 2016. [Accessed 2018 Oct 2]. <https://www.cdc.gov/vaccines/imz-managers/laws/state-reqs.html>.
- Institute for Vaccine Safety. Vaccine exemptions: school exemption laws by state. Johns Hopkins Bloomberg School of Public Health. Published 2016. [Accessed 2018 Sept 10]. <http://vaccinesaftey.edu/cc-exem.htm>
- Rota JS, Salmon DA, Rodewald LE, Chen RT, Hibbs BF, Gangarosa EJ. Processes for obtaining nonmedical exemptions to state immunization laws. *Am J Public Health*. 2001;91:645–48.
- Omer SB, Pan WK, Halsey NA, Stokley S, Moulton LH, Navar AM, Pierce M, Salmon DA. Nonmedical exemptions to school immunization requirements: secular trends and association of state policies with pertussis incidence. *Jama*. 2006;296(14):1757–63. doi:10.1001/jama.296.14.1757.
- Walkinshaw E. Mandatory vaccinations: the Canadian picture. *Can Med Assoc J*. 2011;183(16):E1165–E1166. doi:10.1503/cmaj.109-3992.
- MacDonald NE, Harmon S, Dube E, Steenbeek A, Crowcroft N, Opel DJ, Faour D, Leask J, Butler R. Mandatory infant & childhood immunization: rationales, issues and knowledge gaps. *Vaccine*. 2018;36(39):5811–18. doi:10.1016/j.vaccine.2018.08.042.
- Attwell K, Navin MC, Lopalco PL, Jestin C, Reiter S, Omer SB. Recent vaccine mandates in the United States, Europe and Australia: a comparative study. *Vaccine*. 2018;36(48):7377–84. doi:10.1016/j.vaccine.2018.10.019.
- Trentini F, Poletti P, Melegaro A, Merler S. The introduction of ‘No jab, No school’ policy and the refinement of measles immunisation strategies in high-income countries. *BMC Med*. 2019;17(1):86. doi:10.1186/s12916-019-1318-5.

18. Delamater PL, Leslie TF, Yang YT. Change in medical exemptions from immunization in California after elimination of personal belief exemptions. *Jama*. 2017;318(9):863–64. doi:10.1001/jama.2017.9242.
19. California Department of Public Health. Guide to Immunizations Required for School Entry: Grades TK/K–12. Published 2018. [Accessed 2018 Sept 6]. <http://www.shotsforschool.org/>.
20. Senate Bill S1536. The New York State Senate. Published 2016. [Accessed 2019 Oct 1]. <https://www.nysenate.gov/legislation/bills/2015/S1536>
21. New York Issues Stricter Rules On Vaccine Medical Exemptions. CBS New York. Published 2019. [Accessed 2019 Oct 1]. <https://newyork.cbslocal.com/2019/08/18/new-york-stricter-rules-vaccine-medical-exemptions/>
22. Title 20-A, §6355: Enrollment in school. Maine legislature. Published 2016. [Accessed 2019 Oct 1]. <http://www.mainelegislature.org/legis/statutes/20-A/title20-Asec6355.html>
23. Thistle S. Maine Senate reverses course, ends religious exemption for vaccines. *Press Herald*. Published 2019. [Accessed 2019 Oct 1]. <https://www.pressherald.com/2019/05/14/maine-senate-reverses-course-ends-religious-exemption-for-vaccines/>
24. House Bill 1638. The Washington State Senate. Published 2019. [Accessed 2019 Dec 11]. <https://www.nysenate.gov/legislation/bills/2013/S3134/amendment/A>
25. Washington State Department of Health. MMR vaccine exemption law change 2019. Published 2019. [Accessed 2019 Dec 11]. [www.doh.wa.gov/CommunityandEnvironment/Schools/Immunization/ExemptionLawChange](https://www.doh.wa.gov/CommunityandEnvironment/Schools/Immunization/ExemptionLawChange)
26. Delamater PL, Pingali SC, Bутtenheim AM, Salmon DA, Klein NP, Omer SB. Elimination of nonmedical immunization exemptions in California and school-entry vaccine status. *Pediatrics*. 2019;143(6):e20183301. doi:10.1542/peds.2018-3301.
27. Nyathi S, Karpel HC, Sainani KL, Maldonado Y, Hotez PJ, Bendavid E, Lo NC. The 2016 California policy to eliminate non-medical vaccine exemptions and changes in vaccine coverage: an empirical policy analysis. *PLoS Med*. 2019;16(12):e1002994. doi:10.1371/journal.pmed.1002994.
28. Senate Bill 277. The California State Senate. Published 2014. [Accessed 2019 Sept 29]. [https://leginfo.ca.gov/faces/billNavClient.xhtml?bill\\_id=201520160SB277](https://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB277)
29. Salmon DA, Moulton LH, Omer SB, Chace LM, Klassen A, Talebian P, Halsey NA. Knowledge, attitudes, and beliefs of school nurses and personnel and associations with nonmedical immunization exemptions. *Pediatrics*. 2004;113(6):e552–559.
30. Frew PM, Painter JE, Hixson B, Kulb C, Moore K, Del Rio C, Esteves-Jaramillo A, Omer SB. Factors mediating seasonal and influenza A (H1N1) vaccine acceptance among ethnically diverse populations in the urban south. *Vaccine*. 2012;30(28):4200–08. doi:10.1016/j.vaccine.2012.04.053.
31. Salmon DA, Sotir MJ, Pan WK, Berg JL, Omer SB, Stokley S, Hopfensperger DJ, Davis JP, Halsey NA. Parental vaccine refusal in Wisconsin: a case-control study. *Wisconsin Med J*. 2009;108(1):17.
32. Link-Gelles R, Chamberlain AT, Schulkin J, Ault K, Whitney E, Seib K, Omer SB. Missed opportunities: a national survey of obstetricians about attitudes on maternal and infant immunization. *Matern Child Health J*. 2012;16(9):1743–47. doi:10.1007/s10995-011-0936-0.
33. Seib K, Barnett DJ, Weiss PS, Omer SB. Vaccine-related standard of care and willingness to respond to public health emergencies: A cross-sectional survey of California vaccine providers. *Vaccine*. 2012;31(1):196–201. doi:10.1016/j.vaccine.2012.10.066.
34. Chamberlain AT, Seib K, Wells K, Hannan C, Orenstein WA, Whitney EAS, Hinman AR, Berkelman RL, Omer SB. Perspectives of immunization program managers on 2009–10 H1N1 vaccination in the United States: a national survey. *Biosecur Bioterrorism: Biodefense Strategy Pract Sci*. 2012;10(1):142–50. doi:10.1089/bsp.2011.0077.
35. Choudhury P, Thacker N, Gargano LM, Weiss PS, Vashishtha VM, Amladi T, Pazol K, Orenstein WA, Omer SB, Hughes JM, et al. Attitudes and perceptions of private pediatricians regarding polio immunization in India. *Vaccine*. 2011;29(46):8317–22. doi:10.1016/j.vaccine.2011.08.099.
36. Crosby RA, Holtgrave DR, Bryant L, Frew PM. Factors associated with the acceptance of an AIDS vaccine: an exploratory study. *Prev Med*. 2004;39(4):804–08. doi:10.1016/j.ypmed.2004.03.004.
37. Frew PM, Archibald M, Hixson B, Del Rio C. Socioecological influences on community involvement in HIV vaccine research. *Vaccine*. 2011;29(36):6136–43. doi:10.1016/j.vaccine.2011.06.082.
38. Frew PM, Del Rio C, Clifton S, Archibald M, Hormes JT, Mulligan MJ. Factors influencing HIV vaccine community engagement in the urban South. *J Community Health*. 2008;33(4):259–69. doi:10.1007/s10900-008-9086-8.
39. Frew PM, Hixson B, Del Rio C, Esteves-Jaramillo A, Omer SB. Acceptance of pandemic 2009 influenza A (H1N1) vaccine in a minority population: determinants and potential points of intervention. *Pediatrics*. 2011;127:S113–S119.
40. Gargano LM, Thacker N, Choudhury P, Weiss PS, Pazol K, Bahl S, Jafari HS, Arora M, Orenstein WA, Hughes JM, et al. Predictors of administration and attitudes about pneumococcal, Haemophilus influenzae type b and rotavirus vaccines among pediatricians in India: a national survey. *Vaccine*. 2012;30(24):3541–45. doi:10.1016/j.vaccine.2012.03.064.
41. Gargano LM, Thacker N, Choudhury P, Weiss PS, Pazol K, Bahl S, Jafari HS, Arora M, Orenstein WA, Hughes JM, Omer SB, et al. Attitudes of pediatricians and primary health center physicians in India concerning routine immunization, barriers to vaccination, and missed opportunities to vaccinate. *Pediatr Infect Dis J*. 2012;31(2):e37–e42.
42. Jones AM, Omer SB, Bednarczyk RA, Halsey NA, Moulton LH, Salmon DA. Parents' source of vaccine information and impact on vaccine attitudes, beliefs, and nonmedical exemptions. *Adv Prev Med*. 2012;2012.
43. Khowaja AR, Khan SA, Nizam N, Omer SB, Zaidi A. Parental perceptions surrounding polio and self-reported non-participation in polio supplementary immunization activities in Karachi, Pakistan: a mixed methods study. *Bull World Health Organ*. 2012;90(11):822–30. doi:10.2471/BLT.12.106260.
44. Linkins RW, Salmon DA, Omer SB, Pan WK, Stokley S, Halsey NA. Support for immunization registries among parents of vaccinated and unvaccinated school-aged children: a case control study. *BMC Public Health*. 2006;6(1):236. doi:10.1186/1471-2458-6-236.
45. Navar AM, Halsey NA, Carter TC, Montgomery MP, Salmon DA. Prenatal immunization education: the pediatric prenatal visit and routine obstetric care. *Am J Prev Med*. 2007;33(3):211–13. doi:10.1016/j.amepre.2007.04.027.
46. Priddy FH, Cheng AC, Salazar LF, Frew PM. Racial and ethnic differences in knowledge and willingness to participate in HIV vaccine trials in an urban population in the Southeastern US. *Int J STD AIDS*. 2006;17(2):99–102. doi:10.1258/095642606775455667.
47. Salmon DA, Moulton LH, Omer SB, Chace LM, Klassen A, Talebian P, Halsey NA. Knowledge, attitudes, and beliefs of school nurses and personnel and associations with nonmedical immunization exemptions. *Pediatrics*. 2004;113(6):e552–e559.
48. Salmon DA, Moulton LH, Omer SB, Patricia deHart M, Stokley S, Halsey NA. Factors associated with refusal of childhood vaccines among parents of school-aged children: a case-control study. *Arch Pediatr Adolesc Med*. 2005;159(5):470–76. doi:10.1001/archpedi.159.5.470.
49. Salmon DA, Pan WK, Omer SB, Navar AM, Orenstein W, Marcuse EK, Taylor J, deHart MP, Stokley S, Carter T, et al. Vaccine knowledge and practices of primary care providers of exempt vs. vaccinated children. *Hum Vaccin*. 2008;4(4):286–91. doi:10.4161/hv.4.4.5752.

50. Thacker N, Choudhury P, Gargano LM, Weiss PS, Pazol K, Bahl S, Jafari HS, Arora M, Dubey AP, Vashishtha VM, et al. Comparison of attitudes about polio, polio immunization, and barriers to polio eradication between primary health center physicians and private pediatricians in India. *Int J Infect Dis.* 2012;16(6):e417–e423. doi:10.1016/j.ijid.2012.02.002.
51. Vadaparampil ST, Kahn JA, Salmon D, Lee J-H, Quinn GP, Roetzheim R, Bruder K, Malo TL, Proveaux T, Zhao X, et al. Missed clinical opportunities: provider recommendations for HPV vaccination for 11–12 year old girls are limited. *Vaccine.* 2011;29(47):8634–41. doi:10.1016/j.vaccine.2011.09.006.
52. Centers for Disease Control and Prevention. Contraindications and Precautions. Published 2020. [Accessed 2019 Mar 28]. <https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/contraindications.html>
53. Shaw J, Mader EM, Bennett BE, Vernyi-Kellogg OK, Yang YT, Morley CP. Immunization mandates, vaccination coverage, and exemption rates in the United States. *Open Forum Infect Dis.* 2018;5(6):ofy130. doi:10.1093/ofid/ofy130.
54. Williams JTB, Rice J, Cox-Martin M, Bayliss EA, O’Leary ST. Religious vaccine exemptions in kindergartners: 2011–2018. *Pediatrics.* 2019;144(6):e20192710. doi:10.1542/peds.2019-2710.
55. Mello MM, Studdert DM, Parmet WE. Shifting vaccination politics—the end of personal-belief exemptions in California. *N Engl J Med.* 2015;373(9):785–87. doi:10.1056/NEJMp1508701.
56. Mellerson JL, Maxwell CB, Knighton CL, Kriss JL, Seither R, Black CL. Vaccination coverage for selected vaccines and exemption rates among children in Kindergarten - United States, 2017–18 school year. *MMWR Morb Mortal Wkly Rep.* 2018;67:1115–22.
57. Washburn D Even when districts want more school nurses, they have trouble finding them. EdSource.org Web site. Published 2019. [Accessed 2020 Jun 7]. <https://edsources.org/2019/even-when-districts-want-more-school-nurses-they-have-trouble-finding-them/>
58. Mohanty S, Buttenheim AM, Joyce CM, Howa AC, Salmon D, Omer SB. Experiences with medical exemptions after a change in vaccine exemption policy in California. *Pediatrics.* 2018;142(5):e20181051. doi:10.1542/peds.2018-1051.
59. Mohanty S, Buttenheim AM, Joyce CM, Howa AC, Salmon D, Omer SB. California’s senate bill 277: local health jurisdictions’ experiences with the elimination of nonmedical vaccine exemptions. *Am J Public Health.* 2019 Jan;109(1):96–101.
60. Senate Bill 276. The California State Senate. Published 2019. [Accessed 2019 Nov 13]. [https://leginfo.ca.gov/faces/billTextClient.xhtml?bill\\_id=201920200SB276](https://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=201920200SB276)
61. Senate Bill 714. The California State Senate. Published 2019. [Accessed 2019 Nov 26]. [https://leginfo.ca.gov/faces/billTextClient.xhtml?bill\\_id=201920200SB714](https://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=201920200SB714)
62. Office of Epidemiology and Prevention Services. Medical exemptions information. West Virginia Department of Health & Human Resources Bureau for Public Health. Published 2019. [Accessed 2019 Nov 13]. <https://oeeps.wv.gov/Pages/Medical-Exemptions-Information.aspx>