

Potential Effects of California's New Vaccine Exemption Law on the Prevalence and Clustering of Exemptions

Exemptions from childhood immunizations required for school entry have continued to increase among California kindergartners, and exemptions show spatial clustering within the state. A 2014 change in California's school-entry vaccine exemption law requires parents filing for an exemption to submit signed documents from a health care provider. However, the evidence presented here suggests that the policy change will probably not be sufficient to reverse the growing trend in vaccine refusals. (*Am J Public Health*. 2014;104:e3–e6. doi:10.2105/AJPH.2014.302065)

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STATE-MANDATED IMMUNIZATION requirements for school entry have been instrumental in achieving high immunization coverage rates and ensuring herd immunity against infectious disease outbreaks.¹ However, in most states parents can obtain a personal beliefs exemption (PBE) from school-entry requirements.² A growing trend of parental vaccine hesitancy has led to an increase in PBE rates, and such increases are associated with higher risks of disease outbreaks.³ In California, for example, rates of PBEs among children entering kindergarten increased by 380% from 1996 to 2010 (from 0.5% to 2.3%).^{4,5}

In response to rising PBE rates, California passed Assembly Bill 2109 (AB2109) in September 2012.⁶ California's previous law allowed a parent to obtain a PBE by signing an affidavit stating that immunization is contrary to the parent's beliefs.⁷ This affidavit was preprinted on the California School Immunization Record, making exemptions readily accessible. Previous research demonstrates an association between easier state exemption procedures and higher exemption rates.^{8,9} Authored by state assembly member and pediatrician Richard Pan, AB2109 requires parents filing an exemption to submit an attestation signed by a health care provider stating that they have been provided information about the risks and responsibilities of refusing vaccination and an attestation signed by parents indicating receipt of this information.⁶

AB2109 went into effect in January 2014.

It is not yet known whether this policy change will reverse or slow the trend of increasing PBE rates in California, although a similar regulatory change in Washington appears to have reduced PBEs.¹⁰ Here we present the most recent data on PBEs in California and demonstrate continued spatial variation in PBE rates statewide. These data represent the last kindergarten cohort before AB2109 was passed, so they will provide a useful baseline as the new law takes effect. We also discuss the implications of spatial clustering for the potential effectiveness of AB2109.

PREVALENCE OF PERSONAL BELIEFS EXEMPTIONS

We present data from the California Department of Public Health for the school year beginning in fall 2012. Details on the data source and methods are available in our earlier study.⁵ In brief, the state of California requires every school offering kindergarten to report total kindergarten enrollment and the number of kindergartners who have PBEs on record. Thus, these data reflect the PBE status of every kindergarten enrolled in school in California. To ensure comparability with previously published PBE rates in this population, we excluded schools with kindergarten enrollments of fewer than 10 students from our analyses. Sensitivity testing showed that rates were

not substantially biased by this exclusion. Stata version 11.0 (StataCorp LP, College Station, TX) and ArcGIS version 10.1 (ESRI, Redlands, CA) were used in conducting the analyses.

Statewide, more than 14 000 kindergartners had a PBE on file in 2012 (Table 1).¹¹ The PBE rate was 2.7 per 100 kindergartners, up 17% from 2.3 per 100 in 2010. All but 12 of California's 58 counties saw increases in PBE rates relative to 2010. However, there is considerable heterogeneity in PBE prevalence among the state's counties. In our earlier study, we identified 5 counties (Sutter, Mendocino, Nevada, Humboldt, and Santa Cruz) where more than half of PBE kindergartners were enrolled in schools with high overall rates (at least 20%)⁵; the average PBE rate in these counties is now more than 10 per 100 kindergartners.

Figure 1 shows statewide spatial patterns in terms of school PBE rates. Figure 1a shows average county PBE rates, with cross hatches indicating counties with rate increases since 2010. Increases in rates were widespread, and a concentration of high PBE rates is evident in northern California's coastal and mountain areas.

Figure 1b provides a more detailed view, with regions of higher PBE prevalence shown in red and regions of lower prevalence in green. We used school-level data in a geographic information system, with schools geocoded as points, to create this map. On the basis of these points, we used an

TABLE 1—County-Level Rates of Personal Beliefs Exemptions (PBEs) From Mandated School-Entry Vaccinations: California Kindergartners, 2012

County	Kindergartners, ^a No.	PBEs, ^b Crude No.	PBE Rate/ 100, ^c %	PBE Rate Ranking ^d	Absolute Change in Rate Since 2010, %
Alameda	19 313	314	1.6	43	0.4
Alpine	19	2	10.5	7	10.5
Amador	282	22	7.8	17	3.9
Butte	2625	149	5.7	21	0.9
Calaveras	395	43	10.9	6	5.3
Colusa	399	3	0.8	54	-0.6
Contra Costa	14 593	307	2.1	40	0.0
Del Norte	286	33	11.5	3	4.4
El Dorado	2427	197	8.1	15	0.5
Fresno	17 232	254	1.5	46	0.3
Glenn	378	4	1.1	51	0.8
Humboldt	1505	165	11.0	5	1.2
Imperial	2720	4	0.1	57	-0.2
Inyo	207	3	1.4	47	-0.6
Kern	15 722	272	1.7	42	0.1
Kings	2500	18	0.7	56	-0.5
Lake	720	38	5.3	23	2.6
Lassen	345	21	6.1	19	5.1
Los Angeles	131 145	2422	1.8	41	0.3
Madera	2536	57	2.2	38	1.2
Marin	3389	261	7.7	18	0.6
Mariposa	115	12	10.4	8	7.4
Mendocino	1079	89	8.2	13	1.8
Merced	4743	43	0.9	53	0.4
Modoc	109	4	3.7	30	1.9
Mono	136	5	3.7	29	0.9
Monterey	6620	94	1.4	47	0.3
Napa	1681	61	3.6	31	1.2
Nevada	827	173	20.9	1	3.5
Orange	42 260	1261	3.0	34	0.4
Placer	5530	448	8.1	15	3.8
Plumas	194	18	9.3	10	3.1
Riverside	33 961	773	2.3	37	0.4
Sacramento	19 566	834	4.3	25	1.1
San Benito	890	7	0.8	54	-0.5
San Bernardino	31 972	787	2.5	36	0.7
San Diego	42 433	1625	3.8	28	0.7
San Francisco	6641	91	1.4	47	0.2
San Joaquin	11 139	111	1.0	52	-0.1
San Luis Obispo	3000	172	5.7	21	0.8
San Mateo	9489	200	2.1	39	0.1
Santa Barbara	6082	252	4.1	26	0.9
Santa Clara	24 734	408	1.6	43	-0.1

*Continued***TABLE 1—Continued**

Santa Cruz	3527	324	9.2	11	-0.4
Shasta	2103	172	8.2	13	2.2
Sierra	18	0	0.0	58	-7.1
Siskiyou	457	46	10.1	9	-1.4
Solano	5373	84	1.6	45	0.2
Sonoma	6523	401	6.1	19	0.2
Stanislaus	8614	345	4.0	27	0.7
Sutter	1651	143	8.7	12	1.7
Tehama	892	41	4.6	24	0.8
Trinity	91	15	16.5	2	-0.8
Tulare	8640	105	1.2	50	0.3
Tuolumne	446	51	11.4	4	1.5
Ventura	12 000	409	3.4	32	0.4
Yolo	2406	82	3.4	32	0.6
Yuba	1231	32	2.6	35	0.3
Total	525 911	14 307	2.7	...	0.4

^aSchool-level data from the California Department of Public Health. Schools with < 10 kindergartners were excluded from the analyses. Exemptions are reported in December of each year.

^bNumber of kindergartners with ≥ 1 PBEs on file.

^cNumber of kindergartners with ≥ 1 PBEs/100 kindergartners/year.

^dFrom 1 (highest rate) to 58 (lowest rate). Counties with identical rates are assigned the same rank.

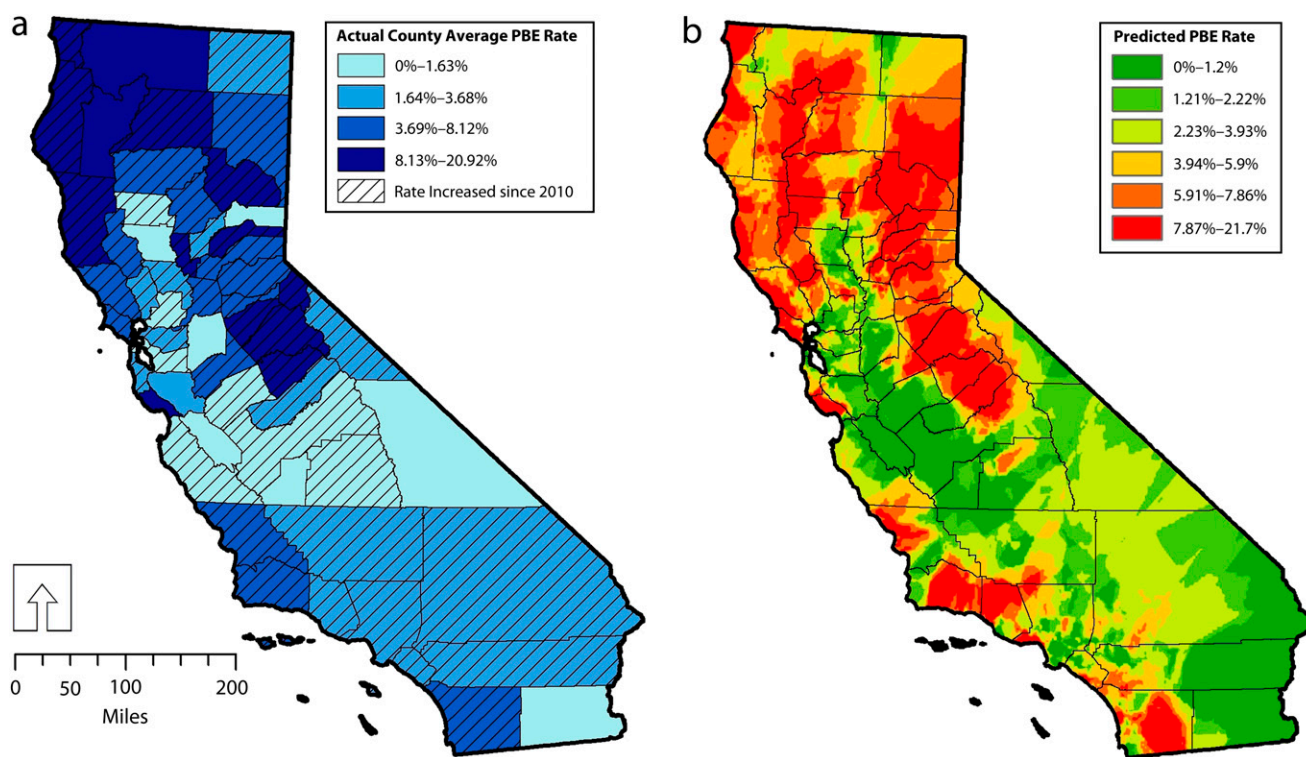
advanced geostatistical method (kriging¹²) to predict a continuous PBE prevalence surface for the state. Because this approach is sensitive to extreme values, we dropped schools in the 99th percentile for PBE rates. The map reinforces the finding of strong spatial patterning of PBE rates, with hot spots (areas where herd immunity is more likely to be compromised) covering much of the northern area of the state and several southern coastal areas.

POLICY IMPLICATIONS

AB2109, passed in September 2012, was intended to alter the trajectory of PBEs in California by ensuring that parents receive factual information about the risks posed by vaccines and vaccine refusal before filing for a PBE. Opponents argued that AB2109 will also increase the opportunity cost of filing for a PBE by adding

administrative steps. In theory, the policy change should reduce PBEs in 3 groups. The first group comprises children who were actually vaccinated but could not show documentation of immunizations. A 2010 pilot study conducted by the California Department of Public Health suggested that as many as half of kindergartners with a PBE have received some or all of the required doses of individual vaccines.^{13,14} Schools may be using the PBE affidavit as way to admit such students without the follow-up associated with a conditional acceptance. This group will likely be eliminated; because these children were actually vaccinated, however, the infectious disease risk scenario will not change.

If PBEs were largely the result of parents who could not show documentation of immunization at school entry, we speculate that PBE rates would be highest in



Note. Predicted PBE rates were calculated from the school-level average PBE rates. The continuous surface was interpolated from the school-level rates within the geographic information system using kriging.¹²

FIGURE 1—Personal beliefs exemptions (PBEs) from state-mandated vaccines by (a) average county rates and (b) a more detailed view: California kindergartners, 2012.

families burdened by poor continuity of health care, language barriers, and frequent life disruptions such as migration. In this scenario, areas with high poverty and immigration rates—the central valley and rural southeastern areas of the state—would have the highest PBE rates. That is not the pattern observed in Figure 1, suggesting that the clustering of PBEs does not reflect socioeconomic pockets where parents have difficulty proving vaccine status, even for vaccinated children. Accurate assessments of the vaccination status of exempted kindergartners are critical to a rigorous examination of disease risk, and this is an important area for additional investigation.

The second group likely to be affected by AB2109 comprises

children whose parents filed for a PBE largely because it was easy to do or because they had some level of vaccine hesitancy that exceeded their motivation to vaccinate, including challenges in accessing health care. Under AB2109, parents in this group may find it easier to vaccinate their child than to ask a provider for an attestation, or they may find that their provider offers advice that convinces them to proceed with immunization. In this case, the true disease risk environment will be affected. However, our analysis of spatial clustering again does not support this as the main driver of recent PBE rate increases. If parents seeking the path of least resistance were driving the trend, we would likely see no clustering at all.

The third group is of most concern for public health policymakers: children whose parents have serious concerns about vaccine safety and have decided to refuse most vaccines. We expect that this group will continue to obtain the necessary paperwork for a PBE under AB2109 and will seek out providers who are willing to sign the attestation. Notably, a credentialed school nurse may sign the health care provider attestation. Although many California schools do not have a full-time school nurse on site, parents may request signatures from nurses during the kindergarten registration process as an alternative to seeking a signature from a regular primary care provider.

Complicating this issue further, at the time of signing the bill into law, California's governor issued

an opinion indicating that parents whose religious beliefs preclude immunization should not have to seek a health care practitioner's council.¹⁵ The new attestation form does provide a religious exemption stating "I am a member of a religion which prohibits me from seeking medical advice or treatment from authorized health care practitioners"; it remains to be seen how frequently this option will be exercised.

Parental hesitancy regarding vaccines is on the rise.¹⁶ In addition to showing that PBEs in California have continued their upward trajectory, our data reveal strong geographic clustering. This pattern suggests information diffusion or contagion, perhaps within social networks. On the basis of the evidence presented

here, we expect that AB2109 may not be sufficient to combat continued increases in exemptions among the children at highest risk for vaccine-preventable childhood disease outbreaks: clustered subgroups of children whose parents have serious concerns about vaccine safety and efficacy. The reason is that these parents are unlikely to be swayed by increasing the opportunity cost of a PBE. Additional research is needed to understand diffusion of anti-vaccine attitudes, to improve public knowledge about vaccines and vaccine-preventable childhood diseases, to increase trust that vaccines are safe and effective, and to combat myths about vaccine risks. ■

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Contributors

M. Jones assisted with study design and data analysis, created the projection models used in Figure 1, and wrote and revised the article. A. Buttenheim originated and designed the study, conducted data analyses, and wrote and revised the article.

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Human Participant Protection

No protocol approval was necessary for this study because no human participants were involved.

References

- Orenstein WA, Hinman AR. The immunization system in the United States—the role of school immunization laws. *Vaccine*. 1999;17(suppl 3):S19–S24.
- Johns Hopkins Bloomberg School of Public Health, Institute for Vaccine Safety. Vaccine exemptions. Available at: <http://www.vaccinesafety.edu/cc-exem.htm>. Accessed June 8, 2014.
- Omer SB, Salmon DA, Orenstein WA, deHart MP, Halsey N. Vaccine refusal, mandatory immunization, and the risks of vaccine-preventable diseases. *N Engl J Med*. 2009;360(19):1981–1988.
- California Department of Public Health. *Childhood Immunization Coverage in California, 2006–08*. 7th ed. Richmond, CA: Center for Infectious Diseases, Division of Communicable Disease Control, Immunization Branch; 2009.
- Buttenheim A, Jones M, Baras Y. Exposure of California kindergartners to students with personal belief exemptions from mandated school entry vaccinations. *Am J Public Health*. 2012;102(8):e59–e67.
- California Legislature. California Assembly Bill 2109: communicable disease, immunization exemption. Available at: http://leginfo.ca.gov/faces/billNavClient.xhtml?bill_id=201120120AB2109. Accessed June 8, 2014.
- California Department of Health Services. *California Immunization Handbook: School and Child Care Immunization Requirements for Schools and Child Care Programs*. 7th ed. Richmond, CA: Center for Infectious Diseases, Division of Communicable Disease Control, Immunization Branch; 2003.
- Omer SB, Pan WK, Halsey NA, et al. Nonmedical exemptions to school immunization requirements: secular trends and association of state policies with pertussis incidence. *JAMA*. 2006;296(14):1757–1763.
- Feikin DR, Lezotte DC, Hamman RF, Salmon DA, Chen RT, Hoffman RE. Individual and community risks of measles and pertussis associated with personal exemptions to immunization. *JAMA*. 2000;284(24):3145–3150.
- Washington State Department of Health. Percentage of kindergartners exempt for required vaccines in school year 2013–2014. Available at: <http://www.doh.wa.gov/Portals/1/Documents/Pubs/348-324-KindergartenExemptGraph.pdf>. Accessed June 8, 2014.
- California Department of Public Health, Immunization Branch. Immunization levels in child care and schools. Available at: <http://www.cdph.ca.gov/programs/immunize/Pages/ImmunizationLevels.aspx>. Accessed June 8, 2014.
- Environmental Systems Resource Institute. How kriging works. Available at: http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/How_Kriging_works/009z00000076000000. Accessed June 8, 2014.
- Lee T, Sharifi M, Nickell S. Vaccination status and school practices among California kindergartners with a high number of personal beliefs exponents. Available at: <http://cdc.confex.com/cdc/nic2010/webprogram/Paper22752.html>. Accessed June 8, 2014.
- California Department of Public Health, Immunization Branch. 2010 kindergarten assessment results. Available at: <http://www.cdph.ca.gov/programs/immunize/Documents/2010KindergartenAssessmentReport.pdf>. Accessed June 8, 2014.
- Brown EG. Communication from the Office of the Governor to the members of the California State Assembly. Available at: http://gov.ca.gov/docs/AB_2109_Signing_Message.pdf. Accessed June 8, 2014.
- Thomson Reuters-NPR. Worries about autism link still hang over vaccines. Available at: <http://www.npr.org/blogs/health/2011/09/29/140928470/worries-about-autism-link-still-hang-over-vaccines>. Accessed June 8, 2014.