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Exposure and Vulnerability of California Kindergarteners to Intentionally Unvaccinated Children

Editor's note: Widespread vaccination coverage among children is responsible for reducing or eliminating 14 serious childhood diseases in the United States. Despite this success, some parents remain concerned about the health effects of vaccines, and choose to keep their children unvaccinated. When population rates of vaccinations remain high enough, even unvaccinated children are protected because everyone around them is immune (so-called "herd immunity"). But clusters of unvaccinated children may threaten herd immunity and lead to increasing outbreaks of preventable diseases. This Issue Brief summarizes a new study that investigates the extent of such clustering, and quantifies the exposure of all California kindergartners to their intentionally unvaccinated schoolmates.

Outbreaks of vaccine-preventable childhood disease are increasing as immunization rates fall

Childhood immunization is one of the great public health success stories in the U.S. For example, measles once infected 4 million and killed 4,000 people each year, mostly young children. Overall, the current vaccination schedule prevents an estimated 42,000 deaths and 20 million cases of disease in each U.S. birth cohort.

- Despite this success, some parents remain concerned about the number and timing of vaccinations. A recent national poll found that 31% of parents are concerned about vaccine safety, and that one in four believes that vaccines are linked to autism. A recent Institute of Medicine review concluded that there is no evidence of this link.
- All states mandate proof of immunization of children upon entering school, except for children with medical conditions that would make vaccinations detrimental to their health. Twenty states allow parents to refuse vaccination because of personal or philosophical beliefs; all but Mississippi and West Virginia allow religious exemptions.
- Herd immunity can protect these unvaccinated children, if overall rates of vaccination coverage remain high enough: 80% to 95% of the population, depending on the disease. Herd immunity is especially important to protect vulnerable populations, including infants too young to be vaccinated and people with compromised immune function.

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- Even when population coverage seems adequate, outbreaks of disease can occur through clusters of unvaccinated children. For example, in 2008, an intentionally unvaccinated child contracted measles during travel in Europe. That led to more than 800 people being exposed to measles and an outbreak of 20 cases in California among the child's siblings, unvaccinated schoolmates, and a baby.

Study assesses personal belief exemptions (PBEs) in California schools

Because of recent outbreaks and relatively high levels of personal belief exemptions (PBEs) in California, Bутtenheim and colleagues analyzed the vaccination status of California kindergarteners over a three-year period (2008-2010). They used annual data that schools report to the California Department of Public Health to understand the prevalence and spatial patterns of PBEs. The data include more than 7,000 public and private schools and about 500,000 kindergarteners in each year.

- The investigators classified students as either exempt (those with a PBE on file) or “adherent” (those up-to-date on immunizations, those whose immunizations were pending, and those with a permanent medical exemption). On average, about 7.6% of kindergarteners in 2010 had pending immunizations, and .02% had medical exemptions. Thus, some “adherents” were still at risk for contracting a vaccine-preventable disease.
- The investigators analyzed the exposure of students with PBEs to other kindergartners and to others with PBEs, and the vulnerability of students in schools with clusters of PBEs. High-PBE schools were defined as having a PBE rate of at least 20%, a threshold that would likely threaten herd immunity for some diseases.
- The investigators calculated the number and proportion of high-PBE schools, as well as the number and proportion of kindergartners (both exempted and adherent) attending high-PBE schools. These measures are a simple way to quantify the risk of disease outbreak due to compromised herd immunity.

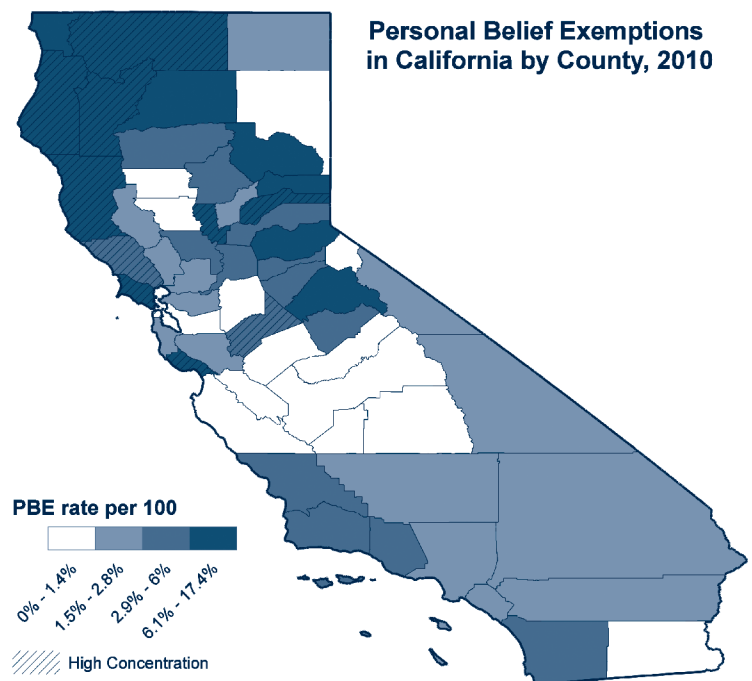
In California, children with PBEs face increasing exposure to other unvaccinated children

Statewide, the study found a trend toward a higher prevalence of PBEs, rising exposure to exempted kindergarteners within schools, and rising numbers of kindergarteners, both exempted and adherent, attending high-PBE schools.

- The number of kindergartners with PBEs rose from 9,201 in 2008 to 11,503 in 2010, a 25% increase. The PBE rate increased as well, from 1.9 to 2.3 per 100 kindergartners.
 - Exposure of adherent and exempted children increased as well. In 2010, the average adherent kindergartener in California attended a school with a PBE rate of 2.0 per 100 (up from 1.6 in 2008); the average exempted kindergartener attended a school with a PBE rate of 15.6 per 100 (up from 14.7 in 2008).
 - The number of high-PBE schools increased from 159 in 2008 to 187 in 2010. Enrollment at high-PBE schools also rose, from 5,322 to 7,522, a 36% increase. By 2010, 1.4% of all California kindergarteners and nearly one-quarter of exempted kindergarteners were enrolled in high-PBE schools.
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Exempted kindergarteners are unevenly distributed across counties and schools

The state-level data mask significant differences across the 58 counties in California. As shown in the map, the study found much variability between counties in the distribution of PBEs in 2010, and clusters of exempted students in certain schools.



- The numbers of PBEs ranged from 0 (Alpine County) to 1,898 (Los Angeles). The highest PBE prevalence rate was 17.4 per 100 (Nevada County).
- Exposure of exempted students to other such students varied significantly, even in counties with similar PBE counts and rates. For example, exempted kindergarteners have a 46% likelihood of encountering an exempted classmate in Sutter County, compared to 16.9% in El Dorado County.
- Clustering of students, and therefore vulnerability to outbreaks, is most apparent in the San Francisco Bay area and rural counties in the north and northwest regions of the state. In five counties (Sutter, Mendocino, Nevada, Humboldt, and Santa Cruz), more than half of exempted kindergarteners are enrolled in schools with a PBE rate of more than 20 per 100.

POLICY IMPLICATIONS

These results indicate a growing number of children who are not vaccinated upon school entry, and an increasing concentration of students with PBEs in counties and schools in California. These conditions create pockets of vulnerable schoolchildren at risk for future outbreaks, and threaten herd immunity and the continued control of many childhood diseases.

- The effects of increasing numbers and clustering of intentionally unvaccinated children are already being felt. Measles, a disease that had been virtually eradicated in the U.S., has returned. In 2011 there were 215 identified measles cases in the U.S., the highest number since 1996. Other outbreaks of vaccine-preventable diseases have occurred in the past few years as well.

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POLICY IMPLICATIONS

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- Maintaining parental choice about child health, including the decision to opt out of vaccine mandates, is important. At the same time, new strategies are needed for health promotion campaigns, vaccine counseling practices, and exemption policies that will alleviate parental concerns, limit the spread of incorrect information about vaccine safety and efficacy, and ultimately minimize exemptions. The methods used in this study can help policymakers identify vulnerable areas requiring focused vaccine promotion interventions.
- A few states have recently passed laws tightening the requirements for obtaining a PBE, including California, Washington, and Vermont. As of 2014, California will require that parents with philosophical objections to vaccines obtain a waiver from a physician or nurse practitioner saying they have received information about the risks and benefits of immunization.

This Issue Brief is based on the following article: A. Buttenheim, M. Jones, and Y. Baras. Exposure of California kindergartners to students with personal belief exemptions from mandated school entry vaccinations. American Journal of Public Health, August 2012, vol. 102, pp. e59-e66.

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