

Personal belief exemptions for vaccination put people at risk. Examine the evidence for yourself.

Enforcement of mandatory immunization requirements for children entering childcare facilities and schools has resulted in high immunization coverage levels. While all states and the District of Columbia allow exemptions from the requirements for medical reasons, and all but two offer exemptions to accommodate religious beliefs, 19 states allow exemptions based on parents' personal beliefs. Several recent outbreaks of measles, pertussis, and varicella (chickenpox) have been traced to pockets of unvaccinated children in states that allow personal belief exemptions. To understand the impact of vaccine refusal, examine the evidence for yourself.

1. **An outbreak of measles in an undervaccinated community.** Gahr P, DeVries AS, Wallace G, et al. *Pediatrics*. July 2014; 134(1):e220–e228.

Summary: In March 2011, measles was confirmed in a Minnesota child without travel abroad. An investigation was initiated to determine the source, prevent transmission, and examine measles-mumps-rubella (MMR) vaccine coverage in the affected community.

Key findings: Twenty-one measles cases were identified. The median age was 12 months (range, 4 months to 51 years) and 14 (67%) were hospitalized (range of stay, 2–7 days). The source was a 30-month-old US-born child of Somali descent infected while visiting Kenya. Measles spread in several settings, and over 3000 individuals were exposed. Sixteen case-patients were unvaccinated; 9 of the 16 were age-eligible: 7 of the 9 had safety concerns and 6 were of Somali descent. MMR vaccine coverage among Somali children declined significantly from 2004 through 2010 starting at 91.1% in 2004 and reaching 54.0% in 2010 ($P < 0.001$). This was the largest measles outbreak in Minnesota in 20 years, and aggressive response likely prevented additional transmission. Measles outbreaks can occur if undervaccinated subpopulations exist. Misunderstandings about vaccine safety must be effectively addressed.

Link: <http://pediatrics.aappublications.org/content/134/1/e220.abstract>

2. **Measles — United States, January 1–May 23, 2014.** CDC. *Morbidity and Mortality Weekly Report (MMWR)*, June 6, 2014; 63(22):496–9.

Summary: To update national measles data in the United States, CDC evaluated cases reported by states from January 1 through May 23, 2014. A total of 288 confirmed measles cases have been reported to CDC, surpassing the highest reported yearly total of measles cases since elimination (220 cases reported in 2011). Fifteen outbreaks accounted for 79% of cases reported, including the largest outbreak reported in the United States since elimination (138 cases and ongoing).

Key findings: The large number of cases this year emphasizes the need for health-care providers to have a heightened awareness of the potential for measles in their communities and the importance of vaccination to prevent measles. Most of the 288 measles cases reported this year have been in persons who were unvaccinated (200 [69%]) or who had an unknown vaccination status (58 [20%]); 30 (10%) were in persons who were vaccinated. Among the 195 U.S. residents who had measles and were unvaccinated, 165 (85%) declined vaccination because of religious, philosophical, or personal objections, 11 (6%)

were missed opportunities for vaccination, and 10 (5%) were too young to receive vaccination.

Link: www.ncbi.nlm.nih.gov/pubmed/24898167

3. **Communication and mass vaccination strategies after pertussis outbreak in rural Amish communities-Illinois, 2009-2010.** Medina-Marino A, Reynolds D, Finley C, Hays S, Jones J, Soyemi K. *J Rural Health*. 2013 Fall;29(4):413–9. doi: 10.1111/jrh.12019. Epub 2013 Mar 25.

Summary: During January 2010, 2 infants from an Amish community in east-central Illinois were hospitalized with pertussis. The local health department (LDH) intervened to control disease transmission, identify contributing factors, and determine best communications methods to improve vaccination coverage.

Key findings: Forty-seven cases were identified, with onsets during December 2009–March 2010. Median age was 7 (interquartile range 1–12) years. Nineteen (40%) patients were male; 39 (83%) were aged <18 years; 37 (79%) had not received any pertussis-containing vaccine. Presenting symptoms did not differ substantially between vaccinated and unvaccinated patients. Duration of cough was longer among unvaccinated than vaccinated patients (32 vs. 15.5 days, $P=0.002$). Compared with vaccinated patients, proportionately more unvaccinated patients reported secondary household transmission (30% vs. 72%; $P=0.012$). Through enhanced vaccination campaigns, 251 (~10%) Amish community members were administered 254 pertussis-containing vaccines. Targeted health communication and outreach resulted in a successful vaccine campaign and long-running monthly vaccination clinic. Amish do not universally reject vaccines, and their practices regarding vaccination are not static.

Link: www.ncbi.nlm.nih.gov/pubmed/24088215

4. **Nonmedical vaccine exemptions and pertussis in California, 2010.** *Pediatrics* 2013; 132(4):624–630.

Summary: Researchers analyzed nonmedical exemptions (NMEs) for children entering kindergarten from 2005 through 2010 and pertussis cases with onset in 2010 in California to determine if NMEs increased in that period, if children obtaining NMEs clustered spatially, if pertussis cases clustered spatially and temporally, and if there was statistically significant overlap between clusters of NMEs and cases.

Key findings: Previous studies have shown that nonmedical exemptions (NMEs) to immunization cluster geographically and contribute to outbreaks of vaccine-preventable diseases such as pertussis. The

2010 pertussis resurgence in California has been widely attributed to waning immunity from acellular pertussis vaccines. This study provides evidence of spatial and temporal clustering of NMEs and clustering of pertussis cases and suggests that geographic areas with high NME rates were also associated with high rates of pertussis in California in 2010.

Link: <http://pediatrics.aappublications.org/content/early/2013/09/24/peds.2013-0878>

5. **Measles—United States, January 1–August 24, 2013.** *CDC. MMWR* 2013; 62(36):741–3.

Summary: CDC evaluated cases reported by 16 states during January 1–August 24, 2013. A total of 159 cases of measles were reported during this period.

Key findings: Unvaccinated people place themselves and others in their communities at risk for measles and other vaccine preventable diseases. Measles is a highly contagious viral disease that is preventable by vaccination. In the United States, measles elimination (i.e. absence of year round transmission) was declared in 2000. However, measles continues to be imported into the United States from countries where measles is still common. During January 1–August 24, 2013, 159 measles cases, including 8 outbreaks were reported to CDC. An outbreak in New York City is the largest outbreak reported in the United States since 1996 (58 cases). Most cases were import-associated [157 (99 percent)] and in persons who were unvaccinated [131 (82 percent)] or had unknown vaccination status [15 (9 percent)]. Among U.S. residents who were unvaccinated, 92 (79 percent) have philosophical objection to vaccination. High vaccine coverage is important to prevent spread of measles following importation.

Link: www.cdc.gov/mmwr/preview/mmwrhtml/mm6236a2.htm

6. **Measles—United States, January–May 20, 2011.** *CDC. MMWR* 2011; 60(20):666–8.

Summary: During the first 19 weeks of 2011, 118 cases of measles were reported, the highest number reported for this period since 1996.

Key findings: Unvaccinated persons accounted for 105 (89%) of the 118 cases. Among the 45 U.S. residents aged 12 months–19 years who acquired measles, 38 (87%) were unvaccinated, including 24 whose parents claimed a religious or personal exemption and eight who missed opportunities for vaccination. Among the 42 U.S. residents aged >20 years who acquired measles, 35 (83%) were unvaccinated, including six who declined vaccination because of philosophical objections to vaccination. Of the 33 U.S. residents who were vaccine-eligible and had traveled abroad, 30 were unvaccinated and one had received only 1 of the 2 recommended doses.

Link: www.cdc.gov/mmwr/preview/mmwrhtml/mm6020a7.htm

7. **Measles in the United States during the postelimination era.** Parker Fiebelkorn A, Redd SB, Gallagher K, et al. *J Infect Dis* 2010; 202(10):1520–28.

Summary: A descriptive analysis of all cases of measles reported in the United States during 2001–2008.

Key findings: A total of 557 confirmed cases of measles and 38 outbreaks were reported during 2001–2008. Of these outbreaks, the 3 largest occurred primarily among personal belief exemptors (defined as persons who were vaccine eligible, according to recommendations of the Advisory Committee on Immunization Practices or the World

Health Organization, but remained unvaccinated because of personal or parental beliefs). During 2004–2008, a total of 68% of reported measles cases were among unvaccinated U.S. residents, who were age-eligible for vaccination but who claimed a personal belief exemption to state immunization requirements.

Link: www.ncbi.nlm.nih.gov/pubmed/20929352

8. **Measles outbreak in a highly vaccinated population, San Diego, 2008: role of the intentionally undervaccinated.** Sugerman DE, Barskey AE, Delea MG, et al. *Pediatrics* 2010;125(4):747–55.

Summary: Researchers mapped vaccination-refusal rates by school and school district, analyzed measles-transmission patterns, and conducted discussions and surveys to examine beliefs of parents who decline vaccination for their children.

Key findings: An intentionally unvaccinated 7-year-old child who was unknowingly infected with measles returned from Switzerland, resulting in 11 additional measles cases and in known measles exposure of more than 800 people. In San Diego, high personal belief exemption (PBE) rates were found in 10 schools (range, 42%–100%); schools and districts with high refusal rates were clustered geographically. Across all surveyed kindergartens, higher PBE rates correlated strongly with lower measles vaccination rates.

Link: www.ncbi.nlm.nih.gov/pubmed/20308208

9. **Parental refusal of varicella vaccination and the associated risk of varicella infection in children.** Glanz JM, McClure DL, Magid DJ, Daley MF, France EK, Hambidge SJ. *Archives of Pediatrics & Adolescent Medicine* 2010; 164(1):66–70.

Summary: A case-control study of 133 physician-diagnosed cases of varicella among Kaiser Permanente Colorado members between 1998 and 2008; each case was matched with 4 randomly selected controls (i.e., people who did not have varicella disease).

Key findings: Compared with children of vaccine-accepting parents, children of vaccine-refusing parents had a 9-fold higher risk of varicella illness. Overall, 5% of varicella cases in the study population were attributed to vaccine refusal.

Link: www.ncbi.nlm.nih.gov/pubmed/20048244

10. **Parental refusal of pertussis vaccination is associated with an increased risk of pertussis infection in children.** Glanz JM, McClure DL, Magid DJ, et al. *Pediatrics* 2009;123(6):1446–51.

Summary: A case-control study of 156 physician-diagnosed cases of pertussis among Kaiser Permanente Colorado members between 1996 and 2007; each case was matched with 4 randomly selected controls (n=595).

Key findings: Vaccine refusers had a 23-fold higher risk for pertussis when compared with vaccine acceptors, and 11% of pertussis cases in the entire study population were attributed to vaccine refusal.

Link: www.ncbi.nlm.nih.gov/pubmed/19482753

11. **Invasive Haemophilus influenzae type b disease in five young children — Minnesota, 2008.** CDC. *Morbidity and Mortality Weekly Report (MMWR)* 2009;58(03):58–60.

Summary: In 2008, during routine surveillance conducted by public health workers in Minnesota for invasive *H. influenzae* type b (Hib) disease, five children ages 5 months to 3 years were reported with invasive Hib disease; one child died.

- Key findings:** Three of the five children with invasive Hib disease had not been vaccinated. One of the children was too young to complete the primary series of Hib vaccine, and another child, who had completed the primary series, was found to have an immune disorder that impairs response to vaccination.
Link: www.cdc.gov/mmwr/preview/mmwrhtml/mm5803a4.htm
12. **Geographic clustering of nonmedical exemptions to school immunization requirements and associations with geographic clustering of pertussis.** Omer SB, Enger KS, Moulton LH, Halsey NA, Stokley S, Salmon DA. *Am J Epidemiol* 2008;168:1389–96.
Summary: Researchers evaluated the geographic clustering of personal belief exemptions in Michigan (1991–2004: N=4,495 schools) and measured the geographic overlap between exemption clusters and clusters of reported pertussis cases (1993–2004: N=1,109 cases among people 18 years and younger).
Key findings: Researchers reported significant overlap between clusters of exemptions and clusters of pertussis cases. In addition, exemption rates appear to be increasing in Michigan, and nonmedical exemptions tend to be geographically clustered.
Link: www.ncbi.nlm.nih.gov/pubmed/18922998
13. **Measles outbreak associated with a church congregation: a study of immunization attitudes of congregation members.** Kennedy AM, Gust DA. *Public Health Reports* 2008; 123(2):126–34.
Summary: Researchers conducted a focus group and interviews with church leaders and families following a measles outbreak among church members in Indiana.
Key findings: Vaccine refusal was attributed to a combination of personal religious beliefs and safety concerns among a subgroup of church members. Among interviewees from outbreak households, none had received MMR vaccine prior to the outbreak. Four of the six outbreak households reported that they would consider some or all recommended vaccines in the future.
Link: www.ncbi.nlm.nih.gov/pubmed/18457065
14. **Update: Measles—United States, January–July 2008.** CDC. *Morbidity and Mortality Weekly Report (MMWR)* 2008; 57(33):893–6.
Summary: A descriptive analysis of reported cases of measles occurring in the U.S. from January through July 2008.
Key findings: A total of 131 measles cases were reported to CDC during the first 7 months of 2008, the highest number of year-to-date reports since 1996. Fifteen patients, including 4 children younger than age 15 months, were hospitalized. One hundred twelve of the reported cases were unvaccinated or had unknown vaccination status; of these, 95 were eligible for vaccination. The majority of these 95 cases (66%) were children who were unvaccinated because of philosophical or religious beliefs.
Link: www.cdc.gov/mmwr/preview/mmwrhtml/mm5733a1.htm
15. **Impact of addition of philosophical exemptions on childhood immunization rates.** Thompson JW, Tyson S, Card-Higginson P, et al. *American Journal of Preventive Medicine*; 2007;32(3):194–201.
Summary: In fall 2003, Arkansas implemented a nonmedical (i.e., religious or philosophical) exemption process (Act 999). Investigators evaluated and compared the number and geographic clustering of exempted students 2 years before (year 1, year 2) and 2 years after (year 3, year 4) philosophical exemptions were made available in Arkansas.
Key findings: The addition of a philosophical or religious exemption from school mandates resulted in a significant increase in the total number of exemptions granted in Arkansas. In year 4, nonmedical exemptions were 2.58-fold higher than in year 1, whereas the absolute number of medical exemptions dropped by more than half compared with year 1. In the 10 districts with the highest exemption rates (range, 7.85–22.97 per 1,000 students), all exemptions granted were categorized as religious or philosophical.
Link: www.ncbi.nlm.nih.gov/pubmed/17296471
16. **Nonmedical exemptions to school immunization requirements: secular trends and association of state policies with pertussis incidence.** Omer SB, Pan WK, Halsey NA, et al. *JAMA* 2006; 296(14):1757–63.
Summary: Analysis of children claiming nonmedical exemptions at school entry, 1991–2004, and incidence of pertussis in children ages 18 years and younger, 1986–2004.
Key findings: Exemption rates for states that allowed only religious exemptions remained at about 1% between 1991 and 2004; however, in states that allowed exemptions for personal beliefs, the mean exemption rate increased from 0.99% to 2.54%. The study found associations between increased pertussis incidence and state policies that allowed personal belief exemptions or easily-obtained exemptions in general.
Link: www.ncbi.nlm.nih.gov/pubmed/17032989
17. **Implications of a 2005 measles outbreak in Indiana for sustained elimination of measles in the United States.** Parker AA, Staggs W, Dayan GH, et al. *N Engl J Med* 2006;355:447–55.
Summary: A case-series investigation of the largest documented U.S.-based measles outbreak since 1996; included molecular typing of viral isolates, surveys of vaccination rates, interviews about vaccination attitudes, and cost surveys.
Key findings: This U.S. measles outbreak was caused when an unvaccinated teenager returned from Romania and introduced measles into a group of children whose parents objected to vaccination. Among people exposed at a church gathering, 50 lacked immunity to measles, 16 (32%) of whom acquired measles. During the 6 weeks after the gathering, a total of 34 cases of measles were confirmed. Of the people with confirmed measles, 97% were members of the church, 94% were unvaccinated, and 82% were children ages 5 to 19 years. In this outbreak, 68% of the containment cost was incurred by a single hospital, where an undervaccinated employee potentially exposed children, immunocompromised patients, and employees to measles.
Link: www.ncbi.nlm.nih.gov/pubmed/16885548
18. **The cost of containing one case of measles: the economic impact on the public health infrastructure—Iowa, 2004.** Dayan GH, Ortega-Sanchez IR, LeBaron CW, Quinlisk MP, Iowa Measles Response Team. *Pediatrics* 2005;116:e1–e4.
Summary: Measurement of activities performed, personnel time and materials allocated, and direct costs incurred in 2004 U.S. dollars by the Iowa public health infrastructure during the study period of March 5 (date of first contact about possible case) through May 12, 2004 (date of final meeting).
Key findings: Total estimated cost of one case of measles: \$142,452, of which 75% was attributable to personnel costs and overhead.
Link: www.ncbi.nlm.nih.gov/pubmed/15995008

19. *Individual and community risk of measles and pertussis associated with personal exemptions to immunizations.* Feikin DR, Lezotte DC, Hamman RF, Salmon DA, Chen RT, Hoffman RE. *JAMA*. 2000; 284(24):3145–50.
- Summary:** A population-based, retrospective cohort study of all reported measles and pertussis cases among children ages 3–18 years in Colorado during 1987–1998.
- Key findings:** Exemptors were 22.2 times more likely to acquire measles and 5.9 times more likely to acquire pertussis than were vaccinated children. At least 11% of vaccinated children in measles outbreaks acquired infection through contact with exemptors.
- Link: www.ncbi.nlm.nih.gov/pubmed/11135778
20. *Health consequences of religious and philosophical exemptions from immunization laws: individual and societal risk of measles.* Salmon DA, Haber M, Gangarosa EJ, Phillips L, Smith NJ, Chen RT. *JAMA* 1999; 281(2):47–53.
- Summary:** A population-based, retrospective cohort study of measles surveillance data collected by the CDC from 1985 through 1992 and a review of annual state immunization program reports on prevalence of exemptors and vaccination coverage. The study group was restricted to school-aged children (5–19 years old).
- Key findings:** On average, exemptors were 35 times more likely to contract measles than were vaccinated persons.
- Link: www.ncbi.nlm.nih.gov/pubmed/10404911