

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, all but five offer exemptions to accommodate religious beliefs, and

17 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. **National Update on Measles Cases – United States, January 1 – October 1, 2019.** Patel M, Lee AD, Clemmons NS, et al. CDC. *Morbidity and Mortality Weekly Report (MMWR)*, October 11, 2019; 68(40):893–6.

SUMMARY: During January 1 through October 1, 2019, a total of 1,249 measles cases and 22 measles outbreaks were reported in the United States. This represents the most U.S. cases reported in a single year since 1992 and the second highest number of reported outbreaks annually since measles was declared eliminated in the U.S. in 2000. Among the 1,249 cases, 1,107 (89%) were in patients who were unvaccinated or had an unknown vaccination status. Eight of the 22 outbreaks occurred in underimmunized, close-knit communities, accounting for 85% of all cases. This includes closely related outbreaks in New York City (NYC) and New York State (NYS) that accounted for 934 (75%) of the 2019 cases.

KEY FINDINGS: The two sustained outbreaks in NYC and NYS were larger and lasted longer than the other U.S. outbreaks due to 1) pockets of low vaccination coverage and variable vaccine acceptance; 2) relatively high population density and closed social nature of the affected community; and 3) repeated importations of measles cases among unvaccinated persons traveling internationally and returning to or visiting the affected communities. Increased global measles activity and existence of under-vaccinated communities place the U.S. at continual risk for measles cases and outbreaks.

LINK: www.cdc.gov/mmwr/volumes/68/wr/mm6840e2.htm

2. **Community Outbreak of Measles – Clark County, Washington, 2018–2019.** Carlson A, Riethman M, Gastañaduy P, et al. CDC. *Morbidity and Mortality Weekly Report (MMWR)*, May 17, 2019; 68(19):446–7.

SUMMARY: On December 31, 2018, Clark County Public Health in Washington was notified of a suspected case of measles in an unvaccinated 10-year-old child, who had recently arrived from Ukraine. By January 16, an additional 12 laboratory-confirmed cases led to an approximately 200 person multiagency response. As of March 28, measles had been confirmed among 71 Clark County residents, with rash onsets from December 30, 2018 to March 13, 2019.

KEY FINDINGS: Among the 71 patients with confirmed measles, ages ranged from 1 to 39 years; 52 (73%) were children younger than 10 years. Sixty-one (86%) were unvaccinated, 3 (4%) had receive 1 dose of MMR before measles exposure, and vaccination status was unknown for 7 (10%).

LINK: www.cdc.gov/mmwr/volumes/68/wr/mm6819a5.htm

3. **Measles Outbreaks from Imported Cases in Orthodox Jewish Communities – New York and New Jersey, 2018–2019.** McDonald R, Ruppert PS, et al. CDC. *Morbidity and Mortality Weekly Report (MMWR)*, May 17, 2019; 68(19):444–5.

SUMMARY: On October 1, 2018, the New York State Department of Health was alerted about an unvaccinated traveler with diagnosed measles. Investigations through April 30, 2019 identified 242 lab-confirmed and epidemiologically linked measles cases in New York, primarily in members of orthodox Jewish communities. Rockland County, having the majority of cases, administered 19,661 doses of MMR vaccine. Nine informational events were held and 45,000 homes received educational materials. During October 17–November 30, 2018, 33 measles cases were confirmed in New Jersey, primarily in members of the orthodox Jewish community in Ocean County. Outbreak control measures included exclusion of unvaccinated students from schools and delivery of >12,500 doses of MMR vaccine.

KEY FINDINGS: Measles cases in unvaccinated travelers in both New York and New Jersey reported recent travel in Israel. In the New York outbreak, vaccination coverage in schools in the outbreak area was only 77%. Low community vaccination rates facilitated widespread measles transmission after introduction of imported measles in unvaccinated travelers.

LINK: www.cdc.gov/mmwr/volumes/68/wr/mm6819a4.htm

4. **Public Health Consequences of a 2013 Measles Outbreak in New York City.** Rosen JB, Arciuolo RJ, et al. *JAMA Pediatr.* 2018; 172(9): 811–7.

SUMMARY: Between March 13, 2013 and June 9, 2013, 58 persons in New York City with a median age of 3 years were identified as having measles. Among these individuals, 45 (78%) were at least 12 months old and were unvaccinated owing to parental refusal or intentional delay. In total, 3,351 exposed contacts were identified. Total direct costs to the New York City DOHMH were \$394,448, and a total of 10,054 hours were consumed responding to and controlling the outbreak.

KEY FINDINGS: This outbreak was fueled by the introduction of measles virus into a small number of families who had previously declined vaccination. The outbreak was prolonged, in part, owing to the spread of measles to infants too young to have been vaccinated and to the delay of vaccination among children. Geographic clustering of persons who refuse or decline vaccination, as observed in this and other outbreaks, has led to outbreaks following importations of a single case of measles. The

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response and containment of the 2013 measles outbreak were resource intensive. The response required assistance from a large number of staff, of whom almost one-third performed duties outside of their routine job descriptions, resulting in resources away from other public health activities.

LINK: <https://www.ncbi.nlm.nih.gov/pubmed/30073293>

5. ***The State of the Antivaccine Movement in the United States: A Focused Examination of Nonmedical Exemptions in States and Counties*** Olive JK, Hotez PJ, Damania A, Nolan MS. *PLOS Medicine*, June 12, 2018, 15(6): e1002578.

SUMMARY: Since 2009, the number of philosophical belief vaccine nonmedical exemptions (NMEs) has risen in 12 of the 18 states that allow this policy. Analysis found states with higher overall NME rates do, in fact, have lower MMR vaccine coverage.

KEY FINDINGS: New foci of antivaccine activities have been established in major metropolitan areas, rendering select cities vulnerable for vaccination-preventable diseases. As noted by the recent experience in Anaheim, California, low vaccination rates resulted in a measles outbreak. In contrast, state closure of NMEs has resulted in an increase of MMR coverage.

LINK: <https://www.ncbi.nlm.nih.gov/pubmed/29894470>

6. ***Containing a Measles Outbreak in Minnesota, 2017: Methods and Challenges***. Banerjee E, Griffith J, Kenyon C, et al. *Perspectives in Public Health*, first published September 4, 2019

SUMMARY: The Minnesota Department of Health undertook rapid public health actions within 2 hours of confirmation of the first cases of measles. A total of 75 cases from March 30 to August 25, 2017 were eventually identified. Somali Minnesotan comprised 81% of the cases, unvaccinated 91%, and 28% were hospitalized. Median age of cases was 2 years (range: 3 mos to 57 yrs). Most transmission (78%) occurred in childcare centers and households. At least 8,490 individuals were exposed to measles. Over 500 persons were excluded from childcare and schools. State and key public health partners spent an estimated \$2.3 million on the response.

KEY FINDINGS: This outbreak demonstrated the necessity of immediate, targeted disease control actions and strong public health, healthcare, and community partnerships to end a measles outbreak.

LINK: <https://doi.org/10.1177/1757913919871072>

7. ***Measles Outbreak – Minnesota, April–May, 2017***. Hall V, Banerjee E, Kenyon C, et al. *CDC. Morbidity and Mortality Weekly Report (MMWR)*, July 14, 2017; 66(27):713–7.

SUMMARY: Between April 10 and May 31, 2017, a total of 65 confirmed measles cases were reported to the Minnesota Department of Health. During that time, confirmed measles patients were identified in 5 schools, 12 child care centers, 3 healthcare facilities, and numerous households. An estimated 8,250 persons were potentially exposed to measles in these settings. Sixty-two (95%) cases were in unvaccinated persons,

including 50 (77%) in children who were age-eligible for vaccination. U.S.-born children of Somali descent accounted for 55 (85%) of the cases. As of May 31, 20 (31%) patients had been hospitalized, primarily for treatment of dehydration or pneumonia; no deaths had been reported. In a community with previously high vaccination coverage, concerns about autism, the perceived increased rates of autism in the Somali-American community, and the misunderstanding that autism was related to the MMR vaccine had resulted in a decline in MMR vaccination coverage, a level low enough to sustain widespread measles transmission in the Somali-American community following introduction of the virus.

KEY FINDINGS: While numerous studies have consistently documented that there is not a relationship between vaccines and autism, this outbreak demonstrated the challenge of combating misinformation about MMR vaccine. In addition, state and county public health personnel were key in creating long-term, trusted relationships with communities to disseminate scientific information in a culturally-appropriate and effective manner.

LINK: www.cdc.gov/mmwr/volumes/66/wr/mm6627a1.htm

8. ***Association between vaccine refusal and vaccine-preventable diseases in the United States: a review of measles and pertussis***. Phadke VK, Bednarczyk RA, Salmon DA, Omer SB. *JAMA* 2016; 315(11): 1149–58.

SUMMARY: A review of 18 published reports of U.S. measles outbreaks from January 2000 through November 2015 and 32 published pertussis outbreaks from January 1977 through November 2015 to assess disease risk in the context of vaccine delay or exemption.

KEY FINDINGS: The researchers found that more than half of the measles cases (56.8%) occurred in children whose parents refused measles vaccination. In the pertussis studies, many of the cases (24%–45%) in the five largest statewide pertussis outbreaks occurred in unvaccinated or undervaccinated populations. In addition, both the measles and the pertussis outbreaks occurred not only among unvaccinated individuals but also among vaccinated individuals in geographic locations with a high prevalence of vaccine exemptions.

LINK: <https://www.ncbi.nlm.nih.gov/pubmed/26978210>

9. ***Measles – United States, January 4–April 2, 2015***. CDC. *Morbidity and Mortality Weekly Report (MMWR)*, April 17, 2015; 64(14):73–6.

SUMMARY: To update surveillance data on current measles outbreaks, CDC analyzed cases reported during January 4–April 2, 2015. A total of 159 cases were reported during this period; over 80% of the cases occurred among persons who were unvaccinated or had unknown vaccination status.

KEY FINDINGS: A total of 111 of the 159 cases were associated with an outbreak that originated in late December 2014 in Disney theme parks in Orange County, California. Cases associated with this outbreak were reported from seven U.S. states, Mexico, and Canada. Other smaller outbreaks without a link to the

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Disney outbreak occurred in Illinois (15 cases), Nevada (9), and Washington (5). The majority of the 159 cases were either unvaccinated (71 [45%]) or had unknown vaccination status (60 [38%]); 28 (18%) had received measles vaccine.

LINK: www.cdc.gov/mmwr/preview/mmwrhtml/mm6414a1.htm

10. **Outbreak of pertussis in a school and religious community averse to health care and vaccinations – Columbia County, Florida, 2013.** CDC. *MMWR*, August 1, 2014; 63(30):655.

SUMMARY: Health department staff in a Florida county investigated a report of an unvaccinated student who had lab-confirmed pertussis. The 316 students in the affected school were part of a larger community that was averse to health care and vaccinations. For example, only five (15%) of 34 students in kindergarten and one (5%) of 22 students in seventh grade were fully vaccinated; of those who were not fully vaccinated, 84% had religious exemptions.

KEY FINDINGS: Despite the availability of free vaccine through the local health department, very few persons from the community took advantage of the offer. At the conclusion of the outbreak, the investigation found a total of 109 cases in the community, including 94 students and one teacher in the affected school and 14 household contacts of the initial case.

LINK: www.cdc.gov/mmwr/preview/mmwrhtml/mm6330a3.htm

11. **Religious exemptions for immunization and risk of pertussis in New York state, 2000–2011.** Imdad A, Tserenpuntsag B, Blog DS, Halsey NA, Easton DE, Shaw J. *Pediatrics* 2013;132(1):37-43.

SUMMARY: Researchers reviewed reported religious vaccination exemptions to the NYS Department of Health from 2000 through 2011. Changes in exemptions were assessed against incidence rates of childhood pertussis.

KEY FINDINGS: Counties with higher exemption rates had higher rates of reported pertussis among exempted and vaccinated children when compared with counties having low exemption rates.

LINK: www.ncbi.nlm.nih.gov/pubmed/23733795

12. **An outbreak of measles in an undervaccinated community.** Gahr P, DeVries AS, Wallace G, et al. *Pediatrics*. July 2014; 134(1):e220–8.

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 U.S.-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: <https://www.ncbi.nlm.nih.gov/pubmed/24913790>

13. **Measles – United States, January 1–May 23, 2014.** CDC. *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: https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6322a4.htm?s_cid=mm6322a4_w

14. **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.

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

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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: <https://www.ncbi.nlm.nih.gov/pubmed/24088215>

15. **Nonmedical vaccine exemptions and pertussis in California, 2010.** Atwell JE, Van Otterloo J, Zipprich J, et al. *Pediatrics* 2013; 132(4):624-30.

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: <https://www.ncbi.nlm.nih.gov/pubmed/24082000>

16. **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

17. **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

18. **Measles in the United States during the postelimination era.**

Parker Fiebelkorn A, Redd SB, Gallagher K, et al. *J Infect Dis* 2010; 202(10):1520–8.

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: <https://www.ncbi.nlm.nih.gov/pubmed/20929352>

19. **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.

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20. **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:** <https://www.ncbi.nlm.nih.gov/pubmed/20048244>
21. **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
22. **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
23. **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:** <https://www.ncbi.nlm.nih.gov/pubmed/18922998>
24. **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:** <https://www.ncbi.nlm.nih.gov/pubmed/18457065>
25. **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
26. **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:** <https://www.ncbi.nlm.nih.gov/pubmed/17296471>

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27. **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:** <https://www.ncbi.nlm.nih.gov/pubmed/17032989>
28. **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:** <https://www.ncbi.nlm.nih.gov/pubmed/16885548>
29. **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:** <https://www.ncbi.nlm.nih.gov/pubmed/15995008>
30. **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:** <https://www.ncbi.nlm.nih.gov/pubmed/11135778>
31. **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;282(1):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:** <https://www.ncbi.nlm.nih.gov/pubmed/10404911>