Measles, misinformation, and risk: personal belief exemptions and the MMR vaccine

Johnathan Bowes

Department of Science and Society, Duke University, Durham, NC.

INTRODUCTION

Across the United States, children entering schools are required to get a series of vaccinations that includes the measles, mumps, and rubella (MMR) vaccine. Designed to prevent those three devastating childhood illnesses, the MMR vaccine has proven highly effective and low risk. By the year 2000, decades of the vaccine’s use in the US led to the official elimination of measles in this country; during those decades, children had severe, vaccine-associated adverse reactions so infrequently that the Centers for Disease Control and Prevention (CDC) does not report them as causally linked. Nonetheless, a now-retracted 1998 paper linked the MMR vaccine with the development of autism. This paper set off the most-recent anti-vaccination movement—a wave of fear and mistrust of vaccines (and particularly of MMR) that persists in some communities to this day.

Because of a clustering of such communities in affluent regions of California, epidemiological conditions in the state became favorable for a new,
widespread outbreak of measles.\textsuperscript{6} Such an outbreak began at Southern California’s Disneyland in early 2015.\textsuperscript{7}

As the outbreak spread to 23 other states and the District of Columbia, it reignited debates about states’ exemptions from their MMR mandates. Those exemptions fall into two categories: medical and non-medical. Generally, the latter category further divides into religious exemptions and philosophical exemptions; the latter of these often becomes the tool that anti-vaccine parents use to avoid MMR. Though only two states (California and Vermont) have entirely eliminated their philosophical exemptions in response to the Disneyland outbreak, several other states have at least considered either restriction or complete elimination of philosophical exemptions as a means to improve vaccination rates. In doing so, those states have sparked debates about the ethics of MMR immunization mandates and their exemptions.

This paper first outlines some of the basic science around measles and the MMR vaccine. This science is essential to understanding the debates around the vaccine exemption laws. This paper then discusses the different types of exemption laws with a focus on who uses them. After summarizing the specific circumstances of the 2015 Disneyland outbreak, this paper considers the two main sides of the ethical debate around vaccine exemption. This consideration leads to the conclusion that states considering changes to their vaccine exemption laws should balance the concerns of both those who support and those who oppose vaccines. Striking that balance will be crucial to developing the right changes to the laws around the MMR vaccine—which will promote higher vaccination rates and prevent future harm to children from measles outbreaks.

\section*{MEASLES AND ITS TRANSMISSION}
Measles is a viral infectious disease that affects humans—primarily young children. Measles’ symptoms characteristically include generalized rash and fever; symptoms can include cold symptoms, conjunctivitis (pink eye), and Koplik spots (white spots on the inside of the cheeks). The rash lasts between a few days and a week, though the other symptoms tend to appear before the rash. Measles can be fatal in some cases.\textsuperscript{8}

The measles virus is transmitted between people through one of two ways: (i) microscopic droplets that remain airborne for up to two hours; or (ii) direct contact with secretions from an infected person’s nose or throat.\textsuperscript{9} On average, it takes 10 days for the virus to incubate in the human body, and a person can be infectious several days before developing the rash associated with the disease.\textsuperscript{10}

Because of these factors, measles spreads both easily and quickly. Estimates for the transmissibility of measles (represented through the basic reproduction rate, or $R_0$)

\begin{itemize}
  \item Karen Kaplan, Vaccine Refusal Helped Fuel Disneyland Measles Outbreak, Study Says, L.A. TIMES (Mar. 16, 2015, 5:30 PM), \url{http://www.latimes.com/science/sciencenow/la-sci-sn-disneyland-measles-under-vaccination-20150316-story.html} (accessed Oct. 6, 2016).
  \item Id.
  \item Department of Health & Human Services, State Government of Victoria, Australia, \textit{Measles}, \url{https://www2.health.vic.gov.au/public-health/infectious-diseases/disease-information-advice/measles} (accessed Oct. 6, 2016).
  \item Id.
  \item Id.
\end{itemize}
mark it as a disease that can easily cause epidemics. In North America, the $R_0$ for measles has been roughly estimated at 12.5.\textsuperscript{11} In practical terms, this means that the average US child infected with measles would spread the disease to more than a dozen other children—were it not for measles vaccination through the MMR vaccine.

**THE MMR VACCINE AND ITS EPIDEMIOLOGIC EFFECTS**

The MMR vaccine is a multi-dose, live attenuated vaccine\textsuperscript{12} most often required for US kindergarteners and seventh graders. (Some jurisdictions, such as Arkansas, also require that incoming college students have the vaccine;\textsuperscript{13} others also offer a version of the vaccine that includes protection for varicella, or chicken pox, in addition to the standard three viruses.) The CDC recommends that children receive their doses of the vaccine while in two specific age ranges: one dose in the few months after their first birthday, and the second dose while between the ages of four and six.\textsuperscript{14} When given via this schedule, the standard vaccine confers immunity to measles (and the other two viruses) to 97% of vaccinated children. The remaining 3% may still contract one of those diseases, though often with milder symptoms.\textsuperscript{15}

Beyond the fairly minimal risk of non-immunity, there remains some risk for a small number of adverse reactions. The most severe of those potential reactions include an acute allergic response to the vaccine’s components, deafness, long-term seizures, and permanent brain damage.\textsuperscript{16} However, such responses are rare: They only occur in one out of every one million cases (or 0.0001%). The vast majority of adverse reactions, including rashes and fevers that occur in 5% and 16% of cases, respectively, are both temporary and mild.\textsuperscript{17} Even with the rarity of severe reactions, clinicians discourage the vaccination of children if they show signs of susceptibility to those reactions. Clinicians also discourage vaccination of children who are not well enough to receive the vaccine (eg those undergoing treatment for cancer or those who have HIV/AIDS).\textsuperscript{18}

In ideal situations, both those who are immunized but not fully immune and those who cannot be immunized still receive the vaccine’s full protection—albeit indirectly. That indirect protection, termed herd immunity, requires high rates of vaccination to surround and shield those vulnerable to the disease by those made invulnerable through vaccination. High rates of vaccination make it more difficult for a vulnerable person to be in close proximity to an infected one. Because proximity is necessary for the

\textsuperscript{11} Nigel J. Gay, *The Theory of Measles Elimination: Implications for the Design of Elimination Strategies*, 189 J. INFECT. DIS. (Supplement 1) S27–35 (2004), https://jid.oxfordjournals.org/content/189/Supplement_1/S27.full.pdf (accessed Oct. 6, 2016).

\textsuperscript{12} Centers for Disease Control and Prevention, *Vaccines & Immunization: Measles – Q&A about Disease & Vaccine*, http://www.cdc.gov/vaccines/vpd-vac/measles/faqs-dis-vac-risks.htm (accessed Oct. 6, 2016).

\textsuperscript{13} Centers for Disease Control and Prevention, *Vaccines & Immunization: Measles Vaccination*, http://www.cdc.gov/vaccines/vpd-vac/measles/ (accessed Oct. 6, 2016).

\textsuperscript{14} Centers for Disease Control and Prevention, *Vaccines & Immunization: Measles – Q&As about Disease & Vaccine*, http://www.cdc.gov/vaccines/vpd-vac/measles/faqs-dis-vac-risks.htm (accessed Oct. 6, 2016).

\textsuperscript{15} Centers for Disease Control and Prevention, *Vaccines & Immunization: Measles – Q&A about Disease & Vaccine*, http://www.cdc.gov/vaccines/vpd-vac/measles/faqs-dis-vac-risks.htm (accessed Oct. 6, 2016).

\textsuperscript{16} Centers for Disease Control and Prevention, *Vaccine Information Statement: MMR Vaccine*, http://www.cdc.gov/vaccines/hcp/vis/vis-statements/mmr.pdf (accessed Oct. 6, 2016).

\textsuperscript{17} Centers for Disease Control and Prevention, *supra* note 1.

\textsuperscript{18} Centers for Disease Control and Prevention, *supra* note 3.
transmission of measles, herd immunity makes it more difficult for children vulnerable to infection to actually become infected.

To achieve herd immunity for measles, the vaccination rate must be roughly 96% or higher. As such, all 50 states, the District of Columbia, and several US territories require that children entering schools and childcare centers (even ones not operated by the government) be vaccinated with at least the MMR dosage recommended by the CDC.

**VACCINE EXEMPTION LAWS AND THEIR USERS**

Nonetheless, policy makers have left certain limited exemptions to their states’ vaccine mandates in place. Because of their eligibility limits, exemptions theoretically allow for only a small number of children to avoid vaccination. As such, while maintaining a high immunization rate overall, exemptions recognize situations in which the vaccination of specific children would be inappropriate. Medical exemptions are allowed, for example, in situations where clinicians deem it medically unsound to vaccinate a child—such as for children who are immunocompromised through chemotherapy or HIV/AIDS. But in addition to medical exemptions, most states have, at least historically, also allowed parents to receive exemptions for their children on two non-medical bases: religious beliefs and philosophical (ie non-religious, personal) beliefs.

The religious belief exemptions focus on communities of faith. They take into account that a number of religious groups and denominations follow doctrines inconsistent with modern vaccination. Some of these groups disfavor only some vaccines because aspects of their production violate their beliefs; until recently, these groups included Roman Catholic congregations, which opposed the rubella 27/3-strain vaccine because of its developmental origins in cells derived from an aborted fetus. Others, including the Church of Christ, Scientist (often known as Christian Science), oppose vaccines in and of themselves. Though not all members of these religious groups seek exemptions to states’ MMR mandates, many of those who are strict adherents will. Before 2015, 48 states and the District of Columbia had laws allowing for religious exemptions to their vaccine mandates (Figure 1a).

Unlike these faith-based exemptions, philosophical exemptions focus on individuals rather than on communities: In jurisdictions that do not combine their religious and philosophical exemptions, the latter cater to people who, for deeply held reasons, object to allowing the vaccination of their children. Many who have such personal beliefs consider themselves as part of an anti-vaccination movement that began in the late 1990s and early 2000s. This movement, which has its strongest influence in the US and the UK, got its start because of a 1998 ‘Lancet’ paper linking the MMR vaccine to autism. Despite the subsequent retraction of that paper—and the medical community’s repudiation of its lead author, Andrew Wakefield—many anti-vaccine parents seek personal

19 Maimuna S. Majumder et al., *Substandard Vaccination Compliance and the 2015 Measles Outbreak*, 169.5 JAMA Pediatrics 494–95 (2015), [http://dx.doi.org/10.1001/jamapediatrics.2015.0384](http://dx.doi.org/10.1001/jamapediatrics.2015.0384) (accessed Oct. 6, 2016).

20 John D. Grabenstein, *What the World’s Religions Teach, Applied to Vaccines and Immune Globulins*, 31.16 VACCINE 2011–23 (2013), [http://linkinghub.elsevier.com/retrieve/pii/S0264-410X(13)00189-8](http://linkinghub.elsevier.com/retrieve/pii/S0264-410X(13)00189-8) (accessed Oct. 6, 2016).

21 Id.

22 Centers for Disease Control and Prevention, *supra* note 1.
belief exemptions on the grounds that MMR and other immunizations pose a danger to their children. To ensure that such misunderstandings and misinformation do not influence the decisions of people seeking philosophical exemptions, some states have required that vaccine-objecting parents consult with a clinician before the state

Andrew J. Wakefield et al., supra note 4.
grants an exemption.24 Prior to 2015, 19 states allowed for personal belief exemptions25 (Figure 1a).

Despite the individual focus of these exemptions, however, many people who use them have tended to cluster together and form communities.26 Tending to appear in affluent and homogeneously Caucasian areas—where access to a high standard of medical care is the norm—these communities inevitably led to childhood vaccination rates that fall far below the thresholds required for effective herd immunity.27 Many communities with such sub-par rates of immunization have developed in California, where some schools and counties have seen MMR vaccination rates fall to only 25% for the 2014–15 school year.28

THE DISNEYLAND MEASLES OUTBREAK AND ITS LEGAL EFFECTS

Those conditions set the stage for an outbreak of one or more of the diseases prevented by the MMR vaccine. Beginning in late December 2014 and lasting well into 2015, such an outbreak began at the Disneyland amusement park in Anaheim, California. An unknown index patient (believed to have traveled from the Philippines) brought the measles virus to Disneyland in mid-December. Because of the incubation period for measles, that patient may not have shown any symptoms of the disease before arriving at the park. Similarly, children infected at the park often did not begin to show symptoms before returning home and passing the virus on to others. At its peak, the outbreak caused 113 children in multiple states to develop measles. Thankfully, the outbreak caused no known deaths.29

In the aftermath of the Disneyland measles outbreak, a number of states began to reevaluate their vaccine exemption laws—particularly their philosophical exemptions. By late July, California had repealed both of its non-medical vaccine exemptions; the state now joins Mississippi and West Virginia in having the least lenient exemption laws. Though nine other states had at least considered similar measures by the summer of 2015, only Vermont removed an entire class of exemptions (personal belief) from its legal code (Figure 1b). Meanwhile, none of the four measures introduced in 2015 to establish new philosophical exemptions succeeded.30

THE ETHICAL DEBATE ON MMR VACCINE EXEMPTIONS

The legal reevaluations that the Disneyland outbreak sparked have reopened debates on the ethics of vaccination mandates, particularly for MMR. Generally speaking, two sides

24 National Vaccine Information Center, Vaccine Laws, http://www.nvic.org/vaccine-laws.aspx (accessed Oct. 6, 2016).
25 State Allowable Exemptions for Schools, CENTERS FOR DISEASE CONTROL AND PREVENTION, http://www2a.cdc.gov/nip/schoolsur/schimirqmt.asp (accessed Oct. 6, 2016) (in the ‘State Allowable Exemptions for Schools’ box, choose ‘All Grantees’ from the dropdown menu labeled ‘Grantees’).
26 Tracy A. Lieu et al., supra note 5.
27 Matthew Bloch et al., Vaccination Rates for Every Kindergarten in California, THE N.Y. TIMES (Feb. 6 2015), http://www.nytimes.com/interactive/2015/02/06/us/california-measles-vaccines-map.html (accessed Oct. 6, 2016).
28 Id.
29 Centers for Disease Control and Prevention, Measles Cases and Outbreaks, http://www.cdc.gov/measles/cases-outbreaks.html (accessed Oct. 6, 2016).
30 Y. Tony Yang et al., Measles Outbreak as a Catalyst for Stricter Vaccine Exemption Legislation, 314.12 JAMA 1229–30 (2015), http://dx.doi.org/10.1001/jama.2015.9579 (accessed Oct. 6, 2016).
exist in those debates: One side supports vaccine mandates as a public good and rejects at least some non-medical exemptions; the other side insists that vaccine mandates infringe individual (parental) rights and duties that philosophical exemptions protect.

Taking the latter position, many non-religious ‘anti-vaxxers’ sincerely believe that immunizations, and the MMR vaccine in particular, are either more dangerous than clinicians will admit or somehow not conducive to the natural development of a child. Parents opposed to vaccines on these grounds thus see their opposition as an essential means of protecting their children from harm. As such, they argue that non-medical exemptions based on personal beliefs help them to properly fulfill their responsibilities as parents. Given the anti-authority bent of many such arguments, this fundamental proposition of the anti-vaccine side resonates with a high proportion of young people—many of whom have just reached typical parenting age in the US.

For the rare immunization opponents, who both recognize the benefits of vaccines for the general populace while still fearing harm to their children from them, these parental rights positions take on a deontological character. Parents adopting such arguments hold that their individual duties as the protectors of their children’s health takes precedence to any duty to protect the children of their neighbors—or to comply with state vaccination mandates. As such, though they do not want to block others from participating in state MMR mandates, they themselves use (and advocate for) philosophical exemptions.

The other side of the debate (which includes the CDC, the American Medical Association, and this country’s most well-respected authorities on health and medicine) completely rejects the belief that the MMR vaccine is an unreasonably risky medical intervention. Instead, these proponents of vaccination tout the fact that vaccine-preventable diseases (VPDs) pose a much greater threat to the health and wellbeing of children than the vaccines themselves; they thus support the vaccine mandates as the primary means of establishing medically effective herd immunity rates around the country. Health authorities have pointed to the documented connections between the Disneyland outbreak and low vaccination rate clusters to support their position.

If some anti-vaccine parents approach the issue of vaccine exemptions from a deontological basis, then most clinicians and medical lay people who advocate for fewer exemptions take a utilitarian stance. That stance focuses on achieving the greatest benefit for the most number of people. As such, it justifies the rare cases of serious harm (such as allergic reactions to the MMR vaccine) by balancing them against the extensive benefits that vaccines bring; after all, though one in one million children will have

31 Taylor Wofford, American Medical Association Announces New Mandatory Vaccine Policy, NEWSWEEK (Jun. 9, 2015, 4:27 PM), http://www.newsweek.com/american-medical-association-time-mandatory-vaccines-341413 (accessed Oct. 6, 2016).
32 National Vaccine Information Center, About National Vaccine Information Center, http://www.nvic.org/about.aspx (accessed Oct. 6, 2016).
33 VacTruth.com, 10 Reasons Not To Vaccinate, http://vactruth.com/2014/12/12/10-reasons-not-to-vaccinate/ (accessed Oct. 6, 2016).
34 California Coalition for Vaccine Choice, SB 277, http://www.sb277.org/ (accessed Oct. 6, 2016).
35 Alexandra Sifferlin, Millennials More Likely to Say Vaccines are a Parent’s Choice, TIME (Feb. 2 2015), http://time.com/3692402/young-people-vaccines/ (accessed Oct. 6, 2016).
36 Maimuna S. Majumder et al., supra note 19.
a severe adverse reaction to their first MMR dose, most of the remaining 999,999 will not contract a life-threatening disease.

**IMPLICATIONS OF THE ETHICAL DEBATE**

The goal for state law- and policy-makers around the MMR vaccine must be to prevent future harm to children through measles outbreaks. The best way to do so is to raise vaccination rates to the levels needed for herd immunity. But given the opposing concerns and approaches of the pro-vaccine side (public health) and the anti-vaccine side (individual liberty and individual health), achieving this solution unilaterally will be practically impossible. While state governments can usually succeed in making the case that public health concerns outweigh the parental duties claimed by anti-vaxxers, doing so does not encourage willing acceptance of necessary immunizations. Neither, too, does writing off anti-vaccine parents as uninformed or unreasonable—in other words, as beyond hope. Though their views do not align with mainstream science and medicine, the involvement of such parents will be necessary in any effort to improve vaccination rates. After all, parents must consent to any treatment of their children.

In working to avoid future outbreaks of measles and other VPDs in the US, it is imperative for politicians and other policy makers to approach the issue of vaccine exemptions in a way that appeals to both sides—or at least in a way that shows both sides a sufficient amount of respect. Doing so will ensure good vaccine policy. Doing so should also encourage more willing compliance with that policy from the maximal number of parents. By approaching anti-vaccine parents in ways that demonstrate respect (rather than ways that cast policy makers as uncaring bureaucrats), they may be more willing to hear what policy makers have to say. The outcomes of better policy and better compliance would ensure the best possible situation for public health and measles prevention.

For states still considering changes to their vaccine exemption laws, this balanced approach could take the form of regulatory parsimony. Often referenced by the President’s Commission for the Study of Bioethical Issues, the idea of regulatory parsimony is to use the minimum amount of governmental power necessary to ensure ethical behaviors. In the context of the MMR vaccine, these states could evaluate how little change is needed to adequately guarantee sufficient immunization rates for herd immunity. In California, for instance, the vast majority of exemptions that parents sought for their children were philosophical ones. The state’s elimination of religious exemptions will thus have an insignificant effect on the MMR vaccination rates in low-rate clusters; while those exemptions are of incredible importance for the small minority that uses them, they have little actual importance to public health efforts to combat measles. Leaving religious exemptions largely intact (or only limiting them in cases of epidemics) could have effectively demonstrated a degree of concern for parental decision-making rights while still decreasing the risk for future dangerous outbreaks. Such a demonstration in other states could start to convince skeptical, anti-vaccine parents that their interests can be aligned with those of public health officials. More overtures towards anti-vaccine parents will likely need to follow, however. When policy makers engage with those who oppose vaccination for their children, protecting children from measles outbreaks will become much more feasible.

---

37 Matthew Bloch et al., *supra* note 27.