

Measles and the Modern History of Vaccination

Elena Conis, PhD, MS, MJ^{1,2} 

Public Health Reports
2019, Vol. 134(2) 118-125
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DOI: 10.1177/0033354919826558
journals.sagepub.com/home/phr



Abstract

The modern era of vaccination was heralded with the licensure of the first 2 measles vaccines in 1963. This new era was distinct from the preceding era of vaccination for 4 main reasons. First, federal leadership in support of immunization at the local level grew. Second, immunization proponents championed the required vaccination of children as the best means of ensuring a protected population. Third, immunization proponents championed the idea that mass vaccination would not only help manage infectious diseases but also eradicate them. Fourth, the focus of local and federally supported immunization initiatives began to extend to the “mild” and “moderate” diseases of childhood (eg, measles), so-called because they were seen as less severe than previous targets of mass vaccination, such as smallpox, polio, and diphtheria. This article follows the history of measles to explore immunization successes and challenges in this modern era, because measles was the first of the mild and moderate diseases to become the target of a federally supported eradication-through-vaccination campaign, one that relied heavily on the preemptive, required vaccination of children. Its story thus epitomizes the range of political, epidemiological, cultural, and communications challenges to mass immunization in the modern era of vaccination.

Keywords

measles, history, vaccines, vaccination, immunization, anti-vaccination

In fall 1962, a new measles vaccine was imminent, and producers at CBS wanted the story. The producers reached out to the Office of the Surgeon General, whose information specialists were eager to help; after all, the US Public Health Service wanted publicity for the vaccine. The specialists worked with CBS’s reporter for weeks, giving him access to “all sources of information.”¹ The resulting broadcast, “The Taming of a Virus,” dramatized the development of 2 new measles vaccines and detailed the disease’s toll in West Africa, where it killed 1 in 5 children younger than age 6.²

In the United States, measles was far less deadly, with a mortality rate of 1 in 500 000 in 1960.³ The television program’s focus on West Africa, then, was strategic. It portrayed the United States as a global superpower exercising its beneficence through biomedicine, and it vividly illustrated something the US Public Health Service was eager to tell the public: that measles was a “major health hazard” that could be “crippling,” if not fatal.² For in the 1960s, measles was not uniformly regarded as serious in the United States. Measles was “often welcomed as a guarantee of lifetime immunity,” as the Surgeon General’s information specialists put it; people saw it as “trivial” and “basically a disease of childhood.”² All these views complicated the US Public Health Service’s job, which was not just to inform the public about the vaccine but to change public opinion about the disease.

This public relations challenge—the need to change the public’s mind about the disease target of a new vaccine—has been met and overcome time and again in the modern era of vaccination, which was heralded in the 1960s with the licensure of the first 2 measles vaccines. This new era was distinct from the preceding era of vaccination for 4 main reasons. First, federal leadership in support of immunization at the local level grew. Second, immunization proponents championed the required vaccination of children as the best means of ensuring a protected population. Third, such proponents championed the idea that mass vaccination would not just help manage infectious diseases but also eradicate them. And fourth, the focus of local and federally supported immunization initiatives began to extend to the “mild” and “moderate” diseases of childhood, such as measles, so-called by medical and public health professionals because they were seen as

¹ Graduate School of Journalism and Center for Science, Technology, Medicine, and Society, University of California, Berkeley, Berkeley, CA, USA

² Department of Anthropology, History, and Social Medicine, University of California, San Francisco, San Francisco, CA, USA

Corresponding Author:

Elena Conis, PhD, MS, MJ, University of California, Berkeley, 121 North Gate Hall, Berkeley, CA 94720, USA.

Email: econis@berkeley.edu

less severe than previous targets of mass vaccination, such as smallpox, polio, and diphtheria.⁴ Measles was the first such disease to become the target of a federally supported eradication-through-vaccination campaign, one that relied heavily on the preemptive, required vaccination of children. Its story thus epitomizes the range of political, epidemiological, cultural, and communications challenges to mass immunization in the modern era of vaccination.

Two New Vaccines

The first 2 measles vaccines were licensed on Thursday, March 21, 1963. “The Taming of a Virus” aired that Sunday, one part of a massive publicity campaign. Nightly news broadcasts, front-page headlines, and medical journals all touted the news that the vaccine was available, necessary, and poised to help the country wipe out measles altogether. “2 Measles Vaccines Licensed; U.S. Sees End of Disease in 1965,” declared the front page of *The New York Times*.⁵

Meanwhile, 3 epidemiologists at the National Communicable Disease Center (CDC)—David Sencer, Bruce Dull, and Alexander Langmuir—laid out the case for measles eradication. Smallpox, polio, and diphtheria had all been vaccinated nearly out of existence in the United States by then. The achievements boded well for measles, a seemingly easier target. Measles had no chronic carriers, as diphtheria did, and caused no inapparent infections, as polio did. Like smallpox and polio, it had no nonhuman reservoirs. Moreover, studies suggested it would take only a modest level of herd immunity to prevent outbreaks, possibly just 55%.⁶ With “potent and effective” vaccines at hand, eradication thus seemed an “attainable goal,” as Surgeon General Luther Terry had told *The New York Times* in 1963.⁵ But Sencer, Dull, and Langmuir stressed that eradication would require commitments to routine infant immunization, immunization of all susceptible children upon school enrollment, surveillance, and epidemic control.⁶

In the 1960s, those commitments seemed within reach. Inspired by the nation’s previous success combating polio via mass vaccination, in 1962 President John F. Kennedy Jr signed the Vaccination Assistance Act,⁷ the first law directing federal funds to states for broad immunization efforts, with an emphasis on children. Under President Lyndon B. Johnson, architect of the era’s Great Society reforms, Congress in 1965 renewed the program and extended it to cover measles.⁸ In 1967, Johnson endorsed CDC’s plan to eliminate measles from the United States within a year.⁴ The plan’s scope and ambitious timeline were unprecedented, but optimism prevailed.⁹ After all, as one White House official put it, it was the “golden age of medical research,” with new vaccines, antibiotics, and other drugs heralding a future of unimaginable freedom from infectious disease.¹⁰ Moreover, global eradication campaigns were already making strides against malaria and smallpox on a much grander scale.¹¹

At first, success came quickly. Six months into the 1967 campaign, the number of weekly cases of measles fell to 200,

down from an average of 1000 cases per week in the prevaccine era.¹² The number did not reach zero within a year, but the decline in measles was dramatic nonetheless: 1968 saw 22 000 cases, compared with an average of 450 000 cases per year in the prevaccine era.⁴ But any sense of imminent victory was short-lived. Measles cases ticked back up in 1969, again in 1970, and again in 1971, to 75 000 cases.⁴ Moreover, something had become uncomfortably undeniable. Vaccination was protecting communities, but not all of them. As such, the epidemiology of measles had changed. Suzanne Dandoy, an epidemiologist at the University of California, Los Angeles, had predicted, in *Public Health Reports*, the problem of vaccination not protecting all communities.¹³ In the years immediately after introduction of the measles vaccines, in Los Angeles, California, the vaccines had been administered primarily by physicians in private practice, most of whom had patients who came from neighborhoods “where young middle- and upper-class white families predominated.”¹³ As a result, measles had quickly become “a disease of the Negro population and the population with Spanish surnames,” she wrote.¹³ Cases had also begun to concentrate among younger children. At the same time, with more attention being paid to the disease, more cases were being reported—revealing a problem of a scale larger than anyone had initially anticipated. The pattern was not unique to Los Angeles; it was evident across the United States.¹³

Immunization officials at CDC blamed uneven support from Washington, DC, where funds specified for vaccination diminished early during Richard Nixon’s presidency.⁴ The first decade of measles vaccination, from the late 1960s to the late 1970s, also highlighted unpredicted challenges: members of the middle class and upper class were easily persuaded that measles was worth preventing, but those living in poverty spoke of more pressing priorities. Long lines and short hours at out-of-reach public health clinics did not help, and neither did improper vaccine storage, poor record keeping, and failure to vaccinate at the recommended age. It had also become clear that a vaccination rate much higher than 55% was necessary to achieve herd immunity. The lessons of the failed eradication attempt left immunization officials pondering technological and legal solutions: a combined vaccine that protected against polio, smallpox, measles, mumps, and rubella (modeled after the combined vaccine against diphtheria, pertussis, and tetanus) and laws to force parents to provide proof of vaccination before their children could enroll in school.

Such laws, targeting other diseases, had been in place for decades. The first few laws requiring vaccination for school enrollment dated to the early 19th century and covered smallpox only. Smallpox vaccine laws were adopted by numerous states in the 1880s and 1890s, supported by the advent of the germ theory and the rise of modern public health administration.¹⁴ In the 1930s, a number of states added laws requiring diphtheria immunization for enrollment in school. Within the decade after the first polio vaccine became available in

1954, roughly half of the states added laws requiring the polio vaccine for school. But as Charles L. Jackson, a public health advisor at CDC, noted in *Public Health Reports* in 1969, the laws were all “compulsory” only in “spirit”—they lacked penalties, they included broad exemptions for medical conditions or religious beliefs, or they were necessarily limited in enforcement so as not to conflict with compulsory school attendance laws.¹⁵ And although 2 Supreme Court decisions—*Jacobson v Massachusetts*¹⁶ and *Zucht v King*¹⁷—had upheld the laws, Jackson remarked that discussion of them still stirred up controversy because of enforcement challenges and ideological disagreements over how they squared with constitutionally protected religious rights and personal freedom.¹⁵

In the 1960s, however, public health officials increasingly made what Jackson called a “humanitarian” argument in favor of such laws. CDC Chief James Goddard had declared racial differences in immunization rates a “blot” on the nation’s health record.¹⁸ Requiring a vaccine by law addressed the problem of those whom health officials considered “hard to reach,” either because of class, race, education, or language.⁹ Vaccine requirements also addressed other obstacles, including attitudes toward specific diseases and uneven buy-in from family physicians. The public was widely protected against polio, for example, because it was a 20th-century newcomer that had become one of the most feared diseases of the postwar years. Immunization rates for age-old diphtheria, by contrast, were far lower. Measles, it was clear, posed a similar challenge, because it too had so long been accepted as a routine part of childhood.

Reaching Elimination

By the early 1970s, a new generation of school mandates thus became one of the most notable legacies of the early measles eradication era. (Most state mandates included exemptions for persons with religious objections to vaccination.) The laws were supported by the eradication spirit of the time, the Great Society ethos, the epidemiological observation that measles circulated among young schoolchildren, and influential supporters. The Joseph P. Kennedy Foundation, helmed by prominent Kennedys and devoted to the prevention of “mental retardation” (many cases of which were thought to be caused by measles-related encephalitis), lobbied governors and lawmakers.⁹ Public health officials argued that the laws were necessary to ensure immunization of the “hard to reach.”⁹ The case for the laws was also neatly made by a measles outbreak in the city of Texarkana, divided by the Texas–Arkansas state line. Arkansas required measles immunization for school enrollment, Texas did not, and the case rate among children in Texas was 12 times higher than among children across the border.¹⁹ By 1969, 17 states had added measles to their compulsory immunization laws; a decade later, all of them had.¹⁴ The final push had come from President Jimmy Carter’s administration, whose multipronged National Childhood Immunization Initiative,

launched in 1977,⁴ funneled federal resources to states to encourage mass immunization and asked governors to ensure their immunization laws covered all recommended vaccines—a list that by then comprised polio, diphtheria, pertussis, tetanus, mumps, rubella, and measles.

The main objective of the Carter initiative was to raise child immunization rates nationally. Health, Education, and Welfare Secretary Joseph Califano recognized that laws, given their inherent limitations, would be insufficient, but that powerful publicity could help. At Califano’s urging, Captain Kangaroo, the National Football League, and Dear Abby all used their bullhorns to encourage immunization. So did Star Wars characters R2-D2 and C-3PO, who filmed a television spot asking “parents of earth” to immunize their children.⁴ Campaign materials reveal that immunization proponents had taken another lesson from the failed measles eradication attempt of the 1960s. The mild and moderate diseases had to be reconfigured as serious and frightening. Federal brochures and press releases emphasized the serious complications of measles, mumps, and rubella in particular, because the public and many health professionals saw them as less severe than smallpox, polio, and diphtheria. Journalists and local health departments were recruited to spread the message.⁴ Measles, mumps, and rubella were not just part of growing up, wrote one reporter, they can “cripple and kill”²⁰; wrote another, “If this sounds scary, it’s meant to.”²¹ One health department dubbed the vaccine-preventable infections the “Seven Deadly Health Sins.” From that time on, measles would never be referred to as anything but a serious disease of major public health importance.

The Carter initiative brought immunization rates among children close to 90% across the board, an unprecedented level.²² The initiative had been so successful, in fact, that Califano tacked on a familiar-sounding goal: measles eradication. This time, the country came much closer. By Carter’s last year in office in 1981, 96% of all schoolchildren were vaccinated against measles—an all-time high—and the number of measles cases—2600—was at an all-time low.⁴ The achievement was chalked up to federal investment and support, widespread publicity, the force of law, and new technology in the form of a combined measles-mumps-rubella (MMR) vaccine, which simplified immunization protocols.

On the face of it, the public seemed content with the new immunization status quo. But in fact, a wave of resistance was already swelling. Vaccine hesitancy—based on feared vaccination risks, religious beliefs, or libertarian values—had been present since the first vaccine, against smallpox, was introduced in the 1790s. More than a century and a half later, the social changes of the 1960s and 1970s revived age-old objections to vaccination and introduced brand-new objections. Parents who were tuned into the rhetoric and ideas of the antiauthoritarian social movements of the day—for patients’ rights, women’s rights, and environmental protection, in particular—found themselves equipped with a vocabulary and set of justifications for questioning the new push for childhood vaccines. The patients’ rights movement

encouraged patients to ask their physicians questions, do their own research, and demand informed consent to treatment and care. The women's movement inspired women to question patriarchal institutions of authority, including orthodox medicine, and women's health activists rallied women to take control of their own health and their own bodies, make their own medical decisions, learn about hidden drug risks, and demand safer options. The environmental movement focused public attention on the ubiquity of chemical encounters in everyday life and the sometimes long delay between such encounters and their health consequences. As these ideas gained cultural currency, some parents began to ask questions: Why was polio vaccine still necessary? Wasn't measles a routine disease? Had all vaccine risks been fully disclosed? And were the required vaccines safe for children over the long run?⁴

These pressing questions helped give rise to "Vaccine Roulette," a 1982 NBC news documentary by consumer reporter Lea Thompson, whose previous work had exposed the dangers of asbestos-lined hair-dryers and nutrient-deficient infant formulas. An hour-long investigation focused on the pertussis component of the diphtheria-pertussis-tetanus vaccine, "Vaccine Roulette" depicted physicians in disagreement about vaccine safety, parents devastated by vaccine injuries to their children, and terrifying statistics on vaccine injury risk, including that 1 in 7000 children had serious adverse effects ranging from high fevers and seizures to brain damage and death after diphtheria-pertussis-tetanus vaccination.²³ The documentary reflected a fear pervasive among the vaccine hesitant: that vaccination was an unexamined but potential cause of the rising number of developmental and learning disabilities in children. In the context of the time, the reporters' job was to investigate medical science, not laud it, and Thompson, a female reporter in a field dominated by men, did just that. The "medical establishment," she reported on air, had been "aggressive in promoting . . . the most unstable, least reliable vaccine we give our children."²³

"Vaccine Roulette" gave voice to parents who had been expressing vaccine worries for the preceding decade. It also marked the start of a decade in which 2 typically opposing ideologies (those favoring big government and those opposed to it) found common ground in the issue of childhood vaccination. "Vaccine Roulette" inspired the formation of a vaccine-safety advocacy group in the Washington, DC, area: Dissatisfied Parents Together, DPT for short. DPT (now the National Vaccine Information Center) mobilized a coalition of supporters to win passage of the 1986 National Childhood Vaccine Injury Act,²⁴ which required the federal government to inform parents of vaccine benefits and risks, required vaccine providers to report vaccine injuries to federal authorities, and established the National Vaccine Injury Compensation Program. For its vaccine-critical supporters, more government was needed to guard against the pitfalls of the new era of mandatory vaccination. But in succession, all across the country, newly formed local organizations, largely

libertarian, began taking aim at laws requiring vaccines for school, calling for repeals and personal-belief exemptions to be added to medical and religious exemptions and gradually getting them. (Just 5 states had such exemptions in 1969; by the millennium's end, 15 states and counting would have them.¹⁴)

By the dawn of the 1990s, then, the country had an organized, national movement that was critical of vaccine safety, a separate movement working to erode mandates, and a dramatic resurgence of measles. As in the early 1970s, the cases were clustered in poor, often urban communities and mostly among the very young. A federal advisory committee concluded that the devastating measles outbreaks of 1989-1991—which caused more than 50 000 cases and 150 deaths—were the result of pricey vaccines, cuts to federal support for immunization, and widespread failure to immunize children before age 2. The committee's white paper²⁵ reserved special blame for the nation's "acutely" broken health care system: inaccessible providers and expensive plans not only did not reach those in need but also created barriers to giving them care by requiring, for example, that children receive a physical examination or enroll in a well-baby program before they could even be eligible to receive a recommended vaccine. "This isn't a measles problem. It's a systems problem," a prominent epidemiologist told the *Washington Post*.²⁶

The "systems problem" would be addressed, to a great extent, by another White House initiative, this one launched during President Bill Clinton's first year in office, 1993. Clinton placed access to childhood vaccines at the forefront of his administration's health reform efforts, moved in part by the measles epidemics of the preceding years and in part by public health officials' conclusions about the cause of the epidemics. The Comprehensive Child Immunization Act²⁷ he signed into law in 1993 created an entitlement program, Vaccines for Children (VFC),²⁸ to provide free vaccines for all Native American and Alaska Native children, children without insurance, children covered by Medicaid, and children whose insurance did not cover vaccines. The Clinton administration had initially proposed a universal purchase program to provide free vaccines for all US children; the program approved by Congress was a compromise, but it helped bring toddler immunization rates to once-again historic heights by the end of Clinton's first term and soon eliminated racial disparities in MMR vaccination rates.²⁹ Clinton's last year in office would go down in public health history as the year measles was officially "eliminated" from the United States: the disease was no longer endemic, and the only remaining cases were imported from abroad or spread by such cases.³⁰

Resurgence Redux

This victory took place in the context of growing popular mistrust of corporations, especially the massive pharmaceutical industry. (Indeed, Clinton had championed his

childhood vaccine program by lambasting “greedy” drug companies.) After VFC launched, though, the list of vaccines recommended for children more than doubled. From the 1990s to the early 2000s, vaccines against hepatitis B, rotavirus, *Haemophilus influenzae* type b, pneumococcal disease, influenza, chicken pox, hepatitis A, meningococcal disease, and human papillomavirus were added to the list of routine immunizations recommended by the federal Advisory Committee on Immunization Practices, which guides state mandates. At first in chat rooms, and then later on blogs and social media, parents began to ask questions that echoed the questions of parents a generation before. Wasn’t chicken pox a harmless part of childhood? Why were their children being vaccinated against diseases they had never heard of? Why were they being vaccinated against diseases that would not spread in the classroom? And given all the negative publicity being directed toward drug companies, were all of these new vaccines assuredly safe?

As in the 1980s, when media attention homed in on a single component of a combined vaccine, reporters in the early 2000s narrowed their focus to the measles component of the MMR vaccine and a feared connection to childhood autism. By then, vaccine-hesitant persons had been articulating a long list of fears for 2 decades: about sudden infant death syndrome, immune dysfunction, neurodevelopmental disorders (including autism), neurological damage (related to the vaccines against influenza and hepatitis B), and cancer (and its connection to polio vaccination). The Institute of Medicine convened a committee to review these concerns from 2001 through 2004. But in media coverage of vaccine fears, just one story, the link between vaccines and autism, prevailed. Autism rates had climbed to unfathomable heights, a single study published in the prestigious journal *The Lancet* had proposed a connection to the MMR vaccine, and it was easy to find heartbreakingly worried parents of autistic children who believed in the connection, celebrities who endorsed it, and physicians who vehemently denied it. The story told itself, and in the radically new media environment of the early 21st century, which was fractured and fiercely competitive, the drama of the vaccine–autism story was good for ratings.³¹

After yet another decade of historic lows, the number of measles cases once again ticked up—albeit from an unprecedented low. In 2011, the nation had more than 200 cases of measles, up from an annual average of about 60 in previous years. At first, blame for the spike in cases fell on travelers who had brought the disease from abroad in an era of increasing global travel. But when an outbreak spread from a case at Disneyland in 2014, and the number of measles cases for the year jumped to 667, blame shifted, particularly in the media.³² The Disneyland outbreak was the subject of non-stop news coverage, much of which pointed a finger at white, upper-class liberals who chose to avoid or delay vaccines for their children for personal reasons; coverage largely ignored the disease’s import from abroad and the complex set of reasons some Americans were vulnerable. California

lawmakers responded to the outbreak and ensuing media storm by eliminating the state’s personal-beliefs exemption (which covered both philosophical and religious exemptions), giving the state one of the most coercive vaccine laws in the nation, save West Virginia and Mississippi. Just a few attentive journalists pointed out that an outbreak among the Amish in Ohio was responsible for the bulk of the year’s cases: 383, compared with 129 cases then connected to Disneyland.³³ (Under Ohio law, a schoolchild may still be exempt from immunization for medical reasons or “reasons of conscience.”³⁴)

Here is where historical perspective helps expose a hidden irony. The path-breaking campaigns to encourage measles vaccination in the 1960s and 1970s had appealed directly to white, middle-class self-interest (even while ostensibly targeting nonwhite, low-income communities). They did not do so by framing measles vaccination as a moral obligation; indeed, because of how the disease was perceived at the time, doing so would have made little sense. (As Langmuir described it, measles was a disease of “short duration, moderate severity, and low fatality,” whose importance was “not to be measured by total days disability or number of deaths” but by “human values” and available “tools.”³³) Campaigns instead promoted vaccination against measles (along with mumps and rubella) as a way to take advantage of the “luxury and ease of health provided by artificial antigens” of the modern era of biomedicine and as a way to ensure that even “mild” or “moderate” infections did not “take the edge off a child’s intelligence.”³⁴ Langmuir himself attached no moral duty to the project. “To those who ask me ‘Why do you wish to eradicate measles?’ I reply with the same answer that [Sir Edmund] Hillary used when asked why he wished to climb Mount Everest,” he said. “‘Because it is there . . . and it can be done.’”³⁵

Some had warned, in the 1960s, that the nation’s public health experts needed to grapple with important philosophical questions about vaccination in the modern era, given that the new disease targets were not severe, that their complications did not threaten all equally, and that mass campaigns and mandates had been used in only limited ways in the past. In light of the biomedical optimism of the time, such questions were largely overlooked—and measles elimination was eventually achieved nonetheless. But elimination, as recent outbreaks attest, is a precarious state, and philosophical questions persist. Philosopher Roland Pierik, for one, argued that there are deep tensions between school mandates and the values of a liberal democratic society. For example, religious exemptions to mandates, which have roots in the values and priorities of the Constitution’s drafters, privilege those historically well established in American society and, as such, are out of date in the modern, secular era, making it “very hard” to separate “genuine” objections to vaccination from “exemptions of convenience.”³⁶

The idea of measles eradication via vaccination—and the approaches it helped encourage, school mandates among them—reflected many spirits of the 1960s, from faith in

Box. Measles: timeline to elimination in the United States

1960s	1962: President Kennedy signs Vaccination Assistance Act (VAA). ⁷ 1963: First 2 measles vaccines licensed. ³⁷ 1964: Federal Advisory Committee on Immunization Practices created, recommends measles vaccination at 9 months. ⁴ 1965: VAA expanded to cover measles ⁸ ; recommended age of measles immunization raised to 12 months. ³⁸ 1967: President Johnson endorses campaign to eradicate measles from the United States. ⁴ 1969: Seventeen states have laws requiring measles immunization for school enrollment. ¹⁵
1970s	1971: Combined measles-mumps-rubella (MMR) vaccine licensed; 75 000 measles cases, up from low of 22 000 in 1968. ⁴ 1976: Recommended age of immunization raised to 15 months. ³⁸ 1977: President Carter launches Childhood Immunization Initiative. ⁴ 1978: Carter administration announces plan to eliminate measles from the United States. ³⁹
1980s	1980: Fifty states have laws requiring measles immunization for school enrollment; schedule of vaccines recommended for children protects against 7 infectious diseases, including measles. ⁴⁰ 1981: 96% of all schoolchildren are vaccinated against measles. ⁴ 1986: President Reagan signs National Childhood Vaccine Injury Act (NCVIA). ⁴¹ 1989: Large measles outbreaks across the United States, Canada, and Mexico. ⁴²
1990s	1991: National Vaccine Advisory Committee white paper attributes ongoing measles outbreaks to inadequate health care system. ²⁵ 1993: President Clinton signs Comprehensive Child Immunization Act, creating Vaccines for Children entitlement program; recommended age of measles immunization revised to 12-15 months. ⁴² 1994: Schedule of vaccines recommended for children protects against 12 infectious diseases, including measles. ⁴² 1998: <i>Lancet</i> publishes article whose lead author proposes connection between MMR vaccine and autism. ⁴³
2000s	2000: Measles eliminated from the United States. ⁴⁴ 2001: Institute of Medicine (IOM) launches program to investigate 8 vaccine safety concerns, including MMR–autism link. ⁴ 2004: IOM investigations conclude, finding no connection between autism and any vaccines. ⁴⁵ 2008: Family of a girl who developed autism-like symptoms related to a mitochondrial disease after receiving required childhood vaccines compensated under NCVIA. ⁴⁶
2010s	2011: <i>Lancet</i> article published in 1998 retracted. ⁴³ 2014: United States has 644 cases of measles, highest number since elimination; 383 cases are associated with outbreak among Amish in Ohio. ⁴⁷ 2015: Multistate outbreak of measles tied to Disneyland causes 129 cases of measles ⁴⁸ ; California tightens school immunization laws. ⁴⁹ 2017: Outbreak of 65 measles cases in Minnesota linked to Somali-American community with autism fears ⁵⁰ ; United States has 117 cases of measles ⁴⁷ ; schedule of vaccines recommended for children protects against 17 infectious diseases, including measles. ⁵¹

biomedicine to a belief in government as the best tool for social melioration. The challenges to eradication that followed were likewise products of their historical moments in time. Studied within that same time frame, the story of measles itself reveals the similarly time-bound nature of our perspectives on a disease and the role of vaccines in reshaping that perspective over time. In the prevaccine era, half a million measles cases per year helped inspire the search for a vaccine, but that vaccine was unevenly sought by a public who considered measles an unremarkable part of childhood. More than half a century later, an outbreak of 129 cases ignited a media and moral panic and inspired one of the strictest vaccine laws in the nation (Box). This storyline is not unique to measles; vaccines fundamentally reframe the way we think about diseases and the importance of their prevalence and prevention. Set in social and cultural historical context, the elimination of measles is truly remarkable. But the disease's history in the modern era of vaccination also reveals how tenuous the grip on elimination will remain until—or only if—we can find ways to better accommodate tensions between vaccine laws and social values, create a world capable of measles eradication, and collectively agree as a citizenry that incremental infectious disease eradication is the goal of our ever-lengthening schedule of vaccines for children.

Acknowledgments

The author thanks T. Keaton Whittaker for research assistance.

Declaration of Conflicting Interests

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Elena Conis, PhD, MS, MJ  <https://orcid.org/0000-0002-3189-4591>

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