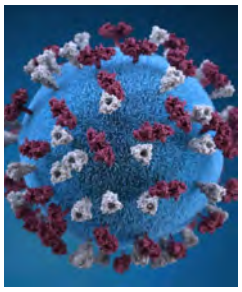

Measles Epidemic: Overcoming Vaccine Prejudice

Author: Tracey Long, PhD, RN, APRN

Contact hours: 2.0

Course Price: $10

Course Summary

This course discusses measles history, measles causes, types of measles, clinical symptoms of measles, treatment and prevention strategies re measles, and addresses positions of anti-vaccination advocates. It begins with a look at the availability of the MMR Vaccine and its vaccine resistance by some members of the public. Emphasis is on addressing the measles epidemic and wiping out measles altogether.

Course Objectives

When you finish this course, you will be able to:

1. List 4 arguments in favor of vaccination for measles.
2. State 3 clinical symptoms of measles.
3. Identify 3 strategies for treatment and prevention of measles.
4. Discuss 2 ways to educate parents regarding measles immunization.

Criteria for Successful Completion

80% or higher on the post test, a completed evaluation form, and payment where required. No partial credit will be awarded.

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To Vaccinate or Not: The Controversy

Four days ago José, a happy 8-month-old baby boy who loved to laugh and bounce on his father's knee developed a fever of 103°F. Then a rash appeared on his face and torso, and he became lethargic and wouldn't feed. Jose's family had visited just two weeks ago with a recently emigrated family. One of their children had also developed a rash, cough, red eyes, and fever. That family told José's parents the rash would go away and he would be feeling better in a couple of weeks. Unfortunately for José, his rash worsened, and he developed a cough, difficulty breathing, diarrhea, and increased lethargy, so his parents rushed him to the emergency department. He was admitted to pediatrics and diagnosed with measles and pneumonia. José's brain began to swell and he developed encephalopathy, dying 3 days later. It was determined that measles was the precipitating factor.

What could have been done to avoid this needless loss of life?

What do you know about measles that you could have taught this family?

What is the role of healthcare professionals in helping children avoid measles?

What tests are done to diagnose measles? What is its cause? How is it transmitted?

What is the nurse's role in the measles epidemic?

What prevention and treatment strategies are available?

We thought that measles had been eradicated in the United States, but these questions have become relevant in the last decade due to an alarming increase in cases of measles. What happened? Why are we still hearing about measles when we have a proven vaccine available? It's a new chapter in the history of measles, and America is back in the story.

Measles outbreaks hit a record high in 2019 despite the CDC's 2000 declaration of its elimination due to an effective vaccine. Measles remains a common contagious disease of children in undeveloped countries because it is easily transmitted. In developed countries with easy access to the vaccine, it should have remained eradicated. So why are we seeing a changing tide in the development of new cases?

Although the Centers of Disease Control and Prevention (CDC) recommends it, many attitudinal arguments against the vaccine have arisen. The resistance to vaccines in the United States is very different from those worldwide. Global cases of measles are seen where the barriers are lack of access to medical services, financial constraints, or lack of adequately trained medical personnel to administer vaccines. Let's take a look at the arguments in our country and then explore the barriers internationally.

Arguments FOR the Measles Vaccine

Effectiveness

The first dose of the **MMR* vaccine** is generally given to children 9 to 15 months of age, with a second dose at 15 months to 6 years of age, with at least 4 weeks between the doses. The case in favor of this vaccine has been established by the scientific community. The scientific evidence is plentiful that the MMR protects the **entire community** from measles if 97% of the population is vaccinated.

*__MMR__. Measles, mumps, and rubella—childhood diseases that have largely been eliminated in recent years. Older Americans can recall have had one or all of them in childhood before the vaccines became available.

Simplicity

In addition to its effectiveness, another argument in favor of the measles vaccine is the simplicity of administration. Two visits to the doctor or a clinic provides lifelong immunity. The effectiveness of the vaccine is 93% from the single dose, and increases to 97% after the second dose, making the risk of contracting the highly contagious disease extremely small.

Minimal Cost

One vaccination of MMR costs $1 per child, so protection can be had for the cost of a couple of dollars. The cost of treating the symptoms and possible complications can reach into the tens of thousands.

Common complications of measles are diarrhea and ear infection. More serious complications, however, include hearing loss, pneumonia, and swelling of the brain. Ultimately, having contracted measles, between 1 and 2 children per 1,000 will die. That is a cost that no parent wants to contemplate.

Herd Immunity

Statistically, dropping from a **herd immunity** of 97% down to 93% of those vaccinated increases the rate of cases two-fold, from 13% to 28%. With each increase in number of measles cases, the probability of developing more severe measles also increases. Only a few percentage points below the herd immunity goal of 97% decreases the protection for the general population. This is discussed further in a later section.

*__Herd immunity__. The resistance to the spread of a contagious disease within a population that results if a sufficiently high proportion of individuals are immune to the disease, especially through vaccination.

Worldwide Epidemics

[Unless otherwise cited, the material in this section is from UN News, 2019.]

In the United States, the lack of vaccination is attributed to fear as well as to claims of personal freedoms and/or religious values, whereas global barriers against measles vaccination have been attributed to lack to access. Proponents of worldwide vaccination programs have recognized many barriers to adequate vaccination.

The global Measles and Rubella Initiative is a collaborative effort between the American Red Cross, CDC, WHO, the United Nations Foundation, and UNICEF. (See Resources for ways to support their efforts.)

Together these entities are working to address the barriers of funding, education, administration, and transportation of the measles vaccine. For example, the American Red Cross and international Red Crescent organizations have vaccinated over 2 billion children through their measles and rubella campaigns since 2001 and the efforts of 17 million volunteers worldwide (American Red Cross, 2018). Unfortunately, these efforts are thwarted during a natural disaster, or times of economic and political upheaval, when their workers cannot deliver services to communities in need (eg, refugee camps).

“More than 1in 10 children—almost 20 million worldwide—failed to receive potentially lifesaving vaccines in 2018,” the UN has said, citing obstacles including conflict, cost, and complacency.

According to a joint study by WHO and UNICEF, ten countries accounted for 11.7 of the 19.4 million under- and non-vaccinated youngsters in the world. At the same time, global protection against four diseases that are regarded as a gauge of overall coverage—diphtheria, tetanus, pertussis, and measles—has “stalled” at around 86% since 2010, the study found. A 95% coverage rate still eludes many countries.

The United Nations has stated that measles outbreaks reveal “entrenched gaps” in coverage. Citing major gaps in measles vaccine coverage across countries at all income levels, the UN report showed that the number of cases of the highly infectious disease doubled from 2017 to 2018, to more than 340,000.

“Measles is a real-time indicator of where we have more work to do to fight preventable diseases,” said UNICEF’s Executive Director, Henrietta Fore, in 2019. “Because measles is so contagious, an outbreak points to communities that are missing out on vaccines due to access, costs, or, in some places, complacency. We have to exhaust every effort to immunize every child.”

A far higher level of coverage is needed to protect against vaccine-preventable disease outbreaks, UN health experts insist, noting that 118 countries achieved a 90% coverage threshold last year. Ideally, it should be 95% across countries and communities globally, they maintain.

Simplified Delivery

American children are at risk not only from their non-vaccinated compatriots but also from others globally. Because the current delivery of the measles vaccine is via injection, it requires administration by skilled personnel. Further, vaccines must be kept both sterile and cold, and the storage, transport, and delivery steps of vaccination are challenging for developing countries that have unstable electricity and refrigeration. Because of international travel, these countries and their non-vaccination affect the entire world.

New vaccine patches are being explored that could simplify the delivery of the vaccine but communication and education for the need for vaccines must be equal in effort. Funding for such projects is still a great challenge for many developing nations.

Political issues that impact the availability of medical services and vaccines for the public were a major cause for measles outbreaks in the Middle East. While politicians argued about power, policies, and finances, public health facilities were closed and thousands went unvaccinated. In the remote villages of Central and South America and Africa, where measles outbreaks occur the most, vaccines are often not available because of lower socioeconomic status.

Instead of improving delivery of systems to provide the vaccines and surveys of families who have received them, the governments of these vulnerable people merely track the cases of measles. There have been valiant efforts to deliver vaccines but Third World and developing countries often do not have the resources to reach all of their populations.

As a healthcare professional, becoming an advocate for vaccination is powerful. People rely on the recommendations of educated healthcare professionals and anyone who is hesitant or resistant themselves can be a negative influence on many people.

The necessary first step is understanding the disease itself, the history of measles and its vaccine development, its clinical symptoms and treatments and, most important, overcoming vaccine resistance.

Alarming Costs of Non-vaccination

As early as 2010 the CDC was warning that the costs of not receiving the vaccine are alarming, saying vaccines are one of the most successful and cost-effective public health tools for prevention of disease and death (CDC, 2010). Following the CDC recommendations for seven childhood vaccinations (DTaP, Td, Hib, polio, MMR, hepatitis B, and varicella) results in an annual cost savings of $9.9 billion in direct medical costs for treating the disease and an additional $33.4 billion indirect costs to families and communities (CDC PB, 2018).

Costs to society from declining vaccination rates (in U.S. dollars) were estimated by AOL's *Daily Finance* in 2011:

- A 2002–2003 outbreak of measles in Italy, "which led to the hospitalizations of more than 5,000 people, had a combined estimated cost between 17.6 million euros and 22.0 million euros."
- A 2004 outbreak of measles from "an unvaccinated student return[ing] from India to Iowa was $142,452."
- A 2006 outbreak of mumps in Chicago, "caused by poorly immunized employees, cost the institution $262,788, or $29,199 per mumps case."
- A 2007 outbreak of mumps in Nova Scotia cost $3,511 per case.
- A 2008 outbreak of measles in San Diego, California cost $177,000, or $10,376 per case. (Alazraki, 2011)

Responding to Vaccine Resistance

We will look at some of the reasons given by people who are anti-vaccination and evaluate them in terms of the common good.

Hoax of Connection with Autism

A supposedly scientific journal article connecting the MMR vaccine with autism was declared a hoax—but its damage was done. Andrew Wakefield, a British gastroenterologist, falsely stated in 1995 his "finding" that aluminum and metal used in the MMR vaccine builds up in the brains of some children, causing autism spectrum disorders and colitis (Alazraki, 2011).

Wakefield's study involved only 12 children and he later lost his medical license for falsifying the study. His original claim was printed in the *Lancet* in 1998 and was later called **"perhaps the most damaging medical hoax of the last 100 years"** (Flaherty, 2011). After other scientists identified misconduct in his research methods—and even fraudulent work—his paper was partly retracted in 2004 and then completely in 2010, but it continues to be cited by anti-vaccination activists (Dyer, 2010). Wakefield was also found guilty by Britain's General Medical Council of serious professional misconduct and his license was revoked so that he can no longer practice medicine in the United Kingdom, his home country (Triggle, 2010).

Wakefield's claim was that the traces of mercury and aluminum that were to be found in the original MMR vaccine were causing autism and colitis. Early studies involved 537,303 children and an additional study with a much larger population of 657,461 children examined any possible truth to Wakefield's claims, however none found any evidence of a link between vaccines and autism (Edwards, 2001).

It is now the scientific conclusion that **there is no link between MMR vaccine and either autism or colitis.** The World Health Organization has expressed fear that the damage done in the minds of cautious parents has creating a generation of protective parents refusing to vaccinate their children. *Time* magazine in 2011 cited Wakefield's fake study as "that paper [that] killed children" and declared that he had been responsible for millions of childhood deaths (Park, 2011).

Online Video: Measles Vaccines Don't Cause Autism

Against Religious Values

Some religious groups follow scriptures that state adherents should never allow a foreign substance in the body. In this thinking, a vaccine is a foreign substance and therefore proscribed. One example of such a group is Orthodox Jews, who believes the Torah clearly forbids vaccines because they intrude on the sacred body.

The debate continues over religious freedom versus protection of society from a preventable disease. A concern is that those who choose not to vaccinate put others at risk, generally children under age 1.

A recent outbreak occurred in the City of New York among ethnic minorities. Measles has spread to 4 out of the 5 major boroughs (*New York Times*, 2019). Health officials confirmed at least 626 (and counting) cases of measles in 2019 in New York City alone. New York Major Bill de Blasio has mandated vaccinations in four city zip codes. He has also declared a state of emergency in public health.

While the CDC makes vaccine recommendations, compliance has been left to the common sense of families for the protection of their children; now, however, in NYC vaccinating children according to the CDC recommendations is mandatory and 123 summonses have been issued for noncompliance. The majority of those summons are within an Orthodox Jewish community. The fine is up to $2,000.

Because of the nature of international flights and people moving into and out of New York, the city remains an area of potential transmission through travel; one person can have droplet contact with thousands of travelers in airports as well as train and bus terminals. New York City still has the highest proportion of the 940 cases identified in the United states in 2019.

When several Jewish parents filed a lawsuit claiming that to mandate a vaccine is against their constitutional rights to freedom of religion, a Brooklyn judge upheld the vaccine order, based on the higher principle of protection for the greater good (*New York Times*, 2019).

Threat to Individual Freedom

In the United States, childhood diseases continue to be seen because of parents who refuse to have their children vaccinated; they express fear of the safety of the vaccines and assert their freedom to choose how to care for their own family. The debate between individual freedoms and protection of the society continues to grow. In the language of philosophy, when a choice is made for the greater good as opposed to the individual right it is called *utilitarianism.* Societies differ in the degree to which they value utilitarianism. For example, North Americans value individuality based on personal freedoms and rights, whereas many Asian societies value what is best for the family (for example, protecting a family's name and honor).

The American attitude has impacted the number of children being vaccinated; unfortunately, it is the innocent children who suffer. Ironically, those who resist vaccinating their children infringe on the rights of others. The unvaccinated child may expose other people's children. It is estimated that 90% of people exposed to the measles virus who are not vaccinated will acquire the disease—and the majority of these are very young children.

Mistrust of Western Medicine

[Material in this section is from WHO, 2019.]

Many of the cases of measles in the United States have been seen in immigrant and ethnic minority communities. Culturally, they may be accustomed to another type of medical care, and that leads them to distrust Western medicine and fail to comply with government recommendations.

Physicians agree that vaccinations are crucial to public health and wellness. The American Medical Association highly endorses compliance with available CDC recommendations for all vaccines, including measles vaccine for children beginning at age 12 months. Proponents of the vaccine also include the World Health Organization, which firmly stated that measles vaccinations reduced global fatalities by 75% between the years 2000 and 2013.

By 2017 the global push to improve vaccine coverage resulted in an 80% reduction in deaths. During 2000–2017, with support from the Measles & Rubella Initiative and Gavi, the Vaccine Alliance, measles vaccination prevented an estimated 1.1 million deaths; most of the deaths averted were in Africa and in countries supported by the Gavi Alliance.

But without sustained attention, hard fought gains can easily be lost. Where children are unvaccinated, outbreaks occur. Because of low coverage nationally or in pockets, multiple regions were hit with large measles outbreaks in 2017, causing many deaths. Based on current trends of measles vaccination coverage and incidence, the WHO Strategic Advisory Group of Experts on Immunization (SAGE) concluded that measles elimination is greatly under threat, and the disease has resurged in a number of countries that had achieved, or were close to achieving, elimination.

Four in five children receive the MMR vaccine that protects them from unnecessary bouts of measles, mumps, or rubella. The other 20% are left vulnerable to sickness that can become life-threatening. The lowest immunization compliance is among the poor, who may have insufficient healthcare; they are also the ones who are likely to have complications. When they are compromised, it threatens the gains we may be making in other areas of maternal and child health.

Fear of Negative Effects on the Body

Like anything introduced into the body, there are potential side effects. The immune system provides surveillance, building and destroying cells and activating signals. When a foreign agent, or **antigen**, is introduced into the body, surveillance cells, known as *dendritic cells*, recognize it as foreign and communicate with specialized white blood cells, known as *macrophages* and *neutrophils*, to attack. *B-Cells* signal which cells are to be attacked and create specialized antibodies within the blood that carry memories of the attack.

The body responds first with a general inflammatory response of *vasodilation* to help move killer cells more quickly to the offending pathogen. The clinical manifestations of heat and swelling come from vasodilation. Vasodilation pushes on nerve endings, causing pain; the side effects of vaccines reflect this natural immune response and indicate the body is responding correctly. When an arm or leg muscle hurts from the injection site, it is a demonstration of the vasodilation stage.

The more advanced stage of antibodies that develop immunity through memory cells takes several days. These memory cells remain in our system for years, but can degenerate over time, which is why a booster vaccine may be needed. Babies and young children don't yet have the memory cells, which is why they seem to get ill so often. Their body hasn't responded to the plethora of pathogens yet, so their immune system is immature.

Vaccines are a way of helping the body quickly develop the needed and protective antibodies against diseases. **Inactivated vaccines** transport to the body, through an injection or oral liquid, the shell or dead pieces of a pathogen. The body recognizes it as an enemy and quickly goes into action through the creation of antibodies. Think of the skin of a snake—it may elicit screams as if it were the live snake, however there is no venom within the snake skin to bite or hurt us. **Live vaccines** are synthetically altered real germs that initiate a strong response but cannot cause the actual disease.

Side effects from vaccines are real but generally not serious. A comparison of effects from the vaccine versus the actual measles disease is shown on the table below. Figures are based on a projection of 10,000,000 children; that is, if that number were in the study, these would be the results based on actual scientific evidence.

Side Effects of Measles Compared with the MMR Vaccine (n= 10 million)

MMR	**Measles disease**
980,000 with fever (10%)	9,800,000 with fever (98%)
490,000 with mild rash (5%)	9,800,000 with rash (98%)
1000 allergic reaction (0.0001%)	800,000 with severe diarrhea (0.08%)
1000 inflammation of genitalia (0.0001%)	700,000 ear infection (7%) may cause permanent hearing loss
	600,000 pneumonia (6%)
0.00001% encephalitis	10,000 develop encephalitis (0.1%)
	2,500 progressive brain inflammation—SSPE (0.0025%)
	2,500 progressive brain inflammation—SSPE (0.0025%)
	2.5 million children will suffer from side effects from measles
1 child may die	20,000 children will die

Source: Author.

The History and Pathology of Measles

History of Measles Outbreaks

[Unless otherwise cited, this section was taken from the CDC, 2018a.]

Measles is a highly contagious disease caused by the *morbillivirus*, also known as the **rubeola virus**. It most commonly affects young children and can easily be prevented by a vaccine, which has been available since 1963. Prior to the modern vaccine, for centuries millions of children contracted measles and many died from its fatal complications.

Measles is an ancient disease and its clinical manifestations were first written about in the seventh century by the Persian doctor Rhazes, who tried to distinguish the measles from smallpox, stating measles was more dreaded than smallpox.

The first written record of measles in the United States was in 1657 by a citizen of Boston, Massachusetts. John Hull, in his personal journal, stated "the disease of measles went through the town, but fortunately there were very few deaths" (College of Physicians, 2020). Twenty years later an English doctor, Thomas Sydenham, published *Medical Observations on the History and Cure of Acute Diseases,* and successfully distinguished measles from scarlet fever and smallpox. In 1740 German measles was identified by a German physician, Friedrich Hoffmann, as **rubella** (also called *three-day measles*).

It wasn't until 1757 that the Scottish physician Francis Home found that the virus was detectable in the blood, and lifelong immunity was possible after recovery from the disease. He produced the disease in healthy people by inoculating people without the disease with blood samples from infected people, proving it was a bloodborne disease.

It is estimated that, prior to the current vaccine, the reported U.S. incidence was at least 12,000 measles-related deaths each year and up to 4 million people were infected annually. Among the reported cases of measles, 8,000 were hospitalized and a thousand suffered encephalitis as a serious and often fatal complication. Up to 75% of measles deaths were of children younger than 5 years old. Prior to the 1950s, nearly all children got the measles and developed active immunity from the active disease (unless they died).

It wasn't until 1954 that a vaccine was created from blood samples of ill students in a breakout in Boston, Massachusetts. Up until then, nearly all children got the measles by age 15. Most children recovered without problem, however it did still cause about 500 deaths annually, which was 0.2% of those with the disease.

Serious **complications from measles** include:

- Chronic otitis media
- Pneumonia
- Encephalitis
- Corneal ulceration leading to blindness

The measles vaccine was licensed in 1963 after demonstrated safety and efficacy in monkeys and then in humans. In 1968 it was improved and renamed *Attenuvax*; the new vaccine did not require an additional injection of gamma globulin antibodies to reduce the typical inflammatory reactions. In 1971 Attenuvax was merged in a trivalent combination with the mumps and rubella vaccines to produce the current **MMR vaccine** in 1971. This combination promotes up to 95% immunity against measles when the first vaccine is received by a child at 12 months of age

In 1971 less than 100 American children had measles due to the widespread availability of the vaccine.

Now, in 2019, cases of measles outpace those of the previous decades. Why is it back after it had been eliminated? Outbreaks in 2013 and 2014 were largely due to unvaccinated children in tight-knit communities of Orthodox Jews in New York, an Amish community in Ohio, a Slavic community in Washington, and a Somali community in Minnesota—all of whom had opted out of the recommended vaccine; this demonstrates the potential for epidemics.

Online **Video**: Why Measles Is Back in the United States

Incidence and Prevalence of Measles

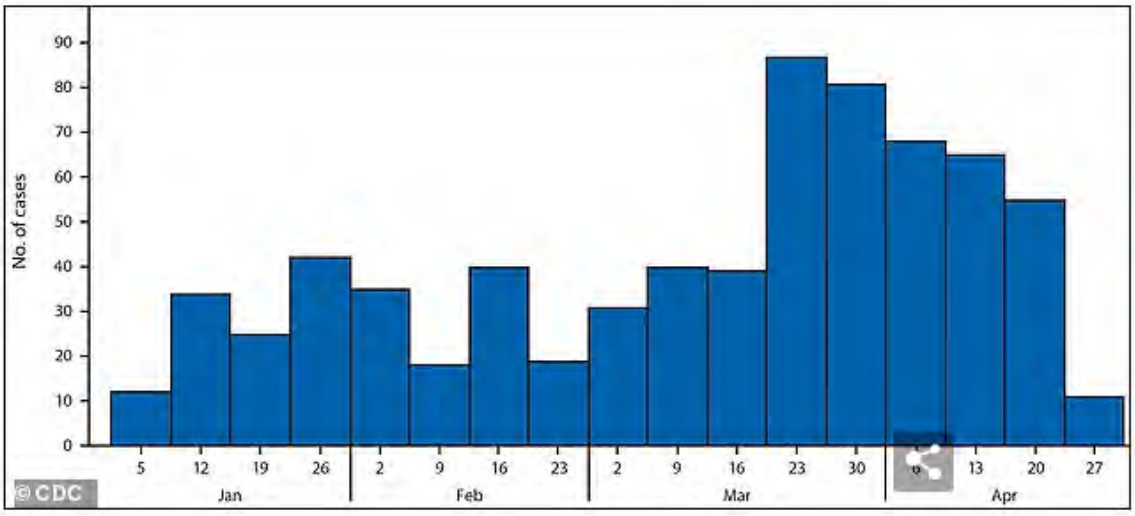
[Material in this section is from CDC, 2019 unless otherwise noted.]

The Centers of Disease Control and Prevention (CDC) in 1978 set the goal of eliminating measles in the United States population within 3 years, which drastically reduced the incidence of measles by 80%. After an outbreak in 1989, the Advisory Committee on Immunization Practices (ACIP), the American Academy of Pediatrics (AAP), and the American Academy of Family Physicians (AAFP) then recommended a second dose of MMR vaccine for all children.

Because of the lack of legislation mandating MMR vaccination, low vaccination rates continued to lead to outbreaks. From 1989 to 1991, CDC reported 55,622 cases with 123 deaths, and 90% of cases were unvaccinated children. They stated: “Surveys in areas experiencing outbreaks among preschool-age children indicated that as few as 50% of children had been vaccinated against measles by their second birthday, and that black and Hispanic children were less likely to be age-appropriately vaccinated than were white children (CDC, Pink Book 2018.)

Incidence of Measles Week by Week in the United States,

January through April, 2019



Source: CDC. The year was only a third over, and already there have been more measles cases in 2019 than the United States has seen in 25 years.

The year 2019 is a record year for measles compared with previous decades following the availability of the measles vaccine. The CDC monitors reported cases of measles through the National Notifiable Disease Surveillance System. This system helps epidemiologists keep track of trends and epidemics to assess for patterns and causes. The 23 states with the highest new cases were New York, New Jersey, Michigan, Washington, and California among unvaccinated communities. An *outbreak* is defined by three or more cases of measles. Because measles is highly contagious, one case easily becomes more. Compared with another highly contagious disease, 1 Ebola patient likely infects 1.5 persons, while **1 measles patient infects 18 others**. Without federal legislation mandating that people be immunized, or adequate federal funding for vaccines, the outbreaks continue.

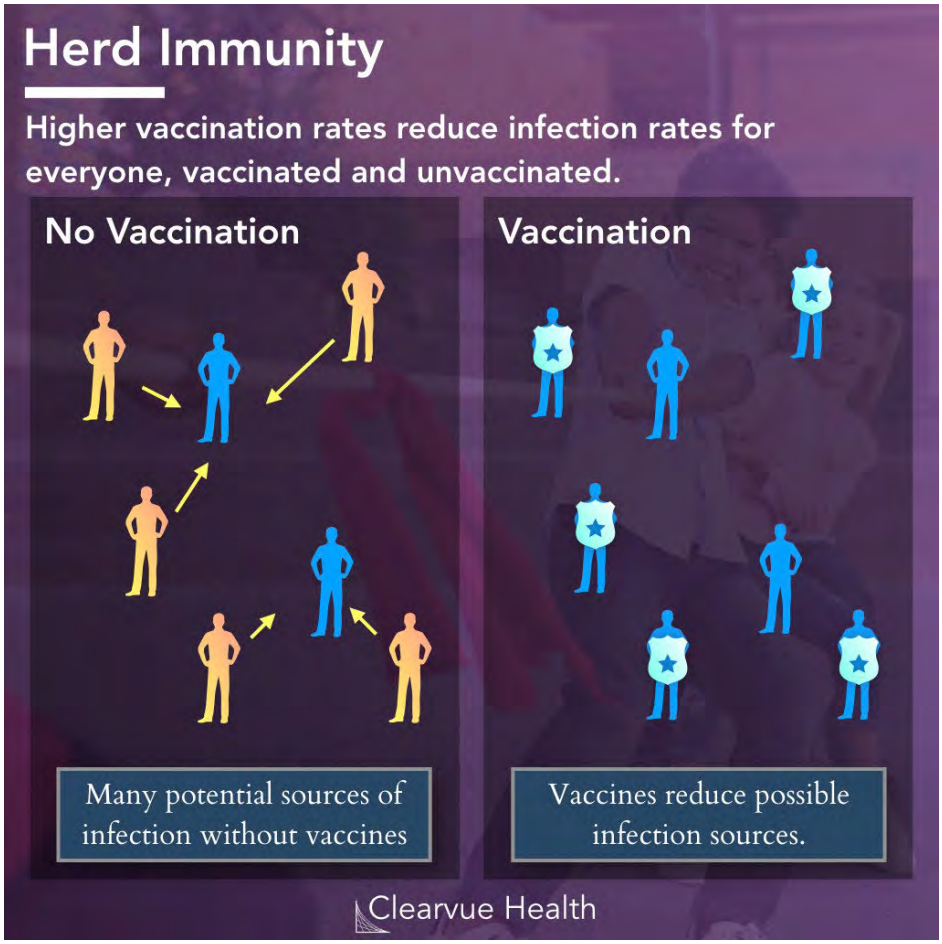
In the year 2000 the CDC declared it had finally reached the worthy goal of measles eradication in the United States after decades of public health education. The term **elimination** has replaced the term *eradication*, but it is still limited to the definition of having no reported cases within the past 12 months. Unfortunately, that declaration of measles elimination was reversed in 2010 due the lack of child immunization and the resultant outbreaks throughout the nation.

As of May 2019, 839 cases of measles have been documented in twenty-three states, with 75% of the victims not being immunized and 13% being younger than 12 months of age. Because the first vaccine for measles is not given younger than 12 months of age, these infants become susceptible in outbreaks in close-knit communities. The largest outbreaks have been in New York and Washington. Although national compliance rates for the CDC vaccine recommendations are 95%, 1 in 12 children are still not receiving their first dose of the MMR on time, creating unneeded exposure risk.

Epidemiologic studies have confirmed that the majority of current cases in the United States have been in U.S. citizens who were unvaccinated and then became infected during international travels, bringing measles back to America. Many cases are the children of parents who opt out of the CDC recommendations for measles vaccine. Currently, the government allows people to withhold from vaccine recommendations for religious or personal reasons.

A recent example of the consequences of abstaining from CDC-recommended vaccines is a cruise ship owned by the Church of Scientology that was quarantined in the Caribbean after a crew member was diagnosed with measles. Fearing an outbreak, approximately 300 people onboard were ordered by the health officials of St. Lucia not to embark in St. Lucia but to stay onboard until the danger had past.

The debate continues between freedom of religious and personal freedom on the one hand and the good of the community on the other. Meantime, **herd immunity** may be achieved when 95% of a community are immunized; the immunity of the 95% protects the remaining 5%. Notably, when the immunized group decreases, the protection for non-immunized persons decreases also.



Source: CDC.

The Pathophysiology of Measles

The measles virus is transmitted by air as droplets infect the respiratory system; it is manifested in a widespread skin rash. The measles virus is transmitted via the respiratory route and replicates in the nasopharynx and regional lymph nodes within 2 to 3 days after exposure. A secondary viremia occurs 1 week later and is spread to nearby tissues. The incubation period from exposure to **prodrome** (early stage of symptoms indicating a disease) is 10 to 12 days, with the onset of rash within 14 to 21 days (CDC, 2019). There are 22 known versions of the measles virus.

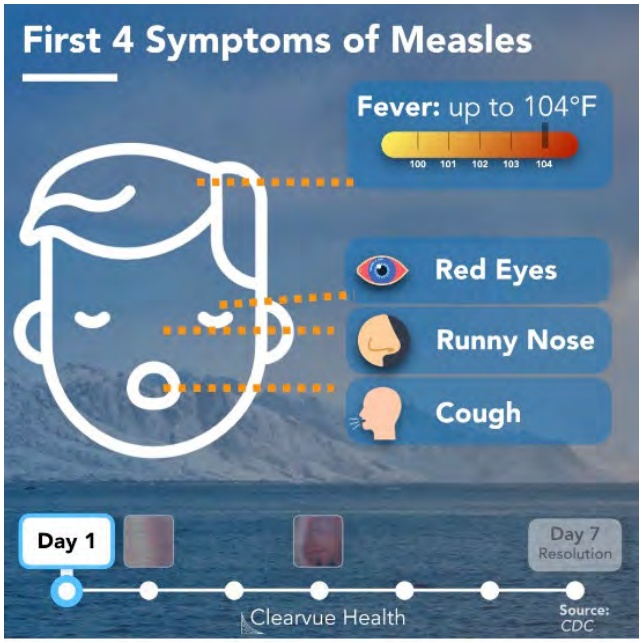
Six different conditions are caused by the rubeola virus. They include:

- **Classic measles.**
- **Modified measles**: someone vaccinated but without adequate immunity. The clinical course is generally not as severe.
- **Atypical measles**: the clinical syndrome from those who were vaccinated with the killed virus vaccine between 1963 and 1967, who did not receive adequate immunity. They may develop the clinical symptoms, but symptoms may be milder.
- **Post-infectious neurologic measles**: causes acute decimated encephalomyelitis (ADEM) and subacute sclerosing pan encephalitis (SSPE)
- **Severe measles.**
- **Complications**: giant cell pneumonia, and Measles inclusion-body encephalitis

The Clinical Symptoms

There are four stages of classic measles, which include incubation, prodrome, exanthem stage of rash, and recovery. In the incubation period, patients generally do not feel symptoms for 8 to 10 days and don't know they have been infected.

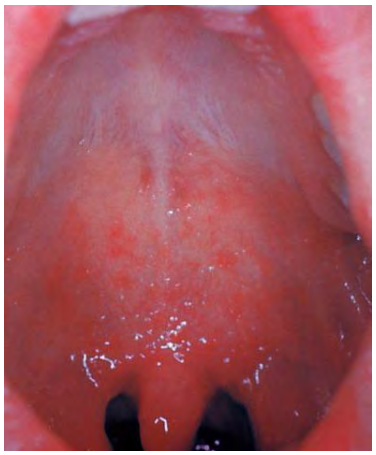
The prodrome lasts from 2 to 8 days and includes the symptoms of fever, peaking as high as 105^{o} F, followed by dry hacking cough, runny nose (coryza), and conjunctivitis. The **Three "C's"** include cough, coryza (rhinitis) and conjunctivitis. Fever is also present and should alert the medical provider to a higher concern than a common cold. Sneezing may also be present, representing the body's response to a respiratory attack.



Source: CDC.

Red and white spots present on the mucous membrane of the mouth 1 to 2 days before the generalized body rash and are known as **Koplik spots**—identified by Henry Koplik, an American pediatrician, in 1896 (HxBenefit, 2019). In the palate, the spots look like grains of white sand on a hot red background. Koplik spots, which are specific to measles, generally appear about 48 hours before the rash appears.

Koplik Spots



This patient presented with Koplik spots on palate due to pre-eruptive measles on day 3 of the illness. Source: CDC/PHIL.

Did You Know . . .

Koplik spots are unique to measles and no other medical condition has them. Identifying oral mucosal spots in the posterior of the oral cavity can be helpful in distinguishing measles from other childhood conditions with fever and rash.

The measles exanthem rash is characterized as a **maculopapular rash** beginning at the head and mouth and progressing downward and outward (confluence) to the chest, hands, and feet, and lasting for less than 1 week. It usually spares the palms and soles of the feet. Initially the lesions blanch but by days 3 to 4 they do not blanch and may create fine desquamation and peeling of hands and feet. The lesions and rash disappear in the same order they appeared. Additional symptoms include anorexia, diarrhea, malaise, and generalized lymphadenopathy as the body works to kill and rid itself of the bloodborne virus.

After the rash appears, 48 hours will see additional fevers but recovery of the Koplik. If the rash continues after 48 hours, it is a signal of potential complications.

Measles Rash Seen on Light and Dark Skin

Left: Child with classic measles rash after 4 days. Source: CDC.

Right: Skin sloughing off of a child healing from measles infection. Source: CDC/PHIL.

Complications are seen in 30% of measles cases, more commonly among children younger than 5 years of age, or adults older than age 20. There have not been many cases of elders with measles because those born before 1963 had childhood exposure and lifetime immunity. Common complications include diarrhea in approximately 8% of cases, otitis media in 7% of cases, and pneumonia in 6% of reported cases; pneumonia is the most common cause of measles-related death, accounting for 60% of those who contract it (CDC, 2019).

Nausea, vomiting, febrile seizures, anorexia, and complications from dehydration may occur. Patients may develop photosensitivity and should protect their eyes if in sunlight during the duration of the illness. Thrombocytopenia also affects the body's ability to clot and may affect bleeding risk. Neuritis and an infection of the optic nerve leading to blindness may result. Encephalitis, toxic encephalopathy, may occur in 1 in 200 people and is a serious complication leading to death.

The person is infectious 4 days after the fever and before the rash appears and continues to be infectious 4days after the rash has appeared. Exposure occurs either by direct contact with the infected person by droplets in the air of the coughing or sneezing measles patient (for up to 2 hours). The virus remains viable even on inanimate objects up to 2 hours. A child who rubs the runny nose and touches others, or objects, may infect others. Approximately 90% of people who are not immunized against measles will develop measles if they inhabit the same household.

Atypical measles is found in persons vaccinated by the inactivated killed measles vaccine (KMV) between 1963 and 1967, which sensitized but didn't protect recipients against the virus. The resultant illness from exposure creates the same clinical symptoms but the rash seems to be limited to the wrist and ankles.

It is recommended that those who received the killed measles vaccine during those years receive the second MMR.

Diagnosing Measles

Not all childhood rashes are measles, but the systemic rash from head to toe is a clinical symptom common to measles. A unique clinical manifestation the Koplik spots. Although the virus can be isolated from urine, the nasopharynx, blood, and throat cell samples within 7 days of symptoms, it is not routinely done for initial diagnosis. Diagnosis is often done by clinical symptoms, history of international travel, risk factors and exposure to others with measles. Two positive serum specimens are required for positive serologic testing by enzyme-linked immunoassay (ELISA). Blood tests for measles IgM antibodies is done to confirm reportable cases. A confirmed case must be reported to the local health department, in addition to the infectious disease departments of hospitals and healthcare facilities.

Lab test results may show decreased platelets, low white blood cells, specifically low T-cells, which puts those who are already **immunocompromised** at greater risk. Chest x-ray may show pneumonitis. In addition to clinical symptoms of Koplik spots and rash, lab values such as circulating antibodies IgM and IgG are helpful in diagnosing the disease. IgM is the most responsive to an acute attack and indicates a recent infection. IgG (think of as “g” for gone) represents the memory of a past infection. The IgM will rise within two days of the rash, is specific for rubeola, and then declines within one month. The IgM capture Elisa and indirect Elisa are diagnostic tests and are both specific and sensitive.

Other diseases may look similar to measles because of the full body rashes such as rubeola, rubella, erythema infectiosum, roseola infantum, and hand-foot-mouth disease. Many other childhood conditions present with fever and rash, and knowing the various clinical presentations can help with the differential diagnoses.

Other diseases that may look similar to measles because of the full-body rashes include rubeola, rubella, erythema infectiosum, roseola infantum, and hand-foot-mouth disease. Many other childhood conditions present with fever and rash, and knowing the different clinical presentations can be useful. The following table compares the clinical symptoms of various similar childhood diseases to help identify the differences between them.

Symptoms of Similar Childhood Diseases

Name	Also known as	Age	Pathogen	Signs/symptoms	Treatment
Rubeola	Classic Measles Red Measles	Any	Rubeola virus	Fever, coryza, cough, conjunctivitis **(3 C's**), **Koplik spots,** spreading maculopapular rash from head to feet, anorexia, malaise	Supportive: antipyretics for fever, hydration, isolation Antibiotics if bacterial infection develops
Rubella	3-day Measles	Any	Rubeola virus	Same as rubeola without high fever and no Koplik spots. Resolves on own in 72 hours. Joint pain and lymphadenopathy	Supportive for fever and hydration
Erythema infectiosum	Fifth's disease	5-14 yrs	Human Parvovirus B19	"Slapped cheek" appearance, lacy exanthema on face, arms, legs, trunk and dorsum of feet. Not contagious after fever breaks. Rash may last up to 40 days.	Supportive for fever and hydration
Roseola Infantum	Sixth Disease	6 mo to 2 yrs	Herpes virus 6	URI symptoms Small pink, flat bumps on trunk and extremities, high fever when rash develops that can last up to 8 days.	Supportive for fever and hydration
Coxsackie virus	Hand-Foot-and-Mouth disease	Any	Coxsackie virus	Inflammation of soft palate of mouth and papulovesicular exanthem of hands and feet. Drooling, fever, malaise, poor appetite from painful mouth sores.	Supportive for fever, pain and hydration.

Source: Author.

Treatment and Management of Measles

In the United States, supportive measures for nutrition, hydration and fever control are the mainstay of treatment for measles. Teaching parents when to seek medical attention after diagnosis is important to avoid complications. Rapid medical attention for problems can help avoid serious complications; however, those who are immunocompromised may have a longer course and may even shed the virus for several weeks after the acute illness.

Acute Care

Antipyretics, such as Tylenol, can be given for fever control and comfort; aspirin is not recommended. Because children with measles develop malaise and anorexia, hydration is essential; children may become dehydrated very quickly based on their smaller body mass. Isolation is important as it is highly contagious, and the virus may continue to be shed during the rash phase, which may last up to two weeks. Home management is generally to keep the child in isolation and comfortable. There is currently no cure for measles. Once a child develops measles his body will create a lifetime immunity from it, however getting through the course of symptoms can be uncomfortable for both the child and the parents who care for him.

Cough medicine will not help a measles cough; however, a humidifier or nebulizer may help relieve chest congestion and dryness. Children with measles may not return to school until at least 5 days after the rash appears. Antibiotics may not help against the measles virus but may be prescribed if a secondary bacterial infection develops (eg, pneumonia, or a skin infection from scratching the rash).

Although not currently endorsed by the FDA, vitamin A and intravenous ribavirin have been shown to reduce the course of measles. Studies for vitamin A come from developing countries that have higher incidences of vitamin A deficiency. The recommended regimen is 50,000 IU for infants aged <6 months, 100,000 IU by mouth at time of diagnosis for infants younger than 1 year, and 200,000 IU for children older than 12 months of age (AAP, 1993).

An additional but exploratory treatment for measles is the use of oral or intravenous ribavirin for hospitalized children with measles. As a virustatic agent, it has decreased the average hospital stay of children with measles by 2 to 3 days (Gururangan, et al., 1990).

Worldwide in developing countries without available vaccines, measles has a higher incidence and prevalence and is more severe in malnourished children with fatalities rates as high as 25%.

Measles is not risk-free. Complications can develop and require hospitalization. Hospitals have requested and received CDC recommendations for caring for a child or person with measles. Management of exposure is guided by the CDC here.

Post exposure prophylaxis is available with one dose of the MMR and immune globulin (IG) if administered within 72 hours after exposure. If the initial exposure does not result in a full case of measles, it can serve as an additional vaccination and poses no harm.

Measles should be reported within facilities to public health authorities and communicated with key facility staff, including leadership, infection control and epidemiologists. Hospitals should be prepared to place the patient in an isolation room.

Hospital Protocols

When a person presents to a healthcare facility with possible measles, several precautions should be taken to minimize potential exposures before arrival to the facility. Phone triage from a physician's office or a home phone call should alert the staff receiving the patient to take appropriate isolation measures. Facilities should post visual alerts and instructions at entry points. Triage stations should be created to rapidly identify patients with measles and provide a facemask to the patient. Preferably, isolation of the patient prior to entry into the facility is advised according to the Standard and Airborne Precautions standards. In a healthcare setting, all healthcare personnel and anyone entering a room containing a patient with measles, should wear an N95 respirator consistent with airborne infection control precautions.

An **airborne infection isolation room (AIIR)** with a **high efficiency particulate air (HEPA) filter** system is preferred, but if not available, the patient should at least be given a private room. An AIIR room must demonstrate at least 6 (if the facility is old) to 12 (for new construction) air changes per hour. Measles can exist in the air for up to 2 hours. Current public air sources have not been built to eliminate the small measles virus.

If patients with measles need to be transported to another facility, they should wear a facemask and notify the receiving facility, so it can make necessary airborne precautions. Airborne precautions should meet current standards, with daily monitoring of air pressure. All healthcare professionals who must enter the AIIR room should use respiratory protection such as an N95 mask. The patient should remain in isolation and AIIR for 4 days after the onset of the rash, or duration of the illness for immunocompromised patients. Limit visitors—especially those without evidence of immunity against measles.

Standard cleaning and disinfection procedures are required for medical waste and there is no additional management needed for waste, according to federal and local rules for regulated medical waste.

Assessment and management of exposure is defined as the time up to 2 hours in a shared air space after the measles patient was present. An example is requiring 2 hours for the necessary time to clean an ambulance after a patient with measles was present. The conservative margin of time is to wait 2 hours with air cycling before a 99% safety status is confirmed.

If there is a large outbreak involving a large number of patients, consult the infection control professionals before a patient is placed, to determine the safety of alternative rooms if an AIIR room is unavailable.

Post-exposure prophylaxis should be offered to people who cannot readily demonstrate immunity against measles; for example, infants under 1 year and pregnant women (Public Health England, 2017). Infants and pregnant women who have not had the vaccine and have been exposed to someone with measles should receive the Human Normal Immunoglobulins (HNIG).

Although the best advance protection against measles still remains two injections of the MMR vaccine, post exposure is better than nothing because the success has been limited. The MMR should be given 72 hours after exposure to infants 12 months or older.

Did you know…

Most other countries have a standard guideline for immunization schedules and post-exposure recommendations. Their recommendations are largely based on the American CDC recommendations and their unique risk for their populations.

Vaccination and Prevention Strategies

Immunization Recommendations

Immunization schedules recommend the first MMR to be given the earliest at 12 months with a repeat vaccine at age 4 to 5 years. Only 2% to 5% of children will have adequate immunity if just the first vaccine is received. With the second dose, the immunity is boosted to 97% (Meissner, 2019).

MMR is provided under the following trade names:

- Immravax (Aventis Pasteur)
- Pluserx-MMR (SmithKline Beecham)
- MMR II (Merck).

Currently the only contraindications for the vaccine are people with severe allergy, pregnancy, or immunosuppression due to the live virus. Precautions for consideration are people with thrombocytopenia, or family history of any seizures of any etiology (American Academy of Pediatrics, 2015). Parents of children who are immunocompromised and should not receive the vaccine should become the loudest proponents for the vaccine. Only by helping create herd immunity can they protect their own child.

It is significant to know that the MMR contains a live virus. It is not recommended for those with HIV, AIDS, or a neutropenic condition. Although the virus is attenuated, and the possibility of actually receiving measles from the vaccine is extremely low, it must be considered carefully for those who already have a depleted immune system. All vaccines work on the biology of immunology, which is the body's ability to recognize an antigen and build up antibodies to fight it.

When a vaccine is received by an individual, the person is considered to have **passive immunity**, whereas, when a person develops the antibodies naturally from direct exposure to the antigen they have **active immunity**. Most vaccines are synthesized chemically and deactivated, so they carry no live antigen, exceptions being the MMR and chicken pox.

A new vaccine includes the chicken pox varicella with the MMR and is called MMRV. It is given at the same recommended time frame of 12 to 15 months with the second dose at age 4 to 6 years. In the United States the measles vaccine is only available in combination formulations, such as the measles-mumps-rubella (MMR) and **measles-mumps-rubella-varicella (MMRV) vaccine**.

To recap: the CDC recommendation is to receive the first dose of MMR live vaccine on or before the first birthday. The ideal window for the first vaccine is 12 to 15 months of age. The second dose of MMR should be given at least 4 weeks (28 days) apart from the first vaccine but is actually recommended at age 4 to 6. If an infant received the first MMR before age 12 months due to international travel, that infant should still receive the scheduled two doses. Only written documentation of the vaccines is valid.

If there is an outbreak of measles in a community and an infant younger than 12 months is traveling to the area, the CDC does recommend the dose at 6 to 11 months, unless there are any contraindications. Studies have shown that infants vaccinated younger than 12 months of age may not reach the 97% effectiveness of immunity. The recommendation is that the infant should receive the vaccine before traveling internationally but receive the second vaccine as per the usual schedule. If an older person missed the vaccine schedule times, it is recommended they receive both doses, but 28 days apart, to establish adequate immunity.

If a person who has been immunized but does not show immunity, the recommendation is to repeat the vaccination. If the status of initial immunity is unknown, it is also recommended to simply offer the initial vaccination rather than order a serology test. Laboratory evidence of immunity is acceptable (including for international travel) if the initial vaccination is undocumented. Having an undocumented memory of the disease may not be acceptable, unless the person was born before 1957.

For those born before 1957, it is assumed they have already had the disease and do not require the vaccine. Unlike the live vaccine that is given now, a killed vaccine was given between 1963 and 1967. It was given to less than 1 million adults, which represents < 5% of all living adults. If someone received the killed vaccine during this time even with proof of documentation, they are advised to receive another vaccination of the MMR.

Measles illness during pregnancy can cause premature labor, spontaneous abortion, and birth defects. For mothers with measles who should be on isolation and are breastfeeding, breast milk given to their infant is still approved by the CDC. Although most vaccines are not given during pregnancy, the annual flu vaccine has been approved. Making sure all vaccines are up to date, including the measles through the MMR, should be done before pregnancy.

Online Video: Guidance for Pregnancy Regarding Flu and Measles Vaccines

Evidence of immunity against measles is acceptable if one of the following is met:

- Written documentation of age-appropriate vaccination with a live measles virus–containing vaccine
- Laboratory evidence of immunity or serologic confirmation of the disease
- Born before 1957
- Disease history

The CDC accepts evidence of immunity with written documentation of one or more doses of the live measles vaccine (MMR) administered after the first birthday. It also accepts two doses of MMR for school-age children and adults who may be at high risk as evidence of immunity.

Prevention and Screening Strategies

Although measles was declared eliminated in the United States in the year 2000, ongoing outbreaks throughout the nation have been reported. **In 2019 the number of annual cases of measles has exceeded the number of cases in any year since the eradication was declared.** The 91% of cases that have been reported are of unvaccinated or unknown vaccination status and the majority of these cases are among children. Recent CDC reports also reveal that 20% of these cases are coming from international sources (eg, immigrants, international students, and tourists) who bring the disease into the United States.

General strategies that help prevent measles transmission include:

- **Community vaccination**, the main prevention for all settings, including schools, hospitals and the general public. Prevention through 95% vaccination in all communities remains the best approach.
- **Screening** is generally not done, as there is no screen for measles until the patient presents with symptoms. Screening for compliance with CDC vaccine recommendations is done however by the public-school systems that require documentation before registration for school.

Educating Parents and Communities

In the original movement against vaccines deceptively created by Wakefield (1993), the media played a large role in the controversy by publicizing the falsehoods and helping to create the confusion (Moore, 2006). The public's fear of vaccines was created through "science by press conference" rather than real science. Unfortunately, poorly backed scientific evidence was presented as truth to the public and the damage of misinformation has continued. To rectify the misperceptions that Wakefield's sham has played in causing the decline of vaccinated children, we must redouble our efforts to make the truth available to every parent.

Healthcare workers who live in ethnically tight-knit communities can spread the word where they themselves live. They may find suspicion toward the American government by ethnically diverse immigrant populations who do not trust allopathic or Western medicine. By educating and using trusted individuals within their own community, public awareness programs and even vaccine clinics could be made acceptable.

Teaching parents about the safety of the vaccine is essential to adherence to CDC recommendations. Public safety campaigns that provide printed and audiovisual materials in physician offices, hospitals, schools, and pubic venues is a proactive approach. Many states mandate the documentation of CDC recommended vaccines before admission into public schools. Schools still allow a parent to opt out of vaccines due to religious or personal values.

In many states, legislators have proposed a bill to ban vaccine exemptions (Goldstein-Street, 2019). Knowing that herd immunity requires at least 95% vaccine compliance, then working to prevent communities from dipping below that will help prevent the measles epidemics. The delicate balance between personal freedoms and community health is currently being debated state by state.

Helping parents understand the vaccine schedule and catch-up process is helpful. When pediatricians provide the overview schedule of recommended well-child visits, parents can anticipate doctor visits and schedule them accordingly. Having parents schedule the 1-year well-child visit ahead of time is a proactive approach. It is estimated that 1 in 4 children who get measles will be hospitalized and that there is a 90% chance a child without the vaccine will contract the disease. A key fact for parents to know is that measles is preventable.

Making vaccines affordable through insurance—or even free with public assistance programs such as Medicaid—can help decrease the barrier of cost. The Affordable Care Act has made efforts to cover the expense of vaccines for many populations.

The role of all healthcare professionals is to be well-informed about measles and the MMR, and to educate correctly the patients they come in contact with about the value and safety of vaccines. For those who work with vulnerable populations, advocacy for vaccine campaigns can be extremely helpful. The health of our entire American community depends on 95% of herd immunity being vaccinated. Every effort to inform and educate the general public about adherence to these guidelines can make the difference.

Global Efforts

Worldwide campaigns are making progress. Formal entities such as the American Red Cross and its counterparts across the world have created initiatives to reach communities far from medical services where they bring the clinics and vaccines to the people.

One organization, UNICEF, tries to partner with governments, private entities, and non-governmental agencies to provide immunizations to communities and families in under-developed countries. In addition to public awareness and education campaigns, their program includes efforts to create partnerships to develop solar power and technology so as to deliver the vaccines protected from extreme temperatures (UNICEF, 2018).

Source: UNICEF, UN0293818/Keïta. Used under UN copyright guidance.

In transient communities of migrant workers, or in Third World nations, parents may work in harsh conditions with their infants strapped to their backs as they work. Their survival is focused on working for *food*, and infant care is secondary. In a typical scenario of millions of physical laborers worldwide, Ramata, known as a "goldmine woman," scratches the dirt in a goldmine valley all day with her baby strapped to her back (see above photo). Her Mali community was only 47% vaccinated. When UNICEF workers came to her actual worksite to offer free vaccines, she said that was her "greatest treasure of the day."

Summary

Our nation's measles epidemic is complicated and concerning. Thousands of lives are lost needlessly due to lack of vaccination and exposure to measles.

Public misinformation originated with falsified research claims by a British physician claiming a connection between MMR and autism. All allegations and claims were refuted and withdrawn and the British doctor lost his license.

Proponents and antagonists of vaccination need to begin a respectful dialog to understand reasons for resistance. Rebuttals to address their concerns have been discussed. Those who are proponents of vaccination have heavy scientific evidence to back up the recommendations; however, those who are resistant are often fueled by emotion and personal values. Arguing with them is not effective, but sharing scientific evidence may make available the protection they can offer their own children and society as a whole.

Correct education of parents is needed to help them understand the much greater advantages of protecting children with vaccines. Legislation is needed to secure adequate funding of vaccines. States, through laws can mandate vaccines in order for children to enter public school. Schools, public health districts and public officials must work together to convey the message of vaccination against measles.

Understanding the CDC recommendation and vaccine schedule is important to full immunity. Following CDC guidelines for contraindications and the treatment of measles is established. Healthcare professionals do not have to wonder about how to treat or prevent measles—science has provided established guidelines to follow.

Proposed strategies to fight the measles epidemic are at various stages of implementation and it will take time. The cost to implement programs, educate stakeholders, and evaluate any negative consequences to appropriate treatment plans requires patience. In the meantime, small efforts can save lives. Your efforts to learn more about the measles epidemic and your role within it are essential!

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Post Test

1. Which of the following is not a cause of the modern measles epidemic?

a. Infants under 12 months who are exposed to measles and not yet vaccinated.

b. International travel.

c. Access to validated scientific MMR vaccine information.

d. Parents refusing to follow CDC vaccine recommendations.

2. What percentage of U.S. measles cases in 2019 have been children?

a. 10%

b. 25%

c. 50%

d. 75%

3. How many people could one person with measles infect?

a. Up to 18

b. No one, it is not contagious.

c. Up to 50

d. Up to 1.5

4. The 3 "C's" of classic measles symptoms do not include which of the following:

a. cough

b. coryza

c. conjunctivitis

d. constipation

5. What is the cause of measles?

a. A gram negative bacteria

b. A virus

c. A gram positive bacteria

d. A respiratory fungus

6. What of the following is not a valid way to diagnose measles?

a. Clinical symptoms

b. History of the disease and exposure

c. CBC with levels of RBCs and WBCs

d. Serology testing

7. In a healthcare setting, all healthcare personnel and those entering a room with a patient with measles, should wear an N95 respirator consistent with airborne infection control precautions.

a. True

b. False

8. Which of the following is not adequate to establish immunity from the measles?

a. Documentation of receiving the two-dose MMR vaccine.

b. Serology testing of antibodies.

c. Memory of having measles.

d. Born before 1957.

9. Which patient could room with a measles patient in the hospital?

a. A patient with upper respiratory infection.

b. A patient who is failing to thrive.

c. A patient with no open wounds but on a ventilator.

d. No one. The patient should be in isolation.

10. What is recommended for someone who has not had the measles vaccine and has been exposed to someone with measles?

a. It is not needed as the chance of getting measles is low.

b. If they are immunocompromised, they may need the human immunoglobulin and one MMR dose within 72 hours of exposure.

c. They need both MMR vaccines two weeks apart.

d. They only need the HNIG.

Answer Sheet

Name (Please print) _____

Date_____

Passing score is 80%

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Course Evaluation

Please use this scale for your course evaluation. Items with asterisks * are required.

5 = Strongly agree 4 = Agree 3 = Neutral 2 = Disagree 1 = Strongly disagree

*Upon completion of the course, I was able to:

1. List at least 4 arguments in favor of vaccination for measles. 5 4 3 2 1
2. State 3 clinical symptoms of measles. 5 4 3 2 1
3. Identify 3 strategies for treatment and prevention of measles. 5 4 3 2 1
4. Discuss 2 ways to educate parents about measles immunization. 5 4 3 2 1

*The author(s) are knowledgeable about the subject matter. 5 4 3 2 1

*The author(s) cited evidence that supported the material presented. 5 4 3 2 1

*Did this course contain discriminatory or prejudicial language? Yes No

*Was this course free of commercial bias and product promotion? Yes No

*As a result of what you have learned, will make any changes in your practice? Yes No

If you answered Yes above, what changes do you intend to make? If you answered No, please explain why.

*Do you intend to return to ATrain for your ongoing CE needs?

_____Yes, within the next 30 days. _____Yes, during my next renewal cycle.

_____Maybe, not sure. _____No, I only needed this one course.

*Would you recommend ATrain Education to a friend, co-worker, or colleague?

_____Yes, definitely. _____Possibly. _____No, not at this time.

*What is your overall satisfaction with this learning activity? 5 4 3 2 1

*Navigating the ATrain Education website was:

_____Easy. _____Somewhat easy. _____Not at all easy.

*How long did it take you to complete this course, posttest, and course evaluation?
_____60 minutes (or more) per contact hour _____59 minutes per contact hour

_____40-49 minutes per contact hour _____30-39 minutes per contact hour

_____Less than 30 minutes per contact hour

I heard about ATrain Education from:

_____Government or Dept of Health website. _____State board or professional assoc.

_____Searching the Internet. _____A friend.

_____An advertisement. _____I am a returning customer.

_____My employer. _____Social Media

_____Other _____

Please let us know your age group to help us meet your professional needs.

_____18 to 30 _____31 to 45 _____46+

I completed this course on:

_____My own or a friend's computer. _____A computer at work.

_____A library computer. _____A tablet.

_____A cellphone. _____A paper copy of the course.

Please enter your comments or suggestions here:

Registration and Payment Form

Please answer all of the following questions (* required).

*Name: _____

*Email: _____

*Address: _____

*City and State: _____

*Zip: _____

*Country: _____

*Phone: _____

*Professional Credentials/Designations:

_____

*License Number and State: _____

*Name and credentials as you want them to appear on your certificate.

_____

Payment Options

You may pay by credit card, check or money order.

Fill out this section only if you are paying by credit card.

2.0 contact hours: $10

Credit card information

*Name: _____

Address (if different from above):

*City and State: _____

*Zip: _____

*Card type: Visa Master Card American Express Discover

*Card number: _____

*CVS#: _____ *Expiration date: _____