



## Vaccines: Narrowing Disparities and Recent Advances Offer Reason to Celebrate

With the return of children and teachers to school and the dropping autumn temperatures come flu season, and vaccines are once again on peoples' minds. Last year's H1N1 pandemic served as a disquieting reminder of how quickly infectious diseases can spread and the important role vaccines play in combating many infectious and non-infectious diseases.

Vaccines have long been heralded as among the greatest public health achievements. While not without detractors, vaccines can be credited with slowing the spread of many infectious diseases used to cause widespread illness, disability, and death. When enough people get vaccinated, diseases can disappear completely. To date, smallpox is the only disease that has been successfully eradicated.

### A Brief History

Dr. Edward Jenner is widely credited with creating the world's first vaccine, to protect against smallpox, over 200 years ago. He had noticed that dairymaids who contracted cowpox rarely became sick with smallpox. Dr. Jenner used cowpox matter to successfully inoculate an 8-year-old boy against smallpox.<sup>1</sup>

Today, most vaccines work by injecting a weakened or killed form of the virus into the body. The body then develops antibodies to fight this form of the virus and if the person is ever exposed to the actual disease, the antibodies will still be there ready to fight off the disease.<sup>2</sup> Currently there are roughly 25 vaccine-preventable diseases.<sup>3</sup>

All 50 states have passed legislation mandating certain vaccinations for school-age children; however, various exemptions are available to children meeting certain criteria. With the exception of West Virginia and Mississippi, all states allow parents to exempt their children from vaccination if it contradicts their religious beliefs. Furthermore, 20 states permit philosophical exemptions and all states allow medical exemptions.<sup>4</sup> In stark contrast to the laws mandating vaccination for child care and school-age children, very few laws govern vaccinations for adults.

### Do Health Disparities Exist?

The Advisory Committee on Immunization Practices, the American Academy of Pediatrics, and the American Academy of Family Physicians recommend vaccinating children against most vaccine-preventable illnesses by the time they reach their 2nd birthday. Childhood vaccination rates have historically been lower among black and Hispanic children compared to whites.<sup>5</sup> Exciting advances have been made over the past decade in closing the gap in childhood vaccination rates among children of different races and ethnicities. The most recent data show no significant differences in vaccination rates among children of varied racial and ethnic backgrounds. The share of children receiving a combined series of six key vaccinations was 73 percent for blacks, 75 percent for whites, 78 percent for Hispanics and 82 percent for Asians in 2008.<sup>6</sup>

Great strides have been made towards eliminating disparities in vaccination rates among children of different races and ethnicities, however, small disparities persist among children of different income levels.



Rates of children living below the poverty level who received four key vaccines grew from 61 percent in 1994 to 75 percent in 2008, a promising trend. Yet the percentage of children living at or above the poverty level who received four key vaccinations was 81 percent in 2008 – six percentage points higher than for children living below the poverty level.<sup>7</sup> While children living at or above the poverty level continue to have higher vaccination rates, the gap is narrowing. Programs such as the State Children's Health Insurance Program, which mandates that all state plans cover the cost and administration of childhood vaccinations, have played a key role in eliminating cost as a barrier to receiving childhood vaccinations.<sup>8</sup>

*Ohio's estimated rate of vaccination coverage for children ages 19 months to 35 months for six key vaccines was 81.8 percent in 2008, higher than the national rate of 76.1 percent that same year.<sup>9</sup>*

### Disease Outbreaks

Having a high proportion of the population vaccinated against a disease helps provide protection to people who choose not to be vaccinated against an infectious disease, who cannot be vaccinated for medical reasons, or who are too young to be vaccinated. This concept is known as community or herd immunity. Individuals who have not developed immunity, either through vaccination or exposure to the infectious disease, are indirectly protected by the majority of individuals around them who do have immunity. Herd immunity begins to fail when the rate of immunization falls from previously high levels to a level below the threshold needed to provide protection.

There are a variety of reasons why 100 percent of the population does not have immunity to vaccine-preventable diseases. Some people get vaccinated against a disease, but do not develop immunity to it; some people are allergic to ingredients in the vaccines or are too sick from other diseases to receive vaccinations; some people have religious or philosophical objections to vaccinations and choose to not get vaccinated; and some infants are too young to be vaccinated.

While media coverage of certain individuals' philosophical or religious objections to vaccines can make the numbers appear larger, in reality, those who refuse all vaccines remain a small minority of the population. According to the Centers for Disease Control & Prevention, the latest research shows that less than 1 percent of young children receive no vaccinations.<sup>10</sup> However, there is some evidence of an increasing number of parents who refuse or delay getting their children vaccinated.<sup>11</sup> This has raised concerns about the potential for disease outbreaks.

Significant public health campaigns have succeeded in achieving high rates of vaccination in the U.S. and other developed countries, yet many vaccine-preventable infectious diseases are rampant in other countries. When there are vaccine-preventable disease outbreaks in the U.S. they sometimes stem from individuals who have travelled overseas, become exposed to an infectious disease, and returned home and unwittingly spread the infection to others. There have been reports of outbreaks of various vaccine-preventable diseases – including measles, mumps, polio and most recently pertussis (commonly known as whooping cough) – in the U.S. over the past five years. →

## Vaccine Research and Development

While media attention often focuses on disease outbreaks of vaccine-preventable diseases or the controversy surrounding vaccination, new advances in vaccine development spend much less time in the limelight. Yet as scientists continue to push the boundaries of medicine, previously unthinkable vaccines become one step closer to reality.

### New Delivery Methods

Anyone who has ever taken a child to be vaccinated understands the desire to come up with alternatives to the needle injection. With most states requiring childhood vaccinations against at least seven common diseases, this translates into children receiving roughly 23 needle pricks before they turn six.<sup>12</sup>

Several oral vaccines have been created over the years. Roughly 50 years ago an oral polio vaccine was licensed for use in the United States. In 2000 the U.S. discontinued use of the oral polio vaccine due to the slight risk of a rare but serious condition, but it is still used in many other parts of the world. An oral rotavirus vaccine, to protect against the leading cause of severe diarrhea among infants and young children, is currently administered to children as part of the U.S. immunization schedule. Aside from oral vaccines, a nasal vaccine to protect against influenza virus – FluMist – has been available since 2003.

Advances in the field do not stop there. Scientists are studying edible vaccines, such as alfalfa tablets and tomatoes encapsulated into gelatin capsules. The potential for mass immunization campaigns has spurred further research into alternative vaccine delivery approaches. Other painless systems that could be self-administered, such as the “patch,” “wipe-and-go,” and self-administered microneedles are also under development.<sup>13</sup>

### Cancer

The medical community has made great progress conquering many diseases once thought to be insurmountable. Scientists are now targeting cancer for future vaccine development. In 1981 the first cancer-preventive vaccine was created to protect against the hepatitis B virus, which can cause liver cancer. Just a few years ago, in 2006, the second cancer-preventive vaccine was created to guard against infection from the types of human papillomavirus that cause most cases of cervical cancer. These cancer-preventive vaccines work similarly to traditional vaccines by attacking a virus which causes a disease.

Vaccines have a long history of being highly effective against viruses. Yet only an estimated 15 to 20 percent of cancers are thought to be caused by a virus. Recent medical advances have caused a new line of thinking about vaccine research and development in the fight against cancer and scientists are now targeting cancer formation.

Northeast Ohio’s medical community is once again being heralded for a medical breakthrough, this time one that has the potential to drastically alter how cancer is fought. Researchers at Cleveland Clinic’s Lerner Research Institute have discovered a vaccine that might prevent breast cancer. The prototype vaccine contains the protein  $\alpha$ -lactalbumin that is found in the majority of breast cancers, but not among healthy women except during lactation. Study results in mice have been promising and have shown that the vaccine not only prevents breast cancer tumors from forming, but also inhibits the growth of existing tumors in mice. Human trials have not yet been conducted, but many are hoping they will begin by next year and yield similar results. In addition to the prototype breast cancer vaccine, scientists across the country are testing vaccines that would treat various cancers including bladder cancer, lung cancer and many others.<sup>14</sup>

## Conclusion

Vaccines have played a crucial role by taming many diseases that once caused widespread illness, disability and death. In the U.S., disparities in rates of vaccination among children of different races and ethnicities have largely been eliminated and vaccination rates among children of different income levels have greatly narrowed.

On the horizon is the potential for new vaccines that would offer protection against various forms of cancer and other diseases. National Institutes of Health scientists announced in July that the recent discovery of HIV-neutralizing antibodies provides proof that the development of an AIDS vaccine is possible.<sup>15</sup> As with any medical intervention, vaccine risks will need to be weighed against benefits, but the potential for new vaccines to further reduce human sickness and suffering remains an exciting prospect.

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### Endnotes

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