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CONCENTRIC VALUE OF VACCINATION:

Intersecting Health, Economic, and Societal Benefits

Support provided by CSL Seqirus, GSK, Johnson & Johnson, Pfizer, and Sanofi

Concentric Value of VACCINATION

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Introduction

The microbial world is both vast and resilient. Bacteria, viruses, and fungi constantly evolve, adapting to environmental pressures and developing resistance to even the most advanced medical treatments. While antimicrobial therapies such as antibiotics often face diminishing effectiveness over time, vaccination remains one of the few interventions capable of not only controlling but eliminating infectious diseases.

Historically, vaccines have played a pivotal role in reducing mortality and morbidity from once-widespread diseases. Conditions such as smallpox and polio, which once claimed millions of lives, have been eradicated or brought under near-complete control due to widespread immunization efforts (Richter, 2022). In earlier generations, the arrival of a new vaccine was often met with relief and optimism. Ironically, in today's environment, this life-saving tool has become the subject of public skepticism. Misinformation, confusion, and mistrust—amplified by digital media—have fueled unfounded concerns about vaccine safety (Ruggeri et al., 2024), leading to declines in immunization rates and resurgences of preventable diseases, including measles.

This report examines the multifaceted impact of vaccines across three domains: individual and population health, economic outcomes, and societal well-being. It presents evidence that vaccines not only prevent illness and death but also reduce long-term disability, contain health care costs, and protect communities. The report incorporates terminology from the fields of medicine, public health, economics, and vaccinology. For clarity and accessibility, key terms are defined in the glossary on page 11.

Insights Into the Concentric Value of Vaccination

The value of vaccines extends beyond individual protection. Their concentric impact—at the personal, economic, and societal levels—is both cumulative and interconnected (see Figure 1). By preventing disease or reducing its severity, vaccines help individuals maintain good health, avoid costly medical interventions, remain active in the workforce, and continue caregiving or community engagement. At the population level, high vaccination coverage reduces disease transmission, protects vulnerable groups, and strengthens the health care system's resilience. In this way, the benefits of vaccines ripple outward—from the individual to the community and the broader economy—reinforcing their role as one of the most powerful tools in public health (U.S. Department of Health & Human Services, 2024).

Brief History and Current State of Vaccines in the United States

At the beginning of the 20th century, infectious diseases were among the leading causes of death and disability in the United States. Diseases such as smallpox, measles, and diphtheria were widespread, infecting tens of thousands annually and contributing to high childhood mortality rates. The development and widespread implementation of vaccines transformed this landscape. Thanks to sustained public health efforts, smallpox has been eradicated globally, and the incidence of other vaccine-preventable diseases—such as measles, mumps, rubella, diphtheria, and polio—has declined dramatically (Centers for Disease Control and Prevention, 1999). These successes have positioned vaccines as one of the most significant scientific and public health achievements of the 20th century.

Despite these historic gains, the United States is currently experiencing a troubling decline in vaccination

FIGURE 1. THE CONCENTRIC BENEFITS OF VACCINES ON HEALTH, ECONOMICS, AND SOCIETY

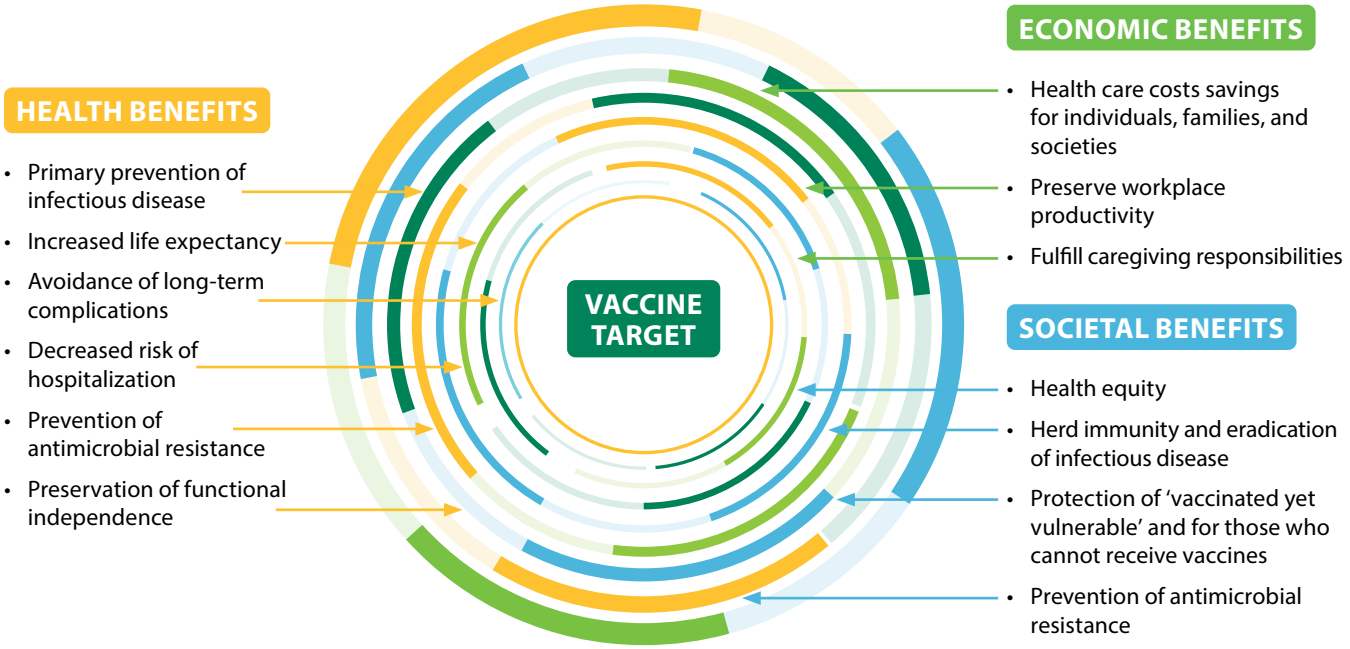
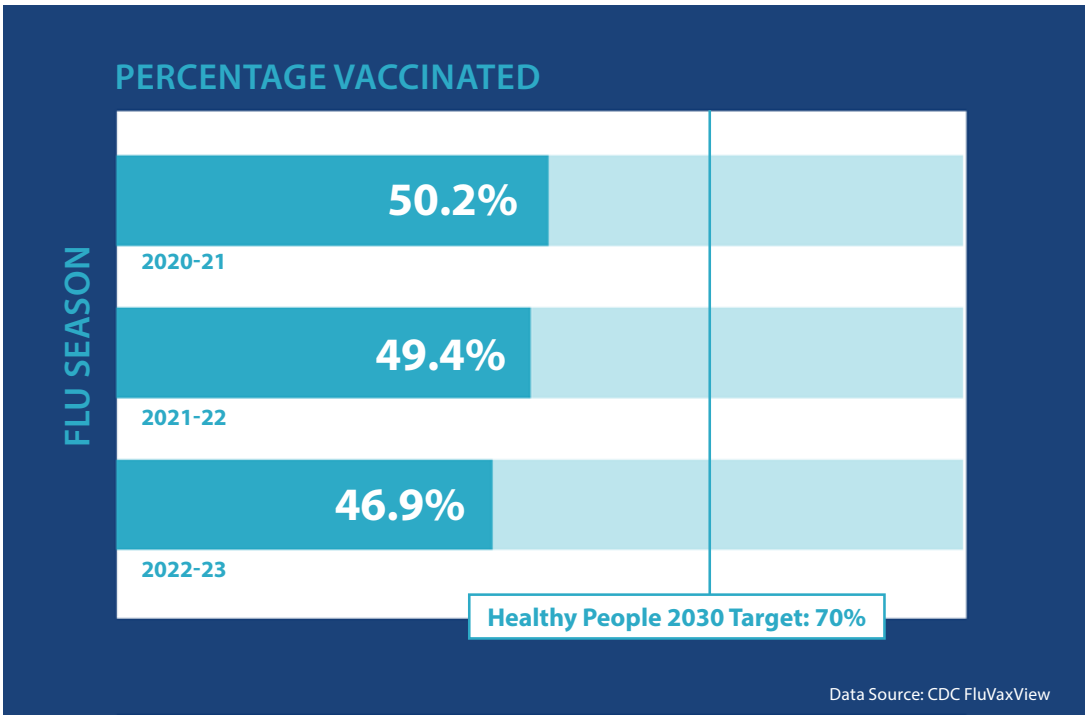


FIGURE 2. DECLINING ADULT INFLUENZA VACCINATION RATES LAG BEHIND PUBLIC HEALTH TARGET



Source: National Foundation for Infectious Diseases (2024 September 9). https://www.nfid.org/resource/call-to-action-strategies-to-improve-adult-immunization-in-the-us/

coverage. Data from the Centers for Disease Control and Prevention (CDC) show that coverage for nearly all routine childhood vaccines has dropped in recent years (Hill et al., 2024). Specifically, vaccination rates among children under two declined by between 1.3 and 7.8 percentage points when comparing birth cohorts from 2018–2019 to those born in 2020–2021. These declines are attributed to multiple factors, including health care access disruptions during the COVID-19 pandemic, rising vaccine hesitancy, and growing misinformation (Larson et al., 2022).

Adult vaccination rates in the United States exhibit notable disparities across racial and ethnic groups, a trend that has persisted over recent years. According to data from the CDC, coverage for vaccines such as influenza, pneumococcal, herpes zoster, hepatitis A, and hepatitis B tends to be lower among Black and Hispanic adults compared to their White counterparts (Centers for Disease Control and Prevention, 2024 June 14).

Healthy People 2030 sets data-driven national objectives to improve health and well-being over the next decade for the US. The Healthy People 2030 goal for annual influenza vaccination coverage is 70%, yet recent data show vaccination rates in the United States remain well below that benchmark (see Figure 2). Among adults aged 65 and older—those at highest risk for flu-related complications—vaccination coverage dropped from 75.2% during the 2020–2021 flu season to 69.7% in 2022–2023. This decline in coverage is particularly concerning given the vulnerability of this population and the preventable burden of disease, hospitalization, and death associated with influenza and other respiratory infections (Sabow et al., 2025; National Foundation for Infectious Diseases, 2024 September 9).

The declining trend in both pediatric and adult vaccination threatens to reverse decades of progress in disease prevention. Without renewed commitment to immunization education and outreach, communities with low vaccine uptake will become increasingly susceptible to outbreaks of diseases previously under control, placing undue strain on public health systems and jeopardizing population health.



Health Benefits of Vaccines

Vaccines are one of the most effective tools in modern medicine for preventing infectious diseases and improving population health. They work by priming the immune system to recognize and combat specific pathogens. Upon vaccination, the body mounts an immune response that not only neutralizes the threat but also creates immunological memory. This allows the immune system to respond more rapidly and effectively upon future exposure. Because vaccines typically contain inactivated or attenuated (weakened) forms of the virus or bacteria, they do not cause illness in healthy individuals but still provide robust protection (U.S. Department of Health & Human Services, 2022).

The dramatic gains in life expectancy during the 20th century are largely attributable to widespread childhood vaccination programs, which significantly reduced mortality from diseases such as diphtheria, measles, and polio. As health care advances have extended life well into older age, the important role of vaccines has expanded beyond early childhood. Increasingly, immunization is recognized as a critical component of preventive care across the life span, particularly for adults, and especially older adults, who face heightened vulnerability to infectious diseases (Centers for Disease Control and Prevention, 2024 December 3).

Aging and older adulthood are associated with a gradual decline in immune system function, a process known as immunosenescence, which makes older adults more susceptible to infections and their complications. One example is shingles, a painful condition caused by the reactivation of the varicella zoster virus—the same virus responsible for chickenpox. While the virus can remain dormant for decades after a chickenpox infection, it often reactivates later in life due to diminished immune surveillance, making vaccination against shingles especially important in older adults.

Respiratory illnesses pose another major threat to older populations. Influenza, respiratory syncytial virus (RSV), and pneumococcal disease are responsible for a significant proportion of hospitalizations and deaths among adults over age 65 (Centers for Disease

The Vaccine Approval Process in the United States

Vaccines undergo a rigorous, multiphase evaluation process before they can be approved for use and recommended for public health implementation in the United States. This process is designed to ensure that vaccines are safe, effective, and manufactured to the highest quality standards. The key stages include:

- Research and discovery
- Proof of concept
- Preclinical testing
- Clinical trials
- Regulatory review and approval
- Public health recommendations and guidance
- Post-marketing safety monitoring

During the preclinical phase, new vaccines are tested in laboratory and animal models to assess safety, immunogenicity, and potential efficacy. Only a fraction of these vaccine candidates meets the rigorous criteria to move into clinical trials involving human participants.

Clinical trials are conducted in three sequential phases:

- **Phase 1** evaluates safety and dosing in a small group of healthy volunteers.
- **Phase 2** assesses immunogenicity, side effects, and optimal dosing in a larger, more diverse population.
- **Phase 3** evaluates the vaccine's efficacy and monitors adverse events in a large-scale population, often numbering in the thousands.

At each phase, the U.S. Food & Drug Administration (FDA) reviews safety and efficacy data before allowing progression to the next phase. Once the vaccine has successfully completed clinical trials, the sponsoring pharmaceutical company submits a Biologics License Application (BLA) or Emergency Use Authorization (EUA) request to the FDA.

The FDA convenes the Vaccines and Related Biological Products Advisory Committee (VRBPAC)—a panel of independent scientific and clinical experts—to review the evidence and provide external guidance. This committee evaluates the data on safety, efficacy, and manufacturing quality, and advises the FDA on whether to approve the vaccine or not. While the committee's recommendations are nonbinding, they play a crucial role in informing the FDA's final regulatory decision.

Following FDA approval, the CDC convenes the Advisory Committee on Immunization Practices (ACIP) to develop evidence-based recommendations for the vaccine's use in public health practice. ACIP considers clinical trial results, population health data, disease burden, age-specific risks, and cost-effectiveness. Their recommendations determine who should receive the vaccine, at what intervals, and under which conditions. These recommendations are incorporated into the US Immunization Schedule, which guides health care providers in clinical decision-making.

Once ACIP recommendations are approved by the CDC Director, the vaccine can be implemented according to the official guidance. Importantly, even after licensure and public rollout, vaccine safety continues to be monitored through systems such as the Vaccine Adverse Event Reporting System (VAERS) and the Vaccine Safety Datalink (VSD) to detect and respond to any rare or long-term adverse events (Centers for Disease Control and Prevention, n.d.).

Note: Readers can download the CDC Vaccine Schedules for Health care Providers at https://www.cdc.gov/vaccines/hcp/imz-schedules/app.html.

Control and Prevention, 2024 December 3). Vaccination against these conditions is critical not only for reducing morbidity and mortality but also for preserving functional independence and avoiding long-term complications. These pathogens are also well known in pediatric care and can become far more dangerous with age, especially when infections move into the lower respiratory tract.

Pneumococcal disease in particular is a serious bacterial infection that can lead to pneumonia, meningitis, and bloodstream infections. It disproportionately affects older adults and individuals with chronic health conditions. Similarly, influenza continues to be a leading cause of preventable death during flu season, while RSV—though often associated with infants—can cause severe respiratory illness in older adults. These diseases are preventable or manageable through vaccination, with guidelines from the CDC recommending immunization for adults starting at age 50, and in some cases, even earlier for those with underlying risk factors (Centers for Disease Control and Prevention, 2024 June 14).



Vaccines remain essential throughout life—not only in childhood but into older adulthood. They reduce the risk of severe illness, hospitalization, and death, particularly in age groups with diminished immune function. Expanding adult immunization efforts is a vital strategy for promoting healthy aging and reducing the burden of infectious disease across the population.

Economic Benefits of Vaccines

Vaccines not only prevent disease and save lives—they also provide substantial economic value. Numerous studies have demonstrated that immunization programs yield a high return on investment by reducing health care spending and improving workforce productivity. For example, every $1 invested in childhood immunizations results in approximately $11 in savings, largely through averted medical costs and preserved economic output. The Office of Health Economics estimates that adult vaccination programs can yield a return as high as 19 times the original investment. These savings are realized through reduced incidence of illness, fewer hospitalizations, and greater labor force stability (Zhou et al., 2024).

A large-scale CDC study assessing the impact of routine childhood immunizations in the United States from 1994 to 2023 found remarkable cost savings. Among the 117 million children born during that period, routine vaccinations were estimated to yield $540 billion in direct medical savings and $2.7 trillion in broader societal savings. These benefits reflect avoided hospitalizations, reduced disease transmission, and decreased long-term disability, along with the preservation of parental productivity and caregiver availability (Zhou et al., 2024).

Vaccination is equally critical in older populations. A 2015 study by McLaughlin et al. estimated that four vaccine-preventable diseases—influenza, pneumococcal

disease, herpes zoster, and pertussis (whooping cough)—resulted in $26.5 billion in total annual health care costs among US adults aged 50 and older. Of these, influenza accounted for $16 billion, pneumococcal disease $5.1 billion, herpes zoster $5 billion, and pertussis $400 million. Increased vaccination coverage among older adults could meaningfully reduce these costs and mitigate strain on Medicare and health care systems.



In addition to health care savings, vaccines prevent public health expenditures associated with disease surveillance, outbreak response, and emergency care. Routine childhood immunizations from 1994–2023 prevented an estimated 32 million hospitalizations and more than 1 million deaths in the United States (Zhou et al., 2024). However, declining vaccine confidence has led to outbreaks of diseases once considered under control. For instance, the 2025 measles outbreak in Texas cost taxpayers approximately $4.5 million—largely due to direct medical expenses and extensive public health interventions (Langford et al., 2025). The cost of tracing and notifying contacts for a single measles case ranges between $30,000 and $50,000 (Mole, 2025).

The economic burden of vaccine-preventable diseases in adults also remains high. According to the National Foundation for Infectious Diseases, nearly $27 billion is spent annually in the United States treating such diseases in adults aged 50 and older. Alarmingly, unvaccinated individuals account for approximately 80% of that burden. These costs include not only treatment and hospitalization, but also the economic impact of lost productivity and caregiving needs (National Foundation for Infectious Diseases, 2024).

Vaccines also have a significant role in preserving workplace productivity. According to the report Vaccine Protection and Productivity, vaccines improve workplace performance by reducing absenteeism, limiting presenteeism, and enhancing overall employee health. Influenza alone contributes to an estimated 17 million lost workdays annually in the United States, yet widespread flu vaccination has been shown to cut this number in half. This leads to lower replacement costs, improved workflow continuity, and decreased disruptions in business operations (Baker, 2025).

Beyond the direct effects on workers themselves, vaccines also benefit caregivers. Approximately 20% of US adults provide care for a family member with a chronic illness or disability. Among these, an estimated 4.5 million Americans belong to the "sandwich generation," caring for both children and aging parents. Vaccination across all age groups reduces the frequency and severity of illnesses that caregivers must manage, enabling them to stay in the workforce and fulfill caregiving responsibilities without excessive disruption. This continuity supports long-term financial stability, including retirement income accumulation, especially for women, who make up a disproportionate share of caregivers (Bärnighausen et al., 2014; Bureau of Labor Statistics, 2023).

Advances in Vaccine Technology

The field of vaccinology—the scientific study of vaccines—has undergone remarkable evolution since its inception in the late 18th century. In 1796, Edward Jenner pioneered the first successful immunization by using material isolated from cowpox lesions to confer protection against smallpox. This early empirical method marked the beginning of the first phase of vaccine science (Bragazzi et al., 2018).

In the late 19th and early 20th centuries, Louis Pasteur and his contemporaries further advanced the field by refining techniques for inactivating bacteria and viruses before injecting them into animals and people. This "isolate–inactivate–inject" model enabled the mass production of vaccines and laid the groundwork for seminal breakthroughs, such as Jonas Salk's inactivated polio vaccine and Albert Sabin's oral polio vaccine during the 1950s and 1960s. This era also marked the beginning of industrial-scale vaccine manufacturing and distribution, expanding access to immunizations on a global scale.

Another important advance was the use of adjuvants—substances that enhance the body's immune response to vaccine antigens. Common examples include aluminum salts and oil-in-water emulsions, which help elicit a stronger, more durable immune response than the antigen alone. The inclusion of adjuvants remains a cornerstone of vaccine formulation today.

A new wave of innovation focused on enhancing vaccine safety and immunogenicity was introduced in the late 20th century. Novel adjuvants were developed, and molecular biology techniques enabled more precise targeting of vaccine components. These advances allowed scientists to reduce adverse effects while improving efficacy, ushering in the second major phase of vaccinology (O'Hagan et al., 2017).

With the advent of the Human Genome Project and high-throughput molecular technologies, the 21st century has ushered in a third phase, marked by a paradigm shift toward rational and data-driven vaccine design. This new model—"discover, validate, characterize, and apply"—has replaced the empirical methods of the past. Scientists can now predict immune responses, tailor vaccine components for specific populations, and optimize efficacy early in the development process.

This approach has yielded several high-impact innovations. For example, the high-dose influenza vaccine, designed specifically for older adults, compensates for age-related immune decline and provides greater protection than standard-dose formulations. Similarly, the recombinant shingles vaccine—which is made using genetically engineered microbes that produce a specific antigen from the varicella zoster virus and contains novel adjuvant systems—achieves efficacy rates exceeding 90%, even in adults over 70 years of age. These advances underscore the growing precision and effectiveness of modern vaccines (Poland, 2018; O'Hagan et al., 2017).

Looking ahead, the field is moving toward personalized or "designer" vaccines, with exciting progress underway in areas such as cancer immunotherapy. Future vaccines may be tailored not only to pathogen characteristics but also to an individual's genetic and immunological profile, ushering in a new era of precision public health.

Societal Benefits of Vaccines

Vaccines play a vital role not only in improving individual health but also in promoting the well-being of society as a whole. In addition to preventing illness and reducing mortality, vaccines contribute to broader public health goals by protecting vulnerable populations, enhancing community resilience, and supporting social and economic participation. These collective benefits are particularly relevant in vulnerable populations, including those who are unable to receive vaccines.

A small but important subset of the population may not be able to receive certain vaccines because of medical conditions or other reasons. Individuals who are immunocompromised—for example, those undergoing chemotherapy, living with HIV, or taking immunosuppressive medications—often have a reduced immune response to vaccination or cannot be safely vaccinated at all. Others may face barriers rooted in health conditions such as severe allergies or autoimmune diseases. Additionally, social and structural factors such as religious objections, vaccine misinformation, logistical challenges, or financial constraints may also prevent some people from accessing vaccines (Centers for Disease Control and Prevention, 2024 June 14).

Older adults generally have higher vaccination rates than younger adults, particularly for influenza, due in part to longstanding public health initiatives and Medicare coverage. However, vaccine uptake across all adult age groups remains suboptimal due to multiple barriers. These include cost concerns, lack of access to primary care, underutilization of preventive visits (such as the Medicare Annual Wellness Visit), and persistent vaccine hesitancy. The intersection of these factors has contributed to stagnant or declining adult vaccination rates in recent years (Centers for Disease Control and Prevention, 2024 December 3).

The concept of community immunity, often referred to as herd immunity, underscores the societal value of widespread vaccination. When a significant proportion of the population is immunized against a contagious disease, the spread of infection is dramatically reduced, thereby protecting those who remain unvaccinated. This indirect protection is essential for medically vulnerable individuals who rely on the immunity of others to shield them from exposure.





For older adults, community immunity is especially important. Even when vaccinated, they may not mount a strong immune response because of age-related immunosenescence. Some live alone or far from family members who could provide care in the event of illness, and they may have underlying chronic conditions that increase the risk of severe disease. Ensuring high vaccination coverage among all age groups not only protects older adults directly, it also helps maintain their independence and reduces the likelihood of complications that require institutional care.

Furthermore, vaccines facilitate continued engagement in work, caregiving, and volunteer roles across the life span. Adults who remain healthy due to vaccination can contribute meaningfully to their families, communities, and the broader economy. This includes maintaining employment, participating in community and social activities, and providing caregiving for family and friends. In this way, vaccines extend their benefit beyond individual protection, reinforcing the social fabric and supporting intergenerational well-being.

Vaccines are a cornerstone of societal health. They protect those who cannot be vaccinated, reduce disease transmission, and help sustain the capacity of individuals to contribute to society. Public health strategies that promote equitable vaccine access and address barriers to uptake are essential to fully realize these societal benefits.

Conclusion

Vaccines stand as one of the most profound public health achievements and have dramatically reduced morbidity and mortality from infectious diseases across all age groups. Vaccines remain the most consistently effective intervention against infectious diseases such as smallpox, rabies, polio, and various childhood illnesses. Their impact extends well beyond individual health protection to encompass substantial economic savings and critical societal benefits, reinforcing the interconnectedness of the concentric value of vaccinations with health, economic, and societal outcomes. This multifaceted impact highlights how vaccines not only prevent illness and reduce health care costs but also enable individuals to remain active contributors in the workforce, support caregiving roles, and sustain community engagement. Despite the enduring success of immunization programs, recent declines in vaccine uptake threaten to undermine decades of progress and expose populations to preventable disease outbreaks.

It is imperative that we continue to educate the public on the safety and benefits of vaccines and ensure they are accessible and affordable for all. Concurrently, sustained investment in vaccine research is essential to develop new vaccines and enhance existing ones, as pathogens continually evolve. The evolving landscape of vaccinology, propelled by technological innovations and data-driven design, promises increasingly effective and tailored vaccines that address emerging and persistent health challenges.

A robust vaccine infrastructure coupled with high uptake rates is critical to safeguarding population health. By doing so, we not only prevent disease and reduce health care burdens but also preserve the societal fabric—enabling individuals to remain productive, caregivers to provide support, and communities to thrive. Ultimately, widespread immunization not only improves physical well-being but also supports sustained workforce participation and community engagement, fostering societal resilience and collective prosperity. Vaccines are indispensable tools in promoting health equity, resilience, and the collective well-being of society.

Glossary

Adjuvants: Substances that enhance the immune response to vaccine antigens while exhibiting minimal adverse effects or independent lasting immune activity.

Antimicrobial resistance: The capacity of micro-organisms to evade the effects of antimicrobial agents, rendering standard treatments ineffective.

Herd immunity / Community immunity: A population-level state in which sufficient immunity—acquired through vaccination or prior infection—prevents sustained transmission of infectious diseases.

Immunogenicity: The ability of a substance to provoke an immune response in the body.

Micro-organisms: Microscopic living entities—including bacteria, viruses, and fungi—generally invisible to the naked eye.

Pathogens / Pathogenic micro-organisms: Micro-organisms such as bacteria, viruses, and fungi that can cause disease and adverse health effects in humans.

Vaccines: Biological preparations designed to induce immunity against specific pathogens—typically containing weakened or inactivated microbes, toxoids, mRNA, or antibodies—administered via injection, oral, or nasal routes.

Vaccinology: An interdisciplinary field covering vaccine research and development, immunogen design, delivery mechanisms, safety assessment, and socioeconomic and ethical considerations. Its scope extends beyond infectious diseases to include cancers, neurodegenerative diseases, and addiction, incorporating novel methodologies such as reverse vaccinology and systems vaccinology.

Resources

CENTERS FOR DISEASE CONTROL AND PREVENTION

- General Vaccine Information: The CDC offers comprehensive information for parents, caregivers, and health care professionals on vaccine safety, recommendations, schedules, and clinical resources for all age groups.
- COVID-19 Vaccination: Resources include clinical and professional materials, up-to-date immunization schedules, standing orders, and patient handouts. The CDC also provides guidance for specific populations and information on vaccine equity initiatives.
- Vaccine Finder and Hotline: The CDC's Vaccines.gov helps locate nearby vaccine providers. CDC-INFO is a contact center for vaccine questions, reachable by phone or online form.
- Educational Materials: The CDC provides downloadable brochures, infographics, and interactive tools for the public and professionals, including information on vaccine-preventable diseases, vaccine safety, and answers to frequently asked questions.
- Special Populations: Guidance is available for children, people with disabilities, pregnant individuals, and other groups with specific vaccine considerations.

CENTERS FOR MEDICARE & MEDICAID SERVICES VACCINE INFORMATION

- Immunization and Vaccine Resources: CMS provides a centralized resource center with information on recommended vaccines for different age groups, vaccination disparities data, flu shot information, and links to CDC surveillance tools and prevention strategies.
- COVID-19 Vaccine Policies & Guidance: CMS offers detailed resources for providers, including information about vaccine coverage, billing, and state Medicaid guidance for COVID-19 vaccines.
- Medicare Coverage: Information on Medicare coverage for various vaccines, including updated COVID-19 vaccines, is available for beneficiaries.
- Vaccine Pricing: CMS publishes vaccine pricing details, including payment methodologies for Medicare Part B vaccines (influenza, COVID-19, pneumococcal, hepatitis B, and others), and updates on payment rates.
- Consumer Fact Sheets: CMS provides downloadable fact sheets explaining who can get vaccines, where to get them, that vaccines are free to all, and what to expect during vaccination.

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