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REVIEW ARTICLE

Pediatric Vaccination in a Changing World. Impact on Child Health, Vaccine Hesitancy, and Future Perspectives of Immunization

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ABSTRACT

Introduction: Vaccination remains one of the most effective and costefficient public health interventions, dramatically reducing childhood morbidity and mortality from vaccinepreventable diseases. However, the global immunization landscape has recently been challenged by pandemic disruptions, misinformation, inequities in access, and resurgent outbreaks.
The Aim is to synthesize current evidence on the health and societal impact of pediatric vaccination, examine determinants of vaccine hesitancy, and highlight future perspectives for immunization programs.
Methods; A narrative review was conducted, integrating epidemiological data, modelling studies, and recent reports from WHO, UNICEF, and peerreviewed literature. Particular attention was given to trends in coverage, disease resurgence, and behavioral determinants of vaccine confidence.
Results: Routine immunization has averted an estimated 154 million deaths since 1974, predominantly in children under five. Yet, in 2024, 14.3 million infants received no vaccine doses, and measles reemerged in multiple countries, threatening elimination status. Vaccine hesitancy was strongly influenced by misinformation, sociocultural factors, and trust in health systems. Evidence underscores that resilient health infrastructure, equitable access …
Conclusions: Scientific advances alone cannot secure immunization gains. Strengthening public trust, addressing behavioral determinants, and ensuring equitable delivery are critical for the future of pediatric vaccination.
Keywords: pediatric vaccination; immunization; vaccinepreventable diseases; public health;

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INTRODUCTION

Few interventions in the history of medicine have reshaped human health as profoundly as vaccination. Diseases that once defined childhood—measles, diphtheria, pertussis, poliomyelitis, tetanus, and invasive bacterial infections—were, until comparatively recently, leading causes of death and lifelong disability. The systematic introduction of routine childhood immunization, accelerated by the launch of the Expanded Programme on Immunization (EPI) by the World Health Organization (WHO) in 1974, transformed this picture across every region of the world.

Originally covering six diseases at a time when fewer than five percent of the world's infants had access to routine immunization, the programme today encompasses vaccines against more than a dozen pathogens and has become a cornerstone of primary health care and a foundation of child survival (1).

The scale of this transformation is difficult to overstate. By the time of the programme's fiftieth anniversary, modelling estimated that vaccination had averted on the order of 154 million deaths, the overwhelming majority among young children, and had become the single greatest contributor to improvements in infant survival over the past half-century (1).

For many families and clinicians, the diseases that immunization prevents have receded so far from everyday experience that their severity is now difficult to imagine, a success that paradoxically contributes to complacency, one of the recognized psychological drivers of under-vaccination (2).

Yet the world in which immunization programs now operate is markedly different from the one in which they were built. Population mobility and rapid urbanization, climate-related emergencies, armed conflict and mass displacement, persistent inequities in health-care access, and the pervasive spread of misinformation through digital platforms have created new and compounding obstacles (3).

The COVID-19 pandemic added an acute shock, disrupting routine services in many countries and leaving millions of children under-vaccinated or entirely unvaccinated, while also reshaping public attitudes toward vaccines more broadly. The result is a landscape in which extraordinary scientific capability coexists with stalled coverage, rising hesitancy, and the return of diseases that had been brought under control (4,5).

This paper examines pediatric vaccination at this pivotal moment. It considers what the accumulated evidence tells us about the impact of immunization on child health, the biological stakes of allowing vaccine-preventable diseases to return, the obstacles that now threaten continued progress, the human and social roots of vaccine hesitancy, and the innovations and strategies that may shape the next phase of immunization. The intent is not to recount past achievements alone but to clarify what is required to protect them.

Objective

The aim of this review is to examine the present-day role of pediatric vaccination within a rapidly shifting global context. Specifically, the paper seeks to: (1) summarize the documented impact of routine childhood immunization on survival, disease burden, and the broader economy; (2) describe the biological consequences of vaccine-preventable diseases, with particular attention to measles and the phenomenon of immune amnesia; (3) characterize the current global challenges confronting immunization programs, including stalled coverage and the resurgence of vaccine-preventable diseases; (4) analyze the behavioral and social determinants of vaccine hesitancy and the role of digital misinformation in shaping parental decision-making; (5) discuss the scientific innovations and programmatic strategies likely to define the next phase of immunization.

By drawing together recent international data and peer-reviewed literature, the review intends to inform clinicians, public health practitioners, and policymakers about the steps needed to protect and extend the gains of childhood vaccination.

MATERIALS AND METHODS

This work is a narrative review of contemporary scientific literature, international surveillance reports, and policy documents concerning pediatric vaccination. Sources were identified through searches of peer-reviewed databases and the official publications of major health institutions, with particular attention to material published between 2024 and early 2026 in order to reflect the most current picture of global immunization, supplemented by foundational earlier work where it remains the authoritative reference for a given concept (for example, the behavioral models of vaccine hesitancy and the immunological studies of measles-induced immune suppression).

Priority was given to primary and authoritative sources, including coverage estimates jointly produced by the WHO and the United Nations Children's Fund (UNICEF), epidemiological surveillance data on measles from WHO and the Pan American Health Organization (PAHO), peer-reviewed modelling studies, and systematic reviews of vaccine hesitancy and vaccine confidence.

Where multiple sources reported the same figure, the most recent or most authoritative was cited. Information was organized thematically around five domains: the health and economic impact of vaccination; the biological consequences of vaccine-preventable disease; current global challenges; the determinants of vaccine hesitancy; and future perspectives in immunization. Because this is a synthesis of existing published evidence rather than an analysis of original patient-level data, no ethical

approval was required, and the review presents no new experimental results. Statements throughout the paper are restricted to claims that are directly supported by the cited literature.

RESULTS

The Impact of Vaccination on Child Health

The contribution of vaccination to child survival is among the most thoroughly documented in modern medicine. A comprehensive modelling study published in The Lancet in 2024, marking the fiftieth anniversary of the EPI, estimated that vaccination against fourteen pathogens averted 154 million deaths between 1974 and 2024. Of these, roughly 146 million were among children younger than five years and 101 million among infants younger than one year. The study estimated that immunization has accounted for about 40 percent of the observed decline in global infant mortality, rising to 52 percent in the African region, and that a child younger than ten years in 2024 is 40 percent more likely to survive to the next birthday than in a hypothetical world without historical vaccination; an elevated probability of survival persists even into late adulthood (1).

The same analysis quantified the broader value of the survival gained. For every death averted, an average of 66 years of full health were gained, translating into approximately 10.2 billion healthy life-years over the half-century—more than 200 million healthy life-years per year globally. Measles vaccination emerged as the single largest contributor, responsible for an estimated 93.7 million of the lives saved (about 61 percent of the total), with tetanus and pertussis vaccines preventing several million deaths each (1).

The benefits of pediatric vaccination extend well beyond the individual child. High coverage generates community (herd) immunity, reducing transmission and protecting those who cannot be vaccinated directly, including young infants, immunocompromised children, and individuals with medical contraindications. This indirect protection is a central reason why high thresholds of coverage are required for the most contagious diseases, and why the willingness to vaccinate partly in order to protect others, what behavioral scientists term collective responsibility, is itself an important determinant of uptake (2).

The disease-specific dimensions of this impact are instructive. Measles, the most contagious of the vaccine-preventable diseases, accounted for the largest share of lives saved precisely because it spreads so readily and disproportionately strikes young children; its control is therefore both the greatest triumph of immunization and its most fragile achievement. The decline of pertussis and neonatal tetanus, meanwhile, reflects the protection of the youngest and most vulnerable infants, often through maternal as well as infant immunization. Beyond preventing death, vaccination averts the long-term sequelae of disease—the deafness and encephalitis that can follow measles, the paralysis of poliomyelitis, the chronic liver disease associated with hepatitis B—each of which carries its own lifelong burden for children and families.

The Lancet modelling captured this dimension through the estimate that, on average, 66 years of full health were gained for every death averted, a figure that reflects both the youth of those protected and the avoidance of disability among survivors (1).

Vaccination also yields substantial economic returns. Analyses of immunization spending have estimated that every dollar invested during the 2011–2020 period produced a return of up to 26 dollars across a child's lifetime when savings on health care and averted productivity losses are considered, with UNICEF reporting comparably high returns in low- and middle-income settings (6,7).

These returns arise from prevented hospital admissions, reduced intensive-care use, avoided long-term complications, and the preserved productivity of caregivers, and they are largest precisely where infectious-disease burdens remain heaviest. Immunization additionally builds durable public health infrastructure—cold chains, surveillance networks, and trained health workers—whose value extends well beyond any single vaccine, as the COVID-19 response demonstrated when existing immunization systems were repurposed for pandemic vaccine delivery.

Table 1. Selected quantitative indicators of the impact of vaccination, drawn from the cited literature.

Indicator	Estimate
Deaths averted by immunization, 1974–2024	≈ 154 million
Deaths averted among children under 5 years	≈ 146 million
Deaths averted among infants under 1 year	≈ 101 million
Deaths averted attributable to measles vaccination	≈ 93.7 million (60.8%)
Years of full health gained (DALYs averted)	≈ 10.2 billion
Years of full health gained per death averted	≈ 66 years
Share of decline in global infant mortality	≈ 40% (52% in Africa)
Return on each US$1 invested (2011–2020)	up to US$ 26

The Biological Stakes: Why Vaccine-Preventable Diseases Still Matter

It is tempting, in regions where these diseases have become rare, to treat the case for vaccination as primarily

statistical. The biology of the pathogens themselves argues otherwise. Measles offers the clearest illustration. Beyond the acute illness—fever, rash, and the well-recognized risks of pneumonia and encephalitis—infection inflicts a more insidious harm on the immune system. Two complementary studies published in 2019 demonstrated that measles infection erases a substantial portion of the antibody repertoire that a child has accumulated against previously encountered pathogens, a phenomenon termed "immune amnesia." Using a tool capable of surveying a person's entire history of antibody exposures from a single blood sample, researchers found that measles eliminated between roughly 11 and 73 percent of protective antibodies, while a separate team showed that the underlying pool of memory B cells was incompletely reconstituted after infection (8,9).

The practical consequence is that a child who recovers from measles may remain unusually vulnerable to other infections for months or years afterward, until the immune repertoire is gradually rebuilt through renewed exposure. Crucially, measles vaccination confers protection from the acute disease without inflicting this loss of immune memory. This biological finding reframes the value of measles immunization: it protects not only against measles itself but against the broader susceptibility that follows infection, helping to explain the historical observation that measles vaccination reduced childhood mortality from a range of unrelated infections (8).

The lesson generalizes. The diseases that routine immunization prevents are not merely inconveniences rendered survivable by modern medicine; many carry consequences—paralysis, deafness, infertility, chronic organ damage, or, as with measles, a quiet erosion of acquired immunity—that no course of treatment fully reverses.

Current Global Challenges in Pediatric Immunization

Despite the historical achievements of immunization, recent data indicate that global progress has plateaued and, in important respects, regressed. According to the 2024 WHO and UNICEF Estimates of National Immunization Coverage (WUENIC) released in July 2025, 89 percent of infants worldwide—about 115 million—received at least one dose of the diphtheria, tetanus, and pertussis (DTP)-containing vaccine, and 85 percent—roughly 109 million—completed all three doses.

Compared with 2023, about 171,000 more children received at least one dose and one million more completed the full series. These gains, while encouraging, are modest and leave coverage short of the targets needed to keep the world on track (4,10).

The most striking finding concerns children who remain entirely unprotected. In 2024, nearly 20 million infants missed at least one dose of a DTP-containing vaccine. Among them were 14.3 million so-called "zero-dose" children who received no vaccine at all—some 4 million more than the level required to remain on track with the goals of Immunization Agenda 2030, and 1.4 million more than in 2019, the baseline year. The number of zero-dose children rose from 12.9 million in 2019 to 14.3 million in 2024, underscoring a widening equity gap (10).

These gaps are heavily concentrated in fragile settings. A quarter of the world's infants live in just 26 countries affected by fragility, conflict, or humanitarian crises, yet these countries account for half of all unvaccinated children globally.

In half of these countries, the number of zero-dose children grew from 3.6 million in 2019 to 5.4 million in 2024, illustrating how rapidly conflict and displacement can erode immunization gains. At the same time, not all trends are negative: coverage with the human papillomavirus (HPV) vaccine rose from 17 percent in 2019 to 31 percent in 2024, demonstrating that scale-up of newer vaccines remains achievable even in resource-limited regions (10).

The trajectory of recent years cannot be understood without reference to the COVID-19 pandemic. The diversion of health workers, supplies, and public attention toward the pandemic response, combined with lockdowns that interrupted routine clinic attendance, produced the largest sustained decline in childhood immunization in decades.

Although the data for 2024 show a partial recovery, with modest increases in the number of children reached, coverage has not returned fully to pre-pandemic levels in many settings, and the cohort of children who missed doses during the disruption represents an accumulated pool of susceptibility. WHO and UNICEF have framed the present moment as one of fragile stabilization rather than robust recovery, warning that the convergence of funding shortfalls, geopolitical instability, and rising misinformation could readily reverse the modest gains observed (4).

The persistence of 14.3 million zero-dose children—above both the 2019 baseline and the 2024 target—indicates that the structural barriers exposed by the pandemic have not been resolved.

The Resurgence of Measles

Among the consequences of stalled coverage, the resurgence of measles is the most visible warning sign. Measles is among the most contagious human diseases—a single case can infect up to eighteen susceptible contacts—and interrupting transmission requires that approximately 95 percent of the population receive two doses of measles-containing vaccine. Even modest declines in coverage can therefore trigger large outbreaks (5).

WHO data published in late November 2025 showed

that between 2000 and 2024 the estimated number of measles cases worldwide fell by 71 percent, from about 38 million to 11 million, while deaths fell by 88 percent, from roughly 777,000 to about 95,000—with the measles vaccine credited with saving nearly 59 million lives over that period. These long-term gains tracked rising vaccination: global coverage with the first dose of measles-containing vaccine increased from 71 percent in 2000 to 84 percent in 2024, and coverage with the critical second dose rose from 17 percent to 76 percent. Crucially, two-dose coverage remains well below the 95 percent threshold required to halt transmission (5, 11)

Table 2. Long-term trends in global measles burden and vaccination coverage, 2000 versus 2024 (WHO, 2025).

Measles indicator	2000	2024
Estimated cases worldwide	≈ 38 million	≈ 11 million
Estimated deaths worldwide	≈ 777,000	≈ 95,000
First-dose (MCV1) coverage	71%	84%
Second-dose (MCV2) coverage	17%	76%
Countries with large/disruptive outbreaks	—	59–60

Against this backdrop, the disruptions of the pandemic, combined with a return to normal social mixing in 2024 and 2025, produced a sharp rise in outbreaks. The number of countries reporting large or disruptive outbreaks rose to 59 in 2024—nearly triple the number reported in 2021—and a quarter of these occurred in countries that had previously eliminated the disease. The resurgence reached even high-income countries once considered free of endemic measles.

In the United States, confirmed cases climbed from 285 in all of 2024 to well over a thousand during 2025, with deaths recorded among unvaccinated individuals. Following sustained transmission, Canada and the wider Region of the Americas lost their measles-elimination status as of November 2025, and the United States' own elimination status was judged to be at serious risk. Europe and Central Asia, after recording more than 127,000 cases in 2024, saw a substantial decline during 2025, but WHO cautioned that the underlying conditions driving resurgence persisted (5,11,12,13)

Vaccine Hesitancy: A Growing Public Health Concern

The WHO has identified vaccine hesitancy—defined as delay in acceptance or refusal of vaccines despite the availability of vaccination services—as one of the leading threats to global health (MacDonald, 2015). (14) Hesitancy is not a single attitude but a spectrum, shaped by complex and context-dependent factors that vary across populations and over time, and it sits on a continuum between full acceptance and outright refusal.

Recent reviews of parental hesitancy describe a consistent set of determinants:

- Concerns about vaccine safety and fear of side effects;
- Distrust of health authorities, governments, or pharmaceutical institutions;
- Exposure to misinformation and disinformation, particularly through social media;
- Religious, cultural, or philosophical beliefs;
- Limited understanding of vaccine-preventable diseases and a perception of low personal risk; and
- Sociodemographic and access-related factors, which often act as correlates rather than root causes.

A useful organizing framework is the so-called 5C model, which holds that vaccination decisions are shaped by five psychological antecedents: confidence in the safety and effectiveness of vaccines and in the institutions that deliver them; complacency, or a low perceived risk of disease when it appears rare; constraints (also described as convenience), the structural and psychological barriers that make vaccination difficult; calculation, the often information-intensive weighing of personal risks and benefits; and collective responsibility, the willingness to be vaccinated in order to protect others. This model usefully explains why interventions that supply facts alone frequently fail—they may address a parent's stated calculation while leaving confidence untouched—and why the same misinformation produces different effects in communities that differ in baseline trust (2).

A review of cross-sectional studies published in 2023 and 2024 concluded that parental hesitancy increased substantially following the COVID-19 pandemic, driven in part by a general societal suspicion that spilled over onto routine childhood immunization (Cross-sectional review of parental vaccine hesitancy, 2025) (15).

Importantly, the literature distinguishes between sociodemographic variables—such as ethnicity, income, or education—which are frequently associated with hesitancy but function largely as markers, and the underlying psychological and trust-based determinants, which more directly explain why hesitancy develops.

Interventions that address only the surface correlates while ignoring the psychological drivers tend to be less effective. This emphasis on trust is reinforced by the largest available mapping of vaccine confidence, which analyzed surveys of more than 284,000 adults across 149 countries and showed that confidence is volatile, can decline sharply in response to local events, and is a stronger predictor of uptake than knowledge alone (de Figueiredo et al., 2020) (3).

The expansion of digital communication has amplified the reach of vaccine misinformation. With billions of people using social media, and many relying on it as a primary source of health information, false claims about vaccine safety can circulate rapidly and influence parental choices. Studies of vaccine-related social media

content indicate that, for hesitant parents, personal stories and narratives can be more persuasive than statistical information—a pattern that anti-vaccination messaging has exploited effectively (Smith et al., 2024; Liebermann et al., 2025). (6,17)

Surveys in the United States found that hesitancy among parents of children aged five to eleven years rose modestly from about 19.8 percent in 2019 to 21.0 percent in 2022.

Set against these pressures, the evidence consistently identifies the recommendation of a trusted health-care provider as among the strongest predictors of vaccine acceptance. Pediatricians, family physicians, nurses, and public health workers occupy a uniquely influential position, and their capacity to engage parents respectfully and to provide timely, accurate information before families turn to online sources is a decisive factor in maintaining confidence. Understanding hesitancy also requires distinguishing it from outright refusal. Most parents who hesitate are not committed opponents of vaccination but individuals weighing competing concerns—about safety, necessity, and trust—often under conditions of information overload. Framing hesitancy through the lens of confidence, complacency, convenience, calculation, and collective responsibility helps explain why purely factual rebuttals of misinformation frequently fail: they may resolve a stated concern while leaving the underlying issue of trust untouched (Betsch et al., 2018; de Figueiredo et al., 2020). (2,3)

Future Perspectives in Pediatric Immunization

The coming years are likely to be defined by both scientific innovation and a more sophisticated, behaviorally informed approach to public health. Advances in vaccine technology—most prominently the messenger RNA (mRNA) platforms validated during the COVID-19 pandemic, alongside novel adjuvant systems—have shortened development timelines and may enable faster responses to emerging infectious threats. The pandemic demonstrated that vaccine research and manufacturing can be accelerated dramatically when scientific, regulatory, and financial resources are aligned.

Beyond the laboratory, programmatic priorities for the next phase of immunization include:

- Expanding equitable access, with a particular focus on reaching zero-dose children in fragile and conflict-affected settings;
- Strengthening surveillance systems for vaccine-preventable diseases to detect and respond to outbreaks earlier;
- Enhancing vaccine safety monitoring to sustain public confidence;
- Developing targeted, locally tailored interventions for under-vaccinated communities;
- Building and modernizing digital immunization registries to track coverage accurately;
- Countering misinformation through evidence-based, empathetic communication; and
- Integrating behavioral and social science into the design of vaccination campaigns.

These priorities are reflected in international frameworks. Immunization Agenda 2030, the global strategy coordinated by WHO and UNICEF with partners including Gavi, the Vaccine Alliance, emphasizes reducing immunization inequities, strengthening health systems, and ensuring that every child benefits from life-saving vaccines regardless of geography or socioeconomic status (WHO, 2024).(5) Achieving these goals will depend heavily on closing funding gaps; WHO and UNICEF have explicitly called for full financing of Gavi's 2026–2030 strategic cycle, warning that funding shortfalls, instability, and misinformation could stall or reverse hard-won progress (WHO & UNICEF, 2025).(4)

Equity is likely to be the defining test of the coming decade. Because unvaccinated children are increasingly concentrated in a relatively small number of fragile and conflict-affected countries, global targets cannot be met without strategies tailored to these settings—mobile and outreach services, integration of vaccination with other humanitarian assistance, and approaches that can function amid displacement and insecurity.

The concept of the zero-dose child, now central to international monitoring, reflects this shift in emphasis from average coverage toward reaching those left entirely behind. Identifying and reaching these children demands accurate data, which is itself a programmatic challenge in unstable environments, underscoring the importance of investment in surveillance and registries (UNICEF, 2025).(7)

Finally, the integration of behavioral and social science into immunization represents a maturation of the field. The recognition that confidence, complacency, convenience, calculation, and collective responsibility shape vaccination decisions has begun to inform the design of interventions, moving public health beyond the assumption that providing information is sufficient (Betsch et al., 2018). (2)

Tailoring communication to the specific concerns of particular communities, engaging trusted local messengers, and addressing the practical barriers that make vaccination inconvenient are increasingly understood as essential complements to scientific and logistical advances. In this sense, the future of immunization will be determined not only in laboratories and supply chains but in the quality of the relationships between health systems and the families they serve.

DISCUSSION

The evidence assembled in this review points to a central paradox of contemporary immunization: at the very moment when the scientific case for vaccination is strongest and the tools more powerful than ever, the

social and systemic foundations that allow those tools to work are under strain. The 154 million lives attributed to fifty years of immunization represent one of the great achievements of modern medicine, yet the simultaneous rise in zero-dose children and the resurgence of measles show that these gains are neither automatic nor permanent (Shattock et al., 2024; UNICEF, 2025; WHO, 2025). (1,4,5)

The persistence of outbreaks despite the availability of safe and effective vaccines demonstrates that scientific progress alone is insufficient. Measles, in particular, functions as a sensitive indicator of the health of immunization systems: because it requires roughly 95 percent two-dose coverage to interrupt transmission, it is the first disease to return when coverage slips.

The near-tripling of countries with large outbreaks since 2021, and the loss of elimination status by countries that had previously controlled the disease, are therefore best understood not as isolated events but as symptoms of broader vulnerability. The biology of immune amnesia adds urgency to this picture, since each measles infection imposes a hidden cost on a child's wider immunity that extends beyond the acute illness (WHO, 2025; Mina et al., 2019;) (5,8).

Three interlocking factors explain much of the current difficulty. First, inequity: the concentration of unvaccinated children in fragile and conflict-affected settings means that global averages, which appear relatively stable, conceal severe and worsening local deficits. Second, fragility of trust: the post-pandemic rise in hesitancy reflects an erosion of confidence that extends beyond any single vaccine and is sustained by a digital information environment in which compelling but inaccurate narratives spread faster than corrections (de Figueiredo et al., 2020; Smith et al., 2024) (3,16).

Third, financing and system capacity: progress depends on sustained investment, and the warnings from WHO and UNICEF about funding shortfalls suggest that the infrastructure underpinning immunization cannot be taken for granted.

The implications for practice are significant. Because hesitancy is driven more by psychological and trust-based factors than by demographic characteristics, interventions must move beyond traditional information campaigns that simply supply facts. Evidence that narratives are particularly persuasive to hesitant parents suggests that communication strategies should be empathetic, story-aware, and culturally sensitive rather than purely didactic (Liebermann et al., 2025) (17).

The consistent finding that provider recommendation is among the strongest predictors of acceptance places frontline clinicians at the center of any effective response; equipping them to engage parents early, before misinformation takes hold, may be one of the highest-yield investments available.

This review has limitations. As a narrative synthesis rather than a systematic review, it does not apply a formal protocol for study selection or quantitative pooling, and it is therefore subject to selection bias in the choice of sources. Coverage estimates derive largely from country-reported data, which carry inherent uncertainty, and surveillance figures for measles are provisional and subject to revision. The modelled estimate of 154 million lives saved likewise reflects assumptions and data gaps inherent in attributing causality over a fifty-year horizon. Nonetheless, the convergence of multiple authoritative sources on the same broad trends lends confidence to the overall picture.

CONCLUSION

Pediatric vaccination remains one of the most successful and cost-effective achievements of modern public health, having saved an estimated 154 million lives over the past half-century and continuing to prevent death and disability on an enormous scale. Yet the immunization landscape is now defined as much by its vulnerabilities as by its successes. More than 14 million children receive no vaccines at all, coverage has plateaued below the levels needed for population protection, measles is resurging across high- and low-income countries alike, and vaccine hesitancy—amplified by digital misinformation—continues to erode confidence.

Addressing these challenges will require coordinated action across governments, health professionals, international organizations, educators, and communities. The priorities are clear: restore and strengthen routine immunization services, close the equity gap that leaves children in fragile settings unprotected, sustain the financing on which programs depend, rebuild public trust through honest and empathetic communication, and harness scientific innovation responsibly. The tools to protect children exist; the central task of the coming decade is to ensure that trust, access, and political commitment keep pace with the science, so that every child can benefit from the full protective potential of vaccination.

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all: Conceptualization, Methodology, Writing-Review & Editing, Supervision.

REFERENCES

1. Shattock, A. J., Johnson, H. C., Sim, S. Y., Carter, A., Lambach, P., Hutubessy, R. C. W., … Bar-Zeev, N. (2024). Contribution of vaccination to improved survival and health: Modelling 50 years of the Expanded Programme on Immunization. *The Lancet, 403*(10441), 2307–2316. https://doi.org/10.1016/S0140-6736(24)00850-X
2. Betsch, C., Schmid, P., Heinemeier, D., Korn, L., Holtmann, C., & Böhm, R. (2018). Beyond confidence: Development of a measure assessing the 5C psychological antecedents of vaccination. *PLOS ONE, 13*(12), e0208601. https://doi.org/10.1371/journal.pone.0208601
3. de Figueiredo, A., Simas, C., Karafillakis, E., Paterson, P., & Larson, H. J. (2020). Mapping global trends in vaccine confidence and investigating barriers to vaccine uptake: A large-scale retrospective temporal modelling study. *The Lancet, 396*(10255), 898–908. https://doi.org/10.1016/S0140-6736(20)31558-0
4. World Health Organization & UNICEF. (2025). *WHO and UNICEF estimates of national immunization coverage (WUENIC), 2024 revision.* https://data.unicef.org/topic/child-health/immunization/
5. World Health Organization. (2025, November 28). *Measles deaths down 88% since 2000, but cases surge.* https://www.who.int/news/item/28-11-2025-measles-deaths-down-88--since-2000--but-cases-surge
6. Sim, S. Y., Watts, E., Constenla, D., Brenzel, L., & Patenaude, B. N. (2020). Return on investment from immunization against 10 pathogens in 94 low- and middle-income countries, 2011–30. *Health Affairs, 39*(8), 1343–1353. https://doi.org/10.1377/hlthaff.2020.00103
7. UNICEF Data. (2025). *Vaccination and immunization statistics.* https://data.unicef.org/topic/child-health/immunization/
8. Mina, M. J., Kula, T., Leng, Y., Li, M., de Vries, R. D., Knip, M., … Elledge, S. J. (2019). Measles virus infection diminishes preexisting antibodies that offer protection from other pathogens. *Science, 366*(6465), 599–606. https://doi.org/10.1126/science.aay6485
9. Petrova, V. N., Sawatsky, B., Han, A. X., Laksono, B. M., Walz, L., Parker, E., … de Swart, R. L. (2019). Incomplete genetic reconstitution of B cell pools contributes to prolonged immunosuppression after measles. *Science Immunology, 4*(41), eaay6125. https://doi.org/10.1126/sciimmunol.aay6125
10. UNICEF. (2025, July 15). *Global childhood vaccination holds steady, yet over 14 million infants remain unvaccinated – WHO, UNICEF.* https://www.unicef.org/press-releases/global-childhood-vaccination-holds-steady-yet-over-14-million-infants-remain
11. Pan American Health Organization. (2025, November 28). *Measles deaths down 88% since 2000, but cases surge – WHO.* https://www.paho.org/en/news/28-11-2025-measles-deaths-down-88-2000-cases-surge
12. Centers for Disease Control and Prevention. (2026). *Global measles outbreaks.* U.S. Department of Health and Human Services. https://www.cdc.gov/global-measles-vaccination/data-research/global-measles-outbreaks/index.html
13. Council on Foreign Relations. (2026, April 10). *Many countries eliminated measles. Why is it coming back in the U.S. and globally?* https://www.cfr.org/article/many-countries-eliminated-measles-why-it-coming-back-us-and-globally
14. MacDonald, N. E. (2015). Vaccine hesitancy: Definition, scope and determinants. *Vaccine, 33*(34), 4161–4164. https://doi.org/10.1016/j.vaccine.2015.04.036
15. Cross-sectional review of parental vaccine hesitancy (2023–2024). (2025). Parental vaccine hesitancy: Recent evidence supports the need to implement targeted communication strategies. *Current Research in Immunology.* https://www.sciencedirect.com/science/article/pii/S1876034124003824
16. Smith, S. E., Sivertsen, N., Lines, L., & De Bellis, A. (2024). Exploring social media influences on vaccine decision-making in parents: A netnography. *SAGE Open Medicine / Vaccine: X.* https://doi.org/10.1177/25151355241249607
17. Liebermann, E., et al. (2025). The persuasiveness of vaccine-focused social media posts to parents of adolescents. *Vaccine: X.* https://pmc.ncbi.nlm.nih.gov/articles/PMC12355988/