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## Contents



## Meeting of the Strategic Advisory Group of Experts on Immunization, March 2026: conclusions and recommendations

The World Health Organization (WHO) Strategic Advisory Group of Experts on Immunization (SAGE) met on 9–12 March 2026. This report summarizes their discussions, conclusions and recommendations. All SAGE recommendations are made using evidence-based methods.[1] The detailed evidence reviewed are provided in the in the background materials for the meeting.[2]

### Report from the WHO Department of Immunization, Vaccines and Biologicals

The report from the WHO Department of Immunization, Vaccines and Biologicals (IVB) provided an overview of the current global immunization context. It highlighted achievements, the expansion and maturity of immunization programmes, emerging challenges, and priorities for sustaining progress and shaping the future of immunization programmes in a rapidly evolving global health context.

The report emphasized that immunization programmes are operating during a period of significant geopolitical and financial challenges. These challenges, coupled with recent and upcoming institutional changes, will require a renewed focus on protecting gains, preventing backsliding and shaping the future of immunization programmes worldwide. The evolving global situation is seeing ever-increasing regionalization and a shift away from countries being dependent on aid to being self-reliant. Extensive discussions on reform of the global health architecture are ongoing, even as the context continues to evolve.

Global health is entering a new strategic period, with several major initiatives beginning or evolving in 2026. These include WHO's Fourteenth General Programme of Work 2025–2028 (GPW 14); the new strategic period (2026–2030) for Gavi, the Vaccine Alliance (Gavi 6.0); the new strategy of the Coalition for Epidemic Preparedness Innovations (CEPI), beginning in 2027 (CEPI 3.0); and the second half of the Immunization Agenda 2030 (IA2030).

At the same time, the evolving global health landscape – coupled with a sharp reduction in development assistance for health – calls for a renewed focus on the delivery of health services and the prioritization of efforts to accelerate progress towards national self-sufficiency. Within this context, WHO and partners are focusing on safeguarding the 'core of the core' immunization functions. For WHO, this encompasses normative guidance, immunization insights and action, strategic coordination, programme support, improved coordination with National Immunization Technical Advisory Groups (NITAGs) and Regional Immunization Technical Advisory Groups (RITAGs), and prioritization of the research agenda. Maintaining public trust and actively countering misinformation will remain central to sustaining gains and accelerating progress.

1 Development of WHO immunization policy and strategic guidance: methods and processes applied by the Strategic Advisory Group of Experts on Immunization (SAGE) to develop evidence-based recommendations. (https://www.who.int/publications/i/item/9789240090729, accessed 30 April 2026).
2 Strategic Advisory Group of Experts on Immunization (SAGE) – September 2025. (https://www.who.int/news-room/events/detail/2026/03/09/default-calendar/strategic-advisory-group-of-experts-on-immunization-march-2026, accessed 30 April 2026).

The IVB report highlighted the remarkable expansion of immunization programmes over the past five decades. The Expanded Programme on Immunization (EPI) was established in 1974, targeting seven vaccine-preventable diseases (VPDs).[3] Today, global immunization programmes protect against more than 30 VPDs. Most countries now target at least 14 VPDs across the life-course in their national immunization schedules. This shift reflects growing recognition of the importance of protecting not just infants and young children, but also adolescents, adults, pregnant people and older adults.

The introduction of new vaccines has accelerated significantly since 2000, with more than 1400 vaccine introductions recorded worldwide. By 2025, more than 80% of countries had introduced vaccines targeted against 10 or more of the 14 VPDs for which WHO recommends vaccination in all countries.[4]

The report also described major progress in national immunization governance structures. More than 90% of countries now have NITAGs, and about 80% of these are considered functional, based on WHO functionality criteria.[5] The WHO African Region in particular has seen notable improvements, with functional NITAG coverage increasing from only 2% in 2010 to about 85% in 2024. Countries have benefited from the advice of NITAGs in making informed choices about the introduction and use of newer vaccines. However, the sustainability of these advisory bodies remains a concern, because many NITAG secretariats in low- and lower-middle-income countries rely heavily on external funding rather than domestic resources.

Vaccine safety monitoring systems have also expanded considerably. More than 90% of countries now operate national monitoring systems for adverse events following immunization (AEFI), and report data to pharmacovigilance platforms such as the WHO global medicines safety database (VigiBase).[6] These data feed into the deliberations of the WHO Global Advisory Committee on Vaccine Safety (GACVS); at the same time, these systems enable countries to monitor vaccine safety and make informed decisions, reinforcing public confidence in immunization programmes.

Looking ahead, the report emphasized the importance of preparing and anticipating geopolitical shifts at different levels. Countries will need to review the efficiency and scope of their immunization programmes. Initiatives such as vaccine portfolio optimization and prioritization (VPOP) can assist countries to realign their national immunization strategies based on available resources and evidence-based recommendations. These processes involve collaboration between national immunization programmes (NIPs), NITAGs, other national health programmes and stakeholders, to determine which vaccines should be introduced or prioritized over the coming years. Such country-level decisions are also expected to influence global vaccine markets and supply dynamics.

The IVB report highlighted efforts to optimize immunization schedules and delivery strategies. For example, many countries are adopting simplified vaccination schedules (e.g. single-dose human papillomavirus [HPV] vaccination) to improve coverage and efficiency. Vaccination strategies for certain diseases (e.g. malaria) are increasingly shifting from national to subnational implementation, to better target populations at highest risk, optimize resource use and enhance impact – albeit with increased policy and operational complexity. In parallel, integrated vaccination campaigns that combine various interventions (e.g. measles–rubella vaccination, poliomyelitis [polio] vaccination, routine immunization catch-up, vitamin A supplementation, malaria prevention and other health services) have demonstrated substantial efficiencies and programmatic synergies. Integrated campaigns have been estimated to reduce costs per child by about 23% in Nigeria, and to reduce implementation time by about 60% compared with conducting separate campaigns in Ethiopia.[7]

Despite progress, there are emerging challenges. For example, there are uncertainties in global vaccine research and development funding, particularly given proposed reductions in funding for major public health research institutions. In addition, the global information environment has become increasingly complex, with misinformation and distorted information contributing to declining vaccine confidence in many settings. Political leadership and public communication are critical factors in either strengthening or undermining public opinion and confidence in vaccination. WHO is coordinating dedicated efforts to build confidence and trust in institutions, systems, communities and individuals.[8]

3 Diphtheria, measles, pertussis, poliomyelitis (polio), smallpox, tetanus and tuberculosis.
4 The 14 diseases against which WHO recommends vaccination in all immunization programmes include: COVID 19, diphtheria, *Haemophilus influenzae* type b (Hib), hepatitis B, human papillomavirus (HPV), measles, pertussis, pneumococcus, poliomyelitis, respiratory syncytial virus (RSV), rotavirus, rubella, seasonal influenza and tetanus.
5 Six WHO functionality criteria: 1) Legal or administrative basis, 2) Formal terms of reference, 3) Disclosure of interests, 4) 5 areas of expertise, 5) One meeting a year, and 6) Agenda circulated one week before meeting. [Source: Duclos et al. Vaccine 2013;31:5314-5320 (Progress in the establishment and strengthening of national immunization technical advisory groups: Analysis from the 2013 WHO/UNICEF joint reporting form, data for 2012].
6 The global medicines safety database (https://who-umc.org/vigibase-data-access/about-vigibase/ , accessed 30 April 2026)
7 Source: National Public Health Care Development Agency, Nigeria and Ministry of Health, Ethiopia.
8 WHO Vaccine Information Hub: (www.who.int/teams/immunization-vaccines-and-biologicals/diseases/vaccination-information-hub/, accessed 30 April 2026).
WHO Tools and guidance to promote demand: (www.who.int/teams/immunization-vaccines-and-biologicals/essential-programme-on-immunization/demand, accessed 30 April 2026).

In conclusion, the IVB report underscored that vaccination remains one of the most effective public health interventions. However, sustaining progress and preventing backsliding will require adapting to a changing global environment. SAGE should continue to play a role in providing transparent and timely evidence-based recommendations, and in strengthening collaboration with regional and national advisory bodies, to guide countries in navigating complex policy decisions in resource-constrained settings. SAGE's role in providing strategic foresight is crucial to achieving the goals of IA2030 and shaping the future of immunization.

## Report from Gavi, the Vaccine Alliance

Gavi's report provided an update of its strategic priorities, reforms and key programmatic developments as the Alliance transitions to its new strategic phase, Gavi 6.0. It highlighted the evolving global health context, and the operational and financial challenges shaping Gavi's work. These challenges include fiscal constraints, misinformation affecting vaccine confidence, limited government budgets, and the complexity of delivering immunization services in fragile and resource-limited settings.

The 2025 replenishment took place in a challenging financial environment. About US$ 10 billion was raised, leaving an estimated US$ 2 billion shortfall relative to the Alliance's funding needs. As a result, Gavi undertook a programme recalibration (which has now been completed) and a broader set of organizational reforms.

To address the challenges, Gavi has introduced the Global Health Leap reform framework[9], which is aimed at strengthening country ownership and improving the efficiency of the global health architecture. The framework is guided by four key principles: country centricity, greater national sovereignty over immunization programmes, clearly defined mandates for partner agencies based on comparative advantage, and a long-term vision for global health institutions to become more self-sustaining and less dependent on donor financing. The reform agenda also seeks to streamline Gavi's internal processes, improve alignment with partners under the Lusaka Agenda,[10] and contribute to broader reforms in global health governance.

The four strategic pillars and overall goal of Gavi 6.0 remain unchanged. The strategy incorporates a renewed approach to strengthening health systems, and introduces a dedicated framework for fragile and humanitarian settings. SAGE recommendations will inform the evolution of Gavi funding policies.

A major component of the Gavi 6.0 strategy is the introduction of a new country vaccine budgeting model that is designed to improve predictability and support strategic prioritization. Under this model, countries receive a defined vaccine budget at the start of the strategic period, rather than applying for multiple individual vaccine programmes over time. The budget includes both a guaranteed allocation to sustain funding for a core set of vaccines[11] and discretionary allocations for other vaccines,[12] with co-financing requirements maintained. Although this approach aims to improve planning and efficiency, it also requires countries to make trade-offs in selecting which vaccines to prioritize within constrained resources.

To support decision-making, Gavi is promoting the VPOP process. This country-led approach aims to help governments to align immunization investments with national priorities and available resources; in turn, this will enable strategic trade-offs across vaccine introductions, campaigns and routine immunization programme strengthening. Gavi Alliance partners will provide technical assistance, tools and training; they will also monitor support to ensure that countries can effectively implement the process.

Gavi is also implementing changes to its country operating model. Eight separate grant applications are being consolidated into a single application process, and grant cycles will be aligned. Also, grant management processes are being fully digitized, with each country receiving access to a dedicated portal that enables end-to-end management of grants.

Internal reforms at the Alliance secretariat, informed by two external reviews, include a 33% reduction in workforce and a 40% reduction in non-workforce operational expenditures.

9 The Gavi Leap (https://www.gavi.org/sites/default/files/2025/Gavi_Leap_brochure.pdf, accessed 30 April, 2026) 26)
10 Lusaka Agenda Overview (https://futureofghis.org/follow_ups/lusaka-agenda-overview/, accessed 30 April 2026)

11 Pentavalent vaccines (containing diphtheria, tetanus, pertussis, hepatitis B and *Haemophilus influenzae* type b antigens), pneumococcal conjugate vaccines (PCV), rotavirus vaccines, measles or measles rubella vaccines (including catchup and follow-up), human papillomavirus vaccines (including multi-age catchup), inactivated poliovirus vaccines (IPV), hexavalent vaccines (pentavalent + IPV), and hepatitis B monovalent birth dose.

12 Malaria, yellow fever vaccine campaigns, Japanese encephalitis vaccine (including campaigns), typhoid conjugate vaccines (including campaigns), oral cholera vaccine campaigns, meningococcal conjugate vaccines (including campaigns), rabies vaccines, diphtheria-tetanus-pertussis containing vaccines for booster doses, and respiratory syncytial virus vaccines.

The report highlighted updates for specific vaccine support programmes. Introduction of the typhoid conjugate vaccine (TCV) has expanded in recent years, with several countries introducing the vaccine in 2025. However, constrained discretionary budgets may limit the scale or continuation of campaigns, and the provision of additional doses if they are recommended in the future. Clear guidance from WHO will be essential to help countries determine optimal vaccination schedules and programme design.

For yellow fever prevention, Gavi noted that only two high-risk African countries – Ethiopia and South Sudan – have yet to complete preventive vaccination campaigns under the Eliminate Yellow Fever Epidemics (EYE) strategy.[13] Given budgetary constraints, the Alliance is awaiting guidance from SAGE on the expanded use of fractional dosing as a cost-efficient strategy for preventive campaigns.

Looking ahead, Gavi's board has issued an in-principle approval to establish new programmes for vaccines for dengue, tuberculosis (novel vaccine), group B Streptococcus and hepatitis E, pending further evidence and conditional on funding availability. Gavi reaffirmed its continued commitment to the global eradication of polio. Overall, the report emphasized the need for strong collaboration among Gavi, WHO and other partners, to support countries in prioritizing immunization investments and sustaining progress in vaccine introduction and coverage, despite increasing financial constraints.

## Regional Reports

Reports from the WHO Regions focused on topics of relevance in each respective Region.

## WHO African Region

The report from the WHO African Region highlighted the resurgence of diphtheria in the Region, following more than a decade of near elimination (2005–2018), and the urgent need to strengthen immunization systems to mitigate the risk of future outbreaks. Between 2023 and early 2026, about 57 000 suspected cases and about 2000 deaths were reported across eight affected countries, with children aged under 15 years being the most affected group. The outbreak has been driven primarily by significant gaps in immunity, owing to low routine vaccination coverage, absence of booster doses in most national schedules, waning immunity among adolescents and adults, and disruptions caused by the coronavirus disease (COVID-19) pandemic. Humanitarian crises, conflict in the Sahel region, population displacement and weak health systems have further exacerbated transmission and hindered response efforts.

Operational challenges in responding to the outbreaks included delayed vaccination campaigns, severe funding shortages, limited laboratory confirmation capacity, and shortages of diphtheria antitoxin and antibiotics. In response, the WHO Regional Office for Africa implemented a two-pronged strategy focusing on immediate outbreak control – through appropriate case management, reactive vaccination campaigns reaching about 10 million individuals aged 1–15 years, improved surveillance and community engagement – and longer term system strengthening. Key recommendations to countries emphasized the need to strengthen routine immunization programmes to ensure high vaccination coverage, introduce booster doses of diphtheria-containing vaccines, strengthen surveillance and laboratory capacity, and improve regional coordination and financing to prevent future outbreaks and build resilient life-course immunization programmes.

## WHO Region of the Americas

The report from the WHO Region of the Americas outlined efforts by the WHO Regional Office to strengthen evidence-based decision-making for NITAGs in the Region. NITAGs are required to regularly evaluate complex policy options (e.g. introducing new vaccines, changing vaccine valency, expanding target populations or modifying dosage schedules). However, many countries lack the technical capacity and structured analytical tools needed to make informed decisions on these options. To address this gap, the WHO Regional Office for the Americas – working with the London School of Hygiene & Tropical Medicine and Wake Forest University School of Medicine – developed two new decision-support tools and updated a third. One key tool, HORIZON,[14] provides rapid cost-effectiveness screening to help identify high-value immunization policy options and ensure that promising strategies are not overlooked. Another tool, VISTA (Vaccine and Immunization Summary Tables for Appraisal),[15] supports prioritization of the policy agenda by producing a rapid assessment before a full evidence review is undertaken.

13 Eliminate yellow fever epidemics (EYE) strategy 2017-2026 (https://www.who.int/initiatives/eye-strategy, accessed 30 April 2026).

14 Horizon: rapid assessment of the priority vaccine policy options to be considered by national immunization technical advisory groups. (https://sites.google.com/view/horizon-vaccines , accessed 30 April 2026)

15 Vista: building custom evidence summary tables for use by national immunization technical advisory groups. (https://sites.google.com/view/vista-tables, accessed 30 April 2026).

The report also highlighted the growing burden of dengue in the WHO Region of the Americas, which accounted for more than 90% of global dengue cases in 2024, with over 13 million reported cases and more than 8000 deaths. Factors such as climate variability, urbanization and the expanding habitat of *Aedes aegypti* are contributing to record levels of dengue transmission. In response, several countries have begun introducing the TAK-003 dengue vaccine (Qdenga®), including Argentina, Brazil, Honduras and Peru in 2024, followed by Colombia and Paraguay in 2025–2026. Initial real-world effectiveness data on the dengue vaccine are now emerging.

Key challenges remain, including variability in vaccine efficacy by serotype and serostatus, safety concerns (e.g. reports of anaphylaxis in Brazil), high costs of vaccines and competition with other vaccination priorities. Looking ahead, further developments include the potential introduction of a newer single-dose dengue vaccine in the region as early as 2026.

## WHO Eastern Mediterranean Region

The report from the WHO Eastern Mediterranean Region focused on leveraging the Big Catch-Up (BCU) initiative to strengthen immunization systems across countries in the Region. It highlighted how the BCU strategy has been used to reach children aged 1–4 years who missed routine vaccinations during the COVID-19 pandemic, helping to close immunity gaps while simultaneously strengthening components of the broader immunization system. The initiative contributed to improving service delivery, strengthening monitoring and reporting systems, and reinforcing health worker capacity through targeted training and policy guidance on vaccinating older children.

Despite these achievements, several operational challenges were identified during implementation. These included delays in receiving vaccine supply, behavioural barriers among health workers and caregivers regarding vaccination of older children, insecurity and instability in some countries, and limited funding for operational activities. To address these issues, countries implemented mitigation measures such as training health care workers; strengthening advocacy and communication efforts with communities and professional associations; developing tailored strategies for hard-to-reach and insecure areas; and mobilizing additional financial and operational resources through partnerships with UN agencies, civil society organizations and local actors.

The immunization system components strengthened through BCU included updating catch-up vaccination policies in all countries in the Region, data digitization, workforce enhancement, community engagement, integrated or expanded outreach activities, and integrated campaigns in certain countries.

Looking ahead, the report emphasized the need for countries to institutionalize catch-up vaccination for children aged under 5 years within routine immunization programmes, strengthen monitoring mechanisms, reconcile vaccination data and sustain the gains achieved through the BCU initiative, despite anticipated reductions in Gavi 6.0 support.

## WHO European Region

The report from the WHO European Region highlighted efforts for strengthening NITAGs in the Region and ongoing efforts to promote a more systematic approach into NITAG decision-making processes. As of 2025, 52 of 53 (98%) countries in the region have established NITAGs, including all middle-income countries. However, the maturity and operational capacity of these NITAGs vary widely; for example, some long-standing NITAGs have been functioning for over 30 years, while 15 were established only during the past decade. Currently, about 66% of NITAGs meet all six WHO functionality criteria.[5]

Standardized evaluations conducted since 2022 assessed the composition, functioning and quality of NITAG outputs using the WHO and Robert Koch Institute (RKI) evaluation questionnaire, combined with reviews of key documents (e.g. terms of reference, standard operating procedures and meeting reports).[16] The assessments identified several strengths, including formal establishment of NITAGs, the presence of secretariats, and the production of policy recommendations that have supported the introduction of new vaccines and reduced immunization inequities across the region. However, challenges remain, particularly limited secretariat capacity, non-standardized recommendation processes, varying levels of immunization expertise among members and limited national visibility of NITAGs.

16 Kulper-Schiek W, Mosina L, Jacques-Carroll LA, Falman A, Harder T, Kakarriqi E et al. Evaluation of National Immunization Technical Advisory Groups (NITAGs) of middle-income countries in the WHO European Region; a synopsis. Front Public Health. 2025;13:1464370 (https://doi.org/10.3389/fpubh.2025.1464370).

To address the main gap on the lack of a standardized approach to formulating policy recommendations, the WHO Regional Office for Europe and RKI developed guidance to help NITAGs apply an adapted evidence-to-recommendation process. This initiative, supported under the Strengthening National Immunization Technical Advisory Groups (SENSE) project (2020–2030),[17] includes webinars, technical support and capacity-building activities aimed at strengthening evidence-based decision-making and ensuring more consistent, transparent vaccine policy recommendations across the region.

## WHO South-East Asian Region

The report from the WHO South-East Asia Region highlighted immunization efforts during humanitarian crises in the Region and the challenges of maintaining vaccination coverage during emergencies. The Region has achieved significant progress in routine immunization, with a 27% reduction in zero dose children[18] – from 2.5 million to 1.8 million – in 1 year, and an increase in coverage of the first dose of vaccines containing diphtheria–tetanus–pertussis (DTP1) from 78% in 2000 to 94% in 2024. However, the current high vaccination coverage can mask immunity gaps due to an accumulation of unvaccinated and undervaccinated children across different age bands; these gaps become visible during emergencies and increase the risk of outbreaks of VPDs.

The Region is particularly vulnerable to health emergencies, owing to a 'triple-threat' context: frequent natural hazards (earthquakes, floods and climate-related disasters); infectious disease threats from persistent endemic diseases and emerging infections; and socioeconomic vulnerabilities such as rapid urbanization, migration and fragile health systems. Humanitarian crises – for example, an earthquake in Myanmar, the Rohingya refugee situation in Cox's Bazar in Bangladesh and earthquakes in Nepal – have disrupted immunization services and increased the number of susceptible children.

Emergency responses have included large-scale vaccination campaigns, mobile outreach services and rapid deployment of temporary immunization posts targeting high-risk groups. To prevent outbreaks and protect vulnerable populations during crises, experience has shown that it is essential to prioritize high-impact vaccines, integrate immunization with broader humanitarian services,[19] strengthen partnerships and engage communities.

## WHO Western Pacific Region

The report from the WHO Western Pacific Region outlined the proposed transformation of the RITAG from a traditional advisory panel into a dynamic, interconnected regional network. Established in 1991, the RITAG has played a critical role in guiding immunization policy and supporting NIPs, contributing to major regional achievements such as polio eradication and measles elimination. However, the immunization landscape has evolved significantly, with programmes becoming more complex owing to the introduction of new vaccines, life-course immunization strategies and expanding policy demands. At the same time, the structure of the RITAG has remained largely unchanged.

The report highlighted gaps in national decision-making capacity across the region, noting that many countries lack fully functional NITAGs. Strengthening these bodies is, therefore, central to the proposed transformation. The new model would reposition the RITAG as a peer-supported network of regional NITAGs; this would enable continuous engagement, shared learning and stronger technical support to countries. Leadership would rotate among members, with ongoing online and in-person collaboration, and specialized analytical support for technical discussions. The network would also act as a bridge between country realities and global policy processes, by linking regional expertise with SAGE. A roadmap has been developed to finalize the concept and terms of reference by mid-2026, and to convene the first network meeting later in the year.

## IA2030 governance and the future of immunization

The session sought feedback from SAGE on its role in the IA2030 governance structures, and briefed SAGE on the process of developing a vision for the future of immunization up to 2050.

## SAGE's role in IA2030 governance

The session followed up on the recommendation from the mid-term review of IA2030 to update its governance structure for the second half of the decade, given the evolving global health context. A central question was whether SAGE's role within

17 SENSE: Strengthening National Immunization Technical Advisory Groups and their evidence-based decision making in the WHO European Region and globally. (https://www.rki.de/EN/Institute/International-activities/GHPP/projects/sense.html, accessed 30 April 2026).

18 Children who have not received the first dose of vaccines containing diphtheria, tetanus, and pertussis (DTP1)

19 Implementing integrated health campaigns. (https://cdn.who.int/media/docs/default-source/documents/immunization/who-campaign_integration_guide_working_draft.pdf, accessed 30 April 2026)

IA2030 governance should change or remain as it is.

The governance model of the Global Vaccine Action Plan (2011–2020)[20] gave SAGE a larger role in the monitoring and accountability process compared with the model used during the first half of the IA2030 strategy period. SAGE members were invited to reflect on four issues to decide on their role in the governance of IA2030: the optimal degree of proximity between SAGE and IA2030, to ensure alignment between its priorities and SAGE's agenda; the balance of SAGE's policy-advisory function with its strategic and advocacy contributions; the level and nature of SAGE's current engagement in IA2030 governance; and any adjustments required to strengthen SAGE's role in IA2030 governance.

SAGE members expressed satisfaction with the current engagement model. They felt adequately briefed on IA2030 progress and able to meaningfully shape priority areas. The consensus view was that SAGE must remain focused on its policy-advisory mandate and not move too far into an advocacy or communications role. However, outputs from SAGE could be used for communication and advocacy purposes.

SAGE was satisfied with its current role in the biannual reporting process. Also, SAGE encouraged the IA2030 Secretariat to return to the group once a redesigned Partnership Council model is available, so that SAGE can assess its potential roles within the updated structure.

## Future of Immunization Initiative

SAGE reviewed progress on developing a vision document to inform the future of immunization, up to 2050. The outputs of a global survey of immunization stakeholders conducted in early 2025 were outlined.

These outputs resulted in six research papers across four thematic areas: global trends, vaccine development innovations, vaccine delivery innovations, and vaccine confidence and uptake.

The initial phase culminated in a 3-day workshop in December 2025. The outputs from the workshop informed the development of scenarios mapped along two axes: the vertical axis was based on the degree of global collaboration and the horizontal axis on the level of trust in health information. SAGE was invited to comment on the scenarios and their potential implications for SAGE's role in formulating policy and strategic guidance, and on steps to steer the work on the future of immunization. SAGE acknowledged the inherent difficulty of forecasting amid global volatility but agreed on its strategic value. Members stressed that the scenarios must be dynamic rather than static, reflecting rapid change and viewed through the lens of different audiences (e.g. countries, communities and implementers).

The six research papers and the foresight analysis based on the four scenarios will be shared with SAGE for feedback. SAGE members and RITAG chairs will then be invited to the upcoming regional engagement process.

## Typhoid Vaccines

In 2018, WHO recommended the use of TCVs in endemic countries. The recommendations endorsed a single-dose TCV schedule, administered to those aged from 6 months to 45 years, with or without catch-up campaigns. For programmatic ease, WHO encouraged the administration of TCV at 9 months of age or in the second year of life. At the time, there was inadequate evidence to define the optimal age for vaccination, or the need for and timing of booster doses.

SAGE reviewed updated evidence on the global epidemiology of typhoid fever; the safety, effectiveness and duration of protection following a single TCV dose; and the immunogenicity of booster dose regimens. In addition, SAGE reviewed the results of multi-modelling analyses assessing the potential benefits and cost–effectiveness of different vaccination schedules and booster doses.

*Salmonella* Typhi (*S.* Typhi) is estimated to have caused about 6 million cases of typhoid fever and 72 000 deaths worldwide in 2023. An updated global epidemiological review indicated that, in endemic areas, the peak age of disease is 5–9 years, with substantial heterogeneity across settings and over time. A recent systematic review suggested that although the incidence of typhoid fever appears to be higher in Asia, the occurrence of typhoid complications (e.g. intestinal perforation) varies across settings, with higher rates and associated mortality reported in Africa compared with Asia. The prevalence of antimicrobial resistance (AMR) also differs between settings. For example, in African settings, there is a high prevalence of multidrug resistance (MDR) and an increasing prevalence of ciprofloxacin non-susceptibility; in comparison, in South Asia, there is a high prevalence of ciprofloxacin resistance, an increasing prevalence of resistance to third-generation cephalosporins, and

20 Global vaccine action plan 2011-2020 (https://www.who.int/publications/i/item/global-vaccine-action-plan-2011-2020, accessed 30 April 2026).

reports of resistance to all antimicrobials used to treat typhoid.

Currently, six TCV products are licensed, of which four are WHO prequalified, and 12 countries have already introduced TCV into their routine immunization programmes. TCVs have demonstrated high effectiveness and have been shown to reduce the incidence of typhoid following national vaccine introductions. In addition, all licensed products have shown a favourable safety profile.

Data on the duration of protection following a single TCV dose indicate varying patterns of waning of protection. In Bangladesh, which is a very high incidence setting,[21] a nested test- negative case–control analysis of participants in a cluster-randomized trial showed vaccine effectiveness of about 85% (95% confidence interval [CI]: 76–91) 1–3 years after a single TCV dose at 9 months of age, which declined to about 55% (95% CI: 37–67) 3–5 years after vaccination and 17% (95% CI: –29–47) 5–7 years after vaccination. In contrast, in Malawi, which is a high incidence setting, an individually randomized controlled trial conducted found an initial vaccine efficacy of about 80.7% (95% CI 64.2–89.6) at 18–24 months that remained largely stable, with cumulative vaccine efficacy of 78.3% (95% CI: 66–86) after a median follow-up of 4.3 years. Evidence also indicates that waning of protection is most pronounced among infants and children vaccinated before 2 years of age.

The multi-modelling analyses explored the potential implications of alternative TCV dosing strategies (i.e. different assumptions about the baseline incidence rate of typhoid fever and the speed of waning of protection). The assessed outcomes included the potential long-term population-level health impact and cost–effectiveness of different vaccination strategies and schedules. Based on data from Bangladesh, the model assumes that vaccine protection wanes faster in very high incidence settings. In these settings, the model predicted that a booster dose would be cost-effective or cost saving, and would maintain protection during school-age years, when the highest burden of disease occurs. Vaccination is estimated to be cost-effective in medium incidence settings with case fatality ratio ≥ 0.5% in community-based studies where ambulatory cases are included.

Based on the evidence reviewed, SAGE recommended that TCV be introduced in settings with a very high incidence of typhoid fever or a high burden of antimicrobial-resistant S. Typhi,[22] with the first dose administered at 9–24 months of age. Very high incidence countries may consider a booster dose at the age of 5 years.

In high incidence settings, SAGE recommended the introduction of TCV, with the first dose administered at 9–24 months of age; a booster dose at the age of 5 years may be considered if there is evidence of waning of protection.

In settings with a medium incidence of typhoid fever and a high case fatality ratio, TCV introduction may be considered, with the first dose administered at or after the age of 2 years, and may be delayed up to the age of 5 years, based on local epidemiology and feasibility.

The use of vaccination should be accompanied by other approaches used to optimize the control of typhoid fever, including improvements in water, sanitation and hygiene (WASH), food safety, health education, and improved diagnosis and treatment.

SAGE also noted that typhoid fever is commonly diagnosed using blood culture confirmation, which is only 55% sensitive, depending on the volume of blood collected and potential antimicrobial pretreatment. Typhoid fever incidence is estimated using blood culture surveillance while adjusting for blood culture sensitivity, health care seeking and proportion of study catchment who seek care at study facility. However, blood culture capacity is not widely available in many settings, making it difficult for some countries to accurately assess disease incidence. To address this challenge, a tool – the Burden and Risk Assessment of Typhoid (BRAT) – has been developed to support national policy decision-making in the absence of comprehensive blood culture surveillance data.[23] SAGE acknowledged the value of the BRAT tool, but also noted the complexity and cost associated with its use; thus, SAGE recommended either the use of this tool or other inferential approaches to assess disease burden.

21 Typhoid fever incidence is classified as follows:
- Very high incidence: ≥500 cases per 100,000 population per year
- High incidence: 100 to <500 cases per 100,000 population per year
- Medium incidence: 10–<100 cases per 100,000 population per year
- Low incidence: <10 cases per 100,000 population per year

These classifications are based on estimated incidence of symptomatic typhoid fever after appropriate adjustments for blood culture sensitivity, testing practices, and healthcare-seeking behaviour. They should not be applied to crude, unadjusted typhoid surveillance data such as national disease registries based on laboratory-confirmed cases. In the absence of direct data in settings where typhoid incidence data are unavailable, countries may make inferences about probable incidence and severity using alternative data.

22 The burden of antimicrobial resistance (AMR) in typhoid reflects the extent to which circulating *S.* Typhi organisms are resistant to antimicrobial agents that are currently available, and in routine use locally. In such cases resistance to these antimicrobial agents constrains effective case management and increasing reliance on alternative, parenteral, more costly, or last-resort therapies and may negatively affect clinical outcomes.

23 Burden and Risk Assessment of Typhoid (BRAT): technical resources. (https://www.technet-21.org/en/resources/tool/burden-and-risk-assessment-of-typhoid-brat-a-methodology-for-countries-to-assess-available-data-on-the-burden-and-risk-of-typhoid-fever, accessed 30 April 2026).

## COVID-19

SAGE reviewed the latest epidemiological data on COVID-19 during the Omicron era, including the disease burden and post-COVID conditions, across population groups. Evidence on the status of vaccine use globally and the safety, effectiveness and cost–effectiveness of currently available vaccines was also reviewed.

The global burden of severe COVID-19 has declined compared with earlier phases during the pandemic, largely due to widespread population immunity through vaccination and prior infection. Nevertheless, COVID-19 continues to cause morbidity and mortality, particularly among older adults, individuals with comorbidities and people who are immunocompromised.

In terms of post-COVID-19 conditions, persistent symptoms following acute infection have been documented in both adults and children, although estimates of prevalence vary considerably across studies owing to differences in case definitions and study methods. Vaccination may contribute to reducing the risk of post-COVID-19 conditions, primarily through prevention of severe disease.

In terms of the burden of COVID-19 during pregnancy and infancy in the Omicron era, the risk of severe disease and adverse maternal and fetal outcomes was lower than during the pandemic. However, people who are pregnant remain at higher risk of severe disease in the Omicron era compared with those of a similar age who are not pregnant. Infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) during pregnancy has been associated with an increased risk of adverse maternal outcomes (e.g. intensive care unit admission) and pregnancy outcomes (e.g. preterm birth).

Data on infants infected with SARS-CoV-2, which are mainly from a few high-income settings, indicate that infants aged under 6 months may experience higher hospitalization rates than older children, although the frequency of severe outcomes is low and varies within these settings.

The currently available mRNA and protein subunit COVID-19 vaccines have an acceptable safety profile across age groups and risk categories, based on 5 years of accumulated COVID-19 vaccine safety data from clinical trials, post-marketing pharmacovigilance systems, surveillance platforms, post-authorization studies and international regulatory reviews. Serious adverse events remain rare relative to the number of doses administered globally (>13 billion); also, most reported adverse events are mild or moderate and transient, typically resolving within a few days. A limited number of rare, platform-specific adverse events have been identified, including thrombosis with thrombocytopenia syndrome (TTS) associated with adenovirus vector vaccines that are no longer being manufactured, and myocarditis/pericarditis associated with mRNA and protein vaccines. However, myocarditis and pericarditis associated with the currently available mRNA and protein vaccines remain uncommon, and have a milder course than post-COVID or conventional myocarditis; hence, the overall benefit–risk balance continues to favour vaccination, particularly among populations at increased risk of serious COVID-19 outcomes. Safety following repeated doses, including revaccination with variant-adapted vaccines, remains reassuring, with no new safety signals identified.[24]

Real-world evidence consistently shows that the vaccines are effective in reducing COVID-19 associated severe disease and death. Vaccines adapted to Omicron lineages continue to provide meaningful protection against severe outcomes. Routine periodic COVID-19 vaccine doses help to sustain protection, despite the relatively rapid waning of protection against infection and limited protection against symptomatic disease beyond 6 months.

Updated evidence on COVID-19 vaccination during pregnancy from observational studies, pregnancy registries, and surveillance systems across multiple countries has not identified safety concerns. Currently it shows no increased risk of adverse maternal or pregnancy-related outcomes, including miscarriage, stillbirth, preterm birth or adverse outcomes in infants born to people vaccinated during pregnancy. Vaccination during pregnancy is safe and it provides protection to the pregnant individual, against COVID-19 associated adverse pregnancy outcomes, and to infants aged under 6 months through maternal antibody transfer.

Cost–effectiveness analyses of COVID-19 vaccination consistently show that programmes targeting populations at high risk of severe outcomes (e.g. older adults or individuals with underlying health conditions) are generally cost-effective or even cost saving across a range of epidemiological scenarios. Broader vaccination strategies may be cost-effective in certain contexts, depending on disease burden, vaccine costs and programmatic factors. Most studies originate from high-income countries, limiting their generalizability to other settings.

24 World Health Organization (2026). Global Advisory Committee on Vaccine Safety (GACVS): COVID-19 vaccines – Subcommittee. Geneva: WHO; [cited 2026 Mar 10]. Available from: https://www.who.int/groups/global-advisory-committee-on-vaccine-safety/topics/covid-19-vaccines/subcommittee, accessed 30 April 2026).

SAGE recommended that countries should consider routine COVID-19 vaccination for those groups at highest risk of severe COVID-19 disease. These include oldest adults;[25] older adults[26] with significant comorbidities or severe obesity; residents in care and long-term care facilities; and individuals aged 6 months or over, who are moderately or severely immunocompromised. For these groups – whether they are unvaccinated or were vaccinated more than 6 months earlier – SAGE recommended at least one dose per year, and preferably two doses administered 6 months apart, owing to the waning of protection against severe COVID-19 disease by 6 months after the last dose. Cost–effectiveness and programmatic feasibility should be considered when determining the number of doses to be administered per year.

SAGE also recommended that countries may consider routine COVID-19 vaccination of additional groups based on local context, cost–effectiveness and programmatic feasibility. These additional groups include the following:

• Older adults without significant comorbidities or severe obesity; adults (not included in the older adult category), adolescents and children with significant comorbidities or severe obesity; and health workers and other care providers. These groups, whether unvaccinated or previously vaccinated more than 6 months earlier, may be vaccinated with at least one dose per year.

•People who are pregnant, whether unvaccinated or previously vaccinated more than 6 months earlier. This group may be vaccinated with one COVID-19 vaccine dose during each pregnancy, at any stage, though ideally during the second trimester. The aim is to optimize protection against severe COVID-19 for the pregnant person, prevent adverse pregnancy outcomes and protect the infant during the first months of life.

•Previously unvaccinated healthy children aged 6–23 months. This age group may be vaccinated if a significant burden is documented; revaccination is not routinely recommended.

Some of the research priorities recommended by SAGE were further assessment of the burden, societal impact and vaccine effectiveness against post-COVID-19 condition, using the WHO standardized definition;[27] studies on cost–effectiveness of COVID-19 vaccination, particularly in low- and middle-income countries, and among groups such as health workers and children; and studies on the social and behavioural drivers of COVID-19 vaccine uptake, to address hesitancy and guide interventions to achieve high confidence and uptake.

SAGE recommendations will inform the development of a WHO vaccine position paper on COVID-19 vaccines; the position paper will replace the WHO SAGE interim guidance reflected in the COVID-19 vaccines roadmap.[28]

## Poliomyelitis

The continued detection of paralytic poliomyelitis cases caused by wild poliovirus type 1 (WPV1) throughout 2025 in the endemic areas of Afghanistan and Pakistan, despite repeated vaccination campaigns, remains a serious concern. SAGE emphasized that recent declines in reported cases of WPV1 should be interpreted with caution, given incomplete laboratory data from Afghanistan resulting from shipment disruptions in late 2025 and early 2026. Ongoing transmission in southern Afghanistan was attributed primarily to operational challenges, including reliance on site-to-site vaccination strategies rather than house-to-house campaigns.

Another serious concern is the persistent detection of circulating vaccine-derived poliovirus type 2 (cVDPV2), particularly the inability to interrupt transmission in Nigeria despite multiple rounds of vaccination with the novel oral poliovirus vaccine type 2 (nOPV2). However, SAGE noted a decline in cVDPV2 detection in wastewater samples in several European countries since October 2024, which suggests declining circulation of the virus in these countries.

SAGE welcomed implementation of the new Global Polio Eradication Initiative (GPEI) Action Plan,[29] which outlines a pathway to achieving eradication within current fiscal constraints. The advisory group was encouraged by the renewed focus on WPV1 eradication, while maintaining robust poliovirus surveillance and refocusing efforts on cVDPV2 elimination.

25 Age cut-off should be determined by countries – often it is 75 or 80 years.
26 Age cut-off should be determined by countries – often it is 50 or 60 years
27 WHO standardized definition for adults: Post-COVID-19 condition occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, usually 3 months from the onset of COVID-19, with symptoms that last for at least 2 months and cannot be explained by an alternative diagnosis. (https://www.who.int/publications/i/item/WHO-2019-nCoV-Post_COVID-19_condition-Clinical_case_definition-2021.1, accessed 30 April 2026); WHO standardized definition for children and adolescents: Post-COVID-19 condition in children and adolescents occurs in individuals with a history of confirmed SARS-CoV-2 infection, with at least one persistent physical symptom lasting for at least 12 weeks after testing positive, that impacts everyday functioning and cannot be explained by another diagnosis. (https://www.who.int/publications/i/item/WHO-2019-nCoV-Post-COVID-19-condition-CA-Clinical-case-definition-2023-1, accessed 30 April 2026)
28 WHO SAGE Roadmap for prioritizing uses of COVID-19 vaccines (https://www.who.int/publications/i/item/WHO-2019-nCoV-Vaccines-SAGE-Prioritization-2023.1, accessed 30 April 2026)
29 GPEI 2026 action plan. (https://polioeradication.org/gpei-action-plan/, accessed 30 April 2026).

SAGE acknowledged that planning for the cessation of bivalent oral poliovirus vaccine (bOPV) in routine immunization programmes has been updated, but noted that timelines may be delayed owing to failure to meet key triggers, particularly certification of WPV1 eradication. SAGE encouraged GPEI to elaborate contingency measures, to inform planning for bOPV cessation should eradication be further delayed.

It was noted that several countries are transitioning to vaccination schedules with three or more inactivated poliovirus vaccine (IPV) doses, often through introduction of whole-cell pertussis hexavalent (wP-Hexa) vaccines.[30] This has prompted consideration as to whether the number of bOPV doses in routine immunization could be safely reduced. SAGE strongly welcomed the increasing number of wP-Hexa vaccine introductions. SAGE concluded that a two-dose bOPV schedule may be considered in certain countries when at least three IPV doses are already administered in the first year of life; this conclusion was based on review of the available evidence on serum and mucosal immunity using two or three doses of bOPV, ethical considerations to reduce the risk of vaccine-associated paralytic polio (VAPP), and cost and supply implications.

Specifically, where bOPV-using countries are categorized by WHO to be at medium or high readiness to move to an IPV-only schedule (based on the WHO-Imperial College Readiness tool), the following polio vaccination schedule may be considered:

- The bOPV doses can be given with the second and third IPV dose in the three-dose primary series schedule starting at 6 weeks of age or later;
- Given the importance of achieving and sustaining high vaccination coverage, SAGE recommended that the reduction to two doses of bOPV be initiated 1 year after a country has introduced three or more doses of IPV, to provide opportunity for coverage improvement; and
- SAGE emphasized the role of RITAGs in monitoring and advocating for high vaccination coverage.

Countries at low risk of polio that still use a birth dose of bOPV could choose to shift to the schedule described above. Alternatively, they could maintain their current vaccination schedule while awaiting further guidance on the continued use of the birth dose of bOPV.

SAGE recommends that countries with endemic polio or at high risk of polio should retain their number of bOPV doses in routine immunization, regardless of any increase in the number of IPV doses given in the vaccination schedule. The aim is to maximize population mucosal immunity and reduce the risk of transmission from imported or vaccine-derived poliovirus.

Finally, SAGE noted that clinical development of nOPV1 and nOPV3 remains on schedule, although regulatory submission is not anticipated until 2030 or 2031.

## Vaccine Portfolio Optimization and Prioritization

SAGE discussed the growing need for countries across all income groups to prioritize their immunization programmes in the context of increasing financial constraints, limited predictability of funding and expanding vaccine portfolios. VPOP promotes a country-owned, evidence-informed process that can be adapted to the local context, to optimally respond to financial constraints and maximize the health impact of NIPs.

SAGE noted the progress made to support countries in these efforts. Over 80 NITAGs across all WHO regions have been sensitized to available tools and guidance. The WHO Vaccine Evidence Compendium was launched as a tool to improve access to evidence to inform national decision-making.[31] The initial set of vaccines included in the compendium will be further expanded. In January 2026, in response to requests from countries, WHO published guidance to support countries in optimizing their current vaccine portfolio, including assessment of trade-offs.[32] In the context of the Gavi 6.0 strategy and establishment of vaccine budgets, VPOP will be an important process for Gavi-eligible countries to inform their decisions.

Experiences shared by Ethiopia, the Islamic Republic of Iran and Mozambique highlighted that effective prioritization relies on strong collaboration between NIPs and NITAGs. In Ethiopia, the prioritization exercise was built on a strong collaboration between the NIP and the NITAG to consider local capacity and feasibility of future new vaccine introductions. Lessons from this exercise will inform the ongoing optimization process in the country. In the Islamic Republic of Iran, the prioritization and sequencing of future new vaccine introductions was led by the NITAG, supported by its secretariat, with recommendations for vaccine introductions from 2025 to 2030. Mozambique highlighted the ongoing parallel and complex

30 Containing diphtheria, tetanus, pertussis, hepatitis B, Hib and inactivated poliovirus antigens.
31 Vaccine Evidence Compendium (https://www.nitag-resource.org/compendium, accessed 30 April 2026)
32 Vaccine prioritisation and portfolio optimization toolkit: Optimization tool (https://www.nitag-resource.org/resources/optimization-tool, accessed 30 April 2026)

optimization processes for different health programmes, and the benefits the VPOP guidance provides to this process. All three countries highlighted the value of the optimization tool in promoting country ownership and enabling reassessment of priorities on a regular basis.

The country experiences also highlighted persistent challenges related to the availability of local data, access to relevant evidence, and national capacity to review and interpret evidence. SAGE emphasized the importance of coordinated partner support to address these gaps, including support for data sharing and capacity-building.

SAGE emphasized the central role of NITAGs as independent technical advisory bodies in supporting portfolio optimization and vaccine prioritization, noting that VPOP represents an expansion of their scope beyond policy recommendations on existing and new vaccines. SAGE recognized the opportunity to build on existing support structures for NITAGs, including the Global NITAG Network (GNN), as well as the need for regional coordination mechanisms. Ensuring the sustainability and independence of these structures was considered critical. SAGE recalled that a previous assessment showed that the staffing of NITAG secretariats was less than one full-time equivalent in 37 (47%) of 84 countries assessed.

SAGE noted that vaccine prioritization and optimization is a relatively new area of work that will continue to evolve, and it recommended close monitoring of country decisions to better understand their impact on immunization programmes at national and regional levels, including potential effects on service delivery, programme performance and community uptake of vaccination. SAGE noted that many countries may require technical assistance to optimally implement the process. Continued monitoring of the global vaccine market was also highlighted as important in anticipating and mitigating potential supply or access challenges.

Finally, SAGE emphasized the importance of supporting countries in communicating decisions related to switches among vaccines or changes to existing immunization schedules. Given the nature of such decisions, broad engagement with a variety of stakeholders – including civil society organizations and professional associations – was recommended to facilitate local understanding, participation and acceptance. Where relevant, linkages with health technology assessment processes should be explored to facilitate analyses of cost–effectiveness and budget impact, and to support implementation of recommendations.