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COMMENT

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Innovative vaccine research through the lens of implementation science: fulfilling the strategic goals of the Immunization Agenda 2030

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The endorsement of the Immunization Agenda 2030 (IA2030): A Global Strategy to Leave No One Behind outlined a global strategic plan for vaccines and immunization during 2021–2030. In this comment, we discuss strategies for implementing IA2030, and explore the integration of implementation science principles into vaccine and immunization research.

Background

Recognizing the significant contribution of immunization to controlling many common infectious diseases in countries where it has been effectively implemented, the World Health organization (WHO) endorsed the Expanded Programme on Immunization (EPI) in 1974. Supported by numerous international initiatives and in response to implementation needs, the first global strategy—the Global Immunization Vision and Strategy—was developed in 2006, renewed as the Global Vaccine Action Plan in 2011, and re-envisioned in 2021 with the Immunization Agenda 2030 (IA2030). IA2030 is an equity-driven initiative that aims to achieve the vision of a world where individuals of all ages and locations benefit fully from vaccination for good health and well-being [1]. Its core principles emphasize being people-centered, country-owned, partnership-based, and data-guided, striving to maximize the impact of vaccines to ensure optimal health outcomes. While the original EPI focused on "expanding" vaccination coverage to reach larger populations, the latest IA2030 mainly emphasizes equity in immunization.

Implementation science can help in achieving these goals. Implementation science is a burgeoning interdisciplinary field dedicated to overcoming challenges of transforming evidence-based interventions into practice, and has become increasingly important for evaluating implementation of public health projects by researchers and decision makers [2]. At the International Symposium on Implementation Science in Vaccines and Immunization held in October 2024, Hangzhou, China, leaders in vaccinology and implementation science shared advances and insights with a focus on the evolving implementation of IA2030 and the pivotal role of implementation science in vaccines and immunization (more details available at https://gwxy.zcmu.edu.cn/info/1021/3031.htm). Here, we summarize the discussion from the symposium and discuss the integration of implementation science methodologies into IA2030, from decision-making to implementation, to guide and promote practical applications and successful realization of the IA2030 vision.

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Immunization Agenda 2030—strategy and progress

Amid a situation where only about 5% of children worldwide were receiving vaccines for six major diseases (polio, diphtheria, tuberculosis, pertussis, measles, and tetanus) in 1974, there was an urgent need to strengthen vaccination efforts. As a result, the EPI was established to unite global efforts in leveraging vaccination as a public health intervention to prevent and control vaccine-preventable infectious diseases worldwide [3]. The year 2024 marks the 50th anniversary of EPI, representing a milestone of promoting vaccine accessibility as foundational elements of primary health care. EPI requires member states to develop and maintain immunization and surveillance efforts against seven diseases and the WHO should intensify its efforts in the following areas: providing technical assistance, ensuring the quality and affordability of vaccine supply, promoting local vaccine production capabilities, conducting research on vaccines and immunization, and strengthening training and education activities. Therefore, vaccine coverage has increased significantly. For example, global coverage of three doses of the diphtheria-tetanus-pertussis (DTP3) vaccine for children under 12 months increased from 5% in 1974 to 85% in 2010 [4]. What is more, EPI has averted an estimated 154 million deaths, including 146 million deaths of children under 5 years of age, of which 101 million were infants [5]. More vaccines are being introduced in low- and middle-income countries; however, this effort requires further acceleration as the breadth of protection is still too narrow [1].

Declines in global vaccine coverage during the COVID-19 pandemic have been associated with an increase in measles and whooping cough cases in some countries, as noted by the WHO. In response, an essential immunization recovery plan has been implemented such as IA2030's "Big Catch-up," which was focused on three key approaches: *catch-up* missed vaccinations among an estimated 85.7 million children, *restore* immunization programs to reach 14.3 million zero-dose children, and *strengthen* primary health care systems to ensure program resilience. Countries need to consider both short-term efforts with action to establish catch-up vaccination policy and schedules, and on-going approaches to implement and integrate catch-up vaccination policies and schedules into routine activities. Not only should all children in need of catch-up vaccination be vaccinated in the short term, but a robust system for monitoring missed vaccinations and ensuring timely catch-up should also be established, for example, by reviewing vaccination history at every health visit (including immunization and other health services).

Over the past few decades, China's immunization program, supported by technological innovation, rigorous monitoring and evaluation, and emergency response measures, has achieved major milestones, including uniformly high coverage with programmed vaccines, only 0.2% zero-dose children, and 25 years of polio-free status. Emerging from the COVID-19 pandemic, China's government-supported immunization system/program has grown more resilient, with enhanced vaccine delivery capacity, integrated digital records, overseas clinical trial capabilities, and novel vaccine effectiveness monitoring platforms. However, challenges remain. Vaccine coverage levels of non-EPI-program vaccines lag far behind coverage levels of program vaccines, underscoring the importance of expanding the breadth of coverage across the life course—for children, adolescents, and adults [6]. Addressing these gaps necessitates optimizing immunization schedules, adopting WHO-recommended vaccines, improving accessibility for families, and targeting adults and key occupational groups along with children. Ultimately, implementing evidence-based strategies is critical, and is well aligned with the goal of implementation science to enhance public health outcomes.

Implementation science and immunization practices

Implementation science is an interdisciplinary and rapidly expanding field that focuses on planning, facilitating, evaluating, and enhancing the effectiveness, reach, and sustainability of evidence-based practices in real-world settings [7]. There is a growing consensus that the interventions outlined in IA2030 involve multifaceted challenges. This complexity is partly attributed to the influence of cultural beliefs and norms on perceptions of disease and subsequent behaviors. Viewing the COVID-19 vaccination efforts through the lens of implementation science helps elucidate the notable success observed in non-Hispanic American Indian and Alaska Native communities. Filial piety, or familial allegiance, is a key factor contributing to the remarkable high vaccination coverage among these communities. Accordingly, these communities harness this cultural value by developing innovative and inclusive strategies to enhance vaccination uptake. For instance, vaccine rollouts often coincide with key ceremonial seasons that are central to tribal life, while restricting attendance to individuals who can provide proof of vaccination [8].

In China, the integration of implementation science and immunization practices is in process. Studies have shown that multifaceted strategic interventions—such as system-level coordination, school-based training, and individual-level education—have effectively increased influenza vaccine coverage among primary school students in Beijing, China [9]. A "pay-it-forward" strategy, which offers influenza vaccines along with an opportunity to anonymously donate for future vaccination

of others, has proven to significantly enhance vaccine uptake and community engagement in China when compared to the standard user-paid vaccination model. The pay-it-forward approach also contributed to increased vaccine confidence and reduced vaccination costs [10].

These examples demonstrate that implementation science serves as a robust framework for enhancing immunization practices and is pivotal to achieving the IA2030 vision and its associated policies at the macro level. IA2030 was built upon key lessons from the Global Vaccine Action Plan (GVAP), which was the global immunization strategy during the "Decade of Vaccines" (2011–2020), and was developed in broad collaborative effort to support bottom-up solutions. Given significant differences across countries in size, resources, and living conditions, fact-based approaches are essential for evaluating and adjusting programs and policies. According to the framework and perspectives of implementation science, evaluation should consider whether to introduce new vaccines, prioritize groups for vaccination, and determine the optimal timing for vaccinating against seasonal infectious diseases. Evidence-based practices have two levels—one is how facts are linked to policy, and the other is how to rely on evidence from other guidelines to facilitate vaccine evaluation. In accordance with policy and implementation science, we should first derive options, scenarios, and optimization metrics, then extrapolate the burden of disease and the overall impact of the policy using appropriate infectious disease and health economic models. These results are then fed back into the decision-making stage to guide necessary adjustments. Epidemiological data from surveillance or statistical analyses, as evidence from guidelines, can complement disease models, enhancing the comprehensiveness of evaluations. Ultimately, this process leads to the formulation of improved vaccination policies.

Conclusions

Implementation science provides the framework and strategies to effectively implement and evaluate the policies and interventions outlined in IA2030, aiming to enhance global immunization efforts through evidence-based practices and context-specific solutions. This comment aims to inspire further discussion and collaboration to bridge the gap between strategy and implementation, fostering their integration for more effective outcomes.

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