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Commentary

A global collaboration to advance vaccine product innovations – The Vaccine Innovation Prioritisation Strategy

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1. Introduction

As highlighted in the global Immunization Agenda 2030, advancements in products, services, and practices are required to achieve immunization coverage and equity goals and ensure that vaccines are accessible to all communities, especially the thirteen million ‘zero dose’ children who are not receiving any vaccines via existing systems and strategies [1]. Innovative vaccine technologies and delivery devices can simplify logistics, increase the acceptability and safety of immunization, minimize missed opportunities, and facilitate outreach by overcoming ‘last mile’ barriers. Although many initiatives have been undertaken to advance promising vaccine product innovations, most have been under

Resourced; were not sufficiently evaluated to define a value proposition agreed upon by key stakeholders; lacked coordination and alignment of strategies and activities between donors, global agencies, and technology developers; and have not had the benefit of intentional market-shaping efforts to ensure that the innovations reach those who need them most. As described in an accompanying article, the result is that few have succeeded in being widely implemented and adopted in the low-resource settings where they could have the greatest impact [2]. The COVID-19 pandemic is now disrupting routine immunization and has further validated the need for new approaches to advance vaccine product innovations, including for COVID-19 vaccines.

The Vaccine Innovation Prioritisation Strategy (VIPS) was formed in 2017 by Gavi, the Vaccine Alliance, and is a partnership between Gavi, the World Health Organization (WHO), Bill & Melinda Gates Foundation, United Nations Children’s Fund (UNICEF), and PATH. VIPS aims to pursue a common agenda of identifying and driving high priority vaccine product innovations forward to address the most important barriers to immunization and improve coverage and equity. VIPS has completed a first prioritization process by engaging with country and other stakeholders, developing common principles to evaluate and compare the

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Fig. 1. VIPS process and timeline (2018–2020).

Fig. 2. Twenty-four vaccine product innovations assessed in phase I.
benefits of innovations, establishing a platform and convening partners to agree upon the highest priority innovations, and communicating clear and aligned perspectives on the priorities to inform investment decisions. Although VIPS was formed prior to the pandemic, the relevance of the innovations to future COVID-19 vaccines as well as supplemental and outreach immunization activities to catch up millions of children who will miss essential services during the pandemic was considered during the final stage of the prioritization process.

2. Progress to date

Over the last two years, the VIPS process and framework to prioritize innovations was developed, implemented, and broadly communicated by members of the constituent VIPS organizations (Fig. 1). Detailed background documents on the methodology and assessments of each innovation type are available on the Gavi website [3]. A process of landscaping and expert consultations was undertaken to identify inclusion and exclusion criteria and select twenty-four vaccine product innovations (Fig. 2) with potential to provide measurable financial and/or programmatic benefits to low- and middle-income countries (LMICs) [3]. These included novel primary containers, delivery technologies, packaging and safety devices, formulation enhancements to improve vaccine thermostability, and primary container indicator labels.

The VIPS process involved engagement with country immunization programs, technology developers, vaccine manufacturers, and regulators as well as oversight by a steering committee comprising 16 members with expertise in national immunization program financing; immunization service delivery challenges; infectious disease epidemiology and disease control; health impact analyses and modeling; and vaccine innovation research, development, and manufacturing. To ensure alignment with existing initiatives, half of the steering committee members were also members of one of two WHO committees: the Immunization Practices Advisory Committee or the Product Development for Vaccines Advisory Committee. Country stakeholders were consulted from the onset and throughout the process, including immunization program managers, procurement staff, logistics and supply chain staff, data managers, senior policymakers, health care service providers, implementing partners, UNICEF and WHO country and regional staff, and in-country research partners. Country stakeholder input was critical to ensure that the prioritization process focused on addressing key barriers to immunization implementation, both general and vaccine-specific barriers, and the product attributes that they most value. These country consultations consisted of two global online surveys as well as in-depth interviews in six countries and are summarized in an accompanying article [4]. Data were collected on each of the twenty-four innovations through literature reviews and intelligence gathered from technology developers, manufacturers, and regulators. The steering committee provided independent and broad-ranging inputs on the innovations, methodologies, and prioritization decisions.

The VIPS framework for evaluation was purposefully designed to allow comparisons between a variety of innovations at different stages along the product development to implementation continuum. In phase I of the prioritization process, the twenty-four innovations were evaluated based on their potential impacts on health, coverage and equity, safety, and economic costs in comparison to current technologies in use. They were also evaluated for their potential ‘breadth of use’ (i.e., applicability to several antigens). This resulted in selection of a short list of nine innovations based on attributes that offered the greatest potential public health value: microarray patches (MAPs), compact prefilled auto-disable devices, auto-disable sharps injury protection syringes, solid dose implants, dual chamber delivery devices, freeze damage resistant liquid formulations, heat stable and controlled temperature chain (CTC) qualified liquid formulations,^1^ combined vaccine vial monitors with threshold indicators, and barcodes/radio frequency identification devices [3]. In phase II, these nine innovations were further assessed in the context of specific licensed and pipeline vaccines that were selected to represent the landscape of vaccine types and presentations that they could be applied to^2^ [3]. Each innovation-vaccine combination was then evaluated against vaccine-specific challenges it could address; its potential impact on health, coverage and equity, safety, economic costs (including commodity, delivery, introduction, and recurring costs), and environment; as well as technical readiness and commercial feasibility. Given resource limitations and the desire to advance the priority innovations in a measurable way, three innovations were selected for advancement by VIPS:

- **Microarray patches** are early-stage but potentially transformational delivery devices that may address many of the key immunization barriers identified by countries due to attributes of improved thermostability, ease of use, avoidance of reconstitution with the associated errors and risks, and improved safety by removing potential for needle-stick injury. The innovation should be applicable to many existing vaccines (including those focused on elimination agendas) and pipeline vaccines as well as a variety of use cases including routine, supplemental, house-to-house, and outbreak immunization.

- **Heat stable and CTC qualified vaccines** encompass formulation enhancements to improve heat stability, as well as regulatory and programmatic approaches to vaccine management, which can improve vaccine effectiveness, enable program efficiencies, facilitate access to harder to reach communities, and alleviate cold chain constraints. They directly address the most frequently identified problem by countries in the phase II global survey, which was heat exposure resulting in vaccine ineffectiveness or wastage [4]. For this innovation category, VIPS will focus on vaccine formats that do not increase vaccine wastage or safety risks. Dry formulations are of interest if they offer additional benefits such as removing the issues associated with manual reconstitution – as would be the case with microarray patches.

- **Barcodes on primary vaccine packaging** are a program implementation and system technology that would strengthen accuracy and efficiency in tracking vaccine products to reduce vaccine stockouts and wastage and strengthen accuracy and efficiency in patient vaccination records to monitor coverage and track adverse events. The selection of this technology also supports the ongoing transitions to electronic record keeping in health systems. While VIPS evaluated the application of barcodes to primary packaging, the focus now is to support current efforts to place GS1 compliant barcodes on secondary packaging and to conduct additional research to more precisely assess the additional benefits at the primary packaging level in the near future.

These three high priority innovations have potential for positive impacts on ‘life-course’ immunization for broader populations beyond children, including adolescents, adults, and older adults.

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^1^ CTC qualified vaccines are heat stable and have received regulatory and WHO prequalification approvals allowing them to be kept at temperatures outside of the traditional cold chain of +2°C to +8°C for a limited period of time under monitored and controlled conditions, as appropriate to the stability of the antigen. CTC typically involves a single excursion of the vaccine into ambient temperatures not exceeding +40°C for a specific number of days, just prior to administration.

^2^ Radio frequency identification devices were removed from consideration during phase II given a number of stronger advantages offered by barcodes at the time of evaluation.
They could also be highly relevant for COVID-19 vaccines; however, they may not be available for first generation products.

3. Next steps

VIPS has achieved its initial remit of identifying and prioritizing three vaccine product innovations with potential to best meet country needs and has communicated the results. Alignment of the five VIPS organizations behind a comprehensive evaluation framework and consensus on the three priority innovations is a major and unique accomplishment; however, catalyzing the development or uptake of these innovations will be critical to achieving real impact. The VIPS partners are now working to define end-to-end integrated strategies for each prioritized innovation, including developing five-year action plans, to accelerate their advancement for use in LMICs. This work is being informed by targeted consultations with technology developers, manufacturers, global implementation partners, and donors to improve alignment, address roadblocks and gaps to innovation development in the context of ongoing and planned activities, avoid duplication of effort, determine the roles and responsibilities of key players, and identify resources where needed to advance specific scopes of work.

Innovation-specific activities are targeted toward de-risking manufacturers' investments for innovation uptake and may include pinpointing research gaps and defining relevant research questions, supporting and/or funding critical clinical trials, identifying and addressing key obstacles facing development (such as scaling up manufacturing), conducting implementation research or modelling to assess effectiveness and how innovations might be used, clarifying potential demand and willingness to pay, developing target product profiles to communicate desired product attributes to developers, defining regulatory and policy pathways for novel products, and ensuring that clear procurement mechanisms and funding are available for products with promising value propositions. Additionally, VIPS partners aim to undertake cross-cutting activities relevant across innovations to tackle issues related to policy, procurement, and country choice such as enabling countries to purchase differentiated vaccine products to meet the needs of specific regions.

As described in the Immunization Agenda 2030, research and innovation, that is explicitly driven by country needs and priorities is needed to accelerate and improve access to vaccines and immunization services (1). One of the strategic priorities of the VIPS initiative is to foster evidence-based priority setting at the country level and help to anchor the global research and development agenda in the needs of communities. Over the next 5 years, the VIPS collaboration plans to monitor and assess the progress of new and existing vaccine innovations and make course corrections as needed, potentially adjusting activities for the three innovations prioritized by the VIPS process and/or prioritizing other innovations based on new data. The intention is to advance vaccine product innovations that are driven by the needs of countries, catalyze increased country influence on research and development efforts, facilitate better alignment among stakeholders advancing innovations, and create new approaches to shape markets and address commercial barriers. The overarching goal is to harness these vaccine innovations to improve immunization coverage and equity, making vaccines accessible to all.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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