Gavi Digital Health Information Strategy
# Technical Brief Series

Increasing demand for immunisation, preventing and reducing loss to follow-up, and promoting community engagement through the effective use of digital health interventions

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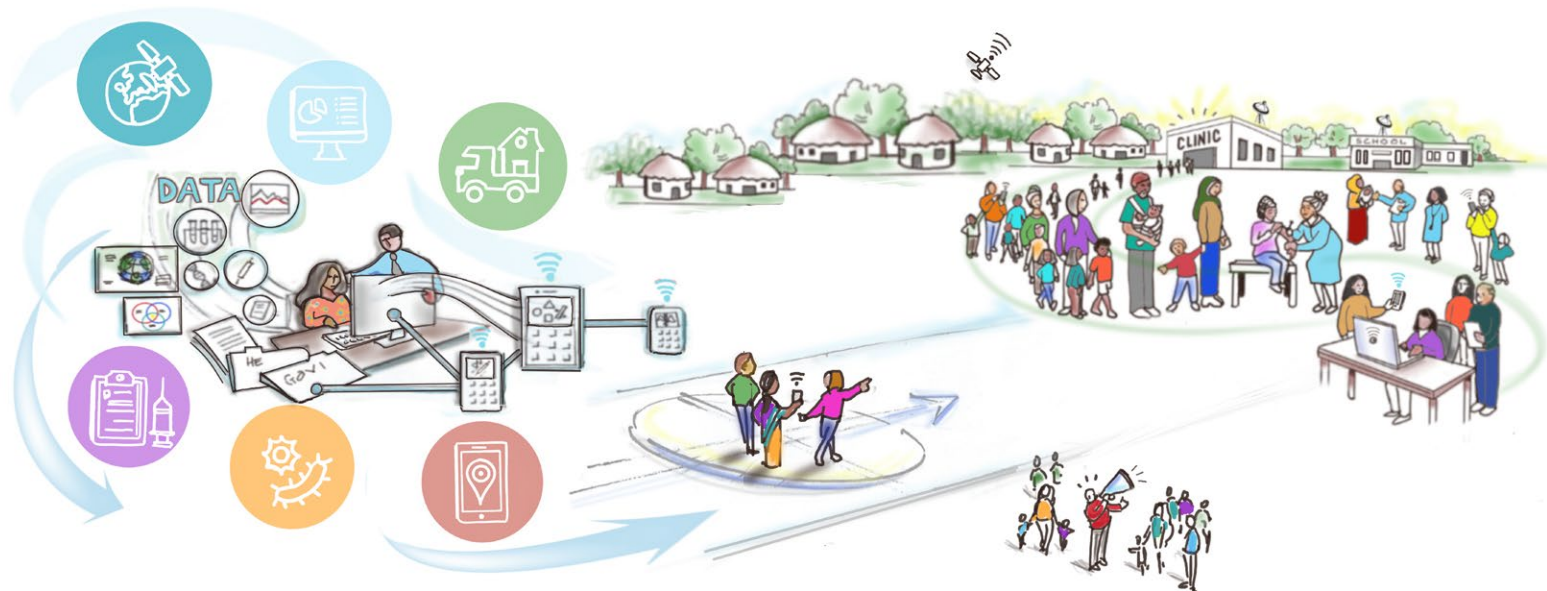
Executive summary

Immunisation programmes are tasked with delivering life-saving vaccines for all children. This responsibility requires immunisation programmes to respond to community needs and concerns, reduce barriers that limit caregiver access and provide respectful, quality services so that individuals and communities have a positive attitude about vaccines, the services available to them and actively seek out and advocate for immunisation. Digital health information (DHI) systems and technologies can be applied in a variety of ways to help improve immunisation uptake by encouraging community demand and improving the service delivery experience.

Immunisation demand is influenced by layers of complex factors that contribute to successful and complete immunisation. One component involves the identification, tracking and retention of children to ensure that they receive the recommended schedule of vaccinations on time. Digital health information tools and technologies can help immunisation completion and reduce loss to follow-up by engaging and supporting caregivers as well as improving the quality of services provided. Gavi, the Vaccine Alliance, has prioritised immunisation demand and community engagement as one of the six areas for digital health information investment to support the successful achievement of Gavi's 5.0 strategic goals. Drawing from the literature, reports and documented country experiences, the following areas are recommended for both Gavi Alliance Members and other partners to support country programmes.

RECOMMENDATIONS

- Review, document and share validated use cases and successful applications of digital health information for community demand, loss to follow-up and improving vaccine confidence

- Support countries to prioritise, apply and scale-up digital health information technologies targeting areas most relevant for the local context to improve immunisation demand and confidence

- Support countries to apply digital health information to enhance community engagement, monitor and respond to adverse events following immunisation (AEFI) and other priority concerns in the community.

This Technical Brief provides a summary of how digital health information (DHI) and related technologies can improve immunisation completion and reduce loss to follow-up to inform the development of Gavi's Digital Health Information Strategy.

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Background

Patients or clients who have had contact with the health system at one time but failed to return for subsequent treatment are "lost to follow-up". In the case of childhood immunisation programmes, children lost to follow-up are those who do not complete the recommended schedule of childhood vaccinations, also referred to as incomplete immunisation, defaulters, under-immunised or drop-outs. The global number of under-immunised children and those who have never had any contact with immunisation services ("zero-dose children") increased in the past year due to Covid-19-related disruptions in services and demand (Muhoza et al., 2021; Causey et al., 2021). Both zero-dose and dropout rates are important indicators of immunisation programme performance, demonstrating the ability of the programme to identify and make first contact with newborns and then to track and follow-up with caregivers to complete the entire recommended schedule of childhood vaccinations (Chard et al., 2020).

Digital technologies, mobile delivery of services and data generated from immunisation programme activities can help improve the identification, tracking and retention of children to ensure that they receive the complete schedule of vaccinations on time. Previous work on the state of digital technologies for social listening discusses how demand for immunisation can be supported by understanding and responding to community concerns and perceptions (Finding the Signal through the Noise: A landscape review and framework to enhance the effective use of digital social listening for immunisation demand generation). This review provides a summary of how digital health information (DHI) and related technologies can improve

immunisation completion and reduce loss to follow-up. Digital applications provide opportunities to expand the reach of the immunisation system to the caregivers and children most in need of support to complete the childhood vaccination schedule.

Alignment with Gavi 5.0 Strategy

Using digital health information to address loss to follow-up aligns with the Gavi 5. Strategy Goal 2: *Strengthen health systems to increase equity in immunisation*, whose objectives are as follows:

- Help countries extend immunisation services to regularly reach under-immunised and zero-dose children to build a stronger primary health care platform

- Support countries to ensure immunisation services are well-managed, sustainable, harness innovation and meet the needs of caregivers

- Work with countries and communities to build resilient **demand**, and to identify and address gender related barriers to immunisation

Digital interventions may be able to help identify and remove barriers for clients, health workers and health systems, but must begin with an examination of the existing and predominant reasons for under-immunisation.

Review of frameworks, literature and experiences

Models and frameworks are useful to help understand and organise the complex layers of factors that contribute to successful and complete vaccination. A detailed analysis of research on associated determinants and reasons for loss to follow-up form the basis of a conceptual framework for vaccine coverage, including the caregiver's intent to vaccinate, the facility readiness to vaccinate and community access (Phillips et al., 2017). *The Socioecological Model* has also been used to help structure assessments and exploration of reasons for under-immunisation (Olaniyan et al., 2021). The Journey to Health and Immunisation (see figure below) can serve as a guide to understanding the factors that influence a caregiver's immunisation decision-making and behaviours (from UNICEF Human Centered Design 4 Health). The World Health Organisation's *Missed Opportunities for Vaccination (MOV) Strategy* can be a useful framework for assessing community, demand and supply-related barriers to complete and timely immunisation (Kaboré et al., 2020; Ogbuanu et al., 2019; WHO Reducing Missed Opportunities for Vaccination (MOV) Strategy and resources).
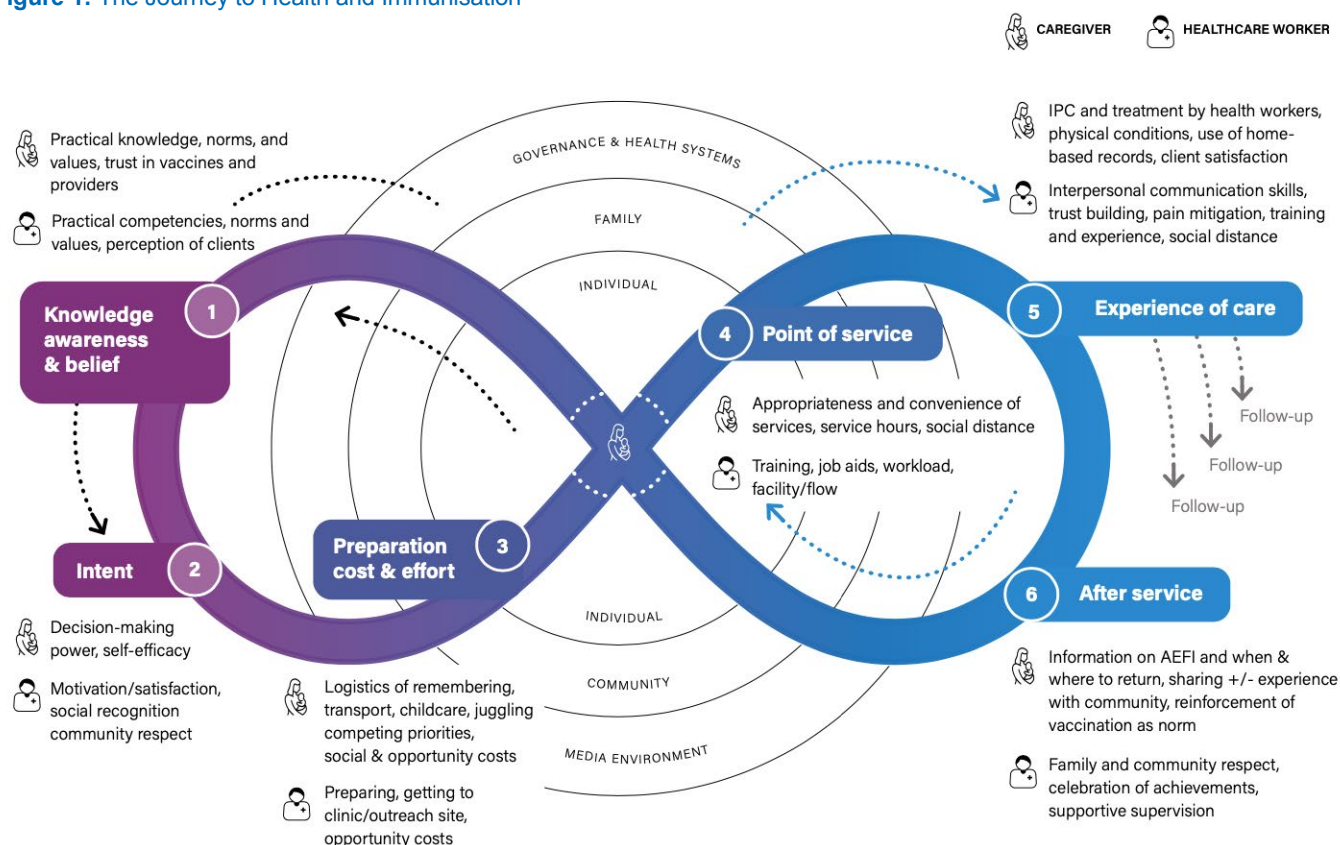
DHI systems and technologies have the potential to improve vaccination programme coverage, delivery and monitoring by influencing factors on both the supply and demand side. The following sections review barriers to immunisation and relevant applications that target demand- and supply-side factors.

Barriers to immunisation supply and demand

Several recent publications have explored incomplete childhood immunisation by examining the correlation of economic, household, demographic and geographic factors with fully immunised and under-immunised children. Factors that have a positive association with immunisation completeness and timeliness include the mother's level of education, proximity to the vaccination centre, household income, previous utilisation of health services for antenatal care and delivery, sources of information and the presence of a vaccination record in the home, to name a few (Cassocera et al., 2020; Thapa et al., 2021; Mbengue et al., 2017; Chanie et al., 2019; Negussie et al., 2015; Ghosh and Laxminarayan 2017; Yismaw et al., 2019; Galadima et al., 2021).

Efforts to understand reasons why caregivers do not return to vaccinate their children can be more useful for designing targeted and context-specific interventions to reduce loss to follow-up. The documented reasons for dropout or default can be categorised into demand factors (characteristics of the individual, caretaker or community that influence vaccine decision-making and care-seeking behaviours) and supply factors (characteristics of the health system or qualities of service delivery that may prevent or promote complete and timely vaccination). Client-related reasons for default may be

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Figure 1: The Journey to Health and Immunisation

from the caregiver being unaware that additional doses are required or lack of knowledge of the benefits of immunisation; a caregiver may forget a scheduled appointment date, have fear of side-effects or mistrust the health system (Nakatudde et al., 2019; Olaniyan et al., 2021; Rahman et a., 2012; Negussie et al., 2015). Documented supply-side factors include inconvenient wait times at the clinic; stock-outs and staff shortages; negative interactions with health facility staff; and inaccurate or unreliable vaccination records and identification systems (Negussie et al., 2015; Olaniyan et al., 2021). Of course, these barriers and challenges vary greatly in different contexts and populations. Careful examination of the context-specific supply and demand-related reasons for under-immunisation can help suggest effective solutions to these barriers.

Although service delivery models have traditionally segregated supply and demand into two distinct categories, it is important to recognise that these are not separate entities but are interdependent and linked at every level. A health worker's motivation and job performance is affected by the supply chain; both the availability of vaccines and interaction with the health worker affects the caregiver's perception of service received and in turn their demand for future vaccination services. This is just one scenario to show how demand influences supply and supply influences demand; each local context includes a range of complex personal and systemic interactions.

A shift in thinking about last-mile delivery where supply and demand are integrated and supported by meaningful community engagement, involving communities in the planning, design, decision-making and delivery of services, will steer immunisation programmes towards more people-centred health services. Increased involvement of community leaders and caregivers as part of a package of community and facility-level interventions can reduce inequality, improve immunisation

coverage and uptake of related services (Demissie et al, 2020; Sabarwal et al., 2015; Odugleh-Kolev and Parrish-Sprowl, 2018). Understanding, recognising and designing approaches that reduce the digital divide and promote equity in access to digital solutions across gender, socio-economic status and geographic distribution will be important steps to increase vaccine acceptance and demand for immunisation. However, more documentation of experiences, lessons and evidence on how community engagement can improve immunisation programmes is needed to formulate recommendations and standardised practices that can be applied and adapted to a variety of contexts.

Technology and digital solutions that target demand-side factors

Reminders

Target: Caregivers who forget follow-up vaccination appointments

Example: SMS or voice messages sent to caregivers before scheduled vaccination appointments

Even caregivers who value immunisation and intend to have their child fully vaccinated sometimes forget their child's appointment, resulting in loss to follow-up. Sending text messages, voice messages or phone calls to a caregiver's mobile phone is a common method to remind them about scheduled vaccination appointments. Numerous qualitative and quantitative evaluations and RCTs of SMS reminders generally show positive effects on immunisation completion, coverage and timeliness but variable study design and low quality of evidence for studies conducted in LMICs leave doubts about

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the certainty that SMS reminders can impact immunisation coverage outcomes in settings that face greater barriers to immunisation completion (Yunusa et al., 2020; Mekonnen et al., 2019; Oliver-Williams et al., 2017; Vann et al., 2018).

Barriers exist even for well-intentioned caregivers who regularly use mobile phones: low literacy prevents reading and understanding written messages, a message maybe missed due to shared ownership of the mobile phone, frequent changes in phone numbers and inability to maintain a balance or battery charge on the phone are all barriers to the potential effectiveness of SMS reminders (Oliver-Williams et al., 2017; Siddiqui et al., 2019; Yunusa et al., 2020). There is some indication that sending the reminder close to the date of the vaccination appointment is important to counter forgetfulness and in some studies, voice reminders or simple phone calls were more effective than SMS text messages alone (Mekonnen et al., 2019; Yunusa et al., 2020; Kazi 2017).

Different delivery methods, timing and effectiveness of appointment reminders vary depending on the caregiver population and setting, emphasising that vaccine reminder initiatives must be tailored and practical to meet the specific needs of the population and known barriers to vaccination follow-up (Kazi 2017). SMS and voice reminders delivered by mobile phone may be appropriate and cost-effective in settings where caregiver forgetfulness is found to be a major barrier to immunisation completion (Gibson et al., 2017).

Incentives

Target: Caregivers who face barriers related to cost, transportation and motivation

Example: Programmes that provide mobile phone-delivered rewards for successful completion of vaccination

Increasing demand for vaccination may require extra motivation or monetary support to help offset the cost of transportation to the clinic. Advances in mobile phones and mobile banking services enables the use of small cash rewards or mobile phone credit to help nudge caregivers to follow-up with scheduled vaccination appointments. Conditional cash transfers (CCT) and other incentive programmes are often coupled with mobile phone reminders, a model that has shown promising results in Pakistan, where groups enrolled in a cash incentive programme showed 24 and 36 percentage-point increase in measles and fully-immunised children coverage as compared to baseline (Chandir et al., 2017; Khan and Chandir, 2017). CCTs have also contributed to significant increases in vaccination coverage in Latin America (Barham et al., 2007). Studies in Sub-Saharan Africa provide less clear evidence on the strength of immunisation improvements, and like most digital health interventions, the impact of CCTs on immunisation outcomes varies greatly by study setting, programme design and type of evaluation (Onwuchekwa et al., 2021; Gibson et al., 2017; Wiysonge et al., 2016).

Educational mobile messages / digital behaviour change communication

Target: Caregivers facing barriers related to knowledge about immunisation, vaccine hesitancy or understanding the benefits of vaccination

Example: Text or voice messages delivered to mobile devices that promote behaviour change through health communication, often as part of a comprehensive maternal, neonatal and child health initiative

A common application of digital technology for health is to send SMS, voice or other automated mobile messages with health prevention and behaviour change content. Behaviour change communication through mobile devices is a cost-effective means to extend access to health information and motivational messages beyond face-to-face interactions with health workers (LeFevre et al., 2018; Willcox et al., 2019). Many programmes centre around comprehensive maternal, neonatal and child health (MNCH) by sending a series of educational messages starting during pregnancy to encourage antenatal care, safe delivery practices, infant and child health practices and services, including immunisation. Mobile message programmes for MNCH that are supported by strong formative research to design appropriate content messages generally have high user satisfaction and report increases in MNCH service uptake and knowledge, including knowledge about routine childhood immunisations and increased intent to vaccinate their children (Crawford et al., 2014; Mildon and Sellen 2019; Watterson et al., 2015; Murthy et al., 2019; Barron et al., 2018). Automated voice messages delivered to pregnant women through their child's first year of life in Mumbai, India, demonstrated significantly more children with complete vaccination born to mothers who received the messages compared to a control group (Murthy et al., 2019).

In the same way that behaviour change communication can help improve a caregiver's knowledge about vaccination, vaccine hesitancy can also be confronted by addressing their beliefs, building trust and strong social norms around childhood vaccination. Sources of data on vaccine hesitancy, rumours and misinformation gathered through social listening could feed into targeted mobile messages aimed at changing behaviours and beliefs [see the Social Listening report for more background and applications of digital social listening for immunisation demand generation]. In countries or communities where knowledge, beliefs and intent are barriers to complete and timely immunisation, mobile delivery of evidence-based behaviour change messages supported by formative research with the target population could help address these demand-side challenges and build strong pathways for the first steps along the Journey to Health and Immunisation.

Client feedback and satisfaction mechanisms

Target: Caregivers who face barriers to immunisation follow-up due to negative perceptions and experiences with immunisation services or health workers; caregivers whose children dropout because of factors that make the service inconvenient

Example: Digital technology can facilitate anonymous client feedback via SMS or call centre data to target improvements in service delivery

Citizen-generated scorecards for public services based on community priorities and participation can increase the quality of care at health facilities, including access, health worker accountability and improved relationships between community and health workers (Ho et al., 2015; Blake et al., 2016). Mobile technology can help promote transparency and accountability by actively engaging citizens in reviewing and providing feedback on health system performance (Holeman et al 2016; Schaaf et al, 2018). SMS or telephone surveys, interactive voice response or chat-bot interfaces, call-centre data and other mechanisms allowing caregivers to file anonymous complaints can be used to understand client experiences and target health system improvements, outreach activities, supportive supervision or staff training in response to caregiver's perceptions about service delivery and interpersonal relationships with health workers (Lechat et al., 2019; Barron et al., 2018).

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Perceptions of quality and accountability are critical to promoting immunisation services, but little is documented about the effects that caregiver feedback can have on immunisation service improvements. In order for feedback mechanisms to boost immunisation demand, the caregiver needs to understand the importance and see the positive results of providing feedback. Likewise, health workers need to value and be encouraged to incorporate feedback in a way that does not create fear of personal consequences. The perceptions and interactions with health facilities have an effect on demand but the solutions need to be implemented on the supply side of the equation. More research is needed to validate digital systems for gathering and applying client feedback for immunisation programme quality and demand.

Adverse events following immunisation (AEFI) reporting, monitoring and support

Target: Caregivers who have concerns about safety and/or reside in communities that lack confidence in vaccines or the immunisation programme

Example: Active seeking of AEFI reports from caregivers facilitated by mobile communication technology to provide support for minor reactions and rapid response for serious cases

Passive or routine surveillance systems for adverse events following immunisation (AEFI) rely on voluntary reporting of adverse immunisation events and reactions from health workers when and if cases present to the health facility. Active AEFI surveillance systems, on the other hand, seek out reports of AEFI with deliberate and purposeful gathering of information by following-up with vaccine providers, caregivers or recipients (Isaacs et al., 2005). Participant-centred AEFI monitoring mechanisms are now feasible with the expanded reach of mobile communication technology to solicit feedback and active AEFI surveillance from vaccine recipients and caregivers.

Caregivers may be contacted by phone or SMS during the post-vaccination period to assess any potential AEFI, provide support for minor reactions and receive immediate care in the case of serious reactions (Sebastian et al., 2019; Cashman et al., 2017; Tsafack & Ateudjieu, 2015). The use of real-time mobile data collection tools by vaccination teams during supplementary immunisation activities can also improve reporting and follow-up of AEFI (Gbenewei et al., 2021). Active collection of feedback, providing support to caregivers during the post-vaccination period and making AEFI data transparent and publicly available are important factors for building public trust and confidence in immunisation programmes (Cashman et al., 2017). Passive surveillance systems usually leave many AEFI unreported, with the result that any adverse event associated in the caregiver's mind with their child's vaccination can leave them in doubt about the safety of future vaccine doses. Digitally-mediated active surveillance systems can provide caregivers with a reliable link to report and receive support in the event of post-vaccination reaction and can boost trust and public confidence in the immunisation programme (Cashman et al., 2017). Any active AEFI reporting and surveillance system must be supported by appropriate and coordinated response mechanisms that can investigate and respond rapidly and effectively to serious reactions.

Although a few mobile-technology systems for active AEFI surveillance have been piloted in LMICs, more research is needed to understand how these systems and caregiver experiences with AEFI reporting impact vaccine hesitancy and public confidence in the immunisation programme. There also needs to be more investigation into linkages with national disease surveillance systems and how consumer-centred AEFI reporting can strengthen wider disease surveillance and response.

Technology and digital solutions that target supply-side factors

Digital identity and registration

Target: Immunisation programmes that face challenges forecasting or planning services and identifying children through paper-based recording and tracking systems

Example: Electronic systems for birth registration and digital identification to correctly match each individual child to their vaccination records

A child's first vaccination should occur as soon as possible after birth, making the immunisation programme an ideal first entry for child registration in a system of birth notification. A system of electronic birth notification can facilitate follow-up with caregivers to reduce under-immunisation. Lack of birth registration is linked to poor health outcomes and reduces a child's chance of having a timely and complete vaccination schedule (Jeong et al., 2018; Brito et al., 2017; Phillips et al., 2015). In many countries with strong immunisation programmes, birth registration falls far behind contact with immunisation services in the first months of life (Corrêa et al., 2019; Rahman et al., 2019). The integration of immunisation and birth registration data has the potential to improve efficiency, planning and monitoring of all public services, including vaccination, by creating better denominator estimates and establishing a child's age to monitor timely age-appropriate vaccination (Corrêa et al., 2019). A decentralised system to register births, aided by mobile technology to transfer registration data and create a digital record, can initiate a cascade of data for planning and monitoring with potential mechanisms to follow-up and track caregivers for future vaccination appointments (Bedasa, 2016; Lynch 2018). Most digital platforms used to track individual immunisation records can also be used for birth notification, creating useful data for planning other public services such as education and maternal child health programmes (Rahman et al., 2019). The DHIS2 *birth notification tracker metadata package*[1] simplifies the recording of births from health facilities to improve complete registration in the national CRVS systems.

Birth notification and registration systems create important statistics for public services and provide a printed birth certificate as documentation of legal identity for the child (Mills et al., 2019a). However, the challenge of matching a child to their record persists in many settings and requires an additional identity management system to link the individual to their digital record with a unique identification number, code or biometrics (e.g. fingerprint, facial recognition, or iris scan) (Mills et al., 2019b; Nagamine 2021). The lack of a reliable identification system can lead to misidentification of children, duplicate records or repeated vaccinations. With or without a registered

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1 The DHIS2 toolkit for immunization includes the birth notification tracker package https://www.dhis2.org/immunization

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birth certificate, health workers and vaccinators should be able to reliably and consistently verify the identity of a child and match the individual to their vaccine history. Advances in digital and mobile technology linked to interoperable health information management systems (HMIS) can help with this challenge. Examples include unique identification numbers linked to electronic health registries, ID cards or vaccination records that can be scanned with a smartphone or other handheld device (Nagar et al., 2020; Chandir et al., 2018). When linked to an interoperable, safe and secure HMIS or Electronic Immunisation Records, vaccination histories can be matched and updated reliably no matter where the child presents for immunisation (Reed et al., 2021; World Bank 2018).

Clinical decision-support tools, job aids and health worker reminders

Target: Overburdened and busy health workers who may miss an opportunity for vaccination because of competing priorities; health systems that lack of coordination between curative and vaccination services

Example: Electronic job aids, checklists and tools to remind health workers to check vaccination records for all children

In situations where Missed Opportunities for Vaccination are identified as a critical priority for reducing loss to follow-up, mobile technologies and digital platforms can be used to support health workers to identify opportunities for vaccination as part of a suite of tools and functions to optimise all health system contacts with children. Training and support for facility-based and community-based health workers via mobile, tablet or web interfaces are used to increase health worker knowledge, send reminders, improve adherence to protocols and performance as well as prompts and messages for counselling caregivers and expectant mothers (Labrique et al., 2018; Mehl 2020; Patel et al., 2019; Munir et al., 2019; Kaewkungwal et al., 2010; Wood et al., 2012; Willcox et al., 2019). Predictive analytics, machine learning and algorithms can be incorporated to automatically generate catch-up immunisation schedules or to identify children who are more likely to default on their vaccination schedule so their caregivers can be targeted for enhanced counselling, reminders and follow-up (Ali et al., 2020; Qazi et al., 2020; Chandir et al., 2018b).

A health worker's motivation and job performance are an important part of maintaining demand for services in the community; the health worker's journey, motivation and performance are intertwined with the caregiver's journey to immunisation uptake and satisfaction. Health worker training and support can be facilitated by mobile delivery of education modules and information. For example, UNICEF's Interpersonal Communication for Immunisation has developed a number of training materials for health workers, including audio job aids that can be delivered by an Interactive Voice Response (IVR) platform to any mobile phone. Digital performance coaching and supervision packages designed specifically for immunisation staff incorporates eLearning modules, self-assessment, support and discussion forums in one mobile interface. Communities of practice and peer-support networks for health workers facilitated through mobile messaging services that can help with stress management and resilience for frontline health workers (for example NurseConnect).

Electronic Immunisation Registries

Target: Immunisation programmes with aggregate reporting systems that require more detailed data on children lost to follow-up to reduce immunisation dropout

Example: Computerised immunisation registry systems capable of recording, monitoring and tracking vaccination data for individual children

An Electronic Immunisation Registry (EIR) is a digitised case-based immunisation record-keeping system meant to replace paper-based immunisation registry and reporting systems. EIRs have the ability to record and track data on individual children as well as generate aggregate data for broad immunisation programme monitoring and planning. EIR systems can incorporate many other features and functions that can help reduce immunisation programme dropout such as birth registry, unique identifiers for enrolled children, health worker decision-support tools, caregiver reminders, links to AEFI monitoring and even integrated stock management systems (PATH 2021; Pancholi et al., 2020; Seymour et al., 2019). Digital registries can create evidence and documentation of each unique vaccination encounter, increasing health worker accountability and enhancing verification that the recorded vaccine was successfully administered to the individual child (PATH 2021).

In countries with adequate infrastructure and HMIS maturity, EIRs can improve overall immunisation programme delivery and monitoring, including reducing children loss to follow-up. Results from the wide-scale implementation of EIR in Vietnam shows significant reductions in drop-out rates and a significant increase in complete vaccination (Nguyen et al., 2017). Health workers using EIR systems report that they can use the individual child data to identify and contact defaulters and that they have more confidence to take action based on the available data (PATH & PAHO, 2019).

An EIR can also serve as an electronic home-based record by providing caregivers access to their family's vaccination history and can also incorporate a cascade of patient reminders, education modules, 2-way communication capabilities, support and appointment systems (PAHO, 2017). Covid-19 has driven recent advances in patient-access systems for vaccination certification which could serve as a starting point for promoting electronic access to routine childhood vaccinations records.

A number of associated digital technologies facilitate automatic and accurate transfer of vaccination transaction data to digital registries, including scannable codes on vaccine vials, immunisation records or identification cards, biometric recognition, image capture and SmartPaper technologies (PATH 2021; Jandee et al., 2015; Ali Khan et al., 2021; Katib et al., 2015).

Despite the promise and potential benefits of EIRs for reducing immunisation loss to follow-up, feasibility and sustainability in many LMIC settings is a concern (PATH 2021; Pancholi et al., 2020). The operational challenges, barriers, risk of duplication and increased data entry burden must be carefully considered and tested in each local context to ensure appropriate and tailored solutions and sufficient infrastructure and commitment to implement a robust and sustainable EIR.

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Key Considerations & Recommendations

Community engagement strives to foster a mutual relationship between the community and the immunisation programme, where both benefit from the partnership. Immunisation programmes are beginning to recognise that communities and caregivers are not passive recipients of immunisation services and that community involvement in the planning, prioritisation and decision-making processes can improve the overall quality of services.

From a caregiver's point of view, there is no separation between supply and demand, there is only the caregiver's motivation, experiences, perceptions and access to services. Likewise, the frontline health worker receives incentives, supplies and support from the larger immunisation programme to work with the public and complete their job responsibilities. Creating genuine demand for immunisation services must go beyond push-education and one-way communication initiatives. An integrated view of supply and demand with meaningful community engagement can build trust, relationships and shared accountability.

A key part of fostering community engagement is to first understand the local context, barriers to uptake, views and perceptions about vaccination in the community. Behavioural and Social Determinant (BeSD) of Vaccine Uptake Tools are a set of standardised questions that examine barriers at the facility and household levels to help programmes measure underlying drivers to inform programme planning and targeted interventions (Wiley et al, 2021). The data collection tools can be administered with the assistance of digital technology either in a traditional interview or as part of a digital community engagement survey or feedback platform. The tool has been optimised for understanding COVID-19 vaccine confidence; publication of the routine childhood immunisation tool is expected soon.

Most of the digital technology approaches mentioned in the sections above can be applied to enhance community engagement and improve integration between supply and demand at the community level. Digital delivery of behaviour change communication, eLearning platforms, communities of practice, crowdsourcing, community mapping, appointment scheduling systems and service experience feedback mechanisms can all be applied to promote dialogue and partnership between the community and the immunisation programme for joint prioritisation, target setting and accountability. These tools will become an integral part of the demand generation toolkit as more experiences and digitally-assisted approaches for community engagement are documented to demonstrate benefits to overall service delivery and immunisation demand.

Recommended Gavi Digital Health Information Investments

Global

- Engage with relevant Gavi Alliance members and digital health experts to prioritise and conduct a review of community-based digital health interventions that help register, track and improve immunisation completion to create a menu of validated tools for country consideration and adoption and resource to guide adoption, adaptation, and implementation.

- Develop and standardise digitally-assisted tools and approaches for the systematic assessment of priority areas for targeted demand interventions.

- Conduct a review of DHI interventions and models to address barriers related to cost, transportation, and motivation.

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Country

- Support countries that have successfully piloted digital health interventions for demand generation to assess, strengthen and plan for scale up of proven solutions.

- Support countries that have identified barriers to immunisation completion to design, implement, monitor and evaluate gender-intentional community-based immunisation interventions for vaccine confidence and demand.

- Support countries that have prioritised the use of SMS reminders and/or mobile messaging to reviews and select appropriate approaches for the local context and digital ecosystem.

- Support countries that have prioritised birth notification and/or linkages to CRVS as a means to initiate and increase immunisation completion.

- Support countries to assess and introduce digital AEFI surveillance, response and support with community participation.

- Support countries that are interested in EIRs with moderate to high digital health and data maturity to assess their readiness for EIR implementation and support EIR implementation in countries with a critical threshold of readiness to introduce and scale up EIRs with clear milestones

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Conclusion

Digital tools and technologies can help reduce immunisation loss to follow-up if applied to the most important and context-specific factors causing vaccine schedule dropout. There is no one-size-fits-all digital solution to solve loss to follow-up, a problem that can result from a variety of cultural, health worker and health system bottlenecks. The majority of digital tools and technologies to reduce loss to follow-up have been developed and implemented at pilot scale in a number of different settings, but will need greater investment in the tools themselves and relevant enablers to be taken to scale. Although there is modest evidence of effectiveness for most relevant digital interventions aimed at reducing loss to follow-up, a thorough needs assessment in the programme or community is needed to understand which interventions may be most appropriate in helping to increase vaccine confidence and demand and remove barriers to immunisation completion. In addition, it will be critical for these interventions to be gender-intentional in the assessment, design, implementation and evaluation approaches.

Acknowledgements

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