Gavi Digital Health Information Strategy
Technical Brief Series

Gender and digital health information in immunisation programming

Gavi
The Vaccine Alliance

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Executive summary

Digital Health Information (DHI) applications can support immunisation programme functions, facilitate decision-making and provide a direct link of communication and engagement between caregivers, the community and the immunisation programme. DHI tools and applications can also provide an opportunity to understand and analyse data on gender-related indicators and can serve as an opening to promote gender equity, agency and decision-making power for marginalised groups. However, the cultural contexts and gender dynamics that surround digital health for immunisation adoption and use affect men, women, children and gender-diverse people differently.

With the growing gender digital divide, Gavi, the Vaccine Alliance, recognises the importance of a gender-intentional lens for all digital health and data interventions in immunisation programming to ensure that every child receives the full course of life-saving vaccines. Drawing from the literature and key informants to align with Gavi's DHI Priorities, the following gender considerations are recommended for collective action by Gavi Alliance Members, Gavi-supported countries, and other partners.

Priority Area of Digital Health Information for Immunisation	Gender Considerations & Suggested Approach
Identification and reach of zero-dose and under-immunised children	• Utilise geospatial modelling and analysis to understand the relationship between gender and immunisation to reveal inequities in coverage, service delivery, access & demand • Mitigate gender bias in access and control of geospatial data collection devices by enumerators, geo-enabled intervention design, and data use
Digital interventions supporting vaccine confidence and demand for immunisation	• Account for gender digital divide, gender norms, gender dynamics, and digital literacy among caregivers & health professionals in communication campaigns, community engagement mechanisms and vaccine confidence surveys
Effective sub-national data use	• Digital system supporting relevant gender disaggregation data and analyses
Real-time planning and monitoring of immunisation campaigns	• Design digital health tools, data integration and visualisation from a gender intentional/equity perspective with considerations for gender dynamics between health workers and supervisors and reducing burden to ensure that gender bias and norms do not impact data collection, quality and use
Digital supply chain information systems	• Provide equal access among health workers to opportunities for professional growth, capacity building & digital literacy training with recognition of how gender roles and dynamics influence supervisory relationships in the workplace
Electronic VPD surveillance data exchange for targeted vaccination and outbreak response	

This Technical Brief provides a summary of the state of evidence and priority areas for investment and attention at the intersection of gender, immunisation and digital health and data that have been used to inform the development of Gavi's Digital Health Information Strategy, which includes gender-intentional strategies, outcomes, outputs, and inputs for global and country consideration and action.

Background

Both the demand and the supply of vaccines and immunisation services can benefit from digital health and data interventions to improve planning, monitoring and decision-making. However, these technology applications are introduced into cultural contexts and power relationships that impact men, women and children differently. A gender-intentional lens for all digital health and data interventions in immunisation programmes is essential to ensure that Gavi can achieve its ambitious goal to reach every child with life-saving vaccines.

This Technical Brief was developed to support and guide Gavi's 5-year Digital Health Information Strategy with Gender as a cross-cutting theme that applies to all digital applications and tools for immunisation programming. This brief is informed by a review of peer-reviewed and other publications, experiences, frameworks, policies and evidence as well as key informant interviews and focus group discussions to explore how gender and digital health information impact immunisation programming and outcomes for children, caregivers, health workers and policymakers. Unless explicitly analysed and monitored, the promotion and use of digital technology in immunisation programmes has the risk of further entrenching inequity and increasing the gender digital divide.

Digital health information (DHI) refers to the information and data generated from applications of **digital health—, the use of technologies, computer science, information and data to support and promote decision-making for individuals and health workers and to strengthen health systems and improve health and wellness for all.**

A gender lens in DHI is important when considering:

- Digital applications and tools as part of the **health system** for use by the **health workforce**

- Digital interventions aimed at supporting access, knowledge and demand of health and immunisation services among **clients and caregivers**

- **Data** that is collected through digital health applications and how they may reflect gender inequities but also identify areas of inequity, monitor progress and suggest areas for improvement

Often the most highlighted area for applying a gender lens for immunisation is the disaggregation of data by sex of the vaccinated child. Although gender equity in vaccine recipients is of critical importance and sex-disaggregated data is still necessary and recommended, gender differences in immunisation status has not been a source of wide-spread systematic inequity over the past 20 years (Hilber et al., 2010; Cata-Preta et al., 2021; WHO, 2016; Morgan et al., 2016). However, gender-related barriers to demand and access to immunisation services, gendered barriers to the creation and use of data generated by digital health applications and how digital health technologies maintain or challenge existing gender norms among the health workforce and caregivers are all critical areas that intersect to impact overall immunisation coverage and equity. In addition, Gavi has identified gender-intentional programming, design and evaluation as a key strategy for increasing the identification and reach of zero-dose children, those who have never had contact with immunisation services, and under-immunised children, those who have not received the complete schedule of childhood vaccinations.

Gavi priority areas of Digital Health Information for Immunisation with illustrative examples

- **Identification and reach of zero-dose and under-immunised children** - geospatial data and technologies to identify settlements and communities that are chronically missed by immunisation services

- **Effective sub-national data use** - dashboards for data triangulation, visualisation and mechanisms to aid decentralised immunisation programme decision-making

- **Real-time planning and monitoring of immunisation campaigns** - mobile and digital technologies for immunisation campaign activities to improve timely reporting, coordination and communication

- **Digital supply chain information systems** - digital data collection and reporting at vaccine service delivery points to visualise stock levels and reduce stock-outs

- **Digital interventions supporting vaccine confidence and demand for immunisation** - mobile and digital technologies to help build trust, enhance community engagement, improve immunisation demand and vaccine confidence, send reminders and facilitate direct communication with caregivers

- **Electronic vaccine-preventable disease (VPD) surveillance data exchange for targeted vaccination and outbreak response** - digital data collection and sharing for vaccine-preventable diseases, testing and trend analysis to detect and target areas for immediate action

The Gender Digital Divide

Global trend analyses show a significant 'gender digital divide', especially in low- and middle-income countries where women are 7% less likely than men to own a mobile phone and 15% less likely to access mobile internet (GSMA 2021). As a result of women's disproportionate exclusion from the digital ecosystem and a lack of a timely and meaningful reaction from programmes and policymakers, the economic impact that results from limited access, underdeveloped digital literacy, skills and agency for women continues to increase, especially in low- and middle-income countries (Alliance for Affordable Internet, 2021). The gender digital divide impacts the ability of women to access information and services delivered through digital technology as well as their ability to engage in decision-making related to the design, implementation, and policies associated with digital health tools and technologies.

Review of frameworks, literature and experiences

Models and frameworks are useful to help understand and organise complex layers of factors that influence gender equity. One model for addressing gender and digital health, Addressing Women's Empowerment in mHealth and MNCH: An Analytical Framework is relevant to the intersection of these areas with immunisation digital health information. It highlights the need to address gender equity and women's empowerment for successful health outcomes, but recognises that gender empowerment in the context of digital health interventions is not well understood (Deshmukh and Mechael, 2013). Women's meaningful partnership and participation in digital health planning, design, development, implementation and as users of digital health applications is necessary to improve their access and use of technology for better health and to promote women's agency and position within existing cultural norms (Deshmukh and Mechael, 2013). In addition, the higher risk among women for sexual and gender-based violence contributes to gender dynamics that make it difficult for women to participate as equals in contributions and benefits from digital health interventions (Deshmukh and Mechael, 2013).

Other useful frameworks, guides and toolkits focus on specific health areas or instances of women's engagement with digital health. For example, gender-intentional programming is explored for immunisation (UNICEF 2019; Feletto and Sharkey 2019; LeDuc et al., 2021; WHO 2019a; WHO UNICEF & Gavi, 2021), malaria (Malaria No More, 2021), and infections disease (WHO 2020), from the health worker or health system perspective (WHO 2019b; WHO 2011), and from caregivers and community member's perspective (Scott et al., 2021). These are just a few examples of the resources available to guide health policy makers, programme designers and implementers as they integrate a gender-intentional lens across the programme cycle.

Despite the recognition of the importance of gender-intentional programming and the availability of many resources to guide gender analyses and planning, the understanding of how gender impacts health outcomes and how best to overcome these challenges is under-researched. Evidence and documentation of experiences on how best to understand the intersection of gender, immunisation, data and digital health is very limited. The bulk of the published literature focuses on the combination of two elements, either gender and immunisation or gender and digital health, with limited discussion about the intersection of all three. There are many recent reviews and research on the relationship between gender and COVID-19 vaccines, but not within the context of digital technologies and data. The available literature must therefore be examined from multiple perspectives to understand the complex interaction of gender, digital health and routine immunisation outcomes.

Gender roles, social norms and gender bias can impact health outcomes from both the supply and demand side of programme delivery (BMGF, 2020; WHO, UNICEF & Gavi 2021; Merten et al., 2015). In the context of immunisation programming, gender and digital health considerations fall into three categories: the immunisation programme, the community and clients, and the data collection and analysis. The following review of these three areas includes relevant examples and experiences from the literature, key informant interviews and focus group discussions.

Health System and Health Workers:

Gender, immunisation & digital applications in the immunisation programme

As tools to support and improve health system functions and decision-making, many digital health interventions are meant

Figure 1: mHealth and MNCH: Addressing Gender and Women's Empowerment - A Framework for Analysis
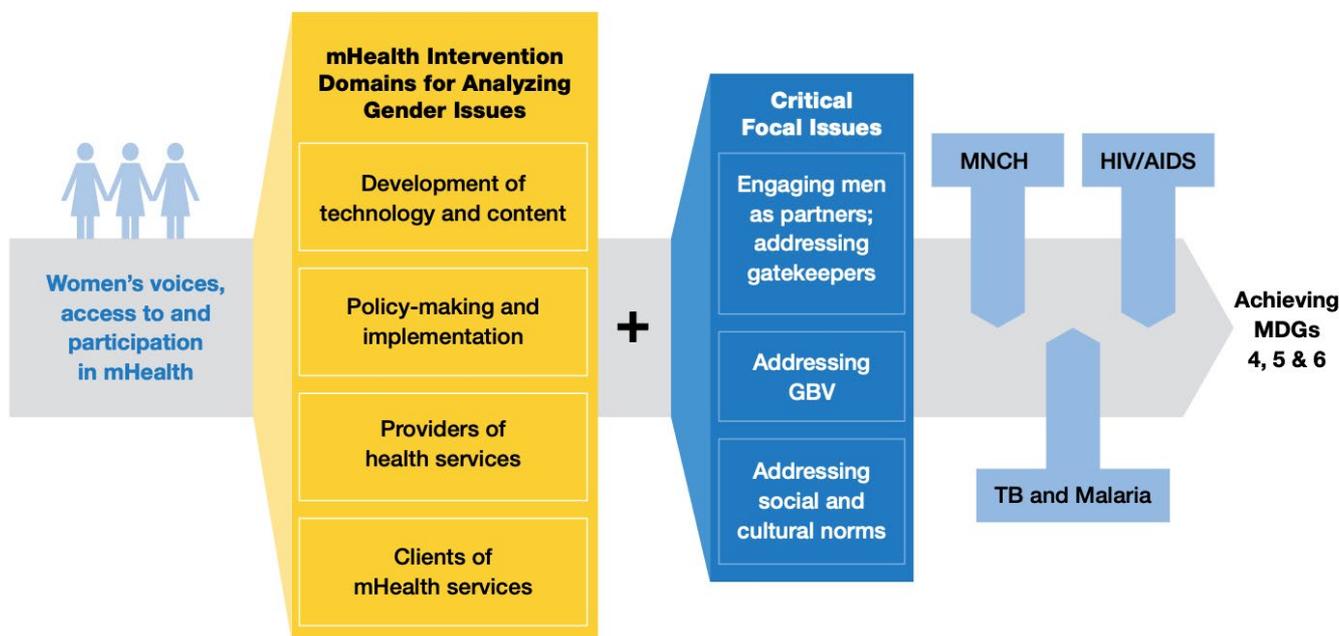
to be delivered by health workers, vaccinators, managers and supervisors in the national immunisation programme. The range of digital health interventions and applications that fall into this category include electronic immunisation registries, health management information systems, electronic logistics management systems, decision support platforms, remote data collection tools and information sharing platforms meant to decentralise decision-making. These tools and applications are subject to gender norms and gender dynamics that exist in the workplace, and their use can be influenced by the nature of relationships between health workers and supervisors, inequities in wages, digital literacy and capacity that may affect division of labour, data use, decision-making and leadership.

In many health systems last-mile delivery and frontline health workers are women, while more senior supervisory roles are held by men (Shannon et al., 2019; Boniol et al., 2019; Ayaz et al., 2021; WHO 2019b). Despite their under-representation in leadership roles, women's roles in the immunisation programme are crucial for the success of many vaccination activities. The involvement of women in polio outreach is recognised as critical to ensure access in more conservative societies where men may not be allowed into the home (Kalbarczyk et al, 2021). A study examining the use of electronic Logistics Management Information System (eLMIS) for immunisation in Senegal found that although they make up a smaller proportion of leadership roles, female health workers demonstrated greater adherence to standard operating procedures, better stock management practices and more responsiveness as compared to male health workers, all factors which contribute to better supply chain performance (Logistimo, 2021). At the same time, female frontline health workers can experience restrictions on their mobility due to cultural norms or security concerns, limiting their ability to perform job-related tasks or advance to more senior roles (Steege et al., 2018a).

While digital health applications have the potential to improve community health service delivery, programmes introducing new technologies require careful consideration of how the digital applications will interact with and challenge gender and power relations to transform women's roles rather than perpetuate disadvantages (George et al., 2018). Female health workers using digital devices such as mobile phones or smartphones to support their work may realise benefits to their status and confidence, but can also find themselves with additional data entry burden and may experience a shift in relations with other colleagues and supervisors (Steege et al., 2018b; George et al., 2018). For example, as part of an initiative using geospatial technologies for polio outreach, male vaccinators laid claim to some of the handheld devices assigned to female vaccinators because of the status associated with controlling the technology (Gammino et al., 2014).

There is little research or systematic documentation on the role that gender dynamics and inequalities play in the use of digital tools for immunisation service delivery, but gendered access to capacity building opportunities, resources, digital tools and data for immunisation must be considered in the design and introduction of digital applications in each local workplace and cultural context (George et al., 2018). The complex layers of influence and gender norms embedded in the immunisation programme have the potential to impact service delivery, interpersonal relationships with caregivers, demand for services and ultimately the vaccination coverage in the population (Feletto and Sharkey 2019).

Community and Caregivers:

Gender, immunisation & digital applications for beneficiaries

The increasing availability of mobile phones and digital technologies in many communities has opened up possibilities for these tools to help deliver immunisation messages, reminders and directly engage members of the community in immunisation topics outside the face-to-face contact with vaccinators at the point of delivery. The range of digital health applications that fall into this category include mobile phone SMS reminders and behaviour change communications for caregivers, direct communication channels to report adverse events following immunisation (AEFI), platforms to provide anonymous client feedback on personal experiences with immunisation services, and digital access to vaccination records. Digital platforms and mobile phones may also be used to gather community concerns and understand behavioural and social barriers to immunisation service access and demand through mobile phone surveys, questionnaires or digital social listening.

Gender dynamics play a role in vaccine confidence and demand for immunisation. Decision-making power in the household, self-efficacy and access to the necessary time and resources to seek vaccination services, and women's treatment by vaccinators and perceived quality of care from the immunisation programme all impact a caregiver's willingness and ability to seek out vaccination for their children (Kalbarczyk et al., 2021; Babirye et al., 2011; Merten et al., 2015). Women's decision-making power in the household and autonomy to initiate care-seeking at the health centre are associated with potential improved health outcomes (Garrison-Desany, et al., 2021).

Gender dimensions in the community impact access to digital health tools as well. In some instances, access to digital health services can improve women's autonomy, decision-making power and status, but can also introduce tension or reinforce traditional gender hierarchies in the home and society (Jennings and Gagliardi, 2013). Inequalities in access to digital devices and mobile data services contribute to less awareness and use of mobile and digital health services by women (Khatun, et al., 2017). While women caregivers and health workers may have high expectations for new possibilities and benefits that may be result from digital health solutions, women also express concern that gender dynamics will compromise their access to digitally-delivered services due to lack of agency and use of mobile phones; some women foresee their use of digital health as a potential source of conflict (Duclos, et al., 2017).

The introduction of digital health tools and information to improve demand and access to immunisation services is subject to the combination of gender dynamics and social norms that impact both immunisation decision-making and digital health. The objective of introducing digital health for the caregiver is to increase trust, engagement and vaccine acceptance—qualities that are intertwined with the local context of gendered access to digital tools, resources and agency in decision-making. Immunisation programmes employing digital health interventions for use by the community must consider and account for the prevailing gender dynamics and relationships governing the use of digital technology and immunisation decision-making or run the risk of further alienating women and girls from the health system.

Commitment to gender responsive and transformative approaches will give immunisation programmes the opportunity to increase trust and engagement, vaccine confidence, and have a positive impact on gender relations in society in addition to improvements in behavioural and health outcomes (George et al., 2018; Feletto and Sharkey 2019).

Gender and barriers to immunisation access and demand

It is important for digital health information interventions to account for the commonly recognised gender-related barriers to vaccination. The following are those highlighted by Gavi:

- Caregivers (both male and female) may lack information and awareness on the benefits of vaccination

- Division of labour in the household may detract fathers' involvement with childcare duties, including vaccination

- Low socio-economic status of caregivers (women in particular) or lack of women's access to household funds may limit means to afford indirect costs of vaccination

- Religious practices or cultural values may prevent female caregivers from seeking immunisation services from male health workers

- Travelling long distances to health clinics may deter women, particularly younger mothers, from bringing children for immunisation due to safety and mobility issues

- Long wait times at clinics and immunisation sites only open during working hours may conflict with caregivers working in income-generating activities

- Negative attitudes of some health service providers may discourage caregivers from return visits to complete immunisation schedule

Data:

Gender, immunisation data, digital data collection and analysis

Systems for immunisation data collection, triangulation, visualisation and analysis are powerful tools to aid both local decision-making as well as national resource distribution, policies and prioritisation. If the data contained in these systems are collected in a way that reflects, perpetuates or exacerbates gender inequity, the resulting policies and decisions will inadvertently maintain the same gender bias. At the same time, digital health applications and analysis of gender-related indicator data and vaccination coverage can be used to understand gender barriers that may not be apparent with conventional data collection and analysis tools. In this way, gender and immunisation data analysis can identify areas for targeted improvements and to monitor progress on gender-intentional programming.

Data collected with digital tools or aggregated in digital health information interventions may obscure gender bias and inequity in some populations. For example, gender dynamics and social norms in the community can affect an enumerator's comfort and willingness to ask sensitive questions of the opposite sex (Regeru, et al., 2020). Data collected through mobile phone or internet surveys, such as digital engagement to understand community concerns or vaccine hesitancy, are subject to the inherent gender bias in mobile phone ownership (Weber et al., 2021). Men and younger age groups are under-represented

in Demographic Health Surveys, which often sample more women and older, married respondents (Weber et al., 2021). Regardless of the sampling methods or enumerator behaviour, the language in the questions themselves can contain gender-biassed phrasing or implications which reinforce gender inequities and are then reflected and perpetuated in the data themselves (Weber et al., 2021). Although these examples are not specific to immunisation, the socioeconomic data from national household surveys are increasingly being used in combination with immunisation indicators in statistical modelling to identify and understand areas for targeted immunisation activities and programme improvements (Bosco et al., 2017; Utazi et al., 2019; Cata-Preta et al., 2021).

Not only must the interface and data collection methods be designed to collect gender-sensitive data, the reported data should to be disaggregated by sex. Despite improvements in gender-equitable immunisation coverage rates in most countries, data to demonstrate that boys and girls are vaccinated at the same rates is still a core component of gender-responsive programming, especially in light of disruptions to routine childhood immunisation and gender-unbalanced impacts of the COVID-19 pandemic (Hawkes et al., 2022; Fisseha et al., 2021). With sex disaggregated data, the Zindagi Mehfooz digital health programme in Pakistan recently detected declining immunisation coverage rates among girls in rural districts during COVID-19 mobility restrictions (Chandir, 2021).

Non-binary and other gender identities are rarely captured in health and development data. Most surveys and data collection tools do not distinguish between sex and gender identity, eliminating the ability to understand the impacts of an entirely different set of socially constructed gender roles and dynamics (Weber et al., 2021). Until data on gender identity is systematically included in standard health surveys, any barriers to immunisation access and inequliaites in immunisation rates experienced by non-binary and gender-diverse community members will remain obscured and unaddressed.

With the rapid increase in data captured within digital health interventions, and the move towards increased use of machine learning and artificial intelligence, comes the need for increased and more robust gender-sensitive approaches for the responsible capture and use of data, data security, as well as privacy.

Gender-intentional data collection and analysis can also be used to uncover areas of immunisation service delivery that need more attention, to monitor progress and advocate for more gender-equity policies. Geospatial data and technologies can be useful tools for mapping immunisation indicators and high-resolution maps of key gender-disaggregated socioeconomic indicators to understand gender-related barriers to access, suggest possible solutions and contribute to the monitoring of progress towards gender-transformative programming (Bosco et al., 2017; Utazi et al., 2019). A number of studies demonstrate a link between characteristics of a child's mother and full immunisation coverage using spatial regression models and gender-related socioeconomic indicators such as female literacy, female-headed households, uptake of antenatal and postnatal care, and financial assistance (Panda, et al., 2020; Khan, et al., 2018; Uthman, et al., 2017; Ajebon, M, 2019; Puri, et al., 2020; Cloustan, et al., 2014, Shemwell, et al., 2017; Saha, et al., 2018). An association between one or more of these socioeconomic indicators and poor immunisation coverage in a particular geographic region or population group can serve as the entry point for improving outreach, service delivery, educational messaging or other appropriate measures to address the vaccination gap.

Digital health information for immunisation can also facilitate rapid data collection, aggregation and traingulation to call attention to sex-biased immunisation rates, as was the case during the COVID-19 pandemic in Pakistan where declining rates of immunisation coverage among girls was quickly identified and targeted for corrective action (Chandir, 2021).

Experiences from COVID-19 vaccine demand and delivery

Key informants highlighted the gender dynamics at play in the distribution and uptake of the COVID-19 vaccine. One significant barrier is that many vaccine registries, as well as data collection tools, rely on smartphones, which women have less access to, in addition to mobile data and connectivity. Thus, not only are fewer women receiving the vaccines, but their reactions (side effects) are being underestimated. In cases where women do have access to phones, they could be the recipients of calls attempting to enrol them in research studies. This has led to women being on the phone with unknown men which upsets the power dynamics in the household and increases a woman's risk to violence. Women could also be aware that others are listening and give answers that are appropriate instead of correct, leading to decreased validity in findings. Although there is not any known impact of the COVID-19 vaccine on fertility, women have raised this as a concern.

Summary of relevant literature review findings and gaps

Participation in digital health services is impacted by gender:

- Women are less likely to own a mobile phone and have access to mobile data (impacting both mothers and health workers)

- Women are less aware of digital health services (impacting both mothers and health workers)

- Gender dynamics in households and communities can potentially compromise the success of digital health services

- There are gendered experiences with designing digital health tools and implementing digital health services and using data, suggesting the need to look at all female teams, all male teams, and various combinations: male supervisors/ female vaccinators, male supervisors/ male vaccinators, female supervisors/ male vaccinators, female supervisors/ female vaccinators

Relevant gaps in the literature:

- Men's use of digital health services for themselves or their children

- Role of gender in the use of data (general data and geospatial data) by EPI programme managers, supervisors, and vaccinators.

- Role of gender in the use of digital health interventions by EPI programme managers, supervisors, and vaccinators and caregivers.

- Pathways of unintended consequences leading to an increase in gender inequality.

- Systematic gender and power analyses in DHI for immunisation

- Impact of gender dynamics and social norms on data quality.

- Role of gender in the creation and use of maps and geospatial technologies to identify zero dose children and missed communities.

Key Considerations & Recommendations

It is clear that gender dynamics and social norms play a role at the intersection of childhood immunisation, data use, digital health information and interventions. Digital health interventions can be useful tools for monitoring and improving gender equity and health outcomes, but can also increase gender inequities and reinforce negative social norms in the local context (George et al., 2018; Jennings et al., 2013; Yehualashet, 2021; Steege et al., 2018b; Figeuroa et al., 2021; Waldman et al., 2015). Women face structural and social barriers that limit their participation in digital health applications for immunisation as both caregivers and as health workers. Gender-related barriers restrict access to services and data, and impact data quality and use within routine immunisation programmes. Gender dynamics are involved from the initial design and development of digital health technologies, all the way through their uptake and use, reflecting the standard policies, workflow and expectations that are predominantly in tune with male-dominant norms (Steege et al., 2018a).

Intentional examination and recognition of the role that gender plays in the application and use of digital health information for immunisation programmes is the first step towards optimising these tools and bringing sustainable and positive improvements towards programme goals. By including gender and power

analyses in the design and implementation of digital health information tools for immunisation, programmes can promote and introduce resources that not only improve gender and immunisation equity but bring about gender transformation.

A gender analysis is the systematic collection of quantitative and qualitative information to understand the different roles, norms and challenges experienced by women, men and gender-diverse people and how gender impacts their lives, choices and engagement with the health system (WHO UNICEF & Gavi, 2021; Morgan et al., 2016; WHO 2019a). A gender lens and analysis should be incorporated from the earliest stage of programme concept and design, throughout the project cycle, and included in the design of data collection tools and survey methods.

Insights from a comprehensive gender analysis can help guide programme and digital health tool design, data collection, implementation, resource allocation, policy and course-corrective actions to make progress towards equity in service delivery, access and immunisation coverage as well as making strides towards a gender transformative workplace culture in the immunisation programme. Engaging diverse gender perspectives as part of a user-centred design or human-centred

approach can advance inclusive programming (UNICEF 2018). Efforts to understand, recognise and respond to gender dynamics among users, supervisors, community members, including men, women and gender-diverse stakeholders, before introducing a digital health intervention can avoid unintended tension and negative outcomes.

Girl Effect is a global initiative using technology to empower girls, providing an example of good practice at the intersection of gender and digital health. Girl

Effect involves girls throughout the research, design, implementation and evaluation of tools that provide users with information and resources on health and relationships. Girl Effect recognises the importance of gender transformation as a measurable and overarching goal of programming.

The following recommendations have been taken into consideration for the Gavi DHI Strategy and Operational Plan.

Recommended Gavi DHI Strategy Investments

Global

- Develop tools, guides, training and resources to help countries include gender and power analyses in the funding requests, design, implementation, monitoring and reporting mechanisms for all digital health and data-related activities.

- Build capacity among partners. Require partners to do a gender analysis from the beginning, demonstrate that they are responding to specific challenges and that gender is integrated into Monitoring, Evaluation and Learning frameworks.

- Align DHI investments with Gavi's Gender Policy six action areas of Understand, Advocate, Identify, Reach, Learn, and Partner

- Train Gavi staff in gender equity strategies with special considerations for the gender digital divide and gender-intentional DHI programming in coordination with broader gavi gender capacity building efforts

- Advocate for gender analysis in the research, development, and evaluation of both technology and vaccines.

- Promote meaningful male engagement in gender-intentional strategies and program design

- Develop clear gender-sensitive criteria (an equity framework) for selecting technology and digital health tools. Involve end users in the selection process

Country

- Promote and support gender responsive and gender transformative approaches in all aspects of DHI and immunisation activity at country level from prioritised interventions to enablers, including policymaking, design, planning, implementation, and evaluation.

- Work with local community organisations to identify existing avenues and groups to address and support women; recruit community advocacy groups to participate in advisory boards, focus groups, and capacity building initiatives on digital health literacy.

- Give power and responsibility to local groups and engage in long-term listening/relationships. Examine power dynamics on the ground, between ethnic groups, households, etc. Create feedback loops that extend beyond the vaccination campaign.

- Promote meaningful male engagement in gender-intentional capacity building and behaviour change interventions

- Support a local gender advisor in Gavi-supported countries or regions

Conclusion

Gender norms are a part of deep-set cultural structures that will not change rapidly or over the course of one project cycle, but sustained and dedicated attention and commitment to gender equity at all levels of immunisation programme engagement will create and strengthen new social norms that accept and celebrate inclusion and equity. Gender analyses and gender-intentional planning should be part of any new digital health information for immunisation programme design, with analysis and understanding of how gender dynamics and social norms impact both the supply and demand side in the use of technology and data to improve routine immunisation services.

More evidence, rigorous health research, monitoring and documentation of experiences is needed to understand the role that gender plays in the application of digital health tools and technologies for health systems and immunisation programmes. Indicators and operational research to measure and understand changes in gender power relations and equity should be included in programme monitoring and evaluation plans from the beginning. A systematic approach to documenting, planning, and monitoring of gender-related considerations will increase visibility into the current state and enable progress to be measured over time.

Acknowledgements

Appendix A:
Literature Review methodology details

A review of published studies, research, project guidance and grey literature was conducted to better understand the context, current approaches and experiences at the intersection of gender, immunisation, digital health and data.

Documents were identified for review from a broad semi-systematic database search using standard keywords (see boxed text). From an initial 3,707 unique citations identified, 40 documents concerning the intersection of immunisation service delivery, outcomes, digital health and gender dynamics or gender-related barriers were identified and included in the review. The documents selected for full-text review represent a combination of evaluation studies, background and review articles, project guidance and reports concerning the use of geospatial technologies, mobile technologies, social determinants of inequity in immunisation coverage, and gender

in health systems. Other documents, project reports and review articles suggested by key informants contributed to the review and overall background.

Literature Review Methodology

Google Scholar, PubMed, Cochrane Library, and ClinicalTrials.gov were searched for relevant literature from 2000 to 2020 using combinations of the following keywords:

Gender, Digital Health, Vaccination, Vaccine, Immunisation, Geospatial data, Geographic information systems, GIS, Geospatial mapping, mHealth, Electronic immunisation registry

References

Ajebon, M., 2019. Geographical perspectives on the social determinants of inequalities in under-five mortality in Nigeria: towards an integrated approach. Doctoral Thesis. [link]

Alliance for Affordable Internet. *The Costs of Exclusion: Economic Consequences of the Digital Gender Gap*. 2021. Web Foundation. [link]

Ayaz, B., Martimianakis, M.A., Muntaner, C. and Nelson, S., 2021. Participation of women in the health workforce in the fragile and conflict-affected countries: a scoping review. Human resources for health. 19(1):1-14. [link]

Babirye, J.N., Rutebemberwa, E., Kiguli, J., Wamani, H., Nuwaha, F. and Engebretsen, I., 2011. More support for mothers: a qualitative study on factors affecting immunisation behaviour in Kampala, Uganda. BMC public health, 11(1), pp.1-11. [link]

Bill and Melinda Gates Foundation (BMGF). 2020. Gender and MNCH: A Review of the Evidence. 2020.. [link]

Boniol, M., McIsaac, M., Xu, L., Wuliji, T., Diallo, K. and Campbell, J., 2019. Gender equity in the health workforce: analysis of 104 countries. World Health Organization. [link]

Bosco, C., Alegana, V., Bird, T., Pezzulo, C., Bengtsson, L., et al. 2017. Exploring the high-resolution mapping of gender-disaggregated development indicators. Journal of the Royal Society Interface. 14(129). [link]

Cata-Preta, B.O., Santos, T.M., Mengistu, T., Hogan, D.R., Barros, A.J. and Victora, C.G. 2021. Zero-dose children and the immunisation cascade: understanding immunisation pathways in low and middle-income countries. Vaccine. 39(32):4564-4570. [link]

Chandir, S., 2021. Electronic Immunisation Registry in Pakistan - Using Big Data to Achieve pre-COVID-19 Routine Immunisation Rates and Address Gender Disparities. Exemplars in Global Health. [link]

Clouston, S., Kidman, R., Palermo, T. 2014. Social inequalities in vaccination uptake among children aged 0–59 months living in Madagascar: An analysis of Demographic and Health Survey data from 2008 to 2009. Vaccine. 32(28):3533-9. [link]

Deshmukh, M., Mechael, P. 2013. Addressing Women's Empowerment in mHealth and MNCH: An analytical framework. mHealth Alliance, UN Foundation. [link]

Duclos, V., Yé, M., Moubassira, K., Sanou, H., Sawadogo, NH., Bibeau, G., Sié, A. 2017. Situating mobile health: A qualitative study of mHealth expectations in the rural health district of Nouna, Burkina Faso Health Research Policy and Systems.15(1):47. [link]

Feletto, M., and Sharkey, A. 2019. The influence of gender on immunisation: using an ecological framework to examine intersecting inequities and pathways to change. BMJ Global Health. 4(5). [link]

Figueroa, CA., Luo, T., Aguilera, A., Lyles, CR. 2021. The need for feminist intersectionality in digital health. The Lancet Digital Health. 3(8):e526-e533. [link]

Fisseha, S., Sen, G., Ghebreyesus, T.A., Byanyima, W., Diniz, D., et al. 2021. COVID-19: the turning point for gender equality. The Lancet, 398(10299), pp.471-474. [link]

Gammino, V.M., Nuhu, A., Chenoweth, P., Manneh, F., Young, R.R., et al. 2014. Using geographic information systems to track polio vaccination team performance: pilot project report. The Journal of infectious diseases. 210(suppl_1):S98-S101. [link]

Garrison-Desany, HM., Wilson, E., Munos, M., Sawadogo-Lewis, T., Maïga, A.,et al. 2021. The role of gender power relations on women's health outcomes: evidence from a maternal health coverage survey in Simiyu region, Tanzania. BMC Public Health. [link]

George, A.S., Morgan, R., Larson, E. and LeFevre, A., 2018. Gender dynamics in digital health: overcoming blind spots and biases to seize opportunities and responsibilities for transformative health systems. Journal of Public Health, 40(suppl_2), pp.ii6-ii11. [link]

GSMA. Connected Women: The Mobile Gender Gap Report. 2021. [link]

Hawkes, S., Pantazis, A., Purdie, A., Gautam, A., Kiwuwa-Muyingo, S., et al. 2022. Sex-disaggregated data matters: tracking the impact of COVID-19 on the health of women and men. Economia Politica. 1-19. [link]

Hilber AM., Bosch-Capblanch Z, Schindler C, Beck L, Sécula F, et al. 2010. Gender and Immunisation: Summary report for SAGE, November 2010. Swiss Centre for International Health & Swiss Tropical and Public Health Institute. [link]

Jennings, L. and Gagliardi, L. 2013. Influence of mHealth interventions on gender relations in developing countries: a systematic literature review. International journal for equity in health, 12(1), pp.1-10. [link]

Kalbarczyk, A., Rao, A., Adebayo, A., Decker, E., Gerber, S. and Morgan, R. 2021. The influence of gender dynamics on polio eradication efforts at the community, workplace, and organizational level. Global Health Research and Policy. 6(1):1-10. [link]

Khan, J., Shil, A., Prakash, R. 2018. Exploring the spatial heterogeneity in different doses of vaccination coverage in India. PLoS One. 13(11). [link]

Khatun, F., Heywood, AE., Hanifi, SMA., Rahman, MS., Ray, PK., Liaw, ST., Bhuiya, A. 2017. Gender differentials in readiness and use of mHealth services in a rural area of Bangladesh. BMC Health Services Research. 17(1). [link]

Leduc, S., Estrada, S., Wiyeh, A., Drain. 2021. Routine Immunisation Strengthening in Polio High Risk Geographies: Gender Integrated Approach. University of Washington. [link]

Logistimo. 2021. Gender in the Immunization Supply Chain, Senegal. Slide Presentation, July 2021. Logistimo, Gavi, Empower School of Health, Ministère de la Santé et de l'Action Sociale, Senegal.

Malaria No More. 2021. Achieving a Double Dividend: The Case for Investing in a Gendered Approach to the Fight Against Malaria. [link]

Merten, S., Hilber, AM., Biaggi, C., Secula, F., Bosch-Capblanch, X., et al. 2015. Gender determinants of vaccination status in children: Evidence from a meta-ethnographic systematic review. PLoS One. 10(8). [link]

Morgan, R., George, A., Ssali, S., Hawkins, K., Molyneux, S. and Theobald, S. 2016. How to do (or not to do)… gender analysis in health systems research. Health policy and planning, 31(8): 1069-1078. [link]

Panda, BK., Kumar, G., Mishra, S., 2020. Understanding the full-immunisation gap in districts of India: a geospatial approach. Clinical Epidemiology and Global Health. 8(2):536-543. [link]

Puri, P., Khan, J., Shil, A. 2020. A cross-sectional study on selected child health outcomes in India: quantifying the spatial variations and identification of the parental risk factors. [link]

Regeru, RN., Chikaphupha, K., Kumar, MB., Otiso, L., Maegtmeyer, M. 2020. 'Do you trust those data?'—a mixed-methods study assessing the quality of data reported by community health workers in Kenya and Malawi. Health Policy and Planning. 35(3): 334-345. [link]

Saha, A., Hayen, A., Ali, M., Rosewell, A., MacIntyre, CR., Clemens, D., Qadri, F. 2018. Socioeconomic drivers of vaccine uptake: An analysis of the data of a geographically defined cluster randomized cholera vaccine trial in Bangladesh. Vaccine. 36(31): 4742–4749. [link]

Scott, K., Shinde, A., Ummer, O., Yadav, S., Sharma, M., Purty, N., et al. 2021. Freedom within a cage: how patriarchal gender norms limit women's use of mobile phones in rural central India. BMJ global health, 6(Suppl 5), p.e005596. [link]

Shannon, G., Minckas, N., Tan, D., Haghparast-Bidgoli, H., Batura, N. and Mannell, J., 2019. Feminisation of the health workforce and wage conditions of health professions: an exploratory analysis. Human resources for health, 17(1), pp.1-16. [link]

Shemwell, SA., Peratikos, MB., Lazaro, GC., Montse, RL., Boon, A., Martinho, S., Cherry, C., Green, A., Moon, T. 2017. Determinants of full vaccination status in children aged 12–23 months in Gurùé and Milange districts, Mozambique: results of a population-based cross-sectional. International Health. 9(4): 234–242. [link]

Steege, R., Taegtmeyer, M., McCollum, R., Hawkins, K., Ormel, H., et al. 2018a. How do gender relations affect the working lives of close to community health service providers? Empirical research, a review and conceptual framework. Social Science & Medicine (209):1-13. [link]

Steege, R., Waldman, L., Datiko, D., Kea, A., Taegtmeyer, M., Theobald, S. 2018b. The phone is my boss and my helper' - A gender analysis of an mHealth intervention with Health Extension Workers in Southern Ethiopia Journal of Public Health (United Kingdom). 40(2):ii6-ii1. [link]

UNICEF. 2018. Demand for Health Services: A Human-Centred Field Guide for Investigating and Responding to Challenges. https://www.hcd4health.org/ Health Section Implementation Research and Delivery Science Unit and the Office of Innovation Global Innovation Centre. [link]

UNICEF. 2019. Immunisation and Gender: A Practical Guide to Integrate a Gender Lens into Immunisation Programmes. [link]

Utazi, C.E., Thorley, J., Alegana, V.A., Ferrari, M.J., Takahashi, S., et al. 2019. Mapping vaccination coverage to explore the effects of delivery mechanisms and inform vaccination strategies. Nature communications, 10(1):1-10. [link]

Uthman, OA., Adedokun, ST., Olukade, T., Watson, S., Adetekunboh, O., Adeniran, A., Oyetoyan, SA., Gidado, S., Lawoko, S., Wiysonge, CS. 2017. Children who have received no routine polio vaccines in Nigeria: Who are they and where do they live? Human Vaccines and Immunotherapeutics. 13(9):2111-2122. [link]

Waldman, L., Morgan, R., George, A. 2021. mHealth and Gender: Making the Connection. Research in Gender and Ethics. [link]

Weber, A.M., Gupta, R., Abdalla, S., Cislaghi, B., Meausoone, V. and Darmstadt, G.L. 2021. Gender-related data missingness, imbalance and bias in global health surveys. BMJ global health, 6(11), p.e007405. [link]

WHO. 2011. WHO Gender Mainstreaming Manual for Health Managers: A Practical Approach. Geneva: World Health Organisation. [link]

WHO, UNICEF & Gavi. 2021. Why gender matters: immunization agenda 2030. World Health Organization. [link]

WHO. 2019a. Gender Equality Strategy 2019-2023. Global Polio Eradication Initiative (GPEI). Geneva: World Health Organization; 2019 (WHO/POLIO/19.01). [link]

WHO. 2019b. Delivered by women, led by men: A gender and equity analysis of the global health and social workforce. Geneva: World Health Organization. Human Resources for Health Observer Series No. 24. [link]

WHO. 2020. Incorporating intersectional gender analysis into research on infectious diseases of poverty: a toolkit for health researchers. 2020. TDR, the Special Programme for Research and Training in Tropical Diseases. [link]

Yehualashet, YG. 2021. Socio-economic and gender determinants of immunisation coverage in the federal capital territory, Nigeria. Doctoral thesis. [link]