Survive and Thrive: Digital Transformation for Improving Child Health in South Asia. Do we need a reboot?

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Table of Contents

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Abstract

Threats to newborn and child health due to climate change, emerging non-communicable diseases among children and adolescents, the existing burden of newborn and child mortality, and added to that ensuring every child and adolescent should survive and thrive. Digital solutions hold promises, especially in reaching remote areas, inclusion and ensuring equitable primary health care. This commentary raises the question, are we ready to use digital solutions and artificial intelligence to achieve transformations in child health at the population level? If not, what is the paradigm shift required to design and implement digital and artificial intelligence solutions at scale that are effective, sustainable, and beyond small pilots?

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Survive and Thrive: Digital Transformation for Improving Child Health in South Asia. Do we need a reboot?

Abstract
Threats to newborn and child health due to climate change, emerging non-communicable diseases among children and adolescents, the existing burden of newborn and child mortality, and added to that ensuring every child and adolescent should survive and thrive. Digital solutions hold promises, especially in reaching remote areas, inclusion and ensuring equitable primary health care. This commentary raises the question, are we ready to use digital solutions and artificial intelligence to achieve transformations in child health at the population level? If not, what is the paradigm shift required to design and implement digital and artificial intelligence solutions at scale that are effective, sustainable, and beyond small pilots?
Keywords: digital health, child health, digital transformation, climate, noncommunicable disease, artificial intelligence

Introduction
Revolutionized information and communications technologies have fundamentally shifted how individuals and communities engage with their own health. Technologies allow us unprecedented access to information and empowering us to take increasing ownership of our own status and outcomes. The WHO and UNICEF Operational Framework for Primary Health Care: transforming vision into action [1] calls for health systems to “use digital technologies for health in ways that facilitate access to care and service delivery, improve effectiveness and efficiency, and promote accountability.” Digitized primary health care systems, including at the community level, contribute to enhancing all three pillars of the Primary Health Care framework: improved service delivery, empowered people and communities, and multi-sectoral action. The potential is huge: the digitalization of health services can directly enhance quality-of-care, reduce human error, improve patient outcomes, increase efficiency, and lead to more equitable coverage and lower overall costs. Moreover, timely, high-quality data exposes inequities in health access and outcomes and enables decision makers to identify unmet needs, including how and where to invest in health facilities, health workers, vaccines, and other supplies.

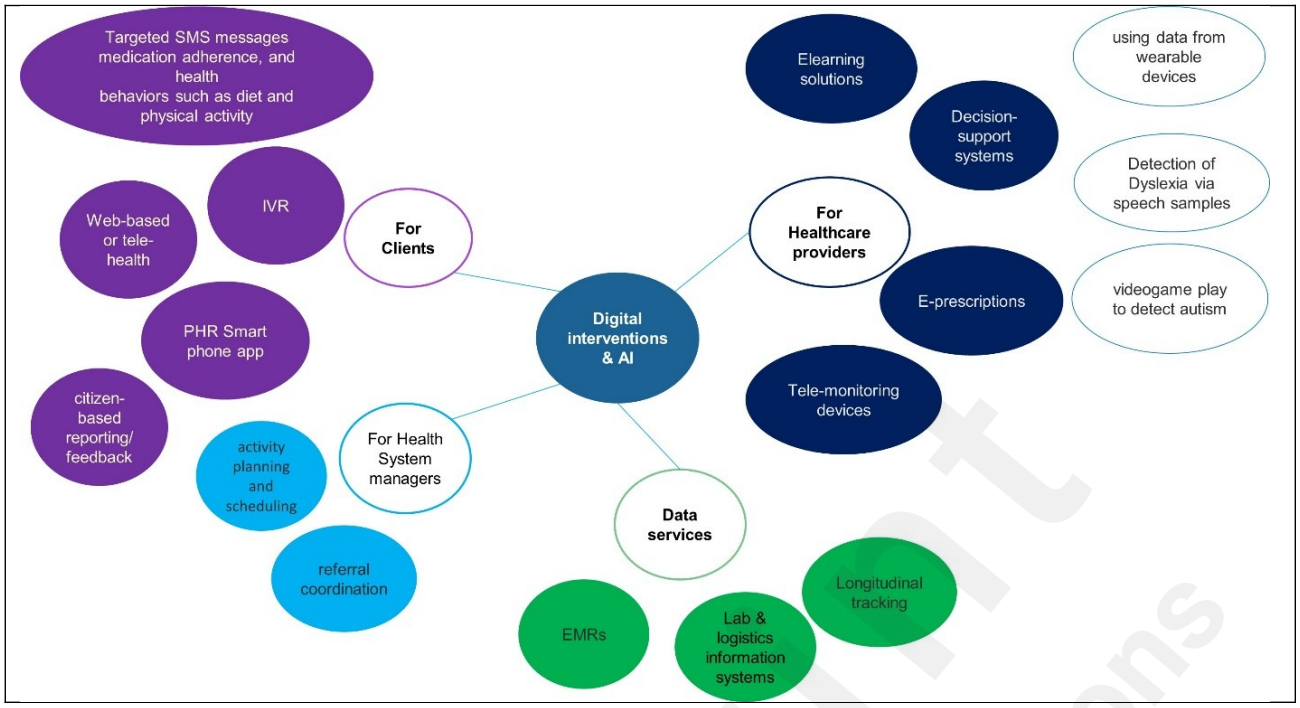
Box 1: Challenges in scaling up promising digital interventions for child and adolescent health

Technical:
- Fragmented and unsustainable systems
- Lack of clear standards
- Unreliability of available data
- Infrastructure gaps
- Workforce capacity gaps

Non-Technical:
- Ethics
- Policy and governance
- Health equity
- Resource gaps
- Quality of evidence

However, as the range of digital tools and AI available to the health sector is rapidly expanding, impact of these for improving child and adolescent health at-scale has yet to be realized. Despite their potential, digital health interventions remain largely at the project or program level or in pilot phase, due to various technical and non-technical challenges (box 1) in the development of the digital public health infrastructure required to optimize data for health outcomes [3]. Coherent data architecture are essential to build machine learning and AI capabilities, and to enable client-centered, quality, and efficient care across the life course and the continuum of care, but are still missing or weak in many countries. Data Architecture coherence includes capabilities for integrated, standardized and automated data processing within the organization, which is crucial to friction-less integration of large-scale data streams across different locations and business functions.
The WHO classification groups digital intervention into four categories, namely, clients, healthcare workers, managers and data services. Figure 1 shows some illustrative digital interventions [4] grouped by the four categories.

Figure 1: Examples of digital interventions to improve healthcare for children and adolescents



Further, AI collects a large amount of data, often without users being fully aware or understanding the implications. This can inadvertently expose children to harmful or age-inappropriate content [2]. AI-based algorithms learn what content kids engage with, filling their feeds with it — even if it could be harmful to them or people around them.

The context of South Asia

Across South Asia[1] millions of children, adolescents and caregivers lack access to effective primary health care. There are 35 million births each year in the region. In 2022, Southern Asia accounted for 34 per cent of global neonatal deaths; every minute, two newborns die; and an estimated 1 in 29 children die before their fifth birthday - the second largest burden globally after sub–Saharan Africa [5]. Despite the progress, an estimated 3 million out of 34 million surviving infants in South Asia did not receive the three recommended doses of diphtheria, tetanus, and pertussis (DTaP) vaccine and are not fully vaccinated. Even within countries, disparities exist which require targeted interventions to vaccinate children [6]. The region is home to the only two remaining polio endemic countries in the world.

The region also carries the highest digital divide between girls and boys. Adolescent boys are one and a half times more likely to own a mobile phone and nearly twice as likely to own a smartphone than adolescent girls. The rate of internet usage among boys is double that of girls in Nepal and quadruple that of girls in Pakistan. Such glaring discrepancy is depriving women and adolescent girls of the opportunities to engage in the digital sphere. The societal expectation about gender roles as well as online safety concerns contribute to curbing their access to the digital sphere [7]. As such, digital infrastructure access and digital literacy are becoming significant social determinants of health outcomes.

Population health, and health systems, in South Asia face increasingly frequent and severe threats. In particular, climate change and environmental degradation are escalating threats to children's well-being, with over 659 million children impacted in South Asia. These challenges jeopardize decades of progress in child survival, development, and protection. Responding to these threats requires strong health systems readiness to communicate quickly and accurately with populations and deliver services, functions which can be significantly enhanced through digital solutions implemented at scale.

Challenges with digital transformation and using AI and Machine Learning to improve child and adolescent health at national level in the South-Asia region

In South Asia, substantial progress has been made in introducing digital health solutions, however significant barriers to scaling this up to the systems level persist, impeding the effective utilization of digital health technologies and restricting access to primary healthcare for every child. Most countries in the region have not adopted standards, national architectures or health information exchanges to enable individuals' health information to move seamlessly through the health system (Global Digital Health Monitor, 2023). This has resulted in poor coordination across the continuum of care for child health.

Machine learning and Artificial Intelligence models increasingly use longitudinal data. However, the heterogeneity in reporting methodology and results, and the lack of electronic health records (EHR)

[1] Includes eight countries: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka

datasets and code sharing, complicate the possibility of replication [8]. Global and regional evidence shows that poor integration and coordination between applications leads to inaccurate data, negatively impacting platform effectiveness and programmatic interventions [9, 10].

Further, the use of AI and big data in public health raises privacy concerns. Linkage of multiple anonymized data sources is often performed to increase the richness of data prior to analysis with AI techniques; however, this also increases the risk of re-identification of individuals or stigmatization of small groups [11]. These risks are particularly alarming when they concern data related to children and adolescents, with implications that could follow them throughout their lifetime.

Re-boot: How can we design robust digitalized primary health care systems for children in South Asia?

Digital transformation is an opportunity to transform primary care and support health systems to be responsive to emerging challenges, such as non-communicable diseases, mental health, and climate change. Transforming primary healthcare can help achieve the quadruple aim of better care, better health outcomes, better provider experiences, and better value for money [12].

Integrating clinical support tools and referral systems into primary health care can help coordinate care and ensure its continuity across primary, secondary, acute and aged care services [13]. Electronic health records capture information about an individual's health, medical conditions, medications and key events, which can be shared for referrals and timely clinical decision-making. Digital technologies can help improve the patient journey. They can prevent duplication of care processes and enhance communication between providers as well as avoid unplanned hospitalizations and visits for urgent care. Ensuring that the general public has access to timely, expert advice by telephone in health emergencies can save lives.

In national health systems, mainstreaming use of digital tools to advance an integrated primary health care approach across the life course and across levels of care from community to specialty services, and scaling up AI and machine learning to optimize care and close the health equity gap for all children, will require a systematic approach to ensure safe, ethical, rights-based implementation and meaningful impact.

Achieving impact for children requires a paradigm shift in the way governments and partners approach digital health, with the following key considerations:

1. An urgent **need to design at-scale and shift from projects approach to health systems approach**. Countries should develop and commit to national coherent digital and data architectures that facilitate interoperability and information exchange. Partners in the health sector need to collaborate in setting up common digital public infrastructures (DPIs) as essential components of the architecture, and to contributing to national plans rather than siloed projects. Only when we will have coherent digital and data architecture in-place at the national level, we will be able to apply AI enabled solutions that will benefit every child.

2. **Strengthen governance mechanisms.** Strong governance mechanisms ensure that governments are in the driving seat with support from donors and partners. This requires clear policy and regulations, structures to oversee the design and implementation and processes that are common for all implementers, partners and stakeholders.

3. **Leverage digital / AI as a platform to accelerate integration of programming and longitudinal data systems.** Primary Health Care calls for integration of health services and a life course approach to providing a comprehensive package of health services. This can be done following a 'client journey' approach and making digital tools interoperable. This will facilitate provision of continuity of care critical for immunizations, nutrition, mental health and other non-communicable diseases (NCDs).

4. **Capacity and digital skills are essential for a globally competitive workforce and digitally literate citizens [14]**. On one hand efforts should be made to design tools that are easier for use by the health workforce and on the other adequate plans should be in place for enhancing the skills of health workers to use the solutions. Investments should be made in educating children and parents about opportunities and risks so they can navigate the digital world safely and responsibly.

5. **Foster collaboration between academia, industry, government, and civil society**. Collaboration across the different groups will help in coordinated efforts, joint learnings and improving primary health care services.

6. **Establish robust data and AI governance practices** to ensure child and adolescent protection and patient rights. Clearly define data ownership and access principles. A review of national AI strategies [15] concludes that current strategies lack meaningful engagement with children's issues, and identifies opportunities to incorporate children's perspectives in AI policies, suggesting human-centered principles and ethical frameworks as starting points. Address legal and regulatory

challenges that hinder responsible data use and undermine children's and patients' rights [16]. The UN Secretary-General's High-level Advisory Body on AI recommends [17] the creation of a global AI data framework, developed through a process initiated by a relevant agency such as the United Nations Commission on International Trade Law and informed by the work of other international organizations.

Conclusion

In the final stretch towards achieving the SDGs in the next 6 years, many countries in South Asia are nearing or exceeding their targets for maternal, newborn, and child mortality. New approaches are needed to pursue dual agendas of 'survive' and 'thrive,' and to build resilient, responsive, and adaptive health systems that are prepared to anticipate, detect, and respond to emerging threats. Reaching the last mile requires more targeted, individualized care based on 'patient-journey' approaches to traditional maternal, newborn, and child care programmes like ANC, PNC, and immunization; while emerging disease burdens such as NCDs, including pediatric onset conditions (sickle cell anemia, type 1 diabetes, congenital heart disease, and developmental disorders, for example, are becoming particularly important in South Asia) require a combination of public health approaches and life-long individualized care. Countries are increasingly reorienting their health systems to a primary health care centered approach, with a strong community-based component, complementing traditional service delivery with essential public health functions, individual and community empowerment, and multi-sectoral action to advance health and well-being.

We envision a coherent digital and data architecture with a focus on longitudinal tracking for every child. Use of tools for early diagnosis and continuity of care across public/private, health services/conditions, and levels of service delivery (community/PHC facility/specialized care) will help achieve rapid transformation in the health sector; application of large AI/ML models on these longitudinal datasets can be a game changer. Some of the use cases of effective application AI/ML include sending targeted prevention or behavior change messages based on risk factors, and self-diagnosis based on algorithms and direct high-risk clients to seek care. AI solutions can provide clinical decision support to healthcare professionals and send reminders for compliance [18]. At the population level, such solutions can support supply chain optimization, process optimization, drug discovery and further research and development.

Additionally, AI algorithms can help convert clinical records to standardized datasets (ICD10/11 or SNOMED). Rapid scale-up of edge technologies that capture data, like voice based medical records, digital stethoscope, and digital ultrasound machines can further reduce the burden of data capture and support health workers to focus on client interaction and treatment. Large scale design and implementation of such tools along with telemedicine, targeted messaging, e-prescriptions and referral care hold tremendous potential to support health system functions to advance child health and well-being. Further, data models that predict, detect, and track emergencies and shocks with an impact on public health, such as severe climate events and emerging communicable diseases with pandemic potential, linked with early warning systems, public communication tools, and remote access to essential healthcare, are critical to enable health system readiness to respond to the impacts of climate change on child and adolescent health.

UNICEF in South Asia has embarked on a journey to integrate the rapidly evolving frontier technologies into the next generation of digitally-enabled health systems, such as Artificially Intelligent chatbots for child and adolescent mental health and community health worker support; data science for trend mapping and early detection of conditions ranging from outbreak-prone communicable diseases to neo-natal defects; GIS mapping for microplanning and efficient service delivery; drones for vaccine deliveries; blockchain for logistics and supply chain management; and other emerging technologies. We are working closely with governments to design and introduce coherent digital health architectures that standardize and automate data processing across diverse and fragmented health information systems.

At the same time, UNICEF recognizes the entrenched digital divide in the South Asia region. We are partnering with global and regional agencies and the private sector to advocate for equitable digital access, address the network connectivity and affordability gap, and ensure that digital health services are contextually appropriate and accessible to everyone.

UNICEF in South Asia invites public and private sector partners to join us in a united action to accelerate digitally-enabled health systems, architecture planning, design and implementation of longitudinal tracking systems and application of ML/AI models to improve the health and well-being of children, families, and communities across the region.

Data availability
The data underlying this article are available in the article and in its online supplementary material.

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