

VIEWPOINT

Newborn Health on the Line

The Potential mHealth Applications

Smisha Agarwal, MPH, MBA, BDS

Johns Hopkins
Bloomberg School of
Public Health,
Baltimore, Maryland.

Alain Labrique, PhD, MHS, MS

Johns Hopkins
Bloomberg School of
Public Health,
Baltimore, Maryland.

Among the 75 countries with the highest burden of child deaths, 40% of such deaths occur during the neonatal period.¹ Complications arising from preterm birth are now the leading cause of neonatal mortality worldwide. Despite significant survival gains in children younger than 5 years, reductions in newborn deaths continue to lag behind.¹ The rapid proliferation of wireless communication in developing countries has led to the ubiquitous availability and use of mobile phones, even in remote, rural places where public health systems are struggling to gain ground. Does this new reality offer innovative mechanisms through which appropriate care can be delivered during the critical period around childbirth? Research is ongoing across a diverse mHealth space to define the extent to which extending access to information for mothers, improving the targeted delivery of timely care, and replacing inefficient data collection and response systems with real-time accountability can improve the fate of the 7.6 million children younger than 5 years who die each year.¹

Mobile technologies are being leveraged to scale up cost-effective evidence-based interventions through the antenatal, intrapartum, and postnatal periods (Figure), in efforts to improve neonatal health outcomes.² A number of large research studies are under way, measuring either neonatal outcomes or upstream processes with direct neonatal survival implications, such as increases in maternal knowledge, antenatal care coverage, and rates of facility-based delivery. At each stage of the continuum of care, mHealth strategies offer ways to potentially improve the efficiency and quality of care for patients, clinicians, and health systems at large.

At the macroscopic health systems level, common mHealth applications include tracking of vital events, point-of-care diagnostics, routine data collection, electronic health records, supply-chain management to improve availability of essential drugs, mobile-based financial incentives, and facilitating improved communication across components of the health system. Several pilot projects have been conducted. **One such open-source data management platform was used by UNICEF and others to monitor 11 502 pregnancies in Rwanda and subsequently showed a 27% increase in facility-based deliveries** after the introduction of short message service (SMS) alerts to community health workers in case of emergencies.³ This platform has also been used since 2011 for birth registration across public health facilities in Nigeria (37 states, 774 local government authorities, and 3148 registration centers) and since 2009 to register, track, and identify infant malnutrition across Millennium Villages Program populations in Kenya.⁴

This technology has also been used in Zambia to alert remote diagnostic laboratories to expedite checking of newborn human immunodeficiency virus status and automate SMS-based result notification from the laborato-

ries to the health facilities.⁵ This system was associated with an approximately 40% reduction in turnaround time for result notification (from 44.2 days to 26.7 days). SMS for Life, another mHealth program in Kenya, facilitated SMS communication between health workers and district health managers about stock levels to improve supply-chain management of malaria commodities. The program reported a 24% and 38% decline in stock-outs of rapid diagnostic tests and artemether-lumefantrine, respectively.⁶ Such systemic process improvements could contribute to timely testing and treatment for malaria, a major cause of childhood deaths. Use of mobile phones to monitor and document birth weight within 7 days of delivery in rural Kenya has shown improvements in timely infant weight monitoring at the community level.⁷

Provision of patient-side decision support tools and mobile-based longitudinal clinician training may improve health care practitioners' knowledge and adherence to treatment protocols. Preliminary evidence suggests that health workers administering integrated management of childhood illness algorithms using personal digital assistants as decision support tools were more confident in their ability to deliver care and demonstrate improved adherence to protocols.⁸ Other programs have provided frontline health workers with mobile phones as an alternative to paper-based records to plan, schedule, and remind them to make routine antenatal and postnatal home visits.

Patient-level strategies include education and behavior change communication through messaging to patient's phones. Initial studies suggest that mHealth strategies can effectively be used to identify women exhibiting signs of obstetric complications and improve facility-based delivery and skilled attendance at birth. An intervention using educational SMS communication and mobile phone cash vouchers sent to pregnant women registered with primary health care facilities in Zanzibar suggested improvements in skilled delivery attendance, compared with those who did not receive such messages.⁹ Mobile Alliance for Maternal Action delivers gestational age-timed health information to expectant mothers and families via their mobile phones in Bangladesh, South Africa, and India. Although evidence for the efficacy of this information on neonatal health is still being generated, initial reports suggest improved maternal knowledge about self-care and childcare.

The volume of rigorous evidence demonstrating the potential benefit of mHealth strategies across the continuum of care, especially in the neonatal period, is limited. mHealth strategies may have the potential to improve neonatal survival by catalyzing and improving the delivery of interventions of known efficacy, improving access to information and modifying demand for quality services, and enabling the provision of targeted care, where and when these

Corresponding

Author: Alain Labrique, PhD, MHS, MS, Johns Hopkins Bloomberg School of Public Health, 615 N Wolfe St, E5543, Baltimore, MD 21205 (alabrique@jhsph.edu).

Figure. An Illustrative Model of Potential mHealth Intervention Strategies Across the Continuum of Care Focusing on Evidence-Based Intervention Strategies With Neonatal Survival Outcomes

	Prepregnancy	Antenatal	Intrapartum	Postnatal
Family-community care				
Conventional strategies		Community mobilization Birth preparedness; promotion of care-seeking Counseling and preparation for newborn care	Clean delivery; clean cord care; thermal care of neonate	Behavior change communication to promote breastfeeding Early recognition and care-seeking for illness Care for low-birth weight babies
mHealth strategies	Patient education and communication: delivery of health content via SMS, voice follow-up calls, audio and video training clips, antenatal and postnatal care checklists, and monitoring for symptoms of perinatal complications Reminders to reinforce behaviors around cord care, breastfeeding, and care-seeking for routine and emergency care Patient-driven mobile labor and birth notification systems; vital events registration			
Outreach services				
Conventional strategies	Nutrition support (eg, folic acid)	Assessment of blood pressure, weight gain, proteinuria, anemia, pre-eclampsia Detection and treatment of infection	Nutrition support (eg, micronutrient supplementation)	Postnatal care to promote healthy practices Early recognition and care-seeking for illness
mHealth strategies	Decision support tools to monitor and record blood pressure, weight gain, and risk factors for complications, and to follow complex diagnostic algorithms (eg, IMCI and ICCM) Surveillance, pregnancy registration, scheduling, and tracking healthcare worker visits Health record access (EHR or PHR) for continuity of care, "high risk" status determination			
Clinical care				
Conventional strategies		Early detection and referral for complications	Skilled attendance at birth Corticosteroids for preterm labor; antibiotics for preterm rupture Emergency obstetric care	Emergency newborn care for illness Kangaroo mother care ^a Resuscitation of newborn Appropriate low-cost respiratory management Management of infection
mHealth strategies	Emergency referral and care coordination for mothers and neonates across formal and informal health sectors Facility support through monitoring supply chain and maintaining inventory of drugs and supplies Facility and staff performance monitoring (eg, absenteeism), performance-based incentives through mobile money channels			

Adapted from Schiffman et al.² EHR indicates electronic health record; ICCM, integrated community case management; IMCI, integrated management of

childhood illness; PHR, personal health record; SMS, short message service.
^a Infant carried by mother, with skin-to-skin contact.

benefits are needed the most. At present, the lack of evidence specific to neonatal health outcomes limits the integration of such strategies into broader maternal and child health programs. Donors and mHealth investors have begun to insist that data go beyond anecdotes of success and to provide support for measurement of effectiveness and cost. Glob-

al health agencies have formed high-level task forces to review the state of evidence in specific mHealth areas and develop appropriate guidance. These apparent signs of maturity and progress in mHealth may indicate that this potential approach to improving newborn health is beginning to receive the serious consideration it deserves.

ARTICLE INFORMATION

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