

Participatory Co-Design of Wearable Solutions for Monitoring Infants in Remote Environments in Sierra Leone

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Introduction: This project explores the potential of digital health technologies, including wearable Internet of Things (IoT) solutions, to remotely monitor and capture parameters and data for detecting and improving communications in accessing health care. The main aim is to facilitate the prevention of various health conditions (e.g., preterm, tetanus, fevers, measles and diarrhoea) in infants in Sierra Leone that lead to high infant mortality rates in Sierra Leone. Sierra Leone has one of the highest infant mortality rates, estimated at 39 per 1000 live births – three times higher than the Sustainable Development Goal (SDG) target of 12 infant deaths per 1000 live births by 2030. Lack of access to and low utilisation of effective and efficient health systems, aggravated by a range of factors, such as inequity in coverage, inadequate human resources and weak infrastructure, referral information and community health systems, are major contributing factors for high infant deaths. The solutions will assist in addressing these challenges.

Objectives: The project aims to assist efforts to reduce infant deaths through developing culturally appropriate, people-led design of digital health technologies, including mobile and wearable IoT solutions to: (i) facilitate remote monitoring of infant health (vital signs such as temperature, pulse rates, respiration blood pressure, etc.) and alerting of potential critical illness in non-clinical settings, and (ii) improve healthcare access and ethical and FAIR data sharing between parents and health workers in Sierra Leone.

Methods: The overall research approach is informed by a participatory design thinking framework, with the emphasis on four fundamental principles critical for developing appropriate and contextualised digital technologies in resource-poor settings: availability, accessibility, affordability and usability. It adopts a mix of socio-technical research using literature review and interviews and a co-design workshop with healthcare providers and caregivers. The socio-technical research provides in-depth insights into the contextual issues around the current healthcare system, challenges and opportunities for new technology innovations. The design workshop embodied inputs from the socio-technical research, participants' experiences, design scenarios, image-based reflections, journey maps and group discussions.

Results: Timing is everything to reduce child deaths. Both healthcare workers and caregivers believe that acting as soon as the first symptoms are detected can make a significant difference in reducing the risk of infant deaths. Therefore, the remote monitoring solutions should provide early alerting for symptoms of common child illnesses such as malaria, pneumonia and diarrhoea, to facilitate informed decision making, timely response and treatment. Results further show a layered deployment of remote monitoring technology ecosystem including a paired wearable design used both on infants and primary carers, a mobile application and community/mobile internet kiosk to facilitate communication among different stakeholders, which, at times, may not even share a common spoken language. This layered approach is also expected to facilitate technology adoption in phases.

Conclusion: Our research confirms that digital technologies solutions designed together with the actual users can address contextually relevant healthcare solutions that reflect their actual needs. The layered deployment ecosystem emerged as a potential solution to strengthen information sharing and timely decision making and provide effective routes for remote monitoring and early alerting and access to the treatment of leading causes of infants' deaths in Sierra Leone.

Keywords: IoT Wearable health solution, Remote health monitoring, Infant health, Co-design, Sierra Leone, Africa