

Development of an mHealth Behavior Change Communication Strategy: A case-study from rural Uttar Pradesh in India

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ABSTRACT

Mobile health interventions are an innovative way to improve health outcomes and may play a powerful role in mitigating health disparities. However, their use poses special challenges and few articles have reported specifically on digital technology interventions for vulnerable populations. This article shares our experience from the Tika Vaani (“vaccine voice”) Intervention which uses a combined face-to-face and mHealth strategy to educate and empower beneficiaries to improve immunization uptake and child health for a poor, low-literate population in rural Uttar Pradesh, India. Based on the mERA checklist, a guide to improve the completeness of reporting mHealth interventions, we provide information about the process of development, implementation and lessons for scaling up the Tika Vaani intervention. This study contributes to the literature to improve reporting on mHealth interventions and provide researchers with key points and actions to take during intervention development to serve hard-to-reach communities and improve health outcomes.

CCS CONCEPTS

• Human-centered computing~Interaction design • Human-centered computing~Human computer interaction (HCI)

KEYWORDS

mHealth intervention; Child Vaccination; Health Promotion; Behavior Change; Vulnerable Populations; Developing countries; Interactive Voice Response (IVR) systems and Pilot Trial.

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1 Introduction

Immunization currently saves between two and three million lives each year by protecting children against serious illness, disability and death from vaccine-preventable diseases [2]. However, in 2018, about 19.4 million children under the age of 1 year worldwide did not receive basic vaccines. Around 60% (11.7 million) of these children live in low- and middle-income countries and 29% (2.6 million) in India [24]. Targeted actions are required to address immunization gaps, especially for vulnerable populations.

Digital technology is an innovative way to improve health outcomes and may play a powerful role in mitigating health disparities [21, 28]. Mobile health (mHealth) is defined as “medical and public health practice supported by mobile devices” [22]. mHealth interventions have been used in a variety of ways to improve health outcomes and for health system strengthening. [11, 37]. eHealth strategies show promise to improve vaccination uptake, advance health literacy concerning immunizations, and improve immunization program efficiency; however, the evidence base is nascent. More research detailing benefits, challenges and barriers is necessary, especially in developing countries, [6].

This article shares our experience with the Tika Vaani intervention, which uses a combined face-to-face and mHealth strategy to improve child vaccination and health in a low-literacy, resource-

poor, rural population in India. Some of us recently conducted an early-stage assessment of this model through a cluster-randomised pilot trial in rural Uttar Pradesh, India from January to September 2018. The study concluded that the intervention model was feasible to deliver and could be a powerful strategy to strengthen delivery of immunization and primary health care. [13, 29]. Information delivery via mobile phone proved viable and contributed to standardisation and scalability; while face-to-face interactions remained necessary to achieve equity and reach. Presentation of mHealth evidence requires a unique lens, encompassing the need to define what the mHealth intervention is, where and how it was implemented [1]. The purpose of this article is to provide this critical information required to support understanding and replication of the Tika Vaani mHealth strategy.

2 Methods

The World Health Organization mHealth Technical Evidence Review Group developed the mHealth evidence reporting and assessment (mERA) checklist to improve the completeness and quality of mHealth reports [1]. The mERA checklist consist of 16 core mHealth items to inform the context of the study, the content of the mHealth intervention, the process of developing and adapting the intervention, performance of the intervention in practice, and additional considerations related to coherence and fit within the health system, scale up and sustainability. The authors argue that uptake of these guidelines (used in conjunction with an appropriate study-design checklist) will improve evidence quality and support replication [1]. To complement the main trial report [13], this paper addresses all mERA core items through five questions: What is the context? What is the Tika Vaani intervention? How was the intervention developed? How did it perform in practice? What are the lessons for scale-up and replication?

3 What is the context?

Setting

The study took place in Hardoi, a rural district of 4 million inhabitants in India's most populous state, Uttar Pradesh. In 2015, Uttar Pradesh had the largest share of India's under-5 deaths, contributing 27.1% (325,500) of the national total (1,200,998), largely due to causes that could be potentially addressed by vaccines [16]. Despite efforts by the government to reduce infant and child mortality, Uttar Pradesh is one of the states with the largest immunization inequities, with coverage lower among disadvantaged groups such as the poorest, less educated parents, the lower social castes and minority religions). A recent study found that 55.8% scheduled castes children and 63.2% scheduled tribes (the most downtrodden and vulnerable ethnic groups in Indian society) were fully immunized, while in Uttar Pradesh, this percentage is lower for 34.1% scheduled castes children and 52.1%, scheduled tribes [36]. Studies highlight the contribution of demand side factors to incomplete immunization [10, 15].

India sees promise in mHealth innovations to improve rural healthcare due to the broad geographical coverage of

communications infrastructure and the low cost and availability of mobile handsets [3, 8, 17]. According to a report from Telecom Regulatory authority of India, of the 1203.77 million number of telephone subscribers in January 2019, 45% (530.86 million) were rural telephone subscribers [31], opening the landscape to develop mHealth interventions that could reduce health disparities, improve healthcare outcomes, while leaving no one behind and achieving universal health coverage.

4 What is the Tika Vaani intervention?

The Tika Vaani intervention model is a new approach to educate and empower beneficiaries to improve immunisation uptake and child health. Tika Vaani operates through two strategies: (i) mHealth and (ii) Community mobilization (Table 1).

mHealth strategy (messages via mobile phone)	
Activities via mobile phone	How was the activity delivered?
13 "Pushed" edutainment & summary capsules	Each week, target families receive a call with a specific health information capsule. Five days later, they receive a reminder capsule
Vaccination "reminders" based on the child's birthdate and the Government of India's immunisation schedule	Families receive three calls informing them that the child's vaccinations are due
"On-demand" access to content.	Person residing in an intervention village can contact the IVR system to speak to an operator to facilitate linkage to content, or to leave a question or comment
Community mobilization strategy (face-to-face)	
Activities with field team	How was the activity delivered?
1 Large introductory meeting	Field team introduces the project to participating communities and explains the operation of the Tika Vaani IVR system. Pamphlets and stickers containing the Tika Vaani phone number are distributed.
3 Small group meetings	Meetings are held in the day, separately for men and women, to receive feedback on a series of educational audio capsules Meetings are replicated several times per village to enable widespread participation.

Table 1: Summary of the Tika Vaani intervention

Although vaccination is the primary focus, the intervention also addresses health care entitlements, prevention, recognition and management of common infectious diseases (diarrhoea, pneumonia, dengue, chikungunya), nutrition, and water, sanitation

and hygiene (WASH). Community mobilization is useful for informing and keeping in touch with community concerns, and has significant potential to create behavior change and improve health [23]. Interventions that combine mHealth strategies with non-mHealth strategies have shown positive impacts on health outcomes outcome in low- and middle-income countries [32].

The Tika Vaani intervention was tested in a pilot study using a cluster-randomised design. Villages were located in Bawan Block, Hardoi district. A total of 387 (184 intervention; 203 control) households with children ages 0 to 12 months in 26 (13 intervention, 13 control) villages were included in the study. All inhabitants (n=8516) residing in the study villages, as well as the 33 health workers of the intervention group (12 Accredited Social Health Activist [ASHA], 11 Anganwadi Worker [AWWs] and 10 AWW Helpers [Sahaika]) were also invited to participate. Overall, in the 13 intervention villages, a total of 1692 participants attended these large introductory meetings. A total of 96 small meetings (n=915 participants) were held during the intervention period. In total, 12 capsules of specific health content and their corresponding reminder capsules were presented to the people.

Access to the mHealth strategy required mobile network coverage in the villages, and ownership or access to mobile phones. To run the IVR, we chose the Mobile Vaani (MV) platform built by a social technology company located in New Delhi, called Gram Vaani [19]. The Gram Vaani team has accumulated over a decade of experience in designing IVR (Interactive Voice Response) platforms for low-literacy rural populations.

A database was created for storing phone numbers of the participants to receive messages with content about child health and timely reminder voice messages for immunization. To ensure data security, the Gram Vaani team stored all data obtained through the Mobile Vaani IVR and app systems on owned servers which are hosted in a data center in India. The servers are configured with standard Linux security methods and are placed behind a series of firewalls to prevent unauthorized access.

5 How was the intervention developed?

Intervention development involved two stages: (1) definition of public health content; (2) adaptation to local populations. Our approach used social marketing theory, which encourages an understanding of key audiences, identification of intervention channels, and development of appropriate messages [7, 9]:

1. Key orientations for the behavior change communication messages were established through a process evaluation of Village Health and Nutrition Days (VHNDs), the Government of India's primary strategy to deliver health care to rural residents. Results showed that a subset basic health promotion and prevention services were neglected in the VHNDs [14].

We consulted the public health literature to develop technical guidance and key messages [33, 34]. Technical content was reviewed by national and international scientific experts and members of India's Ministry of Health.

2. The content was then adapted to local populations through formative research conducted from January 1st, 2017 to January 10th, 2018 in Hardoi district. A dynamic iterative and participatory approach was favored to validate the need for the interventions and to develop a linguistically and culturally appropriate strategy.

Formative research was conducted with three objectives:

1. To assess the perceived need for a new service offering basic health promotion and protection information to families with young children, and to identify specific topics of interest. For this, we conducted an interviewer-administered survey of households with a child less than 24 months. These surveys helped to identify which issues and communications methods were likely to be most important for different audience segments. Data collection took place from June 6th, 2017 to August 8th, 2017. The final sample included respondents from 10 villages: 18 frontline workers and 119 households with at least one child less than 24 months of age. Within these households, 221 independent structured interviews were conducted involving 106 mothers, 56 fathers, and 59 mothers-in-law.
2. To contribute to the design and refinement of the interventions and increase probable intervention uptake, acceptability, satisfaction.
3. To design and pre-test the evaluation instruments. For these, we conducted individual meetings (n=19) with village leaders, outreach activities (wall painting, door-to-door mobilization, and distribution of pamphlets and stickers) and community meetings (n=76) in 38 villages for different user segments (males, females, and older versus younger participants). Activities took place from January 1st, 2017 through January 10th, 2018. There were 4460 participants over the 76 meetings, including 424 family members/ caregivers of a child less than 23 months of age, 55 frontline workers (ANM, ASHA, and AWW), 2761 adult members of the general public, and 1220 children (less than 15 years from the general public).

Overall, participants strongly agreed on the need for the intervention. The proposed communications channels (via face-to-face small group meetings and mobile phone) were felt to be promising, although limits to achievable coverage through each method were also raised and documented. mHealth approaches used in combination with other approaches have been shown to be more effective in improving maternal and neonatal care, as compared to strategies using mHealth approaches alone [32]. Our intervention design therefore retained both channels. Development of technically accurate, comprehensible and engaging content for this rural, low-literate population was especially challenging.

Content was initially not well received by communities for a variety of reasons; the iterative formative research process continued until research and implementation teams were satisfied that the content could be of genuine benefit. Although the iterative formative research process was challenging, it was essential to improving intervention design and ensuring adaptation to the context.

6 How did it perform in practice?

Overall participation in one or more new interventions was 94% (173/184), 82% (144/184) for the face-to-face strategy and 67% (124/184) for the mHealth strategy. mHealth audio vaccination reminders and mHealth edutainment capsules were accessed by 63% (115/184) of target households and 60% (111/184) of target households respectively. An mHealth capsule was considered received if the caller remained connected for 80% or more of the item duration. The small group meetings were attended by 78% (144/184) of the target households. Owning a phone or having easy access to the phone by mothers were factors that shaped the intensity of uptake for mHealth strategies, while living far from the meeting site influenced attendance of small group meetings [13].

The intervention was well-received by participants, who found the content friendly, entertaining and easy to understand and appreciated the convenience of accessing information at home. Participants showed evidence of improvement in basic health knowledge. For example, to the question related to immunization knowledge: *“Do you know the immunization schedule for children from birth to 5 years of age?”*, the probability of correct responses in the intervention group at end line was 66.67% (n=102/153) compared to 26.63% (n=49/184) at baseline. For the control group the probability of correct responses was 44.58% (n=74/166) at end line compared with 34.48% (n=70/203) at baseline.

7 What are the lessons for scale-up and replication?

Our results support the potential contribution of mHealth interventions to increase access to health information in low-resource settings. Our findings are consistent with other studies that have documented that Interactive Voice Response system can provide information access with low technical and functional literacy [5, 20, 26, 27, 30, 35]. Additionally, the IVR system can be used on all types of mobile phones, and thus can enable reach to many users. Studies carried out in rural India showed that mobile handsets equipped with a voice response technology greatly outperform text-based interfaces, and are more useful to meet the needs of less-literate users [18]. We opted by audio messaging due to the low literacy and technological comfort levels of the participants.

We found that an mHealth strategy offers the potential to improve knowledge, but the content must be adapted to meet the needs of less-literate users. In our study, stories and pure information formats were both effective, but story formats were especially appreciated. Dramas that touched the heart and included a crisis,

denouement, and humour, were most successful. Having the underdog win and happy endings were popular. The ideal length was 1 to 5 minutes. Another key lesson was that the content should be designed to be inclusive of all social groups, particularly the marginalised. By thoughtful choice of names and positive portrayal of characters, those designing content can increase relatability and foster a sense of inclusion and respect. Aspirational stories placing female, minority and disabled characters in positions of authority (e.g. doctors, government officers) were universally well received.

Although we did not do a formal economic evaluation, the intervention is low cost. The basic cost of the mobile strategy and a one-year intervention that on-boards and engages 50,000 beneficiaries, is USD \$92,000. The per beneficiary cost for 1 year will be USD \$1.92. Content testing and community meetings (n=3), during the intervention period, cost an additional USD \$ 3,950.

However, several issues require further attention if Tika Vaani is to thrive at greater scale:

(i) The mHealth was very useful to facilitate standardization of health promotion content at low cost, but uptake was uneven. mHealth capsules heard were favoured by mother's possession of a mobile phone, mother's easy access to phone and maternal education; (ii) For community mobilization, distance from place of residence to the meeting site influenced mothers' attendance at small groups meetings. Women's empowerment was a transversal factor influencing uptake for both strategies. Empowerment women strengthens their role in the family and community, increase awareness of their role in their children's health and can improve the effectiveness of interventions [12]; Men participated actively and were own a mobile phone. Active involvement in the Intervention for men and families to share phone becomes necessary to attenuate gender barriers (iii) To achieve equity and reach, both strategies in a complementary way are necessary. However, the logistical and economic challenge to offer the community mobilization component a large scale is important. Given the interest and acceptability of the intervention by frontline health workers [29], the intervention could be incorporated with the Indian health system. Frontline health workers could be trained to become the pivots for community mobilization strategies given their experience, credibility in the communities and their role to implement existing large-scale programs [4, 25]. Adoption of this strategy would require adequate training, supervision and remuneration to facilitate their role in the intervention. It might also be necessary to work with community-based NGOs to offer targeted support for community mobilization activities.

CONCLUSION

A mHealth intervention strategy adapted to the local context and combined with face-to-face communication is a promising method to educate and empower communities in resource-poor rural areas and an excellent way to reduce health inequities. While the mHealth strategy increased standardization, scalability and reach at low cost, face-to-face communication remains necessary to reach the most vulnerable.

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