Experiences from a Mobile-based Behaviour Change Campaign on Maternal and Child Nutrition in Rural India*

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ABSTRACT

Social and behaviour change communication interventions are believed to gain from using mobile technology owing to the reach and rapid scaling promise of technology. In this paper we describe our experiences from the layering of an IVR based content platform for behaviour change in maternal and child nutrition practices in the state of Bihar in rural central India. We specifically show that being able to leverage technology effectively can be quite complex and needs a careful implementation design. We demonstrate that technology adoption takes time and has to be encouraged through offline mechanisms. We also demonstrate that diversification of content on the IVR platform can facilitate greater usage of the platform. We outline the technology assisted concurrent monitoring methods developed by us, and how the data analysis helps identify gaps to take timely corrective action. Finally, we discuss the pros and cons of different pathways to reach women users in rural areas. The insights derived from our work can serve as guidelines for designing technology-based behaviour change campaigns.

CCS CONCEPTS

• **Human-centered computing** → *Empirical studies in interaction design*;

KEYWORDS

SBCC, IVR, Concurrrent Monitoring, Female Technology Adoption, Technology Mobilisation, Maternal and Child Nutrition, Women Self Help Groups, SHG

1 INTRODUCTION

Social and Behaviour Change Communication (SBCC) interventions have traditionally used mass media platforms like TV and radio, and offline pathways like community meetings, street plays and door-to-door campaigns, to influence communities. However, these pathways face shortcomings as door-to-door campaigns and street plays are difficult to scale, and TV[1] penetration and radio coverage[2] is inadequate in several places. With increasing penetration of mobile phones, it is possible to use them to carry SBCC campaigns. A challenge that many interventions using mobile phones have faced though is whether the target group has access to phones, and if yes then does the target group have the capabilities to use technology [11]. This is a consequence of the digital divide across urban and rural areas, and the digital gender divide between male and female users: Urban users are more likely to have access to technology, and male users are more likely to own the technology tools [5, 21, 30]. Researchers and practitioners have attempted to overcome some of these challenges by using IVR (Interactive Voice Response) technology as it runs over normal phone calls instead of requiring mobile Internet connectivity [37], and that navigation using key-presses during a phone call may have a lower learning curve than smartphone based mobile applications[27, 36] .

In this paper we present our experiences from one such IVR-based behaviour change intervention: JEEViKA Mobile Vaani (JMV). Our work is implemented in the Nalanda district in rural Bihar in India, on the topic of behavior change for better maternal and early childhood nutrition. Our project is designed as a communication layer on an ongoing offline behavior change intervention on the same topic, implemented with the JEEViKA network of Self Help Groups (SHGs) [1], with technical support provided by the organisation Project Concern International (PCI) [2]. Many of our experiences should be generalisable to other SBCC interventions in similar contexts.

India, particularly our target geography in the state of Bihar, lags in several health and gender indicators (see Section 3). Low performance on health and nutrition can be attributed to factors like a dominantly patriarchal and superstitious society that often neglects the nutritional requirements of women [11]. This is coupled with the high poverty rate which makes affordability of wholesome nutrition a challenge. Some of these issues can be addressed by using appropriate messaging that can create attitudinal and, eventually, behavioural shifts. The technical partner, PCI, chose to leverage the extensive JEEViKA SHG network in Bihar to reach through offline

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[1]TV penetration is less than 30% in Bihar, our target geography [14]

[2]Commercial FM radio in India is concentrated in a few urban areas only. Community radio coverage in India is also low, with hardly 180 operational stations of which only 40% are in rural areas, and have a small footprint around a 10-15km radius only[18]

means the households with pregnant and young mothers. JEEViKA is a state-run programme aimed at covering all the villages of Bihar, and already works with 70% of rural households through a network of over 700,000 SHGs, with 10-12 women members in each SHG. A group of approximately 10 SHGs in a village is managed by a JEEViKA Community Mobiliser (CM), and PCI conducts regular offline training of these CMs on health and nutrition topics. The CMs in turn take their learning to the SHG members during scheduled group meetings conducted as part of regular financial book-keeping of thrift and credit for the SHGs.

This health layering concept is known to help not just in achieving large outreach but to also nurture the formation of collective structures of solidarity on the ground [6]. Health and nutrition topics in the offline intervention are however at best only discussed during the SHG meetings on a monthly basis. By layering the IVR intervention on top of PCI's offline SBCC efforts, our goal was to create continued and more frequent engagement on the topic, and also create more intra-household conversations on the topic of nutrition because it was felt that JMV could be used by the SHG members on-demand even while at home and could therefore facilitate conversations on mother and child nutrition within the household. A separate non-SHG arm was also implemented by us in a different district, Jamui in Bihar, where we directly developed community outreach pathways through volunteer networks to compare their effectiveness with the SHG driven mobilisation method.

Our main contribution is a description of several improvisations we made in the project, which are likely to be relevant for other SBCC ICTD interventions as well. The main takeaways we outline in this paper are as follows:

(1) *Technology adoption does not happen instantaneously.* It can be nurtured through offline means in the absence of any other pathways, to train and help users understand the benefits from using the technology. This is especially true for women users who typically have had limited exposure in using technology [5, 38].

(2) *Flexibility on serving content and services on topics not necessarily of direct relevance to the project objectives, can help improve user engagement even with the core topics of concern.* Diversifying content beyond the topics of health and nutrition, to local news and livelihood topics of immediate benefit such as agriculture, not just deepened the engagement of users with JMV and the core topics, but also created uptake of JMV among other household members.

(3) *Concurrent monitoring through technology can help implementations be responsive to indicators on inputs, outputs and outcome parameters.* Careful tracking of different process indicators helped us identify weaknesses in our implementation in a timely manner.

(4) *It is hard in general to reach women users for mobile based development interventions.* We found that the JEEViKA SHG pathway indeed has a vast outreach potential with precise targeting to reach women, but can be somewhat limited in creating technology uptake because SHG members are often older women who need greater training and encouragement for technology usage. Volunteer driven non-SHG pathways on the other hand, are able to gain quick traction and also reach remote pockets of marginalised groups, but have poor targeting capability and are used more by men rather than by women.

Our work should not be interpreted as an argument to justify the use of mobile phones and IVR systems for SBCC. On the contrary, we demonstrate that using mobile phones for SBCC is not straightforward and careful implementation design is needed to use technology effectively. The paper challenges the assumption that it is easy to realise the large outreach and scaling potential of mobile based development programmes. In Section 2 we put this work in the context of existing work in related domains. In Section 3 we provide a brief socio-economic background of India and Bihar. This is followed by a description of the implementation design in Section 4. In Section 5 we describe the improvisations and observations from this intervention.

2 RELATED WORK

We situate our work in reference to the latest research in the following areas: usage of IVR as a platform for communication in low-resource settings, Social and Behaviour Change Communication (SBCC) through technological and non-technological methods, and the adoption of technology by female users.

2.1 IVR as a Communication Platform

IVR platforms are suitable for the production and consumption of information in low-literacy and low-affordability contexts as demonstrated in several previous works. CGNet Swara [26] is a citizen journalism platform over IVR which allows people from underserved communities to report on governance and social issues. Avaaj Otalo [31] is a voice forum over IVR for rural farmers. Spoken Web [23] is a design for a hyperlinked network of voice-sites with which users can communicate and navigate using IVR. Mobile Vaani is an IVR-based community media platform [29] on which users can record voice messages and listen to messages by others, and has also seen wide usage on grievance redressal [7] and citizen-government engagement [8, 34]. Some of these initiatives discuss the importance of training [29] but do not provide any detailed quantitative measures about the quantity and type of training. Further, none of these initiatives were targeted specifically at women. In this paper, we expand upon both these aspects.

2.2 Social and Behaviour Change Communication using ICTs

Researchers and practitioners have implemented SBCC interventions through different mechanisms like radio broadcast [15], offline mobilisation [4], offline mobilisation assisted through technology [25], and technology to assist community health workers impart better learning to people [9].

Greenland et al. in [15] report on a diarrhoea control intervention in Lusaka, Zambia through radio adverts, call-in shows, housewives' fora, clinic sessions for mothers and roadshows and find significant behaviour change in the intervention group as compared to the control group. Our channel of communication is IVR which has a higher reach than radio in the target geography. JMV can also be accessed on-demand unlike radio which follows a specific broadcast schedule, and can build deeper user engagement because it allows users to record their views and experiences which can be heard by other users.

Biran et al. in SuperAmma [4] document a successful offline be-haviour change intervention on handwashing with soap, evaluated through a cluster-randomised trial in the state of Andhra Pradesh in India. This intervention used multi-modal communication tools like posters, flipcharts, skits, community meetings and in-school activities. Kim et al. [20] investigated using social networks analysis to identify which targeting methods were more effective in trigger-ing behaviour change, and found that targeting nominated friends produced the most diffusion as compared to targeting influential people in the network. Social networking technologies can possibly exploit this insight to accelerate offline interventions, and we feel this can be an important area of research in the future even on JMV.

Digital Green [25] uses Community Video Education (CVE) to provide new and expecting mothers with information through community screenings of the videos, followed by group discussions among the participants. Our intervention too rides on interactive offline workshops conducted by our technical partner, PCI, and JMV is intended to serve as an additional channel for reinforcement of the key communication messages.

Mobile Kunji [9] is an IVR based platform to serve as a job-aid for frontline health-workers. The health workers are provided with a collection of pictorial index cards corresponding to different stages of pregnancy. Each card also carries a unique shortcode that can be dialled to access respective audio messages. The tool has been evaluated and shown to increase the trust that the community places on the advice provided by the health workers because it is able to assist the health workers to deliver accurate information in an engaging manner to the families. Mobile Kunji is not designed to be used directly by the end users themselves, and also lacks interactivity, unlike JMV.

2.3 Adoption of Technology by Female Users

Researchers have documented several factors that hinder female users from adopting technology [21]. Morrell and Sterling [30] em-phasise that women have a different context for technology usage than men, such as access, literacy, and family commitments, which should be taken into consideration in ICT intervention designs. Blumenstock and Eagle [5] use field surveys and logs from mobile phone usage in Rwanda to identify that phone owners are predom-inantly male, and women are more likely to use shared phones. Steinfield et al. [35] found similar results in Malawi that male re-spondents are three times more likely to own a phone. Reports from the GSMA [12, 13] find that men are also likely to control children's and wives' access to phones to be able to supervise the content that is accessed. In the context of India, Kumar [24] finds that women's non-use of technology is a perception fuelled from patriarchal practices in society, while women actually negotiate within the patriarchal structures to explore available technologies.

In our work in rural Bihar, the findings were similar from an initial formative research phase preceding the actual intervention. Female family members were less likely to own mobile phones and mostly shared the phones with other household members (~50% of shared phone use). Most SHG members did not know their own phone numbers, and ~20% were only able to answer a call but not able to dial phone numbers or send an SMS or save a number. We describe in the subsequent sections how these challenges were overcome.

3 BACKGROUND ON HEALTH AND GENDER STATISTICS IN BIHAR AND INDIA

India's performance on maternal and child health has improved but still remains poor. It ranks 47th from the bottom in Infant Mortality Rate, 56th from the bottom in Maternal Mortality Rate, and 35.7% children under the age of five are underweight (5th rank from the bottom among all countries) [17]. Among the Indian states, the eastern state of Bihar has particularly lagged behind in health and gender indicators. (See the supplementary material for a comparision of indicators for India and the state of Bihar.)

Several factors contribute to the underperformance of Bihar, and India in general [11]. This includes patriarchy and superstitions in society that lead to neglect of the health of mothers, low literacy and education which leads to parents and caregivers not having adequate knowledge regarding nutritional and health requirements, affordability which prevents families from being able to provide good nutrition to the mother and child, and broken social security systems which impede access to nutritional and health entitlements guaranteed under various public funded schemes. Our intervention and the broader offline SBCC efforts attempt to target behavioural and attitudinal factors, and not affordability. JEEViKA separately runs a food security programme through which very poor families can borrow money from the SHGs for food, if needed.

4 IMPLEMENTATION DESIGN

The SHG arm is implemented in 6 blocks in the district of Nalanda, to cover approximately 10,000 SHGs thus providing a pathway to potentially reach 100,000 households directly and many more through their family and social networks. The non-SHG arm of the intervention is implemented in 2 blocks in the Jamui district in Bihar. In this section, we describe four components of the implemen-tation design: the IVR functioning, content design for awareness and behaviour change communication, user training methodology which we term as community mobilisation, and technology driven concurrent monitoring of the intervention.

4.1 IVR-based Community Media

When a user places a call to a unique phone number publicised in the community, the IVR system running behind this phone number cuts the call and places a call back to the user. The system is thus free of airtime charges for the user. Over the call, users can listen to voice content, contribute new content, jump between content items and channels, and participate in IVR-based surveys, thus making the platform interactive and 2-way for asynchronous dialogue. These different actions can be performed on the platform by pressing designated buttons on the phone. In addition to callbacks, out-bound dialouts (OBDs) are also made to registered users according to a pre-defined schedule on a fixed day and time-slot in the week. OBDs are important because we found that a large portion of the audience (approximately ~20% of participants in the formative research) are able to only receive calls on their phones and not dial numbers on their own. Anybody who placed a missed call on the system is included in the OBD list, but the list is continually pruned to
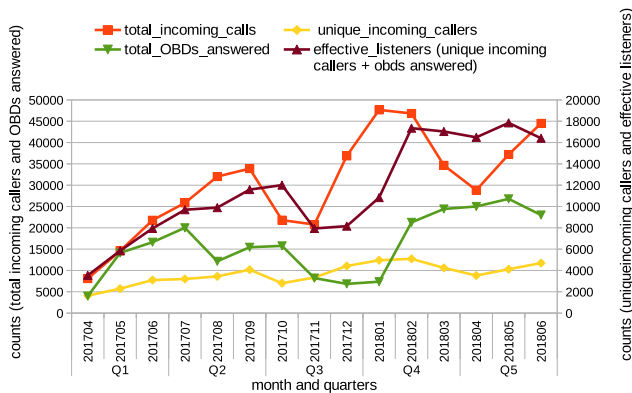
Figure 1: Graph showing month-on-month distribution of total number of incoming calls, total number of OBDs answered, unique incoming callers and the effective number of unique listeners (unique incoming callers + unique users who answered OBDs) for Quarters 1–5 for the SHG arm of the intervention.

exclude users who did not answer three successive OBDs. Typical OBD answer rates were 55-60%, and in most months with OBDs and missed calls put together we were able to typically reach 30% of the cumulative user base until that point.

Figure 1 depicts the usage on the SHG arm of the implementation for Quarters 1–5. This arm went live in April 2017. It was preceded by three months of a formative research phase in a few villages. This arm has received 0.45M missed calls and made 0.24M successful OBDs to over 32k unique users in Quarters 1–5. The number of calls and unique users have generally been increasing month-on-month, except in patches around November–December, 2017 and March–April, 2018 when the number of calls dropped owing to the harvest season, festivals and wedding ceremonies and because many labourers migrated to the cities post harvesting.

4.2 Content Design

In consultation with experts from the partner organisations, the core themes of the intervention were identified to be Maternal Dietary Diversity (MDD), Complementary Feeding (CF), ORS and Diarrhoea Management (ORS) and Social Entitlements (SE). The different content themes were differentially weighted across the intervention period as the content pieces were produced and released on a rolling basis. A content calendar is also designed in consultation with the implementation partners and each content item is vetted by them. The content calendar specifies the content that will run on the top of the IVR on a particular day and timeslot of the week. A portion of a typical content calendar is shown in the supplementary material [3].

Other non-core content themes were also identified through focused group discussion with the end-users. Both women and men expressed interest in information for guidance in the schooling of their children, and also local news, folk songs and cultural programmes. Men expressed a strong preference for information

related to their livelihoods, such as agricultural advisory and information about jobs.

JMV carries two categories of content: Studio Generated Content (SGC) and User Generated Content (UGC). SGCs are content pieces produced in-house by the content creative team. SGCs primarily take two forms: *drama*, with a story arc, and, *informational* in the form of information capsules. Secondary research and primary field visits are conducted to understand the ground realities and feedback is taken to revise the content. The content is thus relatable by the audience, and specific calls-to-action are also anchored on each SGC encouraging the users to undertake some action. The content touches superstitions, social realities like patriarchy, low literacy and affordability, to ride on the identified themes.

The User Generated Content (UGC) pieces are content contributed by the audience over the IVR platform. Typical UGC pieces include feedback on an SGC item, responses to specific questions and reports on calls-to-action put up on the SGCs. UGCs are important in order to create more discussion and engagement within the community, thus making the content more contextual and complete [32]. UGCs undergo a rigorous moderation, curation and rating process by in-house moderators along pre-defined editorial policies before being published.

4.3 Mobilisation

The third critical aspect of the intervention is on-ground mobilisation to train and encourage the users for technology adoption. Our target group is often first time users or non-users of technology, and hence technology adoption needs to be patiently nurtured through offline mobilisation pathways. A Training-of-Trainers model was adopted to train the end-users in the SHG arm. The structure of the JEEViKA SHG network is shown in the supplementary material [3]. Two types of training are conducted: central training in which our field staff explain about JMV and motivate the CMs to participate, and hands-on training in which a field staff accompanies a CM to her SHG meeting, which usually happens once a week, and demonstrates how the IVR platform should be explained to the SHG members. Gradually over 3–4 training per CM, our field staff take a step back and guide the CMs to do more of the mobilisation activities themselves. The topics covered in the training are about how to use the platform and explaining how it can benefit the community and the users. During the course of the intervention, all CMs were also pushed extra activity modules in audio, sometimes even in the voice of their JEEViKA supervisors, to improve the involvement of the CMs in the project. On an average each CM underwent two central training and 3–4 hands-on training. Over 950 CMs were trained by a team of 12–14 field staff over the period of a year.

In addition to the SHG arm, the intervention also implements a non-SHG arm in two blocks in the Jamui district in Bihar where community volunteers directly mobilise the target group, instead of using the SHGs as a pathway. The implementation of the non-SHG arm in described in Section 5.4.

4.4 Concurrent Monitoring

We built a rigorous concurrent monitoring mechanism to observe the inputs, outputs and outcomes of the intervention over time, and take timely remedial action:

Inputs: Our field staff use a custom ODK mobile application [16] to report all training activities conducted by them. They provide details about the CMs with whom the training was conducted, phone numbers of SHG members present in the training, and any special activities conducted by them. They also observe the hands-on training given by the CMs and grade them on a list of pre-defined parameters, like their understanding of the platform and thematic topics. Based on the grades, a performance rating is computed for each CM. The IVR system also tracks the number of calls made by the CMs, and calls made by SHG members linked to a CM. The ratings given to the CMs and the associated call volumes help the field staff distinguish between active CMs and less active CMs, who can be targeted for additional training or persuasion to participate actively in the project. The ratings and call based indicators are also aggregated over various geographical areas to track locations where few training are taking place or the performance is unusually low.

Outputs: The IVR tracks the UGC-rate for content contributions on different themes. The number of UGC pieces contributed by different CMs or their linked SHG members helps assess nuances of the nature of participation by the users. Furthermore, a content analysis of the UGC content helps draw insights on what aspects are users responding to more than others. The IVR system also tracks what content users are skipping by pressing buttons to navigate away from it, quantified as a skip-rate for content that was skipped before listening to 25% of the item.

Outcomes: We measure outcomes by monitoring the retention and understanding of the users through KAP (Knowledge, Attitude, Practice) IVR surveys of exposed and unexposed participants. The surveys test for knowledge change, measured through a difference in differences method for each theme, by comparing the correctness of answers given by users who have been exposed to a certain minimum threshold of content (called exposed users), to the correctness of answers by users who have not been exposed to the content.

The surveys, skip-rates, UGC-rates, and UGC analysis give interesting insights on what content are people listening to more, what content do they respond to, and what content to supplement with additional information. Messages which show low listenership, retention or understanding can then be reinforced through different formats.

5 IMPROVISATIONS AND OBSERVATIONS

We now describe different improvisations and takeaway from our experience with this intervention over the period of a year. Unless otherwise stated, the analyses are done on callbacks made by JMV when a user placed a missed call. This is because missed calls are (generally) placed by the users when the users actually intend to use the platform, whereas OBDs can be intrusive and the user behaviour on OBDs can be unpredictable. We use three-monthly quarters (abbreviated as Q in the text) to analyse the user-behaviour over time with Quarter 1 starting April, 2017. We use the call volumes, user behaviour during the calls, IVR surveys, ODK reports filled by the field staff, and discussions during field visits to analyse and present our findings. We were unable to build test and control groups to evaluate different improvisations because the intervention was rolled out as a part of the larger offline SBCC intervention
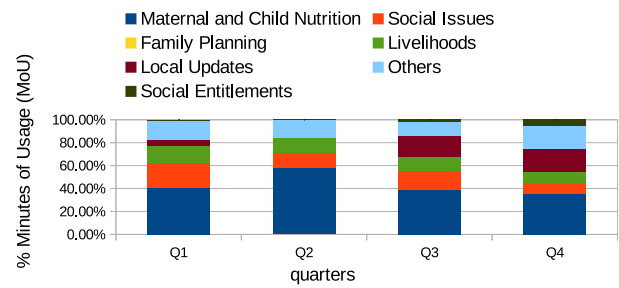

Figure 2: Theme-wise percentage of Minutes of Usage (MoU) of content on the SHG arm across quarters.

with limited scope for flexibility. We therefore rely on stories from the field and feedback from UGCs to build more robustness for inferences obtained from the IVR data.

5.1 Diversification of Content

Figure 2 shows the quarter-wise Minutes of Usage for various topics on JMV, calculated as the total duration of content heard across all users for content belonging to a topic. The content was focussed on the core themes in the first four quarters: maternal dietary diversity (MDD) in Quarter 1, Complementary Feeding (CF) in Quarter 2, ORS and Diarrhoea Management (ORS) in Quarter 3 and Social Entitlements (SE) in Quarter 4. A phone survey was conducted at the end of Q2 with 50 active users (users who called at least once a month in Qs 1 and 2) and 50 inactive users (users who had stopped calling in the last two months). The survey revealed signs of self-selection: users who did not have a pregnancy or an infant in the house were dropping out. Most users who dropped out cited lack of time because they had to attend to household chores. However, the goal of JMV is to create a broad user-base, even among families with no pregnancy or infants in the house, and to deepen the engagement with other household members as well.

We felt that diversifying the content beyond health and nutrition could serve to engage other users with the platform. Researchers have documented the importance of including entertainment content to keep information platforms exciting and vibrant instead of just information oriented and utilitarian [10, 19, 22, 33]. On similar lines, our field discussions during the formative research phase indicated that some non-core topics like local news, children's education and agricultural advisory were of significant appeal to people. Therefore we decided to diversify the content on the platform, and towards the end of Q3 we placed a focus to cover topics like local news updates, agriculture and education.

Figure 1 shows the month-on-month call volumes. Q4 call-counts were 1.6 times the Q3 call-counts which raises the question that was it new users who led this increase, or were the existing users calling more often possibly as a result of the diversified content? Figure 3 shows the CCDF for calls per user for a common set of users who called in both Q3 and Q4, and for whom we have the gender information through IVR demographic surveys (male = 205, female = 457). We observe that both male and female callers who called both in Q3 and Q4, called more times in Q4 when the content
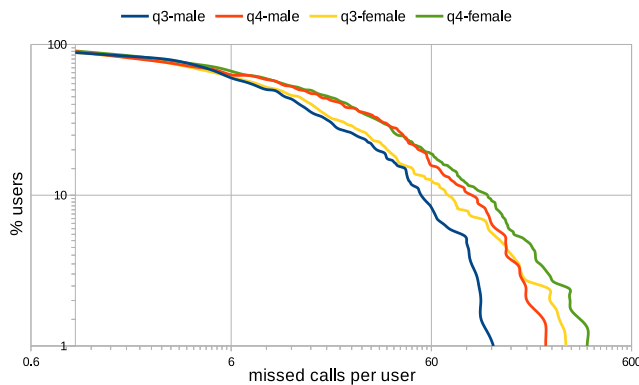
Figure 3: CCDF of calls made on JMV by male and female users who called in both Quarters 3 and 4. Users from both genders called more times in Q4 than in Q3 (63% increase at the 20th percentile for men and 47% for women).

was diversified to include non-core content. Another interesting observation is that the diversification had a greater effect among men than women: the increase in calls by men between Q3 and Q4 was double than that for women with a difference of 16% at the 20th percentile.

The second factor we wanted to analyse is if people are listening to non-core content at the cost of core content. Figure 4 depicts the theme-wise and gender-wise completion rates across Q3 and Q4 for the common users who called in both these quarters. On the platform when a content piece is playing, a user can press 1 and 4 (skip and rewind), 0 and * (change channels), or even hangup the call. All these events are considered as 'skip' or non-completion events for the analyses in this paper. We observe that while the completion rates for core and non-core content largely remained similar for female users before and after the content diversification, for male users the completion rates increased in Q4 for both core and non-core content. This indicates that listenership of non-core content did not come at the cost of core content. Additionally, the minutes of usage of core content heard per caller has gone up by almost a minute in Q4 compared to Q3 (see the supplementary material [3]). The ratio of male and female callers across Quarters 3 and 4 also remained comparable (around 70% female participation) and did not change as a result of the content diversification.

Furthermore, the completion rates of core content for male users is slightly less but quite comparable to the completion rates for female users. This shows that men too listen to health content.

All these observations were validated through field discussions and UGC analysis. The discussions in the field revealed that diversification of content was appreciated and supported by many users. Discussions on children's education was appreciated by women. In addition, the participants also revealed that topics like local news and updates led to an increased usage of the platform among other household members as well. One female participant in the FGDs mentioned, *"Earlier only programmes on female health were carried on JEEViKA Mobile Vaani but now news is also carried. We can now listen to news anytime and anywhere. When I told my son that news on job openings is carried on JEEViKA Mobile Vaani he too started to*
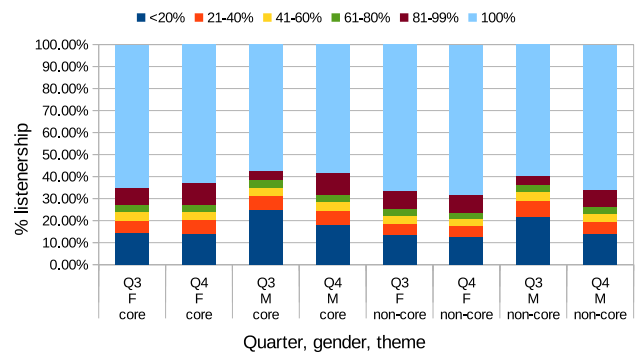

Figure 4: Genderwise and theme-wise content listenership percentages for SGCs in Q3 and Q4.

listen to it. Now all of us listen to it together." Another SHG member said, *"...there is something on offer for everyone in the family, like the children can listen to the content on education, my child came to know that forms for post graduate admissions are now available, my husband used the information on how to improve agricultural yields, and I still like to listen to the drama series on Shanti's life, Dr. Sneha's informational series, and the series on ASHA workers."* Several users, including men and children, recorded UGCs with appreciation for the programme on education which helped the children in their studies and inspired the parents to actively participate in their children's education. The users also benefited from the information on agriculture carried on the platform. Such views were echoed by male and female users alike (illustrated in Table 1). Creating this deeper and wider listenership we realised can be a critical factor to engage multiple household members on JMV, which in turn can improve the chances of behaviour change within the families.

5.2 Technology Adoption Processes

A key observation we make is that technology adoption in this context of rural women in Bihar, takes time and needs continual encouragement.

Formative research showed that around 20% of the SHG members were able to only receive calls on their phone, and were unable to operate other features like making a call or using the addressbook. Furthermore, the women were not in a habit to bring their shared household phones to the SHG meetings. Special emphasis was therefore placed by our field staff to conduct training on mobile literacy, encourage the CMs to conduct these training as well, and continually persuade the SHG members to bring their phones to the SHG meetings in order to get trained on using them. Our data as explained below shows that usage steadily improved over time, and encourages us to postulate that behavior change using technology is indeed a two step process: first to create technology adoption, and then to leverage this to create behavior change.

As a result of continual encouragement for women to bring their phones to the SHG meetings, over a year the median percentage of women bringing phones to the SHG meetings went up from 40% in Q1 to 60% in Q4 (detailed graphical analysis is in the supplementary material [3]).
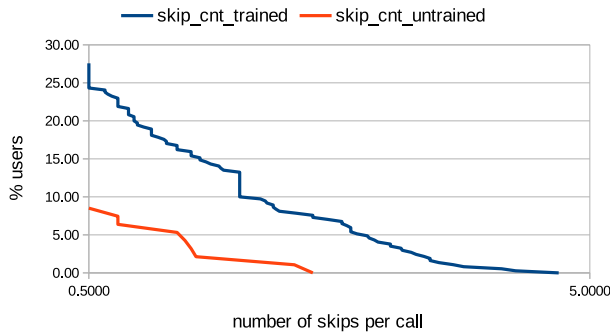
Figure 5: CCDF of number of skips per call for trained and untrained users.
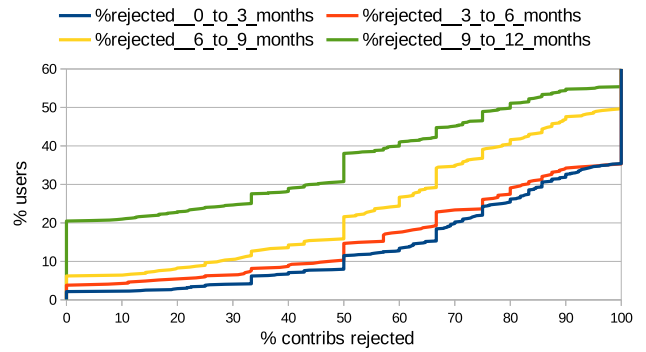

Figure 6: CDF of proportion of rejected contributions per contributor since their first contribution, for callers who contributed at least once every three months.

The fact that the training is relevant is demonstrated by the following analysis. The buttons to skip content or to make a contribution are announced up front on JMV during every call. The analysis compares the usage pattern of skips and contributions between a set of trained users and untrained users. The set of trained users is a sample drawn from among JMV those users who answered OBDs at least five times for more than 60 seconds each time, in the first three quarters (n=370), and were engaged in several rounds of training where a field staff member was present. The set of untrained users is drawn from a similar demography of users as in JMV but from a different geography outside our intervention area, with their phone numbers having been obtained through a partner. These users did not undergo any training but were pushed OBDs regularly, and they answered OBDs at least five times for more than 60 seconds each time in the first three quarters (n=94). Figure 5 shows the CCDFs of skips per call made by the trained and untrained users (see the supplementary section for a comparison of the number of contributions between these two user groups [3]). Trained users can clearly be seen to perform advanced actions on the platform many more times than the untrained users. What is also interesting is that close to 75–80% of even trained users do not press any buttons while listening to the content, showing that there is a wide gap to be filled to create more usage of different technology features.

The field staff also regularly imparted training to help users make good UGC contributions on JMV. We found that users are often hesitant and shy to speak out, but through persuasion and confidence building exercises, they are able to make good quality contributions. Figure 6 shows the CDF of the proportion of rejected contributions (through the moderation process) per user, for three-monthly intervals, since the first contribution by a user. Only those users are included who have contributed in four consecutive three-monthly intervals. The decreasing proportion over time of rejected contributions in Figure 6 shows that with time, persuasion and practice, users are able to make better contributions.

These aspects of the relevance of training and growing maturity in usage over time, is also validated through a regression analysis conducted with CMs. A strong dependence ($p = 0.013$) is found between the number of calls made by a CM in Q4 and the number of training attended by the CM in the same quarter. Also dependent

($p \approx 0.000$) on calls made by the CM in Q4 are calls made by the CM in Q3. The same result is found for analysis conducted between the data for Q3 and Q2, and indicates a continued engagement of the user base over time (see the supplementary section for the regression numbers [3]). Note that another possible explanation could also be that calls happened during the training sessions themselves, but given the overall high volume of calls this is not a likely explanation.

These observations were justified through field discussions with CMs who indeed valued both the central training and the hands-on training sessions. The CMs found central training to be useful because they came to know about the different functionalities of the platform and heard other CMs talking about their experience with JMV. Hands-on training were said to be useful because they were able to ask questions which they were hesitant to ask during the central training. These findings reinforce that technology adoption at scale is a time taking process and requires offline processes for encouragement.

5.3 Concurrent Monitoring of Programme Inputs, Outputs, and Outcomes

We next describe the technology assisted concurrent monitoring processes we built, and how they were useful to improve the implementation of the IVR-based SBCC intervention.

5.3.1 Inputs. As explained earlier, our field staff attend SHG meetings and fill out ODK forms with observations about the training and to grade the CMs on different parameters based on the quality of the training. By monitoring the calls made by the CMs and the SHG members linked to the CMs, in addition to the CM ratings, it is possible to identify CMs who are more engaged and those who are less engaged with the intervention. We found that around 50–60% of the CMs are active. The less active CMs were targeted for supplementary training while the very active CMs were given advanced training to conduct interviews and record news updates. A regression analysis further shows a strong dependence ($p = 0.001$) between the calls made by linked-SHG members of a CM and the
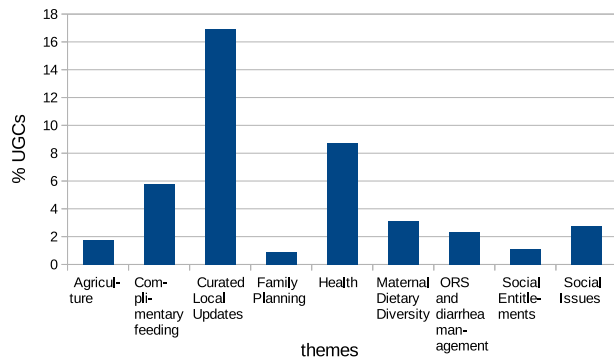
Figure 7: Percentage of UGCs contributed across themes. Note that not all themes are show here.

Figure 8: Theme-wise percentage of users who skipped the content in the SHG arm

rating given to the CM by our field staff, indicating the robustness of the rating process (see the supplementary material for the regression numbers [3]).

The field staff were able to similarly use the monitoring data to identify CMs who were not calling the platform, and followed-up with them to persuade them to call. Certain geographies were also identified from where the CMs did call but did not contribute any UGCs. The field staff conducted extra training with these CMs to make them comfortable in recording contributions on JMV. The monitoring data also helped our project managers to identify some macro patterns, for example, we found that 50% of the intervention locations performed well and these were also the locations where the JEEViKA executives took an interest in JMV (refer the supplementary material [3] for the structure of the JEEViKA SHGs). The managers were then able to instruct the field staff to make extra efforts to engage with the JEEViKA executives and solicit their interest, which could then translate to better performance by the CMs reporting to these executives.

5.3.2 Outputs. The IVR data allows us to see that on average 10–14k users have been cumulatively exposed to 20–25 minutes of content on each theme. Themes which are lagging behind others are prioritised in the content calendar each month, to create uniform listenership.

Analysis of the UGC data also gives actionable insights to guide the implementation. Figure 7 shows the percentage of UGCs contributed by users for different content themes, which helps determine the traction that each theme is able to generate among the audience. The high UGC rates on Local Updates, for example, shows that local news is successfully working as a driver to create user engagement. Qualitative analysis of the UGCs is interesting too. An analysis of UGCs on Maternal Dietary Diversity (MDD) showed that users echoed the awareness points discussed through the MDD content and shared their own experiences with pregnancy. With the themes of Complementary Feeding (CF) and ORS and diarrhoea practices, however, the users did not share as much about their own experiences with their children, but simply echoed some key messages they learned through the content. This could be because of them feeling responsible for their children and not wanting to divulge what kind of practices they followed themselves, as compared
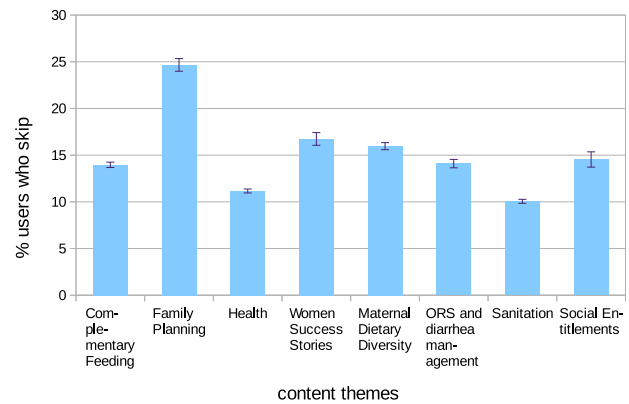
to MDD where they were more comfortable to talk about their own experiences. Table 1 shows examples of a few UGCs. UGCs also help bring testimonials of impact. One female user narrated: *"I wanted to get a toilet constructed for my home, and my CM was even willing to give a loan, but I was never able to persuade my husband and family to get it done. One day I heard information playing on Jeevika Mobile Vaani about toilet construction. I then also made my husband listen to it and discussed it in details with him. This helped convince him to get the toilet constructed. I want to thank Jeevika Mobile Vaani for carrying relevant information which I was able to use."* Some more examples of impact are in the supplementary material [3].

UGCs also help enhance the context and completeness [32] of the messaging carried on different themes. When users are able to describe their own experiences related to what content they heard then it adds context to the content and helps make it more understandable for others. When the UGCs bring new but related concepts then it establishes completeness. A representative sample of the UGCs received, justifying these dynamics of information assimilation, is shown in Table 1. Field discussions with the users also brought out several positive aspects about UGCs. People said that the UGCs help build their confidence and overcome their shyness to express themselves. They also like to listen to personal stories of others through the UGCs. Many users however also revealed that they feel shy to record their own stories, pointing out the need to improve our field training methods to be able to mentor the SHG members to make UGC contributions more confidentially.

Figure 8 shows the skip-rates for different content themes. Skip-rate for a content item is the percentage of listeners who have skipped the item before they completed listening to 25% of it. This metric helps ascertain which themes are resonating with the people. For example, we found the skip-rates for content on family planning is very high (~25%), possibly due to social norms that topics related to family planning are not discussed openly. Such observations can guide changes on content formats or even specific content items.

5.3.3 Outcomes. IVR-based surveys are regularly created on each theme and linked from the platform to assess the retention and

Table 1: Representative sample of UGCs received

UGC	Completeness/ context
Male user: I realised that this is an important information on complementary feeding and I also have small children at home. Now I started sharing this information with young mothers in my family and neighbourhood that after 6 months babies should be given wholesome food. In our village, everybody had this misconception that only *daal ka paani* (lentil soup) can be given to babies. Now I got to know not only *daal ka paani* but cooked *daal* is nutritious. Besides this, I received many other information. Now I will ask my family members and neighbours to listen to the platform and get benefits	An example of context enhancement through an endorsement by a community member
Female user: Pregnant women should be provided with clean mattresses and bedsheets. Men should not smoke in the presence of their pregnant wives or small children	An example of greater completeness by adding relevant aspects that were not discussed in the SGC content
Female user: I got to know through the programme that ORS replenishes dehydration and helps in maintaining water intake during diarrhoea. Another important information highlighted in the programme is to throw away the remaining ORS solution after 24 hours.	An example of increased context, through endorsement by other community members
CM: I want to share that ORS should be kept in home during rainy season and mothers should wash hands before making food and feeding children	An example of completeness, by adding new information not discussed in the SGCs
Female user: Exactly like Shanti (character in drama series) I faced the same situation. When I was pregnant, I was fed only a karela (bitter gourd) dish. It resulted in anaemia and then I had to undergo blood transfusion, otherwise I would have not survived. My husband tried to help me but the family put pressure on him and made it difficult for him too.	An example of increased context and completeness, by citing self-experiences which provide new information which are also locally relevant
CM: Women should practise family planning and not have a lot of kids. Having too many children makes it difficult to take care of the education of the children, expenditure increases and savings go down	An example of context reinforcement through retention of the discussion from the SGC content

understanding gained by the users. Findings from the surveys of exposed and unexposed users revealed, for example, that there was a significantly higher awareness (difference of 18% between exposed and unexposed users) on how frequently should a pregnant woman eat, moderately higher awareness (9%) on the diversity and food groups that a pregnant woman should have in her daily diet, and no difference in the awareness about the quantity of different food groups that a pregnant woman should consume. Similar ranges of 5–20% of improvement were observed on different aspects of other themes as well. While we cannot conclusively claim that these differences are changes observed owing to participation on JMV, because it is also possible that the users who heard the content were already more aware than the users who did not hear the content, but these surveys still give us valuable information about the level of accurate knowledge on different aspects that people have. This consequently tells us which aspects need more emphasis in the content. Our field visits did bring out strong stories of change in awareness through JMV, some of which are documented in the supplementary section.

The content strategy on JMV was modified based on the survey outcomes and other indicators such as skip-rates and UGC rates on different themes. For example, special *Did you know* episodes on maternal dietary diversity were added to bridge the gaps on frequency and quantity of food intake, the calls-to-action on the SGCs for complementary feeding were changed to encourage more UGCs, and the field staff conducted several dozen interviews of SHG members about family planning to make up for the silence on family planning UGCs about personal experiences.

5.4 Mobilisation Pathways to Reach Female Users

The discussion in the paper so far has focused on the SHG arm, and several improvisations we developed for its efficient working. In this section, we primarily contrast it from the non-SHG arm to be able to compare the relative efficacy of these different mobilisation pathways to reach women users.

The non-SHG arm was implemented in 2 blocks in the Jamui district in Bihar. Community mobilisation in the non-SHG arm is done by recruiting volunteers from the local areas. The role of volunteers is analogous to that of CMs in the SHG arm. There are however only 8-10 volunteers per block, as compared to the SHG arm where there are almost 150 CMs per block out of which around 50% are quite active. Similar to the CMs, the volunteers conduct community meetings in which they impart training on how to use the IVR platform and explain its benefits, except that they organise these meetings without any institutional support from organisations like JEEViKA. The volunteers build new connections in different villages from the ground-up and use these connections to organise meetings for community outreach. A collective structure is formed with the volunteers to build solidarity and mutual accountability, small financial incentives are given pro-rata to their performance, and the volunteers are also able to draw significant social credibility from their association with the JMV. This model is explained in detail in other papers [28, 29].

A significant challenge faced in the non-SHG arm was the difficulty to recruit female volunteers who could reach out to other women. The target women audience were not comfortable in speaking to male volunteers. A demographic survey on JMV some months after its initiation indicated that around only 20% users were female. The SHG arm on the other hand allowed a direct pathway to reach women through the SHG network. A successful mobilisation pathway later identified in the non-SHG arm was through school students. A programme on *child journalism* was started in which school students were trained on news reporting. The students would then report on local news and education on the non-SHG arm. These students went on to motivate their parents at home to listen to the platform since they needed the approval of their parents to use the phone, which was typically shared among all the family members. One such child reporter said, *"My mother asked*
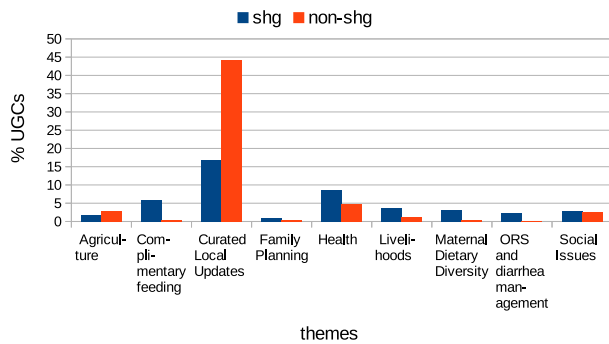
Figure 9: Comparison of UGC percentages across themes in the SHG and non-SHG arms.

me what do I keep listening to on the phone. She rolls bidis for a living. When she was rolling bidis, I dialled the number and got her to listen to it. Now she regularly listens on her own."

Next we compare the content listenership patterns between the two arms. Figure 9 shows the percentage of UGCs contributed for different content themes in the SHG and non-SHG arms. We observe that UGC contributions for core themes related to maternal and child nutrition and health are very low in the non-SHG arm, whereas, for non-core themes like local updates it is distinctively higher. In addition we observe (see supplementary material [3]) that a higher percentage (>35% for the maternal dietary diversity theme, for example) of users skip such content when compared to the SHG arm. This is likely because the non-SHG arm has a larger male listenership as compared to the SHG arm.

However, even in the non-SHG arm, field discussions and surveys of exposed/unexposed users show that good learning is happening among the male listeners. One male participant in the said, *"I learnt from the programme what should a pregnant woman eat and what should an infant eat. Now that I have this information, I can tell the women at home to follow these so that both the women and the children stay healthy."* The surveys showed similar levels of difference of between 5–15% between the exposed and unexposed users, as in the SHG arm. This shows that even in the non-SHG arm, good outreach on health and nutrition information is happening to the target households, but with much lesser targeting towards women because of less direct contact with them, and the impact pathways for behaviour change may operate via the men instead of women.

How do the demographies of the two implementation arms compare? We observe that the SHG arm has more callers who have an agricultural or livestock based source of income than the non-SHG arm, while the non-SHG arm has more callers who are labourers as compared to the SHG arm (see the supplementary material [3] for a detailed analysis). This shows that the demographies of the SHG and non-SHG arms are different, and that the non-SHG arm is possibly reaching a lower strata of people than the SHG arm. This is also somewhat justified through the field visits where we found that 70% of the women attending the SHG meetings have an agricultural or livestock based income. Another observation was that SHG members from poorer families were not able to make the time to attend the SHG meetings, and also often migrated to other

areas for livelihood due to which they were not able to consistently use the platform. The volunteer driven outreach methods in the non-SHG arm were possibly able to reach these households because of their direct village entry approaches, unlike the SHG arm where the CMs only restrict their activities to the SHG meetings. It is however also possible that this difference could be because of inherent differences between the SHG and non-SHG implementation districts, and we are investigating this further by consulting other secondary data sources of demography and livelihood patterns in the districts.

Another interesting contrast between the two arms is in terms of the age profile of the outreach community. In the SHG arm, we found that the SHG members are often older women since JEEViKA formed these SHGs by identifying the key decision-makers in the households. Older women in the SHGs were found to not be much interested in technology or even to know about good nutritional practices since they are beyond child bearing age themselves. Many of them therefore are unlikely to even relay information about JMV to younger members in their families. This probably explains why a potential reach via the SHG network to 100,000 households, only led to around 32,000 cumulative users (identified as unique mobile phone callerids seen by the IVR system), and that the median age of the JEEViKA SHG members is 31-40 while that of the users on the IVR is below 20 (refer to the supplementary material [3]). The SHG arm is therefore not able to realise its full potential for outreach, even though it is very good in targeting the outreach to women. Reaching those left out households probably requires going outside the SHG network, and here a hybrid SHG/non-SHG model can potentially be useful to have volunteers deepen the reach directly especially in pockets where the SHG members might be older, or where the SHG meetings are not held or attended regularly by lower income populations.

6 CONCLUSION

In this paper we describe the experiences from layering an IVR platform (JMV) over an offline behaviour change intervention on maternal and child nutrition. The IVR platform carries content on nutrition and other topics relevant for the target group. We found that it is hard to reach women for the use of technology platforms. An effective pathway for targeting to reach women is through SHG networks. However they have limitations when it comes to driving technology based interventions since the SHG members might be older women and not interested in technology. In the absence of a network like the SHGs, school children can be a good pathway to reach their parents, and we found men to also be interested in listening to health and nutrition related content for their wives and children. We also found that carrying diverse content on the IVR platform was useful to deepen the participation within the target group, and also to widen the reach of the platform outside the target group. Technology was additionally used to concurrently monitor the inputs, outputs and outcomes of the intervention, and was used to continually alter the implementation to obtain better results. The experience also demonstrates that technology adoption needs to be encouraged and takes time, people need persuasion to start using technology and need to realise the benefits from the technology to continue using it.

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