deliver our messages to all in one go instead of repeating in separate one to one calls."

The benefit of peer learning expanded to few community members also. 11 ASHAs reported events of attending the shows with their family members or friends. Some ASHAs even recorded the show call in their mobile phones and made written notes which they later shared with their friends, mothers, and one ASHA showed it to her supervisor also.

9. USABILITY

We attempt to understand the usability of the system on the following parameters:

9.1 System Usage

Initially, we had apprehensions about the interaction environment offered by *Sangoshthi*. We were concerned that an oral conversation over a call between 21 participants may not lead to fruitful learning interactions, and instead become overwhelming for the listener and host. We were also concerned that interactions to contribute to the show would be confusing and hard to remember. For example. to contribute opinion in a show, an ASHA needs to press "1" in her phone keypad and then later identify her chance to speak by recognizing the last 3 digits of her phone number. We anticipated the task of remembering the last 3 digits of a phone number would be difficult for the ASHAs, but surprisingly all of them remembered and reported it to be a simple and useful technique.

"The procedure of pressing "1" was very simple and this way all of us used to get chances uniformly."

Both the expert and the host appreciated this functionality for maintaining synchronicity in the communication. The expert highlights by saying:

"The biggest advantage of this system was that we were able to converse systematically without any overlaps."

In a single Q&A, an ASHA could press "1" only once. Some ASHAs exhibited their eagerness to talk by pressing "1" before the host invited participation from the ASHAs in order to come first in the queue. The system log also captured events of DTMF input other than "1". On average, the system log captured 22 such events per show out of 9 shows and 6 per ASHA for all 9 shows leaving out an outlier who happened to do for a total of 62 times in 9 shows.

The android app displayed the identities of interested speakers in order of who dialed "1" first in order to help the host in deciding who should speak next. We observed that the hosts over a period of time started to manage the speak priorities using an alternative method. For instance, the hosts used to shift the priority order of a particular ASHA who was very prompt in pressing "1" and had already interacted for the maximum number of times, in the interest of giving opportunities to other new listeners.

9.2 Show Experience

All ASHAs found the show duration of 1 hour to be appropriate and enjoyed the show proceedings. A supporting quote from as ASHA:

"The shows used to be so engaging that we never realized the time."

During the occasions when ongoing shows were interrupted and restarted due to issues related to voice transfer or connectivity, most of the ASHAs demonstrated patience, while a few mentioned their inconvenience :

"The problem I faced was the show call disconnection because of which my question was left unanswered once."

The process of successfully connecting 20 ASHAs, on average took 2 minutes. During the process of connecting to ASHAs, the host had the responsibility of making repetitive announcements about the waiting time. Events of show restart in case of network problem made this part of hosting quite frustrating at times. One of the host told us as follows:

"The most challenging part for us while initiating the conference was to get the successful connection from all the ASHAs. In this phase at times of comparatively longer connecting process, sometimes I would get upset by making repetitive announcements of - "keep patience while we connect to rest of the ASHAs." and worry about the show success"

10. SYSTEM USEFULNESS

In this section, we discuss the usefulness of *Sangoshthi* perceived by the stakeholders in the existing structure. We present three important factors that play an important role in understanding the future scope of *Sangoshthi*.

Cost

Estimation of the cost underlying the system use is necessary to understand its sustainability prospects. The main expense in our deployment was the call charges. We subscribed the VOIP-GSM gateway service of the company Doorvaani to establish the show calls over cellular network. Based on the airtime cost of an outgoing call of 1.68 INR (0.025 USD) per minute, the cost per minute for 22 parallel lines of the callers estimates to be 36.96 INR (0.54 USD), incurring the total cost for a show of 60 minutes duration to be as 2217.60 INR (32.61 USD). In our current set-up, the cost per ASHA computes to be 110.85 INR (1.63 USD) which could further be lowered down if ASHAs agree to bear their call charges by connecting to the show calls through outgoing calls. In this scenario, the estimated cost would then be 60 INR (0.88 USD) per ASHA per hour based on the standard call charges of the regular service providers which are much lower than that of Doorvaani. We solicited views of ASHAs on the system usefulness for this model and majority of the them (17) agreed in support of their knowledge gains. On the other hand, both the overall expenditures and per ASHA expense in a traditional face to face training session are quite high. We see a great potential in *Sangoshthi*to establish as a complementary training platform that can be deployed readily without the need of additional infrastructure.

We adopted an incentive approach towards ASHAs participation in this deployment. ASHAs in both the groups (treatment and control) were remunerated on the basis of 100 INR (1.5 USD) per interview (two interviews at pre and post-intervention stages). In addition, ASHAs in the treatment group were given 800 INR (11.8 USD)for participating in the shows. Therefore, each ASHA in the treatment group

received 1000 INR (14.7 USD) and 200 INR (3 USD) in the control group.

Impact on ASHA Routine

Since, generally the societies where ASHAs live follows patriarchal regime, they are responsible for majority of the household tasks and receive limited opportunities for leisure, it is important to understand the impact of our training intervention on their routine. Most of the ASHAs managed to take out time easily. One favorable reason was the time slot that was chosen according to their convenience. ASHAs acknowledged the cooperation from their family members during the training period. Following is the supporting quote from an ASHA:

"We used to finish our housework by that time and our kids used to take food on their own."

On being asked at what frequencies this form of training should be organized, majority suggested for every 5-6 months with two shows in a week.

System Benefit

SWACH expressed the benefit of the system on two parameters: usefulness of content production activity and system's ability to facilitate training sessions remotely. A quote of the expert:

"The system is very beneficial for us because it helped us in building the capacity of ASHAs on home based newborn care remotely which becomes difficult logistically in face to face training sessions. It also helped us to standardize the content which now can be used for reference purposes overcoming the problem of information loss due to the cascade model of training."

Sangoshthi also marked its benefits in the community using ASHA as the main vehicle. 18 out of 20 ASHAs who were able to share their knowledge in the home visits, declared the direct benefits to the families. For example, an ASHA shared her experience as:

"I had a delivery case in my area, in which the mother on discovering the birth of a girl child, cried a lot and went into depression. I pacified her patiently and explained in detail the value of breast feeding, play and communication and measures of reducing depression. Now she is happy and is also feeding her baby."

ASHAs found tremendous value of this training in their increased confidence to articulate the knowledge during home visits, an ASHA words are:

"Earlier we were not able to explain the content to mothers satisfactorily but now we explain better and are able to convince mothers."

Not only the knowledge empowered ASHAs in decision making but also helped them in earning respect in their society, as one ASHA mentioned:

"During my visits while conversing to the mothers when I made references to the training session to support the information, they trust me more."

10.1 Learning and Future Scope

The field deployment of *Sangoshthi* provided us valuable experience in understanding the design requirements for a platform which support the training of ASHAs in rural India. Everyone - ASHAs, NGO, expert - liked *Sangoshthi* and had a positive experience of using it. Literature suggests that providing synergy between all three types of interaction component viz, instructor-learner, learner-learner and learner-content, is important for learning [19]. In the present version, *Sangoshthi*, predominantly supports instructor-learner interaction, but does not provide support for learner- learner and learner-content interactions. In our interviews with ASHAs we found that some overcame this lack of functionality by recording the content and using it in different settings. This included sharing the content with other ASHAs, family, and friends. This gives evidence of the other two interactions which evolved organically around our system. We aim to improve *Sangoshthi* by further incorporating all three modes of interaction within the system. Our design for Sangoshthi included mechanisms to allow discussion among the participants and also to take a quiz. However, due to time constraints we were unable to implement these into the deployed system. In future, we would like to explore how more interaction modalities can be used to engage the listeners beyond the one-hour duration. Learning from other systems, such as *avaaj otalo* [30], we would like to incorporate questions, feedback, comments off-line before or after the show and then incorporate them in planning for the next shows. We also aim to make the content created/generated during a show available to ASHAs and community through regular IVR systems.

As a result of our initial design work, we pre-registered the hosts' devices. This meant that it was not possible to host multiple parallel independent training sessions. In addition, the design of Sangoshthi assumes that all the listeners have feature phones only and thus limits the interaction to pressing a key. However, we did find that around 2% of ASHAs has smart-phones with them. We would like to extend our system for smart-phone listeners by providing more interaction components on their devices. In future, as more ASHAs move to smart-phones, this will help in evolving the system.

Since the deployment of *Sangoshthi*, many additional features have been added to *Citizen Radio* which allow additional functionality that enable easy hosting and management of Radio Shows. *Citizen Radio* now includes several additional features to limit user errors during a live show. *Citizen Radio* also allows use of pre-recorded filler material to overcome the black hole problem reported in [11]. The *Citizen Radio* has also added an initial show set-up functionality to allow the hosts to prepare their show. The initial show set-up functionality allows to host multiple parallel independent training sessions.

11. RELATED WORK

In this section, we will discuss research studies focusing on improving the knowledge of community members living in low-resource settings on the topics relevant to them. The rural populations of many developing countries face serious information deficit due to lack of adequate literacy levels, access to information sources and its mediums. Therefore, simple forms of Information and Communication Technologies have been largely explored. For example, video has

been identified as an effective tool for the purpose of training and information dissemination because of its ability to engage larger audience overcoming literacy and language barriers. Digital Green by Gandhi et al. [7] was a popular work in the domain of agriculture that attempted to educate marginalized farmers about new farming practices by creating localized digital video content. They disseminated the content using TV and DVD players in public gatherings with the help of a mediator. Its remarkable feature was the involvement of the farmers in the creation of videos. A significant improvement (seven times) was observed on adoption of practices over classical extension approaches based on training and visit. On the similar line, Projecting Health by Kumar et al. [15] provided useful information to the mothers on child care by using the model of community-led video education. It also reflected upon the role of community power dynamics and patriarchal structure of the society on the flow of information. Ramachandran et al. [31] used videos in mobile phones of health workers as health messages for persuading women to adopt safe practices. Findings highlighted the impact on the motivation of health workers and strengthening of dialogue between the women and the health workers.

A substantial body of research exploited the power of cellular connectivity to reach the beneficiaries directly [30, 32, 20, 9]. Interactive Voice response systems (IVRs) gained much attention due to its ability to provide information in a more natural way. Avaaj Otalo by patel et al. [30], aimed to teach small-scale individual farmers in Gujarat, India, about the good farming practices using an interactive voice application. Its most popular feature was the voice forum for asking questions and browsing others questions and responses on a range of agricultural topics. CGNET Swara by Mudliar et al. [20] addressed the limited access to mainstream media of rural communities by building citizen journalism network through IVR. TAMA by Joshi et al. [10] presented findings on the use of IVR based system in providing treatment support to people living with HIV. A different direction of earlier work exploited the ordinary phone calls as a medium to make the web content accessible to the underprivileged. For example, TeleWeb [3] provided telephony service for web browsing and SpokenWeb [14] opened a new software development paradigm by allowing creation and navigation of VoiceSites over ordinary phone call interaction.

12. CONCLUSION

In this work, we described our evaluation of Sangoshthi, novel training and learning platform for ASHAs working in resource-constrained settings. While there have been tools to support individual learning or to improve the efficiency of CHW, no platform was available to train a number of ASHAs together. The field deployment of *Sangoshthi* showed its potential to support existing training mechanisms. *Sangoshthi* provided a lively environment of learning through structured interactions among CHWs and the expert. This interaction enriched the content created by the expert which can then be further used for training. Our system fully incorporates the four design principles [18], viz. locally relevant content, accessibility of content beyond the bound of literacy, affordability and fitment into the community ecosystem.

Our deployment highlights the potential of combining feature-phones, smart-phones, and available internet and mobile networks for delivering content in constrained environments for critical applications.

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