

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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14. REFERENCES

- [1] Nirupam Bajpai and Ravindra H Dholakia. Improving the performance of accredited social health activists in india. *Mumbai: Columbia Global Centres South Asia*, 2011.
- [2] Molly Bogan, Jan van Esch, Gayo Mhila, Brian DeRenzi, Caroline Mushi, Timothy Wakabi, Neal Lesh, and Marc Mitchell. *Improving standards of care with mobile applications in Tanzania*. W3C, 2009.
- [3] Yevgen Borodin, Glenn Dausch, and IV Ramakrishnan. Teleweb: accessible service for web browsing via phone. In *Proceedings of the 2009 International Cross-Disciplinary Conference on Web Accessibility (W4A)*, pages 96–97. ACM, 2009.
- [4] Emily Das, Dharmendra Singh Panwar, Elizabeth A Fischer, Girdhari Bora, and Martha C Carlough. Performance of accredited social health activists to provide home-based newborn care: A situational analysis. *Indian pediatrics*, 51(2):142–144, 2014.
- [5] Brian DeRenzi, Neal Lesh, Tapan Parikh, Clayton Sims, Werner Maokla, Mwajuma Chemba, Yuna Hamisi, Marc Mitchell, Gaetano Borriello, et al. E-imci: Improving pediatric health care in low-income countries. In *Proceedings of the SIGCHI conference on human factors in computing systems*, pages 753–762. ACM, 2008.
- [6] Jose F Florez-Arango, M Sriram Iyengar, Kim Dunn, and Jiajie Zhang. Performance factors of mobile rich media job aids for community health workers. *Journal of the American Medical Informatics Association*, 18(2):131–137, 2011.
- [7] Rikin Gandhi, Rajesh Veeraraghavan, Kentaro Toyama, and Vanaja Ramprasad. Digital green: Participatory video for agricultural extension. In *Information and Communication Technologies and Development, 2007. ICTD 2007. International Conference on*, pages 1–10. IEEE, 2007.
- [8] The Hindu. English preferred by urban net users: survey. <http://bit.ly/212fZRs>, 2013. [Online; accessed 23-October-2016].
- [9] Caroline OH Jones, Beatrice Wasunna, Raymond Sudo, Sophie Githinji, Robert W Snow, and Dejan Zurovac. âIEven if you know everything you can forgetâI: health worker perceptions of mobile phone text-messaging to improve malaria case-management in kenya. *PLoS One*, 7(6):e38636, 2012.
- [10] Anirudha Joshi, Mandar Rane, Debjani Roy, Nagraj Emmadi, Padma Srinivasan, N Kumarasamy, Sanjay Pujari, Davidson Solomon, Rashmi Rodrigues, DG Saple, et al. Supporting treatment of people living with hiv/aids in resource limited settings with ivrs. In

- Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pages 1595–1604. ACM, 2014.
- [11] Konstantinos Kazakos, Siddhartha Asthana, Madeline Balaam, Mona Duggal, Amey Holden, Limallema Jamir, Nanda Kishore Kannuri, Saurabh Kumar, Amarendar Reddy Manindla, Subhashini Arcot Manikam, et al. A real-time ivr platform for community radio. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, pages 343–354. ACM, 2016.
- [12] Kate Kelley, Belinda Clark, Vivienne Brown, and John Sitzia. Good practice in the conduct and reporting of survey research. *International Journal for Quality in Health Care*, 15(3):261–266, 2003.
- [13] Zahir Koradia, Goutham Mannava, Aravindh Raman, Gaurav Aggarwal, Vinay Ribeiro, Aaditeshwar Seth, Sebastian Ardon, Anirban Mahanti, and Sipat Triukose. First impressions on the state of cellular data connectivity in india. In *Proceedings of the 4th Annual Symposium on Computing for Development*, page 3. ACM, 2013.
- [14] Arun Kumar, Sheetal K Agarwal, and Priyanka Manwani. The spoken web application framework: user generated content and service creation through low-end mobiles. In *Proceedings of the 2010 International Cross Disciplinary Conference on Web Accessibility (W4A)*, page 2. ACM, 2010.
- [15] Neha Kumar, Trevor Perrier, Michelle Desmond, Kiersten Israel-Ballard, Vikrant Kumar, Sudip Mahapatra, Anil Mishra, Shreya Agarwal, Rikin Gandhi, Pallavi Lal, et al. Projecting health: Community-led video education for maternal health. In *Proceedings of the Seventh International Conference on Information and Communication Technologies and Development*, page 17. ACM, 2015.
- [16] Vishwajeet Kumar, Saroj Mohanty, Aarti Kumar, Rajendra P Misra, Mathuram Santosham, Shally Awasthi, Abdullah H Baqui, Pramod Singh, Vivek Singh, Ramesh C Ahuja, et al. Effect of community-based behaviour change management on neonatal mortality in shivgarh, uttar pradesh, india: a cluster-randomised controlled trial. *The Lancet*, 372(9644):1151–1162, 2008.
- [17] Darshan K Mahyavanshi, Mitali G Patel, Girija Kartha, Shyamal K Purani, and Sunita S Nagar. A cross sectional study of the knowledge, attitude and practice of ashwa workers regarding child health (under five years of age) in surendranagar district. *infection*, 72:55–38, 2011.
- [18] Maletsabisa Molapo and Gary Marsden. Health education in rural communities with locally produced and locally relevant multimedia content. In *Proceedings of the 3rd ACM Symposium on Computing for Development*, page 25. ACM, 2013.
- [19] Michael Moore and Greg Kearsley. Distance education: A systems view (belmont, california: Wadsworth). 1996.
- [20] Preeti Mudliar, Jonathan Donner, and William Thies. Emergent practices around cgnet swara, voice forum for citizen journalism in rural india. In *Proceedings of the Fifth International Conference on Information and Communication Technologies and Development*, pages 159–168. ACM, 2012.
- [21] United Nations. Mdg 4: Reduce child mortality. <http://bit.ly/2mBytER>, 2015. [Online; accessed 20-October-2016].
- [22] Ministry of Health & Family Welfare. Support mechanism for ashwa. <http://bit.ly/2mBlzqt>, 2013. [Online; accessed 25-January-2017].
- [23] Ministry of Health & Family Welfare. Home based newborn care operational guidelines. <http://bit.ly/2l1fkEe1>, 2014. [Online; accessed 20-October-2016].
- [24] Ministry of Health & Family Welfare. Quarterly nrhm mis report. <http://bit.ly/2aZZqMA>, 2016. [Online; accessed 20-October-2016].
- [25] Public Health Foundation of India. State of india’s newborn 2014. <http://bit.ly/2m1ezSh>, 2014. [Online; accessed 20-October-2016].
- [26] Telecom Regulatory Authority of India. The indian telecom services performance indicators. <http://bit.ly/2cy0yLy>, 2016. [Online; accessed 20-October-2016].
- [27] Updates on Ashwa Programme July 2013. Ministry of health & family welfare. <http://bit.ly/2l2ftD0>, 2015. [Online; accessed 20-October-2016].
- [28] World Health Organization. Community health workers: What do we know about them? <http://bit.ly/1vkzmdZ>, 2007. [Online; accessed 11-February-2017].
- [29] World Health Organization. World health statistics 2016: Monitoring health for the sdgs. <http://bit.ly/1TgXpQ0>, 2016. [Online; accessed 10-February-2017].
- [30] Neil Patel, Deepti Chittamuru, Anupam Jain, Paresh Dave, and Tapan S Parikh. Avaaj otalo: a field study of an interactive voice forum for small farmers in rural india. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pages 733–742. ACM, 2010.
- [31] Divya Ramachandran, John Canny, Prabhu Dutta Das, and Edward Cutrell. Mobile-izing health workers in rural india. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pages 1889–1898. ACM, 2010.
- [32] Aditya Vashistha, Edward Cutrell, Gaetano Borriello, and William Thies. Sangeet swara: A community-moderated voice forum in rural india. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, pages 417–426. ACM, 2015.
- [33] WHO. Newborns: reducing mortality. <http://bit.ly/1pG8smq>, 2016. [Online; accessed 23-January-2017].