Lessons From The Scale Up of a Mobile Health Initiative in Rural Nepal

Ranju Sharma
Medic Mobile
ranju@medicmobile.org

Isaac Holeman
Medic Mobile and
Judge Business School,
University of Cambridge
isaac@medicmobile.org

Abstract
This article describes a mobile health intervention implemented in Nepal by Medic Mobile, a non-profit tech company. Reflecting on early co-design work, a pilot with 77 community health workers (CHWs) and scaling up with 950 CHWs, we discuss user insights and iterative changes to core tools. We show how a prototype technology which was not scaled up nonetheless played an important role in the *process* of scaling up. For this reason, we argue that the results of co-design sessions and experimental trials of small pilots should be contextualized as waypoints on the journey to more connected, coordinated health systems. Both findings shift our attention away from discrete technologies or designs, and toward human-centered designing as a lengthy, patient process.

Author Keywords
Co-design; community health workers, human-centered design; mHealth; participatory design; ICT4D; HCI4D.

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H.5.m; H5.2; K.4.0; K.4m

Introduction
In rural Nepal, 68% of women give birth without skilled delivery care, directly contributing to high rates of maternal and neonatal mortality [1]. Nepal's maternal

Tools for Co-Design

Figure 1: In communities where many are unfamiliar with sketching, inviting participants to sort and discuss cards with images of familiar places and items may foster more substantive participation. We have used these cards in Nepal, Uganda and a number of other low and middle income countries [4].

mortality ratio is estimated to be 190 per 100,000 live births [7]. Nepal's network of nearly 55,000 community health workers or CHWs (referred to locally as Female Community Health Volunteers) is one of the many strategies the Nepalese health system has executed to prevent maternal and neonatal deaths.

This paper describes an mHealth intervention implemented in Nepal by Medic Mobile, a non-profit tech company. The system enables CHWs to register pregnant women in their care and provides reminders to the CHWs in time for the registered women's antenatal care (ANC) visits, delivery and postnatal care (PNC) visits. The primary aim was to increase rates of institutional delivery and clinic visits for ANC.

After a pilot with 77 CHWs and an extensive re-design process, the system was implemented with all 950 CHWs in Nepal's Baglung District. These CHWs serve a largely rural population of nearly 300,000 people living in the foothills of the Himalayas. At the start of the pilot, over 80% of births in Baglung took place without the assistance of a trained provider [1].

Design Activities

A human-centered approach to designing in partnership with health workers is central to Medic Mobile's philosophy and practice. Prior to implementing the 77 CHW pilot, two rounds of field tests were run in tentative sites, creating opportunities for CHWs, their supervisors and community leaders to influence systems design, while generating enthusiasm and community support for future implementation.

Field tests involved focus group discussions, mock training sessions, roleplaying and storytelling that allowed us to co-design the mobile tool and training frameworks. One-on-one discussions were also carried out with staff at the District Health Office, the government agency responsible for all public health programs in the district.

Key Insights

CHW motivation

Many CHWs felt quite alone, unsupervised and unsupported in their work. This finding will strike some as counter-intuitive or ironic, given that some policy makers regard CHWs as poorly motivated and too poorly educated to provide vital preventative services. For CHWs in Baglung, the prospect of reporting to a central structure and receiving instantaneous confirmation was very appealing. As one CHW said, "we have been doing this for forever and now they [district staff and national government] are finally going to see everything that we do." It was important to design the system so that CHW work could be "seen" and recognized promptly by health system authorities, not only direct supervisors at local clinics. This was achieved for example through automated SMS confirmations that thank CHWs for each report.

Co-design, Emergence of Work Practices and Iteration

During the pilot a number of work practices emerged that shed new light on issues raised in early co-design sessions, leading us to change how our system accommodated these issues. For example, based on input from early co-design sessions, we had created a feature for reporting danger signs which health systems use to flag high-risk pregnancies. During the pilot, we learned that in practice many CHWs had begun calling nearby health facilities to assist in pregnancy-related emergencies, rather than using the phone to submit a

Text Forms

Figure 2: Text Forms are a way of collecting small amounts of structured data using ordinary SMS. To submit a Text Form, a CHW sends an ordinary text message with values separated by spaces or commas. For example, a CHW may send a text message with the content: "P 3 Jane" where "P" indicates registering a new pregnancy, "3" the number of weeks pregnant, followed by the patient's name. In this project, Text Forms became a viable option after the initial pilot, at which point stakeholders were able to agree on a more limited essential dataset.

danger sign form and waiting for assistance. With this in mind, we re-designed the form to be submitted after the CHW had made an initial phone call. This workflow better supported the fact that calls were typically preferred for time-sensitive issues, while SMS were still seen as an important fallback because they often transmit even when very poor connectivity precludes voice calls. This insight shows the importance of combining relatively brief co-design sessions with a sustained, iterative design process.

The bare essential and appropriate dataset
In designing the pilot, some key choices about which data collection technologies to use were based on the size of the dataset that stakeholders deemed necessary. Staff at one implementing partner (also an NGO) insisted that the full Community Based Newborn Care Protocol, which CHWs had been reporting on paper, be digitized. Despite consensus around the importance of focusing on data with which health workers could take action, it proved infeasible for all stakeholders to grasp these actions in enough detail to determine which data points were unnecessary. Once the pilot was underway, we were able to empirically document the specific actions taken based on mobile data, and the more limited dataset that had sparked these actions. This experience clarified, for a range of stakeholders including health workers, government authorities and partner NGOs, the primary objectives of the system and the more limited set of essential data.

Involving a wider range of stakeholders as users
During the pilot, district staff and partner NGOs were able to view dashboards summarizing all CHW activity. CHW supervisors at local health clinics did not have computers, however, so they only received SMS alerts when danger signs were reported and when a CHW had not confirmed an ANC visit after three SMS reminders. In practice, it became clearer that this was not enough information for them to effectively supervise and support the CHWs in their charge. Following the pilot experience, their participation was deemed vital to scaling up the initiative, which led us to reconsider their role and information requirements.

Iterative Changes to Core Tools

Revisiting Use of SIM Card Apps
During the pilot the CHWs used SafeSIM, a SIM application that runs on a paper-thin SIM card that slides underneath the standard SIM card of an ordinary $20 phone. SafeSIM was created using the open source parallel or thin SIM technology that we have described elsewhere [3]. Using basic phones was deemed vital in this context not only for cost reasons, but because many volunteer CHWs in rural Nepal have poor access to electricity and are unfamiliar with smartphones. SMS was deemed an appropriate communication protocol because it performs more robustly than USSD, IVR or mobile internet in poor connectivity environments. Finally, SIM apps support menu-driven interactions, skip logic and data validation, enabling users to feasibly submit forms with 20 to 50 fields.

When initial stakeholder interviews and co-design sessions indicated that digitizing the entire Community Based Newborn Care Protocol was necessary, SIM apps seemed to be the only data collection technology to suit all of our design requirements. The pilot experience validated design considerations related to locally familiar basic phones and the robustness of SMS, however, it also revealed that the intervention could be supported with a more streamlined dataset. As a result

Integrating Paper and Digital Tools

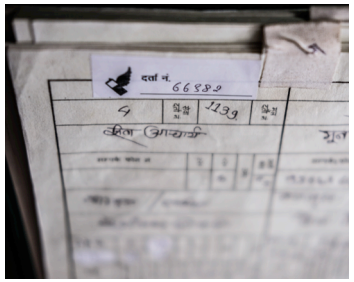

Figure 3: Based on experiences in a 77 CHW pilot, we created a new series of automated SMS that would provide CHW supervisors with information about each woman registered via SMS in their locale. Once this system was in place, many health facilities began using a Medic Mobile sticker to note patient registration IDs so that they can easily track the IDs in the paper registers they regularly use—an example of how they treat the integration of paper and digital records systems.

we were able to build consensus among key stakeholders about exploring other SMS-based tools.

Implementing Text Forms

To submit a Text Form, a CHW sends an ordinary text message with values separated by spaces or commas. For example, a CHW may send a text message with the content: "P 3 Jane" where "P" indicates registering a new pregnancy, "3" the number of weeks pregnant, followed by the patient's name. Medic Mobile's web application then registers the pregnancy, creates a unique patient ID, calculates the expected date of delivery and schedules a series of automated reminder messages related to antenatal care. Similar uses of text forms have been documented elsewhere [5] and the approach is well integrated with the Medic Mobile web application.

Initial co-design activities ruled out Text Forms because this approach would be error prone, tedious and probably poorly adopted for more than handful of data points. However, streamlining the essential dataset made Text Forms seem plausible, and there were two further advantages. First, thin SIM hardware must be purchased for $8-25 USD (depending on batch size) and there are additional, easily overlooked costs for maintenance and repair. Paper thin SIMs can be damaged when they are frequently taken in and out of the phone, which was a common occurrence among CHWs in this project, despite repeated warnings. Replacing thin SIMs entails similar logistical issues as replacing any other hardware in remote areas, with the added uncertainty of procuring them from a producer in Eastern Europe. If any changes needed to be made in the application, the SIMs would need to be physically brought to a central location and updated one at a time. For small scale projects this does not require extraordinary effort. However, as we began redesigning for increasing scale in Baglung (1,000 CHWs) and Nepal (55,000 CHWs), it was clear that the ministry of health did not have a pre-existing team with appropriate skills and free time to perform such tasks.

Second, to our surprise, there was an unexpected usability advantage. While a menu-driven interface is undoubtedly more useable for larger datasets, this cohort of CHWs reported that text messages were more familiar and could be accessed with fewer clicks than navigation to the SIM app.

New Automated Messages for CHW Supervisors

If CHW supervisors were to use the system to promote CHW engagement and run monthly CHW meetings effectively, they needed access to more information. This information needed to be accessible via basic phones rather than computers, it needed to accommodate their busy schedules and reflect their aptitude for taking action based on data. In conversation with CHW supervisors, we determined that the most common and critical use of data in this case would be to verify that all pregnant women were being registered in a timely manner. To this end we updated our automated SMS schedules to alert CHW supervisors at local clinics with the details of each pregnancy registration, including name of CHW, name of pregnant woman, Unique ID, expected date to delivery and time until upcoming appointment. The clinic-based CHW supervisors who would manage this phone then noted the Unique ID in their paper Maternal Neonatal Health register so that they could easily identify anyone who is missing. Once this system was in place, many health facilities began using a Medic

Mobile sticker to note these IDs so that they can easily track the IDs in the paper registers they regularly use—an example of how they treat the integration of paper and digital systems.

Discussion and Conclusions

Our findings have two implications, both of which relate to the nature of design work as a lengthy, patient process. First, observing that a prototype technology was not scaled up should not lead us to conclude that it played no role in the *process* of scaling up. In our case, SIM apps played a key role in early pilots and helped to build consensus among stakeholders. They were justified by our early co-design work; digitizing the entire Community Based Newborn Care Protocol was a genuine issue for one of our design partners. They remained a superior technology for the prototyping process up until the point that all stakeholders were able to agree on a much more limited dataset. Thus SIM apps played an instrumental, if temporary role in scaling up this digital health intervention in rural Nepal. They were not a generally inferior tool so much as a tool that served well in a limited phase of a cooperative design process. In a similar manner Text Forms proved superior for a later stage of the scaling up process, even though they would have proven impossibly tedious and error-prone for the dataset that we necessarily dealt with in the pilot. In other words, tools which are appropriate at a pilot scale may be less appropriate at a larger scale, and vice versa.

The second implication follows from the first. That is, the results of co-design sessions and experimental trials of small pilots should be contextualized as waypoints on the journey to a more connected, coordinated health system. This conclusion stands in contrast to the common view that digital health interventions should be held to the same standards of medical evidence as prescription drugs [6]. In this technology-as-pharmaceutical metaphor, technology interventions should show replicated effects in randomized trails (typically of small pilots) across several distinct settings before they are scaled up, and they should be expected to have similar effects in scale up as they had in small trials. We would argue that this model of medical evidence is less applicable to complex digital health interventions because the appropriateness of digital tools varies so much as circumstances change. As our case study shows, circumstances can change not only from country to country but even in one locale as a project scales up.

Both findings shift our attention away from discrete technologies or particular designs, and toward the extended process of designing. While the call for iteration is hardly new in design research, Bannon and Ehn [2] observe that participatory design is changing with the shift away from bespoke organizational information systems and toward local tailoring of configurable standard tools. They note that "design in these contexts is taking on a very different meaning than in the more traditional design paradigm and this is an area of growing interest and importance for Participatory Design" [2 p. 50]. We elucidate an important aspect of this new scene for co-design by illustrating how off-the-shelf configurable tools may play an important, transient role in making sense of opportunities for cooperation. In so doing, we emphasize human-centered design beyond discrete information systems, as a way of orienting to the complex process of health system strengthening.

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