# *Original Articles*

# High uptake of an innovative mobile phone application among community health workers in rural India: An implementation study

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## ABSTRACT

***Background.*** We assessed the uptake, feasibility and effectiveness of an mHealth intervention in improving the performance of village-based frontline workers, called accredited social health activists (ASHAs), to increase the coverage of maternal, newborn and child health services in rural India.

***Methods.*** A new mobile phone application—Innovative Mobile-phone Technology for Community Health Operations (ImTeCHO)—was implemented in all the 45 villages of two primary health centres in Jhagadia, Gujarat (population ~45 000), between August 2013 and February 2014 after training 45 ASHAs. After 9 months of implementation, 99 mothers of young infants between the ages of 1 and 4 months and 187 mothers of infants between the ages of 6 and 9 months were interviewed during the household survey to assess the coverage of maternal, newborn and child health services in the project and similar control villages. Fifteen ASHAs were purposively selected and interviewed.

***Results.*** The coverage of home-based newborn care (56% *v.* 10%), exclusive breastfeeding (44% *v.* 23%), care-seeking for maternal (77% *v.* 57%) and neonatal complications (78% *v.* 27%) and pneumonia (41% *v.* 24%) improved in the interventional area compared to the control area. The ASHAs logged into the mobile phone application on 88% of working days. Of a total of 10 774 forms required to be completed, the ASHAs completed 7710 forms. During the interviews, all ASHAs demonstrated sufficient competency to use ImTeCHO and expressed a high level of acceptability and utility of all components of the intervention.

***Conclusion.*** A high degree of acceptability, feasibility and effectiveness for the mHealth intervention among ASHAs was supported by its widespread use.

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## INTRODUCTION

Globally, India has the highest burden of maternal and newborn mortality at 16% and 27%, respectively. Over the past two decades, evidence has shown the effectiveness of community-based maternal, newborn and child health services to reduce mortality and morbidity.[1,2] A cadre of village-based community health workers (CHWs), called accredited social health activists (ASHAs), was created for delivery of services under the aegis of the National Rural Health Mission.[3] The village council, with the help of the local government health staff, selects a literate woman who is a resident of the village as an ASHA (one ASHA per 1000 rural population). The ASHAs are expected to have at least 10 years of formal education and work for 3–5 hours every day and receive performance-based incentives for the services they render every month.[3] In 2013, there were 880 000 ASHAs in India serving almost every village.[4]

However, performance evaluations of ASHAs have revealed that the coverage of selected maternal, newborn and child health services is low.[1,5] These services include complete antenatal care, home visitations during the first month after delivery, counselling to promote key health behaviours and managing common childhood sicknesses such as diarrhoea, pneumonia and malnutrition. One key reason for the low coverage is inadequate supervision and support provided to ASHAs.[6,7]

To overcome the problems related to implementation, an innovative intervention in the form of a new mobile phone and web application was developed by a voluntary organization, SEWA Rural, in collaboration with a software development organization, Argusoft India Ltd.[8–10] The Innovative Mobile-phone Technology for Community Health Operations

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(ImTeCHO) is a job aid for ASHAs and staff at primary health centres (PHCs) to increase the coverage of maternal, newborn and child health services by improving their performance, support and supervision. This formative evaluation of ImTeCHO aimed to determine any changes required in the intervention before the initiation of a subsequent trial and to formulate a potential scale-up strategy. We aimed to assess: (i) the uptake, feasibility and effectiveness of ImTeCHO and its components in the context of ASHAs and (ii) their perceptions about ImTeCHO's effect on their personal work environment.

## METHODS

### *Study setting*

The intervention was piloted in 45 villages (population ~45 000) of two PHCs in the Jhagadia block of Gujarat between August 2013 and February 2014 by a voluntary organization, SEWA Rural. Since 1980, SEWA Rural has implemented various programmes to improve the health status and overall development of the local tribal community. Gujarat is located in the western part of India and had a population of 60 million in 2011. With a per capita annual income of ₹22 553 (US $450), it is one of the most socioeconomically advantaged states in India.[11,12] In contrast, Jhagadia is a rural, predominantly tribal area, consisting largely of marginal farmers and landless labourers, with more than one-third of the population living below the poverty line. In 2011, the maternal mortality ratio was 161 per 100 000 live births and the neonatal mortality rate was 29/1000 live births in Jhagadia.[13]

A PHC is an administrative unit that provides primary healthcare to 20 000–30 000 population. We selected the two PHCs due to their proximity to SEWA Rural's main campus and the long-term presence of SEWA Rural's service delivery programmes. Each PHC has a team of 2 doctors, 4 auxiliary nurse midwives (ANMs), 3 multipurpose health workers (men) and other support staff. A total of 45 ASHAs serve the study area.

### *The mHealth intervention*

Detailed information about the ImTeCHO intervention has been published previously.[8] ImTeCHO has two components, a mobile phone application used by ASHAs and a web interface used by the PHC staff. The mHealth strategies of ImTeCHO include scheduling and work planning, behaviour change communication (BCC), point-of-care electronic decision support, tracking of high-risk patients, human resource management, supply chain management, automatic calculation of performance-based incentives/motivation, electronic health records and tracking of vital events. Figure 1 describes in detail the ImTeCHO intervention. All ASHAs were given a mobile smartphone with the ImTeCHO application free of cost and an internet service plan costing ₹150 (US$ 2.5) per month per phone (which was recharged monthly by SEWA Rural) with talk time worth ₹60 (US$ 1) for every 6 months. On average, it took about 12 minutes for an ASHA to complete a digital form with 20–30 data entry fields in the form of questions. The mobile interface has text and images.

### *Training and implementation*

The ASHAs received 5 days of residential classroom training for the use of the ImTeCHO application followed by 2–4 weeks of on-the-job mentoring at the community level. This helped

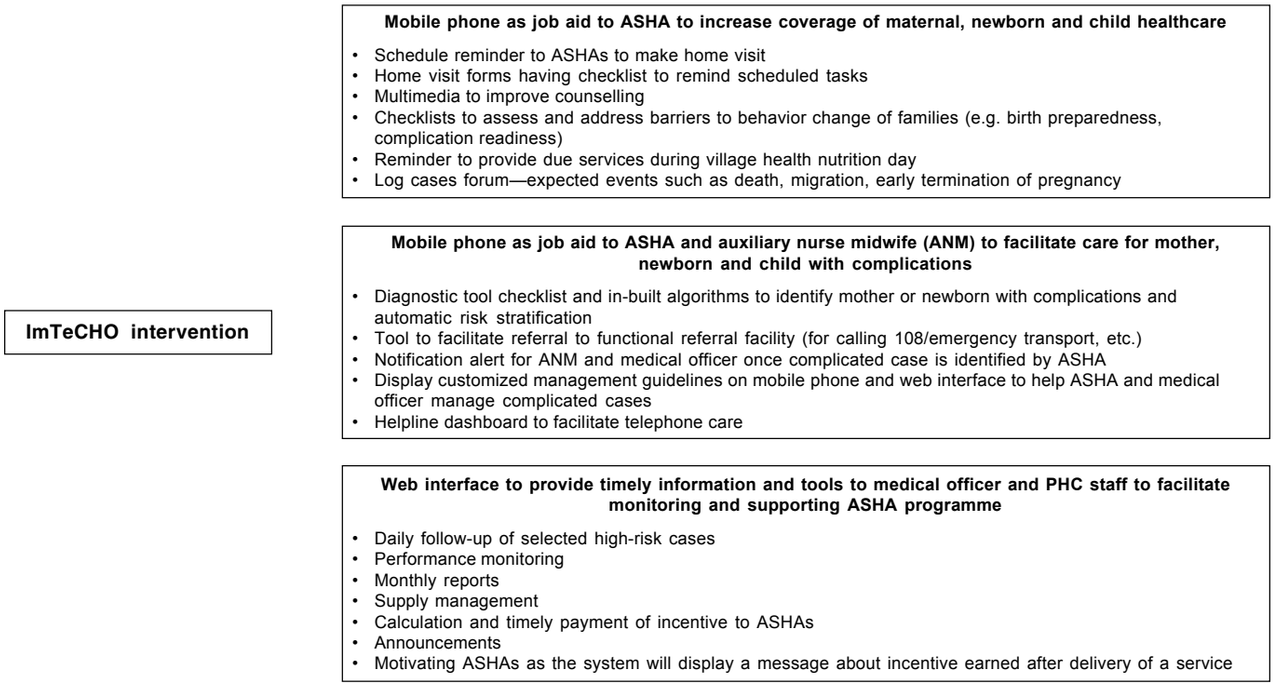


FIG 1. Components of the ImTeCHO mobile phone and web-based application (Adapted from: Modi D, Desai S, Dave K, Shah S, Desai G, Dholakia N, Gopalan R, Shah P. Cluster randomized trial of a mHealth intervention "ImTeCHO" to improve delivery of proven maternal, neonatal and child care intervantions through community-based Accredited Social Health Activists (ASHAs) by enhancing their motivation and strengthening supervision in tribal areas of Gujarat, India: Study protocol for a randomized controlled trial. *Trials* 2017;**18:**270. (Creative Commons Attribution 4.0 International License *http://creativecoomons.org/licensesby/4.0/*)

allay their concerns as also in change management by communicating the value of ImTeCHO for doing their day-to-day tasks. After the training, a team of a facilitator and an emergency responder continued to provide support to all ASHAs by troubleshooting any technology-related problems and managing complicated cases through a call centre. One experienced counsellor—in charge of the call centre—helped ASHAs to coordinate referrals to a higher centre and convinced the families to seek care at higher facilities and follow-up on high-risk cases.

One facilitator from SEWA Rural supervised the ASHAs to ensure optimal uptake and delivery of the ImTeCHO intervention. The supervision entailed the following:

1. To contact the ASHAs who had not logged into the ImTeCHO application for 3 consecutive days (based on the information available on the ImTeCHO web interface) and troubleshoot problems, if any, so that they would login and complete the assigned task(s) the same day.
2. To call each ASHA on the phone once a month for her performance review and motivation.
3. To broadcast positive case studies through ImTeCHO to keep ASHAs motivated.

*Role of government*

The district- and state-level government officers participated in consultations on the development and implementation of the project and helped in streamlining implementation at the taluka level. The medical officers at the PHC regularly logged in and reviewed the ImTeCHO web interface to know about high-risk cases identified by the ASHAs and take follow-up actions. The medical officers were also expected to review information made available on the web interface about important events such as deaths and drug stock-outs and take appropriate actions. The reports from the ImTeCHO web interface were discussed during the monthly PHC performance review meetings. The PHC disbursed performance-based incentives to ASHAs based on performance reports generated by ImTeCHO. The auxiliary nurse midwives (ANMs) received an SMS (short messaging service) whenever an ASHA identified a high-risk case through the ImTeCHO mobile phone application; subsequently, the ANMs made field visits to provide care or referral advice to the beneficiaries.

*Interventional study design and evaluation*

The study combines qualitative methodology to assess uptake, feasibility and effectiveness of the intervention in villages selected for the pilot and quantitative evaluation that examines outcomes in those villages compared to the control villages.

*Quantitative evaluation and analysis*

*Effectiveness measures and data collection.* All 32 interventional villages covered by the first PHC and 51 similar neighbouring control villages were purposively selected for a household survey. The control villages continued to receive usual services without the benefit of the intervention. This community-based survey covered all mothers native to the study area who had delivered in the previous 1–4 months (to assess the coverage of services received during the last pregnancy and intranatal and postpartum periods) or had infants aged 6–9 months at the time of the survey (to assess the coverage of services delivered in the first year of the infants' lives). Mothers were identified through a household survey at the end of 9 months of implementing the intervention. Interviews were conducted by trained data collectors from May to July 2014 using a structured pre-tested data collection tool. The survey included questions about the sociodemographic characteristics, services received throughout pregnancy, delivery and postpartum period along with household practices of the participants. For quality assurance, an independent supervisor from another voluntary organization administered a truncated data collection tool among randomly selected 5% of the respondents, which was compared with observations of records by the data collectors.

The primary outcome of interest of the study was the proportion of newborn babies who received at least five home visits by an ASHA within the first month of delivery and two home visits within the first week. The secondary outcome of interest was the coverage of other proven maternal, newborn and child health interventions. We report the number and proportion of ASHAs who fulfilled each feasibility and acceptability criteria. We report the number and percentage of mothers who received specific maternal, newborn and child health services (e.g. registration of pregnancy within 3 months; at least four antenatal check-up [ANC] examinations) in the interventional and control groups separately. We report the relative odds (odds ratio [OR] and 95% confidence interval [CI]) of receiving maternal, newborn and child health services in the interventional compared with the control groups. The p values for difference based on Fisher's exact tests are also reported. Data analysis was done using STATA IC 10 (StataCorp LP, College Station, TX, USA) and SAS 9.4 software (SAS Institute, Cary, NC, USA).

*Measurement of uptake of the mHealth intervention in the form of data usage.* We assessed the feasibility and acceptability of the ImTeCHO application as a job aid to ASHAs by using the quantitative data on usage of the application directly from the smartphones and from the PHC supervising staff. We used four outcomes to assess the acceptability, feasibility, usefulness and uptake of ImTeCHO among the ASHAs: (i) the average task completion rate (TCR), which was defined as the proportion of tasks completed by ASHAs compared to the expected number of completed tasks. The expected number of tasks was the number of tasks generated by the ImTeCHO system based on national guidelines for various programmes to be implemented by ASHAs; (ii) the average login rate (LR), which was the proportion of days the ASHA logged into the ImTeCHO mobile phone application compared to the total number of days in the field; (iii) the proportion of ASHAs who were unable to learn to operate the ImTeCHO application; and (iv) the proportion of ASHAs who refused to use the ImTeCHO application or who stopped using it during the pilot study. The TCR and the LR were obtained in real time from the ImTeCHO web interface from the time of completion of the training to the end of the study (September 2013 to February 2014). Data on the remaining outcomes were obtained through routine programme management activities and our interactions with the PHC staff. All the 45 ASHAs from the two PHCs contributed data for this component of our analysis.

*Qualitative analysis*

The ASHAs from the interventional area were purposively selected for interviews. Six ASHAs were individually interviewed at the community level and nine ASHAs participated in a focus

TABLE I. Sociodemographic characteristics of mothers who delivered in previous 1–4 months (*n*=50 respondents in the intervention and *n*=49 respondents in the control areas)

| Sociodemographic characteristics | Frequency (%) | | p value |
|---|---|---|---|
| | Women who received the intervention | Women who did not receive the intervention | |
| *Maternal education* | | | |
| No maternal education | 10 (20) | 14 (29) | 0.479 |
| Class I–VIII | 26 (52) | 20 (41) | |
| More than class VIII | 14 (28) | 15 (30) | |
| *Gravida* | | | |
| 1 | 14 (28) | 15 (31) | 0.844 |
| 2 | 17 (34) | 14 (29) | |
| 3 or more | 19 (38) | 20 (40) | |
| *Caste* | | | |
| Scheduled tribe | 50 (100) | 44 (90) | 0.068 |
| Other backward caste | 0 | 4 (8) | |
| Other caste | 0 | 1 (2) | |
| *Standard of living index* | | | |
| Lowest quintile | 13 (26) | 7 (14) | 0.364 |
| 2nd quintile | 10 (20) | 11 (22.5) | |
| 3rd quintile | 7 (14) | 11 (22.5) | |
| 4th quintile | 12 (24) | 8 (16) | |
| Highest quintile | 8 (16) | 12 (25) | |

TABLE II. Coverage of best practices and services during the last pregnancy and intranatal and postnatal periods among mothers who delivered in previous 1–4 months after 1 year of implementation (*n*=50 respondents in the intervention and *n*=49 respondents in the control areas)

| Service delivered | Frequency (%) | | Unadjusted OR (95% CI) |
|---|---|---|---|
| | Women who received the intervention | Women who did not receive the intervention | |
| *During pregnancy* | | | |
| Early registration of pregnancy within the first 3 months | 41 (82) | 28 (57) | 3.42 (1.37–8.55) |
| At least four ANC examinations by an ANM or doctor | 48 (96) | 45 (91) | 2.13 (0.37–12.22) |
| Visited at home by an ASHA at least three times during the last pregnancy | 45 (90) | 28 (57) | 6.75 (2.28–19.94) |
| Received satisfactory counselling for ANC from an ASHA during home visit | 43 (86) | 18 (36) | 10.58 (3.94–28.41) |
| The respondent able to state at least three danger signs of pregnancy | 34 (68) | 28 (57) | 1.59 (0.70–3.62) |
| The respondent took more than 100 tablets of iron folic acid during pregnancy | 25 (50) | 21 (42) | 1.33 (0.60–2.94) |
| *During delivery and postpartum period* | | | |
| Hospital delivery | 38 (76) | 35 (71) | 1.27 (0.52–3.11) |
| Early initiation of breastfeeding | 45 (90) | 36 (73) | 3.25 (1.06–9.97) |
| ASHAs visited at home within 24 hours of delivery (in case of home delivery) or within 24 hours of return to home from hospital in case of hospital delivery | 42 (84) | 34 (69) | 2.32 (0.89–6.11) |
| At least two home visits by an ASHA within the 1st week of delivery | 41 (82) | 25 (51) | 4.37 (1.75–10.90) |
| At least five home visits by a ASHA within the 1st month of delivery and two home visits within the 1st week | 28 (56) | 5 (10) | 11.2 (3.80–32.99) |
| Received satisfactory counselling for postnatal care from an ASHA during home visit | 34 (68) | 9 (18) | 9.45 (3.70–24.08) |
| Mother able to state at least three danger signs of newborn | 45 (90) | 36 (73) | 3.25 (1.06–9.97) |
| Delayed bathing of newborn after 3 days of delivery | 33 (66) | 34 (69) | 0.86 (0.37–1.99) |
| Did not apply ash/clay/anything to the cord | 32 (64) | 18 (36) | 3.06 (1.35–6.95) |
| Care-seeking for complications | | | |
| Sought help from an ASHA for antenatal maternal complication | 24 out of 31 cases (77) | 19 out of 33 cases (57) | 2.53 (0.85–7.51) |
| Sought help from an ASHA for postnatal maternal complication | 8 out of 13 cases (61) | 1 out of 11 cases (9) | 16.0 (1.54–166.05) |
| Sought help from an ASHA for neonatal complication | 15 out of 19 cases (78) | 5 out of 18 cases (27) | 9.75 (2.15–44.14) |

CI confidence interval OR odds ratio ANM auxiliary nurse midwife ANC antenatal care ASHA accredited social health activist

TABLE III. Coverage of best practices and services among mothers of infants aged 6–9 months ($n$=95 respondents in intervention and $n$=92 respondents in the control area) and care-seeking among complicated cases after 1 year of implementation

| Service | Frequency (%) | | Unadjusted odds ratio (CI) |
|---|---|---|---|
| | Women who received the intervention | Women who did not receive the intervention | |
| Exclusive breastfeeding during the first 6 months | 42 (44) | 22 (23) | 2.50 (1.29–4.98) |
| Child was fed solid, semi-solid or soft food at least once within the past 24 hours | 73 (74) | 71 (79) | 0.77 (0.37–1.62) |
| Mother knew the status of child on the WHO growth chart | 28 (29) | 5 (5) | 7.20 (2.56–25.17) |
| Mother obtained ORS from an ASHA for child's diarrhoea (%) | 6 of 44 cases (14) | 2 of 32 cases (6) | 2.30 (0.38–25) |
| Mother sought help from an ASHA for child's pneumonia/ fever (%) | 45 of 111 cases (41) | 21 of 89 cases (24) | 2.20 (1.14–4.33) |

ORS oral rehydration solution CI confidence interval ASHA accredited social health activist

group discussion (FGD) at the SEWA Rural campus. All six home visits conducted by the selected ASHAs on the day of the interview were observed. Interviews and FGDs were conducted by a team of researchers, one external and two belonging to SEWA Rural, none of whom were connected with the development of the intervention for or training of the ASHAs. The statistical software WEFT-QDA (version 1.0.1) was used to analyse the data.[14]

### *Ethical considerations*

Approval was obtained from the Multi-institution Ethics Committee, Mumbai, before the start of the study. Trained data collectors explained the risks and benefits of the study to the participants and provided an information sheet and the consent form. Subsequently, written consent was obtained from all the consenting participants before the data were collected.

## RESULTS

### *Quantitative results*

*Study outcomes to assess effectiveness.* The demographic characteristics were similar in the interventional and control groups (Table I). The coverage of maternal, newborn and child health services largely improved during the antenatal, postpartum and early infancy periods due to the intervention; however, there was no significant difference in the intranatal services (Tables II and III).

*Usage and uptake data of mHealth intervention along with efforts for supportive supervision.* All ASHAs demonstrated sufficient competency to use the ImTeCHO application. None of the ASHAs stopped using the ImTeCHO mobile phone application throughout the project. Two women stopped working as ASHAs during the course of the project due to reasons unrelated to ImTeCHO, and their replacements continued to use ImTeCHO.

During the pilot phase, 10 774 tasks were generated, of which 7710 (71%) were completed by the ASHAs. The average LR was 88% from September 2013 to February 2014. Figure 2 shows the trend of TCR and LR throughout the study period. The failure rate, defined as the proportion of forms that failed to get synced with the server, was <1%. The facilitator received 1.43 calls/ ASHA/month for support or to report any problem. The facilitator made an average of 0.87 calls per ASHA for performance review and 0.63 field visits per ASHA per month to troubleshoot any technology-related issues. The ASHAs' average monthly performance-based incentives increased to ₹270 (by 18.9%) after the second part of the intervention was implemented

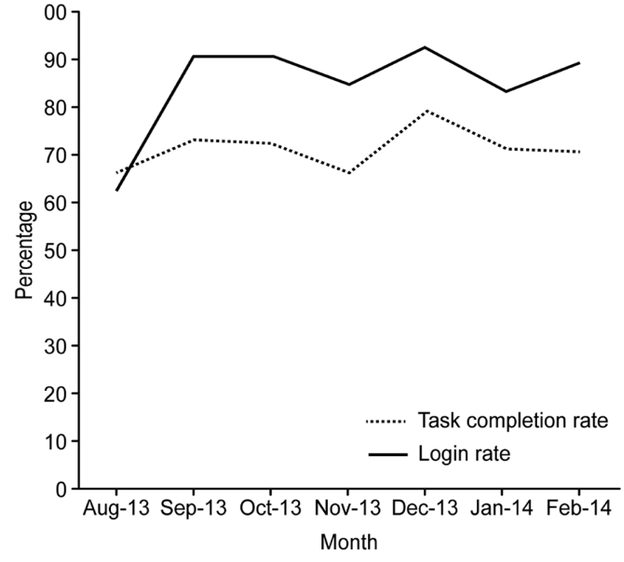


FIG 2. The trend of task completion rate and login rate throughout the study period

(September to November 2014), compared to the baseline period (May to July 2013). There was a significant improvement in care-seeking from ASHAs for postnatal maternal care (OR 16.0, CI 1.54–166.05) and postnatal neonatal care (OR 9.75, CI 2.15–44.14).

### *Qualitative study results*

The results of the qualitative theme-wise evaluation are briefly described below.

*Work scheduling and workload.* Most of the ASHAs agreed that the ImTeCHO application supported them in their work, and did not add components to the ones they were expected to collect before the use of ImTeCHO. A snippet of conversation to the effect is as follows:

*ASHA 2:* 'We meet beneficiaries more frequently after the introduction of ImTeCHO.'

*Interviewer:* 'Why?'

*All ASHAs:* 'Now we have visits and we meet beneficiaries more frequently otherwise the colour of the text on device will turn red and we will not get our incentive. We will get the incentive only if we do the visit.'

The ImTeCHO application made home visitations considerably systematic for the ASHAs. The colour of text on the mobile screen served as a reminder for a task 'turning red' (when the task was not completed by the due date) and put moral pressure on them. They felt obligated to prevent this from happening. Moreover, they realized that they would receive a call from the facilitator from SEWA Rural if this happened frequently. However, some of the ASHAs felt that their workload increased with the mobile application. The ASHAs found the ImTeCHO's childcare schedule (children older than 2 months) to be more intensive than what they would like, especially because this was a non-incentivized task.

*Point-of-care electronic decision support and medical information.* The aspect of ImTeCHO most appreciated by the ASHAs was that they no longer needed to remember medical information. This application automated what they were expected to ask and what they were expected to do. A snippet of conversation to the effect is as follows:

*Interviewer:* 'You used to examine based on your memory [before the introduction of ImTeCHO]. Now, there is a series of questions [in the mobile] that reminds you to complete the examination.'

*ASHA 3:* 'Yes, there are many questions, and if we answer them all, we get some suggestions and respond accordingly.'

Several ASHAs reported that they felt more confident in treating complications due to medicines because ImTeCHO gave them advice on indications and dosage. Supervisory notes revealed that there were instances of a false-positive diagnosis of complications, which were mainly due to errors by the ASHAs while entering data. However, the incidence of false-positive diagnoses was significantly reduced over time.

*Behaviour change communication (BCC)*

The ASHAs appreciated the BCC videos loaded in the application. They found the content of the videos to be culturally acceptable, and the brief videos (2–3 minutes long) easy to use. They perceived that videos reduced their task of counselling: '*you don't need to talk anymore'*. They felt that the credibility of the information was increased because it was provided by the video in the voice of a doctor. Brief snippets of conversation to the effect are as follows:

*ASHA 4:* 'It's easier for beneficiaries to understand [key messages] when we show them videos. They ask fewer questions [which might arise earlier due to lack of understanding].'

*ASHA 5:* 'The videos make it easier especially for illiterate beneficiaries to understand key messages.'

During the field visits, it was observed that some ASHAs verified whether the client had understood the information provided by the video, whereas others did not engage in any conversation about the client's understanding. In all the field visits it was observed that the beneficiaries as well as their families watched the video attentively. Some ASHAs complained that beneficiaries found the videos monotonous because of repetition.

*Supervision, support and motivation*

During all the interviews, it was clear that the real-time information made available through the ImTeCHO application to the ASHAs made their supervision tasks easier. The ASHAs found the support provided by the SEWA Rural's facilitator and emergency response team useful and essential. The inputs provided by the SEWA Rural team can be divided into three categories, i.e. technology support, supervision and patient care support/referrals.

The ImTeCHO facilitator from SEWA Rural provided technology support when the ASHAs encountered issues related to data transfer, camera and new update. A snippet of conversation to the effect is as follows:

*ASHA 6:* 'Once, there was a technical problem related to the camera. The ImTeCHO facilitator could not resolve it when he visited me. Later, he got the phone repaired from a technician and brought it back to me.'

The emergency response team provided support towards patient care and managing referrals. The team would also contact the beneficiary over phone or in person to counsel complicated high-risk cases (to get referred to hospital in case they are not willing), facilitate referral and regular follow-up after discharge.

*Many ASHAs:* 'I can call the emergency response team to resolve problems in the field such as counselling difficult beneficiaries, facilitating referrals and obtaining advice for treatment.'

Some of the ASHAs did not appreciate the frequent phone calls for supervision from the emergency response team in case of any complicated high-risk cases which they considered took significant time away from their own tasks.

*ASHA–beneficiary interaction*

All the ASHAs agreed that the beneficiaries found ImTeCHO acceptable. This was confirmed by the observation of the visits. None of the beneficiaries displayed or expressed discomfort with the presence of the mobile phone.

A significant change produced by ImTeCHO in the ASHAs' understanding of their work was the definition of a 'home visit'. The ASHAs who were interviewed recognized that they had previously defined visits arbitrarily. The imperative of entering specific information into the mobile phone and performing certain examinations had helped structure the visit to a great extent. A snippet of conversation to the effect is as follows:

*ASHA 6:* 'Previously, we did not need to fill in such a long form; we only had to weigh the baby, ask the mother whether the baby was taking adequate feed and document it [the responses to the questions asked] in our diary. But it is better now because we meet the woman and weigh the baby at the recommended time. We used to commonly skip the home visits, but it is not happening now with this new system [the ImTeCHO application]. I am just saying the truth!'

## DISCUSSION

The findings of this qualitative study show that there was a high degree of acceptability, feasibility and usefulness for the intervention among the ASHAs, which was supported by a high uptake of ImTeCHO, as demonstrated by consistently high TCR and LR. The intervention was found to be effective towards increasing coverage of many of the maternal, newborn and child health interventions during pregnancy, postnatal period and infancy. It was observed that the beneficiaries were more likely to seek care for complications from an ASHA in the interventional area, which might indicate improved confidence of the villagers in ASHAs. Although the focus of the enquiry was on the acceptability, usefulness and feasibility of the intervention in its given context, it is important to extrapolate the findings to further modify the ImTeCHO mobile phone application and implementation plan to overcome potential challenges when the intervention is scaled.

Other studies have reported high levels of perceived acceptability of mHealth interventions among CHWs and initial enthusiasm for using mobile phones.[15–18] However, only a few studies have examined the uptake of mHealth interventions, and almost all of these studies have reported low uptakes. Most of the users expressed verbal readiness to use the technology platform; however, they did not end up using it regularly when the technology intervention was implemented.[17,18] The reasons for low uptake despite a high perception of acceptability range from misunderstanding about how to use mobile phone applications to inability to motivate the CHWs through the intervention. Researchers have emphasized the need to understand the motivations of CHWs and closer supervision for higher uptake.[17,18] A systematic review noted that mHealth interventions, when used as a job aid, helped health workers adhere to treatment protocols and improved patient outcomes.[19] The coverage of selected maternal and newborn care interventions was found to be low in this study; however, similar results were found in other studies as well. In a study done in Uttar Pradesh, the coverage of iron folic acid supplementation for at least 3 months during pregnancy was only 3%,[20] whereas only 19% of the neonates were visited by ASHAs at their home within the first 3 days of birth. Less than 1% of the families sought care from ASHAs or *Anganwadi* workers when their children were suffering from diarrhoea and pneumonia.[21,22]

The high level of uptake among users of ImTeCHO might be explained by the fact that we identified genuine challenges faced by the ASHAs and used the technology platform to overcome some of them using principles of change management and the human-centric design applied throughout the development and implementation of ImTeCHO.[23,24] Some of the actions taken to understand and solve the challenges are listed below. An in-depth gap analysis was conducted before the development of ImTeCHO to identify the challenges faced by ASHAs, which may be associated with suboptimal performance. We identified factors that motivate ASHAs. One of the major motivations for ASHAs is performance-based incentives. By streamlining the incentive system, ImTeCHO created value for the ASHAs. Similarly, we used the ImTeCHO platform to address other factors that motivate ASHAs. Most importantly, the benefits of using ImTeCHO were repeatedly communicated to the ASHAs and PHC staff. Their participation in implementing and refining the ImTeCHO application through an iterative process made them partners in producing this 'change'. This was coupled with encouragement from local and national health administrative bodies.

Important lessons can be learnt for a potential scale up of the ImTeCHO application based on formative evaluation. Supervision and support provided by SEWA Rural was essential in the functioning of the intervention; such support will be essential for a potential scale up, at least during the initial period of implementation. The training and ongoing support should be modified to further leverage mobile phone technology to improve coverage of certain key maternal, newborn and child health services. It is imperative to expand the scope of the software platform to include other important domains of public health and other cadres of frontline health workers in case the project is scaled up so that all health workers use a single digital platform instead of many. A call centre to provide support for technology-related issues and coordinate referral will be vital for large-scale implementation.

We urge that the use of technology should be explored to impart ongoing training. Although there was good ownership among the ASHAs, it was challenging to engage the staff at the PHC; however, the official instructions from the district- and state-level administrators helped to get the required buy-in.

It should be noted that the ImTeCHO pilot was conducted in an area where long-term programmes on maternal and newborn health have been implemented, which involve routine visits and detailed note taking by CHWs. It is important to test the above-stated objectives in areas without such a history of implementing community-based services. However, a sensitivity analysis found that TCR and LR were also high among those ASHAs who were not involved in the above-mentioned long-term programme. Among other limitations of the study are lack of baseline data and a relatively small sample size. In addition, the effectiveness observed in this study might not be only attributed to ImTeCHO considering the managerial inputs from SEWA Rural; therefore, the intervention should be tested with a more robust study design to attribute the effect to the intervention, for which we plan to conduct a cluster randomized trial.

### *Conclusion*

The ImTeCHO mobile phone application was found to be highly acceptable, feasible and useful to ASHAs. The underlying assumptions were tested successfully. Important lessons were learnt, which may be useful for further improving the ImTeCHO application. The intervention might be useful for improving antenatal and postnatal care along with care of complicated cases; the widespread use of mobiles in the country, therefore, makes use of mobile phone technology an important strategy to reduce maternal, newborn and infant mortality.

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*Conflicts of interest.* None declared

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