ORIGINAL RESEARCH

TeCHO+ program in Gujarat: a protocol for health technology assessment

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Received 18 May 2019
Revised 31 December 2019
Accepted 4 June 2020

Check for updates

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To cite: Saha S, Kotwani P, Pandya A, *et al*. *BMJ Innov* Epub ahead of print: [please include Day Month Year]. doi:10.1136/bmjinnov-2019-000363

ABSTRACT

The Health and Family Welfare Department, Government of Gujarat, is implementing a program named Technology for Community Health Operation or TeCHO+ addressing state's priority health issues. This program envisages replacing the existing mother and child tracking system or e-Mamta application in the state. This program is based on ImTeCHO—Innovative Mobile Technology for Community Health Operations—which was piloted in Jhagadia, Bharuch district of Gujarat in 2013. The program showed improvements not only in terms of coverage of maternal and newborn care packages averting malnutrition but also was cost-effective. This paper details the protocol for health technology assessment to assess the impact of TeCHO+ program on data quality, improvement in service delivery coverage, reduction in morbidity and mortality as well as assess the cost-effectiveness. The study will be conducted in five districts of the state. A mixed-method approach will be adopted. Data will be validated in a phased manner over a period of 3 years along with an assessment of key outcome indicators. Additionally, key informant interviews will be conducted and cost data will be gathered to perform cost-effectiveness analysis. The study will inform policymakers about the impact of TeCHO+ program on quality, access and cost-effectiveness of healthcare services.

INTRODUCTION

Sustainable development goals (SDGs) aim at a reduction in maternal, newborn and child mortality and undernutrition. However, there is low coverage of maternal and child health services in Gujarat. As per National Family Health Survey 4 data, only 30.7% of the pregnant women have received full antenatal care (ANC) and 50.4% of the children were fully immunised. There is a huge burden on the health system with 38.5% of the stunted children and severe wasting in 9.2% of the children in Gujarat.[1] Besides, the current mother and child tracking system (MCTS) is inefficient in reflecting the latest grass root level data due to huge backlog in data entry.[2] The poor coverage of health services and inadequate data management pose itself as an obstacle to achieving SDGs.[3 4]

In response to the need for addressing above issues, the Health and Family Welfare Department, Gujarat, in collaboration with SEWA Rural, a voluntary organisation, had piloted a mobile health program, named ImTeCHO (Innovative mobile technology for Community Health Operation), in two talukas of Bharuch district in Gujarat. Based on the success of the ImTeCHO program, the Health and Family Welfare Department, Gujarat, has scaled up the program as TeCHO+ (Technology for Community Health Operations) across the state addressing 11 priority health issues in a phased manner. Key differences between ImTeCHO and TeCHO+ program have been highlighted in table 1.

TeCHO+ is a mobile and web-based application that essentially enables data entry by the person providing service, at the time and place of service delivery to improve the coverage and data quality. The program encompasses unique features such as real-time data entry, generates alerts for high-risk cases, tracks beneficiaries as well as health workers, web-based dashboard enables health

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Table 1 Difference between TeCHO+ and ImTeCHO

TeCHO+	ImTeCHO
Implemented by H&FW Department, Government of Gujarat	A mHealth intervention was piloted by a non-governmental organisation, SEWA Rural in partnership with H&FW Gujarat and with financial support from ICMR
Implemented across the state	Piloted in Bharuch District
Smartphones are given to all FHW	Smartphones were given to all ASHAs (Accredited Social Health Activists) in the intervention area
Comprehensive care targeted at improving 11 health indicators – maternal health, infant health, low birth weight babies, complete immunisation, malnutrition, anaemia during pregnancy, epidemics, sex ratio at birth, mental health, birth spacing and non-communicable conditions	Targeted at improving reproductive, maternal and child health only

FHWs, Female Health Workers; H&FW, Health and Family Welfare; ICMR, Indian Council of Medical Research; ImTeCHO, Innovative mobile technology for Community Health Operation; SEWA, Self Employed Women's Association; TeCHO+, Technology for Community Health Operations.

officials at different levels to access progress reports and extends supportive supervision to health workers. These unique features are expected to enhance Gujarat's performance in 11 priority areas. Box 1 presents features of TeCHO+ program.

For effective implementation, the said program is divided into three phases. The first phase was dedicated to fetch data from e-Mamta and to do family health survey; the second phase primarily focused on reproductive and child health indicators and third phase will incorporate the remaining components. As of March 2019, the second phase of TeCHO+ program has been implemented across the state.

Box 1 Features of Technology for Community Health Operations (TeCHO+).

1. **Real-time data entry:** The health workers enter data offline/online. They receive daily work plan in the application; therefore, daily log-in is mandatory.
2. **Alerts for high-risk cases:** It stratifies risks and generates alerts for high-risk cases, which notifies health worker as well as respective health officials like medical officer at primary health centre (MO-PHC), district and taluka TeCHO+ coordinator (DTC and TTC) for an action.
3. **Tracks beneficiaries**: Artificial intelligence function tracks beneficiaries, their movements (migration), eligible couples and under 5 children for the purpose of immunisation and other reproductive and child health-related services.
4. **Dashboard and automatic report generation:** The web interface is updated daily. The state, district and taluka level reports are autogenerated, which can be accessed by the supervisory cadre of health officials.
5. **Supportive supervision and monitoring:** Health workers can seek assistance for any technical problems through helpline number. Any operational or technical troubles faced by health workers are immediately resolved by TTC or DTC who provide supportive supervision when needed. Further, GPS tracker enables real-time monitoring of health workers' visits, services delivered and automatic updation of dashboard to track the work progress.

The TeCHO+ program aims to improve the service coverage and data quality by early identification of morbid condition and timely treatment. The conceptual framework of the proposed study has been shown in figure 1.

The proposed study aims to undertake a health technology assessment of the TeCHO+ program from a health systems perspective. The study will inform policymakers specifically about the impact of TeCHO+ program on quality of, access to and cost of healthcare services.

Proposed protocol for health technology assessment of TeCHO+ program

Health technology assessment of TeCHO+ program has four objectives: (1) assess the incremental cost of delivering TeCHO+ solutions, (2) assess key outcome indicators for measuring program impact, (3) estimate the incremental cost-effectiveness ratio (ICER) of the program and (4) assess pathways to the observed program outcomes.

The details regarding 'Participants, Intervention, Control, Outcome and Timeline (PICOT)' are presented in table 2.

METHODS

The study will adopt a mixed-method approach. Quantitative survey will be used for validation of the data. Key informant interviews will be undertaken for identification of program-related cost along with the review of cost records. The study will compare key program outcome indicators of TeCHO+ program with e-Mamta as a comparator arm.

Objective specific methods and plan of analysis adopted are elaborated in the section below.

Objective 1: assessment of the incremental cost of delivering mHealth solutions

Cost data will be collected from a health systems perspective. An incremental costing approach will be adapted for the study. Financial record of TeCHO+ program will remain a key source of information. In addition, a time usage study will be conducted to

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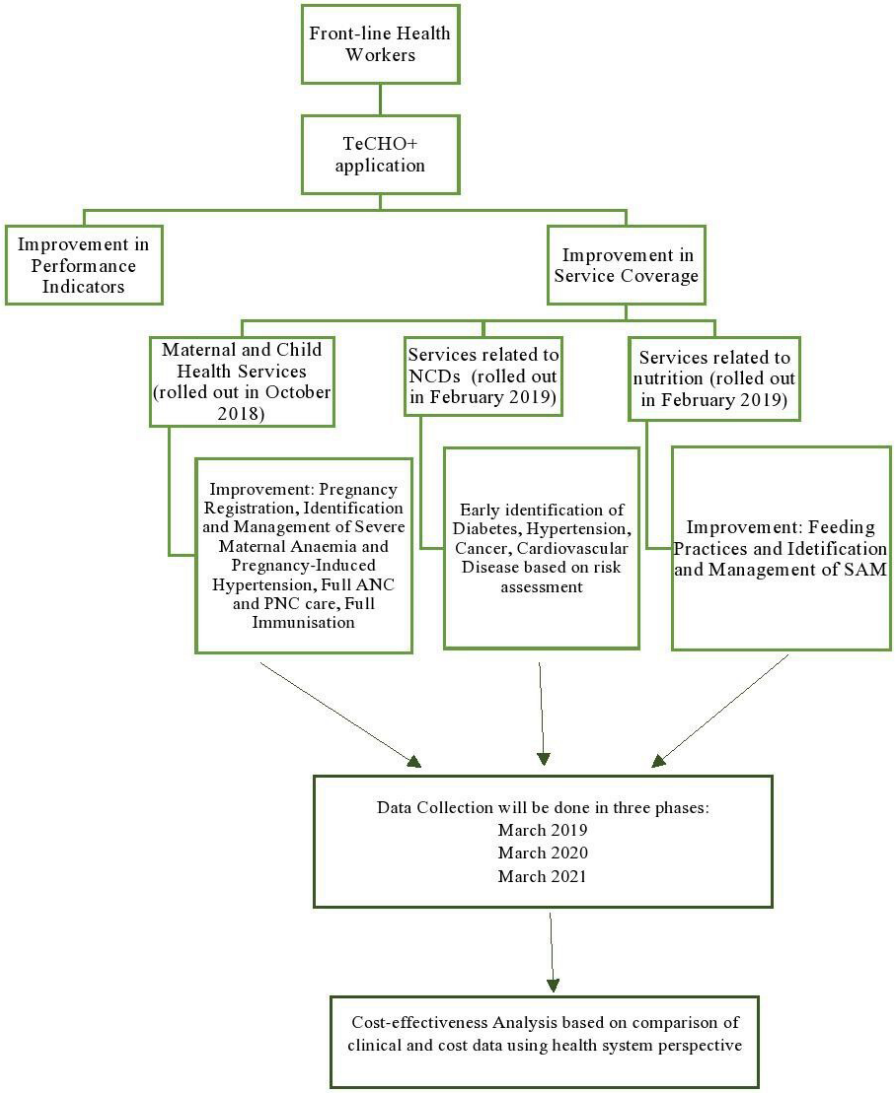

Figure 1 Conceptual Framework of the Study. ANC, antenatal care; NCD, non-communicable disease; PNC, postnatal care; SAM, severe acute malnutrition; TeCHO+, Technology for Community Health Operations.

assess the true cost incurred by the state from a health systems perspective. The time usage study will also aim at estimating any time saved as a result of the TeCHO+ program. This will be collected by interviewing key stakeholders and program staffs at every level.

We will include two cost heads, start-up cost and annual implementation cost at 2018–2019 price. Capital costs including start-up costs such as software development will be estimated by completing a checklist of all equipments (such as mobile phones, computers, server, motorbikes and other hardware) and furniture used in the program and useful life of the equipment. Cost of capital items will be annualised across the project life, with discounting at an annual

Table 2 Participants, Intervention, Control, Outcome and Timeline (PICOT) for the HTA

Bird view of PICOT for the HTA of TeCHO+ program	
Participants:	FHWs, TeCHO+ coordinators (district/taluka/territory), women and newborn (phase 1) and the entire family (phase 2)
Intervention:	Service delivery facilitated by TeCHO+
Control:	Baseline data validated from e-Mamta (mother and child tracking system)
Outcome:	Adherence and coverage, improved data quality, morbidity management and mortality (in phases) and cost-effectiveness
Timeline:	Data will be collected in three rounds. March 2019 for measuring adherence and coverage of essential MNCH packages, March 2020 for measuring morbidity management and March 2021 for measuring mortality indicators. This will enable addressing common trends or time-invariant differences in the observed effect.

FHW, Female Health Worker; HTA, Health Technology Assessment; MNCH, Maternal, Newborn and Child Health; TeCHO+, Technology for Community Health Operations.

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rate of 3% as recommended by the Department of Health Research, Government of India.[5]

Orientation training cost will be considered since the launch of the program. Refresher training is assumed to be a recurrent activity. Cost of time spent by various technical partners of TeCHO+ program towards capacity building, software development and resource utilisation will be assessed through interviews and financial record. Primary health centre (PHC) data entry operator and auxiliary nurse midwives (ANMs) will be interviewed to estimate the amount of time spent on various activities at a different time of the intervention.

Objective 2: assessment of key outcome indicators for measuring program impact

Program impact will be measured over 3 years 2019–2021, with three rounds of data collection each year during March–April. The objective would be to assess whether TeCHO+ program improved coverage and morbidity management over the study reference period.

At baseline, data from a sample of existing MCTS known as e-Mamta in Gujarat will be obtained. The study team will undertake validation exercise in sampled households among five districts of Gujarat, namely Gandhinagar, Sabarkantha, Bharuch, Panchmahal and Devbhumi Dwarka. The selection of these five district is explained in the sample selection and sample size section.

The first step of assessing any routine health information system such as e-Mamta is the registration of eligible beneficiaries; however, incomplete registration is a major concern. In India, registration of pregnant women in the MCTS is suboptimal and few authors argue it to be as low as 35%.[6]

In order to address the limitation of the e-Mamta program, data will be gathered at two levels:

1. A line list of all eligible households will be obtained from the respective ANMs for her subcentre. A sample of those households will be surveyed, as detailed below. This will enable an intent-to-treat analysis and will also cover households who have received services from ANM, but whose entries were missing in e-Mamta.
2. A list of all eligible households will be obtained from e-Mamta. All details about their ANC, postnatal care, child health services and morbid conditions will be obtained from e-Mamta for the selected sample. This will enable per-protocol analysis.

In the subsequent rounds, data from TeCHO+ program will be validated to assess the coverage and morbidity management. Table 3 presents indicators with a specified timeline for the reference.

Table 3 Indicators and timeline for measurement

Indicators	March 2019	March 2020	March 2021
Maternal care			
No of pregnancy registrations	√		
Task completion rate by FHW	√		
Identification of severe maternal anaemia		√	
Mothers who received full antenatal care (%)		√	
Mothers who received full postnatal care (%)		√	
Institutional births (%)		√	
Management of severe maternal anaemia			√
Pregnancy-induced hypertension and management			√
Children care and immunisations			
Identification of LBW (less than 2.5 kg) and its management		√	
Identification of SAM (%)		√	
Referral of children to NRC/CMTC/CMAM (%)		√	
Children aged 12–23 months fully immunised (BCG, measles and three doses each of polio and DPT) (%)			√
Feeding practices			
Children under age 6 months exclusively breast fed (%)		√	
Children aged 6–8 months receiving complementary feeding (%)		√	
NCD indicators			
To be determined based on actual rollout—expected around March 2019			√

CMAM, Community-Based Management of Acute Malnutrition; CMTC, Child Malnutrition Treatment Center; DPT, diphtheria, pertussis, tetanus; FHW, Female Health Worker; LBW, Low Birth Weight; NCD, Non-Communicable Disease; NRC, Nutrition Rehabilitation Center; SAM, Severe Acute Malnutrition.

Participants' inclusion criteria for validation

At baseline, the inclusion criteria are as follows:

1. Women who have delivered between 1 November 2018 to 31 January 2019.
2. Children in the age group of 12–15 months for child-related indicators (ie, 1 November 2017 to 31 January 2018).
3. Pregnant women and children with specific high-risk conditions (2018–2019).

Participant's exclusion criteria for validation

For the proposed study, population will not include the residents of urban talukas and municipal corporation areas.

Sample selection and sample size

The study participants will be surveyed from 80 subcentres spread across the five selected districts of Gujarat. The selection of the district is done based on the category of Human Development Index (HDI) ranking of Gujarat, 2001, and maturity of TeCHO+ program. The selection of talukas will be done purposively based on their distance to their respective headquarters. However, a simple random sampling method

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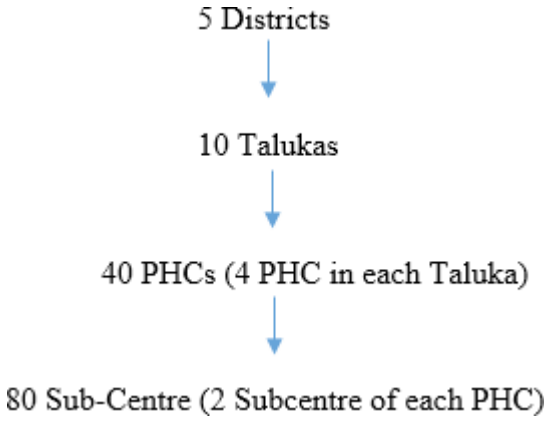

Figure 2 Sampling design. PHC, primary health centre.

will be adopted to select the PHC and subcentre using a table of random numbers. Figure 2 presents the sampling of the proposed study.

The sample size for assessing the indicators related to maternal care is 634 women considering a 50% prevalence of anaemia during pregnancy,[1] with 10% non-response rate at design effect 1.5 accounting for intracluster variation. To achieve the desired sample size, a household survey of eight women will be done at each subcentre. However, for immunisation and feeding-related indicators in children, we will survey 240 children (210+ additional sample to account for non-response rate) based on the WHO model of validation.[7]

For morbidity and its management-related indicators, all the high-risk women suffering from severe maternal anaemia and pregnancy-induced hypertension and children suffering from severe acute malnutrition and low birth weight reported at the selected PHCs will be surveyed.

Objective 3: estimation of the ICER of the program

Cost-effectiveness ratios will be estimated by dividing the incremental cost of the intervention with the number of deaths averted to estimate the cost per quality-adjusted life-years (QALYs) gained.

Proximal outputs in terms of changes in service coverage will be modelled to estimate key outcome variables, deaths averted and QALYs gained in Gujarat. Probabilistic sensitivity analysis will be undertaken to account for parameter uncertainties.

According to the most commonly cited cost-effectiveness thresholds, an intervention is considered cost-effective if the ICER (cost per life-year saved) is equal to less than per capita GDP.[7]

Objective 4: assess pathways to the observed program outcome

Several factors are expected to contribute to the observed effect. To understand the pathway to change is important for any health technology assessment study. This includes an in-depth understanding of the contribution of factors including supportive supervision, behaviour changes among Female Health Workers (FHWs) and medical officer at primary health centres (MO-PHCs) and the contribution of the software application to the observed outcome. Hence, a mixed-method approach incorporating in-depth interviews in a realist paradigm will be undertaken to understand the contribution of each of the program components. Program managers from the Health and Family Welfare Department, important stakeholders, MO-PHCs, FHWs and Accredited Social Health Activists (ASHAs) will be interviewed to understand the program pathway.

Plan of analysis

Data over the 3 years' time period will enable an analysis of whether TeCHO+ program improved coverage and morbidity management. These proximal outcomes in terms of changes in service coverage and morbidity management will be modelled to estimate key outcome variables, deaths averted and QALYs gained in Gujarat. Probabilistic sensitivity analysis will be undertaken to account for parameter uncertainties. Cost data analysis will enable a complete assessment of program cost and thereby undertake a comprehensive cost-effectiveness analysis of the program. In addition, the possibility of conducting an extended cost-effectiveness analysis[8–10] alongside modelling national scale-up of the TeCHO+ program will be explored.

DISCUSSION

The rapid development of mobile communication devices has fuelled an increase in mHealth services. It is not clear whether the promise of greater access to improved quality and reduced cost of healthcare has been realised.

Previous mHealth interventions performed in India proved themselves to be cost-effective. ImTeCHO[6] in Gujarat was found to be effective in averting malnutrition and improving coverage of essential maternal and newborn package of services. The improved service coverage significantly resulted in a reduction in illness during pregnancy, immediately after childbirth and during the neonatal period.[6] Furthermore, ImTeCHO intervention was found to be cost-effective from a program perspective at an incremental cost of US$39 per life-years saved and US$2649 per death averted.[11] Another mHealth application, ReMiND, was implemented in 2012 through 259 ASHAs in two blocks of Kaushambi district of Uttar Pradesh state of India that resulted in a reduction of 0.2% maternal and 5.3% neonatal deaths. The incremental cost of ReMiND program was US$205 per Disability Adjusted Life Year (DALY) averted and US$5865 per death averted.[12]

The proposed HTA will inform whether TeCHO+ program is effective in improving access to and quality healthcare services and whether costs associated with mHealth are reduced. The qualitative study will also highlight further research and innovation in terms of the benefits and shortcomings of TeCHO+.

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Based on the outcomes of the above-cited two randomised control trials of mHealth interventions and unique features of the TeCHO+ program, it is expected to reduce maternal and neonatal mortality, improve the status of malnutrition in the under 5 children and early diagnosis and treatment of non-communicable diseases. Overall, the wholesome package of TeCHO+ is estimated to improve the quality of life years gained. Furthermore, the study can assist policymakers to make informed decisions in designing or implementing similar interventions or scaling-up TeCHO+ program nationally.

Acknowledgements The study is proposed to be conducted in collaboration with Health and Family Welfare Department, Government of Gujarat, and Department of Health Research, Ministry of Health and Family Welfare, Government of India.

Contributors SS has conceptualised and coordinated the study. PK has drafted the protocol, field-tested it and prepared the manuscript. AP aided in the manuscript writing and ensured that all the elements of the protocol were reflected in the manuscript. DS, TP and SD have reviewed the content of the protocol and edited the manuscript. DR has contributed to field testing of the protocol and reviewing the manuscript. JR has reviewed the manuscript. All authors read and approved the final version.

Funding This work has been carried out through the Regional Resource Centre for Health Technology Assessment established at Indian Institute of Public Health Gandhinagar with support from the Department of Health Research, Ministry of Health and Family Welfare, Government of India.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The ethics approval for the study has been obtained by the Institutional Ethics Committee on 19 March 2019.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data sharing not applicable as no datasets generated and/or analysed for this study. This is a protocol for health technology assessment study.

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