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Assessing the implementation of a mobile App-based electronic health record: A mixed-method study from South India

D.M. Shilpa[1], Poonam Ramesh Naik[2], Hemant Deepak Shewade[1,3,4], H Sudarshan[1]

Abstract:

BACKGROUND: Government of India recognizes the use of "information, communication, and technology" in the provision of comprehensive primary healthcare. In 2014–2015, Karuna Trust, a nongovernmental organization, Bengaluru, India, introduced an electronic health record (EHR) innovation, namely "Comprehensive Public Health Management" application (CPHM App). Data could be entered in an offline mode followed by syncing with cloud. The CPHM App was piloted in primary health center (PHC) Gumballi, in Karnataka, with focus on household survey and maternal and child health (MCH) services.

OBJECTIVES: To compare the consistency of selected MCH process indicators for Health Management Information System [HMIS] available from paper-based records and those generated through the CPHM App (2016–2017). We also explored the implementation enablers, barriers, and suggested solutions from the user perspective.

METHODS: A sequential mixed-method study design was followed. Quantitative phase involved aggregate data analysis looking into the consistency of selected MCH process indicators available from paper-based records and those generated through the CPHM App (2016–2017) followed by thematic analysis of in-depth interviews of healthcare providers. Consistency was defined as a percentage where the numerator was the HMIS-related process indicator data from CPHM App and denominator was the data from paper-based records.

RESULTS: Three out of 12 selected MCH indicators had consistency of >80%. The quarterly consistency reduced over the 2 years. Dual burden of entry and regular monitoring of paper-based records by district health and family welfare department were the reasons why more importance was given to entry in paper-based records. Ability to generate aggregate indicators with CPHM App, easy to use and retrieve data in the field, and reminder facility for planned health activities were some of the factors facilitating CPHM implementation. The key barriers were limited technical expertise and support from the technical team and no internet connectivity in the field and traveling to PHC to sync the data. Provision of real-time technical support and availability of data connectivity in the field were some of the solutions suggested.

CONCLUSION: There should be a minimum of 1–2 years of simultaneous use of EHR and paper-based records after which one must shift to EHR.

Keywords:

Comprehensive Public Health Management App, electronic health records, health system research, maternal and child health services, Structured Operational Research and Training Initiative

[1]Karuna Trust, Bengaluru, [2]Department of Community Medicine, Yenepoya Medical College, Yenepoya (Deemed to be University), Mangalore, Karnataka, [3]The Union South-East Asia Office, New Delhi, India, [4]International Union Against Tuberculosis and Lung Diseases (The Union), Paris, France

Address for correspondence:
Dr. Poonam Ramesh Naik, Department of Community Medicine, Yenepoya Medical College, Yenepoya (Deemed to be University), Mangalore, Karnataka, India.
E-mail: drpoonamnaik@gmail.com

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Introduction

The Astana Declaration (2018) focused efforts on comprehensive primary healthcare (CPHC). It is defined as a whole-of-society approach to health that aims to ensure the highest possible level of health and well-being and their equitable distribution by focusing on people needs and preferences, contributing to the sustainable development goals and universal health coverage (UHC).[1]

The report of the third global survey of the WHO global observatory for eHealth documented specific eHealth Apps (mHealth, telehealth, electronic health records [EHR] systems, and eLearning) and how these contribute to the goals of UHC.[2] The presence of population-level EHR which is linked with facility-level electronic medical records (EMRs) in public health systems helps in (i) improving patient care (diagnostic and therapeutic decisions), (ii) improving administration of healthcare systems at various levels, and (iii) generating population-level data on burden of key communicable and noncommunicable diseases.[3] Globally, there is limited implementation and research evidence related to EHR in public health settings.

In India, under the National Health Mission (NHM), CPHC is delivered through primary health centers (PHCs – administered by a medical officer) which cater to a population of 30,000. Under them are health subcenters (HSCs – staffed by an auxiliary nurse midwife [ANM]) which cater to a population of 3000–5000.[4] PHCs are expected to deliver CPHC addressing reproductive and child health care (RCH, includes maternal and child health [MCH] services), communicable diseases (tuberculosis, vector borne diseases, leprosy, and HIV), and noncommunicable diseases (diabetes, hypertension, blindness, mental health, etc.). The ANM and other staff maintain more than 30 registers. This includes paper-based household health survey data as well as data related to various disease control programs. Process indicators are generated, around 108 indicators on a monthly basis which are fed into an online Health Management Information System (HMIS) platform at the level of PHC.[5,6]

The NHM has encouraged piloting and scaling up of innovations that address enhancing the health outcomes. Under the recently launched Ayushman Bharat (meaning *long live India* in Hindi) program aiming at CPHC, one of the key elements is '*increase utilization of Information, Communication, and Technology (ICT) – empowering patients and providers.*' The Comprehensive Public Health Management App (CPHM App) has been selected as one that can address this key element at the national level.[7]

Karuna Trust (*karuna* means empathy in Sanskrit) is a nongovernmental organization based in Bengaluru, India, that manages public PHCs through a not-for-profit public–private partnership. In 2014–2015, for the first time in India, Karuna Trust in collaboration with Dell EMC2 introduced an EHR innovation, namely mobile tablet-based "Comprehensive Public Health Management" App (CPHM App). Data pertaining to household survey, RCH, noncommunicable diseases, and other health programs could be entered in an offline mode (digitized registers) in CPHM App followed by syncing with cloud as and when internet access is available. This was introduced to increase the efficiency of the field staff in data collection and to have electronic database. The CPHM App was piloted in PHC Gumballi, in Karnataka state, in South India, with a focus on household survey and MCH services.

There is limited literature on the use of EHR in routine public health settings. Understanding the implementation issues of the App from the provider's perspective will help in maximizing the desired effects. Assessment of this requires a combination of quantitative and qualitative research methods.

In this mixed-method study, we compared the consistency in reporting of selected MCH indicators available from HMIS through the registers and those generated through the CPHM App. We also explored the enablers, challenges, and suggested solutions related to its implementation from the user perspective.

Methods

Study design

This was a sequential, mixed-method study design where quantitative phase involved aggregate data analysis followed by a descriptive–qualitative phase.[8] The qualitative phase not only explained the results of quantitative phase but also studied in-depth operational issues around CPHM App implementation.

Setting

General setting

Gumballi PHC of Chamarajanagar district is located in southern part of Karnataka state (in South India) and has a population of around 23,000. It has one medical officer, one administrator, one dentist, one block health education officer, four staff nurses, one pharmacist, one laboratory technician, five ANMs, and two male health workers (MHWs).

The ANMs are supported at village level by frontline community health workers: Accredited Social Health Activists (ASHA) for health, water, and sanitation; and *Anganwadi* workers for nutrition (*anganwadi* means child

care center under the Integrated Child Development Services aimed at physical and psychological development of under-five children).

Karuna Trust

In accordance to the NHM guidelines, Karuna Trust has been managing 30 public PHCs across 23 districts of Karnataka.[9] Karuna Trust has constantly attempted to look out for ICT innovations, which help contribute toward a comprehensive primary healthcare approach.

Comprehensive Public Health Management App

The utility of the App is summarized in Figure 1. In field, ANMs are expected to enter data in the CPHM App as they conduct household survey or update the household survey data and provide services related to RCH. They receive updates in CPHM App from time to time if someone is due for antenatal visit, tetanus injections, iron supplementation, and immunization. The male health workers are expected to enter data related to noncommunicable diseases and vector-borne disease control. Similarly, the PHC medical officer is expected to ensure that updates regarding key health problems identified in PHC are updated in the CPHM App.

Since April 2017, RCH App has been introduced by the Department of Health and Family Welfare, Government of Karnataka. In this individual level, data starting from eligible couple (along with use of modern contraceptive) to pregnancy, child birth, and immunization are to be entered. Since this App is online mode supported by the SIM-card and the internet connectivity, data get automatically synced. Karuna Trust in collaboration with Dell EMC2 also plans to launch the NCD App; formal training for the same was given to the staff in July 2019.[10]

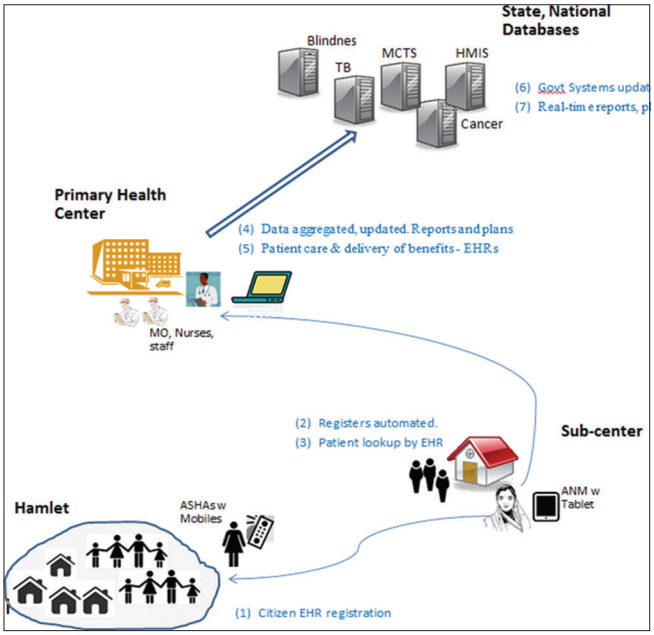

Figure 1: Utility of CPHM App in comprehensive primary health care delivery. CPHM App = Comprehensive Public Health Management App, EHR = Electronic health record, HMIS = Health management information system, MCTS = Mother and child tracking system

Study population and data collection

For the period 2016–2017, the data on selected process indicators in HMIS pertaining to MCH from PHC Gumballi (cumulative numbers) were collected manually from paper-based records and the CPHM App. These indicators were (all cumulative numbers for 2016–2017) women registered for antenatal care (ANC), women received tetanus toxoid immunization, pregnancies registration by 12 weeks of gestation, pregnant women given 180 iron folic acid tablets, pregnant women who completed four or more ANC visits, pregnant mothers with mild and severe anemia, institutional deliveries, live births, still births, neonatal deaths, low birth weight babies, mothers who received complete postnatal care, and children who completed primary immunization.

In the qualitative phase, we interviewed (between June and August 2019) a total of seven healthcare providers (key informants) of different cadres belonging to PHC Gumballi (purposive sampling). This included four ANMs, one MHW, one ASHA, and one administrator. Medical officer had not initiated the use of CPHM App to make entries of key health problems identified at PHC, and thereby, we did not include him/her for interview. The sample size was guided by saturation of findings.

Face-to-face interviews were conducted by DMS in Kannada (local language) to understand in-depth perception of the use of CPHM App. An interview guide containing broad open-ended questions was used. DMS (a master of public health) is trained in qualitative research methods. She/he is a part of the Karuna Trust team that supervises the staff at PHC Gumballi (insider expert).[11] Therefore, the role of DMS was clearly explained to the participants. DMS did not provide suggestions or report findings to the superiors (as his/her role in routine settings) based on the information collected from the interviews. The participants were assured of confidentiality and anonymity. Prior written consent was obtained from study participants (this included consent for audio recording). Verbatim notes were also taken. The participant and the researcher were present during the interview. After the interview was over, the summary of the interview was read back to the participants to ensure participant validation.

Analysis and statistics

The data collected from CPHM App and paper-based records were compared, and consistency was defined as a percentage where the numerator was the HMIS-related process indicator data received from CPHM App and denominator was the data from paper-based records.

As the paper-based records were used to report these indicators routinely to the program, these were used for comparison (used as denominator). If this percentage was close to 100 for most of the indicators, it meant that the CPHM App was used regularly in routine.

In the qualitative phase, transcripts were prepared the same day in English based on the verbatim notes and audio recordings. Manual descriptive thematic analysis was done by the two investigators (DMS and PN). Discrepancies, if any, were resolved by a third investigator (HDS). This was done to reduce subjectivity in analysis and enhance interpretive credibility.[5] The decision on coding rules and theme generation was done using standard procedures and in consensus.[12] The codes/themes were related back to the original data to ensure that the results are a reflection of the data.[13] To ensure participant validation, a summary of interview was shared with participants at the end of the interview.

Themes have been reported below in single quotation marks (bold and italicized), verbatim quotes in double quotation marks and italicized, and author explanation within quotes in square brackets. Due to confidentiality issues, the details on who said the quotes have not been provided. These findings were reported using "Consolidated Criteria for Reporting Qualitative Research" (COREQ) guidelines.[14]

Ethics

Ethical approval was obtained from the Ethics Advisory Group (EAG) of the International Union against Tuberculosis and Lung Disease, Paris, France (EAG number: 124/18). Administrative approval was taken from the concerned authorities before the start of the study. Quantitative phase involved aggregated data that were collected routinely. Hence, waiver for informed consent was sought and approved from the ethics committee. For qualitative part, written informed consent was obtained from the participants.

Results

Quantitative phase

Consistency for key MCH indicators is summarized in Table 1. More than 80% consistency has been observed for women registered for ANC (84%), children completed primary immunization (81%), and women with mild anemia (87%). Pregnant women having completed four or more antenatal check-ups showed consistency of 48%. Complete postnatal care had consistency of 9%. The consistency for these indicators was never more than 100% when analyzed quarterly between 2016 and 2017. The consistency reduced over the study period [Figure 2].

Qualitative phase

Of the seven participants interviewed, repeat interviews were conducted among four participants. The average duration of interviews was 15 min.

We tried to explore the reasons for discrepancy in data available from CPHM App and paper-based records. Dual burden of entry (both in CPHM App and paper-based records), entry-related errors, and regular monitoring of paper-based records by district health and family welfare department may be the reasons. More importance was given to entry in paper-based records.

Table 1: Cumulative maternal and child health indicators (key process indicators) for primary health center Gumballi, Karnataka, India, available from Comprehensive Public Health Management App and paper-based records (2016-2017)

MCH services	Process indicators	CPHM App	Paper-based records	Percentage*
ANC services	Women registered for ANC	510	604	84
	Antenatal mothers who received tetanus toxoid	342	583	59
	Antenatal mothers with early registration^	320	576	56
	Antenatal mothers who received 180 iron folic acid tablets	179	342	52
	Pregnant women who completed four or more ANC	276	580	48
	Antenatal mothers with anemia (mild)@	382	438	87
	Antenatal mothers with anemia (severe)#	10	33	30
Child birth	Total institutional delivery	250	552	45
	Total live births	248	558	44
	Still birth	0	5	0
	Neonatal deaths	1	0	-
	Low birth weight** babies	10	25	40
PNC services	Mothers who received PNC^^	43	476	9
Immunization	Children completing primary immunization (0-9 months)	462	572	81

*Percentage is calculated by taking numerator as HMIS-related process indicator data received from CPHM App and denominator as the data from paper-based records, Number of pregnant women registered within 1st trimester (within 12 weeks); @Hemoglobin <11 g%; #Hemoglobin <7 g%; **Weight <2.5 kg; ^^Women receiving postpartum check-up from 48 h of delivery to 14 days. CPHM App=Comprehensive Public Health Management App, MCH=Maternal and child health, ANC=Antenatal, PNC=Postnatal care

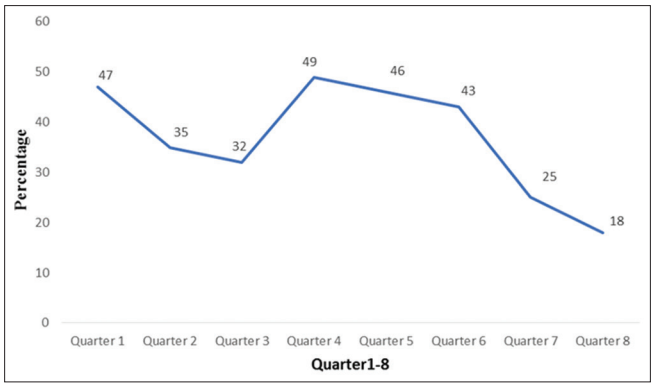

Figure 2: Quarter-wise trend of consistency in indicators generated from Comprehensive Public Health Management App and paper-based registers, from primary health center Gumballi (2016–2017). The consistency of the data captured from primary health center Gumballi from January 2016 to December 2017 shows the trend by each quarter

"There is regular monitoring of paper-based records by Government officials and so we do it meticulously and keep it complete and updated."

The qualitative findings exploring the implementation-related issues have been presented in three separate sections: perceived enablers, barriers, and then suggested solutions.

Enablers [Figure 3]

Implementation of CPHM App for recording information was welcomed and appreciated. They perceived its utility in increasing their knowledge and skill. Five themes were identified.

'Record security and easy retrievability'

First, there was easy access to the data on the CPHM App as compared to the paper-based records. Participants (users) felt that they could retrieve the records from the CPHM App even after 5–10 years. They found it faster to search and have access to certain specific records in CPHM App as compared to the paper-based records.

"Paper-based records are not lifelong. If it becomes old, we will not be able to read it."

"CPHM allows us [field staff] to access the old records promptly and easily."

They perceived the usefulness of the CPHM App in providing information about previous year. This information gave them insights into program progress and steps required to improve it.

"The App helps us [field staff] to review previous year's data and know how we can improve." This was specifically appreciated while storing the household survey data

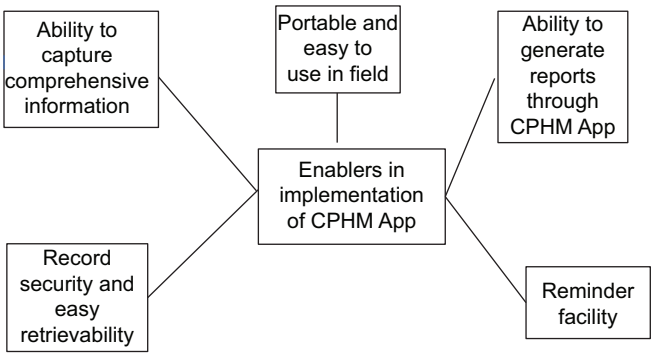

Figure 3: Nonhierarchical thematic diagram showing enablers in implementation of CPHM App as perceived by the health care providers, PHC Gumballi, Karnataka, India (2016–2017). CPHM App = Comprehensive Public Health Management App, PHC = Primary health center

in CPHM App. Earlier, they used to note these details on a notebook, and there was a possibility of losing this information. This may require collecting the information again from the family which the family members would be unwilling to provide.

"If we [field staff] visit a home, we would have done the survey of the home earlier, if we come across an antenatal mother in that home, we would have the details for that home available. So, we can open the App and understand the entire history …. If we come across a new ANC case, we would have to check the past history……. is there a history of Asthma, TB, Mental health etc… This way we are able to remember as to how we should discuss medical care with her."

'Ability to capture comprehensive information'

CPHM App was perceived as more useful than the RCH App of the Government as it had provision to capture data pertaining to communicable and noncommunicable disease in the same App.

"After using this CPHM App provided by the Karuna Trust, I feel this application is better than RCH app."

'Portable and easy to use in field'

Using CPHM App reduced the burden of carrying all the records in the field.

"We [field staff] cannot take the books everywhere but we [field staff] can take tab everywhere and do the entry."

Many used CPHM App to enter data in the field and later make entries in register after coming to the PHC.

"We [field staff] enter in the CPHM tab as it is very convenient to carry and enter, I come to PHC and make my field diary and enter in the register. CPHM App has all the components which is there in our registers, so it is not a problem."

'Reminder facility'

The participants appreciated the reminders for planned healthcare activities such as child immunization and TT vaccine for antenatal woman.

"There are different reminder options in the App…. If there is a scheduled immunization, the reminder appears. Even if we [field staff] forget, the App reminder helps us to track the activity. It shows a red mark for reminder."

'Ability to generate reports through the CPHM App'

CPHM App enabled them to generate indicators for HMIS report.

Barriers [Figure 4]

We describe the barriers under five themes.

'Limited technical expertise'

The participants (users) were initially reluctant to use the CPHM App as they were unaware of this technology. However, with support of software team and training, they started using. However, in some instances, they perceived that software support in times of "App failure" was not promptly available.

"My [field staff] CPHM App is deleted, I have informed them [technical team] but I have not received any support."

'Dual burden of carrying registers and three tablets [one each for CPHM, RCH and NCD App]'

Despite some using CPHM App to collect data in field and then returning to fill the registers, there was always a fear that they would be asked to show the registers for review by district health and family welfare officials during supervision. Hence, the dual burden of carrying registers and tablets to the field. This also meant that they had to do double data entry. In addition to paper-based records, the field staff had to maintain three different tablets which included CPHM and NCD tablets given by Karuna Trust and RCH tablets given by Government of Karnataka. RCH App is similar to the CPHM App in terms of details pertaining to RCH.

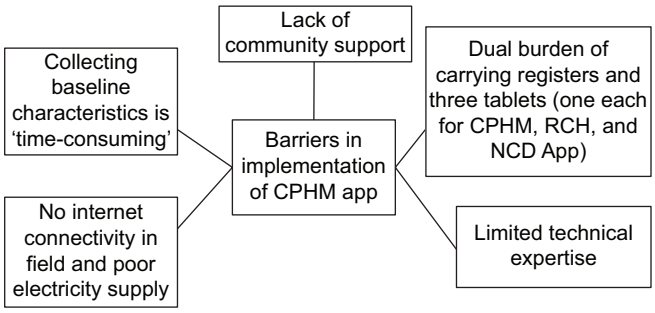

Figure 4: Nonhierarchical thematic diagram showing barriers in implementation of CPHM App as perceived by the healthcare providers, PHC Gumballi, Karnataka, India (2016–2017). CPHM = Comprehensive Public Health Management, PHC = Primary health center, RCH = Reproductive and child health, NCD = Noncommunicable disease

"They [district health and family welfare officials] say Karuna Trust is doing very good job in providing such innovation technology in health care especially for the field workers to reduce their burden but [they] still expected the registers to be present and completed up to date."

Collecting baseline characteristics is 'time-consuming'

They perceived this activity of collecting the data as time-consuming as they had to collect personal data about the family.

"Collecting one such individual or family data takes lot of our time and effort. We [field staff] know how much we would struggle to go to their house and collect their data."

'No internet connectivity in field and poor electricity supply'

The tablets did not have internet data as there were issues with recharging the internet pack. The staff had to come to the PHC traveling long distances and upload the data. They felt that RCH App given by the government had the provision of data entry in online mode which got uploaded at the same time. They preferred this method of online data entry as it did not require them to come back to the PHC for syncing the data.

"They [field staff] can immediately sync the data entered in the field, no need to come to PHC for this work, and sometimes the WiFi connection will also be shut in PHC due to some reasons"

They have to keep the tablet for charging the whole night for usage on the next day. Villages face frequent problem of electricity cutoff and this leads to tablet discharge. This seemed to be a common and major problem faced by the field staff.

"I [field staff] have done the baseline data entry for 10 households, after that battery will be completely drained off, I cannot proceed further. We come back to PHC. For this issue, if you [researcher] can organize something, we will be very happy."

'Lack of community support'

Few families were reluctant in providing personal information and family details.

"People do not support us [field staff] with required details and documents which is required to be entered in the App.

Since it is a small village, few people think negatively and are not willing to give personal details, family details and all."

Suggested solutions [Figure 5]

The following solutions were suggested by the field staff, we describe them under four themes.

'Training of staff'

This was the first time when the staff were introduced to an App. They were completely unaware of this technology earlier. They felt that it will be useful if the new staff receive training during implementation and postimplementation. They also expressed that continuous monitoring practice and technical support would help them to improve the data quality and completeness.

"Whatever App you [researcher] add, it will be good if you would provide us training, we will participate in the same and keep doing our work."

'Inclusion of HMIS format in CPHM to avoid duplication of efforts'

The field staff opined that the CPHM App may include HMIS format. This will avoid duplication of efforts of the staff.

"HMIS format can be added in CPHM App only and include our monthly reporting formats also, which will be very useful".

'Ongoing supportive supervision by the technical support team and implementer'

The field staff felt that it would be better to have ongoing technical support from the implementing organization and the technical support team. This will enable them to discuss their concerns and receive support in terms of data entry and maintenance.

"We will inform the PHC here; however, the response is a bit less. But, regular follow-up should happen from both ends."

'App should be available in online entry mode'

They were of the opinion that it will be effective to have the App in online mode as the syncing happens immediately and saves time. It also gives them the opportunity to have a look at the data immediately.

"If App is available online [internet connectivity to the tablet], it will save our time."

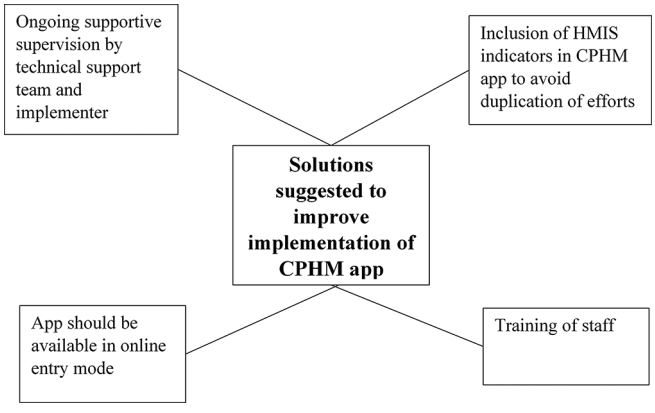

Figure 5: Nonhierarchical thematic diagram of suggested solutions in implementation of CPHM App as perceived by the healthcare providers, PHC Gumballi, Karnataka, India (2016–2017). CPHM = Comprehensive Public Health Management, PHC = Primary health center, HMIS = Health Management Information System

Discussion

Moving over from paper-based records to EHR is a welcome step in the field of public health. Mobile phone Apps are supposed to let the field staff make efficient use of time and therefore enhance the delivery of health services. In this context, this is the first mixed-method study from India on the implementation of an EHR App in routine public health setting. The field staff appreciated the use of the App in easy retrieval of records and portability.

Key findings and implications

There were some key findings. First, easy retrieval of past records and ability to link to family details on the App were appreciated by the field staff. These helped them in identifying and assessing the progress of the health profile on follow-up visits. Reminders for planned healthcare activities facilitated provision of continuum of MCH care. Mobile Apps providing decision support and facilitating case management for health workers are one common application of mHealth programming. These findings align with other studies that have reported improvement in the continuity of care in rural populations by equipping health workers with data management technologies.[15] Several studies have suggested that mobile phone-based App is an effective way to collect and report data from the community and transfer the information to a centralized database.[16] A study from rural India reported decrease in the time period from data collection by field staff to receipt of information by the regional coordinator. This reflects the efficient use of mobile-based Apps in public health in terms of data collection and management.[16-19] Similar findings were reported from a study conducted in rural Uganda, demonstrating the ability of the village health workers to use the smartphone App.[20] Accessibility to real-time data has increased the efficiency in data collection. This was similar to the study conducted in

Africa where community health workers preferred to use the Android phones to paper for data collection because they felt that the system facilitated their work and made it easier.[21]

Second, average consistency reduced from quarter 1 to quarter 8 for the selected indicators. This decrease over the quarters may possibly be due to long periods of maintaining both EHR (CPHM) and paper-based records. Field staff reported duplication of work in terms of data entry in both the App and paper-based records. During the district- and subdistrict-level meetings, supervisors review the paper-based records and the extent of indicator achievement. They may focus more on completion of paper-based records. This may lead to compromising the quantity and quality of data entered in the CPHM App. This may possibly be the reason for inconsistency of CPHM and paper-based records. Multiplicity of Apps requiring baseline data to be filled for the entire population in each App could be another reason. There should be a minimum of 1–2 years of simultaneous use of EHR and paper-based records, after which one must shift to EHR. If multiple Apps are present, they should be provided in the same tablet with provision for transfer of baseline household data.

Third, limited technical expertise and nonavailability of prompt support from technical team and implementers were the major barriers perceived by the field staff. This may lead to demotivation among the field staff to continue using the App in data collection and also deteriorates the quality of data collection. Real-time technical support and ongoing follow-up training and supportive supervision activities may be necessary to resolve these barriers. A study conducted in Northern Nigeria demonstrated that healthcare intervention using mobile Apps was associated with higher quality of ANC scores. The study also reported improved client satisfaction.[22]

Finally, limited internet connectivity in the field leading to traveling long distances to the PHCs for syncing the data and battery drainage were few other implementation challenges faced by the field staff. Poor network connection and inadequate training have been reported as limitations in implementation of mobile-based App in other studies.[23-27] Transport-related barriers and inability to sync the data may result in delayed data transfer, and battery drainage may compromise on the quantity of data entry done at the field level. Program (s) may consider providing tablets with internet connectivity enabling the syncing of data in the field itself and resolve the issue of long-distance travels. At the same time, there should be an option to enter data offline.

Findings from the study reflect the user perspectives and field observations. This will help in optimizing the use of mobile-based Apps in the field of health. We believe that the findings may be applicable in other public health settings as well. We adhered to Strengthening the Reporting of Observational Studies in Epidemiology and "COREQ guidelines for reporting quantitative and qualitative components, respectively.[8]

Though a public PHC, the study PHC was managed by a nongovernmental organization under a not-for-profit publicprivate partnership. This has an inherent limitation that any pilot that is tried by the organization is in addition to the routine work expected from staff in a public PHC. The present medical officer working in the PHC had newly joined, and thereby, we could not explore implementation challenges as perceived from his perspective.

Results of this study may be used to guide future research on mobile-based Apps to address challenges related to transition from paper-based records to EHR, real-time technology solutions, and network connectivity. Use of mobile-based Apps in improvement of health outcomes, health systems, and cost-effectiveness of service delivery may be areas of future research.

Conclusion

The study gives important insights into use of mobile-based Apps in public health from users' perspective. Efficient use of time and efforts, easy retrievability of records, planned reminders to ensure service delivery, and auto generation of reports were some of the important factors facilitating the use of CPHM App. Key barriers included dual burden of entry in App and paper-based records and lack of prompt real-time technical support and network connectivity. It is essential to address these challenges to optimize the use of mobile-based Apps for EHR. The findings have implications not only for the nongovernmental organization that manages the study PHC but also for the public health system at large.

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Conflicts of interest

There are no conflicts of interest.

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