

A Training, Process, and Impact Evaluation of Utilizing Accredited Social Health Activists (ASHAs) for NCD Screening and Referral (ASHA Study)



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A TRAINING, PROCESS, AND IMPACT EVALUATION OF UTILIZING ACCREDITED SOCIAL HEALTH ACTIVISTS (ASHAS) FOR NCD SCREENING AND REFERRAL (ASHA STUDY)

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**STUDY UNDER THE IMPLEMENTATION RESEARCH- HEALTH
SYSTEMS STRENGTHENING (IR-HSS) PLATFORM**





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EXECUTIVE SUMMARY

Diabetes and hypertension are leading risk factors for premature mortality globally. India, with 275 million people affected, is a critical battleground to reverse the global rise and devastation from these conditions. In India, most adults with these conditions remain undiagnosed, untreated, or poorly treated resulting in uncontrolled blood pressure and blood glucose leading to high morbidity and mortality.

Government of India initiated the National Programme for the Prevention and Control of Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) in 2010. Under the National Health Mission (NHM) in 2016, NPCDCS sought to integrate prevention and management for non-communicable diseases (NCDs) into primary healthcare in rural areas through universal screening of all adults aged ≥ 30 years. Principal components of the NPCDCS include screening, routine follow up, and appropriate referral for hypertension and diabetes at the population-level. Within health facilities, patient management of NCDs was to be facilitated by an Electronic Case Record Form (eCRF) maintained by the Auxiliary Nurse Midwife (ANM) and Medical Officer (MO). To increase public awareness and reach of the screening program, NPCDCS advised including Accredited Social Health Activists (ASHAs) for community-based risk assessment, owing to the successful role demonstrated by ASHAs in community mobilization and enhancement of utilization of maternal and newborn services. ASHAs were deemed fit for the role of completing a paper-based “Community Based Assessment Checklist (CBAC) Form for Early Detection of NCDs” within the NHM. The form facilitates ASHA-driven identification of high-risk community members who should be referred to the ANM for further screening and referral. In addition to risk assessment, they were assigned the responsibility of following up with community members who have been diagnosed with hypertension and/or diabetes to ensure that appropriate care is received.

The paper-based CBAC form, however, required manual data entry to be linked to eCRF that were being used to screen and treat patients at healthcare facilities. To ensure more efficient and effective linkage of community risk assessment and facility-based screening and treatment services, there was a need for inclusion of ASHAs in the digitization of NCD care. Thus, a smartphone application was developed by the Government of India to complete the enrolment of community members and to complete the CBAC form. Data entered by the ASHA in the smartphone NCD risk assessment was directly synced and linked with a database containing a patient’s eCRF maintained and utilized by healthcare providers, including the ANM and the MO. While the deployment of smartphone application was occurring in some districts of the country as of 2020, there was a need for an evaluation of the feasibility, effectiveness, and sustainability of integrating the CBAC risk assessment for NCDs and follow-up using the smartphone application within the routine workflow of the ASHAs. Thus, in 2019, the Implementation Research for Health Systems Strengthening (IR HSS) platform (erstwhile NKP) at NHSRC funded the ASHA study embedded within the Integrated Tracking, Referral, and Electronic Decision Support, and Care Coordination (I-TREC) project. I-TREC itself is an ongoing implementation science study focused on improving diabetes and hypertension detection and management within existing primary care infrastructure. The ASHA NCD risk assessment sub-study was designed to provide evidence on




feasibility, effectiveness, and sustainability of inclusion of ASHAs for priority NCD risk assessment and referral. The addition of the ASHA evaluation allowed for a complete characterization of the feasibility, effectiveness, and sustainability of using health information technology to enhance the cascade of care, linking communities to appropriate health services across the entire health system to inform the evolving NPCDCS program. The integrated system (Fig. 1) mirrors the national NCD program that spans across all health facilities, i.e., from the AB-HWC to the District Hospital.

A mixed-methods approach comprising both quantitative and qualitative data collection was used for the evaluation. Mukandpur block served as the “Intervention block” and Sujjon served as the “Control block”. Donabedian model was used to evaluate domains related to structures, processes, and outcomes of the ASHA driven risk assessment programme. Evaluation involved assessing feasibility of deployment of various versions of ASHA App. Village assessment, NCD content training, pre-post knowledge assessment, and ASHA questionnaire were also administered in control block. No contamination was present since the ASHAs of control block did not have access to the smartphone App for doing enrolment.

The evaluation was conducted among 89 ASHA workers who were trained in Mukandpur for technical aspects related to usage of smartphone-based App for enrolment and screening. The ASHA App was initially developed in English and Hindi and it required customization to suit the context. First, ASHA feedback was obtained to modify version 1 of the App to improve the visual user interface, navigation across various screens, and include Punjabi language for the local setting. A majority of ASHAs perceived version 2 of the App was better than version 1. Version 2 of the app was deployed in the field for community risk assessment. Feasibility and Sustainability: 97% of ASHAs were able to successfully use the mobile phone App for CBAC completion. Usage of App significantly reduced time to enroll a family by at least 25 mins. The total process now involved only one step i.e. digital entry by ASHA which was completed in ~50 mins in comparison to the two steps where ASHA manually filled the form first which was digitized later by ANM which took ~75 min. Almost all (98.9%) felt App is beneficial for NCD risk assessment and follow-up as workplans can be clearly seen. ASHAs considered refresher trainings and handholding helpful in retention of knowledge related to important aspects of NCD care and App usage. As a residual benefit, smartphone usage boosted self-confidence of ASHAs since they were now considered a credible source of information. Challenges: Inhibition to approach male members for filling CBAC was observed. Some ASHAs lacked the minimum level of English literacy which was necessary for use of a smartphone App. ASHAs felt that additional duties make it difficult to work efficiently. Impact on community: An independent community survey was done in July 2021- Dec 2021 for 2866 individuals residing in Mukandpur and Sujjon blocks. Community-based respondents were recruited based on the representative sample of adults 30 years and older recruited for the baseline survey of the I-TREC project (described below).

The survey highlighted that while referrals were low in both communities, a higher fraction of community respondents in Mukandpur (9.1%) vs Sujjon (3.6%) reported being referred to see an ANM or MO by an ASHA. Similarly, blood pressure and blood sugar were more often measured by an ANM in the past year in Mukandpur (16.1% and 15.2%, respectively) compared with Sujjon (0% and 0.1%, respectively). Separately, the NCD dashboard data showed that ASHA risk assessment and priority screening by ANMs were higher in intervention block as compared to adjoining districts. Approximately 55.6% participants have been enrolled in family folder; 37.6% participants’ CBAC form was filled; 33% individuals were screened first time by ANMs. Approximately 10% screened individuals were sent to PHC for confirmation of diagnosis.



Importantly, the evaluation study was done during the COVID pandemic, so healthcare seeking behaviors may have been different, and continued impact evaluation is useful.

Conclusion: Study demonstrated the feasibility and acceptability of training and implementing ASHA-driven hypertension and diabetes risk assessment using the smartphone-based application for filling CBAC. The digitization of the CBAC form significantly reduced time taken in the enrolment process thus improving efficiency of ASHAs and suggesting promise for sustainability. Interviews indicated that App in local language was critical and eased adoption by the users. The intervention block showed higher referral for screening than the control block, though referrals and uptake of screening were generally low. Community impacts must be interpreted in light of the COVID-19 pandemic, which was active during the time of survey. Therefore, overall, current data support the feasibility and acceptability of the app, and further study is needed to evaluate the impact of the program in diverse contexts in routine conditions.

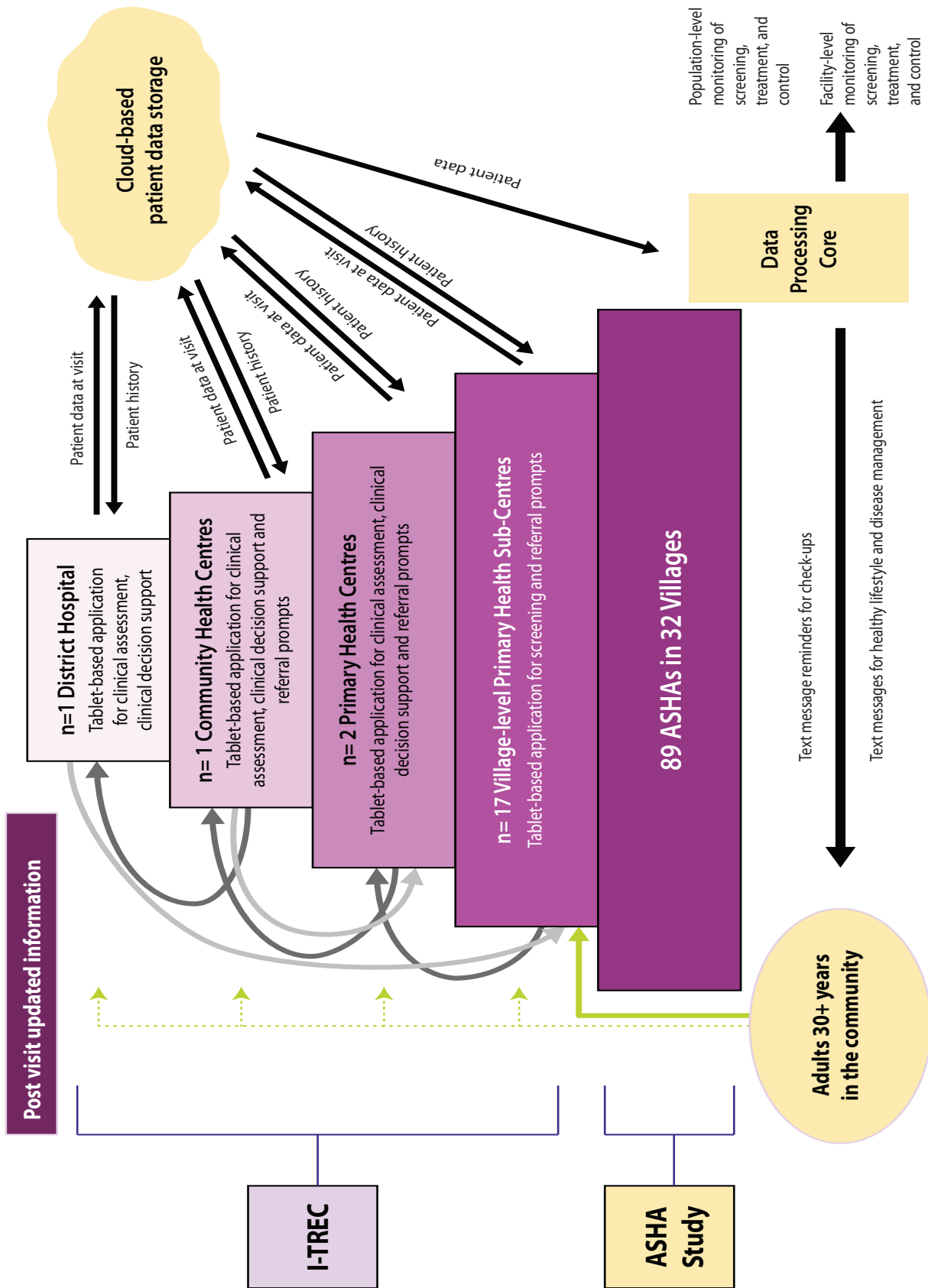


Figure 1: Diagrammatic representation of the I-TREC and ASHA studies embedded in the existing healthcare delivery system

OBJECTIVE OF THE STUDY

To conduct a training, process, and impact evaluation of an ASHA-driven hypertension and diabetes risk assessment using the NHM smartphone-based application for risk assessment.

METHODOLOGY

STUDY AREA

The ASHA evaluation was implemented in two blocks in Shaheed Bhagat Singh Nagar District, Punjab: Mukandpur (population ~97,300; 89 ASHAs) and Sujjon (population ~1,33,000; 136 ASHAs).

EVALUATION METHODS

A mixed-methods approach with both quantitative and qualitative data collection was used for the evaluation. Mukandpur block served as the “Intervention block” and Sujjon served as the “Control block”. Following the Donabedian model,² we targeted three domains for evaluating ASHA-driven NCD health services: (1) structures (the context and environment for risk assessment and referral), (2) processes (number of ASHAs trained, activities related to risk assessment and referral), and (3) outcomes (community-level impact of risk assessment and referral). Data was triangulated from several data sources to collect information on the domains; described in Table 1.

SELECTION OF SAMPLE

The sample included all the ASHAs of Mukandpur and Sujjon block that were registered under the Department of Health and Family Welfare, Punjab. For the purpose of qualitative data collection ASHAs were selected through purposive sampling technique. A total of 16 ASHAs were included for IDIs. For conducting IDI ASHAs were contacted and permission was sought. ANMs and ASHA facilitators facilitated in arranging of meetings with ASHAs.

INCLUSION CRITERIA

ASHAs who attended all the trainings conducted by the programme implementers and were actively involved in risk assessment activities.

EXCLUSION CRITERIA

Any ASHA who had not attended all the trainings and did not conduct risk assessment using smartphone App.

SELECTION OF PARTICIPANT FOR ASHA COMMUNITY SURVEY

A list of participants that were interviewed during the baseline survey was available in the database. For the ASHA survey only the participants from the list were contacted and permission was taken to administer the follow-up survey

INCLUSION CRITERIA

Participants who participated in the baseline community.

EXCLUSION CRITERIA

Participants who were not available or were unwilling to participate.

DESCRIPTION OF THE APP

The App for ASHAs was developed by Dell Technologies and was based on Community Based Assessment Checklist developed by NHSRC. The initial App that was launched had to be tested in both its staging and final version by the ASHAs. Major issues were reported in the initial version of the App developed by Dell during internal testing by I-TREC field team and subsequently by ASHAs during the training. The App was predominantly in English and allowed English input only. (e.g. Fields like name, address, search options only allowed English text). This posed difficulty in comprehending the digital version of family folder and CBAC by few of the ASHAs. Approximately 5% of ASHA had no literacy in English and required complete assistance in inputting the text in these fields. The user interface was less user friendly and had issues in the functioning (e.g. the navigation between screens was difficult; Punjabi language content already existing in the App was incorrect). The issues were communicated to Dell. To assist in quick resolution the issues/errors along with complete correct Punjabi translation was provided by I-TREC team to Dell in May 2020. The revised App (version 2) with new user interface was provided by Dell in June 2020. It was further internally tested by the field team during June-July 2020. The revised version was comparatively more user friendly.

INCENTIVES

To motivate ASHAs about the uptake of smartphone application, a one-time honorarium of INR 500 was given to the ASHAs for participating in the research study to test usability of App. No separate/additional incentive was given for individuals who were already enrolled or for enrolling new individuals. This was done to maintain parity with the incentives that were already given to ASHAs as per the national and state structure for filling paper based CBAC forms for everyone over the age of 30 years.

ASHA TRAINING AND REFRESHER TRAININGS

NCD content training - All 89 ASHAs participated in the 5-day training conducted in 2017. Owing to



the poor retention of the knowledge provided in the training that was provided 2 years previously (2017), a two - day refresher NCD training was given to all registered ASHAs in November 2019. All 225 ASHAs in the intervention (n=89) and control (n=136) blocks were trained about NPCDCS programme, management of NCDs and procedure to fill paper version of the Community Based Assessment Checklist (CBAC). The refresher trainings were conducted in November 2019 in five batches at CHC Mukandpur and CHC Sujjon. First day of training comprised of NCD content while hands on training was done on the second day. To enable ASHAs to do enrolment of individuals, dummy family details consisting of individuals were provided. The task included completion of 2 family folders and a total of four individual CBAC forms on paper.

Smartphone based technical training – One day smartphone/technical training for ASHAs (Mukandpur block only) about the usage of smartphone-application for enrolment and referral was done. To enable interactive sessions, training was done in four batches from 12-14 March 2020 in CHC Mukandpur. During the session ASHAs were provided a recapitulation of NCD care, management, and details about family folder. A “hands on” training session was conducted and ASHAs were asked to complete 2 family folders and a total of four individual CBAC forms in the staging/practice version of the smartphone application.


RE-TRAINING OF THE VERSION 2 OF APP

Since the App was completely revised in June 2020 it was essential to do a re-training for ASHAs about the new features that were introduced. Due to COVID-related restrictions, an online re-training was done in August 2020, for each sub centre from 4-7 August 2020 in four batches. (Details about impact of COVID-19 and its mitigation is discussed in next section)

HANDHOLDING AND SUPPORTIVE SUPERVISION

After the completion of the virtual training session, a series of handholding sessions were done by the field supervisors to enable ASHA to use the App. ASHA workers were asked to practice on the staging version for a week. During the visit the field supervisor observed the process of filling dummy CBAC forms and responded to queries of ASHA workers. Repeat visits were planned for those ASHA workers who faced difficulty. An ASHA worker was deemed fit to fill in the actual data of the individuals on the main ASHA App when she was able to login and fill all sections of family folder and CBAC independently.

COVID implications and its mitigation: COVID-19 caused delays in the process related to the implementation of the project. Immediately post training in March 2020, a national lockdown was imposed due to COVID-19 and any non-essential activity (routine care at the health facilities) was prohibited. All the ASHA workers were mandated by central and state government to do a rigorous house to house COVID surveillance from 20 March - 15 July 2020. Since, immediately after the IT training, lockdown was imposed, ASHAs did not get an opportunity to practice and participate in the usability testing exercise that had to be observed by the I-TEC project team in the field. Thus, after completion of COVID surveillance and ease in restrictions by Department of Health and Family Welfare, Punjab, a one-day virtual re-training of the revised App was planned for ASHA workers in intervention block in Aug 2020. The virtual training was planned at sub-Centre level in multiple batches to adhere to COVID guidelines. Each day, a maximum of 25 ASHA workers from 4-5 subcentres were trained. During the training, 2 project staff were present on site to provide immediate assistance during the hands-on session. A total of 89 ASHAs workers



along with 5 ASHA supervisors were re-trained in four batches. Handholding and supervision were also carried out in small batches based on sub-centres.

EFFECT OF COVID-19 ON USAGE OF HEALTHCARE FACILITIES

Mixed effects of COVID-19 were seen. To tackle the rapidly increasing cases of COVID, District hospital was converted into an isolation facility and became operational for NCD services only in April 2022. CHC Mukandpur was also functional with very limited staff mainly for emergency services. All PHCs in the intervention and control blocks were non-functional, and all the staff were deputed for COVID-19 duties. A detailed analysis is required to analyze the impact of COVID-19 on utilization in SBS Nagar and in Punjab. Since, then low utilization of government healthcare facilities was observed due to various factors like unavailability of doctors, medicines, or investigations during pre-covid times also. The majority of the people in SBS Nagar preferred private facilities over government facilities due to the above-mentioned reasons.

ADVOCACY FOR IMPROVING HEALTHCARE SERVICES IN GOVERNMENT FACILITIES

Due to persistent problem of non-availability of drugs and medical officers (mostly deputed for VIP duties or due to the post being vacant) advocacy was done with the state health authorities for fixed timings and making available healthcare personnel for OPD. It was requested that at least one representative drug per class according to IPHS guidelines for the appropriate level of health facility (e.g. metformin for glucose lowering; telmisartan for blood pressure lowering) should be made available and dedicated days should be fixed for holding the NCD Clinic. Post advocacy, days were fixed for OPDs, but if there was a VIP duty, MOs were deployed for that responsibility, and the clinics rescheduled. In PHC Kamam (intervention block) no Medical Officer was willing to take duty since facility was located in the outskirts and drug addicts often visited the facility and thus general population considered it unsafe.



Table 1: Timeline of activities and place of administration

Tools/Data sources/activities	Place of intervention		Time of administration	Status
	Mukandpur	Sujjon		
Activities				
ASHA NCD content trainings	X	X	Baseline	Completed
ASHA smartphone App trainings	X		Baseline	Completed
Tools				
ASHA pre-post training knowledge assessment	X	X	Mid-line	Completed
ASHA Village assessment form	X	X	Baseline	Completed
ASHA questionnaire	X	X	Baseline	Completed
Hand holding and supportive supervision	X		Mid-line	Completed
Usability testing	X		Mid-line	Completed
Smartphone application community database	X		Mid-line	Completed
ASHA community survey	X	X	Mid-line	Completed
ASHA in-depth interviews	X		End-line	Completed

DESCRIPTION OF TOOLS

For gaining in-depth understanding of aspects related to change in knowledge after training and to assess perceptions regarding ease of use of smartphones for enrolment of the individuals, both quantitative and qualitative tools were used. A summary of the activities and tools used is summarized in Table 10.


ASHA village assessment form: A structured village assessment form was deemed appropriate to assess the contextual constraints and facilitators of risk assessment using the smartphone-based App by ASHAs and referral for screening performed by ANMs. The checklist included information regarding ratio of ASHAs to population, internet connectivity, distance of households from health facility, age-eligible population for NCD enrolment and screening. The instrument was developed and given to experts and revisions were done according to the suggestions. The tool was pilot tested in a subsample. The assessment was conducted at Subcentres.

ASHA questionnaire: ASHAs in both blocks were invited to take a self-administered survey regarding perceived confidence to do chronic disease outreach, workload, task efficiency, and job satisfaction before and after being trained in NCD risk assessment; ASHAs in the intervention block were additionally surveyed on the use of smartphone application. These data provided quantitative indicators of their perceptions of integrating NCD activities into their routine workflow, as well as provide a mechanism to track ASHA retention. The instrument was developed and given to experts and revisions were done according to the suggestions. The questionnaire was pilot tested in a sub sample, and changes were made in the language or content before it was administered.

ASHA pre-post training knowledge assessment questionnaire: A series of training and refresher trainings on NCDs were done for ASHAs of both the blocks. On completion of NCD content training a self-administered questionnaire was administered to document the change in knowledge level in the ASHA's knowledge in NCD content domains. The questionnaire included domains like: knowledge about NPCDCS programme, risk factors of NCDs, signs and symptoms of NCDs, incentives, and roles and responsibilities of ASHA worker. A standard knowledge test questionnaire devised by NHSRC was used.

Usability testing: A formal usability test which involved observing the ASHAs perform specific and standardized tasks using the smartphone APP (e.g., creation family folder and recording details of a dummy individual). The activity was conducted to understand difficulties and ease of using the App. The usability test was used as a mechanism to certify ASHA workers before actual usage of the App to enroll individuals. The usability test comprised of three main sections with 21 tasks including questions pertaining to: 1) Logging in the App, 2) Family folder and, 3) Individual CBAC form and risk assessment/referral. The evaluation of the task was done on the parameters like time taken, clarifications sought or understanding of content/ format (steps), and ease of use of the section. The instrument was developed and given to experts and revised accordingly. The observation tool was pilot tested first in a small sample, results were, discussed and necessary changes were made before it was administered to all ASHAs.

SMARTPHONE APPLICATION COMMUNITY DATABASE: The database of community records entered into the smartphone application by the ASHA workers during enrolment was recorded in the central server of the National NCD portal. Review of database of community records entered into the smartphone application by ASHAs was done to determine the continuum of care indicators e.g. number of people enrolled, screened, new hypertension/ diabetes cases



identified, number of referrals related hypertension/ and diabetes, patients on treatment and patient who achieved control. I-TREC team had no direct access to the data. Dell and Tata trust teams after receiving permission from government provided aggregate anonymized backend data to the state authorities and I-TREC team.

ASHA IN-DEPTH INTERVIEWS

Interviews were deemed appropriate for the present study since it enabled the researchers to understand in detail the context, barriers, and facilitators to utilizing the smartphone application for enrolment, risk assessment, and referral. We conducted in-depth interviews with ASHAs in a subsample of 16 ASHAs of Mukandpur block. The interviews provided information on: ASHAs' experiences using the smartphone application (including general digital literacy and readiness to use this application); ASHAs' perception of community views of barriers to seeking care at local public health centers; ASHAs' perception of pathways to care for community members with NCDs; barriers and motivating factors for ASHAs to work related to NCD care. The instrument was developed and given to experts and revisions were done according to the suggestions. The in-depth interview tool was first pilot tested in a small sample, results were discussed and necessary changes were made in the language or content and a final tool was devised.

ASHA COMMUNITY SURVEY

For the purpose of triangulation, an ASHA survey was administered in the community. Prior data regarding indicators of hypertension and diabetes awareness, treatment and outcomes, and other health services usage indicators in the selected intervention and control block were already available from the I-TREC baseline community-based survey conducted in December 2018-February 2019 (n=3213 in Mukandpur and Sujjon).

We modified the baseline community survey tool for the ASHA community survey. The survey included questions related to contact information; Interaction with the ASHA and health system; hypertension; diabetes; Impact of COVID-19; anthropometric measurements and Sehat score. One year after the smartphone-based application was launched, all the participants interviewed during baseline were contacted and consented for repeat survey. 2866 participants that were available and consented were interviewed. Participants were asked about the health system interactions first and were described about the Sehat score (Sehat means health in Punjabi and Hindi, ASHA during the filing of CBAC informed participants about the level of risk they have for NCDs and how healthy they are).

Such an analysis allowed us to compare community-level changes in key processes of care for hypertension and diabetes (such as disease awareness; contacts with ASHAs and government health workers, where patients seek care; the regularity of follow up; treatment adherence; health improvements) before and after the ASHA-driven risk assessment program was implemented.

PROCESS OF DATA COLLECTION:

Process of data collection was completed in four phases:

Phase 1: Tool development and pilot testing

Phase 2: Baseline quantitative data collection prior to training of ASHAs

Phase 3: ASHA quantitative data collection post training of ASHAs

Phase 4: Qualitative data collection

PHASE 1: TOOL DEVELOPMENT AND PILOT TESTING

Tools were developed after reviewing literature. The process of data collection was spread over a period of time. The data collection started with a pilot visit in each level of facility and community. The District Family planning officer and the Civil surgeon facilitated the pilot visits.

Conversations were first held with the district level health officials to get a rough idea of the locale. Visits were then made to the villages where ASHAs were deployed. Conversations were also held with medical officers. During the pilot visit, interview schedules were administered to 5 ASHAs in a pilot block, Rahon. Before administering, they were translated into Punjabi. Amendments were made to the tools based on the input gathered from the pilot visit. Several questions that were close ended were made open ended to elicit detailed responses. The section on the technology was made more exhaustive to include questions on not just planning, but also on sustainability, and up scaling the project.

PHASE 2: BASELINE QUANTITATIVE DATA COLLECTION PRIOR TO INTERVENTION

Prior information on ASHAs registered was obtained from district health officials. The information collected pertained to the socio demographic profile, perceptions regarding healthcare utilization and perceptions regarding technology use in NCD care. For the ASHA community survey/ midline community survey, information was available from baseline community survey. The investigator introduced herself to the participant before the start of the interview. Participants were provided with the information sheet in Punjabi, and they were explained about the study. A written consent in Punjabi was obtained.

2.4C. PHASE 3: ASHA QUANTITATIVE DATA COLLECTION POST INTERVENTION

The ASHA community survey was administered one year after the ASHA intervention. The investigator introduced herself to the participant before the start of the interview. Participants were provided with the information sheet in Punjabi, and they were explained about the study. A written consent in Punjabi was obtained. Three more visits were made if the participant was not available for interview on the first visit.

2.4 D. PHASE 4: QUALITATIVE DATA COLLECTION

There were no issues faced in getting the qualitative data. ASHA facilitators along with district officials helped in fixing up meetings with ASHAs across 17 subcentres.

DATA ANALYSIS

QUALITATIVE ANALYSIS.

Interviews were conducted by a trained interviewer in Punjabi language that lasted approximately 45-60 minutes. A recent analysis of in-depth interviews showed that 16 interviews were needed to reach meaning saturation, providing a rich description of key themes in the data. Digital audio-recordings were created during the interview, verbatim transcripts were created from the recordings, and the text was translated into English for analysis and back-translated to ensure accuracy of meaning. Textual data was reviewed and coded using both inductive (derived from the textual data) and deductive (based on literature and theory) codes; inter-coder reliability was assessed; and thematic analysis methods were used to describe the perceptions, experiences, and suggestions of the ASHA workers both during and after the program period. Data was analyzed using NVIVO.

QUANTITATIVE ANALYSIS.

Data was entered into a Microsoft Access Database for exporting and analysis. Statistical analysis was conducted using SAS 9.4 Software (Cary, NC). Descriptive analyses were done to examine all structure, process, and outcome indicators cross-sectionally. Process and outcome indicators in the community survey were also evaluated for change from pre-intervention to post-ASHA intervention (e.g., change in the reported measures of risk assessment, referral, treatment seeking, and ultimate disease control in adults over age 30 years). For quantitative data analysis, all the variables were coded in categories as 0, 1 and 2. Further hypotheses were generated.

ETHICAL CLEARANCE

The study was approved by the Ethics committee of All India Institute of Medical Sciences, Delhi. Participant information sheet was prepared in the local language, i.e. in Punjabi. This participant's information sheet was explained and given to the participants. It carried information regarding the study, its objectives, its procedures, and the rights of the participants. Written consent was taken from the participant in Punjabi. Consent performare are attached in annexure.

Table 2: Overview of study results

Objectives	Tools	Purpose	Status	Outcome/Results
To assess the context and environment for risk assessment and referral	ASHA village assessment form	To gather contextual data such as ratio of ASHAs to population, internet connectivity, distance of households, age-eligible population for NCD risk assessment	Completed	Usual ratio of ASHA to individuals of 1:~1000 was seen Internet connectivity was mostly fair in all the villages and ASHAs were able to sync their data. In the case of some villages which were in outskirts, the mobile network connectivity was poor Each ASHA served 150-200 households depending on the size of the villages
	ASHA questionnaire	To understand perceived confidence to do chronic disease outreach, workload, task efficiency, and job satisfaction before and after being trained in NCD risk assessment To understand the perception regarding technology use	Completed	Mean age of ASHA workers 43.9 ±7.7 years Mean number of years of schooling was 10 ± 1.94 51% were working as ASHA workers for the past 12 years All ASHAs reported their work mostly includes mother and child healthcare, polio vaccination, 67% of ASHA considered NCD work as their regular work Almost 97% ASHA used mobile phones for work; 53% used them for social media 77% ASHA reported that they still use paper for their work All ASHA workers were trained for NCD App training 72% ASHAs felt highly confident in completing the digital CBAC form and family folder post training. There was a mixed response in terms of workload; almost 43% reported increased workload Almost 50% ASHA felt that people perceive their work as important and treat them with respect

Objectives	Tools	Purpose	Status	Outcome/Results
To document the processes involved in implementation of the programme	ASHA pre-post knowledge assessment questionnaire	To assess the change in knowledge level in the ASHA's knowledge in NCD content domains	Completed	Increase in score across all domains was seen
To assess community-level impact of risk assessment and referral done by ASHA driven smartphone App	Hand holding and supportive supervision Usability testing	To facilitate understanding of the smartphone app To learn difficulties in using the application before full-scale deployment to enhance our training approach	Completed	<p>Three rounds of handholding and supportive sessions were conducted to ease adoption of smartphone application</p> <p>Mean time taken to complete creation of family folder and CBAC of individuals in the family 64.3± 25.3 minutes</p> <p>Sections which were very easy were</p> <ul style="list-style-type: none"> • Login • Enrolment • Sync <p>Sections which required more practice and required more content and format clarifications</p> <ul style="list-style-type: none"> • Adding individual to existing family • Workplan related actions <p>Almost all ASHAs reported search and sync feature as the best features in the app</p> <p>The least liked feature was sections requiring information linked to Aadhar id and use of tobacco</p> <p>Almost all ASHAs (98%) felt using App is faster and easier to use in comparison to paper CBAC form</p> <p>Photo capture feature was the most appreciated feature.</p> <p>Almost all (98.9%) felt use of App is better for follow-up and NCD risk assessment as clear notifications can be seen through workplan feature</p> <p>Some suggested there should be a feature of speech to text for name search or inputting address</p>

Objectives	Tools	Purpose	Status	Outcome/Results
<p>To assess community-level impact of risk assessment and referral done by ASHA driven smartphone App</p>	<p>Smartphone application community database</p>	<p>To assess the number of individuals in continuum of care under population-based risk assessment</p>	<p>Completed</p>	<p>Approximately 55.6% participants have been enrolled in family folder 37.6% participants' CBAC form was filled 33% individuals were screened first time by ANMs Approximately 10% screened individuals were sent to PHC for confirmation of diagnosis</p>
	<p>ASHA in-depth interviews</p>	<p>To understand the barriers and facilitators to utilizing the smartphone application for risk assessment and referral</p>	<p>Completed</p>	<p>ASHAs perceived use of smartphones as beneficial for enrolment and follow-up visits</p> <p>Facilitators If the ASHA already had a smartphone, it was easy for her to understand navigation in the App The more educated the ASHA worker the more efficient she was in use of App The App was easy to use, and navigation made it easier to complete the form with much faster speed The App allowed real time data entry and syncing The workplan feature helped to understand weekly tasks</p> <p>Post training related to population-based risk assessment felt confident in using App Supportive supervision and handholding help in clarification of doubts and usage of App. Second version of the App was user friendly and with majority fields in Punjabi except fields like Search, Name, and Address</p> <p>Barriers Initial version of the App was not user friendly with difficulty in navigation across different tabs App was not fully translated in Punjabi Dual entry: it was seen paper based CBAC forms were filled and then entered in App, which added to the work burden</p>

Objectives	Tools	Purpose	Status	Outcome/Results
<p>To assess community-level impact of risk assessment and referral done by ASHA driven smartphone App</p>	<p>ASHA in-depth interviews</p>	<p>To understand the barriers and facilitators to utilizing the smartphone application for risk assessment and referral</p>	<p>Completed</p>	<p>Some ASHAs were only literate in Punjabi that caused problem in data entry fields that were in English</p> <p>Increased workload in addition to mother and child work(work related to NCDs), less honorarium given by state government for CBAC filling</p> <p>Additional findings</p> <p>Lack of availability of drugs, investigations and healthcare staff</p> <p>Low awareness of NCD care and management in the community</p> <p>Delay in seeking care</p> <p>Low perceived threat for NCDs</p> <p>Perceived trust in private sector as compared to government facilities</p> <p>Less adherence to treatment regimen</p> <p>Complete enrolment of eligible individuals was done by ASHAs and susceptible individuals were sent to ANMs for risk assessment</p> <p>ANMs screening was not complete due to unavailability of glucose strips</p> <p>Screened positive individuals were sent to MOs for confirmation by ANMs</p> <p>If referred people prefer to go to private facilities</p>

Objectives	Tools	Purpose	Status	Outcome/Results
<p>To assess community-level impact of risk assessment and referral done by ASHA driven smartphone App</p>	<p>ASHA community survey</p>	<p>To compare community-level changes in key processes of care for hypertension and diabetes (such as disease awareness; contacts with ASHAs and government health workers, where patients seek care; the regularity of follow up; treatment adherence; health improvements) before and after the ASHA-driven risk assessment program has been implemented.</p>	<p>Completed</p>	<p>Private sector predominantly is the preferred choice for seeking care, management and procuring medicines Assessment of efficacy of follow-up post ASHA intervention cannot be clearly defined due to COVID-19 impact and involvement of ASHAs in COVID-19 related activities</p>

FINDINGS

All the field and data collection activities were completed by Dec 2021. Several components were delayed due to technical development issues (e.g., Punjabi language options in the App that were in English) and the Covid-19 pandemic. A summary of results corresponding to each tool used in the study is presented in Table 2: Overview of study results.

The Donabedian model was used to understand the underplay of critical factors that governed adoption. It was observed that the adoption of technology depends majorly on trilogy of three factors and their criticality and inter relatedness. These are the contextual or system related factors, processes (normative care and Individual factors), and outcomes (adoption, enrolment, risk assessment). The framework discusses how each component is important for a decision to adopt the technology and change the NCD related care scenario in the community. Figure 2 shows the depiction of model of care.

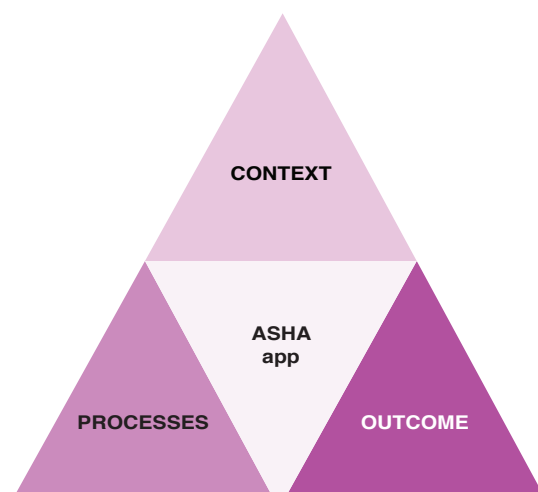


Figure 2: Donabedian model and ASHA study

CONTEXT RELATED FACTORS - The contextual factors were the predisposing factors that already existed in the study area and directly affected the healthcare status of the community and their healthcare utilization behaviour.

SOCIO DEMOGRAPHIC PROFILE OF THE COMMUNITY

The mean age of the interviewed participants was 51.5 ±13 years. Majority of people (64%) living in the community were Hindu and approximately 34% were Sikhs. About 60% of the population belonged to Scheduled caste/ scheduled tribe. 98% of people spoke Punjabi. 70% of respondents had received some form of formal education. Only 2.4% of respondents belonged to the lower income category and had Below poverty line (BPL) cards. Since most of the respondents

belonged to the upper middle class, they preferred private facilities over government facilities. The villages were semi-urban in nature and had overall fair internet connectivity only few villages which were located in the outskirts had poor mobile network connectivity. Alcohol consumption (25.3%) was slightly higher than tobacco consumption (15%) in the area.

SOCIO DEMOGRAPHIC PROFILE OF ASHA WORKERS

The mean age of ASHA workers was 43.9 ± 7.7 years. The mean number of years of schooling was 10 ± 1.9 . It was observed that the majority of ASHA workers attending the training were educated till high school. 51% were working as ASHA workers for the past 12 years. It was observed that ratio of ASHA to individuals was ~1:1000 and that was in line with the national guidelines. Each ASHA served 150-200 households depending on the size of the villages.

HEALTH STATUS AND CONTINUUM OF CARE INDICATORS IN THE COMMUNITY

Poor level of awareness regarding their health condition was observed in the community. It was seen that people had less perceived threat towards NCDs. In addition to poor healthcare seeking behaviour of community, the government healthcare facilities also lacked in terms of staff, medicines, and investigations which was the main reason for low healthcare utilization of the govt facilities.

PERCEPTION OF ASHAS REGARDING HEALTHCARE FACILITIES

Most of the ASHAs (78.4%) perceived that the healthcare system lacked proper NCD care. ASHA reported that healthcare facilities need to strengthen their availability of health staff and medicines and risk assessment or screening alone will not improve healthcare status of people.

HYPERTENSION CARE

It was seen that most of the patients got their BP measured once a month (Fig 3). Approximately 60% of the population reported taking medicine only when needed for BP management (Fig 4). Most patients got BP checked by visiting either RMP or private facility (Fig 5). It was seen that a higher percentage of participants in Sujjon got their BP checked once a month. People in both the blocks procured hypertension medicines from private hospital/pharmacy (Fig 6).

Issues regarding availability of same drugs was also reported. It was observed that there were times that same drug was not available in a particular class e.g. instead of telmisartan, losartan was available in the Pharmacy and that was given to the patients. Patients highlighted that their BP or blood sugar were not controlled if they changed medicines.

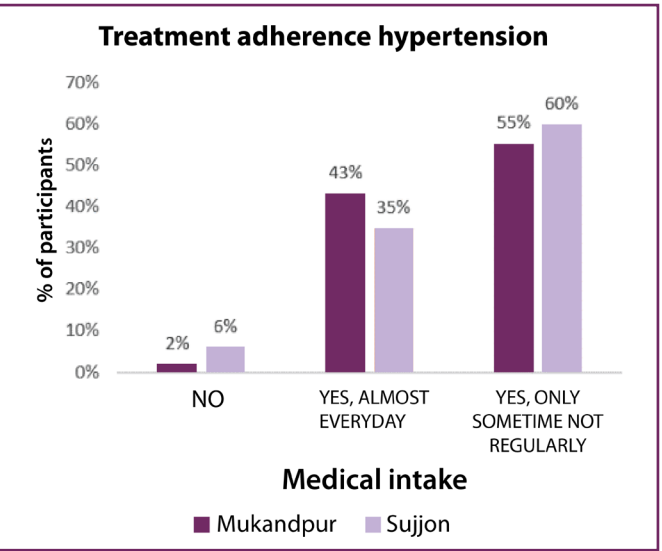
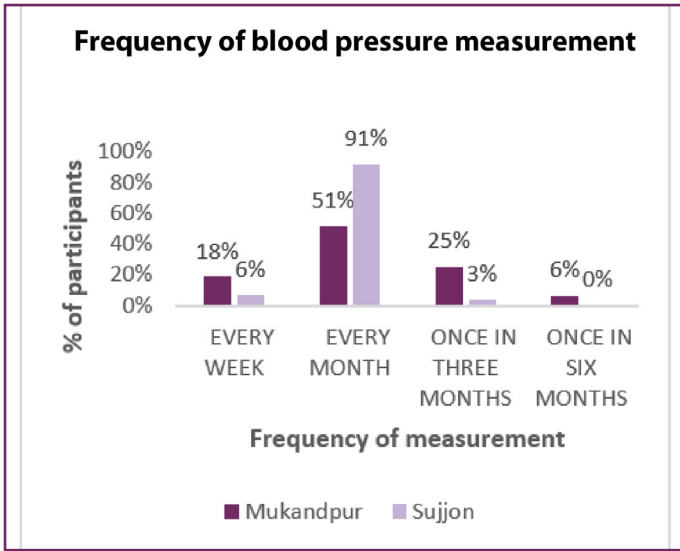


Figure 3: Frequency of blood pressure measurement

Figure 4: Treatment adherence hypertension

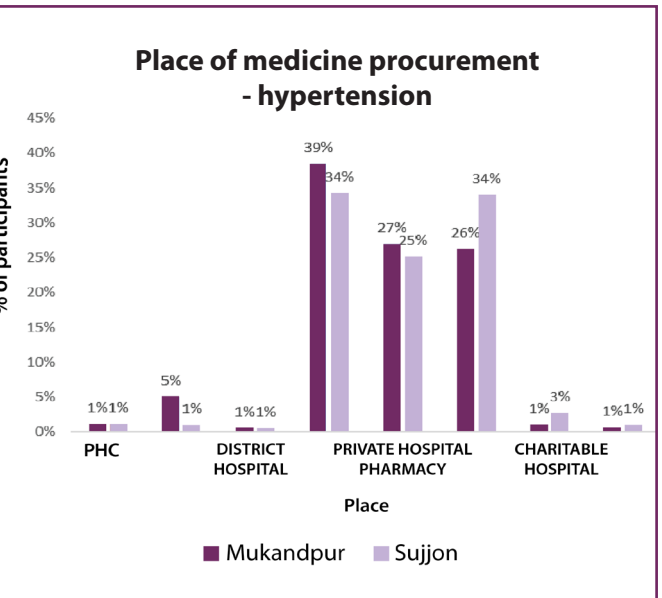
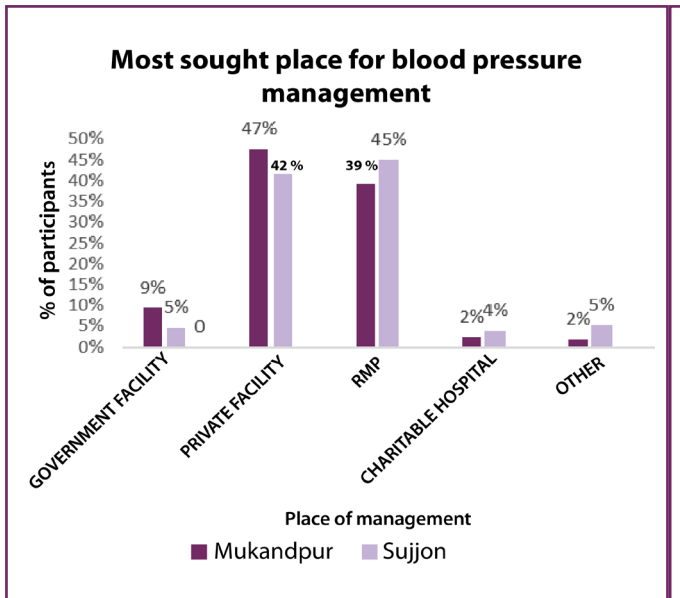


Figure 5: Most sought place for blood pressure management

Figure 6: Place of medicine procurement - hypertension

DIABETES CARE

It was seen that place of procurement of medicine was similar to procurement of hypertension medicine from private pharmacy (Fig 8). However, it was seen that community members perceived diabetes as more severe and thus were regular with their daily drug intake (Fig 7).

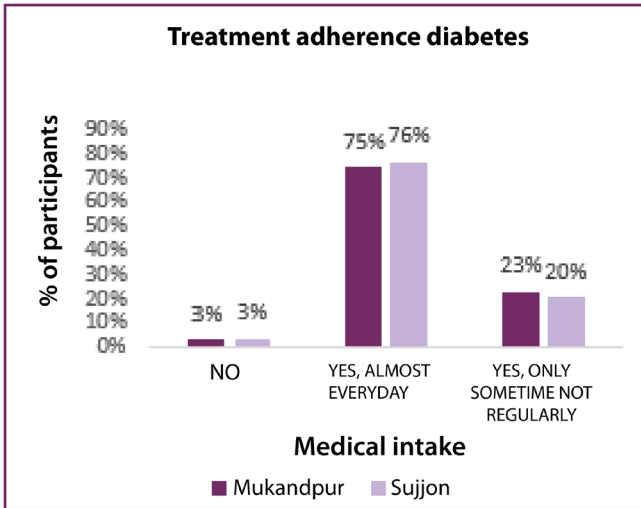


Figure 7: Treatment adherence diabetes

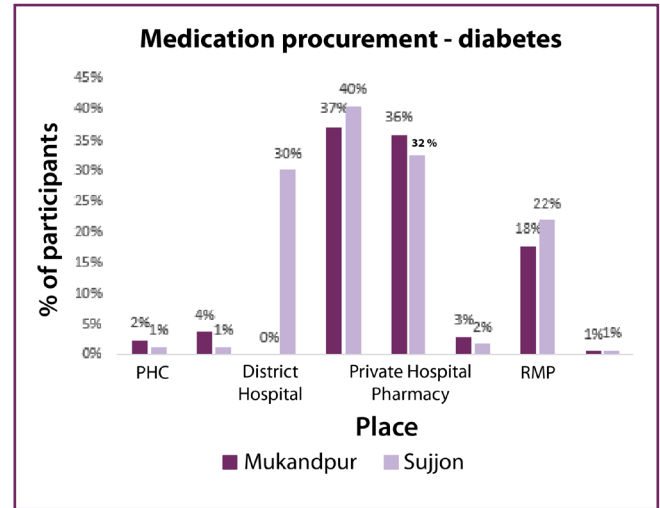


Figure 8: Medication procurement - diabetes

It was seen that people preferred private facility and RMPs for blood sugar management (Fig 9 & 10). Similar to frequency of BP measurement, people went once a month for blood sugar measurement also (Fig 11.).

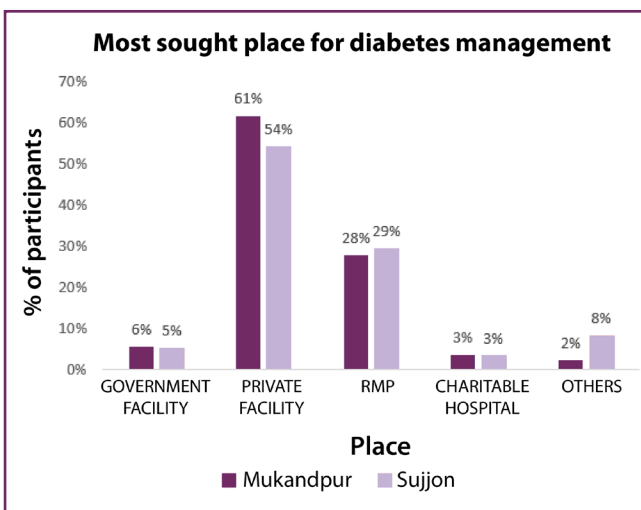


Figure 9: Most sought place for diabetes management

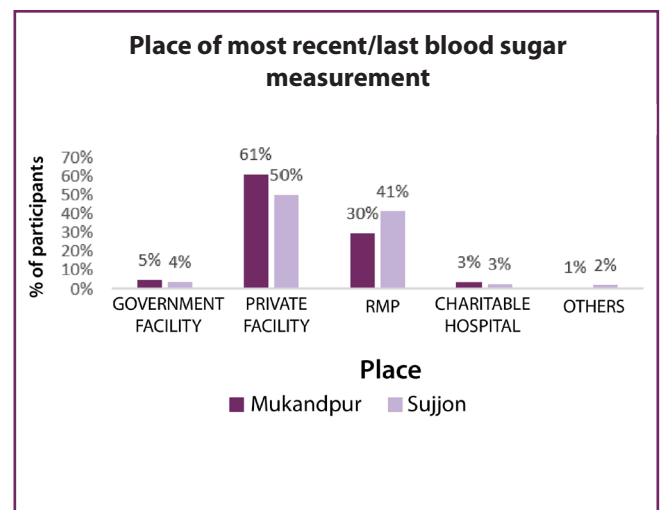


Figure 10: Place of most recent/last blood sugar measurement

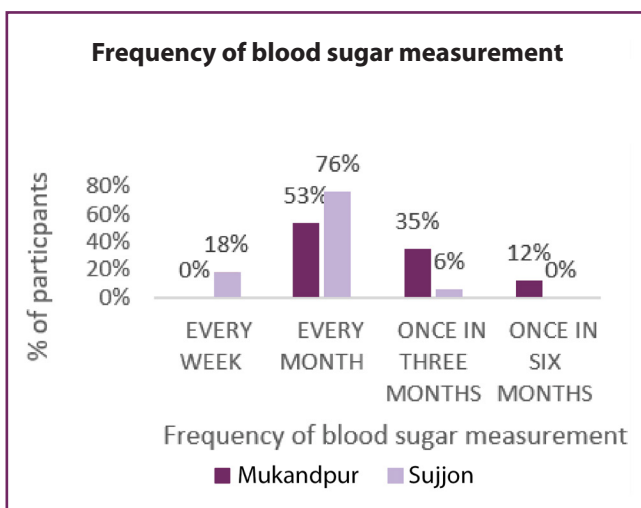


Figure 11: Frequency of blood sugar measurement

KNOWLEDGE RELATED TO NCD CARE.

Findings showed that there was low knowledge of non-communicable diseases and the kind of work expected from them prior to the refresher training. Thus, refresher training and handholding sessions were strategically planned to enhance the knowledge related to NCD care. To assess the change in knowledge levels, a pre-post knowledge assessment was done before and after NCD content training. An increase in score was seen across all domains. Interactions with ASHAs also highlighted that retention was poor and refresher training helped in ensuring clarity and retention of knowledge provided. It was also clearly evident that although knowledge level was good in Sujjon yet Mukandpur Asha's were successful in doing risk assessment and enrolment of individuals. Table 12 summarizes the knowledge score across various domains.

Table 3: Pre-post NCD knowledge scores

Variables	Total score	Mukandpur		Sujjon		Pre-test score	Post-test score
		Pre-test N=92 Mean ± SD	Post-test N=91 Mean ± SD	Pre-test N=133 Mean ± SD	Post-test N=97 Mean ± SD	N= 225 Mean ± SD	N= 188 Mean ± SD
Knowledge about NPCDCS programme	12	4.88 ± 2.99	7.41 ± 2.55	5.58 ± 2.72	7.98 ± 2.78	5.29 ± 2.85	7.70 ± 2.68
Knowledge related to screening	24	10.32 ± 4.64	16.00 ± 6.00	13.00 ± 8.00	17.00 ± 8.00	11.87 ± 5.01	15.41 ± 4.65
Knowledge related to signs & symptoms	16	4.00 ± 6.50	11.65 ± 4.87	10.08 ± 5.70	12.58 ± 5.39	8.33 ± 5.90	12.13 ± 5.15
Knowledge related to diagnosis & follow ups	5	1.00 ± 2.00	± 1.51	2.00 ± 2.00	3.00 ± 2.00	1.00 ± 3.00	3.16 ± 1.77
Knowledge related to risk factors	30	11.59 ± 7.35	21.16 ± 7.04	15.60 ± 7.66	23.00 ± 9.00	13.96 ± 7.77	21.14 ± 7.14

PROCESSES

These were the implementation related factors reflected that were responsible for adoption and non-adoption of the smartphone App for risk assessment and enrolment.

PERCEPTION OF ASHAS REGARDING NCD CARE

All ASHAs reported their job predominantly includes work related to mother and child health and creating awareness by mobilizing community about vaccination at polio booths or during home visits as a part of polio vaccination drive. 67% of ASHA considered NCD work as part of their

regular work. There was a mixed response in terms of overall workload; almost 43% reported increased workload due to addition of component of NCD care. Most of the ASHAs felt that the amount of honorarium given by the state government for the NCD work (for enrolment using CBAC) was small and needs to be revised.

PERCEPTION REGARDING SMARTPHONE APP FOR RISK ASSESSMENT

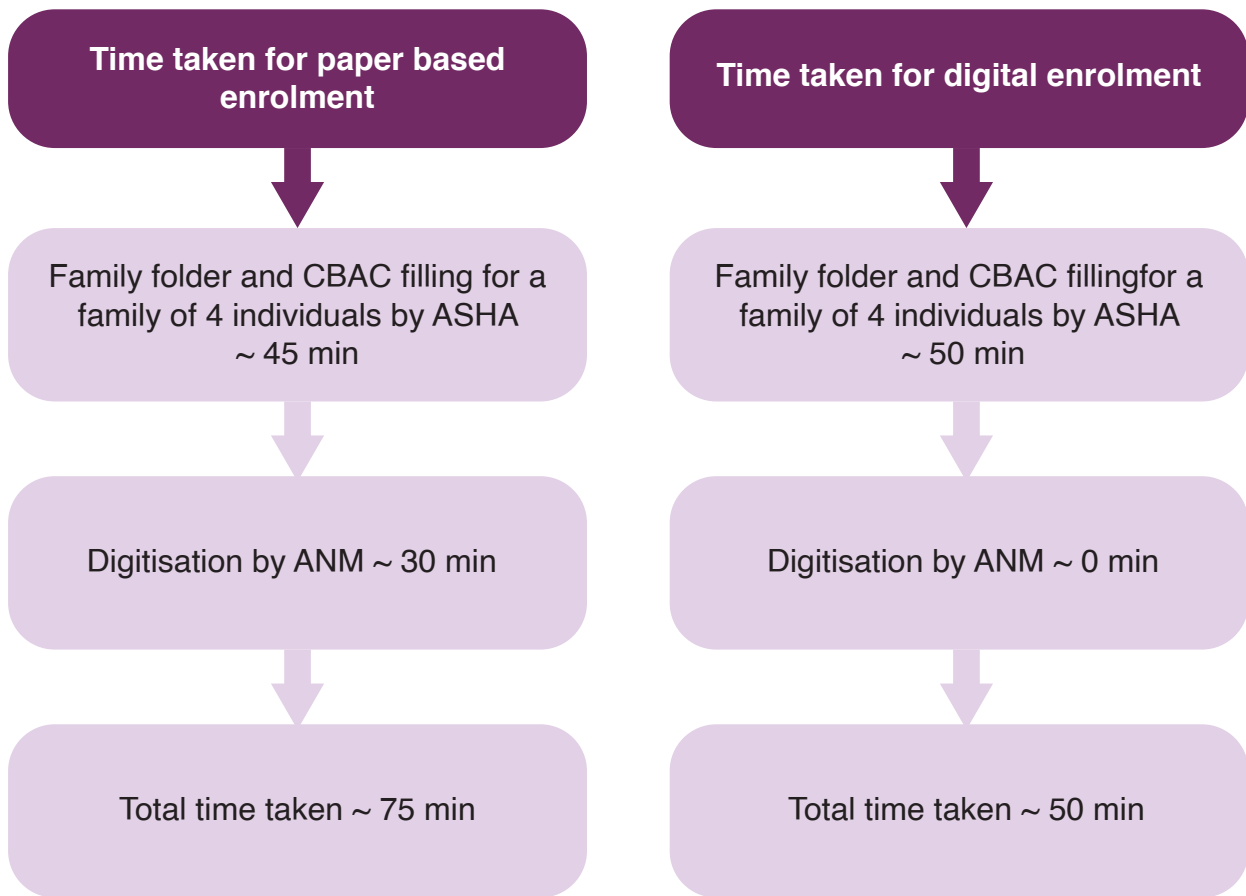
All 89 ASHA workers were trained on smartphone App for risk assessment. ASHAs were satisfied with the level of training and handholding provided for doing risk assessment using smartphones. Some of the ASHAs also felt that they are abreast with technology with this smartphone App just like their fellow health workers (ANM). Almost 97% ASHA reported use of mobile phones for NCD work (risk assessment); 53% of ASHAs also used them for private social media. 77% ASHA reported that they still use paper for their work along with smartphone-based App according to the mandate by the district authorities. However, ASHAs felt confident in completing the digital CBAC form and family folder and reported that App eases the overall enrolment process since every section is carefully linked. The “Search” option using phone number and identification of individual by the photo were rated as the best features by the ASHAs. ASHAs preferred carrying smartphone over carrying heavy files of physical papers. Further, ASHAs felt that real time data entry saves time spent from the double work of filling paper form first and digitizing it later. It was also observed that majority of ASHAs were literate in Punjabi and had difficulty comprehending CBAC in Hindi or English. ASHAs suggested that App should be available in local language also. Since, they were not comfortable in either English or Hindi language, App was translated in Punjabi. Further, the language barrier was seen for few ASHA who were less educated or had no knowledge of English while they performed few yet critical steps like: login, search and adding the address of the individual. Since the input field in these was in English, these ASHAs were unable to even initiate the process of enrolment. Use of mobile phones for work impacted credibility of ASHA in the community, ASHAs were now considered credible source of information. It was reported that younger ASHAs felt inhibited as compared to older ASHAs while they filled CBAC form for men. Although an adequate number of CBACs were not filled using smartphone but the indirect impact reported showcased that ASHA can be trained for risk assessment and improve NCD care.

EASE OF USE AND CERTIFICATION FOR DATA ENTRY

The usual process of enrolment included paper based CBAC filling by ASHAs in the community as the first step and digitization of paper form by ANM in the next step. To understand the difficulties ASHA faced using the application post App training, a usability test consisting of observation of the ASHAs perform specific and standardized tasks using the smartphone application (e.g., login in the app, create family folder and record details of a hypothetical individual) was administered. The usability test was used to certify ASHA workers before actual usage of the App to enroll individuals. It was observed that a total of three rounds of handholding by I-TREC team were required in addition to the CBAC self-practice tasks assigned to ASHAs for using the staging App. The activity ensured that only certified ASHAs were given access to the final ASHA App for entering details of actual individuals. All ASHAs were certified during the three rounds of handhold visits. The activity included direct observation of ASHAs by the field supervisor as they enrolled community members and recorded data into the smartphone App. First round of handholding was done for all 89 ASHA workers; 46 ASHAs qualified for certification in first round; 34 ASHAs were certified in 2nd repeat round of handholding and usability test, and 9 ASHA



workers required third round of handholding to independently complete all steps of digital data entry on the ASHA app and get certified.



The paper-based enrolment involved two steps: first filling of paper based CBAC form by ASHAs and then digitization of the form by ANMs. On the other hand, digitization of CBAC by ASHA was a one step process. It was seen that initially ASHAs took almost double the time (~80-90 min) in completing family folder and individual CBAC form for a family but with practice the average time taken by ASHAs to digitize all CBAC forms directly on phone for each household reduced to ~50 min in total. It was also observed that total time spent in paper based CBAC enrolment was more in comparison to real time digitization via App. However, it was seen that those ASHAs who had difficulty in typing English took almost same time as enrolment done on paper. Since they first filled out paper form and then sought help from family members to digitize the CBAC.

OUTCOME

To see the reach of the ASHA intervention (number of people enrolled and screened), a review of the smartphone app data housed in national portal was done for all the 17 subcentres. Also, the number of new NCD cases identified, and the number of individuals referred up to higher levels of care, and the number of the NCD cases engaged with care were assessed. As reported by ASHA workers, more than 80% of the paper-based CBACs were already filled prior to the introduction of the smartphone app. Table 13 summarizes the continuum of care indicators. Approximately 67% eligible individuals were enrolled by ASHAs. 88% of the enrolled participants had been fully screened. 5.8% of the suspected individuals were referred to PHCs for confirmation of diagnosis.

Table 4: Number of individuals in continuum of care (**aggregate data has been taken from the backend of national NCD portal as on 4.11.2022)

Facility	CHC Mukandpur	PHC Aur	PHC Kamam	PHC Khankhana	Total
Enrolled	21882	23132	19637	18854	83505
CBAC completed*	15081	14882	12668	13724	56355
Screened First Time	12595	14036	10033	12973	49637
Fully Screened	12549	11698	9639	12947	46833
Partially Screened	46	2338	394	26	2804
Re-Screened	798	714	153	244	1909
Referred To PHC	56	1015	278	285	1634
Referred By Early Detection	27	12	15	30	84
Referred By Screening	30	1005	263	257	1555
Referred For Cervical Screening	25	2701	19	25	2770
Referred To Secondary	1280	29	188	221	1718
Referred To Tertiary	0	0	0	0	0
Examined	1697	1579	618	1121	5015
Examined Without VIA	19	383	37	76	515
VIA Examinations	0	0	0	0	0
Diagnosed	919	478	323	550	2270
Under Treatment	911	468	322	539	2240
Follow-Up Adherence	19	25	5	44	93

*CBAC numbers reflect both paper and digital forms. Data on digital forms alone were not available to researchers.

COMMUNITY REACH AND IMPACT OF APP-BASED ASHA ENROLLMENT AND RISK ASSESSMENT ACTIVITY

The community survey was administered from July 2021- Dec 2021 (n= 2866 in Mukandpur and Sujjon). The ASHA survey showcased that approximately 92% of individuals interacted with ASHA in the past 6 months. During the interaction only 3.3% ASHA used the mobile to digitize CBAC. About 58.8% individuals whose CBAC form was filled in were informed about their CBAC score (risk level/ Sehat score). People reported that ASHA only visited the household for filling CBAC, no visits were done for follow up or counselling. Table 14 summarizes the interaction of the community members with ASHA and the health system.

Table 5: Community reach and impact of App-based ASHA enrollment and risk assessment activity: Household survey data from Mukandpur and Sujjon blocks

Variable	Mukandpur n (%)	Sujjon n (%)
Community Reach: Interaction with ASHA		
Total individuals interviewed	1430	1436
Contact with an ASHA worker within last six months	1323 (92.5)	1308 (91.1)
ASHA worker asked questions regarding hypertension and/or diabetes	792 (59.9)	642 (49.1)
Mobile phone usage for filling CBAC		
Yes	43 (5.4)	0 (0.0)
No	734 (94.5)	605 (100.0)
Asked about alcohol use ***	410 (52.2)	123 (20.3)
Asked about tobacco use ***	391 (49.7)	105 (17.4)
Measured waist circumference ***	366 (46.6)	29 (4.8)
Community Awareness: CBAC score communication		
ASHA told about CBAC risk or Sehat score (normal, high or low) \$		
Normal	43 (3.3)	16 (1.2)
High	23 (1.7)	2 (0.2)
Did not tell/do not remember	1148 (86.8)	1147 (87.7)
Community Impact: Referral from community to healthcare provider		
Asked to see ANM/MO	121 (9.1)	47 (3.6)
Blood pressure measured by ANM in the past year	213 (16.1)	0 (0.0)
Blood sugar measured by ANM in the past year	201 (15.2)	1 (0.1)
ANM referred to MO/doctor after measuring BP/BG	38 (22.1)	0 (0.0)
Visited a doctor after ANM's advise	24 (63)	
Type of doctor seen after ANM's advice		
GOVERNMENT	9 (38)	
PRIVATE	13 (54)	
CHARITABLE HOSPITAL	1 (4)	
OTHER	1 (4)	

Variable	Mukandpur n (%)	Sujjon n (%)
Diagnosed with hypertension after ANM's referral	17 (1.8)	
Diagnosed with diabetes after ANM's referral	9 (0.6)	
Diagnosed with hypertension before ANM's visit	384 (26.9)	404 (28.1)
Diagnosed with diabetes before ANM's visit	145 (10.1)	157 (10.9)
Visit related		
ASHA visits in the past one year for diabetes/hypertension		
Not visited even once in six months	235 (51.9)	296 (62.1)
Visited only once at the time of CBAC filling	155 (34.2)	164 (34.4)
2-5 monthly visits	60 (13.2)	17 (3.6)
More than 5 monthly visits	3 (0.7)	0 (0.0)
ASHA advised on lifestyle modification (hypertension/diabetes management, diet, physical activity)	14 (3.1)	0 (0.0)

*** Selected indicators to independently assess and verify recollection of CBAC completion from the community member perspective

\$ Sehat score defined level of fitness of an individual. High Sehat score means high risk for an NCD

A detailed analysis showed that only 9% of the suspected individuals were sent to ANM/MO for priority screening and then confirmation of diagnosis. Out of those referred, 63% visited a facility for confirmation of disease. Approximately 70% of individuals were newly diagnosed with hypertension in the past one year, whereas only 38% of patients were diagnosed with diabetes.

The ASHA survey is a follow up survey on the same participants who were evaluated during baseline. Prevalence of hypertension was higher in comparison to diabetes. Findings from the study are similar to the findings from STEPS-2 survey that showcases higher prevalence of hypertension (55%%) in study area as compared to what is reported in STEPS survey for Punjab (40.1%). The prevalence of diabetes was similar to what was reported in STEPS-2 survey (about 13% as compared to 14%).

The data (table 15) showcases that control in both hypertensives and diabetes is poor which calls for increased focus on the need of interventions targeted on continuum of care and follow-up.

Table 6: Hypertension and Diabetes Care Continuum in Study Catchment Area: Comparison of study blocks and statewide data

	I-TREC baseline	I-TREC midline (follow-up)	STEPS
Age (In Years)	30+	30+	18-69
Location	2 blocks Punjab	2 blocks Punjab	Punjab state
	N= 3213	N= 2866	
Hypertension status			
Aware	649 (37%)	788 (63%)	980 (48.3)
On treatment	539 (31%)		
Controlled	181 (10%)	172 (13.7%)	373 (18.3)
Diabetes status			
Aware	297 (73%)	302 (86%)	115 (34.2)
On treatment	277 (68%)	293 (83.4%)	95 (28.2)
Controlled	118 (29%)	116 (33%)	48 (14.2)


DISCUSSION

The present study was carried out to document the continuum of care indicators in the community and to how an ASHA-driven hypertension and diabetes risk assessment using the NHM smartphone-based application affect screening, referral and management of patients engaged in care. Analysis of the App was also done to understand the feasibility of deployment of the technology for NCD care. In addition to these, determinants for adoption of technology were also analyzed.

The Donabedian model helped to understand an interplay of multiple factors in development and adoption of technology, indicating that development of technology is only a first step towards widespread adoption of such tools. The major barriers are the incorporation of technologies as an intrinsic component of the health system across the country and their acceptability by healthcare providers. Successful evidence-informed public health interventions often fail to have an impact/ get adopted beyond the study period or the study population due to lack of systematic and efficient uptake by the relevant stakeholders, including governments and health systems in low- and middle- income country settings. This exacerbates the “know-do” gap. Thus, to manage chronic conditions, it is imperative to be cognizant of continuum of care approach and evaluate the processes involved.

The context factors included the healthcare system and its functioning (both government and private), access to care, socio demographic factors of patients and the healthcare workers, ASHAs workload and prevalence of hypertension and diabetes in the community. The findings clearly reflected that the study area had a high number of middle age population, and the disease burden was high in the community. It was a prudent decision to involve the grassroot functionaries (ASHA) for the task of risk assessment to expedite screening and engaging patients in care. The health system activities like advocacy with the state and district health administration were directed to strengthen the already existing system and its functioning. Despite increased efforts by ASHA, treatment adherence was limited in nature as there were several other impediments at health facility level that prevented utilization of healthcare services. Also, it was observed that coherent messages regarding NCDs from different sources like MOs, ANMs, ASHAs helped in increasing the credibility of information received by the participants. Thus, this restored faith of community members in ASHA and health system. The study findings were similar to a study done by Abdel-All (2019) in Andhra Pradesh in terms of the understanding of the frontline/grassroot workers in community processes and dynamics consequent to their being a resident of the community. The study showed in addition to strengthening government healthcare facilities it is essential to do rigorous community mobilization activities to increase awareness regarding NCDs and their prevention. Factors like few follow up house visits by ASHA and targeting only suspected individuals might not be a worthwhile approach. The whole family approach needs to be used for ensuring lifestyle modification at the household level and engaging all the stakeholders. The study clearly reflected that contextual factors clearly play a crucial role in influencing behaviour of people.

Evaluation of process factors indicated that efforts in training ASHAs on NCD care and use



of technology for risk assessment helped in creating a suitable environment for increasing credibility of ASHAs workers in the community. This was directly reflected in their capacity to influence susceptible individuals for screening. Analysis of feasibility of App use showcased that with proper handholding, ASHAs that were literate in both English and Punjabi/local language were able to use the smartphone App for enrolment of individuals. Intrinsic factors like motivation to work, and prior smartphone experience also contributed to better efficiency in App usage. Also, strategic planning of refresher trainings, hand holding and App revisions for making it more user friendly is needed in other States planning to adopt smartphone App for Population based screening.

It was worth noting that almost all enrolment of eligible participants were done by ASHAs but there was a delay in screening activities by ANMs due to unavailability of glucometer strips. Despite the adoption of the ASHA App being in the fledgling stage, it served as a catalyst in timely initiating screening and referrals by healthcare providers. The study also endeavors to understand how use of IT based solutions for ASHAs helps in effective linkage of high-risk individuals/ confirmed patients and their follow up when engaged in care. Thus, this additional step of digital inclusion of ASHA workers strengthens the already existent guideline-based system, the CDSS enabled CPHC system.

It was seen that strategic management of the processes related to training, handholding and supervision contributed to easy implementation of the study. It was also seen that the technical support unit of the TATA trusts (government's implementation partner) was actively involved in resolution of the problems faced by ASHAs. All these factors contributed to the strength of the study.

The ASHA study also had some limitations. It was observed that mere training of ASHAs on App cannot help in use or adoption of the technology, rigorous handholding and supervision is required by the state and district administration to promote use and adoption. Further it was observed that by the time ASHA study was implemented more than 80% of the paper-based enrolments were completed, hence usage of App was observed only for a short duration. It is suggested that observation for longer duration should be done to understand confounding variables which were not evident in this observation of short duration. Also, study highlights that the App can only work and sync data where internet connectivity is good. In addition to these it was documented that COVID-19 contributed to delays in the processes like training and implementation but did not directly impact the use and adoption of App. It is also essential to ensure prerequisites like investigation, drugs and availability of healthcare provider are met for successful adoption and sustainability of use of technology in future. Since technology can only identify susceptible individuals the real shift in paradigm will happen when healthcare services are optimal.

CONCLUSION

In conclusion, the study clearly demonstrated that ASHAs can be successfully trained for risk assessment using digital platform and can contribute to timely identification of high-risk individuals by engaging them in care. The study showed that the use of App significantly reduced the time by almost 25 mins per family, avoided the double work burden of first manually filling forms and then digitizing them by two different cadre of workers. This helped in improving efficiency of work while enabling early screening and management of high-risk cases. The refresher trainings ensured retention of knowledge and introduction of version update features. It is critical to have a mechanism for conducting regular refresher trainings to ensure check on the usage of technology and resolution of the issues faced. It is worth noting that although technology is a solution for the overburdened health system, a standalone App for each health programme is useful only for testing purpose but it is crucial to have a policy that promotes integration of various vertical programmes and their subsequent Apps.

This integration will enable availability of participants' details across all health programmes thus providing single point data access for monitoring and evaluation. Further, this single point system will tackle issues related to data merger across various platforms making it easier to plan follow up of all patients segregated by different actions, e.g., Mamta app for mother and child and CPHC NCD system for NCDs. We envision that the evaluation of the ASHA driven smartphone risk assessment and management will provide opportunities and roadmap for policy makers and other states to improve hypertension and diabetes care through usage of this app.



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