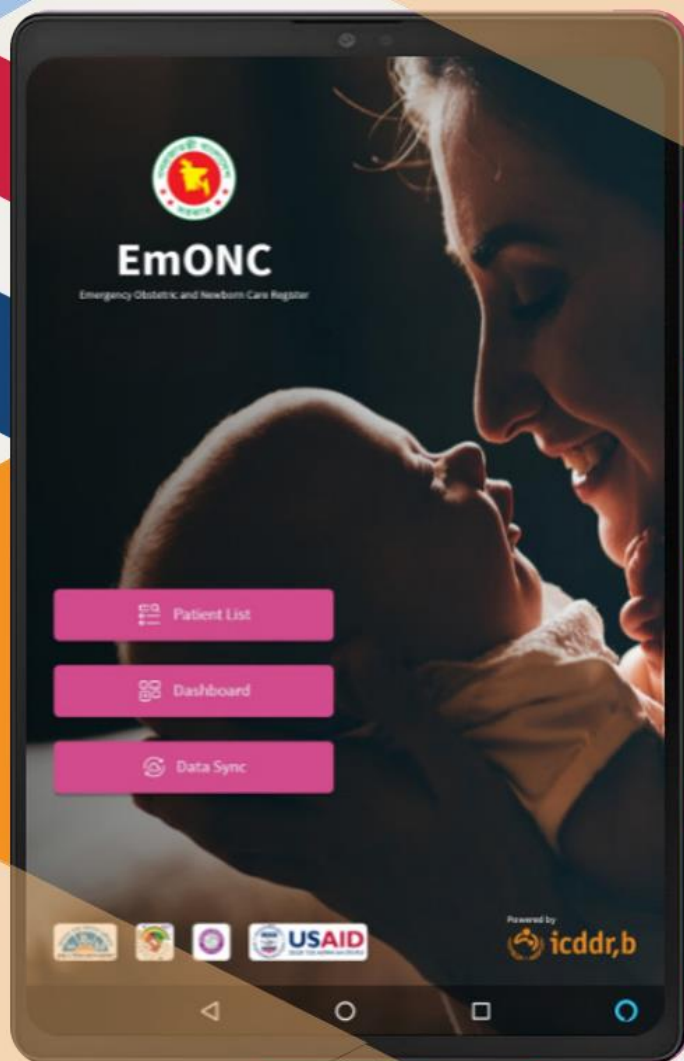


REPORT ON FEASIBILITY ASSESMENT OF DIGITAL EmONC REGISTER



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ACKNOWLEDGEMENT

This digital EmONC register application was developed by the Data Management Support (DMS) of Maternal and Child Health Division, International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b) with the support of the United States Agency for International Development (USAID) under the terms of USAID's Research for Decision Makers (RDM) Activity. The authors would like to thank all the policy makers, healthcare facilities and its managers, health care providers who participated in the implementation research. The authors also thank the mothers and their family members who came to deliver their child in the implementing facilities and was interviewed in this study.

icddr,b is grateful to the Government of Bangladesh for its long-term financial support. icddr,b is also thankful to its international core donors, Canada (Global Affairs Canada), Sweden (Sida), and the United Kingdom (FCDO). Keeping with the Paris Declaration on Aid Effectiveness, they provide long-term core funds to support the advancement of icddr,b's strategic plan.

ACRONYM

AMTSL	Active Management of Third Stage of Labor
BDHS	Bangladesh Demographic and Health Survey
BMMS	Bangladesh Maternal Mortality and Healthcare Survey
CHX	Chlorhexidine
DGHS	Directorate General of Health Services
DHIS	District Health Information System
IDI	In-depth Interview
LMIC	Low and Middle-Income Countries
MIS	Management Information Systems
MMR	Maternal Mortality Rate
NMR	Neonatal Mortality Rate
PNC	Post-natal care
SDG	Sustainable Development Goal
SOP	Standard Operating Procedure
SUS	System Usability Scale
TAM	Technology Acceptance Model
TFA	Theoretical Framework of Acceptability
TOT	Training of Trainers
WHO	World Health Organisation

EXECUTIVE SUMMARY

Despite numerous interventions throughout the years, both the Maternal Mortality Rate (MMR) and the Neonatal Mortality Rate (NMR) continue to be high in Bangladesh. Insufficient data on maternity and newborn healthcare services is one of the most significant contributors to this issue. This research aimed to develop and implement an electronic maternity and newborn care registration system in selected facilities in Bangladesh so that researchers could collect, assess, and utilize the data to enhance maternal and newborn healthcare services.

To collect clinical data relevant to pregnant women and infants, the study team converted the paper based EmONC register to a digital one. The program was designed to be intuitive and to have built-in validation questions. The team also developed a web-based dashboard for real-time monitoring and analysis of the acquired data. The software and dashboard were updated with the assistance of healthcare professionals, facility administrators, and legislators after undergoing a series of testing. The team had to ensure that the app and dashboard were complementary so that data monitoring and visualisation would be basic and uncomplicated.

The healthcare providers at these selected facilities were trained on how to use the application. The study found that the electronic maternal and newborn care registration system was not only feasible, but also acceptable to healthcare practitioners, facility administrators, and legislators. The system improved the completeness and accuracy of the data, reduced the effort and time necessary for data entry, and enabled real-time monitoring and analysis of the data. The research also revealed that the approach could improve the quality of medical treatment offered to pregnant mothers and infants.

Throughout the process of designing and implementing, the study uncovered some barriers. Due to their lack of a medical background, the IT team had trouble deciphering the technical, medical terms utilized throughout the app development phase. In contrast, the study team struggled to comprehend IT jargon. Within the constraints of the two-day training period, however, it was challenging to boost the confidence of senior healthcare professionals who lacked technological expertise.

The electronic maternal and newborn care registration system has the potential to improve maternal and neonatal healthcare services in Bangladesh by providing accurate, timely, and comprehensive data for decision-making purposes. The research demonstrates that the system is both practicable and acceptable. It has also identified areas where the system's design and practical implementation may be improved. According to the findings of the study, the computerized maternity and newborn care registration system should be expanded to other facilities in Bangladesh in order to improve maternal and newborn health outcomes.

BACKGROUND

Obstetric prevalence refers to the incidence and distribution of specific health conditions or events that occur during pregnancy, childbirth, and postpartum. This information can be used to identify trends in maternal and neonatal health and inform public health policies and programs. An essential part of monitoring mother and child health is gathering data on obstetric prevalence. Data on obstetric prevalence can be found in a number of places, including population-based surveys, clinical research, and national and local health databases. It is possible to enhance maternal and newborn health outcomes and lessen the burden of pregnancy-related problems and mortality by monitoring obstetric prevalence and treating risk factors through appropriate interventions.

The Sustainable Development Goals (SDGs) are a set of 17 goals adopted by the United Nations in 2015 as a global framework for sustainable development of the environment, society and economy for people, planet and prosperity (1).

One of the specific targets under SDG 3 is to reduce the global maternal mortality ratio to less than 70 per 100,000 live births by 2030. According to the World Health Organization (WHO), the current South-Asian maternal mortality ratio is estimated to be 157 maternal deaths per 100,000 live births (2). While this represents a significant improvement of about 60 percent from previous years, it still falls short of the SDG target.

The Bangladesh Maternal Mortality and Health Care Survey (BMMS) Final Report of 2016 provides insight into the situation of maternal and prenatal health in Bangladesh. The maternal mortality ratio in Bangladesh was estimated to be 196 deaths per 100,000 live births (3). The report notes that timely access to quality emergency obstetric care is essential to reducing maternal mortality and highlights the importance of improving the quality of maternal health services in Bangladesh (3).

The Bangladesh Demographic and Health Survey (BDHS) of 2017 provides comprehensive information on various aspects of maternal and child health in Bangladesh (4).

In order to provide better care and track maternal health trends, a register is maintained by the health care facilities as per international guidelines, called the EmONC register. The EmONC (Emergency Obstetric and Newborn Care) register is maintained for maternal care because it serves as a vital tool for tracking the quality of emergency obstetric and newborn care services provided to women and newborns. The register helps to ensure that women and newborns receive timely and appropriate emergency care when complications arise during pregnancy, childbirth, or the postpartum period. The EmONC register contains detailed information on the number of women who receive emergency obstetric care, the types of emergency obstetric care provided, the outcomes of emergency obstetric

care, and the availability and quality of essential maternal and newborn health supplies and equipment.

By maintaining the EmONC register, healthcare providers and health authorities can identify gaps in emergency obstetric and newborn care services and take necessary measures to improve the quality of care provided. This register also helps to monitor progress towards achieving the Sustainable Development Goals (SDGs) related to maternal and newborn health. The EmONC register is essential for ensuring that women and newborns receive the emergency obstetric care they need to survive and thrive and for improving the quality of maternal and newborn health services.

OBJECTIVES

General

To assess the feasibility and acceptability of introducing an eRegister at the selected health facilities.

Specific

- a) To assess the usability of eRegister among healthcare providers
- b) To assess the acceptability of eRegister for providing EmONC services among healthcare providers (direct caregivers, supervisors, and managers) and care receivers
- c) To assess the level of adoption of eRegister (i.e., actual use) in the selected facilities
- d) To explore the fidelity (i.e., data completeness) of eRegister
- e) To assess the utility (i.e., quality of care) of eRegister among healthcare providers
- f) To assess the implementation cost of introducing eRegister in the selected facilities
- g) To investigate the barriers to, and enablers of, using eRegister among healthcare providers in providing EmONC services

GAPS IN THE PAPER-BASED SYSTEM

To standardise the documentation and reporting practices linked to EmONC services, the national maternal health program keeps a paper-based standardised register in all district hospitals and Upazila health complexes. The medical professionals in charge of giving birth fill out the EmONC registers and distribute monthly reports using a defined format. The statisticians upload the monthly reports to the DHIS2 portal. However, these manual systems have flaws and holes (5, 6). The regular healthcare system has traditionally relied heavily on manual data gathering, especially at the periphery levels in low- and middle-income countries (LMIC) (7).

The following disadvantages are identified for the paper-based registers.

- Recall time gap
- Recall error
- Reporting gap
- Portability and safety of use
- Portability and safety of use

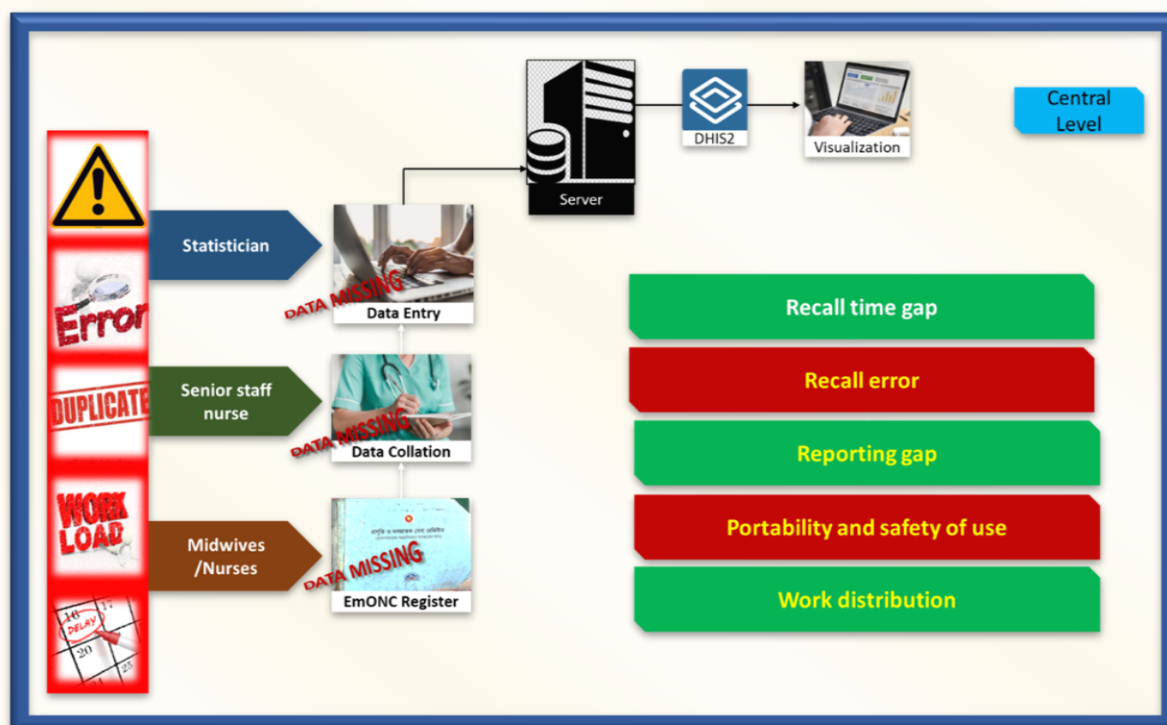


FIGURE 1 DISADVANTAGES OF PAPER-BASED EMONC REGISTER

PROPOSED SOLUTION

DIGITAL EMONC REGISTER

We developed Android-based eRegister for EmONC services focusing on service automation and data digitalisation. It was a platform shifting from paper base tool digitalisation of the existing 50 variable containing EmONC register. We adopted a human centred design to prepare the user interface such as logic model wireframing an initial prototype. Later we created a simple and user friendly app to capture the priority indicators based on the expectation and feedback of the stakeholders on user interference and user experience. From starting to end of the process there were heavy engagement of the stakeholder in each steps. We implemented the apps in the study facilities to assess their feasibility. To make the Apps users friendly and easily accessible and get a quick result with accuracy, multi methods have been applied in this research, i.e. sensitisation and consultive workshop, field visit and interview, checking data entry on the spot, getting feedback from the field level users, and IDI with the specialist, virtual orientation, planning and sensitisation meeting with district and local level, review of the eRegister, QA testing, and demonstration.



FIGURE 2 SHORT DESCRIPTION OF TECHNOLOGICAL INNOVATION OF THE APP

The Digital EmONC Register App will be used as a service app for providing emergency maternal and newborn healthcare at healthcare facilities. Where health care providers can collect and save data related to maternal and newborn health care. From the Digital EmONC Register web link, facility

managers, Statisticians and Research teams can view the following reports directly and print hard copies at any time of the month.

- Monthly Report
- Data view similar to paper based EmONC register
- Dashboard
- Generated report from the dashboard

From the Digital Health Register web link, Health facility Managers, Statisticians and Research Team will be able to directly monitor the aforementioned reports and print hard copies of them at any time of the month. Various filters (eg time, service provider designation type, service type) can be used while generating the report. Besides, the statistician of the service center can extract the 'Monthly report' from the web link at any time of the month and upload it to DHIS2.

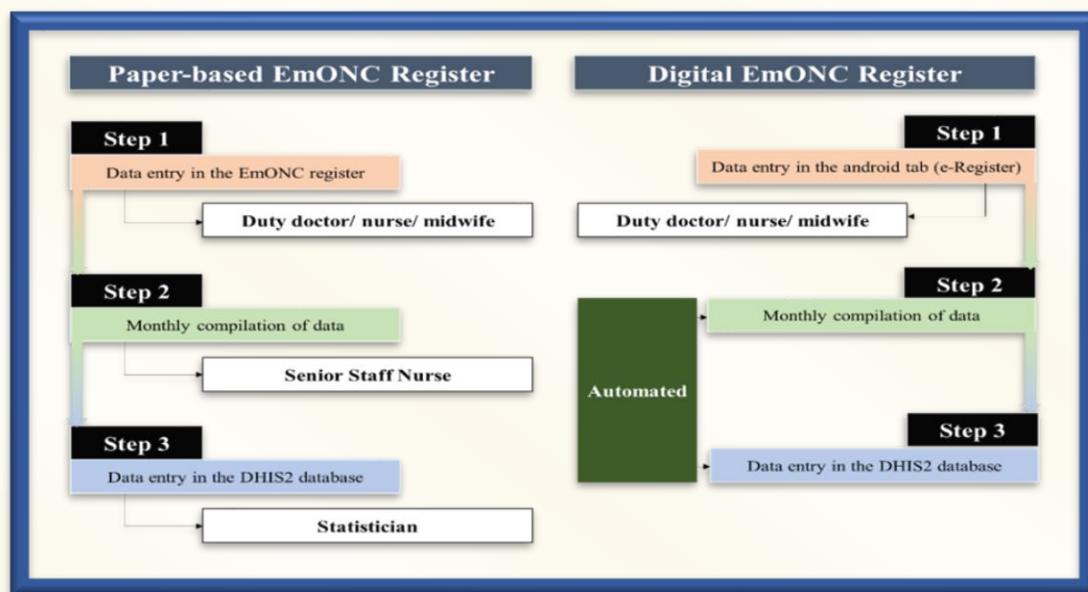


FIGURE 3 COMPARISON BETWEEN WORKFLOW OF PAPER-BASED REGISTER AND APP

- ▶ When the data entered in the app is uploaded to the central/central server system, it is very important to synchronise the data. Internet connection is required for Data synchronisation. If data sync is allowed, the data provided in the app will be directly uploaded to the central server system.
- ▶ Every time the patient list page is refreshed, the information provided in the app will be uploaded to the central server system.

- ▶ After inputting all the information of 5 sub-headings/pages of the app (Registration, Delivery, Newborn, PNC, Discharge) and after clicking on the 'save and next' button, the saved information will be uploaded to the central server system.
- ▶ In the central server system, there will be database backup facility of the app. At a specified time interval, the database of the app in the central server system will be updated automatically. In the absence of internet connection, the information provided in the app will be stored in the tab software and once the internet/WIFI connection is available, the information stored in the tab software will be automatically uploaded to the central server system.

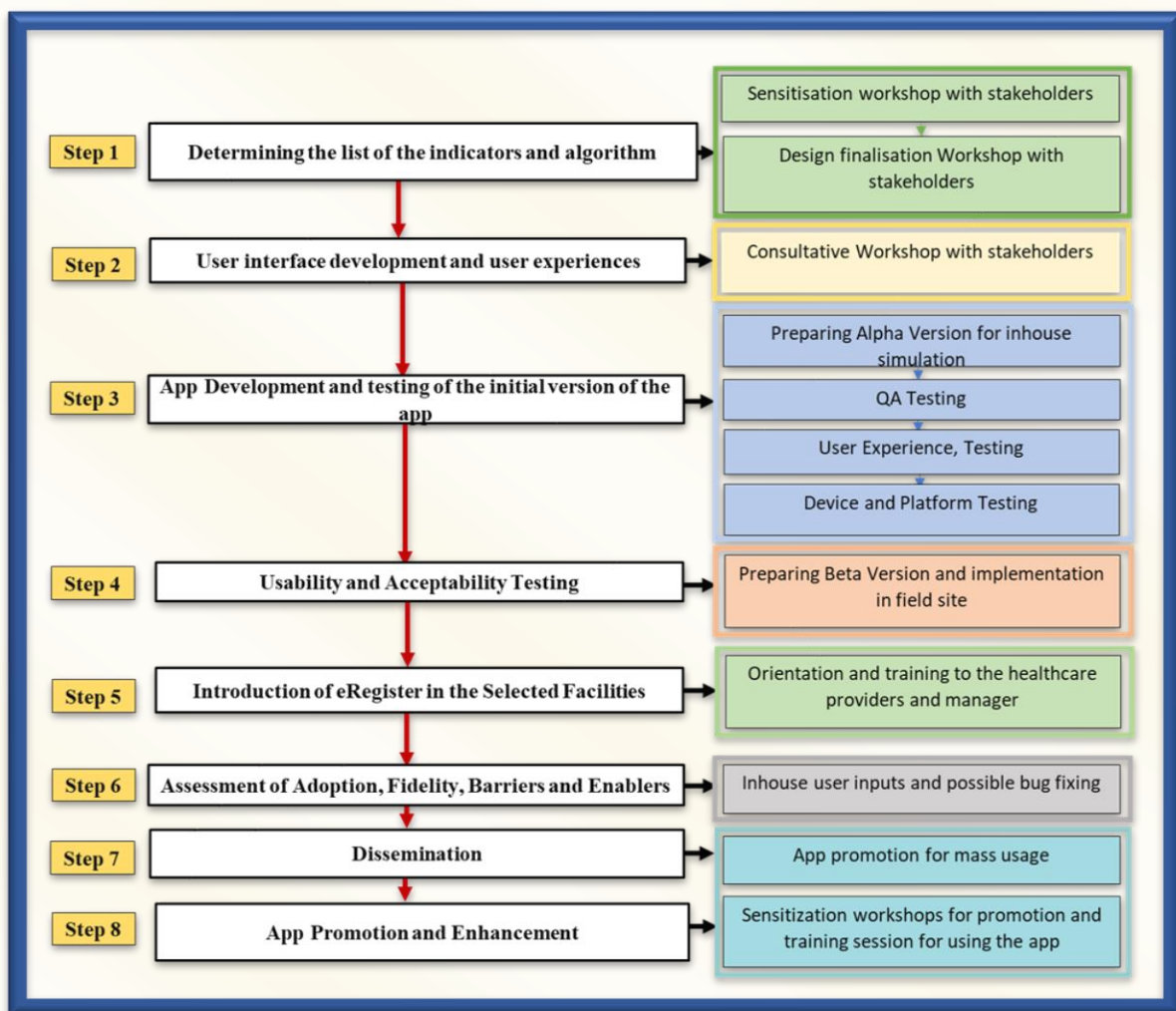


FIGURE 4 DIGITAL EMONC REGISTER APP DEVELOPMENT PROCESS

ADVANTAGES OF THE DIGITAL EMONC REGISTER

1. It will reduce workload, recall error and recall gap.
2. The app will have a built-in system for error and data range checks. If the software discovers an error, such as when the user enters the baby's weight in kilograms, it will alert the users.
3. Real time report production.
4. The android tablet-based system is very mobile and can be used on the go.
5. The statistician's dependency on compiling data to get a real-time reading will be completely redundant as the app can provide real-time data.
6. The app can be used as a teaching tool to train and mobilise communities and provide suggestions on what to do in life-threatening deliveries.

METHODS

We adopted the WHO-recommended implementation research approach to design, develop and demonstrate an Android-based eRegister for EmONC services focusing on service automation and data digitalisation (8). We assessed the feasibility and acceptability of the digital EmONC register. The duration of the study was from November 2021 to February 2023. The app was implemented in the facilities as per following dates. The study was conducted in the Kushtia and Dinajpur district. As primary level health facility Kumarkhali Upazila Health Complex and Hakimpur Upaila Health complex were selected. Kushtia and Dinajpur district hospitals were selected as the secondary health care facilities. The facilities were ensured to have internet connectivity in the app installation sites.

Study population:

Primary: Front line service providers (caregivers) who conduct deliveries such as doctors, nurses, and midwives, Policy makers, facility managers, statisticians

Secondary: Care receivers (mothers who have delivered their child in the implementing facility)

Data collection: Data was collected both in quantitative and qualitative method. We extracted the EmONC registers three months prior to implementation of the e-Register. Data collectors were deployed to tally the total number of patients admitted in the labour ward.

Sample size: Our estimated sample size was recording 414 deliveries by the e-Registers in three months' time duration. But we could reach the sample size and took all the deliveries those were recorded in this duration. The following number of deliveries were collected from the different sources.

Data source	Recorded number of deliveries	Duration
<i>Paper based Emergency Obstetric and Newborn Care register</i>		
Total deliveries in the facility	1235	(April, May, June, 2022)
Total livebirths in the facility	1140	
<i>(DHIS2)</i>		
Total deliveries in the facility	1414	(April, May, June, 2022)
<i>Digital Emergency Obstetric and Newborn Careregister</i>		
Total deliveries recorded in the facility	1644	(November & December 22, January 2023)
Total livebirths recorded in the facility	1568	
<i>Data collectors register</i>		
Total deliveries in the facility	1675	(November & December 22, January 2023)

TABLE 1 TOTAL NUMBER OF DELIVERY DATA COLLECTED FROM THE DIFFERENT DATA SOURCES IN THREE MONTHS

Total 31 qualitative interview were taken from policy makers, facility managers, health care providers and care receivers.

Data analysis:

Quantitative: All the data were given an appropriate identifier to maintain anonymity. STATA 15.0 was used for the data analysis.

Qualitative: We will use the Theoretical Framework of Acceptability (TFA Version 2) as the analytical framework.

RESULTS

Quantitative

Usability: we measured the usability of the app among the healthcare providers of the facility. A total of 32 providers participated and the measured usability of the e-Register using the System Usability Scale (SUS) was 83.7.

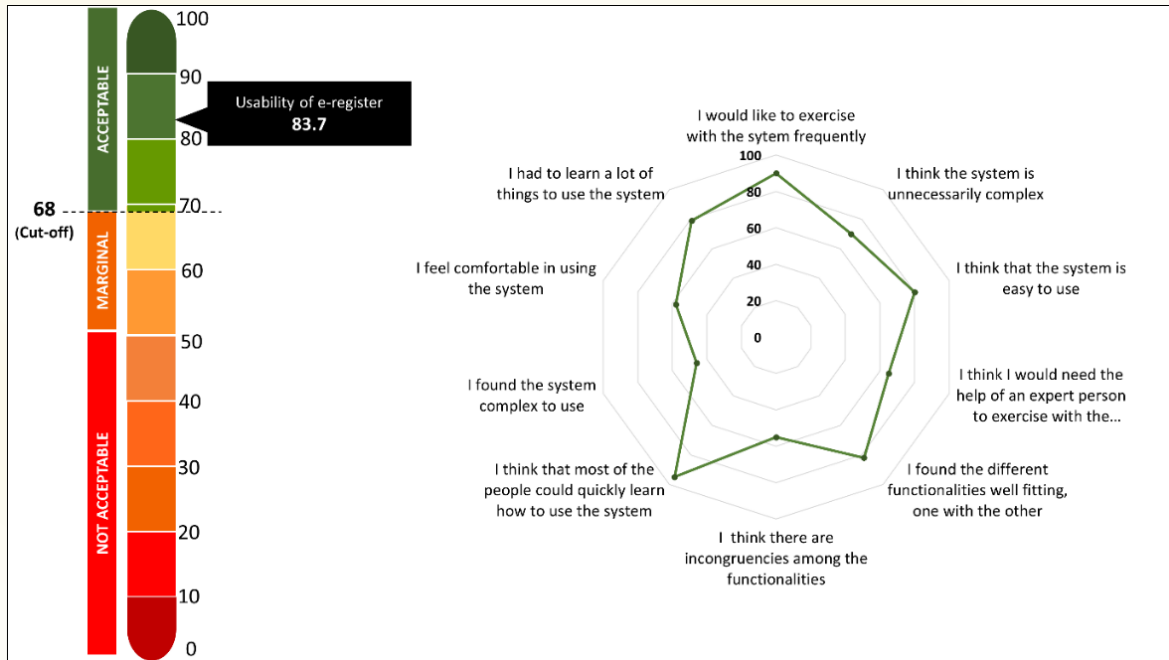


FIGURE 5 USABILITY SCORE OF DIGITAL EMERGENCY OBSTETRIC AND NEWBORN CARE REGISTER USING SYSTEM USABILITY SCALE (SUS) (N=32)

Acceptability: Technology acceptance model (TAM) was used to assess perceived usefulness, perceived ease of use, attitude towards using the app, intention to use and actual use of the e-register among the healthcare providers. Figure-6 shows that all five components of the technology acceptance model (TAM) received an average score exceeding 95%.

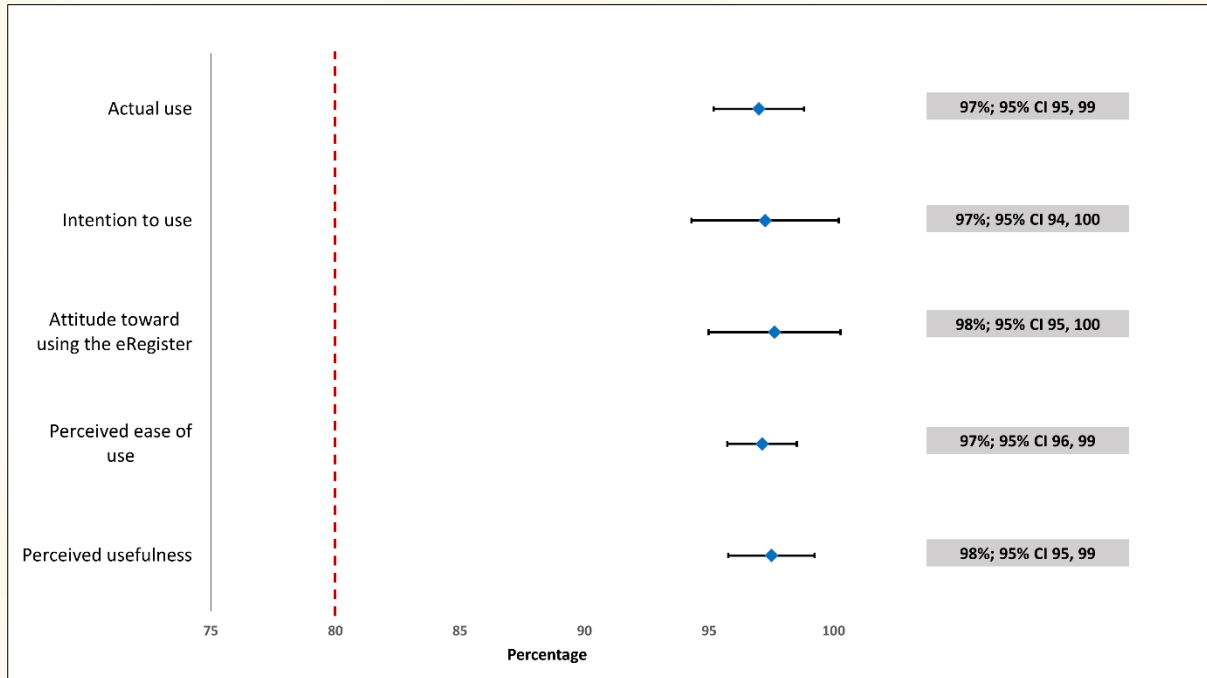


FIGURE 6 AVERAGE SCORE OF ACCEPTABILITY OF THE DIGITAL EMONC REGISTER IN THE COMPONENTS OF TECHNOLOGY ACCEPTANCE MODEL (TAM) (N=32)

Outcome variables:

Figure 7 provides a comparative analysis of the outcome variables: adoption, fidelity, and utility of the digital Emergency Obstetric and Newborn Care register in contrast to the paper-based register. During the implementation period, the adoption rate of the e-register was 98% (95% CI; UR 98, 99), a notable contrast to the 87% (95% CI; UR 86, 89) adoption rate observed in the paper-based register. In terms of fidelity, the electronic register achieved a rate of 90% (95% CI; UR 88,91) when considering cases with more than 80% of data elements properly recorded while the paper-based register displayed a much lower fidelity rate of 14% (95% CI; UR 12,16). Furthermore, the utility of the digital Emergency Obstetric and Newborn Care register was 89% (95% CI; UR 88,91), which exceeded the utility rate of the paper-based register, that stood at 64% (95% CI; UR 61,67).

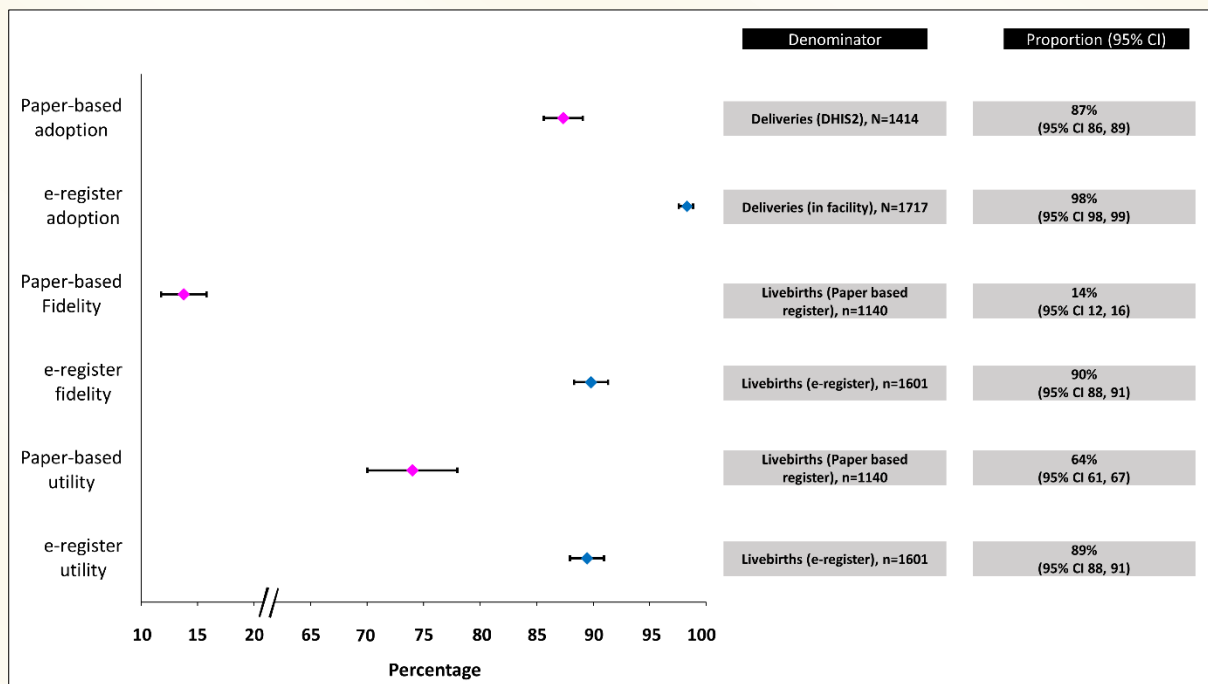


FIGURE 7 COMPARISON OF THE PROPORTION OF DELIVERIES RECORDED, PROPORTION OF DELIVERIES WITH MORE THAN 80% DATA ELEMENTS RECORDED AND PROPORTION OF LIVEBIRTHS WITH A VALID RECORD ON AMTSL, BIRTH WEIGHT AND CHX APPLICATION RECORDED BY THE PAPER-BASED REGISTER AND E-REGISTER

Figure 8 offers a comprehensive view of the outcome variables, stratified by month, district, and facility type. The adoption proportion consistently exceeded 95% each month, with the peak occurring in the middle of the implementation period. Both primary and secondary referral facilities boasted adoption rates above 95%, with confidence intervals confirming this in the range of 95%. Notably, Dinajpur district exhibited slightly higher adoption compared to Kushtia district. Fidelity in using the digital EmONC register increased progressively as the implementation duration advanced, reaching a remarkable peak of 92% (95% CI; UR 90, 94) in the last month. This rising trend was evident across all facility types. The utility of the electronic register was most pronounced in the second month, which was 93% (95% CI, UR 91, 95). Interestingly, Upazila Health complexes outperformed in both digital (94%) and paper-based (85%) platforms. Moreover, the utility of the digital EmONC was notably higher in Dinajpur district, recording 95% (95% CI; UR 92, 96).

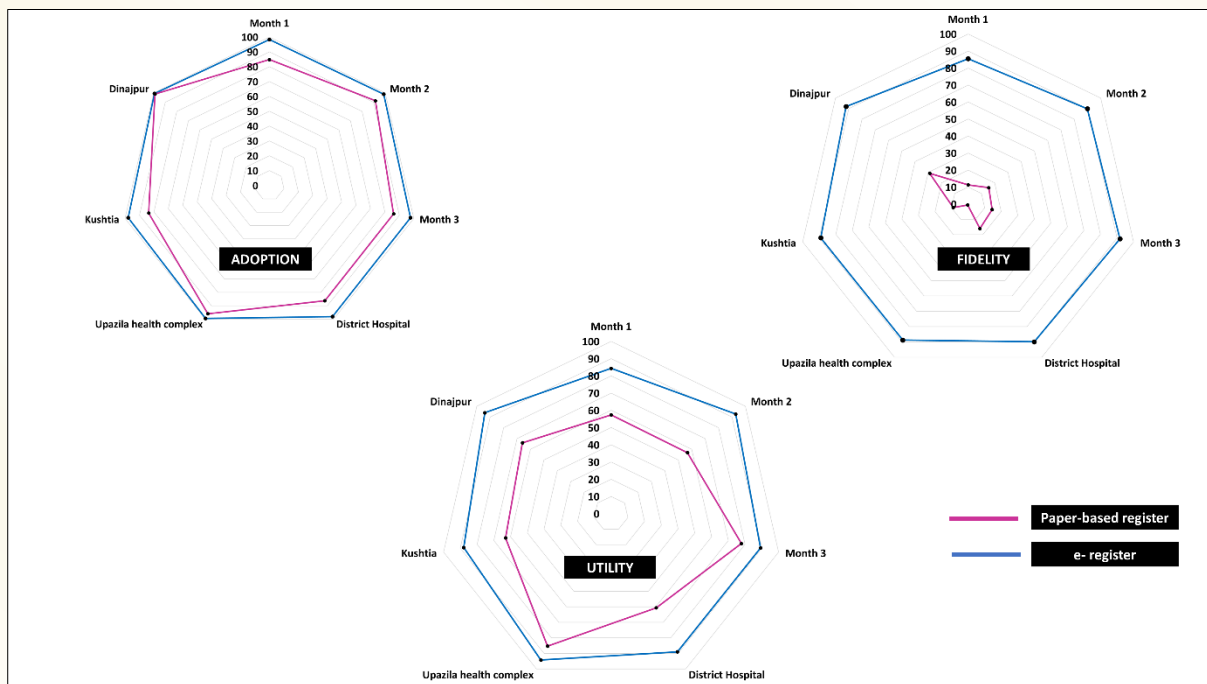


FIGURE 8 COMPARISON OF THE ADOPTION, FIDELITY AND UTILITY BY MONTH, BY FACILITY AND BY DISTRICT RECORDED BY THE PAPER-BASED REGISTER AND E- REGISTER

Figure 9 presents the proportion of the WHO variables achieved concerning the benchmark. It was evident that all the variables successfully exceeded the benchmark value.

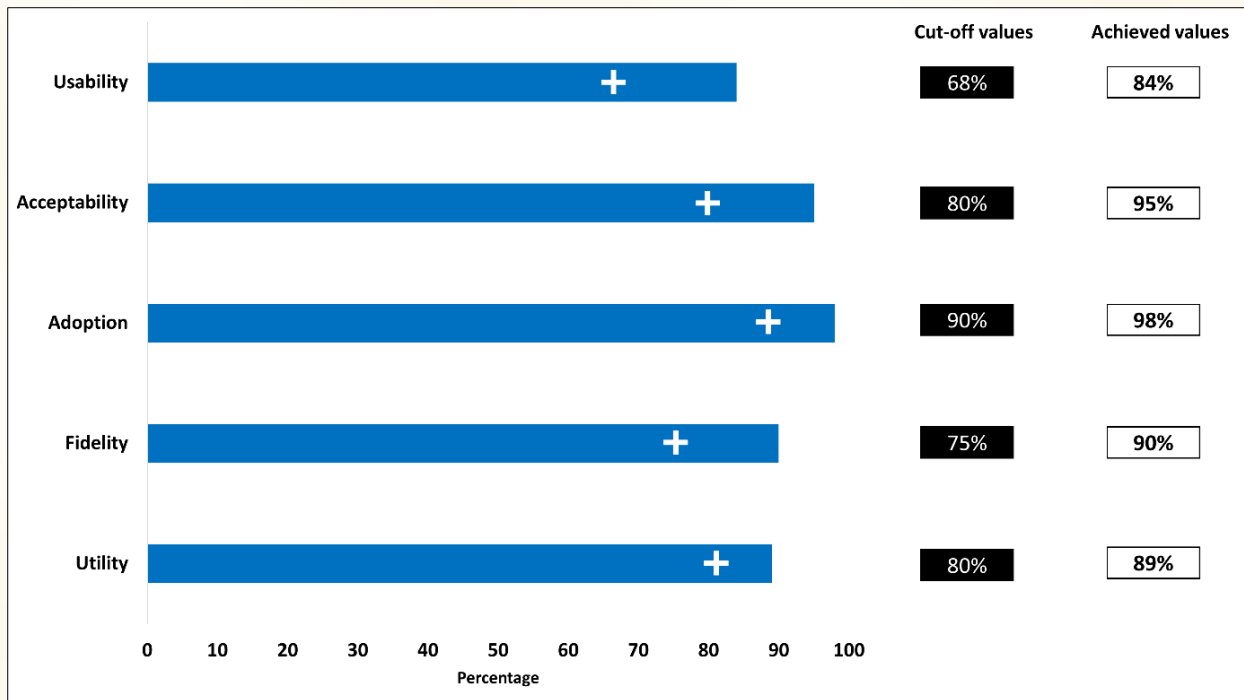


FIGURE 9 ACHIEVED VALUES OF THE OUTCOME VARIABLES FOR FEASIBILITY ASSESSMENT OF THE E- REGISTER

Qualitative

The qualitative result was based on ten themes namely, affective attitude, burden, ethicality, intervention coherence, opportunity costs, perceived effectiveness, self-efficacy, experiences in taking services and challenges. From the interview, it was evident that the use of digital platform has made the monitoring and supervision easier at the healthcare manager and policy maker level. It has reduced the excessive workload due to task duplication in the provider level and initiated real time data entry which reduced the recall time gap, recall error and data manipulation. One of the healthcare providers mentioned,

“We often had made mistakes while making a paper-based entry but the benefit of e-register is we have to input the data instantly. Then we keep on inputting the data stepwise. We do not see any possibility of making mistakes.”

As the software is designed to identify the wrong entry and data missing it has improved the data quality to a significant level. The software comes in a very user-friendly device with user interface and user experience-based design which is able to generate the monthly reporting form in just a click. A large volume of data can be entered in the shortest possible time. One of its users said,

“E-registration requires less effort than a paper-based system. In a paper-based system, I have to write down the data manually and maintain the large register book. In contrast, I require very little effort and less space for the same volume of data in the tab.”

Most of the service providers believe that only minimal personal patient data is being collected here. They also feel, as the tab is password protected, data confidentiality will be maintained very well than the paper-based register as it was kept open in the front desk of the labour ward of the public facility.

Every change comes with some challenges in the initial stage and digital EmONC register was no exception to it. At first the providers were not comfortable using the android tablet which gradually became familiar to them. However, most of the providers feel that the senior health care provider will not be able to overcome the challenges of using as they are not even accustomed in using smartphones by themselves. One of the providers mentioned in this regard,

“The aged people may initially feel uneasy to use the app as it is a mobile app. On the contrary, young people have no problem using the app, I think. Now, everybody uses a smartphone. It is advantageous for all. It is my personal opinion”.

On occasions, the facilities experience some network issues which they cannot rectify themselves independently due to lack of technical experts. Sometimes, the internet connection is disrupted due

to power failure or the connection may be present with less than minimum strength. One of the interviewees mentioned,

“The other thing is about the network line. Internet line is not available all the time. Our Internet line is sometimes available and sometimes not. So, when the internet connection is unavailable, we are facing a little problem inputting data into the app. Because proper internet support is not given in Bangladesh yet. That’s why sometimes problems are seen with our internet connection. When there is an internet connection problem, we cannot input data to the app, it gets a little late.”

KEY CHALLENGES

All challenges faced by the research team are given under three broad headings. Each heading represents a particular phase in the project. The phases are:

App Design and Development

- ▶ The app development required discussion sessions between the research team and IT team, which were challenging due to technical and medical language barriers.
- ▶ The app and dashboard had to complement each other to monitor and visualize data effectively.
- ▶ The app's design had to be centered around service delivery rather than data collection to avoid hindering midwives' and nurses' workflows.

Training:

- ▶ Participants received a two-day training session, which healthcare providers felt should have been longer.
- ▶ The research and IT teams were diligent during the sessions to ensure that the participants were confident and skilled enough to operate the app after the allotted sessions.
- ▶ Training sessions had to consider individual facility's data flow, and upskilling non-tech-savvy seniors among healthcare providers was tricky.

Implementation:

- ▶ Implementation started immediately after the training sessions, leaving little time to change the app and dashboard based on feedback.
- ▶ Different facilities had different start dates for implementation, posing a challenge.
- ▶ Data had to be entered into the app on a later date for the monthly report to be generated correctly in facilities with delayed implementation.
- ▶ Fixing mistakes in data or duplicate entries after 24 hours of discharge required correction from the central server.

SUCCESS STORY

The success of the digital EmONC register app in the Dinajpur District has been a remarkable achievement for the project team. The app has received positive feedback from healthcare providers and facility managers, as it has significantly reduced their workload and simplified their daily tasks. This success has not gone unnoticed, and the Civil Surgeon of the Dinajpur District has expressed interest in scaling up the initiative in all Upazila Health Complexes in the district, excluding the Sadar Upazila and Hakimpur where it is already deployed. Team icddr,b successfully scaled up the digital EmONC register in all the Upazila Health Complexes with hands on training to the designated healthcare provider to use the app.

CONCLUSION

The EmONC application project faced hurdles during development, training, and implementation. Non-tech-savvy healthcare personnel required additional training, and gathering input from practitioners and administrators was difficult. Despite obstacles, the project successfully delivered a tool for emergency obstetric and neonatal care data management. Scaling up the app nationwide will have a lasting impact on improving the quality of maternal and newborn services in developing countries through enhanced data quality.

RECOMMENDATIONS

The following recommendations can be made:

- ▶ **Scale-up the app:** The success of the app in the pilot phase highlights the need for its widespread implementation across the country. The government should allocate funds in the standard operating procedures (SOP) for the procurement of tablets and training of healthcare providers. The app can be disseminated through nationwide sensitisation campaigns to ensure that all healthcare facilities have access to the app.
- ▶ **Internet connectivity:** Internet connectivity is crucial for the app to function properly. The government should ensure that healthcare facilities have a stable internet connection. It can be self-funded by the facility or provided by the government through the SOP.
- ▶ **Training:** The training sessions can be improved to ensure that healthcare providers are adequately skilled to use the app. A Training of Trainers (TOT) model can be adopted to train a group of master trainers who can then train others. Yearly refresher training sessions can be conducted to update healthcare providers on any changes in the app.
- ▶ **Integration with the Management Information System (MIS) of DGHS:** The app's database and dashboard can be integrated with the MIS of the Directorate General of Health Services (DGHS). This will enable real-time monitoring of maternal and neonatal health indicators and facilitate data-driven decision-making.
- ▶ **Dedicated support team:** To ensure the smooth functioning of the app, the MIS should have a dedicated team that provides 24/7 support to healthcare providers in case of any technical difficulties. The support team can also monitor the data to ensure its accuracy and completeness.
- ▶ **Continuous monitoring and evaluation:** The app's impact should be continuously monitored and evaluated to assess its effectiveness in improving maternal and neonatal health outcomes. The feedback received from healthcare providers and facility managers should be used to make necessary improvements to the app.

By implementing these recommendations, the app can be scaled up and contribute significantly to improving maternal and neonatal health outcomes in Bangladesh.

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Submitted by

USAID's Research for Decision Makers (RDM) Activity

Funded by

U.S. Agency for International Development (USAID), Bangladesh

October 2023

Disclaimer: This research protocol/activity/study/video (others as appropriate) was produced with the support of the United States Agency for International Development (USAID) under the terms of USAID's Research for Decision Makers (RDM) Activity cooperative agreement no. AID-388-A-17-00006. Views expressed herein do not necessarily reflect the views of the U.S. Government or USAID. icddr,b is also grateful to the Governments of Bangladesh and Canada for providing unrestricted/institutional support.

