

USE OF MOBILE TECHNOLOGY FOR THE ACHIEVEMENT OF SDG GOALS RELATED TO MATERNAL HEALTH

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Key Messages

The mobile-based reporting system is quick to establish the monitoring system for health projects. Real-time information on the implementation of the program will support managers in increasing the efficiency of the program.

Abstract: *Context:* Bihar aims to achieve a maternal mortality ratio (MMR) of less than 70 per 1, 00, 000 live births, towards achieving its Sustainable Development Goal. The same can be achieved through robust monitoring of the health programs in the state. The present study critically analyses the use of a mobile-based reporting system on achieving the SDG for the state.

Aims: The study aims to assess the use of mobile phone-based reporting systems for Sustainable Development Goals. Thus, establishing the usefulness of a mobile-based reporting system. The study also explores the cost of running the project.

Settings and Design: It is a quasi-experimental design. The study was conducted with Front Line Workers (FLW -Accredited Social Health Activist & Auxiliary Nurse Midwife) of two intervention blocks in the Saharsa District of Bihar. The two blocks were using mobile phones for reporting RMNCHA services. A total of 109 FLWs were contacted in Jul 2017.

Methods and Material: Quantitative methods were used in the study. Two tools were administered to the respondents at the facility level.

Statistical Analysis Used: The study compares the increase in the utilization of health care services from FY 13-14 to FY 16-17. The case is defined as the block in which the front-line workers use mobile phones for reporting and control is where the reporting is through paper-based mode. To arrive at a net difference, the study used the difference in a different technique to analyse the data. Data were obtained from the government reporting system. To corroborate the results, the mean values were calculated, by dividing the blocks of the district into two groups case and control. The step-down costing of the project was performed to arrive at the unit cost of implementation.

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Results: The current projects required 108 \$/FLW/Year to set up the project and a recurring cost of 55\$ /FLW/Year. The total cost for the first year was 226\$/FLW and for the second year, it was 75\$/FLW. The whole project cost 1, 41, 748 \$ for the first year and 46,569\$ for year two.

The mean value of data elements assigned to Antenatal care, communication with patients, Complication of sterilisation services, Delivery services, follow-up services, and post-natal care is higher than the mean value of non-intervention blocks value.

Appropriateness of the reporting time increases by 4.1 times, when the FLW receives the needed service from the mobile platform, while her effectiveness would decrease by 89% when she is worried about a hard copy of the data.

Conclusions: Under Sustainable Development Goal 3, which states Health and Wellbeing for all, maternal health is of prime importance. This study clearly indicates that the use of the mobile phone for follow-up and counselling increases ANC registration, and full ANC coverage and ultimately leads to institutional delivery. Therefore, it is helpful in reducing maternal death by institutionalising deliveries. Hence, the study recommends using the mobile-based solution to achieve SDG 3.

Introduction

Bihar is one of the states in India with an MMR of 165 in 2015-17 (Office of the Registrar General & Census Commissioner, 2019). The SDG vision document of the state claims to bring down the MMR to less than 70. Antenatal care plays a vital role in reducing MMR. So, the state has the vision to increase the first trimester ANC to 90%, 4 ANC visits to 80%, consumption of 100 IFA tablets to 60%, and full ANC to 60%. Institutional delivery to be scaled up to 90%. Postnatal care is to be at 90% within 2 days of delivery (Department of Planning and Development, 2017).

In low-middle income countries the mobile-driven solutions in terms of provision of antenatal services, increasing institutional delivery, and supporting high-risk pregnancies will result in saving the lives of many mothers (Tamrat, 2012: 1092). Mhealth project succeeded in replacing the paper-based reporting system. The analysis of the data was automated to provide estimates at regional levels, it was possible due to real-time reporting on the mobile phone. Community health workers (CHWs) and health facility workers are using the mobile at the point of care for diagnostic and referrals, as a decision support tool and tracking the patient and following them up. Evidence suggests that mhealth interventions improve maternal health outcomes, where the target groups were pregnant women and health workers (Ilozumba, 2018:e019345).

“The World Health Organization defines mHealth as the use of mobile and wireless technologies to support the achievement of health objectives”(WHO, 2011:6). The current research is based on small-scale mhealth initiatives(Wong J, 2017:121). mHealth programs

provide a high return on investments (Bowser, 2018: 592). Mhealth is used in 12 common ways to improve maternal and child health, including education and behaviour-change communication. The majority of mHealth projects are small-scale (Tomlison, 2013:2), which contributes to the lack of evidence on the effects of mhealth in maternal health interventions.

The availability and ease of handling of mobile phones pave the way for its potential to reduce inequalities in programs such as HIV, maternal and child health, family planning, malaria, and tuberculosis (Andreatta, 2011:148). Hence it should be part of the health system (Leveille, 2016: 23). In a study conducted in Bihar, 80% of FLW are willing to use the mobile phone for reporting and 40% were worried about the lack of a hard copy of data (TN, 2018:9). Achievement of MDG Goals fastens with the spread of mhealth initiatives. mHealth supports the MDGs, particularly in child mortality, maternal health, and HIV/AIDS (Tamrat I. K, 2011: 211). The United Nations' post-2015 development agenda stresses a need for a "data revolution" (UN, 2015:3). Health system should be using the real-time data obtained from the mobile-based reporting application to inform the policymakers. (Khandade TN, 2018: 9). Market for mhealth to grow from USD 50.8 bln in 2020 to 213.6 bln in 2025, CAGR of 33%. Largest share by mhealth apps in mhealth market in 2019 (Market standards.com, 2020:1).

Rationale for study: Bihar aims to achieve a maternal mortality ratio (MMR) of less than 70 per 1, 00, 000 live births, towards achieving its Sustainable Development Goal. The same can be achieved through robust monitoring of the health programs in the state. The present study critically analyses the use of a mobile-based reporting system on achieving the SDG for the state.

Research Objective: To assess the use of a mobile phone-based reporting system for Sustainable Development Goals.

Research Methods: This is a quasi-experimental design study involving the Frontline workers (Anganwadi Worker (AWW) and Accredited Social Health Activist – 120). It was conducted in two selected intervention blocks of the Saharsa district in Bihar state in India. Data were analysed using the difference in difference and step-down cost analysis methods.

Results

The current projects enrolled 569 frontline health workers in mobile-based reporting. It required 108 \$/FLW/Year to set up the project. It included a mobile phone, micro SD, SIM, application set up and training. Other one-time costs came around 44\$ /FLW/Year, which is comprised of application report requirements and ground support.

Recurring cost is required at 55\$ /FLW/Year including application maintenance, data plan, handset maintenance and insurance. The project also incurred another recurring

cost of 20\$/FLW/Year towards ground support in terms of deployment of human resources and data plan for that resource. In total, the cost for the year was 226\$/FLW and for the second year, it was 75\$/FLW. The whole project cost 1, 41, 748 \$ for the first year and 46,569\$ for year two.

Assumptions for DID analysis: Parallel trend assumption was kept in the study in terms of service utilization at the facility level.

Mobile phone-based reporting would provide timely data to decision-makers, thus improving the performance of the program. The mobile phone also works as a job aid for Front Line Health workers to deliver standard Information, Education and Communication material, which will generate demand from the community side. Automated due list preparation by the mobile phone software reduces the job task and fastens the transaction between beneficiary and service delivery point. Data were obtained from the government reporting system (DHIS – 2) of Bihar. It is a reliable source of data, as a review of government functionaries is conducted on this data only. The DID was performed to see if the changes are similar in intervention and non-intervention groups. Data from the health management information system of the government of India and for the Saharsa district of Bihar was obtained for the same. In the study of relevant indicators, the percentage difference in the service utilisation from FY 13-14 to FY 16-17 was calculated. It was applied to two pairs of intervention and non-intervention blocks of Saharsa. Pair one comprised on intervention block Saur Bazar and non-intervention block Mahishi. Part two includes Sonbarsha as an intervention block and Salkua as a non-intervention block. These blocks were adjacent to each other and hence taken for analysis. The difference in difference is calculated by subtracting the change of non-intervention block from a change of intervention block. The DID value arrived as a change in a percentage point. The results were matched with responses given by the study respondents to derive the strength and meaning of the results.

Table 1: DID Analysis

<i>Category</i>	<i>Data element</i>	<i>Mahishi vs Saur bazar (DID)</i>	<i>Salkua vs sobarsha (DID)</i>	<i>Study respondents view (n=109)</i>
Ante Natal Care	ANC registration	47%	13%	Fully agree (49.54%)
Follow up services	Three ANC check-ups	144%	-95%	Fully agree (85%)
Immunization	Full immunization (0-11 months)	10%	63%	Fully agree (80%)

The use of the mobile phone for follow-up and ANC check-up increase the registration of pregnant women. 50% of respondents fully agree with the statement. Automated reminders from the mobile phone helped pregnant women to receive three ANC check-ups. 85% of the respondents were in sync. Data on sterilisation complications started to come into the reporting system through mobile phone reporting. 90% of the respondents neither agree nor disagree. More children are immunised due to on-time preparation of duelist by using a mobile phone-based reporting system. 80% of the respondents fully agreed. Counselling to adolescents is now more effective, using content stored on the mobile phone in the form of job aid. 85% of respondents fully agree. HMIS data was further analysed to see the mean difference in intervention and non-intervention groups. Data from seven non-intervention blocks and two intervention blocks were added and then the difference was derived from FY 13-14 to FY 16-17. The difference was divided by seven to arrive at a mean value.

Non-intervention blocks - Banma itarhi, Mahishi, Nauhatta, Pachgachiya, Patalghat, Selkua, Simri Bakhtiyarpur. Intervention block - Sour bazar, Sobarsa. Excluded from analysis - Urban block (Due to contextual difference), Kahar (It was the third intervention block of the project but not included in the study).

Table 2: Correlation

<i>Variables</i>	<i>Pearson chi2 (P-Value)</i>
Immunization checklist prepared on time – Data Quality improved	11.52 (0.021)
Sterilization complication reporting increased - The credibility of FLW increased	16.20 (0.001)
Data quality improved - The credibility of FLW increased	49.12 (0)
Data quality improved - The self-confidence of FLW increased	21.04 (0.002)
Mobile hanged during reporting - Credibility of FLW increased	7.73 (0.052)
Mobile hanged during reporting - Acceptance of FLW increased	9.37 (0.052)
Follow-up of beneficiary increased - Acceptance of FLW increased	25.29 (0.001)

FLWs use the mobile phone primarily for reporting purposes. But it is also used for reminders and for IEC activities with beneficiaries. So, when the FLW uses a mobile phone for preparing the immunization duelist at the Subcentre level the data quality improves ($\chi^2 = 11.52$, $p < 0.021$). When FLW uses the phone for reporting the sterilization complication data her credibility increases in the community ($\chi^2 = 16.02$, $p < 0.001$). Reporting over the mobile phone does increase the data quality and in turn, increases the credibility of FLW in the community ($\chi^2 = 49.12$, $p < 0.000$) and increases the self-confidence of the FLW ($\chi^2 = 21.04$, $p < 0.002$). FLW do follow up with the beneficiary with the use of automated reminders through mobile software, it is having increased the acceptance of

FLW in the community ($\chi^2 = 25.29$, $p < 0.001$). Mobile phones should run smoothly throughout the day to achieve the required reporting level. But in this project the phone hung sometime, thus decreasing the credibility of FLW in the community ($\chi^2 = 7.73$, $p < 0.052$) and acceptance in the community ($\chi^2 = 9.37$, $p < 0.052$)

Table 3: Logistic regression-1

<i>Reference category - Outcome variable</i>	<i>Odds ratio (P value)</i>
FLW receives the needed service from the mobile platform - Appropriateness of the reporting time	0.2415 (0.047)

Appropriateness of the reporting time increases by 4.1 times when the FLW receives the needed service from the mobile platform.

Table 4: Logistic regression- 2

<i>Reference category - Outcome variable</i>	<i>Odds ratio (P value)</i>
Effectiveness of the work of the FLW - Worried about the lack of hard copy of the data.	0.1215 - (0.041)

The effectiveness of the work of the FLW would decrease by 89% if she is worried about the lack of a hard copy of the data.

Table 5: Analysis of mean

<i>Category</i>	<i>Data element</i>	<i>Non-intervention (Mean value) (n=7)</i>	<i>Intervention block (Mean value) (n=2)</i>
Ante Natal Care	ANC registration	2593	4091
Ante Natal Care	First trimester (within 12 weeks) ANC registration	1827	3827
Ante Natal Care	Pregnant women receiving TT1	647	1245
Ante Natal Care	Pregnant women receiving TT2 or Booster	2389	3187
Ante Natal Care	Pregnant women receiving 100 IFA tablets	-1144	949
Communications with patients	Number of Adolescents counselled	64	231
Complication of sterilisation services	Number of cases of complications (NSV)	0	2

contd. table 5

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<i>Category</i>	<i>Data element</i>	<i>Non-intervention (Mean value) (n=7)</i>	<i>Intervention block (Mean value) (n=2)</i>
Complication of sterilisation services	Number of cases of complications following female sterilization	0	3
Delivery services	Deliveries conducted at Public Institutions (Including C-Sections)	1031	1651
Family planning	Total Number of NSV or Conventional Vasectomy conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State-owned public institutions (sum of items from 9.1.1.a to 9.1.1.d)	0	9
Family planning	Total Number of Laparoscopic sterilizations conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State-owned public institutions (sum of items from 9.2.1.a to 9.2.1.d)	0	-171
Family planning	Total Number of Mini-lap sterilizations conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State-owned public institutions (sum of items from 9.3.1.a to 9.3.1.d)	-627	-765
Family planning	Total Number of Post-Partum sterilizations conducted at Public facilities i.e. PHC, CHC, SDH, DH and other State-owned public institutions (sum of items from 9.4.1.a to 9.4.1.d)	46	85
Family planning	Total Number of IUCD Insertions conducted at Public facilities i.e. SC, PHC, CHC, SDH, DH and other State-owned public institutions (sum of items from 9.5.1.a to 9.5.1.e)	170	686
Family planning	Out of the above total, Post-Partum (within 48 hours of delivery) IUCD insertions	116	395
Family planning	Number of IUCD removals	10	129
Family planning	Number of Oral Pills cycles distributed	676	1764
Family planning	Number of Condom pieces distributed	4829	12752
Family planning	Number of Centchroman (weekly) pills given	31	-1
Family planning	Number of Emergency Contraceptive Pills distributed	177	327
Follow up services	Pregnant women received 3 ANC	2141	3394
Immunization	BCG (0 to 11 months old)	1633	3320
Immunization	DPT1 (0 to 11 months old)	-3645	-3834
Immunization	DPT2 (0 to 11 months old)	-3255	-3381

contd. table 5

<i>Category</i>	<i>Data element</i>	<i>Non-intervention (Mean value) (n=7)</i>	<i>Intervention block (Mean value) (n=2)</i>
Immunization	DPT3 (0 to 11 months old)	-2917	-2865
Immunization	Pentavalent1 (0 to 11 months old)	5214	6968
Immunization	Pentavalent2 (0 to 11 months old)	5147	6983
Immunization	Pentavalent3 (0 to 11 months old)	5120	6981
Immunization	OPV 0 (Birth Dose)	949	2436
Immunization	OPV1 (First Dose) (0 to 11 months old)	1615	3112
Immunization	OPV2 (Second Dose) (0 to 11 months old)	1670	3562
Immunization	OPV3 (Third Dose) (0 to 11 months old)	2263	4102
Immunization	Hepatitis-B0 (0 to 11 months old)	1261	2635
Immunization	Hepatitis-B1 (0 to 11 months old)	-3503	-3615
Immunization	Hepatitis-B2 (0 to 11 months old)	-3157	-3159
Immunization	Hepatitis-B3 (0 to 11 months old)	-2791	-2640
Immunization	Measles immunisation (First Dose)	2453	4181
Immunization	Number of Infants (more than 16 months old) who received Measles immunisation (Second Dose)	3323	4624
Immunization	No. of Children aged 9 to 12 months who received JE 1st dose	-1	3
Immunization	Total number of male children (9 to 11 months old) fully immunised (BCG+DPT123/Pentavalent123+OPV123+Measles) during the month	1290	2028
Immunization	Total number of female children (9 to 11 months old) fully immunised (BCG+DPT123/Pentavalent123+OPV123+Measles) during the month	1214	2035
Immunization	Total number of children (9 to 11 months old) fully immunised (BCG+DPT123/Pentavalent123+OPV123+Measles) during the month (sum of items 10.1.13.a and 10.1.13.b)	2504	4063
Immunization	Total number of children (12 to 23 months old) fully immunised (BCG+DPT123+OPV123/Pentavalent123+Measles) during the month (sum of items 10.3.1.a and 10.3.1.b)	37	164
Postnatal care	Women getting post-partum check-ups within 48 hours after delivery	1253	4598
Postnatal care	Women getting a postpartum check-up between 48 hours and 14 days after delivery	1503	3470
Post-natal care	PNC maternal complications attended	-2	0

Mean value of all the data elements assigned to Antenatal care (five elements), communication with patients (one element), Complication of sterilisation services (two elements), Delivery services (one element), follow-up services (one element), postnatal care (three elements) is higher than the mean value of non-intervention blocks value. In family planning, category 3 data elements out of eight show higher value in the non-intervention group. In immunization, category 4 out of 18 data elements show higher value in the non-intervention group. Overall 39 data elements out of 46 are showing greater mean value intervention blocks.

Discussion

In September 2015, the agenda of sustainable development by 2030 (UN, 2015: 3) was approved at the United Nations (UN) Sustainable Development Summit held in New York. The outcome of this summit was 17 new Sustainable Development Goals (SDGs) and 169 targets.

Mobile services positively affect sustainable development, by decreasing the information gap between system and individual (Aker, 2010:217). It allows overcoming the lack of physical infrastructures such as roads and landlines. It can empower people by reaching out to those geographically or socially isolated from the information. Not only do more people then have access to information, but it is also accessible around the clock. In this way, the increase in availability and accessibility of mobile technology aligns with leaving no one behind the ideal of sustainable development. Mobile services have great potential for development in reaching socially and geographically isolated people. The benefits for developing countries are major in, but not limited to, the agricultural, health and financial sectors. As the newest saying goes around, “The quickest way to get out of poverty right now is to have one mobile telephone.” By 2011, 93 of 112 health systems in countries surveyed by the WHO had already adopted some form of e-health or m-health approach (World Bank, 2016). These mobile phones become the backbone of the internet of things. It is a term used to indicate that personal mobile devices can be linked to one another and with physical things, hereby increasing connectivity between people, data and devices.

The government program and policy apply to each facility of the state. Also, the inherent problems of the system in terms of lack of Human Resource, Shortage of supplies and poor infrastructure is applicable to the intervention and non-intervention block. In this background, the endogenous variable acting in the study area to confound the results is very less. The study reaches the inference since; the health system needs data for the review of programs. It should come to decision makers on time and with acceptable quality to derive information from it. The current health system is troubled with digitised

data generation without errors. This is consuming most of the time and then there is no time left for analysis of the data. Mobile phone-based reporting would be the validation on a real-time basis and makes the quality data availability fast. This data then can be analysed readily either through software or in person. The information thus derived will reach the decision-makers in time and will great value to decision-making. The efficiency of the program management will improve, as they can correct the course of the program before it is too late. SDG achievement demands a robust data system and measurement tools in place for the state and country. Without timely measurement of SDG, no state or country can take decisions in terms of increasing the supply side provisions and focusing on demand generation from community mobilisation. With the help of a mobile phone-based dashboard, the review meeting of the health system will be more productive and together we can achieve the SDG. We need to remember, that what cannot be measured cannot be managed. Under SDG three, which states Health and well-being for maternal health is of prime importance. This study clearly indicates that the use of the mobile phone for follow-up and counselling increases the ANC registration, and full ANC coverage and ultimately leads to institutional delivery, it helps reduce maternal death, as delivery is happening in institutions by trained personnel. The cost of implementing such a mobile-based solution is around 226\$ for the first year when we start it with 569 FLW, it will decrease in scale-up mode. So, this study suggests using the mobile-based solution to achieve SDG 3.

Conclusion

The mobile-based reporting system is quick to establish the monitoring system for health projects. Real-time information on the implementation of the program will support managers in increasing the efficiency of the program. The mobile-based solution is a need of the hour and would support the achievement of the SDG 3 goal of maternal health.

Every country needs to track the Sustainable Development Goal at regular intervals. Based on the findings the implementation priorities are changed. The mobile phone will play a game-changer role in the measurement of SDG in real-time. It will provide an early diagnosis of any error in implementation and will provide ample time to correct it. The policymakers will have the information derived from the data in an automated way, thus reducing the risk of errors and human mistakes. It will increase its reliability. As timely data has good value and motivated the stakeholders to use it.

Recommendations

1. National and Sub-national governments should use mobile-based reporting systems for real-time measuring of sustainable development goals.

2. Provision of mobile phones to Front Line Workers for reporting and communication on a national health program to the beneficiaries
3. Use of mobile phones as a job aid to improve the satisfaction of front-line health workers
4. The mobile phone as a tool to improve governance of the public health system

Limitation /Challenges: The study analyses the reporting aspect of mobile health through which data quality, availability and decision-making fasten to achieve the SDG goal. It only looks after the maternal health component. Other aspects of SDG achievement are not studied in this study (Supply chain, Human resource training).

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Conflict of interest: None

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