



GENEVA CHALLENGE 2020

TATA INSTITUTE OF SOCIAL SCIENCES, MUMBAI

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Abstract

12% of the global maternal deaths occurred in India in the year 2017. A large proportion of it includes the tribal women who are devoid of the healthcare services attributing to the numerous sociodemographic factors and healthcare barriers. The marginalised tribal women are often missed out of the radar of the maternal health services and programs leading to inability in identifying the risks and treating them right and at the right time.

In response to this, the team proposes Strengthening Aid for Maternal Health in Tribal Women (SAMHIT), with an aim to include the marginalised tribal women in the mainstream healthcare provisions. The main objective is to identify high-risk pregnancy cases based on quality data of the pregnant women and their prompt management to provide emergency speciality care. Trustworthy data is proposed to be collected through Block Chain enabled application and analysed using Predictive Analytics. It aims at streamlining the channels of providing the antenatal, intranatal and postnatal care through chain of actions amongst the healthcare professionals to handle the high risk and emergency cases. The application captures social factors along with clinical parameters to predict complications. This enables the frontline health workers to deliver proactive healthcare services with timely referral for an uneventful situation. Thus, the project aims to provide a contextualized solution to cater to the indigenous needs to tribal women in different geographies. The solution is proposed to be piloted in selected four geographies in India, which can be tweaked and scaled further.

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ABBREVIATIONS

WHO	World Health Organization
MMR	Maternal Mortality Rate
UNICEF	United Nations Children's Fund
UNFPA	United Nations Population Fund
PDS	Public Distribution System
ICDS	Integrated Child Development Services
NSSO	National Sample Survey Office
NFHS	National Family Health Survey
ANC	Ante Natal Care
PNC	Post Natal Care
MCH	Maternal and Child Health
IFA	Iron Folic Acid
EMoC	Emergency obstetric care facility/services
PHC	Primary Health Centre
SRS	Sample Registration System
CRS	Civil Registration System
MCTS	Mother and Child Tracking System
RCH	Reproductive and Child Health
PW	Pregnant Woman
ANM	Auxiliary Nurse Midwife
ASHA	Accredited Social Health Activist
SC	Scheduled Caste
ST	Scheduled Tribe
mHealth	Mobile Health
EHR	Electronic Health Records
DSS	Decision Support System
IoT	Internet of Things
KBK	Kalahandi, Balangir, and Koraput
MNCH	Maternal Newborn and Child Health
ID	Identity
DEO	Data Entry Operator
EDD	Expected Date of Delivery
NITI	National Institution for Transforming India

1. INTRODUCTION

1.1 Maternal health, challenges and sustainable development

Women are a crucial part of our society and their health and wellbeing is of prime importance for sustainable development. Healthy women can be more productive in their work and earn steadily throughout their lives. However, so far, women still die of many preventable causes during pregnancy and childbirth and most of them lack access to quality healthcare. They witness huge disparities in society in terms of exercising their human rights and providing full contribution in economy, politics and social development. Further, women from marginalised communities face even worse fate. Maternal mortality is higher in women living in rural areas and among poorer communities (1). The vision of the United Nations' Global Strategy includes helping women in every setting realize their basic health rights so that they can contribute in shaping prosperous and sustainable society. The objectives of this strategy are to help women **survive, thrive and transform** to reduce their risk of preventable deaths. Thus, to achieve this goal, there is a need for inclusive development of women from all strata of the society (2).

In India, social determinants with respect to caste, tribe, religion, economic and social status play an important role in generating disparities in utilization of maternal care services and outcomes. Introduction of different programs and policies to ensure institutionalised births and increasing coverage of formal maternal care services whereas implementation of such programs has resulted in cacophony between the community's need and the nature of maternal care services provided by the health system (3). Also, there is an absence of a robust surveillance system to monitor the implementation of these programs in low resource settings like remote tribal hamlets. Thus on one hand it is noteworthy that these remote ethnic women remain socially excluded from mainstream developmental processes even today while on the other hand women living in the urban and semi urban areas could avail the maternal care services and facilities in a better way compared to the remote tribal women. So, in order to empower marginalised tribal women and achieve their timely inclusion in maternal healthcare services and programs it is necessary to adapt innovative solutions and implement cross-cutting technology.

1.2 Maternal health indicators- Global and Indian scenario

The world suffers from an unexpectedly high burden of maternal mortality with an overall estimated MMR of 211 maternal deaths per 100 000 live births in the year 2017 (4). Although there has been a 38% reduction in MMR since the year 2000, it is quite far from the target set by WHO and it still needs more efficient and rigorous efforts to achieve it.

Looking at the estimates of maternal mortality in the World, Central, and Southern Asia are the biggest contributors to global maternal mortality. (4)

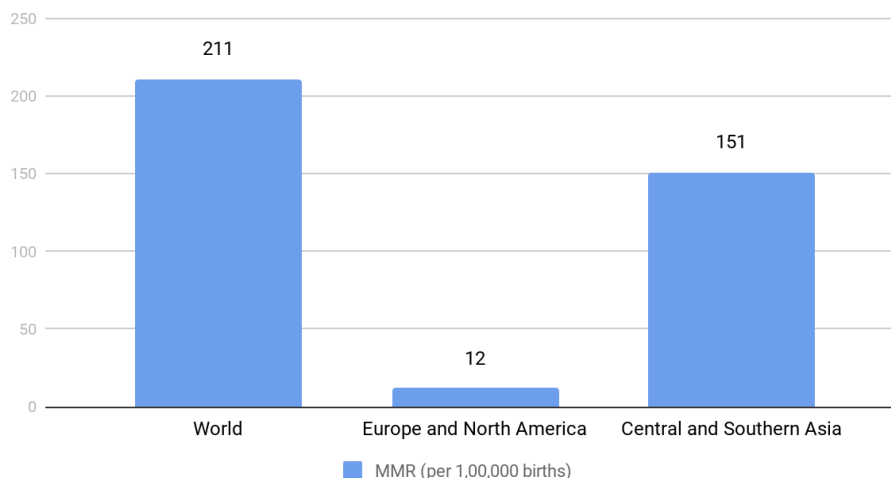


Figure 1: Comparison of MMR

India suffers from high MMR, with the death toll of women summing up to 100000 every year. India accounted for 12% of global maternal deaths in the year 2017. Although India has shown the highest reduction of 61% in MMR from 2000 till 2017, the MMR estimate of India (145) is higher than China (29), Sri Lanka (36), and Pakistan (140), for the year 2017. (4)

1.3 Tribal maternal health in India and exclusion of tribal women:

The tribal population forms 8.6 percent (84.33 million person) of the total population of India, enumerated in the country as Scheduled Tribes (2011 census). In recent times, status of the tribal people has improved but their social indicators are still worst performing as compared to other populations. The tribal women who live in the underserved areas are considered to be the most marginalised because of various structural barriers like caste, income, age, gender, literacy and social status (5). They are known to lead inequity in access to healthcare. They are the victims of social exclusion not only because of the historical exclusion, geography and marginalisation but also because of disruption of their natural habitats and erosion of their autonomy (6). About 700 tribal communities are included in the wide Indian population. The women and children of these tribal communities have been lagging behind in measures of economic, health and education against the measures of national population. This situation is a consequence of the decades of discrimination and an infringement of rights of the tribal (7). Further, maternal healthcare services are most underutilized amongst tribal women (5)

2. CHALLENGES IN MATERNAL HEALTHCARE IN REMOTE TRIBAL AREAS

Maternal health is not just a clinical phenomenon, rather it needs a holistic understanding of complex network of underlying factors:

2.1 Social determinants

1. **Income**- There is a 23% points' difference of income between tribal and non-tribal displaying an increasing disparity. This is due to lack of access to productive income-earning assets, non-utilization or inability to utilize available resources and lack of equal opportunities. (8)
2. **Heavy workload**- Tribal Women are burdened with responsibility of providing necessities to the family, involving long hours of strenuous work (almost 14 hours a day) as compared to men (9 hours a day). They often carry out these tasks even in their advanced pregnancies leading to overstrain (9).
3. **Language**- Only a little over 1% of the tribal population speak the languages common to the other India population, causing inconvenience and reluctance to visit healthcare facilities (7)
4. **Nutrition**- Most tribal women are malnourished leading to profound effects on physical and psychological health in pregnancy. Nutritional anaemia is a result of this malnourishment adding up to the complications. Such deficiencies make these tribal women vulnerable to morbidities and complications during childbirth leading to mortality if not managed in time with proper obstetric care. **On the other hand, policies and programs (PDS, ICDS) have weaker coverage in tribal areas. NSSO 66th round has revealed a significant difference in food expenditure of tribal and Non-tribal areas. Such disparities show exclusion of these marginalised ethnic women from getting their human rights in mainstream society.** (10)
5. **Literacy**- Lower literacy rates hinder healthcare utilization. The National Family Health Survey-3 indicated that approximately 88% of women with 12 years or more of complete education received at least one ante-natal care visit as opposed to 29% of women with no education (7)
6. **Insurgency**- Insurgency in various Indian states aggravates the healthcare challenges. Ethnic tension and armed insurgencies demotivate the healthcare workers in reaching out to these areas and cuts off the access to quality reproductive health services. (11)
7. **Cultural practises**- Childbirth as normal event- Pregnancy and childbirth is considered as normal process in Tribal communities. Women underwent childbirth without disturbing their normal daily routine. Thus, small problems like, swelling of hands and feet during ANC and rise in body temperature during PNC period and is considered normal during pregnancy. Such practises lead to avoidance of important danger signs during pregnancy and often puts the women at high-risk during pregnancy and even after delivery (3). Thus, tribal culture in some sense also acts as a barrier in achieving quality maternal care services. **However, interventions focusing on tribal maternal health need a thorough consideration of their cultural practises and local context to get desired results. Culturally sensitive tailored interventions are required to improve MCH outcomes among tribal populations.**

2.2 Healthcare system challenges:

Despite the efforts of the Reproductive and Child Health (RCH) Programme under the National Health Mission, Government of India aimed at providing ANC and PNC, little progress has been achieved in eliminating the disparity that exists in reducing maternal mortality and morbidity among the women belonging to Scheduled Tribes.

1. Coverage and utilisation of services amongst Tribal Women:

Poor maternal health outcomes are highly associated with poor availability of services, poor utilization of antenatal & delivery care services. Following table shows how tribal women lack in utilization of healthcare services:

Indicator	Tribal	Non-tribal
Received ANC from skilled provider	73%	86%
Delivery in health facility	68%	83%
Received PNC check-up within first 2 days of birth	59%	69%

Table 1: Utilization of Healthcare Services among Tribals and Non-Tribals (3)

According to 71st round of NSSO, women belonging to scheduled tribe were found to be more devoid of ANC as, 13.2% pregnant women of this group did not consume IFA tablets, 10.2% did not receive TT dose, and 13.8% had not received any ANC during their pregnancy despite having vast public health infrastructure and motherhood programs (12)

- Several studies have documented poor access to quality maternal health services in districts with higher tribal populations. For instance, an investigation of maternal deaths in Barwani, Madhya Pradesh, (which has a high proportion of tribal population), found an absence of antenatal care, lack of skilled birth attendants and poor emergency obstetric care. (14). **A study in Godda district of Jharkhand which is predominantly tribal district identified that the response to maternal complications and institutional birth rates in case of ST women was poor (3). Various reasons such as geographical challenge to reach the health facility within time, lack of network in many of the interior villages cause problems in reaching out to the ambulance services in emergency conditions. Thus, the tribal women residing in interior villages are more vulnerable compared to other non-tribal women living in rural and urban areas.**

Studies conducted by Indian civil society organisations found that the repeated referrals and cyclical delays in getting desired maternal care ultimately lead to the deaths and the reason for such delays is insufficiencies in existing maternal health services. Such inequities put the marginalised woman on the process of further marginalization.

Even among the tribal population, there was regional disparity in the health indicators and utilization of health care. The utilization was low among women belonging to tribes of central

India as compared to the tribes of eastern and southern India, attributed to the diversity of socio-economic, demographic, and cultural factors. (15)

3. **Government Policies and Cost of healthcare-** The cost of institutional delivery, distance and lack of transport continue to be deterrents of access to maternal healthcare services. India has brought up several vertical programs (conditional and unconditional cash transfer schemes) at state and national level to address the issue of maternal health by implementing free ANC services such as *Janani Suraksha Yojana*, *Vijaya Raje Janani Kalyan Bima Yojana*, *Prasav Hetu Parivahan Evam Upchar Yojana*, etc. **These schemes were implemented with the focus of reducing out of pocket expenditure which was the barrier for institutional delivery. Such provisions resulted in increased institutional deliveries dramatically from 39% in 2005-06 to 79% in 2015-16** (16) (17). However, they fail to cover the costs completely. The expenditure on childbirth at the health centre amounts to an average of ₹4,000. This amount is way more than what Janani Suraksha Yojana covers (13). The public healthcare system has not been adapted in local contexts. The services offered are incompatible with the necessity to the tribal women. (3) This top down approach of policies and programs to institutionalise childbirth is incompatible with the local realities.
4. **Emergency obstetric care facility/services (EMoC):** In addition to essential obstetric services, there is the need for prompt, effective, affordable, and appropriate emergency obstetric services in times of complications. There are very limited reports on the presence of Emergency services and absence of situational analysis reports to capture the presence of EMOC.
5. **Lack of data, monitoring and surveillance** -It is important to note that there are disparities between different reporting systems along with under reporting of data. The non-availability of SRS data for small units such as PHC makes it compelling to rely on various other sources like CRS, Health department or ICDS (18). Common reason for under reporting given by the health system and ICDS was that maternal deaths beyond their administrative areas are not included and another reason being fear among health staff is that it may result in a series of inquiries and punitive action (19). **The implementation of target orientated programs may lead to the arm twisting and falsification of data and such practises indicate ignorance to the needs of tribal women. The overall improvement in institutional births across the states ignored the inequities among geographic and socio-economic group.** (3)
6. **Attitude of healthcare workers-** Interaction with women from the tribal community revealed that the outreach workers do not address their set of beliefs and the reason for new practices were not clear to the women. Thus, the antenatal care does not address the women's concerns. In addition to this, they face language barriers which adds up to the understanding gap. 27% of the tribal women still deliver at home. One of the cause for this is, unfriendly behaviour of healthcare workers. The lack of friendly approach makes the women sceptical about utilizing the "alien system" (13).

3. SOLUTION APPROACH: HOW TO TACKLE THE MAJOR BARRIERS

3.1 Lack of accurate data

Social determinants of a community are its inherent characteristics. If they tend to become barriers in the development of a community, it is the responsibility of a system to handle them sensitively and promote inclusion. In the case of tribal women in India, we observed that the health system is not able to cope up with their problems since they are not in line with their social determinants. Thus, there is a need to innovate and contextualize the system as per the needs of the tribal women.

Reducing preventable maternal deaths and improving maternal health needs strengthening of the existing ANC and PNC services, which are the key interventions for reducing maternal morbidity and mortality. (20). A good ANC, intranatal and PNC links the mother with the healthcare system to ensure an uneventful delivery and death. Moreover, it also helps in strengthening the emergency care services. However, the major factor driving the effectiveness of these services is correctly capturing the data of the pregnant mothers and using it effectively for the planning and implementation of interventions required as per the local context.

The expert committee on tribal health has stated that there are no recent estimates for maternal mortality in the tribal women. **Lack of data, monitoring and evaluation is mentioned as one of the ten burdens of tribal health and has masked all the other burdens (13)**

Till today, there is scanty data on tribal health culture, systems and the health status. Huge data gaps are attributed to disaggregation at the level of reporting. (21) **However most of the data gets tampered by the outreach workers at ground level since they are pressurized by upper authorities to ensure the coverage of maternal services for every single woman in the community. Thus, to achieve the desired results many a times the ANC/PNC parameters are fudged which could be misleading in identification of high-risk cases and may lead to casualties and emergencies at times.**

A mother needs to be tracked right from the day of conception till her postpartum period for which there are adequate maternal health care programmes, but their implementation and monitoring are not up to the mark to achieve desired results in tribal areas. The reasons being:

1. Women in tribal areas lack quality care and emergency care services.
2. There is lack of coordination between lower and upper health facilities and hence complicated cases are not well managed.
3. Incomplete documentation explaining the high-risk parameters.
4. Mismatch of local demands and health systems.
5. Demotivated healthcare workers and their non-compliance with the program guidelines.
6. Ineffective centralized technology for tracking maternal health

3.2 Shortfalls of the existing maternal data tracking system: RCH register and MCTS

1. One of the major issue with MCTS/RCH portal is time lag in service delivery and data entry in the portal. There are high chances of mismatch between the date of registration of beneficiaries and the date on which the details are uploaded; which should not be the case in practise.

1.3.2 Tracking of Pregnant Women (PW-1)

Table-6: Column-wise instructions for PW-1 format

No.	Heading	Instructions to record the information
1	Sr. No.	Write the same serial number of the respective pregnant woman as written in the Index of this Section –II. Example- If the serial number allotted to a pregnant woman is 15 under Index of this Section –II, it should be '15' under 'PW -1' also. Record details of each pregnant woman in the row against the serial number of the respective pregnant woman.
2	MCTS/RCH ID No. of pregnant woman*	Write the same MCTS/RCH ID number allotted to this pregnant woman as indicated in the Index of the Section –I (Tracking of EC).
3	Name of pregnant woman	Write name of the pregnant woman.
4	Address	Write complete postal address of the pregnant woman.
5	Name of the Husband**	Write the name of the husband. If name of the husband is not disclosed, write 'Not Applicable'
6	Mobile No. of self/ husband/ neighbour/family (specify)	Write mobile number of PW/ husband/ neighbour or any other family member. If it is a family member, please specify the relation. Please do not keep this column blank. It is mandatory to write the mobile number.
7	Religion	Write the religion of the pregnant woman (Hindu/ Muslim/ Sikh / Christian). If the religion is other than these, please write 'Other' and specify it.
8	Caste SC/ST Other	Write the caste of the pregnant woman in this column, if the caste is other than Scheduled Caste (SC) or Scheduled Tribe (ST), this will come under the category of 'Other'. Note: If the option is other, specify; OBC (Other Backward Class), General category etc.
9	BPL / APL	As per the criteria of the respective state, write the category to which pregnant woman belongs to i.e. Below Poverty Line (BPL) or Above Poverty Line (APL).
10	Age of PW (DOB)	Write the date of birth (DOB) (dd/mm/yyyy) of the pregnant woman, if DOB is not known, write the age in complete years at the time of registration. If she is 21 years and 3 months, write 21 years.
11	Date of LMP	Write the date (dd/mm/yyyy) of the first day of the last menstrual period (LMP) of the pregnant woman.
12	Date of Registration	Write the date (dd/mm/yyyy) on which you have registered and recorded the details of the pregnant woman for the first time in this register. This date may be different from the date on which 'this pregnant woman' details are uploaded on MCTS/RCH portal.

Figure 2: Snippet of instruction manual for ANM (22))

- No additional space to record additional emergency ANC visits other than the 4 visits.

SECTION-II
Tracking of Pregnant Women **PW - 2**

Ante Natal Care (ANC) Details

23 Sr. No.	24 Name of Pregnant Woman	25 Serial No. of ANC Visit ⁽¹⁾	26 Date of ANC	27 Facility/ Place/Site of ANC done	28 No. of weeks of pregnancy	29 Abortion (if any) ⁽²⁾			31 Wt. of PW (Kg)	32 BP mm Hg		33 Hb (gm%)
						No	If Yes, (I/S) No. of weeks of pregnancy	If induced, abortion indicate facility (Govt./Pvt.)		Systolic	Diastolic	
		1st visit										
		2nd visit										
		3rd visit										
		4th visit										
		1st visit										
		2nd visit										
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		4th visit										
		1st visit										
		2nd visit										
		3rd visit										
		4th visit										

(1) IDEALLY ANC VISITS SHOULD BE - 1ST VISIT - WITHIN 12 WEEKS OF PREGNANCY; 2ND VISIT - WITHIN 16 TO 26 WEEKS OF PREGNANCY; 3RD VISIT - WITHIN 26-34 WEEKS OF PREGNANCY (PREFERABLY TO BE DONE BY THE MEDICAL OFFICER); 4TH VISIT - BETWEEN 36 WEEKS AND FULL TERM. IF MOTHER COMES FIRST TIME, ANY TIME DURING HER PREGNANCY, SHE SHOULD BE ENTERED IN FIRST VISIT COLUMN, GIVE HER ALL THE SERVICES DUE TO HER AS PER THE PERIOD OF PREGNANCY INCLUDING SERVICES OF FIRST ANC.
(2) INDUCED / SPONTANEOUS (I) - INDUCED, (S) - SPONTANEOUS

Figure 3: Snippet Section from instruction manual for ANM (22)

- Data is collected and entered by ANM and not by ASHAs who are the first point of contact for mothers and visit the mothers more often than ANMs.

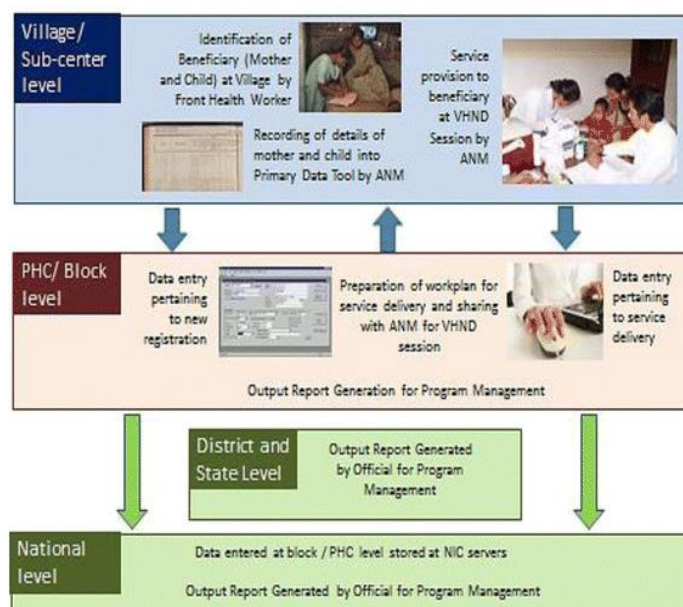


Figure 4: Mother and Child Tracking System - Data Flow (23)

4. Evidences from studies about inefficiency of MCTS:

A study conducted in 2 states having higher maternal mortality have shown incompleteness in MCTS portal as compared to primary data source. Data collected was incompletely transferred to the MCTS portal by health staff.

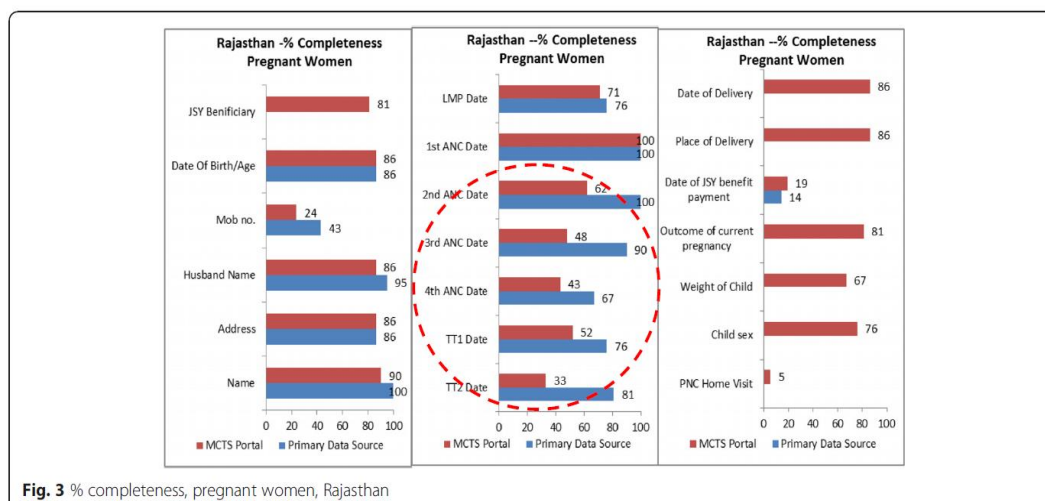


Figure 5: Data completeness of Pregnant Women in Rajasthan (23)

Another study from Haryana revealed that the data columns in MCH registers — the basic tool available with health care workers to maintain the records of clients for MCH services — do not match with the information required to be filled in the MCTS portal. Health care workers have to fill work plans and registers separately for entry into the MCTS portal, which increases the work burden (24)

5. The MCTS portal needs internet connectivity for regular entry and update of database which is a big burden in rural and tribal areas.

3.3 Essential aspects of tracking maternal data

Reliable, complete and timely information is a pre-requisite for decision making and action. It also aids in policy making, planning, programming, monitoring of maternal health (25). A robust surveillance system would monitor/secure each transaction done on daily basis by these community health workers which could be done with the help of some strong technology which will -

1. Identify high risk pregnancy,
2. Effective referral system and coordination between all levels of health systems,
3. Increase in quality maternal care and access to emergency obstetric care
4. Secure the data and analyse the data overtime to design the intervention based on the trends of the data in context of the local demand.
5. Involvement of these tribal women/communities in planning and management of maternal healthcare programs to achieve desired results. (26)

3.4 Need of emerging technology

It is evident that there are three major issues in the system of tracking maternal data - Trust, effective data access and effective utilization of data. These issues can be tackled very effectively by utilizing emerging technologies like Blockchain and Machine Learning on top of Cloud and Mobile platforms. (27) Blockchain as a concept was developed to build trust in a system and Machine Learning has shown effective results in building cognitive features in a system to enable data driven decision making. (28) Cloud platform ensures the perpetual availability and accessibility of data and mobile platform provides ease of accessing the data remotely. However, it is very important to stitch these technologies together effectively and tackle the issue of internet unavailability in remote areas.

Studies have shown that several low and middle-income countries have weak health information systems which resulted in the need for statistical modelling exercises to develop internationally comparable mortality estimates (29). This is where we provide our solution to bridge this gap of lack of data, monitoring and surveillance of maternal health in tribal areas.

4. MARKET ASSESSMENT

We surveyed the emerging solutions implemented in different geographies of India which are operating to resolve the issues of maternal health in urban and rural settings. We observed that only one solution is implemented in tribal settings specifically and others are majorly aiding the Community Health Workers to carry out their jobs. Following table gives a comparison:

NAME	TYPE	LEVEL	FOCUS	SHORTCOMING
ReMind	mobile health (mHealth) CommCare application or mobile tool for community health workers	State level (Uttar Pradesh) collaborated with NHM	Focus on delivering ANC and PNC at community level. Also delivers support services to mothers and their families by means of ASHA workers.	Focus only on the work of ASHA whereas no accountability of next higher authorities. Little change in institutional delivery.
mMitra	Free automated voice calls to deliver critical information on maternal and newborn care	9 states	Behaviour change through weekly/biweekly communication on preventive care	Outreach only upto rural areas, slums and few hospitals. No evidence about penetration in tribal areas.
mSakhi	Multimedia guided Android app for frontline health workers	State level (Uttar Pradesh government) + IntraHealth international + Qualcomm	Self-learning, community counselling, decision support and client management, automated home visit schedulers, reminders, and reporting for maternal, newborn and child health with Access to real-time data	Emergency case alerts, No mechanism to prevent data tampering and there might be inaccuracy in data.
ImTeCHO Project	Mobile phone app	SEWA Rural in partnership with the Department of Health and Family Welfare,	Job aid to ASHAs to increase coverage of MNCH care, screen and adequately manage morbidities among mothers, newborns and children and facilitate timely referral, Web interface to provide timely	Task completion rate lower in PHC staff. Not effective I coverage of MNCH where ASHA was not the primary provider and

		Govt. of Gujarat	information to PHC medical officers for monitoring and supporting programme	relied on other cadres and infrastructure.
Savemom	IoT based maternal health care solution	NA	Constantly monitor the health of women in a non-invasive device	No penetration in the tribal areas.
Suyojana	Mobile-based clinical-decision support system (DSS)	Karnataka	Constant and consistent guidance to ANMs regarding ANC, PNC and neonatal care	Sole focus on ANM. Lacks in collaborating work between ASHA and ANM
WONDER Project	Bluetooth-enabled wearable biometric devices	Thalavadi	Integration of wearable biometric devices in the clinical setting, EHR data collection and alert tools with help of IOT	No penetration in the tribal areas.

5. SCOPE

The team has selected four districts in India under the scope of the project - Banswara (Rajasthan), Jashpur (Chhattisgarh), Koraput (Odisha) and Jhabua (Madhya Pradesh). These districts are experiencing high MMR which is more than state and national average (16). The selection of these aspirational districts will help us understand the process of implementation of the solution in the areas of high-density population of tribal people. It will enhance the process of capturing the data to identify the major drivers of the high-risk pregnancies and design the desired interventions based on local needs to further reduce preventable deaths among these ethnic groups.

Banswara district of Rajasthan

Banswara is in southern Rajasthan and includes rugged terrain. Banswara district consists of **92.9% rural and 7.1% urban population**. The Scheduled area in the State extends over the entire district of Banswara. The **Scheduled Caste and Scheduled Tribe** population in Banswara district is **4.5% and 76.4%** respectively. (16) A month long sting operation conducted in 2020 by a daily newspaper brought to light the horrifying truth of maternal care in the district. Deliveries were being conducted by drunken ward boys, sweepers and other helpers in the public hospitals. Other stories of abuse of the mothers also came forth.



Fig 6: Map of Banswara

Source: <https://www.mapsofindia.com/maps/rajasthan/tehsil/banswara.html>

Jashpur district of Chhattisgarh

Jashpur district is in the North-East of Chhattisgarh State adjoining the borders of Jharkhand and Odisha States in the eastern side. **The Scheduled Castes (SC) population constitute 5.74% and the Scheduled Tribes (ST) constitute 62.28% of the total population of the district.** (16)

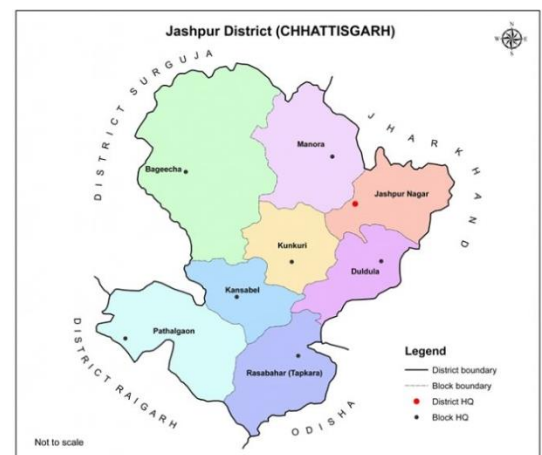


Fig 7: Map of Jashpur

Source: <https://www.mapsofindia.com/maps/chhattisgarh/tehsil/jashpur.html>

Koraput district of Odisha

The Kalahandi, Balangir, and Koraput (KBK) districts are in the southwest province of Odisha. Maternal mortality and under-five mortality continue to be at a higher level in this region. The district lacks in basic health facilities and skilled health personal. Geographical and logistics barriers and low income in this region are majorly responsible for lower utilisation of health care services. (30)

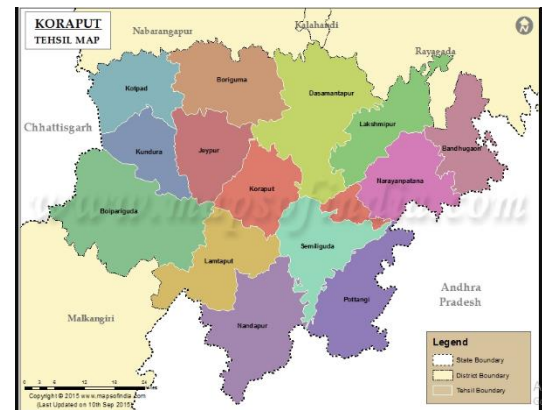


Fig 8: Map of Koraput

Source: <https://www.mapsofindia.com/maps/orissa/tehsil/koraput.html>

Jhabua district of Madhya Pradesh

Madhya Pradesh is the 2nd largest state of the country in terms of area. The state is facing number of issues and high MMR being one of them (31). Mothers getting full antenatal care in Madhya Pradesh is **just at 11.4%** in terms of ANC which is quite below the national average, and in tribal districts **like Jhabua, it is just 4.8%** (16). Such tribal predominant districts, like Jhabua, needs lots of inputs to scale up their maternal health services.



Fig 9: Map of Jhabua

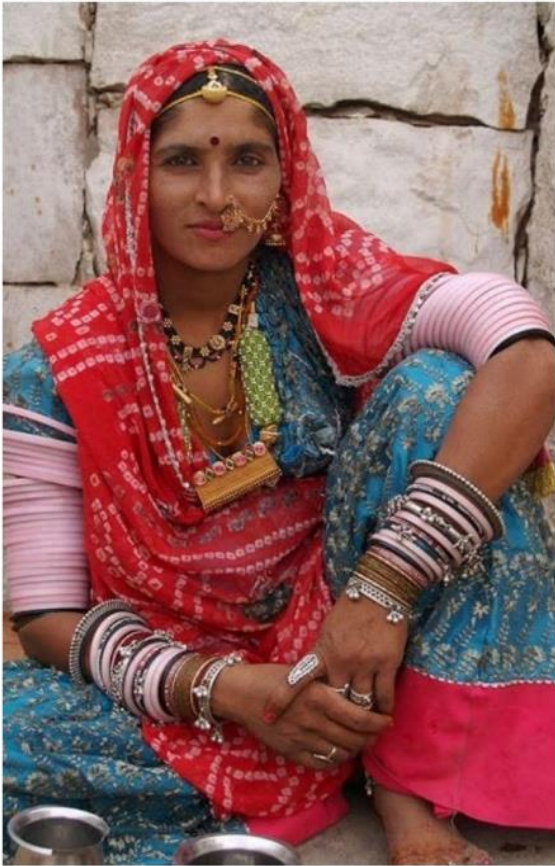
Source: <https://www.mapsofindia.com/maps/madhyapradesh/tehsil/jhabua>

Evidently from the data provided above, these four districts have higher MMR and morbidity. These districts are mostly situated in hilly terrain with scheduled tribes form most of their population. Poor economic conditions, lack of health personnel, inaccessibility to health care facilities are among the common causes of poor utilization of maternal health services in these districts. Women face social exclusion and maternal health is adversely affected due to it. The solution is an active way of improving maternal health and reducing maternal mortality among these remote tribal women. Focus area of our solution is empowerment of the tribal women by enabling use of technology for “reaching the unreachable” section of the society who are intentionally or unintentionally excluded from the mainstream society, who still live nomad lives; bring in social inclusion of the women in these areas and eventually help in reduction of maternal mortality and morbidity. (15)

A tribal woman living in remote tribal hamlets of the country often misses the perks of enjoying the maternal care/ speciality care compared to a non-tribal woman residing in urban or semi-urban areas. Instead these marginalised tribal women have to continue with the daily routine even during pregnancy to support her family and to take care of her children also their cultural beliefs and practises, and the geography they resides in acts as barrier in accessing the required maternal care services at times. This is when they knowingly or unknowingly put their life at risk of developing complications during pregnancy.

	Banswara		Koraput		Jashpur		Jhabua	
At least 4 ANC visits								
Tribal	37.5		57.0		29.1		18.1	
Non-tribal	67.6		57.2		43.0		28.4	
ANC visit in 1st trimester								
Tribal	59.6		54.8		55.0		24.5	
Non-tribal	75.5		58.5		65.1		44.0	

Table 2: % comparison of women receiving maternal healthcare services between tribal and non-tribal areas of above districts (16)



6. THE SOLUTION: STRENGTHENING AID FOR MATERNAL HEALTH IN TRIBAL WOMEN

SAMHIT is an application with the main objective of augmenting and enhancing the already existing activities of maternal health care in tribal areas. It also aims to leverage technology for capturing, maintaining and helping the field force to drive proactive actions to provide better health care. The application helps in capturing the essential physical, clinical and social parameters of pregnant women during pregnancy and in the postpartum period. They are based on local context in tribal areas. The parameters are analysed automatically to enable health professionals in early identification of high-risk pregnancies and emergency cases after delivery. The solution also focuses on proactive co-ordination amongst the healthcare professional to handle the high risk and emergency cases. The application will facilitate prior coordination between the front-line referring facility and upper referral facility. Thus, one of the important features of the solution is to offer proactive specialty obstetric care in upper referral facilities.

The application is proposed to be operationalized on mobile platform as front end and local data storage. It also consists of cloud platform as the host for centralized data storage, blockchain transaction builders and machine learning computations.

6.1 Conceptual Framework for capturing data of High-risk care for Tribal women

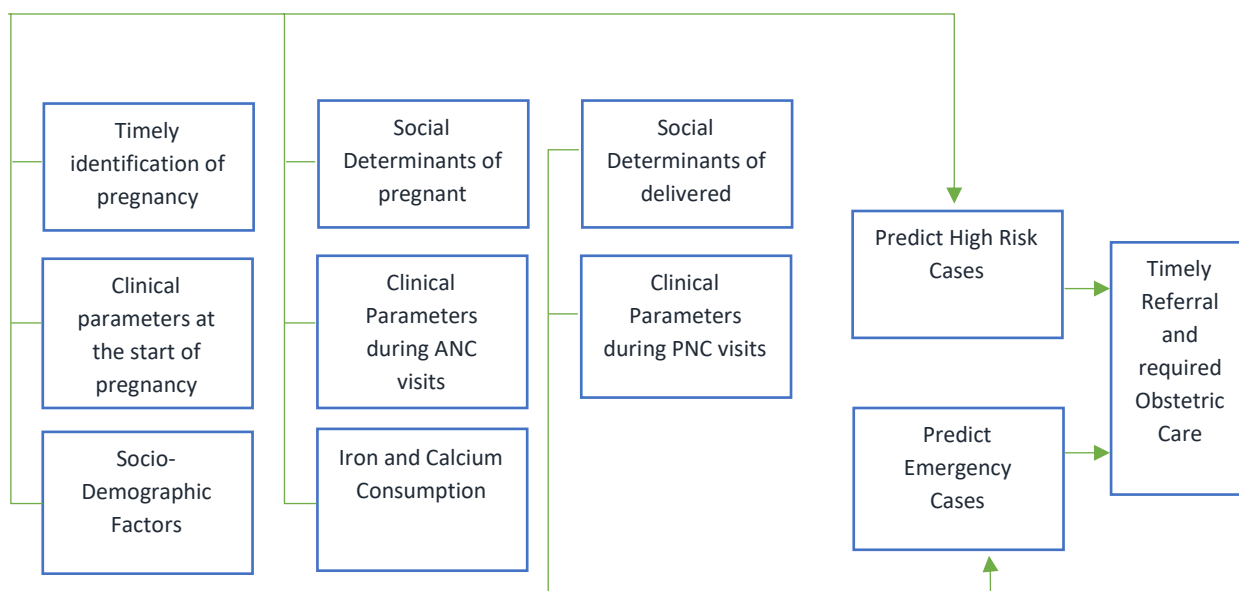


Figure 10: Conceptual framework for capturing data of High-Risk Care for Tribal Women

6.2 Components of the solution

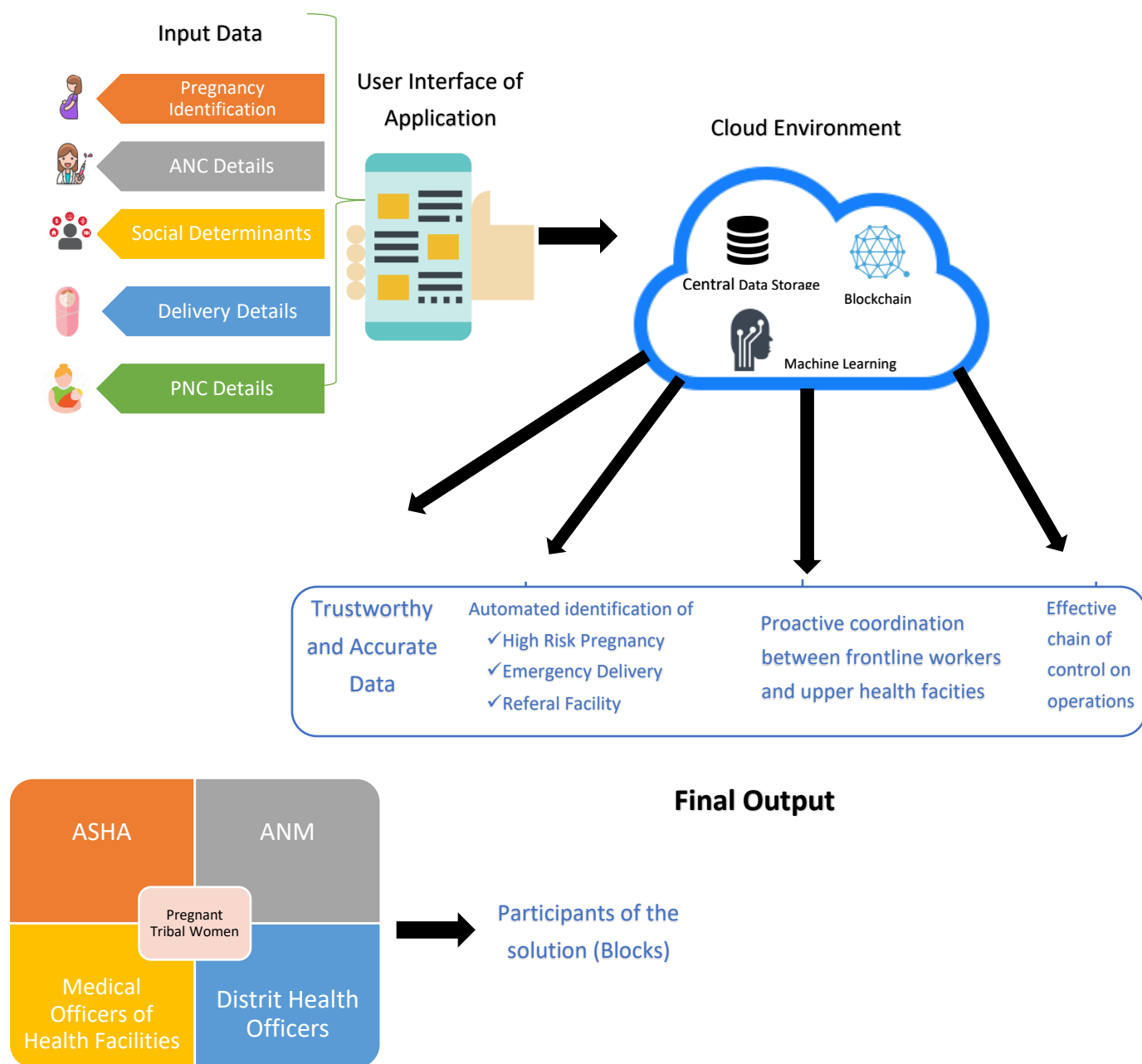


Figure 11: Components of the Solution

Input Data

The data would be collected by the frontline ASHA (Accredited Social Health Activist) workers who are the touch points for the pregnant women and can collect first-hand data. The most important aspect of this component is the early identification of pregnancy of the tribal women to help them align with the healthcare throughout the pregnancy. The second important aspect of this component is the data of social determinants and the physical, clinical parameters of the pregnant women. The analysis of these parameters would further help in automated identification of high-risk cases.

Mobile Application

The major issue in tribal area is weak mobile signal and internet connectivity. Hence, to remove the dependency on the infrastructure, we propose a mobile based application to capture the data and store locally. The proposed solution suggests providing smartphones to the ASHA workers with pre-installed mobile application. The ASHAs will report to the ANM (Auxiliary Nurse Midwife, Supervisor of ASHA) for weekly inspection of reports, approvals, etc. The ANM will collect each mobile to do her operational tasks by logging in each one of them. Further, the application would be installed on the smartphones of the Medical Officers (who are supervisors to ANM), In-charge of the upper health facilities and District Health Officers.

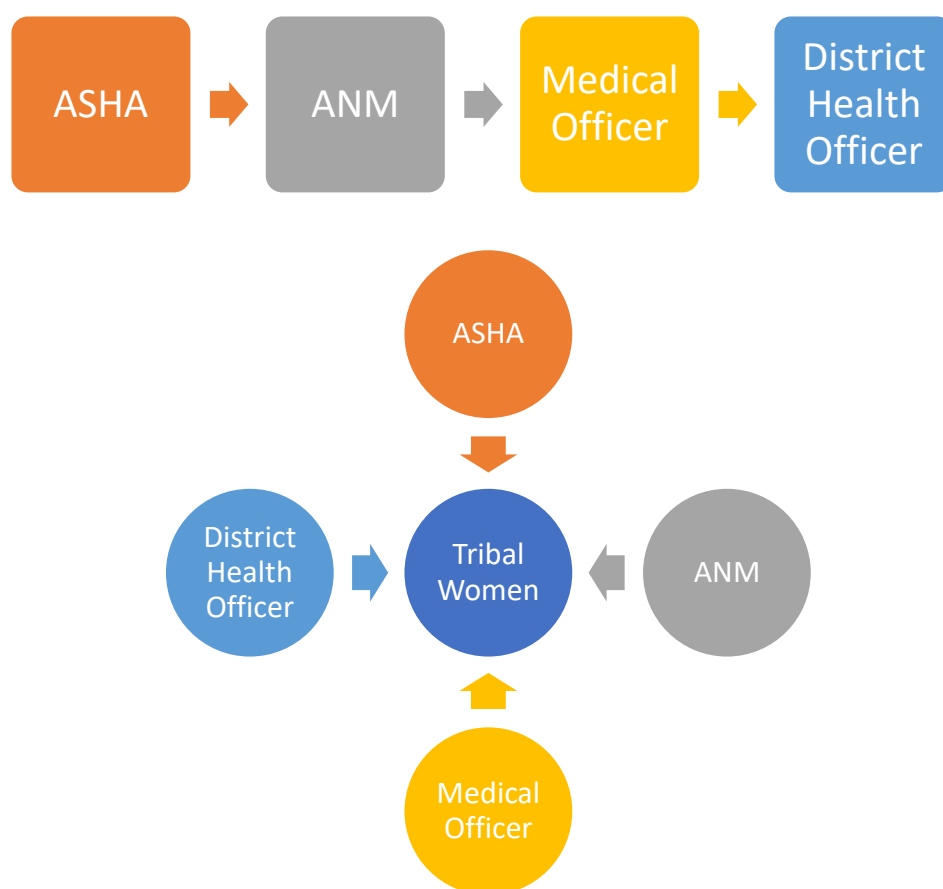
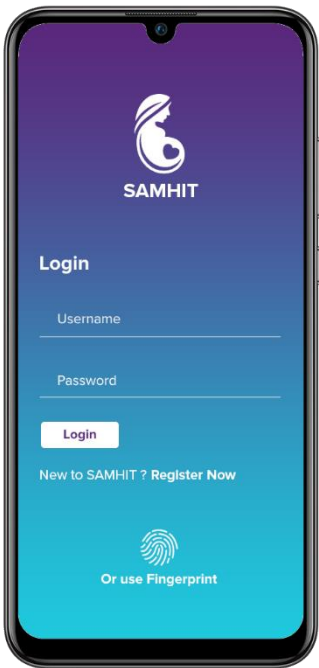
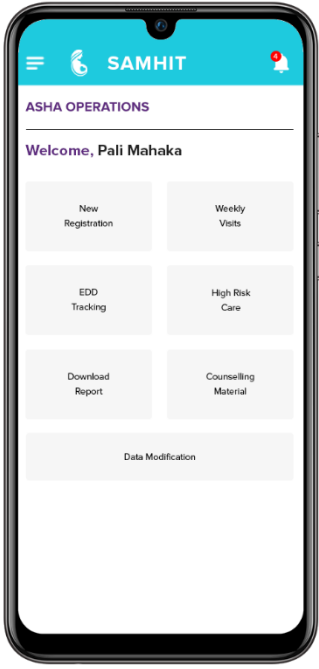
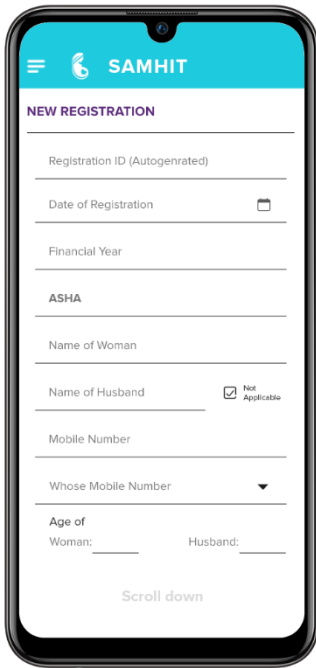


Figure 12: Traditional Chain of actions vs. Proactive Coordination using SAMHIT

User Interface of the Application

Screen	User	Functionality
 <p>The login screen features the SAMHIT logo at the top. Below it, there is a 'Login' section with input fields for 'Username' and 'Password', followed by a 'Login' button. A link 'New to SAMHIT? Register Now' is positioned below the button. At the bottom, there is a fingerprint icon and the text 'Or use Fingerprint'.</p>	<ul style="list-style-type: none"> • ASHA • ANM • Medical Officer • Health Facility In-Charge • District Health Officer 	<p>All the participants of the application from a specific geographical area will be pre-registered during the application setup and will be provided with unique login credentials. The ANM would be using the application on ASHA's mobile using their credentials. This will help in inherent segregation of data of women from different areas being looked after by corresponding ASHA.</p>
 <p>The ASHA Operations screen displays a header with the SAMHIT logo and a notification icon. Below the header, it says 'ASHA OPERATIONS' and 'Welcome, Pali Mahaka'. The screen contains several buttons: 'New Registration', 'Weekly Visits', 'EDD Tracking', 'High Risk Care', 'Download Report', 'Counselling Material', and 'Data Modification'.</p>	<p>ASHA</p>	<p>The ASHA will be able to:</p> <ul style="list-style-type: none"> • Register the pregnant women on the application • Feed the input data during their visits to the pregnant women • Track the delivery dates of the registered pregnant women • Track the High Risk and Emergency Cases • Access counselling videos and infographics of danger signs and preventive care to show them to the pregnant women • Download reports of the registered women for reference or printing or for keeping paper records in case required. • Modify any wrong data entered.



SAMHIT

NEW REGISTRATION

Registration ID (Autogenerated)

Date of Registration

Financial Year

ASHA

Name of Woman

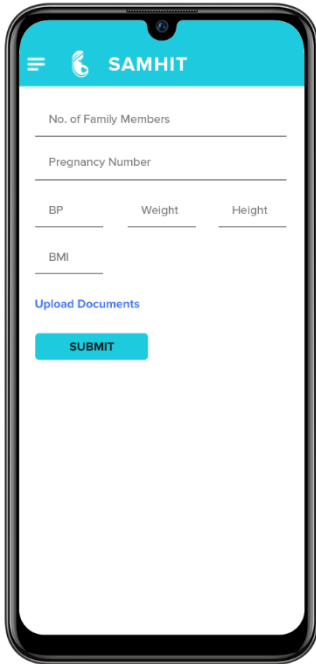
Name of Husband ☒ Not Applicable

Mobile Number

Whose Mobile Number

Age of
Woman: Husband:

Scroll down



SAMHIT

No. of Family Members

Pregnancy Number

BP Weight Height

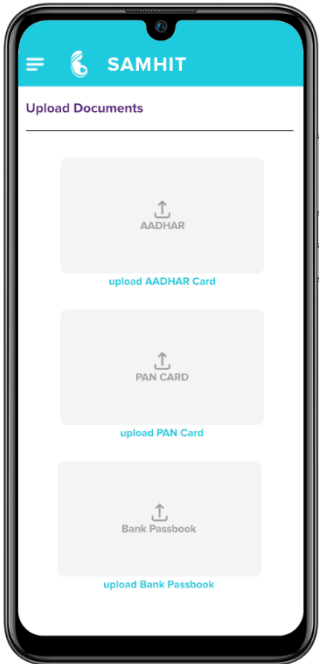
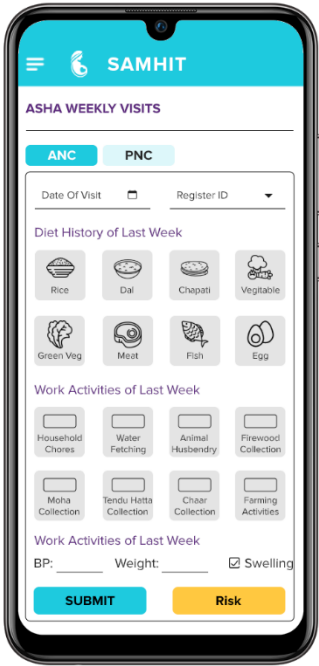
BMI

Upload Documents

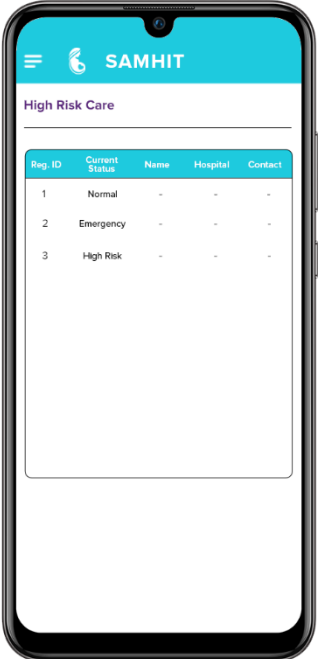
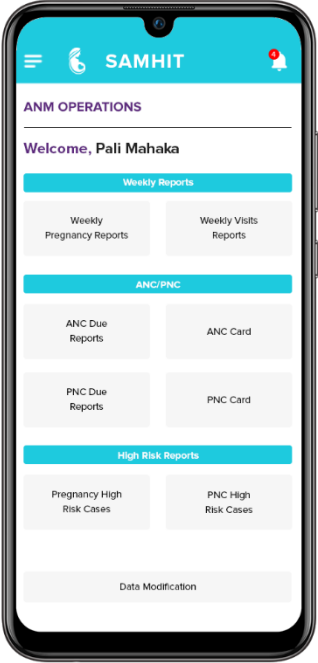
SUBMIT

ASHA

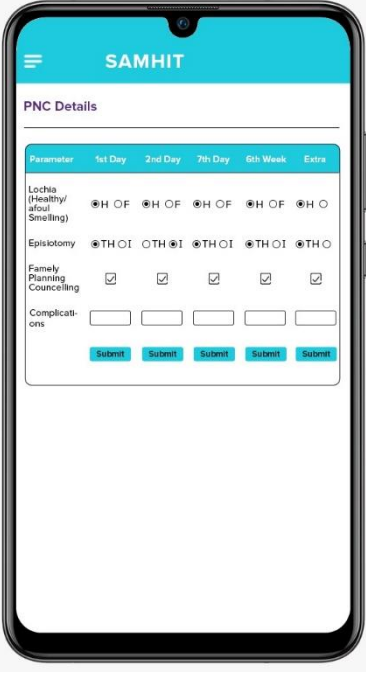
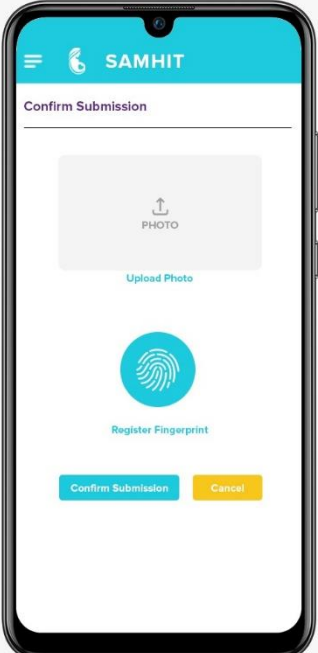
The ASHA will be able to register the pregnant women in the application using this screen. A unique Registration ID will be generated automatically and assigned to the women for reference to their data. The registration will capture the demographic and initial clinical parameters of the pregnant women along with their National IDs for identity verification.

	ASHA	<p>The National IDs include Permanent Account Number Card (helpful in maintaining bank account for receiving any funds from government schemes), Aadhar Card (Single Identification card), Bank Passbook (for bank account details to get amount from schemes)</p>
	ASHA	<p>The ASHA will be able to capture the weekly diet history and weekly activities of the pregnant women along with clinical parameters. This data is useful for analysis of high-risk cases. The “Risk” button will indicate whether the pregnant women is at high risk or not. Based on every week’s data, backend calculations will change the colour of this button -</p> <p>Green - The woman is not at risk. Amber - The woman is at potential moderate risk. Red - The woman is at potential high risk.</p>

	ASHA	<p>This screen will help ASHA to capture the disbursement of IFA and Calcium tablets and against that how many were consumed each week.</p>
	ASHA	<p>This screen will help ASHA to track the delivery dates of the women who are registered under them. This will help ASHA to mobilize resources to help the pregnant woman for institutional delivery.</p>

	<p>ASHA ANM Medical Officer</p>	<p>This is the most important screen in the application. It will help the ASHA to identify the high risk and emergency cases to mobilize the resources for referral.</p>
	<p>ANM Medical Officer</p>	<p>This screen is meant for approvals/acknowledgements of the data captured by ASHA. The first level of approval will be ANM and second level of approval will be Medical Officer. The ANM will be able to:</p> <ul style="list-style-type: none"> • Verify the data of new registrations and their weekly status. • Verify the ANC due, Delivery due, PNC due pregnant women to instruct ASHA for coordinating and mobilizing resources for further respective processes. • Fill ANC and PNC details during the respective camps. • Verify the High Risk and Emergency cases for proactive mobilization of resources. • Modify any wrongly entered data. <p>The Medical Officer will get the Weekly Reports tab enabled which will give a consolidated view of each registered pregnant women. They will have to validate and acknowledge their data.</p>

	<p>ANM</p>	<p>This screen will help ANM capture the ANC details of the registered women during each ANC visit. They would be able to capture the details for any extra visit.</p>
	<p>ANM</p>	<p>This screen will help ANM capture the PNC details of the registered women during each PNC visit. They would be able to capture the details for any extra visit.</p>

		
	ASHA ANM	This screen is a universal submission screen which ensures the participation and validation of pregnant women in this process.

Cloud Environment

We propose, to use a standard cloud environment like Amazon Web Services or Microsoft Azure Services to setup a central storage, blockchain transactions and machine learning components. This will ensure availability of data at a central location and can be accessed from any physical location as required. Further, the “pay as you use” pricing models of the cloud providers, they will be very cost effective in saving recurring costs. The blockchain setup will ensure trustworthiness and traceability of data. Further, the machine learning component will help in setting up an automated analysis system which will learn from the data over a period to predict high risk and emergency cases accurately.

6.3 Process flow for the solution for one sample Geographical Area

Identification of Pregnancy

- ASHA makes her regular visits to tribal women for counselling.
- She tries to detect if any woman is pregnant or not and confirms with Pregnancy Kit.

Registration of Pregnant Women on SAMHIT application

- ASHA registers the pregnant woman on SAMHIT, feeding demographic details and clinical parameters.
- She uploads the available identity and bank documents.
- She captures the photo of tribal woman and takes her fingerprint on the mobile to save the data. This information will be verified by the system locally whenever some data is being saved for the respective pregnant woman. This would ensure the participation of the tribal women in the process and help them realize the importance of healthcare during pregnancy.
- The data gets saved locally in the mobile.

ANM Verification and data transfer

- ASHAs from different villages report to ANM every week.
- ANM verifies the data of each new registration entered by ASHA and acknowledges it in the weekly report.
- Data Entry Operator (DEO) from the area's primary Health Centre visits ANM at the same time for data transfer. The DEO has a preloaded application on his mobile containing data from the cloud.
- Every ASHA submits their mobile for data transfer. The data on mobile gets transferred to DEO's mobile and vice versa. The DEO then transfers the data to cloud.
- This creates transactions for each pregnant woman in the blockchain ledger.
- The ANM can download the report and even print it to keep a paper copy.
- After, this step three parallel actions will be triggered
 - ANC Registration
 - ASHA weekly visits
 - Medical Officer verification

ANC Registration

- Once the registration is confirmed, the next action is triggered for ANM to mobilize ASHA and bring the pregnant woman for ANC registration and check-up.
- Usually ANM in tribal areas plan the ANC check-up once in a month when they conduct immunization camps.
- ANM will be able to view the ANC due report to verify which pregnant women are due for ANC and which corresponding ASHA is to be instructed for the same.
- ASHA would be responsible to motivate the tribal women to register for ANC within 2-4 weeks of registration on SAMHIT and provide institutional support for the same to get the pregnant women to the ANC camps.
- In the camp, ANM along with the lab technicians will register the pregnant women for ANC, conduct the check up and fill all the details in the “ANC Card” section of ANM login.
- Before saving the data, the application will ask for the photo of the woman and her fingerprint.
- The ASHA would be responsible to help the tribal women avail all the 4 ANC visits and if required one more extra visit.

ASHA Weekly visits

- ASHA visits the pregnant women every week (which is a part of her job) to counsel them on best practices. She uses “Counselling Material” section to refer to videos and infographics and to show them to the pregnant women.
- ASHA would use the “Weekly Visits” section to fill up the data for each woman to capture the social determinants and basic clinical parameters.
- Before saving the data, the application will ask for the photo of the woman and her fingerprint.

Medical Officer Verification and District Health Officer Overview

- The transactions created in step 3 triggers a next action for the Medical Officer to verify and acknowledge the data of each registered pregnant woman, her ANC details and weekly visits data (if available) in weekly reports. (The ANC details will be updated every month, as and when the camps are conducted.)
- The Medical Officer can use their login credentials in the SAMHIT application installed on their mobile to perform their tasks.
- The Officer can download the report and even print it to keep a paper copy.
- These reports will also be available to District Health Officers to review every month using their login credentials in the application installed in their mobile. They will also have to acknowledge these reports by using a “Bulk Acknowledge” action.

Automated Data Analysis and Alerts

- Every week when the data gets uploaded in the cloud, machine learning engine will be triggered to perform predictive analysis on the data to identify high risk cases.
- The socio-demographic characteristics, ANC details and the weekly data of social determinants and basic clinical parameters would be used as independent variables to classify a pregnant woman as potential - “No Risk”, “Moderate Risk” or “High Risk”.
- This machine learning model will be developed on the variables captured by conducting a survey before implementing the solution in a geography. Further this model will be retrained with every new data coming in so to make itself learning to increase the accuracy of prediction.
- This classification of every woman would be transferred to ASHA and ANM during weekly synchronization.
- This will change the colour of the “Risk” button in the weekly visits section and the ASHA would be able to take further care and proactive actions. Similarly, it will be reflected in the weekly reports for ANM so that she is also aware of the same.
- If any woman is identified as potential High Risk, an SMS will be sent from the system with her Registration ID and basic details to - respective area’s ANM, Medical Officer, Top 3 nearest Upper Health Facility In charge based on the geolocation of the tribal woman. Along with this SMS, up to three automated calls will be made to them within 24 hours of detection of high-risk case. This will ensure that the information on high risk cases does not get missed.
- The details of such women will be reflected in the “High Risk Care” section of the application. It will also contain the contact details of top 3 nearest health facilities.

High Risk Cases Proactive Care

- Based on the automated detection of the high-risk cases, next actions are triggered for ANM, Medical Officer and the Upper Health Facility In charge to coordinate amongst themselves to identify the top 3 referral facilities if the High-Risk cases turn into emergencies.
- The ANM would instruct the ASHA to monitor the high-risk cases and meticulously fill up the data in weekly visits.
- The automated data analysis will keep on analysing the weekly data captured for the high-risk cases and predict whether the women are still at high risk or their health is improving because of the care being taken. The system also analyses the data of other women as well to identify high risk cases from those who were not at risk and the cycle goes on for automated alerts.
- If the women are still predicted to be high risk, ANM and ASHA keep on tracking their delivery dates through the application in the “EDD Tracking” section. They will mobilize institutional logistics to transfer the women to the referral facility identified earlier.

- In the meanwhile, the referral facility accepting to treat the woman at high risk will have all the case history ready for reference from the application and would mobilize their resources proactively to mitigate the risk.
- Once the woman is treated and delivery is completed, the ANM, Medical Officer and the Health Facility In charge will acknowledge the same in the “Weekly Reports” section.

PNC Details, Identification of Emergency Cases, Proactive Care

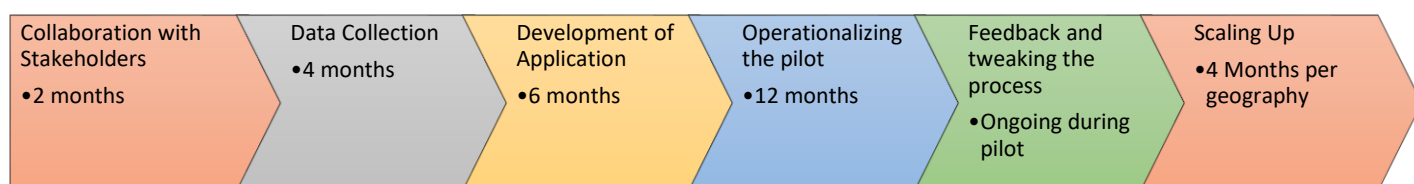
- After the delivery, next action would be triggered to ANM for mobilizing ASHA for PNC registration of women within 2-4 weeks of delivery.
- ASHA would register the delivered mother onto the application and help her avail PNC care.
- ANM will be able to view the women due for PNC using the “PNC Due Report”.
- Like before delivery steps, ASHA and ANM would coordinate with each other to record PNC details in the “PNC Card” section.
- Another machine learning model will take this data as input and classify whether a woman is at high risk or not. All these processes would be managed through the triggered actions and all these transactions would be maintained in the Blockchain ledger.
- Finally, the emergency cases are handled in the same way as the high-risk cases with proactive actions.

Modification of Data

- Since the system is based on blockchain transactions, the modification of entered data is not possible directly.
- However, new transactions can be triggered by ASHA or ANM through “Data Modification” option which will have to be acknowledged by the Medical Officer.
- A report of these modifications will be sent to the District Health Officer every month for acknowledgement.

7. IMPLEMENTATION

The project is proposed to be implemented in following six stages illustrated below. The timeline considered is representative and might change based on handling different risks. The pilot phase is estimated to take approximately 20 months for successful executing and the solution can be scaled up to different geographies with approximate time of 4 months per area.



- 1. Collaboration with Stakeholders:** The first stage of the project will be to approach a software development company working in emerging technologies to collaborate in procuring the required hardware (smartphones), cloud services and developing the application. Further the team will present the solution to the Government authorities and get a buy in from them for the implementation of pilot in the four areas proposed in the scope to get funds for implementation. With the help of Government, the local healthcare facilities in charges, ground workforce – ASHA, ANM will have to be involved as partners for execution of the project. The timeline for this stage is approximated to be 2 months to accommodate all kinds of interactions and approval processes based on past experience of the team.
- 2. Data Collection:** The four areas proposed in the scope will be surveyed for collecting the demographic characteristics, clinical parameters, ANC and PNC details and social determinants of the pregnant women. This data will form the training dataset for developing a predictive model for estimating the likelihood of high risk and emergency cases. The sample of the women chosen for the survey needs to be evenly distributed as per their trimester so as to cover the characteristics of women in different trimesters. The time approximated for this stage is 4 months – One month per area considering the availability of pregnant women and their willingness to participate in the survey.
- 3. Development of Application:** The software development company will be engaged in :
 - a. The procurement of the smartphones and cloud services.
 - b. Setting up a team with internal or external Application Developers, Cloud Architects, Data Scientists, Blockchain experts, Database Administrators, DevOps Developers and Security Administrators.
 - c. Development, testing and deployment of the mobile application on Cloud Environment using Agile development methodology.
 - d. Installing the application in the mobiles of stakeholders
 - e. Conducting user acceptance testing and training the users.

- f. Carrying out a test run in a sample area, generate reports and get acceptance and approval from the Government Authorities.

Emerging Technology Experts from a reputed software consulting company (Name of the Company not disclosed due to Confidentiality Clause) and the timeline for the development of the application for pilot phase was estimated to 6 months. This stage can be started in parallel with the data collection.

4. **Operationalizing the pilot:** The execution team will be responsible for operationalizing the solution in the pilot areas. The software development company will also be engaged in providing dedicated technical support and Data Entry Operators for synchronization of data between the mobiles and cloud environment. The key performance indicators will be set based on the high risk and emergency cases identification and handling, improvement in the healthcare of tribal maternal health and increase in utilization of the institutional healthcare facilities. The data will be published every week and every month to the required stakeholders to evaluate the key performance indicators and the effectiveness of the solution. Based on the experts' view from the consulting firm, it was established that minimum 12 months should be considered for operationalizing the system and capturing feedback. This will help in effective evaluation of women in different trimesters and will also give enough time for the participants of the system to get familiar and produce effective results.
5. **Feedback and tweaking in the process:** The success of the project depends on how we are able bring about the inclusion of tribal women in the process of providing better maternal healthcare and avoid deaths due to preventable causes. Hence, a monthly feedback system will be setup where sample tribal women and institutional stakeholders will be surveyed during the pilot phase by the team, with the help of institutional support. Based on the feedback, timely changes will be made in the system.
6. **Scaling Up:** The pilot project can be scaled up not only to different tribal areas in the country but can also be used to augment the existing data collection process using the MCTS and RCH portal across the country. The major activities in scaling up the application will be:
 - a. Collaborating with the Government Authorities and local stakeholders.
 - b. Collecting the data of pregnant women in the specific geography to establish a localized context and tweaking the predictive model. (1 month)
 - c. Setting up the application in the mobiles of the stakeholders. Providing them required training. (1 month, can be done in parallel with the survey)
 - d. Scaling up the cloud infrastructure as per requirement and doing adjustment tweaks in the application based on the local context. (2 months, can start with previous steps)
 - e. Dry run of the application and providing hands on to the stakeholders to capture their feedback and do any required changes. (2 months)

8. COST ESTIMATIONS

The total cost of implementing the pilot project is estimated at \$4,50,870.00. All the costs related to IT were estimated with the help of an expert Solutions Architect from an IT Consulting firm. The major components are application development and procurement of mobiles for ASHA which constitute of 90% of the cost. Further, the scaling up cost is estimated at \$ 85,000.00 per geography which is 19% of the initial cost and reasonable enough as per the expert based on the economies of scale. Once the project gets operational on scale the major IT capital expenditure on infrastructure and application maintenance will be \$30,870 which is very low given the scale of the population it will cover.

Cost for Pilot Project	
Data Collection	\$ 5,000.00
Cloud storage and database (12 months)	\$ 870.00
Application development cost in 6 months	\$1,00,000.00
Application maintenance cost for 12 months	\$ 30,000.00
Mobiles procurement for ASHA (Approximately 1500 per district)	\$3,00,000.00
Training and Miscellaneous	\$ 15,000.00
Total	\$4,50,870.00

One Time Cost of Scale up for each Geography	
Data Collection	\$ 1,250.00
Application setup	\$ 5,000.00
Mobiles Procurement	\$ 75,000.00
Training and Miscellaneous	\$ 3,750.00
Total	\$ 85,000.00

9. RISK MITIGATION

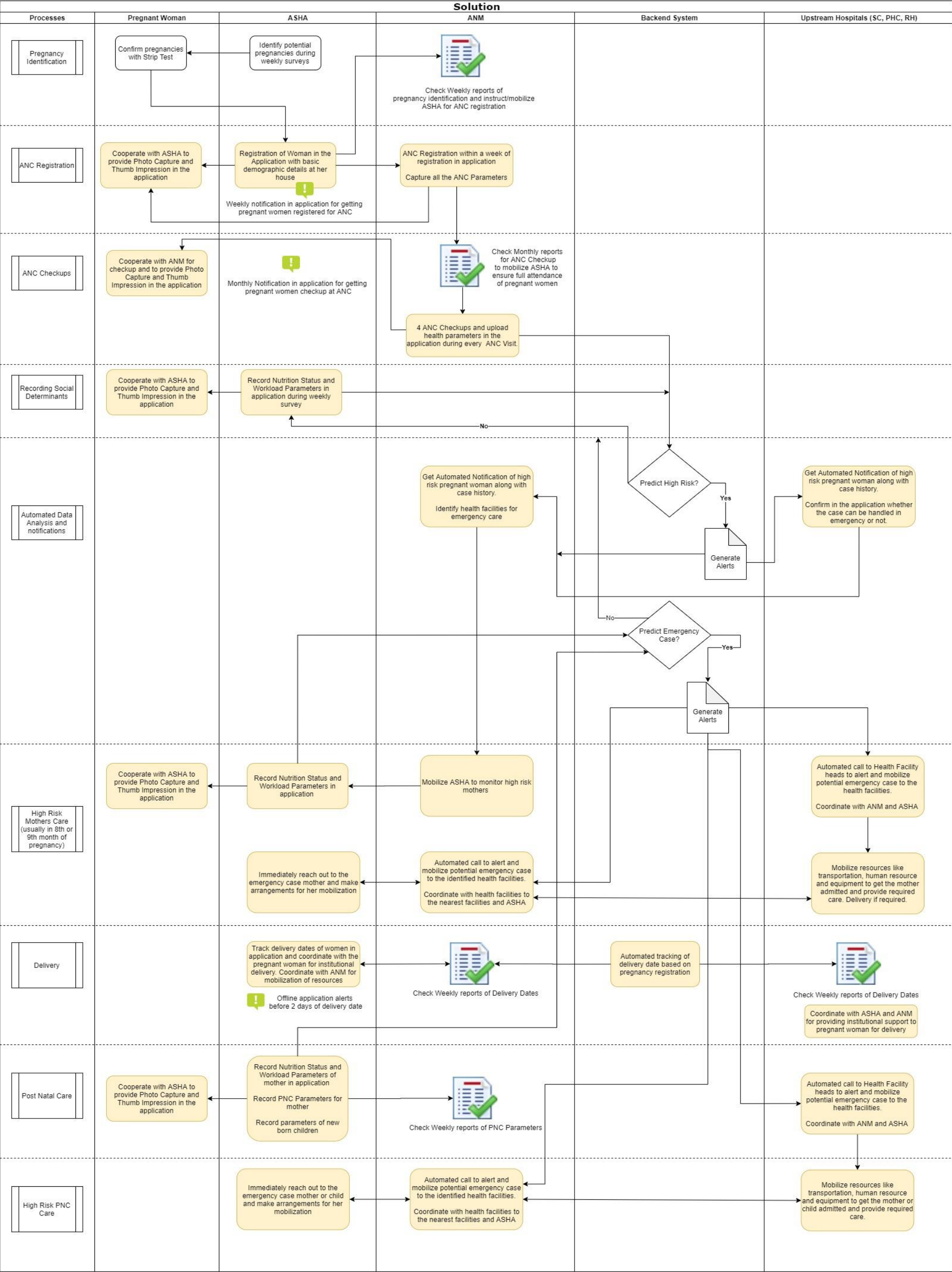
RISK	MITIGATION
New technology Blockchain being new, there is issue of acceptance; especially by the government	The policy Think Tank of India, NITI Aayog has realized the potential of Blockchain in governance and lessons from pilots and PoCs have already been highlighted in the report. The team will approach the government to implement this technology for maternal health in similar way for effective and easy governance.
Collaboration of all stakeholders The project needs not only the higher authorities but also the ground level healthcare workers to be in the loop of the technology. So there is need of coordination among all of them	The team will have conversation with the different stakeholders as to how they view the issue of maternal health. Each perspective will be considered and they will be explained how the project will help with addressing the issues of maternal health by giving importance to each one of them in the decentralized system of maternal healthcare services
Funding for project The project will need funding for initial development of blockchain infrastructure and operational costs	The costing is relatively low for the infrastructure. It will not replace existing systems, rather it is a tech component which will be integrated to enhance the exiting tracking systems so there is no need of entire new infrastructure. Project funding can be obtained by pitching various private organizations, government and can be implemented as a PPP model.
Market competitors There are various mHealth apps existing in India. SAMHIT needs to different than those apps to avoid duplication	The comprehensive research of exiting market has shown that they lack capturing the social context of the region contributing to risks in maternal health. No exiting project uses blockchain technology. SAMHIT's interface is developed in regional context with emerging technology which also secures the data entry and management of data.
Geographical Distance The team is located at Mumbai city and while the project locations are in different districts. Hence timely communication with stakeholders is a challenge.	The team plans to collaborate with all the four state Government authorities for implementation of the project. The team will also ensure that the projects fits local settings with the help of local Government.

10. CONCLUSION

It is evidenced that the marginalized communities face inherent discrimination and the official systems do not cater to their indigenous needs and ground realities are very much different than what is portrayed. It is high time that we leverage emerging technologies which have the power to establish robust processes and align the systems to evidence based and outcome based key performance indicators. SAMHIT is one such tool envisioned to augment the existing processes and make them data driven and outcome driven. It aims at creating an automated process which will remove operational activities of the stakeholders of the health system and help them concentrate on the process of providing better healthcare. It is also scalable to other geographies and has a flexibility to get contextualized to the local needs, thus promoting social inclusion of the marginalized strata of the society.

11. APPENDIX

11.1 Visualization of Process flow of the application



12. References

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