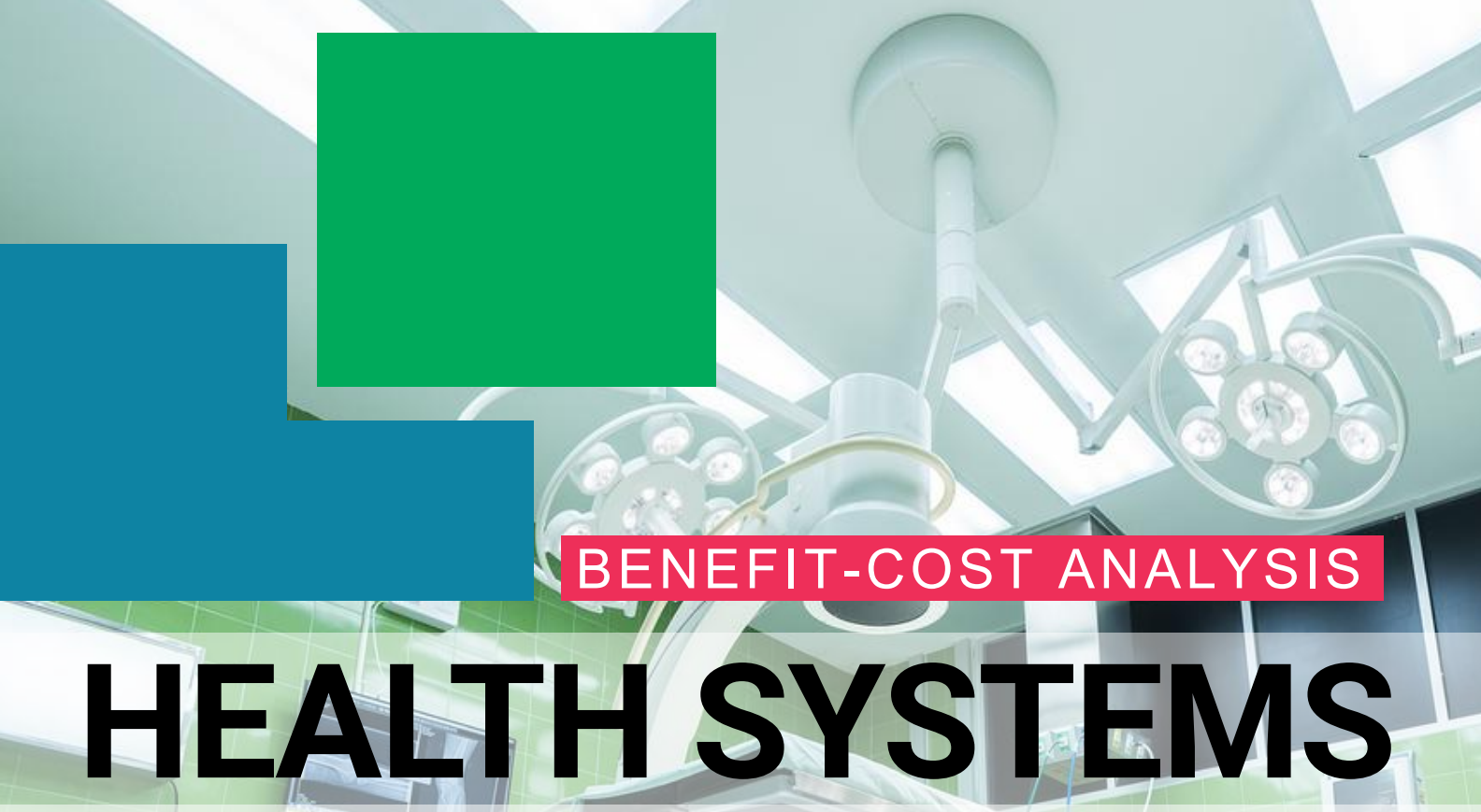

BENEFIT-COST ANALYSIS

HEALTH SYSTEMS

Rajasthan: Health Scenario, Health System Interventions and Cost-Benefit Studies

RAJASTHAN

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TATA TRUSTS

Rajasthan: Health Scenario, Health System Interventions and Cost-Benefit Studies

Rajasthan Priorities
An India Consensus Prioritization Project

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Academic Abstract

Rajasthan State is situated in the north-western part of India and belongs to a group designated as High Focus States under the National Rural Health Mission (2005-12). These states were identified by NRHM for focussed interventions based on poor health indicators. The State's health indicators – infant mortality rate, maternal mortality rate and total fertility rate – are poor compared to the National average (NFHS 4). About one-third of the population of the state belongs to Scheduled Castes/Scheduled Tribes, which traditionally have lower health indicators. Also, the western Rajasthan is desert, which has a low population density. This makes healthcare delivery quite a challenging task in this part of the State. At current levels of health indicators, the State has an uphill task to achieve SDG goal 3 in the next 12 years. Hence, it is of utmost importance for the State to realign its efforts, resources, and healthcare programme interventions to enhance the pace of change and simultaneously address the issue of quality, access, and equity.

In this context, India Consensus partnered with the State Government of Rajasthan to undertake cost-benefit studies of potential healthcare interventions which were identified and prioritized through a process of stakeholder consultations. The interventions are:

i). strengthening basic and surgical capacities to reduce maternal and neonatal deaths;

ii). improving emergency referral management using 108 ambulance services; and

iii). family planning interventions.

The study findings show that investment in these interventions would have benefit-cost ratios of 9.7, 8.8, 3.3 and 32 for improved maternal and neonatal care, improved emergency response in urban and rural areas and improved family planning respectively . These analyses reveal that investment in these interventions would improve allocative efficiency and help in strengthening public health services in the state.

Policy Abstract

The Problem

In recent times, the Indian healthcare sector has evolved both in terms of quality and quantity. The sector currently faces a double burden in the form of both non-communicable diseases and communicable diseases. The health sector plays a vital role in improving the well-being of the community and contributes to the overall development of the nation. Public and private institutions and development partners have started putting their focus on this sector, and the change is evident from the current health indicators.

However, many states in India are still far behind both the national average and the international benchmark health indicators. Rajasthan is a state located in the north-western part of the country. It is the second largest in land area and represents 5.67% of country's population. It has an estimated population of 77,124,923 in 2017, with 72.9% residing in rural areas. Following the recent health sector reforms and use of information technology in public health management, progress towards achievement of the SDG targets has accelerated. Despite visible success in this sector, many health indicators are still a cause of concern for the state. Most recent data on key health indicators such as maternal mortality ratio (244 per 100,000 live births in 2011-13), infant mortality rate (41 per 1000 live births) and under-five mortality rate (51 per 1000 live births) suggest that the state is far behind the targets set in the Sustainable Development Goals (SDG). Women in the reproductive age group continue to face a higher toll of death and disability, which could be due to the low socio-economic status of women in the state and inequitable distribution of healthcare facilities and human resources. In such a situation, both public and private sector actors and development partners have a role to play, contributing to evidence-based multisectoral and multidisciplinary approaches to achieve the SDG targets.

Hence, it is of utmost importance for the state to realign its efforts, resources, and healthcare programme interventions to enhance the pace of change and simultaneously address the issue of quality, access, and equity. In this context, India Consensus partnered with the State Government of Rajasthan to undertake cost-benefit studies of the potential interventions

which had been identified and prioritized through a process of stakeholder consultations. In the health sector, these are:

i). strengthening basic and surgical capacities for reducing maternal and neonatal deaths;

ii). improved emergency referral management using 108 ambulance services; and

iii). family planning interventions were finally shortlisted for cost-benefit analysis.

These analyses suggest that investment in these interventions will improve allocative efficiency and help to strengthen public health services while reducing maternal and infant mortality in the state.

Intervention 1: Strengthening emergency obstetric and newborn care to reduce maternal and neonatal deaths

Overview

Complications during pregnancy and childbirth cause 4,267 maternal deaths and almost 30,000 neonatal deaths per year in Rajasthan. The maternal and child health indicators in Rajasthan are lower than the national average; hence the state needs to redesign its interventions to accelerate improvement in these indicators and address the issues of quality, access, and equity. Achieving the SDG targets on maternal and child health will require significant effort. In this context, we are looking at improving the coverage of basic and, to some extent, the emergency surgical capacities to provide better care for mothers and newborns in Rajasthan.

Implementation Considerations

The intervention will work in a prospective manner initially for 20 years. The benefits will be same for next 19 years as in the first year as per the assumptions. The goal of this intervention is a decrease of 66% in the Maternal Mortality Rate (MMR) compared to the pre-intervention status.

Costs and Benefits

This study adopted the economic model from Goldie et al (2010), which focused on maternal mortality (MM) in India overall and a few selected states. In our study, the key focus area was

to reduce the MMR by strengthening the service quality of maternal health interventions. Specifically, we used the incidence and case fatality rate of haemorrhage, obstructed labour, hypertensive disorder, sepsis, and unsafe abortion to define our baseline and estimate progress. We estimated the number of post-intervention preventable deaths and post-intervention MM. These interventions are estimated to result in a reduction of MM by 66%, saving 1,805 maternal lives per year. They would also reduce neonatal mortality by 20%, saving 6,542 newborn lives per year.

The total cost of the intervention is estimated as INR11,495 crores and the total economic benefit of saving the maternal and neonatal lives is expected to be INR111,563 crores at a 5% (annual) discount rate. Using these assumptions, the benefit-cost ratio of this intervention would be 9.7.

Intervention 2: Improved emergency referral management by 108 ambulance services

Overview

Ambulance services constitute a critical component of Emergency Medical Services (EMS) by transporting patients to health facilities quickly, which is essential to ensure timely and adequate care. In Rajasthan, there is a shortage of ambulances, which results in an unintended delay in timely health service delivery. This often leads to the death of the victims in a number of medical and surgical emergencies. Therefore, we aim to calculate the required number of additional ambulances and staff, followed by the calculation of total investment and benefits.

Implementation Considerations

It is challenging to ensure an adequate number of ambulances for the population of a large geographic region. Based on available literature, we identified an approximate number of ambulances that should be made available in Rajasthan to serve the healthcare needs of the population. The intervention considers deployment of additional ambulances, which are expected to remain operational for the next 10 years. The indicator to measure the improvement in population health will be the coverage of the ambulance services.

Costs and Benefits

Costs

In this intervention, we calculated both capital and recurrent costs on various heads. The capital cost is a one-time investment for the next 10 years; in addition there will be recurrent annual costs such as salaries, maintenance, training etc. We estimated the total number of ambulances required as 33 per million population in the urban area and 99 per million population in rural areas. Hence, the total cost to fulfil the need for ambulances in urban and rural areas of the state comes to INR1,092 crores and INR 7,790 crores, respectively.

Benefits

For the calculation of benefits, we used the data of referrals for ischemic heart disease, road traffic accidents, and obstructed labour cases. The total benefit in economic terms would be INR9,645 crores in urban areas and INR12,076 crores in rural areas. It means such interventions would have benefit-cost ratios of 8.8 and 3.3 respectively in urban and rural areas of Rajasthan.

Intervention 3: Family Planning

Overview

Family planning helps women to have the desired number of children and/or ensure the spacing of pregnancies. It is achieved using contraceptive methods and the treatment of infertility. It prevents unwanted pregnancy-related health risks in women, indirectly reduces infant mortality, reduces the spread of sexually transmitted diseases, empowers people and enhances education, reduces adolescent pregnancy, helps in reducing population growth etc. Thus, adequate family planning measures promote the well-being and autonomy of women and improvements in various health indices of Rajasthan.

Implementation Considerations

This intervention looked forward over the next 50 years, as our ultimate target is to reduce the number of unwanted children and decrease the prevalence of unwanted pregnancy-related abortion. Even to maintain the current birth rate, family planning plays an important role. However, it is always a tough task to identify the roughly 5% of the female population

who still need contraceptives, but we still assume that we will be able to reach these women through expansion of supply.

Costs and Benefits

Costs

The cost of the intervention includes the cost of service delivery and procurement of contraceptives for the target population. The total per capita cost is about INR614 at 5% annual discount rate.

Benefits

The major benefit would come by way of demographic dividends but the child and maternal lives saved due to family planning methods would also be important. The total per capita economic benefits would be about INR19,728 which is about 32 times the investment cost.

BCR Table

Table 1: Summary of Benefit-Cost Ratio

Interventions	Benefit	Cost	BCR	Quality of Evidence
Maternal and Neonatal health*	111,563	11,495	9.7	Medium
Ambulance (Urban)*	9,645	1,093	8.8	Limited
Ambulance (Rural)*	39,762	12,076	3.3	Limited
Family planning (per capita)	19,728	614	32	Medium

Notes: All figures assume a 5 percent discount rate; * Benefit and Cost values are in crores of INR except family planning which is in per capita-years

1. Introduction

1.1 INDIA'S HEALTH SCENARIO

Health is the responsibility of the government as per the Constitution of India. Health is a state subject primarily, and states are responsible for providing health services, though the policy is developed by the Federal government. Health systems in India have evolved into a massive network of health institutions since their inception in 1951. The health of the people was considered as central to community development with the district as a functional and administrative unit across the country. The genesis of healthcare in India is rooted in the concept of comprehensive health care as recommended by the Health Survey and Development Committee (1946), popularly known as Bhore Committee Report. The guiding principles of comprehensive healthcare were to provide preventive, promotive and curative health services; healthcare being accessible and available as close as possible to the beneficiaries and available to all irrespective of their ability to pay for it; special provision of care for vulnerable sections of the population, particularly women and children; and involvement of communities and people in healthcare planning and delivery of services and maintaining a healthy environment. There are 156,231 sub-centres and 25,650 primary health centres (PHCs) at the village level that provide primary health care. The secondary level health and referral services are provided by 5,624 community health centres (CHCs) located at the block level (HMIS-MoHFW, 2017). In each district, there is a district hospital with 100 – 300 beds. The district hospitals are the main providers of secondary level healthcare. In all, there total 14,379 hospitals and 634,879 beds, with 67% in the urban areas (CBHI, 2017). The private sector has a significant presence in healthcare in the country and its shares in hospitals and hospital beds are estimated at 74% and 40%, respectively. In India, private health care accounts for 74% of the country's total health care expenditure (IBEF, 2017).

India has made significant progress, not only in health infrastructure and resources but also in various health indicators. The mortality rate has declined from 27 per 1000 population to less than 7 per 1000 population, life expectancy has increased from a low of 32 years to the current 69 years. There has been a phenomenal decline in the infant mortality rate (~200/1000 live births) and maternal mortality rate (~500/100,000 live births) to 37 per 1000

live births and 167 per 100,000 live births (Govt. of India). The major communicable diseases have been brought under control, and smallpox and polio have been eradicated.

A key policy initiative was taken in 1983 when India announced its first formal Health Policy, which was part of a major effort to achieve the goals of primary healthcare post the Alma-Ata Declaration – Health For All by 2000 AD (Singh and Singh, 2004). The policy focused on creating and expanding health infrastructure, human resource development, and equipping health facilities with requisite equipment, essential drugs, and material. In the process of evolution, the second version of the National Health Policy was announced in 2002. The launch of the National Rural Health Mission (NRHM) in 2005 by the Government of India was the a breakthrough in the country's healthcare, with a focus on reducing maternal mortality and infant mortality, while also implementing management interventions to improve the efficiency and effectiveness of health systems to achieve the Millennium Development Goal 3. The NRHM paid rich dividends and India almost achieved MDGs 4, 5 and 6 (WHO- South-East Asia, 2008) (Ministry of Statistics and Programme Implementation, 2017).

India announced its third National Health Policy in 2017, focusing on achieving health-related Sustainable Development Goals (SDG 2015) to reduce maternal deaths to fewer than 70 per 100,000 live births, infant mortality to 12 deaths per 1000 live births, and under-five mortality to fewer than 25 per 1000 live births (UN India, 2016). Universal Health Coverage (UHC) that aims to enhance access and availability of quality health services, and provides financial protection to the poor, is the major approach to achieve the unfinished agenda of the MDGs and realize the health goals of the SDGs.

India faces serious challenges in the implementation of policy intentions and strategies. There are gross inequities in access and availability of health services, especially for the poor and disadvantaged. Despite a vast network of public-sector healthcare institutions, a large health workforce and resource mobilization, almost 70% people use a private health facility for out-patient care. They incur about 70% of total health expenses out of pocket (Nandi *et al.*, 2017)(T *et al.*, 2015). Health systems are afflicted with low efficiency and effectiveness with poor implementation of health programmes and interventions.

Maternal, neonatal and under-5 mortality rates are still high. The major preventable causes of maternal deaths are haemorrhage during and after childbirth, puerperal sepsis, pregnancy-induced hypertension and eclampsia. Neonatal mortality accounts for 60-65% of infant deaths, together with diarrhoea, acute respiratory infections (ARI) and severe malnutrition. This is due to poor coverage of critical mother and child care services. According to NFHS 4, only 30.3% pregnant women received full antenatal care. In rural areas, only 16.3 % of pregnant women received full antenatal care, in contrast to their urban counterparts (31.1%). Further, on average women had INR3,198 of out-of-pocket expenses in public health facilities. Almost one -fourth of the women (22.9%), were undernourished with of BMI less than 18.5 kg/m^2. Half the pregnant women were anaemic. An even larger proportion of children (58.5%) had anaemia. Malnutrition among children under age 5 was rampant, with 38.4% being stunted and 21.0 wasted. Full immunization coverage among children 12-24 months was only 62.0% (NFHS 4 India, 2015).

In addition, the disease burden due to tuberculosis continues to be high, though the mortality rate has declined. Treatment faces a major threat from strains resistant to the usual anti-tubercular medicines. Although trends of HIV have shown a reversal, it remains a major health problem. While India struggles with these chronic diseases, there is a rise in the disease burden caused by non-communicable diseases (NCD) such as diabetes, hypertension, various forms of cancers and Chronic Obstructive Pulmonary Disease (COPD). It is projected that NCDs will account for over 70% of total disease burden by 2025 (Kontis *et al.*, 2015) ('Economics of Non-Communicable Diseases in India', 2014).

1.2 Rajasthan: Health Systems and Status

Rajasthan is situated in north-western India and it belongs to a group of High Focus States under the National Rural Health Mission (2005-12). These states were identified by NRHM for focussed interventions based on poor health indicators. The state's health indicators, such as Infant Mortality Rate (41 per 1000 live births), Maternal Mortality Rate (244 per 100,000 live births), Total Fertility Rate (2.4 children per woman), and under 5 mortality rate (51 per 1000 live births), are poorer than the National average. About one-third of the population of the state belongs to Scheduled Castes/Scheduled Tribes, which traditionally have lower health indicators. Also, western Rajasthan is desert, which has a low population density. This makes

healthcare delivery quite a challenging task in this part of the state. At current levels of health indicators, the state has an uphill task to achieve SDG goal 3 in the next 12 years. Hence, it is of utmost importance for the state to realign its efforts, resources, and healthcare programme interventions to enhance the pace of change and simultaneously address the issues of quality, access, and equity.

Along with this, the state of nutrition among women and children was again a concern as 46.6% of pregnant women and 60.3% of children were reported to be anaemic. Malnutrition among children under five was high, with 39.1% found to be stunted, 36.7% underweight, 23% wasted and 8.6% severely wasted (NFHS 4 Rajasthan, 2015). Rajasthan's public system has a well-developed health infrastructure with 14,408 sub-centres, 2,080 PHCs and 571 CHCs. There are 752 hospitals in the public sector with a total of 31,848 beds (CBHI, 2017). However, despite this vast network, there are gaps in the availability of infrastructure as compared to IPHS standards. The private sector has a significant presence in healthcare delivery in Rajasthan.

As documented in published literature, key stakeholder consultations and national level surveys, the priority areas for health system interventions in Rajasthan include maternal and child health (MCH), emergency medical service and family planning. In this paper, we discuss prospective interventions addressing these health issues through strengthening the health system in Rajasthan to achieve better health outcomes and impacts. Also, we analyze the benefit-cost ratio for each intervention.

We have selected three interventions for benefit-cost studies, namely,

1. Strengthening emergency obstetric and newborn care to reduce Maternal and Neonatal deaths
2. Improving emergency referral management using 108 ambulance services
3. Family Planning services

2. Strengthening emergency obstetric and newborn care for reducing maternal and neonatal deaths

2.1 Description of intervention

The rates of maternal and neonatal death continue to be high in Rajasthan. Most of these deaths are avertable by better care during childbirth, especially surgical care, and appropriate care during the postpartum period. Complications during pregnancy and childbirth are considered as leading causes of deaths and disabilities among women of reproductive age in developing countries. These associated risks contribute to raising the critical maternal mortality indicator ratio. However, the majority of maternal deaths are preventable if diagnosed and treated in time. About three-quarters of all maternal deaths are caused by postpartum haemorrhage, hypertensive disorders such as pre-eclampsia/eclampsia, infections, unsafe abortion and other delivery-related complications (UNICEF). In practice, however, even if a woman can access prenatal care and deliver in a health facility where skilled birth attendants are available, poor quality of care can be threatening enough for the mother and newborn. Moreover, a wide spectrum of non-communicable diseases also plays an important and growing role contributing to the deaths that occur during pregnancy, delivery, or during the postpartum period.

For the purpose of our study, we have adopted WHO definition of maternal death. Maternal death is defined as "the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes" (WHO, 2014).

Basic Emergency Obstetric Care (BEmOC) and Comprehensive Emergency Obstetric Care (CEmOC) have been extensively promoted to improve maternal and neonatal health outcomes. However, the consensus about universal access to high-quality BEmOC and CEmOC services is facing challenges due to uncertainties about how best to implement them in specific situations (MoHFW, 2007). It is essential to ensure an adequate number of skilled staff, efficient emergency support systems, and well-equipped facilities for CEmOC to overcome barriers to maternal care, predominantly in rural areas (Goldie *et al.*, 2010). In this

study, we focus on a couple of interventions which collectively play their roles in reducing the maternal mortality ratio (Shiffman and Ved, 2007).

The study by Goldie et al 2010 considered the costs, feasibility, and operational complexity of alternative interventions and estimated the clinical and population-level benefits associated with strategies to improve the safety of pregnancy and childbirth in India. They found that early intensive efforts to improve family planning and control of fertility choices and to provide safe abortion, accompanied by a paced systematic and stepwise effort to scale up capacity for integrated maternal health services over several years, is as cost-effective as childhood immunization or treatment of malaria, tuberculosis, or HIV. In just 5 years, more than 150,000 maternal deaths would be averted through increasing contraception rates to meet women's needs for spacing and limiting births; nearly US$1.5 billion would be saved by coupling safe abortion to aggressive family planning efforts; and with stepwise investments to improve access to pregnancy-related health services and to high-quality facility-based intrapartum care, more than 75% of maternal deaths could be prevented. If accomplished over the next decade, the lives of more than one million women would be saved. However, this model used projections up to 2015 but now the situation has changed in Rajasthan, due to improvements in infrastructure and various health indicators. The interventions used in the paper are still good ones and now we are scaling-up them up to target the SDGs.

2.2 Data

The data necessary for a cost-benefit analysis of BEmOC and CEmOC as interventions to reduce maternal and neonatal deaths was collected from available online sources and primary data sources like unpublished Government documents and interviews with Government officials working in the relevant agencies at the state level. Global Burden of Disease (GBD) 2016 data was used to collect information about age-specific deaths. Niti Aayog and Census data were used for various projections. Further, the cost data from the Goldie et al. paper was used on various interventions and projected based on the adjusted inflation rate. Total incentives were calculated on the number of beneficiaries and incentive per beneficiary.

2.3 Situation analysis

A study by Prakasamma M. 2009 revealed a disproportionately low focus on maternal health in peripheral hospitals resulting in the low use of these facilities for childbirth (Prakasamma, 2009). Moreover, the expansion of services offered through primary health centres was not done with adequate planning, which weakened the peripheral health system further. Also, there was little emphasis on developing a cadre of midwives who would have focused primarily on maternal and newborn health. Lastly, the low socioeconomic status of women in the state has affected timely referral and access to maternal health services for a large proportion of the population.

Another study by Revu et al 2018 found that a combination of critical factors like poverty, and ineffective or unaffordable health services contribute to increased rates of maternal death (Revu *et al.*, 2018). Moreover, the success of JSSY is often affected by a lack of awareness among the target population. It is essential to consider these socioeconomic factors when implementing further interventions in this area. Furthermore, findings from the Rajasthan NFHS 4 report show that 46.6% of females among the reproductive age group (15-49 years) are anaemic (NFHS 4 Rajasthan, 2015) and a study by Nirmala D. et al 2015 found that severe anaemia during pregnancy is associated with maternal morbidity and mortality (NirmalaDevi, Varalaxmi and Jyothirmayi, 2015). Therefore, effective preventive measures in the form of regular antenatal checkups and iron-folate supplementation are recommended to prevent complications from anaemia in pregnant women. Furthermore, delays at different stages of maternal care contribute to subsequent mortalities and morbidities. The first delay takes place in making the decision to seek health services for obstetric complications, which commonly occur at the household and community level. The second delay occurs in transporting the patient from home to the nearest health facility. Finally, the third delay occurs in obtaining care at the desired facility, which is one of the most tragic issues affecting the survival of the mother and is a direct reflection of the quality of care during major obstetric emergencies (Thaddeus ' and Maine, 1994) (Carvalho Pacagnella *et al.*, 2012).

It is evident from the above description that maternal care services in Rajasthan are far behind the optimal level in terms of availability and accessibility. These critical issues in maternal care remain a real cause for concern despite rapid expansion of healthcare

infrastructure. Moreover, the quality of services offered by healthcare facilities is often compromised due to deficiencies in the skilled workforce, other allied resources and standard operating procedures. Further initiatives should address the earlier gaps as mentioned above to develop a robust and resilient health system capable of delivering optimal maternal care in Rajasthan.

2.4 Calculation of Costs and Benefits

2.4.1 Costs and Benefits

This study model is a modified version of that used by Goldie et al. Their study covered maternal mortality (MM) in India along with a few state-specific rates. The key focus area is to reduce MM by strengthening the service quality of maternal health interventions. In our study, the incidence and case fatality rate (CFR) of haemorrhage, obstructed labour, hypertensive disorder, sepsis, unsafe abortion, and other causes were adapted from Goldie et al. and used after projecting them for the year 2017. We calculated the number of post-intervention preventable deaths to estimate the post-intervention MM. The outcome of these interventions is about a 66% reduction in the MM.

Table 2: Overview of parameters for various causes of maternal mortality

	Haemorrhage	Obstructed Labor	Hypertensive disorders	Sepsis	Unsafe Abortion	Others
Incidence rate[#]	0.114	0.047	0.035	0.05	0.128	
CFR* [#]	0.023	0.019	0.021	0.028	0.009	
↓ CFR [#]	75%	95%	59%	90%	98%	
CFR calculated	0.008	0.001	0.003	0.008	0.002	
RR post-intervention	25%	5%	41%	10%	2%	19.03%
Potential impact fraction	0.60	0.85	0.43	0.78	0.73	0.66
Deaths avoided	986	67	95	580	296	803

Source: [#]Goldie et al 2005 and authors calculation; *Adjusted value

Costs

Census 2011 data was used to identify the number of ever-married females among the 15-49 age group population. The same proportion was used to calculate the estimated number of ever-married females in 2017 among the projected population of Rajasthan. GBD 2016, cause and age-specific data for different age groups between 15 and 49 were extracted. Among the other causes of MM, indirect maternal deaths, late maternal deaths, deaths aggravated by HIV/AIDS were also included. Present value (PV) of years of life lost (YLL) was calculated with the help of mean YLL value of individual age group. This value was estimated at 3%, 5%, and 8% discount rates.

It is not possible to reduce maternal mortality sufficiently by a single intervention. So, here we used a group of interventions like family planning for unmet need for spacing, facility births, skilled birth attendants, transport from home, availability of primary level health centres, BEmOC and CEmOC services. According to Goldie et al, the collective efforts of such services show a significant reduction in the maternal mortality rate (MMR). Various updated data sources like the NFHS- 4 report, rural statistics 2017 etc. were used to verify the updated status of all these interventions and the status represents an improvement in the situation; however, there was a gap which requires more attention and resources to fill it. Therefore, we projected our targets based on these gaps and tried to cover 95 – 100% of the pregnant females in the 15–49 age group. Our view is to provide at least the BEmOC services to all and CEmOC services to all identified females who need it.

All the unit costs were adapted from the Goldie et al paper with present values calculated by using the adjusted inflation rate for 2007–2011. Costs of direct health and non-health care indicators were calculated. Direct healthcare cost includes the cost of induced abortion and treating abortion or pregnancy-related complication like eclampsia, haemorrhage, sepsis etc., and salaries of healthcare providers including counselling, skilled birth attendants (SBA), clinicians' time etc. Costs related to prenatal care (e.g., additional prenatal visits, nutritional supplementation, treatment of anemia or other existing diseases, screening for sexually-transmitted diseases), cost of providing safe abortion or family planning options (e.g., sterilization, intrauterine device, oral contraceptives), emergency obstetric care (e.g., facilities with the capacity for transfusion, parental antibiotics, surgery, anesthesia) are also included.

Direct non-health care costs include drugs, vaccines, salaries, infrastructure by intervention and by service location or level (e.g. hospital, health centre, health post), and facility costs. They are categorized as (1) family planning; (2) antenatal care, including treatment for chlamydia, gonorrhea and anemia; (3) abortion (incomplete and elective) and post-abortion complications; (4) delivery care; (5) emergency/pre-referral care; (6) assisted vaginal delivery (CEmOC treatment of obstructed labor); (7) cesarean section; (8) postpartum hemorrhage; (9) puerperal sepsis; (10) severe pre-eclampsia/eclampsia; (11) treatment of long-term complications such as PID and obstetric fistula; and (12) postpartum care.

Coverage of all 4 ANCs is used as the proxy indicator for BEmOC services, which is 38.5% in Rajasthan (NFHS 4 Rajasthan, 2015) and in CEmOC services we are looking for a minimum 25% scale-up from BEmOC to CEmOC which accounts for a 23.8% improvement (95% * 25%) from the current status. So, in our calculations, the target population for BEmOC services is 'total estimated live births in 2017' * (target percent – present status) {1874136 * (95%-38.5%) = 1058887} and for CEmOC services 'total estimated live births in 2017' * target percent (1874136 * 23.8% = 445107). In family planning services, an average cost of temporary methods like oral contraceptives, condoms, injectables, and IUDs is used to satisfy the requirement of unmet need for spacing (5.70%) among ever-married females. For transportation-related costs, we used the per patient transportation cost of 760 INR (AP Govt., 2017). The target population for transport service costs is the percentage of females who used an inconvenient mode of transport during NFHS 4 survey, such as motorcycle/scooter, cart, on foot etc. and this is about 31% (Table 6).

Facility expenditures were calculated by multiplying the unit cost by the required services number. Abortion-related calculations were performed at two levels: first elective abortions were calculated at 26 per 1000 live births (Stillman Melissa, Frost Jennifer J., Singh Susheela, 2014) and among them, post-abortion complication cases were calculated at an incidence rate 0.128 (Goldie *et al.*, 2010). With them, total abortion costs were calculated by multiplying the unit cost for each. For remaining causes like obstructed labour, haemorrhage, pre-eclampsia, sepsis, and other maternal mortality causes, we used the incidence rate, target population, and unit cost for total cost calculations. The CEmOC cost was not calculated for those where the beneficiaries are getting the same service at the BEmOC

centre. The sum of all relevant costs is the total cost of BEmOC and CEmOC service. For financial incentives, we include the JSY incentives for both rural and urban area population.

Table 3: Cost of BEmOC and CEmOC

Intervention	Unit cost	BEmOC	Unit cost	CEmOC
ANC	1,799.38	1,905,339,948		Covered in BEmOC
Anaemia	107.52	103,292,616		Covered in BEmOC
Facility expenditures	2,591.02	2,743,600,230	3430.10	373,479,859
Incomplete/Elective abortion	1,621.76	44,648,801		Covered in BEmOC
Post-abortion complications	4,574.87	8,139,483		Covered in BEmOC
Obstructed labour	2,056.59	102,351,469	9794.87	61,622,778
Haemorrhage	3,093.84	373,466,721	14934.75	163,276,660
Pre-/Eclampsia	6,303.63	233,619,011	10795.23	16,371,009
Sepsis	3,434.32	181,827,696	7801.53	154,653,802
Post-partum care	526.01	308,556,989		Covered in BEmOC
		6,004,842,964.55		769,404,108.26

This total cost includes investments in physical and human infrastructure (building, renovating and equipping medical facilities; training and retaining staff; improving the referral and medical supply system) as well as demand creation, outreach, supervision, monitoring and evaluation activities. All the cost estimates are available in Table 3 and 4.

Table 4: Total cost of the intervention

Intervention	Present status	Target	Target population	Unit cost	Total cost
Family planning (Unmet need for spacing)	5.7%	0.0%	861197	1,012.2	871,719,088
Facility births	84%	95%	206155	1524.3	314,232,776
SBA (home births)	3.2%	5%	33734	678.9	22,900,706
Transport from home	14.4%	30.9%	579894	760	440,719,139
Primary-level health centre	100%	100%			
BEmOC	38.5%	95%	1,058,887		6,004,842,965
Availability and quality of CEmOC		25% of those requiring BeMOC	445,107		769,404,108
Financial incentives for facility births	84%	95%			360,524,306
					8,784,343,089

Benefits

The calculation of overall benefits due to saving the life of a mother is not limited to the female only; it goes beyond that and impacts society as a whole as well. But, here we included the direct benefits related to the mother and newborn baby only. For this, we identified the reduction in death rates by scaling-up and performing all the identified interventions. With that, a total number of avoided deaths was calculated. The next step is to calculate the DALYs at 3%, 5%, and 8% discount rates with previously calculated present value and total avoided deaths. Two approaches are used to calculate the total benefits. In one, DALYs are multiplied by three times the GDP cost and in the second the value of a statistical life year is multiplied by total avoided deaths to calculate the total benefits.

The study finds that maternal deaths would be reduced from the projected number of 4,311 in 2017 to 1,483, which means that 2,827 deaths (about 66%) could be averted due to maternal health interventions. By reducing these deaths 70,227, 50,479, and 34,234 DALYs per year could be averted at 3%, 5%, and 8% discount rate.

Benefits due to neonatal lives saved were calculated for all available causes from GBD 2016 data and the Darmstadt et al 2005 paper. Our major focus is to cover the benefits at intra- and post-partum level because these will be the indirect benefits due to providing the

maternal health facilities. The reduction rate is the average value of the upper and lower limits of the reductions. The next step is to calculate the cause-specific total avoided deaths. We estimate that 6,542 neonatal deaths per year could be averted due to this intervention, out of a total of 29,833. By reducing these deaths 199,852, 136,473, and 91,516 DALYs per year could be averted at 3%, 5%, and 8% discount rate.

The total benefits of avoided maternal and neonatal mortality plus the small value of marginal financial incentives is Rs. 197,788 crores, 111,563 crores, and 56,726 crores over the 20 year period of the intervention at 3%, 5% and 8% discount rates respectively (Table 5).

Calculation of Benefit-Cost Ratio

The results are presented in Table 5. For a 3% discount rate, the BCR is 14.7; in other words, for every rupee spent, the net economic benefit has a present value of 14.7 rupees. With a discount rate of 5%, every rupee spent yields an economic benefit of 9.7 rupees. The lowest return is at a discount rate of 8%, with just 6.1 Net Present Value (NPV) return for every rupee spent. Clearly, these results are highly sensitive to the discount rate used.

Table 5: BCR of the intervention

Discount rate	Benefits 3 x GDP per cap* (in Rs. crore)	Costs (in Rs. crore)	BCR 3 x GDP per cap
3%	197,788	13,461	14.7
5%	111,563	11,495	9.7
8%	56,726	9,315	6.1

Source: Authors calculations; * Includes maternal and neonatal benefits

2.5 Assessment of Quality of Evidence

The impacts of the intervention on maternal and neonatal health are from Goldie et al (2010), and Darmstadt et al (2005). The first of these studies provides evidence from the India-specific context while the second study maps overall reductions from global experiences in developing countries. The underlying data is from reliable data sources but they are not tailored to this particular state. The quality of evidence is assessed as "Medium".

3. Improved emergency referral management by 108 ambulance services

3.1 Overview

An emergency Medical Service (EMS) is defined as "a comprehensive system which provides the arrangements of personnel, facilities and equipment for the effective, coordinated and timely delivery of health and safety services to victims of sudden illness or injury" (Al-Shaqsi, 2010). An emergency medical system is expected to be effective and efficient enough to provide universal emergency healthcare services, which means that such services should be available for all who need it. However, this area has been neglected and did not get prioritized in the context of low-and-middle-income countries (LMICs). The identified reasons for this are a poor focus on care during transportation and/or at a healthcare facility level, and the perception of expensive emergency care (Kobusingye *et al.*, 2005). These services cover a wide range of medical conditions including communicable and non-communicable diseases plus obstetrics and injuries and it has been very challenging to define the demand for an EMS in a given community. However, ambulance services are collectively considered as the key resource to reach victims and provide the emergency care needed. But this system has been ineffective due to poor availability of vehicles, poor infrastructure, the lack of trained prehospital personnel, and a lack of access to services (Sharma and Brandler, 2014). A major proportion of beneficiaries are either pregnant females or the victims of vehicular trauma who need immediate medical and surgical attention, and an organized EMS system can play an important role in saving lives. Many organizations provide different emergency services among which Emergency Management and Research Institute (EMRI) is a pioneer in India (*Emergency Management and Research Institute | GVK EMRI*,). It handles medical, police and fire emergencies through the “108 Emergency Service”. Rajasthan receives the benefits of such services with a fleet of 741 ambulances (Govt. of Rajasthan). However, this number is far smaller than the total required, as the suggested number of ambulances is 33 per 1 million people in urban populations and about 3 times higher in rural areas (Olive C Kobusingye *et al.*, 2006). Furthermore, this number varies with the population dynamics and geographic diversities in rural and tribal areas.

So, in this intervention, we are looking to scale up the available services in terms of improved quality and quantity of ambulances. For the same objective, we estimate the benefit-cost ratio of investment in EMS and try to focus the attention of government, policymakers, and other relevant stakeholders on this sector.

3.2 Data

For the intervention, baseline data was collected from available online resources and primary data source like the interviews with government officials. Cost data for ambulances includes the capital cost of the ambulance and annual recurrent costs including human resources (paramedical staff, driver), maintenance, fuel, salary, annual training etc. GBD 2016, cause and age-specific data on road traffic injuries and ischemic heart disease were extracted for all age groups whereas in obstructed labour only the 15-49 age range is considered.

3.3 Situation Analysis

In recent years, the demand for EMS, as well as ambulances, has increased rapidly, which requires efficient planning of such vital systems. Since utilization relates to the geographic and demographic distribution, it makes this factor important when planning and managing such services (Sariyer *et al.*, 2017).

It was evident from the NFHS-4 data that only 24% (Table 7) of pregnant females were transported during the study period by any (public/private) ambulance service in India. The situation in Rajasthan was even worse, with a coverage of only about 14.5%. However, this was due to the proportionate availability of ambulances, which calls attention to increasing the number of ambulances in line with the requirement.

Table 6: Transport used by the respondent to go to a health facility for delivery

	Rajasthan		India
	Valid Percent	Cumulative Percent	Cumulative Percent
Government Ambulance	13.6	13.6	21.9
Other Ambulance	.9	**14.5**	**24.0**
Jeep/Car	54.6	69.1	57.4
Motorcycle/Scooter	8.9	77.9	64.7
Bus/Train	1.7	79.7	68.1
Tempo/Auto/Tractor	16.2	95.9	93.6
Cart	.4	96.3	94.4
On Foot	3.3	99.6	97.8
Other	.4	100.0	100.0
Total	100.0		

Source: NFHS-4 data

Table 7: Ambulance coverage of pregnancy-related cases in Rajasthan

	Rajasthan	2014-15	2015-16
	Birth rate	25	24.8
	Population	72,245,688	73,471,198
	Total live births	1806142	1822086
Ambulance coverage	Total Emergency Cases	413365	334962
	Pregnancy Cases	201279	178955
	Coverage of pregnancy cases	11%	10%

Source: http://nrhmrajasthan.nic.in/DHANWANTRI%20AMBULANCE%20YOJNA-%91108%92.htm

The performance indicators of ambulance services in Rajasthan, are above the benchmark (Govt. of Rajasthan). But, with increasing service utilization, the EMS must improve its quality and quantity, so that the community can benefit more.

3.4 Calculation of Costs and Benefits

3.4.1 Costs

Cost of the intervention includes capital and recurrent costs. The capital cost is 20 lacs per ambulance, which is a one-time investment for the next 10 years, as per official data. Further, we calculated the total cost based on the required number of ambulances in the urban and rural areas. The optimal number of ambulances in an urban area is 33 per million population and in a rural area it is 99 per million population (Olive C. Kobusingye *et al.*, 2006). However,

the requirement in a rural area may vary based on the population living in that locality or other relevant conditions. In Rajasthan, currently 741 ambulances are providing services of which about 42% are deployed in urban areas. This provides the estimated number of ambulances for both areas. The recurrent cost includes the cost of supervision, paramedical staff and driver's salary, maintenance expenditure and cost of training. We calculated the required number of supervisors by using the estimates of one supervisor for 3 ambulances (Olive C. Kobusingye *et al.*, 2006). The contractual salary rate for them was taken from the service-providing agencies' site: about 1.8 lac per annum. To scale up the available ambulance services, we considered increasing the additional requirement of ambulances and paramedical staff. We estimate five additional paramedics per ambulance and calculated total salary for them at 1.8 lac per annum per head contractual salary. The training cost for all the available and new staff is added based on DCP3 Chapter 14 (Thind et al. 2017), which suggests that $50 per trainee is required for two years' refresher training programme. A gross amount (1.3 lac per ambulance) was suggested by officials to cover remaining expenditures like human resources (paramedical staff and driver), maintenance, fuel etc. Therefore, we estimate a total capital cost of 753,456,380 and 10,276,365,697 for urban and rural areas respectively and total recurrent costs of 1,254,849,113 and 13,627,152,149 respectively. Assuming that this recurrent cost will be same for next 9 years, we calculated the net present value at 3%, 5%, and 8% discount rate, which we use for the calculation of BCR.

3.4.2 Benefits

Calculation of overall benefits for any health intervention is relatively difficult due to multiple streams of benefits from diversified ends. However, limiting the benefits to a key focus area might result in an underestimation of benefits. To mitigate this issue, we include benefits derived from the victims of vehicular accidents, ischemic heart disease, and obstructed labour as they contribute a major proportion of the need for emergency transport services for subsequent treatment. From the GBD report, we estimate about 71,405, 16,861, and 70 deaths due to ischemic heart disease, vehicular trauma, and obstructed labour respectively during 2016. We apportion them into urban and rural populations using the population distribution. Age-specific distribution for all three causes and age-group wise value of years of life lost (YLL) from life tables are used to calculate the present value (PV) of YLL at 3%, 5%,

and 8% discount rate. We assume 0.33, 0.18, and 0.5 times reduction in deaths from vehicular trauma, ischemic heart disease, and obstructed labour respectively by providing EMS (Olive C. Kobusingye *et al.*, 2006). This is used to calculate the relative risk, which is 0.67, 0.82, and 0.5 respectively. This is used in turn to calculate the potential impact fraction for urban (0.21, 0.11, 0.35) and rural (0.31, 0.17. 0.48) areas. A total of 3,047 and 12,637 deaths in urban and rural areas are avoided due to all three causes and 46,489 and 191,318 DALYs averted at 3%, 36,967 and 152,397 at 5%, and 27,999 and 115,628 at 8% discount rate in urban and rural areas respectively. Two approaches are used to calculate the total benefits. In the first, DALYs are multiplied by 3 times GDP cost and in the second, the value of a statistical life year is multiplied by total avoided deaths to calculate the total benefits. A similar approach is used to calculate the benefits of subsequent years.

Calculation of Benefit-Cost Ratio

The results are presented in Table 12, with the assumption that the required number of ambulances will remain the same for next 10 years. For a 3% discount rate, the BCR will be 11.4 and 4.2 in urban and rural areas respectively; in other words, for every rupee spent, the present value of the net economic benefit is 11.4 in urban and 4.2 rupees in rural areas. The result differs from the discount rate of 5%. In this case, every rupee spent yields an economic benefit of 8.8 and 3.3 rupees. The lowest return is at a discount rate of 8%, with NPV returns of just 6.4 and 2.4 for every rupee spent. Clearly, these results are highly sensitive to the discount rate used, because of the long period of 10 years over which the intervention is assessed.

Table 8: BCR for Ambulance network intervention

Scenario 1: Urban Ambulance Network						
	Costs	Benefits 3 x GDP per cap	BCR	Costs	Benefits VSL	BCR VSL
3%	11,778,697,370	133,991,938,675	11.4	11,778,697,370	210,774,653,643	17.9
5%	10,927,549,221	96,452,341,375	8.8	10,927,549,221	190,804,933,387	17.5
8%	9,847,207,249	63,423,422,362	6.4	9,847,207,249	165,653,777,506	16.8

Scenario 2: Rural Ambulance Network						
	Costs	Benefits 3 x GDP per cap	BCR	Costs	Benefits VSL	BCR
3%	130,006,008,771	551,418,665,880	4.2	130,006,008,771	874,139,485,278	6.7
5%	120,762,885,266	397,623,861,259	3.3	120,762,885,266	791,319,655,265	6.6
8%	109,030,809,864	261,922,034,734	2.4	109,030,809,864	687,011,010,576	6.3

Source: Authors calculations

3.5 Assessment of Quality of Evidence and Sensitivity Analysis

The available literature and online materials were used to assess the situation. These sources are reliable, but we consider the quality of evidence as "Medium" because very few studies are available that are conducted in the context of Rajasthan. The sensitivity analysis using 3%, 5%, and 8% discount rates was performed to see the effect of changing required number of ambulances in both contexts and findings were relatively the same in both the contexts.

4. Family Planning

4.1 Description of intervention

Family planning helps women have their desired number of children and/or determines the spacing of pregnancies, in addition to improving the health of both women and children. The main strategy involves promotion and use of various contraceptives and sterilization for men and women; together with information and communication for behaviour change. Contraception prevent pregnancy-related health risks in women, reduces infant mortality, prevents the transmission of sexually transmitted diseases, empowers people and enhances education, minimizes adolescent pregnancy and reduces population growth etc. (WHO,

2018). Moreover, using family planning methods, women can make informed choices about pregnancy and subsequent spacing, which directly influence her health outcomes and overall well-being. Thus, they can prevent unintended pregnancies and limit the size of their families. Indirectly it reduces the need for unsafe abortions and the risk of neonatal/infant mortality.

In 1952, India launched the world's first National Programme for Family Planning. This initiative gradually led to the National Population Policy (NPP) in 2000 to reduce fertility rates (MoHFW, 2016). Now, this programme has expanded to include sub-centres in rural areas, with the pace of technological advances and improved quality. Results of this programme include a fall in the Crude Birth Rate (CBR), Total Fertility Rate (TFR) and growth rate (MoHA, 2011).

Globally, the prevalence of unmet need for contraception is still high. There are several reasons which prevent the target population receiving and using family planning methods, which include:

- limited choice of methods;
- limited access to contraception, particularly among young people, poorer segments of populations, or unmarried people;
- fear or experience of side-effects;
- cultural or religious opposition;
- poor quality of available services;
- users' and providers' bias
- gender-based barriers.

Considering the potential health impacts and gaps in the current scenario, efforts are being made to providing improved family planning services and interventions in the community to limit family sizes and improve the health of women and children.

4.2 Data

For the intervention, we collected baseline data from available online resources source like NFHS 4, Census 2011, GBD 2016 and Niti Aayog sites. References from relevant studies will

also be used as needed. Also, we collected the projected unit cost of family planning methods from the study of Goldie et al 2005.

4.3 Literature Review

The National Population Policy (NPP) of India was adopted in 2000 to achieve a total fertility rate (TFR) of 2.1 by 2010. However, it is still about 2.3 in 2017, although in 17 states the TFR has reached the target. In Rajasthan, the TFR is currently at a higher level (2.4), which calls for a focus on it. Along with this, the total unmet need for contraception stands at 12.3% (NFHS 4 Rajasthan, 2015).

However, the current use of family planning methods has increased by 12% since 2005-06 and interestingly it is almost the same in rural and urban areas. But the use of spacing methods is much higher in urban areas, whereas female sterilization is a more common method in the rural context (NFHS 4 Rajasthan, 2015). This shows that the family planning services in India are skewed towards sterilization, particular of women (FHI, 2010). Use of a modern method among currently married women in India is 48% and female sterilization accounts for 36% of this group (NFHS 4 India, 2015).

These indicators are well supported by the latest 3rd round report of the PMA 2020 in Rajasthan, which indicates the increasing use of modern contraceptives methods. Along with this, the key reasons of not using contraceptives were 'not married' (53.1%), 'perceived not-at-risk' (35.6%), and 'method or health-related concern' (9.8%) (PMA 2020, 2018). To achieve the replacement level of fertility rate, the unmet need for contraceptive methods should be met and the demographic dynamics of the next birth cohorts should be considered in facilitating and promoting such activities.

4.4 Calculation of Costs and Benefits

The price of contraceptive methods was USD 23.03 (Goldie *et al.*, 2010), which is converted into INR according to the 2017 exchange rate. Here, the average value of temporary (oral contraceptives, injectables, condoms, intrauterine devices) and permanent (female and male sterilization) contraceptive methods for the current year are used. The estimate of service delivery cost is referenced from K. Sarah et al. 2017 paper, which is 0.3 $ per head (19.24 INR). The total annual cost will be the sum of the cost of family planning and cost of service

delivery for the target population. To estimate the total number of the target population, we use women of the childbearing age group (15-49 years), which we calculate by using the age group proportions of the 2011 Census population, and total unmet contraception need of 12.3% (NFHS 4 Rajasthan, 2015). This helps us to identify the target population with unmet needs.

The second step is to identify the number of females planning birth spacing, which we calculate by 'total births per year' * 'unmet need for spacing'. Of these, we assume that 75% will successfully space the birth by using family planning methods. We use the percent births less than 2 years apart and 2-3 years apart, which is 29% and 34.7% respectively (Rutstein, 2011). The rest {1- (29% + 34.7%)} – 36.3% – is an estimate of the percentage of births more than 3 years apart. We estimate the under-5-mortality rate for < 2, 2, 3, and 4 years between birth respectively as 97, 54, 40, and 40 per 1000 live births (Guttmacher Institute, 2002). So, the implied under-5-mortality rate is 61, which is the sum product of annual percent births apart and the annual estimates of under-5-mortality rate. With these estimates, we adjusted the gradient of child deaths by birth spacing to reflect state-specific U5 mortality rate. For example in < 2 years calculation, 'actual under-5-mortality'* 'under-5-mortality rate for < 2 years between birth' / 'implied under-5-mortality' (51*97/61 = 81). We decided to apply a 50% discount to avoided under-5-mortality to approximately account for correlation (instead of causation) in the relationship between mortality and spacing.

The number of <2-year spaced births avoided due to family planning will be 'number of successfully spaced births' * 'percent births less than 2 years apart (29%)'/ 'percent births less than 2 years apart (29%)' + 'percent births 2-3 years apart (29 + 34.7%) = 36,475. Along with this, the child lives saved due to family planning will be 'the number of <2-year spaced births avoided due to family planning'*Discount rate (50%) * (under-5-mortality rate per < 2 years (81) – under-5-mortality rate at 2 years between birth (33))/ 1000 = 864. So, the per-user child death averted will be 0.000380 for births less than 2 years apart. Similarly, for 2-3 years apart, it will be 0.000112 per user. So, the total child deaths avoided per user is 0.000492. We assume that we will save an average of 69 DALYs per child life saved. These DALYs are discounted at 3%, 5% and 8% rates, and followed by calculation of total DALYs.

To estimate avoided maternal deaths, we use 'the MMR of Rajasthan 244 per 100,000 live' births * 'number of births avoided due to family planning intervention' = 46'. We calculate the number of avoided abortions among the avoided live births by assuming that it will be half of the avoided live births. With this, we calculate maternal deaths averted per user of family planning service among the target population (46 + 23)/ 2,273,188 = 0.00003. Now, we assume that we will save an average of 40 DALYs per life saved. These DALYs are discounted at 3%, 5% and 8% rates, and followed by calculation of total DALYs.

To estimate the effects of fertility reduction on economic growth, we follow Ashraf, Weil, and Wilde (2013). That paper identifies multiple mechanisms under which a reduction in fertility can lead to increased economic growth such as reduced dependency, capital shallowing, reduced costs of childcare and schooling and more. Through these channels, the authors develop a model which estimates that a 0.5 point reduction in total fertility rate increases GDP per capita by 5.6% over 20 years and 11.9% over 50 years. We apply this broad relationship to the estimated fertility reduction in Rajasthan, following Stenberg et al (2017).

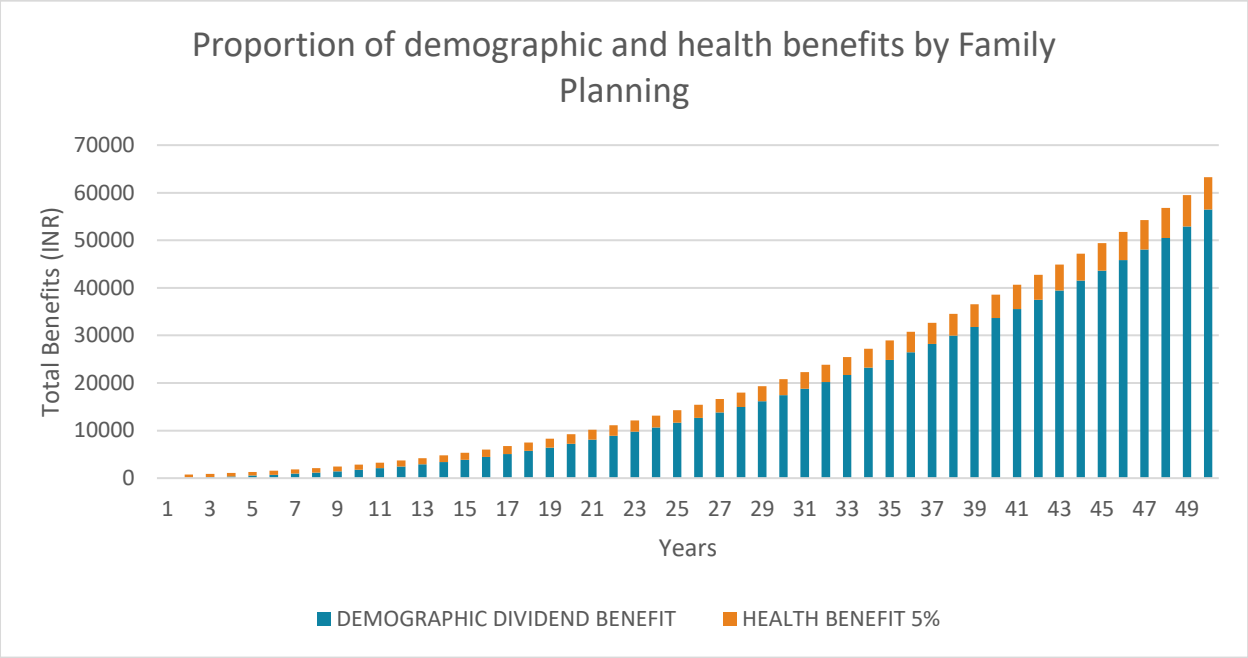
The calculation approach is approximate, and several dynamic elements of population and income growth have not been fully accounted for. However, it is likely this still provides a reasonable order of magnitude of the demographic dividend benefit.

In Rajasthan, the current TFR is 2.4. The unmet need for family planning for fertility reduction is only 6.6%. We use the unmet need for fertility reduction only, and not for spacing because avoided population growth is the primary mechanism by which economic growth benefits occur. The study by Joshi and Schultz (2007) in Bangladesh shows that provision of family planning reduces TFR by 15%. So, the estimated TFR reduction from this intervention is 2.4 * 6.6% * 15% = 0.024 or roughly a reduction of 1% of births.

Applying the Ashraf et al (2013) effect to this fertility reduction in Rajasthan, we can estimate that in 20 years' time GSDP per capita will be 0.27% higher than in the baseline scenario and in 50 years' time 0.57% higher. In between years, we have assumed a linear interpolation between these figures. These small per capita effects are large in absolute terms when expanded across the entire population. We estimate the population with the intervention by applying a constant reduction of 1% in the crude birth rate of 24.3 per 1000. This is admittedly approximate but seems to generate reasonable figures. After 50 years, the

population would have been 99m and with the intervention the population is instead 98m, or about a 1% reduction in population in the long run.

Using the new profile of the population, we multiply the GDP per capita increases above to estimate the welfare gain from family planning via a demographic dividend. The benefits are substantial and dominate the benefits from avoided deaths. In the first year, the benefit is 105 crores. By 2066 these benefits are 56,494 crores. The demographic dividend represents 85% of the undiscounted benefits from the intervention.



4.5 Calculation of Benefit-Cost Ratio

To calculate the BCR of the family planning intervention, we calculate the per capita cost and benefits at 3%, 5% and 8% discount rates. This is important because family planning is different from other welfare calculations. With fewer people, the economy actually shrinks, though everyone in the economy is better off. So here we are not doing the calculation in absolute terms.

The results are presented in Table 9, with the assumption that the growth rate will continuously increase at the same rate due to the intervention. For a 3% discount rate, the BCR is 47; in other words, for every rupee spent, the present value of the net economic benefit is 47 rupees. The result differs with a discount rate of 5%. In this case, every rupee spent yields an economic benefit of 32 rupees. The lowest return is at a discount rate of 8%,

with just 19 NPV return for every rupee spent. Clearly, these results are highly sensitive to the discount rate used, because of the over long period of 50 years.

Table 9: BCR of Family Planning Intervention

	Costs per capita*	Benefits per capita*	BCR
3%	859	40,081	47
5%	614	19,728	32
8%	416	8,007	19

Source: Authors calculations, * in INR

4.6 Assessment of Quality of Evidence

The available literature and online materials are helpful to assess the situation. Although these sources are reliable, the quality of evidence was between limited to medium because of availability of studies that consider the fertility preferences in the context of Rajasthan.

5. Conclusion

Based on the challenges and priorities in the health system assessed by the State government, evidence generated by the research team on the initiatives in the State and in similar contexts was used as a base for analyzing the return on investment in all three interventions. Our estimation showed that on providing relevant health services to the target populations, the investment would provide wide ranging coverage, directly and indirectly impacting the target population. The largest returns could be achieved with the family planning intervention, followed by the emergency ambulance service, and then surgical capacity intervention. Since the interventions target different population groups, the findings should be used more as complementary rather than competitive for priority setting.

Strengthening basic and surgical capacity was estimated to avert maternal deaths of pregnant women and neonates, by 2,827 and 6,542 cases, respectively per year. Using an expanded ambulance service, we found that 3,047 deaths in urban areas and 12,637 in the rural areas could be avoided per year among victims of Ischemic heart disease, road traffic accident, and obstructed labour. Providing family planning services could avert an estimated 1,174 and 69 deaths respectively for child and mother annually, as well as additional benefits arising from reducing population growth rate.

The basic and surgical capacity intervention includes a group of small interventions, which were not mutually exclusive. These interventions make a critical contribution at different levels and none of them alone will address the overall reduction in maternal and neonatal deaths. Hence, the returns are greater than the investments made in this sector.

Providing ambulance service in rural areas is very important; however, the BCR in an urban area is 8.8 at a 5% discount rate, which is almost three times greater than the rural area (3.3) benefits. The key possible reason behind this is the wider distribution of a rural population which causes delays in service delivery. However, there are various other reasons as well. The return on investment, in family planning service, is relatively high due to a large proportion of benefits come from the demographic dividend part and a decrease in population growth rate. It estimates that 0.5 points reduction in total fertility rate increases GDP per capita by 5.6% over 20 years and 11.9% over 50 years.

There may be several limitations of this study. The data on target population, intervention effects and interventions costs were collected from different sources, and efforts had been made to keep them comparable. Costs of interventions data were used from online data sources, personal interviews with officials, and research studies. Where recent updates were not available, we projected existing figures using the rate of inflation. In estimating the benefits, we considered the current year data from GBD 2016 and other official sites. Therefore, the projections made in our study may vary. We also could not capture the economic loss in terms of years lost due to disability (YLD) because of the lack of available relevant data. Thus, the return on investment is a conservative estimate.

Table 10: Summary of BCRs

Interventions	Discount	Benefit	Cost	BCR	Quality of Evidence
Maternal and neonatal health	3%	197,788	13,461	14.7	Medium
	5%	111,563	11,495	9.7	
	8%	56,726	9,315	6.1	
Ambulance network (Urban)	3%	13,399	1,178	11.4	Limited
	5%	9,645	1,093	8.8	
	8%	6,342	985	6.4	
Ambulance network (Rural)	3%	55,142	13,001	4.2	Limited
	5%	39,762	12,076	3.3	
	8%	26,192	10,903	2.4	
Family planning* (per capita)	3%	40,081	859	47	Limited to medium
	5%	19,728	614	32	
	8%	8,007	416	19	

Notes: * Cost and benefits are in crores INR, except family planning which is in per-capita years

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Rajasthan is the largest Indian state. It has a diversified economy, with mining, agriculture and tourism. Rajasthan has shown significant progress in improving governance and tackling corruption. However, it continues to face acute social and economic development challenges, and poverty remains widespread. What should local, state and national policymakers, donors, NGOs and businesses focus on first, to improve development and overcome the state's remaining issues? With limited resources and time, it is crucial that priorities are informed by what can be achieved by each rupee spent. To fulfil the state vision of "a healthy, educated, gender sensitive, prosperous and smiling Rajasthan with a well-developed economic infrastructure", Rajasthan needs to focus on the areas where the most can be achieved. It needs to leverage its core competencies to accelerate growth and ensure people achieve higher living standards. Rajasthan Priorities, as part of the larger India Consensus – a partnership between Tata Trusts and the Copenhagen Consensus Center, will work with stakeholders across the state to identify, analyze, and prioritize the best solutions to state challenges. It will commission some of the best economists in India, Rajasthan, and the world to calculate the social, environmental and economic costs and benefits of proposals.

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