

PRACTICUM REPORT

For the Partial Fulfillment of Course Requirements of the

Master of Public Health Program

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In Cooperation with IIHMR University

By

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**Cohort-4
2016-18**

Under the Guidance of

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Certificate by Advisor

TO WHOMSOEVER MAY CONCERN

This is to certify that ***Dr Neeraj Sharma***, a student of Master of Public Health Program offered by IIHMR University, Jaipur in cooperation with Johns Hopkins Bloomberg School of Public Health, Baltimore has undergone Practicum Training at **IIHMR University, Jaipur** from ***date*** October 16th, 2017 to March 31st, 2018.

The Candidate has successfully carried out the study designated to him during practicum training and his approach to the study has been sincere, scientific, and analytical.

The Practicum Training is in fulfilment of the course requirements.

I wish him success in all his future endeavours.

Dr Anoop Khanna

Practicum Advisor

CERTIFICATE BY SCHOLAR

This is to certify that the Practicum Project titled “Cost-benefit analysis of health system interventions for Andhra Pradesh and Rajasthan” submitted by me, *Dr Neeraj Sharma* Enrollment No. IIHMR-U/07/2016-2018/0021;JH ID:640B28 under the supervision of **Dr D K Mangal** for award of **Master of Public Health** carried out during the period October 2017 to March 2018 embodies my original work and has not formed the basis for the award of any degree, diploma associateship, fellowship, titles in this or any other Institute or other similar institution of higher learning.

Dr Neeraj Sharma
MPH Candidate 2016-18

Certificate from the organization

INSTITUTE OF HEALTH
MANAGEMENT RESEARCH

(WHO Collaborating Centre for District Health System Based on Primary Health Care)



Date: April 23, 2018

To Whom It May Concern

This is to certify that Dr Neeraj Sharma has worked on India Priorities Project at IIHMR University, Jaipur. In this project, IIHMR-U has worked in collaboration with Copenhagen Consensus and TATA Trust to study cost-effectiveness of identified health interventions in Rajasthan and Andhra Pradesh. He was formally engaged in this project from October 15, 2017, and has successfully ended his tenure as practicum trainee on March 31, 2018. His fulltime engagement in the project during the period from October 15, 2017 till March 31, 2018, is more than the practicum requirement of 160 hours.

In this health policy research project, we focused on two domains- Health Systems and Adolescent Health. As a researcher in this project, Neeraj contributed in collecting policy and economic data, performing situational analysis, developing methodologies of econometric analysis, preparing the findings and interpretation, writing the reports and coordinating the research partnership with eminent scientists and economist within IIHMR-U and collaborating research partners from India and abroad. In addition, he facilitated the academic and research activities beyond his primary assignment which informs his potentials and dedication in the field of health education and research. Lastly, through his integrity and resilience during the project, he has proven himself as a valuable researcher and public health leader. A person like Neeraj would be a great asset for any institution he will join in future.

I wish him a prosperous academic and professional journey.

A handwritten signature in blue ink, appearing to read 'D.K. Mangal', written over a horizontal line.

Prof. Dr D.K. Mangal
Dean (Research)
The IIHMR University.

About Practicum

This practicum report is one of the essential requirements to complete the course-work of Master of Public Health' (MPH) program. This program is conducted by Johns Hopkins School of Public Health (JHSPH), Baltimore, USA in collaboration with IIHMR University, Jaipur, Rajasthan. In the first year, we have completed the 76-credit coursework and this practicum work includes remaining 4 credit points. In which, we must work with an organization either on the job or as a practicum trainee to learn the real exposure of public health work as per our interest area. Here, we apply our learned skills and try to convert them into our competency in a definite path. For the same purpose, JHSPH provided us guidelines which include six key competencies out of which we are supposed to address anyone or maximum three.

As a fresh graduate I was keen to learn lots of things and for the same, my first target was to select an organization with learning internal environment. In this line, I got a chance to work with our IIHMR University itself under the guidance of few senior faculties. Here, I joined to work on a project organized by Copenhagen Consensus. In India, they are working with Tata trust in form of India consensus. I was assigned to work in two states- Andhra Pradesh and Rajasthan. Here, this consensus is working with the name of Andhra Priority and Rajasthan Priority in two sectors adolescent health and health system.

Introduction of associated organization for practicum

IIHMR University

Established in 1984 as an institute and now under the IIHMR-University Act, 2014 become a University. IIHMR University is a leading knowledge sharing university of the country engaged in teaching, research, and training in the domains of public health, health and hospital administration, pharmaceutical management, and rural development. Over the past thirty-four years, IIHMR has carved a niche for itself among management institutions, both in India and abroad. The institute was termed as an ‘Institute of Excellence’ by the Government of India’s Ministry of Health and Family Welfare for the initiative with World Health Organization’s Collaborating Center for Strengthening Health Systems based on Primary Care. IIHMR has already conducted more than 500 research projects and studies on the health, social and developmental systems, and policies in India and wider South-East Asian Region. Now in the fourth decade, we are generating knowledge to help, and develop effective health, social and public systems, and socially relevant health technologies.

India Consensus

India Consensus is a partnership between Tata Trusts and the Copenhagen Consensus Center. The aim is to identify the smartest solutions to some of India's most pressing development challenges and working in two states of India - Andhra Pradesh and Rajasthan inform of Andhra Pradesh Priorities and Rajasthan Priorities. It involves stakeholders across the state to identify, analyze, and prioritize the best solutions to state challenges. It utilizes the knowledge of some of the best economists in India, Rajasthan, Andhra Pradesh, and the world to calculate the social, environmental, and economic costs and benefits of proposals.

The Andhra Pradesh and Rajasthan Priorities engages institutions, NGOs, decision makers, sector experts and businesses from all parts of society, as well as the public through newspapers, radio, and TV. It works with all stakeholders to set their priorities for the state, sparking a conversation about the most effective and efficient solutions for both the states.

Learning Objectives of Practicum

The main objective of this practicum is to imply the knowledge of key competencies which were achieved during the course-work of MPH.

In this practicum, I have identified following areas to convert them into competencies:

- 1) Analytics/Assessment skill
- 2) Communication skill
- 3) Cultural competency

About the project work

IIHMR University assigned me a project entitled as “Benefit-cost analysis of health system interventions in Andhra Pradesh and Rajasthan”. This project was under the Andhra Pradesh and Rajasthan Priorities with IIHMR University. Here, we were looking forward to identifying the benefit-cost ratio. The strategy was to look at the benefits in monetary terms on 1 Rupee investment.

Health system background information

Health is a fundamental human right and a basic requirement by all for a better quality of life. Improving the quality of life is always at priority in developed and in many developing countries to grow at a faster rate. People are looking for better health, education, and at the availability of equal and wider job options for everyone. The multidimensional phenomenon of health is not only linked with economic development but also with the overall development of country's status and it begins with the quality of human capital who must be physically healthy to utilize the natural resources for the development of the nation.

However, Indian healthcare sector is developing both quality and quantity wise but, still, it falls well below the international benchmarks. This area is now in focus and coming up as a priority for investment in both public and private sector. Due to huge competition, the government of India have started realizing the significance of improving health system for economic growth **(1)**.

Table 1: Number of Sub-Centres, PHCs & CHCs Functioning

	2005			2016		
	Sub-centre	PHCs	CHCs	Sub-centre	PHCs	CHCs
All India	146026	23236	3346	155353	25412	5513
Andhra Pradesh	12522	1570	164	7659	1075	193
Telangana				4863	668	114
Rajasthan	10512	1713	326	14408	2080	571

Source: Rural Health Statistics in India 2014-15

Table 2: Doctors at Primary Health Centres

	2005					2016				
	R ¹	S	P	V	S	R ¹	S	P	V	S
All India ²	23236	24476	20308	4282	1004	155353	33910	26424	8803	71477
Andhra Pradesh	1570	2497	2137	360	*	7659	2270	1412	858	*
Telangana						4863	1318	1024	294	*
Rajasthan	1713	1517	1506	11	207	14408	2807	2382	425	*

Source: Rural Health Statistics in India 2015-16;

R – Required, S – Sanctioned, P – In Position, V – Vacant, S – Shortfall, * - Surplus.

¹ One per Primary Health Centre

² Total given in the Table are not strictly comparable as figures for some of the States were not available in 2005. For calculating the overall percentages of vacancy and shortfall, the States/UTs for which manpower position is not available may be excluded

This one of the largest healthcare system has better status than a decade before. As mentioned in Table 1 and 2, the infrastructure at various levels and availability of minimum one doctor per PHC was there in Andhra Pradesh and Rajasthan, but the overall status of the country was poor. The condition is worse at a higher level where we expect the availability of a sufficient number of specialists for all the expertise (Table 3), but there is a shortfall throughout the country. The ultimate result of such issues is in front of us in terms of various slowly improving but still poor indicators (Table 4).

Table 3: Total specialists at CHCs

	2005					2016				
	R¹	S	P	V	S	R¹	S	P	V	S
All India ²	13384	7582	3550	6110	6110	22052	11262	4191	7359	17867
Andhra Pradesh	656	406	224	182	432	772	384	159	225	613
Telangana						456	284	147	137	309
Rajasthan	1304	811	581	230	723	2284	1654	497	1157	1787

Source: Rural Health Statistics in India 2015-16;

R – Required, S – Sanctioned, P – In Position, V – Vacant, S – Shortfall, * - Surplus.

¹ Four Specialists per Primary Health Centre

² Total given in the Table are not strictly comparable as figures for some of the States were not available in 2005. For calculating the overall percentages of vacancy and shortfall, the States/UTs for which manpower position is not available may be excluded

Table 4: Health indicators in India

Indicator/Year	Birth rate	Death rate	Infant Mortality rate	Maternal Mortality Ratio	Total Fertility Rate
1951	40.8	25.1	148	1321	6.0
1961	38.7	20.6	129	1180	5.9
1971	36.9	14.9	120	853	5.2
1981	33.9	12.5	110	810	4.5
1991	29.5	9.8	80	424	3.6
2001	23.8	7.6	58	254	2.9
2011	21.8	7.2	44	167	2.4
2012	21.6	7.1	42		2.4
2013	21.4	7.0	40		2.3
2014	21.0	6.7	39		2.3
2015	20.8	6.5	37		2.3
2016	20.4	6.4	34		2.3

Sources: <http://niti.gov.in/state-statistics#>

<http://www.iosrjournals.org/iosr-jbm/papers/Vol9-issue2/I0927482.pdf>

To improve such basic but very important indicators, we must rethink our key strategies which directly or indirectly belongs to them. Each intervention requires attention and evaluation of current aspect and their future perspectives based on community need assessments.

Study Objective

To calculate the benefit-cost ratio of identified interventions of the health system in Andhra Pradesh and Rajasthan.

Methodology

It was a unique project with defined guidelines and timelines. Following steps were followed during the project:

1. Situation analysis of health system in both the states.
2. Identification of key problems, previously defined solutions for those problems, summarization of all the information for stakeholders.
3. Identification of key-stakeholders of the health system in both the states.
4. Stabilizing contact with all of them.
5. Organizing stakeholder consultation to identify the major problems/interventions along with their solutions, which have an impact on the community and system.
6. Submission of the consultation report to the authority.
7. In-depth review of identified interventions.
8. Identification of input costing variables at different levels and output indicators.
9. Collection of cost data from the identified stakeholders on input and output indicators (like social benefits).
10. Conversion of output data into monetary terms.
11. Calculation of DALY, YLL and YLD.
12. Calculation of total cost and benefits.
13. Calculation of BCR (Benefit-cost ratio)
14. Preparation of final reports for both the states on health system intervention.

Shortlisted Interventions

The following interventions were shortlisted for this project work:

- a) Strengthening basic and surgical capacity for maternal and neonatal health
- b) Better emergency referral management in rural and tribal areas – 108 ambulance services

Strengthening basic and surgical capacity for maternal and neonatal health

Description of intervention

Maternal death is “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). Complications during pregnancy and childbirth are a leading cause of death and disability among women of reproductive age in developing countries. These associated risks are measured with an indicator known as the maternal mortality ratio.

The majority of maternal deaths are preventable. 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). Theoretically, all the major causes of maternal death can be treated with effective and timely clinical interventions. In practice, however, even if a woman manages to access prenatal care and deliver in a health facility with a skilled birth attendant, poor quality of care can be life-threatening. Along with that, non-communicable diseases also play an important and growing role, contributing underlying causes to deaths that occur during pregnancy, delivery, or during the postpartum period.

In addition to these, the consensus about the universal access to bEmOC and cEmOC services of high-quality is facing challenges due to uncertainties about their implication in an ideal mode in specific situations. There is a necessity for an adequate number of skilled workforce, efficient emergency support system, and well-equipped facilities for EmOC to overcome a formidable barrier predominantly in rural areas (Goldie et al., 2010). In Indian states, such challenges are very much relevant to its largely rural population, and striking disparities between states. In this report, we are focusing on a couple of interventions which collectively play their role to reduce the maternal mortality rate. Here, we are scaling up the model of Goldie et al. paper (Goldie et al., 2010).

Data

Various reliable data sources were used in the intervention. Baseline data was collected from available online sources and primary data source like an interview of government officials. GBD 2016 data was used to collect the information about age-specific deaths. NITI Ayog and Census data were used for various projections.

Cost data of 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.

Situation analysis

Achieving the SDG target of a global MMR of fewer than 70 maternal deaths per 100,000 live births by 2030 will require continued investment in maternal health research, programs and policy at the global level and very focused action in countries. India's maternal mortality rate reduced from 212 deaths per 100,000 live births in 2007 to 167 deaths in 2013. Still, the condition is worse in Rajasthan than countries status of MMR, as the MMR was 244 deaths per 100,000 live births in 2011-13 (Govt. of India). Our focus is to work on key interventions to reduce this MMR.

Calculation of Costs and Benefits

Costs and Benefits

This study model is a modified version of a study Goldie et al. In this study, maternal mortality (MM) of India along with few state-specific rates was targeted. The key focus area of the study to reduce the MM by improving the service quality of few relevant interventions. In our study, 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. A number of post-intervention preventable deaths of MM were calculated and with that post-intervention, MM was identified. The outcome of these interventions will be about 66% reduction in the MM.

Costs

Census 2011 data was used to identify the number of ever-married females among the 15-49 years 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 15-49 were extracted. Among the other causes 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 revised at 3%, 5%, and 8% discount rate.

It is not possible to reduce the maternal mortality by a single intervention. So, here we used the group of interventions like family planning for unmet need for spacing, facility births, skill birth attendant, transport from home, availability of primary level health centre, bEmOC, and cEmOC services. According to Goldie et al, the collective efforts of such services shows a significant reduction in the maternal mortality rate (MMR). Various updated data sources like NFHS- 4 reports, rural statistics 2017 etc. were used to verify the updated status of all these interventions and the status represent the better situation than before but, still, 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 pregnant females of 15 – 49 years 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 and by using the adjusted inflation rate for 2007 – 2011, we calculated the present value for all of them. Cost of direct health and non-health care indicators were calculated. Direct health care cost includes the cost of induced abortion and treating abortion or pregnancy-related complication like eclampsia, haemorrhage, sepsis etc., and salaries of health care providers including counselling, skill birth attendants (SBA), clinicians time etc. Costs related to prenatal care (e.g., additional prenatal visits, nutritional supplementation, treatment of anemia or other existing disease, screening for sexually-transmitted diseases), cost on providing safe abortion (e.g., manual vacuum aspiration) 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) were also included.

Direct non-health care costs were including drugs, vaccines, salaries, infrastructure by intervention and by service location or level (e.g. hospital, health centre, health post), and facility costs. They were 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. Costs for additional maternal complications including (1) premature rupture of membranes; (2) prolonged labour; (3) trichomoniasis and (4) antepartum haemorrhage.

In family planning services, the average cost of temporary methods like oral contraceptives, condoms, injectables, and IUDs was used to satisfy the requirement of unmet need for spacing among ever-married females. To calculate the abortion-related cost, first we identified the number of abortions with abortion rate and among them, post-abortion complications were calculated with case fatality rate (Stillman Melissa, Frost Jennifer J., Singh Susheela, 2014). The total abortion-related cost was calculated by multiplying the unit cost for both. In transportation-related costing, we used the cost of upgrade 1 from Goldie et al. which covers scaling up services up to 45%. Here, our target was to facilitate transportation services to all pregnant females; among them, 95% transport facility cost was used for home to the primary facility- bEmOC and based on the required cEmOC services home to the tertiary facility- cEmOC cost was added.

Facility expenditures were calculated by multiplying the unit cost to the required services number (50% rural deliveries – which was calculated by using the same proportion of the rural population). Abortion-related calculations were performed at two levels, first elective abortions were calculated at 26 per 1000 live births (Stillman Melissa et al 2014) and among them, post-abortion complication cases were calculated at CFR 0.128 (Goldie et al). With them, total abortion cost 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 were getting the same service at the bEmOC centre. The sum of all relevant cost was the total cost for bEmOC and cEmOC service.

This total cost was including the investments on physical and human infrastructure (building, rehabilitating, 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.

Benefits

Calculation of overall benefits due to saving the life of a mother is not limited to the female only, it passes beyond that and impacts the whole society as well. But, here we included the direct benefits related to the mother and new-born baby. 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. Next step was to calculate the DALYs at 3%, 5%, and 8% discount rate with already calculated PV and total avoided deaths. Two approaches were used to calculate the total benefits. In first one, DALYs were multiplied by 3 times of GDP cost and in second value of statistical life year was multiplied by total avoided deaths to calculate the total benefits.

Benefits due to neonatal lives saved were calculated on all available causes from GBD 2016 data and Darmstadt et al 2005 paper. Our major focus was 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 was the average value of upper and lower limit of the reductions. Next step was to calculate the cause-specific total avoided deaths. Followed by the calculation of DALYs at 3%, 5%, and 8% discount rate for both the above-mentioned methods.

Assessment of Quality of Evidence

The impact of the intervention on maternal and neonatal health is from Singh K. et al 2013. The study focuses on early antenatal care attendance and skilled delivery, and the child health outcomes. The underlying data is from the reliable data sources. However, the quality of evidence is “Medium” due to the adaptation of model from the studies and there may be some variation.

Better emergency referral management in rural and tribal areas – 108 ambulance services

Overview

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" (2). The emergency medical system should be effective and efficient to provide universal emergency health care services. Which means, such services should be available for all, who need it. However, this sector is on low priority in the health sector of low-and-middle-income countries (LMICs). The identified reasons behind this are a poor focus on care during transportation and/or at the health-care facility level, and the perception of expensive emergency care (3).

Although, these services cover a wide range of medical conditions including communicable and noncommunicable diseases with obstetrics and injuries. Thus, it's always challenging to define the burden on EMS. Ambulance service is the key resource in it to reach victims site and provide the emergency care to them. But, this system has been ineffective due to poor availability of vehicles, poor infrastructure, the lack of trained prehospital personnel, and lack of access to services (4). A major proportion of beneficiaries are either the pregnant females or the victims of vehicular trauma, who need immediate attention and an organized EMS system can play an important role in saving lives when treatable conditions are involved.

Various organizations are providing such 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 is getting the benefits of such services with 741 ambulances (Govt. of Rajasthan). However, this number is far behind than the required number of ambulances, as the suggested number of ambulances is 33 per 1 million people in the urban population and about 3 times higher in rural population (7). However, this number may vary based on the various key factors for rural and tribal areas.

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

Data

For the intervention, baseline data was collected from available online resources and primary data source like an interview of government officials. Cost data of ambulance was collected in two means like the capital cost of the ambulance and annual recurrent cost including human resources (paramedical staff), 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 15-49 years data was considered.

Situation Analysis

In recent years, the demand for EMS, as well as ambulances, has amplified rapidly, which requires the vital and efficient planning of such systems. Since the utilization relates to the geographic and demographic distribution, it makes this factor more important when planning and managing such services (8).

Table 5: Transport used by the respondent to go to a health facility for delivery

		Rajasthan		India
Mode of Transportation		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 6: 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 impact was evident from the NFHS-4 data that only 24 percent (Table 5) pregnant females were transported during the study period by an ambulance service in India. The scenario becomes worse in the state (Rajasthan) specific data where the coverage was only about 15 percent. However, this was due to the proportionate availability of ambulances. Which seeks attention to increase the number of ambulances based on the requirement.

However, the performance indicators of ambulance services in Rajasthan, are above the benchmark (6). But, with the increasing service utilization, these EMS must improve its quality and quantity, so that the community can get more benefits with them.

Calculation of Costs and Benefits

Costs

The capital cost is a one-time investment for a minimum of next 10 years. Further calculations were based on the required number of ambulances in the urban and rural area. The ideal requirement of ambulances in an urban area, 33 ambulances per million population and in a rural area, 99 ambulances per million population was identified (9). However, the requirement in a rural area may vary based on the locality or conditions. To overcome this variation, we performed the sensitivity analysis for both urban and rural areas. In recurrent costing, the supervision cost was included in the required number of supervisors (one supervisor for 3 ambulances) (9). Data of contractual salary for them was used from the service providing agencies site.

To scale-up the available ambulance services, we increased the additional requirement of ambulances and paramedical staff. Training cost for all the available and new staff was added with the reference of DCP3 Chapter 14 (Thind et al. 2017) which suggests that \$50 per trainee is required for two years refresher training program. The gross amount of remaining expenditures like human resources (paramedical staff and driver), maintenance, fuel etc. was used for further calculations. Assuming that this cost will be same for next 9 years, we calculated the net present value at 3%, 5%, and 8% discount rate. It was used for the calculation of BCR.

Benefits

Calculations of overall benefits for any health intervention is relatively difficult due to multiple streams of benefits from diversified ends. In addition to this, limiting the benefits to key focus area may cause under evaluation of benefits with respect to the cost. To overcome such situation, our focus was to cover maximum benefits from a minimum number of interventions. So, we included patients transported due to vehicular accidents, ischemic heart disease, and obstructed labour as they are contributing to a major proportion of emergency transport services and/or EMS have a high impact for the survival of such cases. Based on the proportionate distribution of urban and rural population, we divided the number of deaths for all three causes. 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 revised at 3%, 5%, and 8% discount rate.

To estimate the benefits due to EMS, initial step was to identify the reduction rate by providing such services at an improved level. Based on that, we calculated post-intervention relative risk to calculate the population impact fraction for all three causes. With that, we calculated the total number of avoided deaths. Next step was to calculate the DALYs at 3%, 5%, and 8% discount rate with already calculated PV and total avoided deaths. Two approaches were used to calculate the total benefits. In first one, DALYs were multiplied by 3 times of GDP cost and in second value of statistical life year was multiplied by total avoided deaths to calculate the total benefits. A similar approach was used to calculate the benefits of subsequent years.

Assessment of Quality of Evidence and Sensitivity Analysis

The available literature and online material were helpful to assess the situation. However, these sources were reliable, but still, the quality of evidence was limited because of availability limited studies who were directly related to the study context.

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 same in both the contexts.

Key Results

Table 7: Benefit-Cost Ratio Summary

Interventions	Discount	Benefit	Cost	BCR	Quality of Evidence
Maternal and neonatal health	3%	2,019,666,728,561	179,308,561,607	11.3	Limited
	5%	1,150,883,205,671	153,115,428,181	7.5	
	8%	595,269,192,888	124,076,027,572	4.8	
Ambulance network (Urban)	3%	133,991,938,675	6,145,934,420	21.8	Medium
	5%	96,452,341,375	5,729,635,338	16.8	
	8%	63,423,422,362	5,201,236,878	12.2	
Ambulance network (Rural)	3%	551,418,665,880	83,553,618,619	6.6	Medium
	5%	397,623,861,259	77,896,617,717	5.1	
	8%	261,922,034,734	70,716,321,890	3.7	

Benefit-Cost Ratio

Maternal and Neonatal Health: The results are presented in table 7. For a 3 percent discount rate, the BCR is 11.3; in other words, for every rupee spent, the net economic benefit in its present value is 11.3 rupees. The result differs from the discount rate of 5 percent. In this case, every rupee spent yields an economic benefit of 7.5 rupees. The lowest return is at a discount

rate of 8 percent, with just 4.8 Net Present Value (NPV) return for every rupee spent. Clearly, these results are highly sensitive to the discount rate used.

Ambulance Network: The results are presented in table 7, with the assumption that the required number of ambulances will be same for next 10 years. For a 3 percent discount rate, the BCR in the urban and rural area are respectively 21.8 and 6.6; in other words, for every rupee spent, the net economic benefit in its present value is 21.8 and 6.6 rupees. The result differs from the discount rate of 5 percent. In this case, every rupee spent yields an economic benefit of 16.8 and 5.1 rupees. The lowest return is at a discount rate of 8 percent, with just 12.2 and 3.7 NPV return for every rupee spent. Clearly, these results are highly sensitive to the discount rate used, both because of the long period of 10 years.

Discussion

Based on the challenges and priorities in the health system by the state government and evidence generated by the research team on the initiatives mainly in the state and in similar contexts were used as a base for study and 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 benefits in a wide range due to size to coverage, and a direct and indirect relationship of the impact on the target population. However, the larger returns will be available in family planning intervention, followed by the ambulance service, and strengthening basic and surgical capacity intervention. Since the interventions targeted different population groups, the findings should be used more as complementary rather than competing for priority setting.

Strengthening basic and surgical capacity for a delivery estimate to reduce deaths of pregnant women and neonates by 2827 and 6542 cases, respectively. Using ambulance service, we find that 3047 and 12637 lives in the urban and rural area can be averted due to Ischemic heart disease, road traffic accident, and obstructed labour.

The basic and surgical capacity intervention includes a group of small interventions, which are not mutually exclusive. These interventions make a critical contribution at different levels and

none of them alone will address the overall issue of maternal and neonatal health. So, it influences about the more investment in this sector.

Providing ambulance service in rural areas is very important, however, the benefits in an urban area are 16.8 times in 5 percent discount rate, which is about 3 times higher than the rural area (5.1) benefits. The key possible reasons behind this are the distribution of a rural population is vary based on the geographic areas which cause a delay in service delivery and completing one round. However, there are various other reasons as well.

The estimations had several challenges. For instance, data on the target population, intervention effects and interventions costs are collected from different sources, and efforts had been made to keep them comparable. Costs of interventions data are used from online data sources, person interview of officials, and research initiatives. That cost where the recent updates are not available, we projected them by using the inflation rates. In estimating the benefits, we considered the current year data from GBD 2016 and other official sites. Based on those, we projected for further calculations. However, we could not capture the economic loss in connection with years lost due to disability (YLD) because of the lack of relevant data. Thus, the return on investment will be a conservative estimate. However, how these interventions, i.e., service deliveries should be organized for reaching the target populations is out of the scope of this report.

Key learnings from the practicum

The objective of this practicum was to apply our core competencies in the public health domain and for the same, I selected 3 out of 6 key competencies to apply in my project work. Those were:

- 1) Analytics/Assessment skill
- 2) Communication skill
- 3) Cultural competency

Analytics/Assessment skill

In the assigned work, we were looking for the Cost-Benefit Analysis, which is an economic analysis. We applied this to health system interventions. The Benefit-cost ratio was calculated by

identified total cost and benefits of the interventions. This was a huge analysis in a limited time and we did this for multiple interventions. For the purpose, we used Excel and IBM SPSS Statistics 22 software. It was an important assessment for state and national government perspective. The findings can be used for policy making and/or policy changes.

Communication skill

The initial task in the project was to communicate with the relevant stakeholders for the purpose of identification of interventions in the health system. To set the priority, we called all the stakeholders and this job was assigned to me. Along with this organizing stakeholder consultation at various places and sharing the message of the project was other tasks. Even after completing the project the task was to share the findings of the project by Power-Point presentations in front of the Government officials, NGOs, Policymakers, etc.

Cultural Competency

This is one of the very important competencies for me. As I was a part of two state project (Andhra Pradesh and Rajasthan), which are culturally very different. One is in the south-east and another one is in the north-west of India, and different tradition and language make the work more difficult. Along with this, the project participants were from multiple countries, so coordinating with them at different time zone is again challenging. But, more than these my competency helped me to overcome such hurdles.

Challenges faced during the practicum work

The following key-challenges were faced during the various steps of the work:

- This project was with strict guidelines and timelines, and we must follow them in terms of submission of final deliverables.
- Working at the new place (Andhra Pradesh) among culturally different people was a new challenge for me.
- Working with different time zone stakeholders was again a challenge, however, we had gone through such situations during our MPH coursework.

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