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INDIRECT ESTIMATION OF INFANT MORTALITY RATE IN ASSAM: A DISTRICT LEVEL ANALYSIS

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ABSTRACT. Infant mortality rate is considered as a sensitive indicator of good health and well-being of a country This recognition has made by the international organizations as well as National Governments to exaggerate their efforts to improve infant survival. In India, inequality of child health is discernible along several dimensions. Evidence of inequalities exists along with several dimensions of child health in India as summed up by different sources. Here Palloni and Heligman version of Brass method is adopted to estimate the infant mortality rate of all the districts of Assam. Children ever born and children ever surviving data were taken from census 2011 of India. QFIVE package of MORTPAK is used to compute the entire computation. The estimation is based on South Asian pattern of model life table. Significant reduction of infant mortality rate was observed in majority of the districts of Assam. Kokrajhar, Dhubri, Hailakandi and Darrang district is still very far from up to the mark. Dibrugarh and Tinsukia have showed against their previous performance. Rural area scenario is better than ten years back. More effort should be disbursed to reduce the infant mortality rate for achieving the up to the mark fix by different developmental goals.

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1. INTRODUCTION

Infant mortality rate is considered as a reliable indicator of socio-economic and quality of life conditions of a country. High infant mortality indicates the existence of adverse socio-economic and environmental condition during birth to one year of age [1]. Different reports have suggested that though India is successful to some extent in reducing the infant mortality but in comparison to many developed countries, it is still lacking behind [2]. The Infant Mortality Rate of India in the year 2000 was 68 per thousand live births and after 17 years it has declined to 33 per thousand live births [3, 4]. It can also be observed that there is a huge disparity exist in infant mortality in India spatially [5]. Sustainable Development Goals [6] in its targets aimed to reduce infant and maternal mortality rates globally by 2030. The third major indicator of Sustainable Development Goals is good health and well-being, which targets to globally reduce neo-natal death (death within first 28 days of life) at least 12 per thousand live births and under the age five mortality rates to be lowered to at least 25 per thousand live births [7]. After the Alma Ata declaration of 1978, the Government of India aims to achieve infant mortality rate to 60 per 1000 live births by the year 2000 [7]. To realize this goal the Sixth and Seven Five-year plans had taken different programmes throughout the nation. Over the years the central Government of India had put a lot of effort to implement policies and programmes regarding child survival with special emphasis on reducing infant mortality rate by 2000 which is reflected in National Health Policy, 1983. To achieve the Millen¬nium Development Goals (MDG), Ministry of Health and family Welfare, Govt of India launched a nationwide initia¬tive – National Rural Health Mission (NRHM) in 2005 and National Urban Health Mission (NUHM) in 2013 which is popularly known as National Health Mission (NHM). National Health Mission focuses on the issues of infant mortality rate, maternal mortality rate, women's health, immunization and nutrition, control of communicable and non-communicable diseases, water, sanitation and hygiene etc.

Government of Assam also has launched several health and welfare schemes to reduce infant death. Some of them are- "Janani Suraksha Yojana", "Mamoni" and "Mamata", which were launched in 2005, 2009 and 2010 respectively. These schemes can be termed partially successful because the people of Assam

from remote area avoid institutional delivery (63.8 percent women had delivery at home) and prefer local midwives (4.80 percent home delivery was assisted by skilled persons) [8]. Past researches have also showed that the awareness about the different health and welfare schemes among women related to child and mother health in the rural area of Assam is not up to the mark [9]. According to NFHS-IV [10], the infant mortality rate of Assam is 48 per 1000 live births which is much lower than national level (41 per 1000 live birth). One way to reduce the infant mortality may be to implement policies considering small administrative area like in a district so that they can be executed and organized in a better way. The first step to do this is to gather districts wise information on infant mortality. But the district level information on infant mortality rate of Assam is not available which might be very crucial information for the government for formulating district wise health and welfare policies. Variation is also noticed among the states and districts of India in terms of utilization of health facility and health outcomes [8]. Thus, this is likely that there are vast disparities in infant mortality across districts of Assam. So, there is a need to estimate infant mortality rate for district level.

In India the quality of mortality data obtained from registration system is considered very poor due to incomplete registration [11]. So, by using vital registration data it is inappropriate to estimate infant mortality for districts of Assam. Indirect estimation method can be used to estimate the mortality indicators to fulfill the gap of authentic or reliable information of vital data. Various indirect method is available to estimate infant mortality from the data on children ever born, children surviving and number of women with respect to the corresponding age groups. Brass [12] was the pioneer in the estimation of indirect method of infant and child mortality estimation method.

Thus, in this research work an attempt has been made to estimate the infant mortality rate for all the districts of Assam by using indirect method. Infant mortality rate with respect to gender and place of residence is also estimated district wise. For estimation of infant mortality, 2011 national census data is used.

2. Review of Relevant Studies

Over the past decades some of the indirect techniques of estimation of infant mortality were developed by using census and survey data [12–15]. Pathak and colleagues [16] suggested a new method to estimate infant mortality from the data on children ever born and children surviving. Saha and Roy [11] used Trussell variant of Brass method to estimate infant and child mortality from selected districts of West-Bengal using 1991 census data. They constructed Abridge Life Table using the Brass two parameter logit life table system for the selected districts by blending the child and adult survivorship probability. Sarma and Choudhury [17] had estimated the infant mortality rate for all the districts of India by using Trussel variant of Brass method where they used 1991 and 2001 census data as input. They used two parameter Weibull survival function to smooth the estimate. By using those method, they found that infant mortality rate has increased between 1991 and 2001 in many States and Union Territories [18]. Validation of the estimates has done by comparing their estimated values with the values of Office of the Registrar General of India. Barman and Talukdar [19] had studied on numerous socio-economic and demographic factors affecting infant mortality rate of Assam. They studied the infant mortality rate trends of Assam from previous studies and find out some significant factors which have immense impact on infant mortality rate.

3. Methods

W. Brass proposed a method to estimate infant and child mortality rates indirectly by using the data of child ever born and child surviving [20]. Brass had developed a method for estimating infant mortality rate in an ingeniously simplified form. Palloni-Heligman version of Brass method yields more efficient estimates compared to Trussell version of Brass method when mortality pattern of childhood is close to Chilean pattern. Considering these facts in this study we considered Palloni and Heligman version of Brass method to estimate infant mortality rate [21]. The required data was collected from the report published by Office of the Registrar General of India [22] on Estimates of fertility Indicators.

The estimation process is done with the help of MORTPAK, which gives the infant mortality rate form the data of children ever born and children surviving given birth by women in conventional age group [18]. Among the available MORTPAK packages QFIVE gives different estimates based on different model life tables. The user can choose the appropriate model life table among the four models of Princeton Regional life table [23] and the U.N. model life table of four different kinds for developing countries. For India, south Asian pattern of model life table is most commonly accepted for estimating the mortality indicators. So, here in this study the researchers have adopted South Asian pattern of model life table for estimating Infant mortality rate. The spatial distribution of infant mortality rate was shown in the map constructed by using QGIS 3.4 which was projected into Dautam WGS84 and UTM zone 46N.

4. Data Sources

Infant Mortality estimates are computed by using secondary data collected form census 2011. The fertility series tables of different area and category are available at Census Commission website. Children ever born and children surviving data were collected from F-1 and F-5 tables respectively. The mean age at childbearing information is collected from the published report of Office of the Registrar General of India [22].

5. Result and discussion

The Infant mortality rate of Assam has been improving with time but the scenario is still not in a up to the mark compared to some other parts of the country. Table 1 presents the trend of infant mortality rate of Assam from 1998 to 2014 [24, 25].

From TABLE 1, it can be observed that the infant mortality rate of Assam has been improving with a tiny pace. In Assam, during 1998, the infant mortality rate was 76 per thousand live births and in 2014 it has reduced to 49 per thousand live births. This improvement is because of the collaborative efforts of State, Central Government and other national and international agencies working in this regard. The central as well as the state government has launched different schemes to address the child health issues.

TABLE 1. Infant Mortality Rate of Assam, 1998 to 2014

Year	2014	2013	2012	2011	2010	2009	2008	2007	2006
Total	49	54	55	55	58	61	61	66	67
Rural	52	56	58	58	60	64	66	68	70
Urban	27	32	33	34	36	37	39	41	42
Year	2005	2004	2003	2002	2001	2000	1999	1998	
Total	68	66	67	68	70	73	76	76	
Rural	79	69	70	72	74	76	79	80	
Urban	38	39	35	34	33	33	36	36	

Source: Statistical Hand Book, Assam, 2013 and 2016

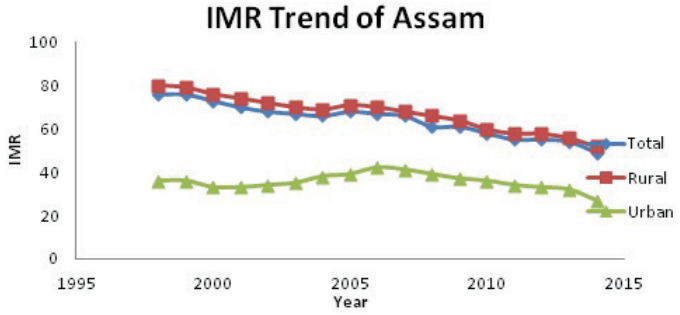

FIGURE 1. IMR Trend of Assam from 1998 to 2014

TABLE 2. Estimation of Infant Mortality Rate using Palloni and Heligman Multipliers for the category Total Persons of Assam

Age group	15-19	20-24	25-29	30-34	35-39	40-44	45-49
CEB_i	163409	1110724	2280679	2673626	3126149	2769684	2601968
Total surviving children	147124	1010577	2100401	2462118	2850758	2493698	2317270
Total women W_i	1473092	1493825	1422105	1155813	1106794	865743	749168
Mean CEB	0.110929	0.743544	1.603735	2.313199	2.824508	3.199199	3.473144
Mean CS	0.099874	0.676503	1.476966	2.130204	2.57569	2.880414	3.093125
IMR from MLT (q_x)	0.102762	0.078296	0.062697	0.059415	0.062582	0.066791	0.069437
Reference year	2010.1	2008.9	2007.3	2005.1	2002.5	1999.5	1995.7

The secondary data used for analysis were collected form census 2011 which was published by the Office of the Registrar General of India. Table 2 shows the numbers of children ever born; children survival and total women in reproductive age groups for the category total persons of Assam. The proper estimation of infant mortality rate depends on the second and third age groups, viz., 20-24 and 25-29 [26]. By using the information of mean children ever born and qx values of the second and third age group, infant mortality rate is estimated by weighted average method. Estimated infant mortality is found to be 68 per 1000 live births for the year 2007. Taking the average of the reference period, the exact reference period is December 2007. The estimated value mostly explains about the time period December 2007.

According to NFHS-IV [10], the infant mortality rates of Assam for overall persons of the areas viz., rural, urban and total are 50, 28 and 48 infant death per thousand live births respectively. The infant mortality rate for overall Assam reported by NFHS-III (2005-06) was 66 per 1000 live births. The number of decrements in ten years is 16 infant deaths per 1000 live births. This research work estimates that the infant mortality rate of Assam for the year 2011 is 68 and for the same Office of the Registrar General of India reports 72 according to 2001 census [18, 27].

Here in this present study same methodology is used as adopted by the Registrar General of India to estimate infant mortality rate. Table 3 shows the estimated infant mortality rate of 27 districts of Assam (Districts are as according to Census, 2011). The estimated infant mortality rate for Assam (68 per thousand live births) is higher than that of national level (63 per thousand live births). But, the urban area scenario of Assam in infant mortality rate is almost similar with urban areas of India. Regarding rural areas of Assam, the infant mortality rate status is abysmal in comparison with other parts of rural India. Among the districts, Kokrajhar (IMR 87 per thousand live births), Hailakandi (IMR: 81 per thousand live births) and Dhubri (IMR: 80 per thousand live births) have been experiencing a very poor infant survival. Kokrajhar and Dhubri have 24th and 27th rank among the districts of Assam according to Human Development Index [25, 26]. On comparison with these three districts Morigaon, KarbiAnglong, Darrang, Sonitpur, Karimganj, Goalpara and Barpeta have performed slightly better as they registered infant mortality rate between 70 to 80 per

TABLE 3. Estimates of Infant Mortality Rate with respect to Sex and Residence using Palloni and Heligman multipliers, 2011

	Total			Rural			Urban		
	Persons	Male	Female	Persons	Male	Female	Persons	Male	Female
Kokrajhar	87	82	92	88	83	93	59	62	55
Dhubri	80	81	78	81	82	79	64	66	63
Goalpara	71	69	73	72	69	75	61	63	60
Barpeta	70	63	76	70	63	76	69	54	82
Morigaon	76	77	75	70	78	76	65	66	58
Nagaon	69	71	66	70	72	67	60	63	57
Sonitpur	74	68	80	74	69	79	71	51	89
Lakhimpur	61	58	63	61	58	64	56	55	58
Dhemaji	61	59	62	60	59	61	72	64	80
Tinsukia	55	53	57	56	54	58	46	43	48
Dibrugarh	56	58	55	56	58	53	58	53	63
Sivasagar	62	69	55	63	70	56	53	59	47
Jorhat	54	58	50	56	60	51	46	48	45
Golaghat	62	66	58	62	66	58	62	66	56
Karbi Anglong	75	75	76	76	76	77	61	63	59
DimaHasao	60	60	60	63	61	65	49	56	41
Cachar	62	64	60	63	66	61	55	56	55
Karimganj	74	78	70	75	78	71	62	66	58
Hailakandi	81	87	74	81	87	74	72	79	65
Bongaigaon	63	68	59	65	70	59	51	48	54
Chirang	64	64	63	65	66	63	49	37	61
Kamrup	61	64	58	62	65	59	46	45	46
Kamrup Metropolitan	54	56	51	58	60	55	52	55	49
Nalbari	53	*NA	52	55	56	53	38	35	40
Baksa	62	62	62	62	62	63	49	52	45
Darrang	75	80	69	75	80	70	63	74	50
Udalguri	69	74	63	69	74	64	53	56	50

***NA: Can't be estimated due to absence of data**

thousand live births. Twelve districts, viz., Nagaon, Udalguri, Chirang, Bongaigaon, Sivasagar, Golaghat, Cachar, Baksa, Lakhimpur, Dhemaji, Kamrup and DimaHasao lie in the category 60 to 70 infant death per thousand live births. The infant mortality rate of Nalbari district is estimated as the lowest (53 per thousand live births) which is followed by Kamrup Metropolitan in which infant mortality rate is 54 per thousand live births. The three districts of Upper Assam

viz. Tinsukia, Dibrugarh and Jorhat also registered a low rate of infant death. The spatial distribution of infant mortality is shown in the Figure 2.

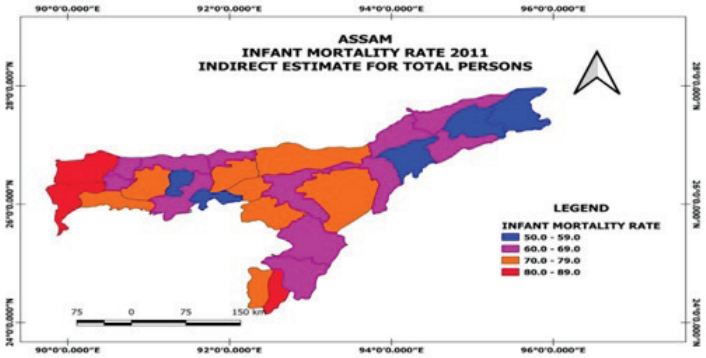

FIGURE 2. Spatial distribution of Infant Mortality Rate of all the Districts of Assam for the Category Total Persons, 2011

The decadal difference of estimated infant mortality rate using Brass method is shown in table 4. Dhubri obtained the top position among the districts of Assam regarding infant mortality rate as estimated by the Office of the Registrar General of India [18, 28]. The estimated infant mortality rate for the year 2001 was 93 per thousand live births and in this present study infant mortality rate is estimated as 80 per thousand live births. Infant mortality rate of Dhubri district is showing significant improvement for other categories also. Other sources showed that Dhubri district had obtained the last position in Human Development Index ranking (HDI=0.35) among the districts of Assam and the literacy rate is also very poor which was only 58.34 percent (Census, 2011). Among the districts of Brahmaputra valley three district, viz., Dhubri, Goalpara and Nalbari have shown improvement in the infant mortality rate with time. Cachar district is the only district in Barak Valley which shows improvement in infant mortality rate. The reason behind the improvement of infant mortality rate in Cachar district is influenced by many direct and indirect factors. In this regard some of the factors which can be mentioned are improvement in literature rate, institutional delivery and Human Development index [8, 29]. Cachar is among one of the districts in which health facility is good in rural areas. About 20% villages are getting doctors and 44.20 percent villages getting some government medical facility and 93 percent villages have Anganwadi Workers [8, 30]. Dibrugarh and Tinsukia districts performed against their traditional performance

TABLE 4. District wise decadal difference of estimated Infant Mortality Rates between 2001 and 2011

	Total			Rural			Urban		
India/Assam Districts	Persons	Male	Female	Persons	Male	Female	Persons	Male	Female
Kokrajhar	-14	-12	-15	-14	-12	-15	-10	-14	-5
Dhubri	13	12	15	14	13	15	5	0	9
Goalpara	10	12	9	10	13	8	6	7	4
Barpeta	7	12	3	8	13	4	-13	-2	-22
Morigaon	1	-1	4	8	-1	3	3	-1	11
Nagaon	6	2	12	7	4	12 -	4	-13	5
Sonitpur	-2	3	-6	0	4	-3	-19	-5	-31
Lakhimpur	4	5	5	5	6	5	-2	-5	0
Dhemaji	1	1	4	4	2	5	-22	-16	-28
Tinsukia	-3 -	5 -	2	-2	-4	0	-11	-12	-10
Dibrugarh	-11	-19	-3	-10	-17	-1	-15	-20	-10
Sivasagar	2	-7	11	1	-8	11	10	4	17
Jorhat	2	-6	10	1	-6	9	6	-3	14
Golaghat	-3 -	10	5	-2	-9	5	-17	-24	-7
Karbi Anglong	3	-1	5	5	1	7	-8	-14	-2
DimaHasao	60	60	60	63	61	65	49	56	41
Cachar	13	10	17	14	10	17	5	3	6
Karimganj	8	4	14	9	5	14	-12	-22	-3
Hailakandi	-4 -	13	5	-3	-11	7	-24	-36	-13
Bongaigaon	15	9	20	16	10	23	-6	-3	-8
Chirang	64	64	63	65	66	63	49	37	61
Kamrup	0	-6	6	5	-2	12	1	-3	4
Kamrup Metropolitan	54	56	51	58	60	55	52	55	49
Nalbari	13	NA	17	11	7	16	2	1	4
Darrang	13	7	20	14	8	20	2	-10	16

***NA: Can't be estimated due to absence of data**

regarding infant mortality rate. Though these two districts health scenario is better than many other districts but, for the year 2011 they had shown upward move in case of infant death.

From the figure estimated by the present study it is clearly seen that infant mortality rate in many districts of Assam is not sufficiently acceptable as target set by different developmental goals. Though government is giving their best

effort to reduce the infant mortality rate but it is somehow noticeably incrementing in some cases. Here negative figures show the decadal increment of infant mortality rate.

Comparing the rural and urban infant mortality rate, urban scenario is deteriorating with time. National Rural Health Mission has a tremendous role in infant mortality and child mortality control. Rural infant death is improving after the implementation of National Rural Health Mission but urban scenario is deteriorating with time. Kokrajhar district showed the maximum infant death among all the districts of Assam and rate of infant death is increasing abruptly as compared to 2001 census commission estimates. Differing from the previous record Dibrugarh and Tinsukia districts showed an increasing scenario of infant mortality rate. As the administrative boundary of the five districts viz., Dima-Hasao, Chirang, Kamrup Metropolitan, Baksa and Udalguri have changed from the previous census (Census 2001). So, the precise reflection of the estimates of these districts may vary from the intended one. Therefore, theoretically it is invalid to make comparison of these five districts.

TABLE 5. Number and Percentage distribution of Infant Mortality Rate of the Districts of Assam with respect to Sex and Residence

IMR	<40	40-49	50-59	60-69	70-79	80-89	>=90
				Total			
Persons			5(18.52%)	12(44.44%)	7(25.93%)	3(11.11%)	
Male			6(23.08%)	11(42.31%)	5(19.23%)	4(15.38%)	
Female			9(33.33%)	9 (33.33%)	7 (25.9%)	1(3.7%)	1(3.7%)
				Rural			
Persons			5(18.52%)	11(40.74%)	8(29.63%)	3(11.11%)	
Male			5(18.52%)	11(40.74%)	7(25.93%)	4(14.82%)	
Female			9(33.33%)	8(29.63%)	9(33.33%)		1(3.7%)
				Urban			
Persons	1(3.7%)	6(22.22%)	8 (29.63%)	9(33.33%)	3(11.11%)		
Male	2(7.4%)	4(14.81%)	10(37.03%)	9(33.33%)	2(7.4%)		
Female		8(29.63%)	11(40.74%)	5(18.52%)		3(11.11%)	

Regarding urban area, the scenario of Infant mortality rate of Nalbari district is better as compared to other districts of Assam for the categories of 'persons' and 'male'. Table 5 shows that for the category of urban male, the infant mortality rate for Nalbari (35 per thousand live births) and Chirang (37 per thousand

live births) districts lie in the first category (<40) i.e., Infant mortality rate having less than forty. The percentage distribution of Urban populations for the categories of persons, male and female are six districts (22.22%) four districts (14.81%) and eight districts (29.63%) respectively which lie in the range "40 – 50" of the mortality indicator. The maximum number of districts lie in between the range "50-80" for all the categories. Highest infant mortality rate was recorded (90+) in Kokrajhar district for the categories of Total female and Rural female. These values lie in the last categories i.e., more than 90 and this estimate is shown in figure 1 in red marks.

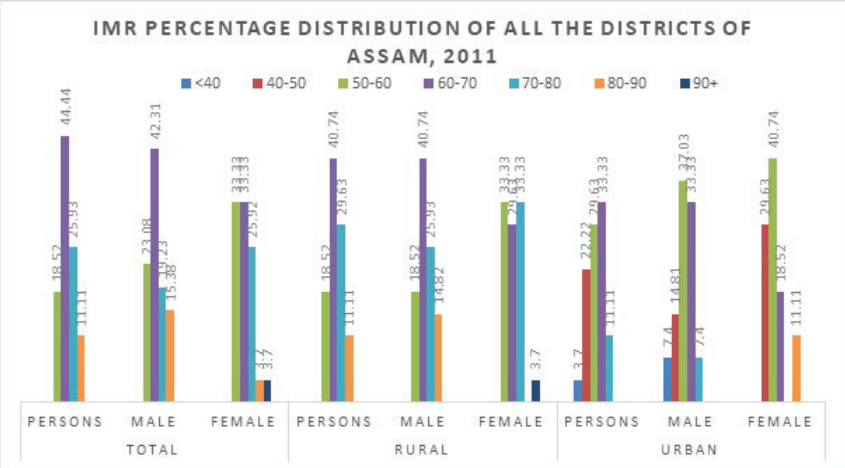

FIGURE 3. Infant Mortality Rate Percentage distribution of All the Districts of Assam, 2011

Figure 3 shows the percentage distribution of infant mortality rate with respect to different categories for all the districts of Assam. Here, the overall scenario of infant mortality rate is not satisfactory compared to national and global status. Both central and state Government should give more efforts jointly for the upliftment of those conditions in heath areas which are lagging behind in order to reduce infant mortality rate.

6. CONCLUSION

For the upliftment of a healthy and prosperous society, it is utmost important to ensure the good health and well-being of children and mothers. Though the State and the Central Government of India has been putting a lot of efforts to

reduce infant mortality rate, but we have found in this research study that a number of districts are still lacking far behind to achieve the predetermined satisfactory goal. In the last few decades Assam had continuously remained among the top states of India regarding high rates of infant death. The status of infant mortality rate of Assam in the year 2011 is slightly improved as compared to census commission's published report of 2001, but this slight improvement can't be considered as satisfactory. Government is paying more attention and effort to lower infant mortality rate compared to the previous Five-Year plans. National Health Mission has tremendous role in the improvement of the health scenario of rural areas but, for the same the urban areas scenario is remaining stagnant regarding infant death throughout the last few years. Different sources viz. Sample Registration System, National Family and Health Survey, District Level Health Survey, Annual Health Survey, Census reports etc. signifies that still Assam is lacking behind from the satisfactory level regarding infant mortality rate. This research work shows that, maximum number of people in rural areas are not aware about the health facilities provided by Government. Communication gap, lack of awareness and proper education are some of the significant obstacle in receiving the health facilities. NFHS-IV shows that the rural women are still preferring delivery at home and depends on untrained midwives who deals with all delivery related cases (International Institute for Population Sciences, 2017) [21]. Right now, Government has been taking initiatives on serious note for breaking the barriers in health facilities by appointing Anganwdi Workers (AWWs), Accredited Social Health Activist (ASHA) and Auxiliary Nurse Midwife (ANM) and different health workers to assist the people. The primary duty of these health workers is to aware the people and help them in attaining the care and medical treatments provided by Government and various agencies, so that the quality of health facilities will increase and ultimately leading to a satisfactory level of infant mortality rate.

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