## Use of Mobile Communication for Enhancing HealthCare Services in Rural India

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#### Abstract

Mobile communication services have expanded beyond simple voice communication in the past couple of decades into other areas such as commerce, banking, education, and healthcare just to name a few. Due to adoption of wireless communication in these services, people are connected anytime, anyplace, any device, and anywhere. It is also observed that an Average Revenue per User (ARPU) has been dropping for the past few years as voice communication has been commoditized. Telecom operators are providing number of value added services (VAS) to users in the urban and rural sector of India to enhance revenue. Healthcare service is one such area which provides maximum revenue enhancement potential for the operators. Penetration of smartphones, availability of connectivity, and availability of relevant apps are some of the key drivers and enablers for services. The teledensity in the urban sector is over 154% while it is about 51% in the rural sector(TRAI, 2016).

This study was undertaken for understanding the present status of the healthcare services in the rural areas and how mobile communication could be used to improve or provide additional services to enhance health in rural population. The healthcare services sector was chosen for the study as 70% of the population of the country is in the rural areas where quality of healthcare services is poor. Improved healthcare services in these areas will have direct impact on productivity and efficiency of people working in farms hence the contribution to the Gross National Product (GDP) of the country.

The survey was conducted in three villages surrounding the urban city of Pune. The data is analyzed to study the interdependence of various factors related to present healthcare service system. Recommendations are provided to telecom operators based on the outcome of data analysis.

**Keywords**: mobile communication, healthcare, rural, value added services, digital penetration

## **1. Introduction**

India has almost 68% of the population that lives in rural part of the country. There are 6,450,867 (Census, 2011)villages in the country and farming continue to be the primary mode of earning for the population in rural India. Since land size per farmer is very small compared to their counterparts in the western world and farming depends mostly on monsoons, the returns from farming in most of the country are not adequate. Hence

farmers have limited disposable income to be spent on education and healthcare. Due to lack of education the literacy level is very low compared to the urban sector. According to the  $15^{\text{th}}$  official population census conducted in 2011, the literacy rate in India is 74.04% (census 2011). Education is an integral part of increased awareness about health and hygiene. Service providers need to take this into account while planning to offer health related services.

Service providers stayed away or had a limited focus on the rural sector due to low affordability of farmer hence a weak business case. This has deprived farmers an access to information, education, healthcare *etc.* in India for years. It is only recently the management guru like Late. C. K. Prahlad has brought rural sector, the bottom of the pyramid, in India in the focus of businesses (Prahlad, 2004).

Mobile communication can play a key role in providing number of value added services including healthcare in the rural areas. According to the Telecom Regulatory Authority of India (TRAI) penetration of mobile phones will continue to increase in the rural parts of India as the teledensity increases. Telecom operators and Over the Top (OTT) companies need to develop applications for providing healthcare services targeted towards the rural sector and make them available at affordable price. Since the rural sector in the country is large, operators have an excellent opportunity to enhance revenue. India is the country with diversity in culture, customs, languages, and values hence localization of the content will be an important factor.

Traditionally, healthcare systems are viewed as the "iron triangle" of access, quality and cost. No one factor can change without affecting another. Improving access or quality requires increased investment, and lowering costs will either affect quality or access. In India, providing healthcare services using mobile communication is one of the disruptive technologies that can sever the iron triangle by increasing access, improving quality and lowering costs for all of its market segments (S. Lunde, 2012).

An extensive literature survey was conducted to understand application of mobile communication in healthcare services sector and the current status of healthcare in the rural areas. The research methodology that is adopted in this study includes designing the questionnaire for conducting a survey. Since the literacy level is low, questions had to be framed so that villagers could understand them. The data that was collected was analyzed using SPSS to draw conclusions. Based on the findings in the analysis, set of recommendations are made to various stakeholders for implementation.

## 2. Literature Review

Healthy individuals are an integral part of any successful society, which in turn reflects in a country's growth. It is noted that healthcare services in rural areas of the country continues to be one of neglected sectors while there is substantial progress in other areas. This can be improved by integration of healthcare services and ICT industry.

Doug Rosendale (2013) has discussed about mobile devices being incorporated in every aspect of life, thus deploying mobile technology in health sector is the next logical step, which would empower the health service provider to provide efficient, low cost health services to patients in real time with help of intelligent system. The focus would shift from disease management to wellness. The device would also help patients being a helping hand for reminding patients to take their medicine, vaccination for babies or regular health checkup. The intelligent systems would algorithmically identify abnormality in health status of individuals and intervene by alerting predefined locations.

Andre Guillemi and Kevin Benedict (2013) have presented their findings about digital transformation and its impact in various sectors. Technological innovation and culture shift are creating this transformation. Primary developments are noticed due to the emergence of social media and use of mobile communication, analytics, and cloud computing (SMAC). These researchers have identified use of new technology, population

age, faster technology adoption, and personalized health care as key factors for this change.

Harry Greenspunand Sheryl Coughlin (2012) have proposed that "mHealth" has been defined as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices."

C.J. Fitch and C. Adams (2006) have discussed issues and challenges for managing mobile provision for community healthcare (CHC) support. Some of these relate to organizational issues, focus on job function, availability and appropriateness of equipment, availability and integration of notes and records, to name a few. The fact is many CHC professionals cannot perform community activities without using mobile communication. New value added services could offer much improved patient/client care in the community and result in efficiency benefits.

Jeni Williams (2011) stresses on the value of mobile apps in health care. The researcher has proposed three broad guidelines for hospitals while developing a mobile app and they are 1) help patients determine whether a physician visit is required, 2) have financial professionals play a supporting role in development of in-house mobile health apps, and 3) keep it simple for end users.

Kevin Doughty (2011) discusses how smartphone applications can play a critical role in supporting healthcare. Smartphones will be very useful to vulnerable groups like people with sensory disabilities, diabetics, and people suffering from mental health problems or communication issues. Applications will be offered in tandem with home telecare services to give more independence to the service user extending from home to outside environment.

Kituya G. Mayoka, Agnes S. Rwashana, Victor W. Mbarika and Stephen Isabalija (2012), have proposed a framework for designing sustainable telemedicine information systems in developing countries. The key requirements identified were need for speed, ease of use and affordability. It also identified lack of skilled staff, training and policies as major problems faced by telemedicine users.

O' Connor *et al.* (2012) proposed that successful infusion is determined by three characteristics namely, technology, user and task characteristics. However, as per Fadal (2007), at an individual level infusion is not likely to occur unless the user of the technology engages with the technology. Yvonne O' Connor, John O' Donoghue and Phillip O' Reilly (2009) proposed thattechnology characteristic has the following dimensions such as availability, maturity and portability. Authors have presented a checklist of critical success factors which healthcare organizations should consider in order to successfully infuse mobile health services.

Morphew, Tricia, Scott, Lyne, Li, Marilyn, Galant, Stanley P, Wong, Webster, Lloret, Maria I. Garcia Jones, Felita Bollinger, Mary Elizabethand Jones, Craig (2011) noticed that underserved populations have limited access to care. Improved access to effective asthma care potentially improves quality of life and reduces costs associated with emergency department (ED) visits. The total annual morbidity costs avoided per patient were \$1395. Hence, mobile health care is a cost-effective strategy to deliver medical care to underserved populations.

## 3. Research Methodology

The research methodology adopted in this study involves conducting a survey by formulating questions. This survey is conducted in surrounding villages of Pune city in India. Though the questions were formulated in English due to low literacy level each question was explained to respondent and then only respondents provided their answers. The data analysis is conducted using SPSS software tools.

## **3.1. Research Objectives**

To investigate use of technology for providing healthcare services, especially to the rural population involves multiple issues. Hence following are the key objectives of this research:

- Study the present condition of medical facilities in rural areas/villages around Pune, India.
- Identify major diseases, health issues, connectivity, and accessibility to nearest medical Centre.
- Ascertain availability of doctors and medical help.
- Understand grievances and issues faced by the rural population regarding healthcare services.
- Identify key factors affecting the health conditions.

## 4. Data Collection

The target population for conducting survey included residents from all walks of life in the surrounding villages of Pune. Due to low literacy level, questions had to be explained to the respondents before they could answer them. The languages spoken in the area is either Marathi or Hindi hence the explanation had to be provided in the local languages.

## 4.1. Constructs

Based on the literature survey and understanding the rural environment three key constructs were used such as Healthcare awareness, Use of mobile communication, and Government support for providing healthcare services. Under each construct, questions were formulated addressing issues related technology and services.

#### 4.2. Questionnaire

Questions had to be designed such that villagers could understand them easily with little explanation. Questions were framed to extract information regarding current status of healthcare services, expected services, and level of affordability. A pilot was conducted with 15 respondents for refining or reformulating questions. The final questionnaire was prepared post pilot.

The survey also collected respondent's details such as name, age, sex, village, occupation, education, number of family members, and income.

#### 4.3. Sample Size

Total number of 156 samples was collected from three villages. It is recommended that at least 1:10 ratio of between variable and number of samples per variable responses is acceptable (Heir *et al.*, 2006). This study had total 8 variables under three factors hence the sample size was acceptable. The survey was conducted in villages namely, Lavale, Sus, and Ghotawad in the outskirts of the city of Pune, India.

#### 4.4. Sampling Method

There are various sampling methods recommended but selection of a certain method depends on the topic under investigation and targeted population. This study is targeted towards people in general population in the villages hence random sampling method was used for collecting data. The respondents represent different age groups, variations on the basis of family size, and gender.

28 .000

## 5. Data Analysis

Kaiser-Meyer-Olkin (KMO) and Bartlett's test of spherecity is conducted on the data to ensure sample adequacy for further analysis. The KMO value ranges between 0to 1, calculated KMO measure should be greater than 0.6 or more (Kaiser, 1974). Table 1 shows the KMO measurefor the data is 0.616 which shows that the samples are adequate for further analysis.Bartlett's Test of Spherecity should be significant (p<0.5). Probability associated with Bartlett .000 which satisfies the requirement.

Kaiser-Meyer-Olk Sampling Adequad	.616	
Bartlett's Test of	Approx. Chi- Square	211.005

df

Sig.

Sphericity

Table1. KMO and Bartlett's Test

Table 2 shows Communalities providing explanation about the level of the variance in each of the original variables explained by extracted factors. Higher communalities are desirable. The factor solution should explain at least 50% of variance, so the communalities value for each variable should be above 0.5 or higher.

Factors	Initial	Extraction
SMS	1.000	.457
IVRS	1.000	.847
Conference	1.000	.723
Voice SMS	1.000	.443
Medical		
services in	1.000	.610
area.		
Government	1 000	735
support	1.000	.735
Use of	1 000	578
Technology	1.000	.378
Health	1 000	570
awareness	1.000	.579

**Table 2.Communalities** 

Table 3 shows that there are three factors for which the Eigen values are greater than 1. The latent root criterion for number of factors to derive would indicate that there are three components to be extracted from these variables.

Factors	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Fotal	6 of Variance	Cumulative %	Fotal	6 of Variance	Cumulative %
1	2.418	30.225	30.225	2.418	30.225	30.225	1.911	23.885	23.885
2	1.373	17.161	47.386	1.373	17.161	47.386	1.565	19.556	43.442
3	1.181	14.762	62.148	1.181	14.762	62.148	1.497	18.706	62.148
4	.841	10.507	72.655						
5	.761	9.509	82.164						
6	.607	7.585	89.748						
7	.480	5.997	95.745						
8	.340	4.255	100.000						

# Table 3. Total Variance Explained (Extraction Method: Principal ComponentAnalysis)

Table 4 shows rotated component matrix three components:

**Factor 1** (**Awareness**) includes- SMS, technology help improving health services, and holding frequent health camps to improve health awareness.

Factor 2 (Mobile Communication) includes- IVRs and Conference

Factor 3 (Government Support)includes- Quality of medical facilities and

Government support for health care services in the area.

Factor loadings represent how much a factor explains a variable in factor analysis. Loadings can range from -1 to 1. Loadings close to -1 or 1 indicate that the factor strongly affects the variable. Loadings close to zero indicate that the factor has a weak effect on the variable.Loadings for each variable is shown in Table 4 that there are few variables whose loading is less than 0.6 which is a minimum observable loading for the variable to be considered in further analysis.

	Factor		
	1	2	3
SMS	.608		
IVRS		.918	
Conference		.736	
Medical services in area.			.724
Government support			.710
Use of Technology	720		
Health awareness	683		

**Table 4. Rotated Component Matrix** 

Table 5 shows grouping of variables under each factor. Variable having loading less than 0.6 will be excluded in the further analysis.

Variables	Items	Factor loadings
Awareness	SMS	0.608
	Technology help improving health	-0.720
	services	
	Frequent health camps helpful for health	-0.683
	awareness	
Mobile	IVRS	.918
Communication	Conference	.736
Government support	Quality of available services	.724
	Government has adequate healthcare services support	.710

## Table 5. Factors Grouping

Regression analysis was conducted treating availability and quality of medical facilities in the area while Government support, Use of Technology, and Health awareness were considered as independent variables. Variables Entered/Removed are a list of predictors that are entered into the equation.

The model summary is shown in the Table 6. In this case the value of R is 0.399 which means almost 40% variation is explained by the model while remaining is the measurement error. Although it is less than desirable, it is primarily due to the level of illiteracy among respondents. Adequate explanation was provided to the respondents while filling out the survey but the lack of education and awareness was obvious.

Table 6. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.399 <sup>a</sup>	.159	.143	.73511

a. Predictors: (Constant), Government, Health\_Camp, Technology

## Table 7. ANOVA

	Model	Sum of Squares	df	Mean Square	F	Sig.
	Regression	15.554	3	5.185	9.594	.000 <sup>b</sup>
1	Residual	82.138	152	.540		
	Total	97.692	155			

a. Dependent Variable: Medical\_facilities\_in\_the\_area

b. Predictors: (Constant), Government, Health\_Camp, Technology

The unstandardized coefficient (B) is the regression coefficient. The standard errors of regression coefficient can be used for hypothesis testing and constructing confidence intervals.

The multiple regressions was performed on the data yielding the regression coefficients as shown in the Table 8. The dependent variable for the regression was chosen as

'Medical facilities in the area' while 'Health Camp', 'Technology', and 'Government support' was used as independent variables.

	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		В	Std. Error	Beta		
	(Constant)	1.340	.279		4.797	.000
	Health_Camp	.125	.074	.140	1.698	.092
1	Technology	.236	.080	.245	2.963	.004
	Government support	.180	.057	.234	3.147	.002

**Table 8. Regression Coefficients** 

a. Dependent Variable: Medical\_facilities\_in\_the\_area

It is noted from the regression that Technology and Government support play critical role in enhancing medical facilities in the rural area. Holding health camps in the area is also recommended to enhance health related awareness among the rural population.

## 6. Recommendations

Based on the data analysis and interactions with the villagers, following recommendations are made so that mobile communication could be used to enhance the health care services in the area.

It was observed that, the population age, technology adoption of the age group and availability of the technologyhas to be taken into consideration while proposing the recommendations. The data analysis demonstrated that the government and telecom operators will have to work closely to improve the health care services in Rural India.

## 6.1. Recommendations for Telecom Operators

Telecom service provider (TSPs) have a unique role to play in delivery of healthcare services in India. Providing healthcare related services will not only benefit the population living in rural parts of India but will also provide an additional revenue stream to the telecom service providers over a period of time given large size of the target market. Information about health camps, regular check-ups, polio drives *etc*. could be sent to the villagers in the form of SMS alerts and IVRS.Telecom operators could charge the users for SMS or IVRS alerts on monthly basis. Telecom operators may bundle these services with other value added services offered in the package such as talk time and data.Telecom operators will have to ensure that the SMS and IVRS are made available in the regional languages so that they are easy to understand for the common masses who can interpret only in their regional languages.

It was observed from thedata that the population in rural India is willing to pay approximately Rs.100 (\$1.5) per month for mobile applications related to healthcare. According to the customer's disposition to pay, telecom operators could provide various plans to suit their requirements.

## 6.2. Recommendations for the Government

Government has the most important role to play in improving the health care services in the rural parts of India. It was observed during the survey through personal interactions that there is very little awareness among the rural masses about health care services that are being provided by the government. The vital information about medical camps and polio dose *etc*. does not reach the villagers. This could be one of the reasons why the infant mortality rate in rural areas is higher than that in the urban areas. In order to create such awareness, Government should organize health camps where the rural population could be educated about simple technologies such as IVRS and SMS so that important information about heath drives could be made available via SMS or IVRS. Government could also work with the education system in the rural India for including use of such services and for enhancing health related awareness among masses in the rural part of the country.

Population living in rural India hasfinancial limitations for paying more than Rs. 100 (\$1.5) per month for such services. Government should tie-up with telecom operators to provide such services at affordable rates. Government could also provide subsidy to encourage the people and also the telecom operators.

#### 7. Conclusions

This study had certain limitations such as extremely low level of illiteracy in the target area. Another limitation was lack of awareness among population about basic health care services and health related issues. Localization of the content is the key so that users could relate to the information that is pushed down on their phones. Although the teledensity is improving, it is at much slower pace compared to the urban areas. Hence the penetration of smart phones and improvement in teledensity will be key imperatives for using mobile communication to enhance health care services in this part of the country.

The entire ecosystem of rural population are working for gaining basic need where their income depends on multiple environmental factors such as healthy monsoon, availability of seeds at affordableprices, availability of farming and basic infrastructure. Measures to improve infrastructure, education and basic services, would increase the potential and leads to higher growth and productivity. Presently due to excessive dependency on external and environmental factors for the rural population they are suffering financially hence health care is neglected.

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