Adoption of Telemedicine in India – An Exploratory Study

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Abstract- The Information and Communication Technology (ICT) based Telemedicine has proved itself as the greatest blessing of the scientific era that has redeemed the humanity by penetrating into the Healthcare delivery system to provide ‘Healing by Wire’. The presence of diverse geographical features, exponentially rising population, urban-rural bias, regional dialects, underserved people, are some of the reasons that have endorsed the adoption and implementation of Telemedicine in India. The present study, supported by the empirical evidence collected through a survey method (Questionnaire) from all over India, evaluated through statistical analysis, is a scrutiny of many socio-political variables that influence the diffusion of Telemedicine. The research vividly certifies that a collective, comprehensive, positive, sincere and dedicated approach, on the part of multidisciplinary Healthcare role players, is the prime most essentiality for enhancing Telemedicine capabilities.

Keywords- Telemedicine, ICT, Healthcare role players, Socio-Political Variables, Diffusion of Telemedicine, Telemedicine capabilities.

I. INTRODUCTION

Department of Economics and Social Affairs (World Population Prospects: UN; 2013) of United Nations have projected the rise of population in the developing nations from 5.9 billion in 2013 to 8.2 billion in 2050. During the last five years (2010-2015), the population growth pace is estimated to have increased by an additional 2.9% per annum, due to the reduced mortality and increased life expectancy. Further as reported by WHO (WHO, 2013), by the year 2035, the world will be short of 12.9 million healthcare workers, the current status being 7.2 million across the globe. Thus, various healthcare delivery systems across the globe are in Doldrums. The exponential rise in population and drastic shortage of healthcare workers have resulted in the tragic deficiency in providing even the basic health services to the citizens, especially in the developing nations.

World Health Organization (WHO), however defined Telemedicine as “The delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment of diseases and injuries, research and evaluation and for continuing education of healthcare providers, all in the interest of advancing the health of individuals and their communities.” (WHO, 1998.)

On the Global waters, India is sailing on the same ship as that of many developing countries, as far as the present Healthcare scenario is concerned. India being the second largest populous country i.e. 17.5% of world’s population living densely on 2.4% of the world’s land surface area depicts only the tip of the iceberg in the realm of inappropriate geographical distribution of Healthcare systems. The economic divide existing in India between the ‘haves’ & ‘have not’s has restricted the adoption and implementation of Telemedicine on many fronts, like 75% of total qualified medical workforce cater to only 30% of the urbanites (Wright D, 1998) whereas almost 70% of Indian population is deprived of any healthcare facility, rather 25% poverty stricken Indian population even lack the ability to afford even rising costly Healthcare services.

Defined by the American Telemedicine Association, “Telemedicine is the use of medical information exchanged from one site to another via electronic communications to improve patients’ health status. Thus, ICT based healthcare applications like Telemedicine Technology has played the role of a hovering rescuer, to fill the gap of this inequality, between haves or have-nots, or between accessibility or non-accessibility of adequate healthcare resources irrespective of any inhibitions in all the developing and under developed countries. The applications of Telemedicine technology when applied and implemented professionally cost far less than the traditional medical practices (Kifle et al., 2006; McIntosh and Cairns, 1997). This is considered as one of the two reasons for the implementation of the Telemedicine in developing countries by Craig (Craig et al., 2005). The other reason notified by them is that no other alternative will prove to be as beneficial as the applications of Telemedicine, considering the deterrents already existing in these nations. Thus, the ICT based Telemedicine technological applications construct a smooth bridge to bring the healthcare service providers and the recipients on one platform, that too at an affordable cost. (Bashshur et al., 2002; Kifle et al., 2006).
Accepting the challenge to build this ‘bridge’ of equitable, safer, accessible and affordable Healthcare delivery system catering to all ‘divides’ of India, on the ICT based Telemedicine applications, the Indian Government confronts many other stumbling blocks like lack of proper medium of communication, dependable software solutions for transmission of data, images and video equivalent to international state-of-art, non-availability of skilled hands and above all, lack of required awareness at both the ends (the provider as well as the receiver).

The Indian Scenario

Thus, telemedicine technology includes both store-and-forward – asynchronous as well as live videoconferences – synchronous transmissions via satellite networks (Wootton et al., 2000). The Union Government of the largest democracy of the world, in its endeavour to provide Healthcare (through Telemedicine technology applications) to all Indians, has been working in collaboration with the States’ governments, for the last fifteen years. Acknowledging the need for providing a substantial ICT Infrastructure, updating the state-of-art Healthcare Infrastructure, allocating investment funds to protract the existing projects and for enhancing the Telemedicine capabilities, the government has launched many ‘Mission Mode Projects’ in the Healthcare sector. Adopting a holistic approach, to encourage the private sector as well, the Indian government has not only constructed the supportive environment, framed many liberalized, developmental healthcare policies but also has allocated adequate funds to Health and Family Welfare sector in order to bridge the existing economic and infrastructural divide. During the last decade, increase in total expenditure to the tune of 20% approx. in the Health and Family welfare sector, has facilitated various Government agencies and healthcare providers in the private sector as well, to adopt and implement Telemedicine using various communication modes and to actively participate in the successful initiation of these pilot projects.

The Indian Government’s Department of Electronics and Information Technology (Deity) under Ministry of Communications and Information Technology (MCIT), was among the first few to develop and implement Telemedicine technology in support of Healthcare department. Deity has implemented the pilot projects using either VPN or ISDN technology, in the state of Himachal Pradesh, Punjab, North Eastern States and West Bengal. Under their National flagship project, NoFN initiatives are taken to bring every Panchayat (the smallest division of state administration), in the Broadband Connectivity (2mbps-100mbps) network i.e. connecting Panchayats with fibre optics.

Indian Space Research Organization (ISRO), through its indigenously developed space technology and a network of Indian Satellite system, having advantages of communicating at remote places where no other communication medium is available, has successfully connected more than 51 Super Speciality Hospitals to provide Telemedicine services to rural and remotely located people of India. Mobile healthcare units are also experimented by ISRO in collaboration with 16 other agencies using VSAT mode of communications. ISRO network is the largest in the country using GRAMSAT programme. Ministry of Health and Family Welfare, (sMoH & FW), has initiated many projects on Healthcare including Telemedicine. A project on Tele-Ophthalmology was launched at the National level, utilizing all types of communication modes. Similarly, in order to provide remedial, preventive and research opportunities in the field of Cancer, a project ‘OncoNET India’ is being implemented (Ganapathy et al., 2009) under which 27 Regional Cancer Centres(RCC) and 108 Peripheral Cancer Centres (PCC) are connected to a Single network which will be accessible by all the major hospitals. Likewise, many State Governments have also initiated the Telemedicine Projects, especially those States which have hardly any healthcare facilities in remote areas. Like ISRO has established State wide Telemedicine Healthcare network (with VSAT Technology) in the state of Chhatisgarh, enabling the State to provide healthcare to people in remote areas. At the private sector front, many hospital groups like Apollo, Fortis, Narayana Hrudalaya Bangalore, Dr. Balabhai Nanavati Hospital Mumbai, Escorts Heart Institute and other such institutes have established their own Telemedicine networks. For communication these institutes are using different types of communication mode including ISRO’s VSAT facility.

II. THEORETICAL BACKGROUND

Though the success achieved through the launch of these pilot projects has opened various frontiers in the realisation of Telemedicine capabilities yet the momentum of the execution and extension of the Telemedicine technology has not gained the expected acceleration [Sood & Bhatia, 2006]. A lot of research has been undertaken to ascertain the reasons (factors) behind such a retarded adoption. Lack of availability of and accessibility to ICT Infrastructure is blamed for this slow adoption. (Adam, L. 2001; Bashshur et al., 2005). Obstacle of not having proper regulation policies is cited as another reason by some (Anderson, J.G., 2000; Scott et al., 2004), where as human resource and cultural barriers are seen as a problem by others. (Hu, et al., 2000; Terry, et al., 2007; Kifle et al., 2005; Bangert et al., 2003).
Lack of health information security and importance of privacy in adopting electronic health records (Angst et al., 2009) are considered as impediments in the diffusion and adoption of Telemedicine. Conversely, the above stated problematic issues are termed as the potential benefits related to the telemedicine technology diffusion (telemedicine capabilities in India i.e. TMC) such as improving accessibility is conceived as Telemedicine Infrastructure (TMI) in our study, providing high quality healthcare and containing costs of healthcare is theorised as Healthcare Readiness (HCR) whereas Human Resource Readiness (HRR) is coined for facilitating effective delivery of healthcare services at both the providers’ and the receivers’ end. (Bashshur et al., 2002).

III. RESEARCH QUESTIONS

However, the slow performance of the Telemedicine as analysed in the aforesaid studies remained focussed on one or the other element (factor). The current research is undertaken with a comprehensive approach to present a meticulous appraisal of all those elements, factors that influence the Telemedicine. And in Indian context, the reasons (factors) for the sluggish performance of Telemedicine technology can be vividly explained by finding out the answers to the three Questions (derived from the literature study):

Ques.1 What factors of Telemedicine Infrastructure impact Telemedicine capabilities in India?
Ques.2 What factors of Human Resource Readiness impact Telemedicine capabilities in India?
Ques.3 What factors of healthcare readiness impact Telemedicine capabilities in India?

As such, the present study elaborates on the efforts made to find out the factors (variables) that enable us to extract the maximum out of the above stated potential benefits of Telemedicine. In our endeavour to find the answers (factors/variables) to these questions, we have exerted to establish the relationship such as improving accessibility to Telemedicine refers to Telemedicine Infrastructure, providing high quality care and facilitating effective services of healthcare refer to Human Resource Readiness and containing costs in healthcare delivery systems refers to Healthcare Readiness. These in turn translate the impact of Telemedicine relationships are termed as TM capabilities in India. However, these models containing the factors/variables that narrate the whole story of adoption, diffusion, execution and extension of Telemedicine capabilities in India.

IV. RESEARCH MODELS

4.1 Telemedicine Infrastructure Model

In the Telemedicine Infrastructure Model there are mainly three factors that impact the adoption and implementation of Telemedicine at national level in India, these are: ICT Infrastructure; Healthcare Infrastructure; Technical environment.

ICT Infrastructure: The prime requirement for the adoption of the Telemedicine technology to link all the Healthcare providers, users and beneficiaries, is the solid network of telecommunication infrastructure. Nationwide accessibility of pocket-friendly telecommunication infrastructure with enough bandwidth for using internet enables the implementation of Telemedicine (Datta and Mbarika, 2004; Tulu B. et al., 2005). Among the other developing nations, India enjoys an edge over others in this context, as almost all the Indian states and urban areas are interconnected and the efforts are being continued by the Indian government to establish the remaining connectivity up to last mile. This facility of easy availability and accessibility will enhance the capability of Telemedicine to deliver safe and qualitative transmission of data, image and video etc, realizing there by a greater positive impact of Telemedicine in India.

Healthcare Infrastructure: The next step to encash the potential benefits of the Telemedicine applications is the strong and well spread healthcare infrastructure. In order to absorb the positive effect of the execution of the Telemedicine technology, the Indian government has initiated many pilot projects in most of its states. The Union government in collaboration with the States’ government has drafted and implemented many investment plans, liberalized the import policies in the healthcare (Sood S. P, 2002), to encourage the public sector as well as private sector to invest (Mishra S.K. et al., 2012), to create resource and equipment as well as to upgrade and train the existing human resource professionally to meet the changing needs of the community.

Technical Environment: The magnitude and momentum that will be decisive in the adoption and performance of the Telemedicine technology in any country or even in any organization depends upon its existing technical environment and its ability to absorb the exposure to the innovations in the technology. The exposure of these innovations to service providers and users of the technology will enhance their familiarization, willingness and readiness to adopt without any resistance (Kifle M. et al., 2005, Straub D.W.et al., 2002)
4.2 Human Resource Readiness model

In the absence of skilled human power the adoption and implementation of Telemedicine Technology can never be materialized. The enhancement in the readiness of the human resources is directly proportional to the effectiveness of the Telemedicine technology. In the present study, ICT awareness, Healthcare Environment, Knowledge of Telemedicine, Fear Psychosis and Organizational Behavior, are some of the factors that describe the power of Human Resource Readiness.

Awareness of ICT: The paucity of skilled hands states the machines to be simply the Iron boxes. In case of the acceptance and utilization of the Telemedicine technology, the requirement of manpower that is skilled in ICT applications only, is not sufficient. To realize the potential benefits of Telemedicine technology, awareness of ICT as applicable in the field of Healthcare, is the necessity of the hour.

Healthcare Environment: The issue of inadequate and inequitable distribution of healthcare resources (equipment, infrastructure and human resource) can hardly provide any quality and thus puts a stumbling block in the effective functioning of the Telemedicine technology(Datta P. and Mbarika V., 2004; Straub et al., 2002). Unless the local government assures to manage the resource distribution in a more just way, a negative effect will prevail regarding the acceptance, adoption and implementation of the technology on the part of enthusiastic healthcare service providers and users.

Knowledge of Telemedicine: As per (Gagnon et al., 2009) keeping pace with ever evolving ICT based Telemedicine technology, the HealthCare workforce must integrate the knowledge of ICT and ICT applications in healthcare otherwise their inability will lead to underutilization of this technology. Thus, up to date knowledge of Health Informatics will positively influence Telemedicine technology.

Fear Psychosis: Fear Psychosis faced by the Healthcare users will mar the positive impact of Telemedicine technology. The users may be afraid of losing the data or may not be able to operate the ICT based Telemedicine applications properly. All this leads to a paralysed workforce who will never be able to generate the capability of appropriate utilisation of Telemedicine technology (Sheyrl and Miller, 2014).

Organisational Behaviour: The successful adoption and execution of Telemedicine technology loses its ground if the organisational goals and strategies are not compatible with it. Organisational readiness in the form of prevailing culture and conditions are confronted as challenges. The reluctance of Healthcare workforce to accept and degree of decentralisation of power in Organisational hierarchy will certainly be reflected in the negative impact of Telemedicine technology. “Power distance brings inequality among the workforce and there by demotivates them.”(Starub D.W.et al., 2002).

4.3 Healthcare Readiness Model

The zest of various governments to practically materialize the adoption and implementation of Telemedicine technology is reflected through their national objectives and goals, as per WHO (2004) report. In order to improvise the Healthcare delivery system in Indian context, the government at all the levels of administration has, not only consented to formulate many positive changes in the public policy but also has initiated various sponsorships to boost the contribution of the private sector (Bashshur R.L.et al.,2000). At present, the constructive efforts of the government are reflected through the four elements which truly translate the impact of Telemedicine in India. These four elements are: HealthCare Policies, Institutional Environment, Telemedicine Investment and Technology Transfer Environment.

HealthCare Policies: The introduction of ICT Act (ICTA 2000) by the Indian govt. has enabled a greater pace in the adaptation of ICT based Healthcare Telecommunication Technology. Deity (Department of Electronics and Information Technology of India), has already proposed Telemedicine Operation Standards, to enhance the positive attitude in adoption, execution of TM technology but it has yet to announce its e-health policies. However, it is clearly ascertained that HR Readiness is positively linked with Healthcare policies.

Institutional environment: The desire and the ability of any institute to transform, to absorb the structural, workflow or portfolio changes and the tendency to accept the changes and to make efforts for their optimal fit in existing environment, to adopt and implement the Telemedicine technology based on the ICT applications truly reciprocate the positivity of the environment preventing at the institutional level.

Telemedicine Investment: To have a first-hand experience of the implementation of Telemedicine technology, the Indian government invested in a good number of pilot projects and later on allocated appropriate funds to sustain these projects. The positive outcome of these projects is clearly manifested in generating an increased awareness (at both the ends), in the adoption and execution of Telemedicine by the healthcare service providers and its beneficiaries, at the receivers’ end.

Technology Transfer Environment: Healthcare professionals are concerned about many factors, like patient market extension, competitive enhancement, service improvement, organisational performance etc., while the transfer of technology is undertaken.
But as per (Hu, P.J.H et al., 2000) “the adoption of Telemedicine technology by a healthcare organisation may result from compromises between physicians and management or proceed without due consideration of important decisions factors”. Thus, to practically materializing the transfer of any Telemedicine technology, all the efforts of these healthcare providers strive for channelizing the strength of existing indigenous elements to behave as optimal fit.

V. RESEARCH METHODOLOGY

The major steps in the methodology followed in this research are: The research questions were formulated on the basis of thorough review of the related literature like journals, books, articles, conference proceedings, workshops, discussions with experts etc. Based upon the reviewed literature and previous studies in the similar field, the researcher then took up the problem related field work to draw a frame work and conceptualize the variables (independent/dependent) to answer the research questions. In order to collect the meaningful data, the data collection method to be deployed was then finalized. Based upon a complete study of various research designs, a specific research design was selected as per all the above stated factors and the best capability of the researcher’s cognitive skills. Acknowledging the importance of the Quantitative approach and following the concept of the Deduction method, a cautious selection of the population for collecting the data was made. After this in the next step the methods and procedures were defined to manipulate, tabulate and present a complete picture of the useful and meaningful data so collected. The classified data so generated was then incorporated in various predefined analytical techniques to interpret the data and to make the predictions.

VI. DATA COLLECTION

After a comprehensive study of dexterously crafted and well-validated Questionnaire from a few previous studies, it was selected to be utilised to develop our survey instrument. Our survey instrument contains well defined 53 Question put together in 12 sections. The first three sections ICT Infrastructure, Healthcare Infrastructure and Technical Environment contained 12 questions and belonged to dependable variable Telemedicine Infrastructure (TMI). The second dependable Human Resource Readiness (HRR) had five sub-sections Awareness of ICT, Knowledge of Telemedicine, Fear Psychosis, Healthcare Environment and Organisational Behaviour consisting of 26 questions.

Whereas the third dependable variable, Healthcare Readiness (HCR) was the collection of four sub-sections Healthcare Polices, Institutional Environment, Telemedicine Investment and Technology Transfer Environment with 15 questions. There were 12 questions to collect demographic information from the participating population. The respondents were asked to provide Demographic data along with answers to designed questions using seven point Likert scale with values ranging from 1 (strongly agree) to 7 (strongly disagree). The contents of the Questionnaire were discussed with experts in a workshop conducted by the researcher (Kifle et al., 2005; Mbarika et al., 2005). In order to make it feasible in the said research study in the Indian context, the strategy to address the required population for collecting the empirical evidence was discussed as well. On the basis of that discussion, the Questionnaire was mailed and out of the total population of 340, the responses from the 62% of the participants were received. Hence out of the total 213 respondents, the data received from 205 respondents only, was selected finally as the data provided by them appeared to be relevant for the study. Eight (8) were rejected because their data lacked sufficient information or the data provided was not understandable.

VII. DATA ANALYSIS

This section of the study presents data analysis of the empirical evidence so collected in terms of respondent profile and statistical testing through measurement reliability, construct validity and regression.

7.1 Respondent Profile

Out of 205 respondents, 47 (22.9%) were females and 158 (77.1%) were males, 76(37.1%) of them were from the age bracket of 36-45 years, whereas 57(27.8%) from 26-35 years, 47(22.9%) from 46-55 years, only 8(3.9%) from >56 years, while in the age group of <25 years only 17(8.3%) responded. Of these 205 respondents, 70(34.1%) confirmed that they found Telemedicine technologies somewhat knowledgeable, 83(40.5%) simply knowledgeable and 34(16.6%) very knowledgeable, which was an encouraging factor. And rest 18(8.8%) had no knowledge about the Telemedicine technologies. Most of the respondents 147(72.7%) out of 205 belonged to public sector, whereas 16(7.8%) to private sector, only 5(2.4%) worked in NGOs and rest 35(17.1%), to other categories. The respondents, for collecting the data for this research study, were chosen from Telemedicine projects using almost all modes of telecommunication technologies available.
It was found that maximum respondents 100(48.8%) were using Broadband (fixed lines), 60(29.3%) utilised VPN technology, 13(6.3%) respondents used ISDN technology, 11.2% (23) were using VSAT based technology and 9(4.4%) respondents only, used Wireless Broadband connectivity to access the Telemedicine applications.

7.2 Statistical Testing

The data collected using developed instrument, was tested for Research Model fitness and reliability. Correlation matrix and statistical significance of the hypotheses were statistically analysed by using SPSS version 17.0 (SPSS Inc., Chicago, IL, USA) software package. Various tools of software package were used to evaluate for descriptive data for Mean, SD, Mode, Median, Skewness and Kurtosis on one hand and tools like independent t-test, One-way ANOVA (F-test), Correlation and Stepwise Multiple Regression were used as the main statistical tools of analysis. Independent t-test, One-way ANOVA test were applied to know the mean difference of all dimensions between two or more groups. The correlation test and Stepwise multiple regression tests were deployed to predict relationship between dependent and independent variables

7.3 Measurement Reliability

It is essential to ascertain both the stability and internal consistency of developed instrument. Cronbach’s Alpha test was used to determine the reliability and internal consistency for the indicators of each construct of the Research Instrument. There were 9 constructs in this instrument and their Cronbach alpha value must vary between 0 to 1 to exhibit very good internal consistency (Nunnally, J.C.1978). As shown in Table 1, alpha value of all the 12 constructs indicated a value closer to or higher than 0.70, equivalent to a common Reliability coefficient that is acceptable in most of the research models. The values clearly indicated that measurement model demonstrated higher internal consistency. (Nunnally, J.C.1978)

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<tr>
<th>Dimension</th>
<th>N</th>
<th>Cronbach alpha</th>
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<tr>
<td>HC Infra.</td>
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<td>Tech Trans Enviro</td>
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7.4 Measurement of Validity

Validity is defined as the degree to which a research study measures what it intends to measure. In this research study Discriminant/Divergent Validity is used to check the validity of the instrument and it is attestation that a measure is not unduly associated with alike but dissimilar, constructs. Correlation coefficients related to measures of a construct and measures of conceptually distinct constructs normally act as testament of a distinct validity. The value of correlation coefficient (r) varies between -1 and +1. The value of correlation coefficient 0.8 or above is generally considered to be strong and less than 0.5 is usually described as weak

The table 2 given above clearly depicts that out of 9 independent variables, almost 6 variables are strongly and positively correlated with TMI (dependent variable) the values of correlation coefficient lie between either close to 0.8 and close to 0.5, whereas in case of HRR and HCR (dependent variables), 3 independent variables (Institutional Environment, Healthcare policies and Technical Transfer Environment) establish somewhat weak correlation as their correlation coefficient values are far less than 0.5.

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7.5 Measurement of Stepwise Multiple Regression

The relationship between dependent and independent variables (i.e. whether they were significantly or directionally consistent with expectations or not), was predicted by applying stepwise multiple regression in this research study. Preliminary analysis of correlation defined in Table 2 had already predicted that the assumption of linearity and homoscedasticity was not violated and all correlations were found to be significant at 0.01 level of significance. The relationship between the three Models based upon dependable variables TMI Infrastructure (TM1), Human Resource Readiness (HRR) and Healthcare Readiness (HCR) and the combined overall Model for Telemedicine Capabilities (TMC), was established through the Multiple Regression. The mathematical representation of research model for the above relationship was given as:

Model: \[ Y = \alpha_0 + \alpha_1X_1 + \alpha_2X_2 + \alpha_3X_3 + \alpha_4X_4 + \alpha_5X_5 + \alpha_6X_6 + \alpha_7X_7 + \alpha_8X_8 + \alpha_9X_9 \]

Where: \( X_1 = \) ICT Infrastructure, \( X_2 = \) Health care infrastructure, \( X_3 = \) Health care Environment, \( X_4 = \) Fear Psychosis and \( X_5 = \) Telemedicine Knowledge, \( X_6 = \) Awareness of ICT, \( X_7 = \) Institution Environment, \( X_8 = \) Health Policies and \( X_9 = \) Technology transfer Environment and \( \alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7, \alpha_8 \) and \( \alpha_9 \) are the coefficient of the dimensions.

7.5.1 Detection of the Multi-Co linearity

It was recognized that the use of all explanatory variables to predict future prospects might give rise to some of the redundant variables and multi-co linearity problems. Multi-co linearity problem is likely to occur when explanatory variables correlate with each other. Consequently, the effect of each variable of the dependent variables becomes difficult to identify. Hence following the diagnostics of multi-co linearity:

A) Variable Inflation Factors (VIF): \( VIF = 1/ (1-R^2) \) is the co-efficient of the multiple determination of the regression produced by regressing the variable \( X_i \) against the other \( Y \) variables. If any VIF exceeded 10, the correspondent variable should be considered to be deleted or otherwise to use an alternative method instead of Ordinary Least Squares (OLS).

B) Tolerance value: The tolerance of an independent variable is an additional method to measure the effects of multi-co linearity in a data set. The value of the tolerance of the variable has a range from 0 to 1. The tolerance value of the variable closer to 1 it indicates the independence, and if the tolerance value is closer to 0, the variables are multi-co linear.
In order to predict relationship between combined overall model (TMC) Telemedicine capabilities and independent variables of this model Stepwise Multiple Regression was applied to construct nine sub-models.

The sub-model 9 had more variations as compared to remaining sub-models, so results of this sub-model were predicted.

### Table 3

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Model Summary Statistics Between Dependent And Independent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Model</td>
<td>R</td>
</tr>
<tr>
<td>-----------</td>
<td>---</td>
</tr>
<tr>
<td>9</td>
<td>0.96</td>
</tr>
</tbody>
</table>

* *p<0.01

Table 3 was constructed when all the nine independent variables ICT Infrastructure(X₈), Healthcare Infrastructure (X₂), Health care environment(X₃), Fear Psychosis(X₄), Telemedicine Knowledge(X₅), Awareness of ICT(X₆), Institutional Environment(X₇), Health policies(X₈), Technology transfer Environment (X₉) had a linear relation with total as depicted from values, F=254.0 & p=.000 which are significant at 0.01 level of significance. The value of R² was found to be 0.96 which implies 96.0% variance in predicting that dependent variable overall combined model (TMC) Telemedicine capabilities of respondent was accounted for by the independent variables (X₁,X₂,X₃,X₄,X₅,X₆,X₇,X₈, and X₉). The change in R² found to be 0.2% and change in F=4.5and change in the value of p is =0.04 which are significant at 0.05 level.

The following table presented the values of Multiple Regression to predict the relationship between dependent variable Combined Overall Telemedicine Capabilities (TMC) and independent variables ICT Infrastructure, Healthcare Infrastructure, Awareness of ICT, Health care Environment, Telemedicine Knowledge, Fear Psychosis, Healthcare policies, Institutional Environment, and Technology Transfer Environment.

### Table 4

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Beta’s Coefficient, Se, T Values, Tolerance And Vif Between Dependent And Independent Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>Beta coefficient</td>
</tr>
<tr>
<td>Constant</td>
<td>35.69</td>
</tr>
<tr>
<td>Health policies</td>
<td>1.61</td>
</tr>
<tr>
<td>Telemedicine Knowledge</td>
<td>0.97</td>
</tr>
<tr>
<td>ICT Infrastructure</td>
<td>1.38</td>
</tr>
<tr>
<td>Health care environment</td>
<td>1.72</td>
</tr>
<tr>
<td>Institutional Environment</td>
<td>1.42</td>
</tr>
<tr>
<td>Fear Psychosis</td>
<td>1.25</td>
</tr>
<tr>
<td>Awareness of ICT</td>
<td>1.22</td>
</tr>
<tr>
<td>Technology Transfer Environment</td>
<td>1.21</td>
</tr>
<tr>
<td>Healthcare Infrastructure</td>
<td>0.48</td>
</tr>
</tbody>
</table>

It was evident from the values of tolerance and VIF (as shown in the above Table) are within limit, which clearly indicated that data had no problem of multi-co linearity. The Regression equation between dependent and independent variable was

\[
Y = 35.69 + 1.38X_1 + 0.48X_2 + 1.72X_3 + 1.25X_4 + 0.97X_5 + 1.22X_6 + 1.42X_7 + 1.6X_8 + 1.44X_9
\]

From the above table, results of the assessment of the structural model were summarised as follows: The relationship between the overall model TMC (Telemedicine Capabilities)

1) And ICT Infrastructure was found to be significant as \( \beta = 1.38 \) & \( t =11.64 \), \( p <0.00 \), significant at 0.01and 0.05 levels. This suggested a strong relation between them implying uniform spread of various telecommunication applications (Internet facility with enough bandwidth) irrespective of the geographical, financial, time barriers would definitely cast a positive and enhanced influence on Telemedicine Capabilities. This would result in improved qualitative healthcare delivery even to the remotest areas within no time, at an affordable cost.
And Healthcare Infrastructure documented a significant influence as the value of $\beta = 0.48$ & $t =2.13$, $p <0.04$, significant at 0.01 and 0.05 levels. This established a positive relation between them implying that the efforts of the Indian govt. (on the basis of the success of pilot projects) through its positive investment and liberal import policies to boost public as well as private sector to create improved state-of-art Healthcare Infrastructure would certainly lead to a greater accessibility, efficiency, quality of services and cost restricted influence on the Telemedicine Capabilities.

And the Awareness of ICT showed a significant impact as the value of $\beta = 1.22$ & $t =6.67$, $p <0.00$, significant at 0.01 and 0.05 levels. This exhibited an emphatic cord between them implying that as and when the awareness, adoption and execution of ICT induced Healthcare applications by the service providers, the users and the people in authority attain a higher level, it would ultimately enhance the performance of Telemedicine Capabilities.

And Healthcare Environment indicated a momentous relation as the value of $\beta = 1.72$ & $t =8.73$, $p <0.00$, significant at 0.01 and 0.05 levels. This suggested a strong bond between them implying that the positive attitude of the govt. to manage the resource allocation in a more equitable and adequate manner and their acceptance and appropriate utilisation on the part of the Healthcare workforce to generate enthusiastic Healthcare environment that would enable them to extend Telemedicine Capabilities catering to the Health related needs of Indian masses.

And Telemedicine Knowledge denoted a positive aspect as the value of $\beta = 0.97$ & $t =12.02$, $p <0.00$, significant at 0.01 and 0.05 levels. These values assisted to establish a favourable linkage between them implying that manpower involved in the Healthcare Delivery System must keep abreast of the self-evolving ICT induced Telemedicine technologies in order to make better and complete utilisation of them and to provide improved and latest Healthcare facilities to their people. Thus, up to date knowledge of Health Informatics will boost up the Telemedicine Capabilities.

And Fear Psychosis reflects a positive status as stated in the research model of Human Resource Readiness (HRR). This was well established by the values of $\beta = 1.25$ & $t =8.60$, $p <0.00$, significant at 0.01 and 0.05 levels that endorsed the fact that to utilise the potential benefits of the Telemedicine technology to its fullest, this hurdle of Fear Psychosis has to be overcome.

This necessitates the efforts on the part of the govt and people in authority to provide the required atmosphere, resources, equipment, on-the-job trainings etc., while the presence of positive attitude and intensity of acceptance at the front of the Healthcare service providers and users is equally essential. Thus, lesser degree of Fear Psychosis will get translated into greater level of Telemedicine Capabilities.

And Healthcare Policies bore a strong bond between them as suggested by the values of $\beta = 1.61$ & $t =8.10$, $p <0.00$, significant at 0.01 and 0.05 levels. The introduction of the ICT Act (ICTA 2000) has provided a large spectrum of ICT induced Telecommunication services; the Indian govt. has yet to officially announce its e-health policies. However Healthcare policies supported by Telecommunication policies do exist in India and in order to enable the ICT based Telecommunication in the field of Healthcare to spread at a faster rate many other govt policies like Telemedicine Operation Standards (proposed by Deity) are being framed to be implemented. Hence, the growth of Healthcare policies will directly influence the Telemedicine Capabilities.

And the Institutional Environment expressed a direct linkage between them as depicted by the values of $\beta = 1.42$ & $t =6.63$, $p <0.00$, significant at 0.01 and 0.05 levels. For the adoption and execution of the Telemedicine technology it becomes imperative for any institute to develop in-built shock absorbing abilities like the ability to absorb structural, workflow, portfolio changes etc. It must not only make efforts to accept the changes positively but also strive for the technological changes to be optimally fit in its existing environment. Their abilities would definitely get reflected in the greater influence on the Telemedicine Capabilities.

And Technology Transfer Environment documented a positive influence on the enhancement of the Telemedicine Capabilities as shown by the values of $\beta = 1.21$ & $t =4.43$, $p <0.00$, significant at 0.01 and 0.05 levels. Transfer of technology comes under the preview of top management level that has to observe the effect of the change, (specifically and collectively as well) on the organisation’s behavioural, financial, constitutional, market and competitive factors also. But in order to keep pace with the latest developments in the field of Healthcare Telecommunication networks, the Healthcare professionals must do their utmost, without any prejudice, to welcome the Transfer of Technology to make their contribution for the welfare of the society.
VIII. CONCLUSION AND CONTRIBUTION

This study endorses earnestly the fact that the adoption and implementation of Telemedicine in India in terms of preventive Healthcare and disease treatment management can reach greater heights of success, only if the multidisciplinary role players make serious and dedicated efforts together in the same direction. Whatever success is achieved in the pilot projects to implement the telemedicine in India, has been quite inspiring, but at the same time it has started losing its sheen due to the laxity of attitude on the part of the multidisciplinary role players, ranging from a wide variety of healthcare workers, information and communication technologists, to economists, managers and policy makers. The results of the study confirm that for sustainability and enhancement of Telemedicine Capabilities in terms of accessibility, cost-effective, user-friendly (at both the ends), quality-assurance, legal standards and privacy of records, etc. have to be prioritised before designing an explicitly focussed exercise to be undertaken by the role players. The detailed research study acknowledges the sincere efforts made by the federal Indian government (managers, technologists, economists and policy makers), towards the adoption and implementation of the Telemedicine technology, during the last fifteen years in India.

Though India enjoys an edge over other developing nations from the point of view of the presence of a reasonable sound base of Telecommunication system yet it has to exert itself in the direction of creating a strong (international state-of-art) network of ICT, to unleash the benefits of Telemedicine for the welfare of India’s exponentially growing population. To give the required impetus to Telemedicine in India, the Indian government has to make, the funds allocation more sufficient and just, its import policy more liberal, conscious efforts in implementing the Standards and Protocols (HL7and DICOM) for Telemedicine technology and efforts to develop a customised operating system interface to overcome the language barrier and increase the regional usability of the Telemedicine technology. Moreover the Indian government, in order to provide low-cost, more reliable, secure and quality-consistent Connectivity, to schedule transmission of data, images, scan or videos at otherwise difficult Indian terrain, is supporting ISRO’s commitment to expand India’s reach and range of ICT based Telemedicine Capabilities with their indigenous network of satellites. Besides all these measures, the government has still to find solution to the existing potential legal and security issues, (to protect the interest of both physicians & patients) and also find ways to save it from the pangs of snail-pace of bureaucracy and protectionist policies.

Throughout the research a dire need, on the part of people in authority in the Healthcare delivery system of developing nations, to shouler the responsibility of the adoption, execution and sustainability of Telemedicine technology, is realised. It is high time, for the physicians, clinicians, nurses and other healthcare providers to liberate themselves from the conventional line of action and collaborate with the government rather to be the pioneers to implement and sustain the Telemedicine technology for the welfare of the humanity.

Our study results suggested that the Fear Psychosis faced by the medical workforce affects the Telemedicine Capabilities negatively implying that the physicians and medical workers have to get rid of their professional fundamental inhibitions; rather they need to cultivate and solidify a collective positive attitude of medical workforce toward Telemedicine and its enabled services. Instead of considering them as ramifications to their medical practices in the wake of legal liability, service disputes, insecurity in record-keeping, breach of patients’ privacy etc., they must involve themselves in the Telemedicine system with real commitment, prioritise their own actions for not only using the available resources rationally, inculcating the favourable attitude of the healthcare workforce but also ensure stringently that the policy-makers materialise their promises and decisions without much delay. However, despite diverse geographical features, multi-lingual haves & have-nots, growing exponentially, Indian Healthcare delivery system has already scaled a respectable niche in this evolving area among numerous developing nations. Thus, a collective, comprehensive, positive and sincere dedication on the part of multidisciplinary Healthcare role players seem to poise itself to accentuate the accessibility, adoption and implementation of the Telemedicine technology, to another echelon in India and can also serve as a platter for research satiety of many others.

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