Critical Success Factors for eHealthcare

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***Abstract*—As healthcare enterprises move towards a sustainable healthcare delivery model, an ehealthcare strategy is being adopted. In this study, the critical success factors for an ehealthcare strategy were identified. Their relative importance was determined based on increasing access to healthcare and reducing its cost. To succeed in ehealthcare initiatives the necessary factors are appropriate government policies, literacy levels, and telecommunications and power infrastructure. The focus should not be on technology; instead, factors such as healthcare provider and consumer mindsets should be addressed to increase the acceptance of ehealthcare services.**

Keywords-ehealthcare; critical success factors; efficiency; AHP; ISM.

I. INTRODUCTION

In the developing world, ehealthcare is often proposed as a solution to certain healthcare problems – accessing the rural population and trying to bridge the huge gap between the demand and supply of healthcare services. In the Indian context it is important to understand the healthcare and demographic scenario. There are huge differences between urban and rural India in terms of quality of available healthcare. Approximately 70% of the Indian population lives in rural areas whereas approximately 90% of the secondary and tertiary healthcare services are located in urban areas. The primary healthcare facilities in rural areas are also inadequate.

Ehealthcare exists as fragmented efforts by various Ministries of the Government of India (GOI) and a few corporate hospitals to address the challenge of providing healthcare to over 1 billion people. The Department of Information Technology (DIT), Ministry of Communication and IT (MCIT), GOI has setup about 75 nodes in collaboration with various State Governments for applications such as tropical diseases, cancer care and consulting specialists from remote areas. Another DIT project is the setting up of Common Service Centers (CSC) – about 100,000 nodes, in rural areas. These are envisaged as serving as a front-end for government services of which ehealthcare is one of the services to be provided [9][10]. The Indian Space Research Organization (ISRO) has an ehealthcare network consisting of 225 hospitals – 185 in rural areas connected to 40 super specialty hospitals. The Village Resource Center (VRC) is a project of ISRO along the lines of the CSCs to provide services including ehealthcare services. The Ministry of Health and Family Welfare (MoH&FW), GOI implemented an Integrated Disease Surveillance Program that connects district hospitals with medical colleges of that state. Tele-opthalmology projects and a national cancer network are additional projects that have been funded [9][10].

Policy initiatives by different ministries of the GOI include those by the DIT of the MCIT: standardization of ehealthcare systems, hardware, software, security and privacy issues to enable planning and implementation of ehealthcare networks. A project called the "The Framework for Information Technology Infrastructure for Health (ITIH)" to address the information needs of various stakeholders has been undertaken. A National Task Force on Telemedicine was set up in 2005 by the Ministry of Health and Family Welfare (MOH&FW), GOI and a part of their mandate is to evaluate all players and projects in ehealthcare in India, define standards of electronic medical records, work on different modes of ehealthcare networks in the country and develop a national policy for ehealthcare for the 11th Five Year Plan [9][10].

A review of literature showed that improvements in healthcare delivery are achieved by ehealthcare in terms of improved access and quality, and reduced costs [2][3]. The challenges to the advancement of ehealth that remain are issues relating to confidentiality, reimbursement, and legal and ethical considerations.

When considering costs the literature shows that health outcomes improved at lower costs with ehealth as compared to traditional home visits by healthcare professionals [4][5]. Though there are initial set up costs, studies indicate overall lower costs due to better triage as a result of ehealthcare, reduced length of hospital stay, and reduced travel costs [6][7]. Costs, however, are incurred by the healthcare provider whereas savings benefit the payer, so these savings need to be realized by both [8].

With limited resources it is important to ensure the success of new and sustainable ways of healthcare delivery [1]. There exist frameworks for the introduction of ehealth technologies based on standard models for technology development and introduction [19]. Factors that would ensure the success of technology innovation and diffusion have, however, not been studied in detail, and neither has their importance been ranked [18].

Based on a literature survey, we identified ten critical success factors (CSF) that influence the efficiency of ehealthcare in terms of their impact on increasing access and

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reducing the cost of healthcare delivery. The relative importance of these factors was determined as well as the relationships among them.

In the following sections, the critical success factors are identified and ranked in their order of importance. No evaluation has, however, been done in terms of cost-benefit analysis of ehealthcare or its impact on public health.

II. METHODS

A search of peer-reviewed literature databases such as MEDLINE, PUBMed, academic journals, conference proceedings, and Google Scholar was done. Websites of the World Health Organization (WHO) [21] and GOI [22] were also searched. Search terms such as "ehealth", "ehealthcare", "telemedicine" and synonyms were used. Abstracts of articles were used to identify relevant articles. The 'snowball' method [23] was used to further identify articles from the reference lists of these articles. Ten CSF for ehealthcare were identified:

A. Critical Success Factors

The ten CSF and their relevance to ehealthcare are listed below.

- Data warehousing and data mining - appropriate data warehousing and data mining techniques are important, as online patient record storage and retrieval of relevant data for medical decision making is an indispensable component of any ehealthcare paradigm [9]. Health information needs to be integrated with technology, which has been done in the West but not in India.
- Expert systems - decision support systems for diagnoses as well as for demographic analysis for public health programs are extensively applied in the delivery of ehealthcare [9].
- Data access control - the healthcare sector in the West has stringent requirements for data security and controlling access to confidential patient data. In the United States the Health Insurance Portability and Accountability Act (HIPAA) was passed for improved patient privacy and data security. Interoperability standards need to be in place along with data security [2]. In India, however, laws and standards for protecting a patient's electronic healthcare record are still in their infancy.
- Biomedical engineering technology - appropriate biomedical engineering technology is necessary to support ehealthcare applications. Technical support is necessary throughout installation and needs to be ongoing for all stakeholders along with user-friendly technology. Quality of service needs to be ensured, e.g., low down-time. Diffusion of ehealthcare technology needs initial champions as in the introduction of any other technology [2][11]. A study on the intention to use wireless technology for healthcare in India showed that technology factors are important along with financially viability [9][12].
- Telecommunications and power infrastructure - reliable networks will be of prime importance as ehealthcare activities increase [11]. This is very important in India where uninterrupted power supply is yet to be realized in most parts of the country. This will need to be coupled with a high-bandwidth, zero-downtime telecommunications network to support ehealthcare delivery. A study on the intention to use wireless technology for healthcare in India showed that communications factors are important [9][12].
- Government policies - international studies have shown that policy and legislation are important for ehealthcare success [2]. Indian studies also show that licensing, ethical, and legal issues need to be addressed to promote integration of IT tools to facilitate ehealthcare [9][10]. Government policies concerning healthcare, education, infrastructure, technology, insurance, and legal issues all have a bearing on the success of ehealthcare in India.
- Healthcare insurance - financing is an important factor as insurance companies need to have tariffs in place for this new mode of healthcare delivery [2]. Health insurance is another sector where the entry of third party administrators and private players is set to change the way healthcare coverage is provided in India.
- Literacy levels - a literate population with a minimum level of computer awareness is essential for the success of ehealthcare. Technology is useless when faced with ignorance and an inability to use it appropriately and effectively. As of figures reported in 2008 only 65.38% of India's population is literate with only 2% being well-versed in English [9].
- Consumer mindset - a literature review on the effect of ehealthcare on doctor-patient communication showed that ehealthcare was favored in approximately 80% of the studies [13]. In India some studies show an acceptance of technology as a result of reduction in travel costs and time, whereas other studies report a lack of confidence on the part of patients in ehealthcare [9].
- Healthcare provider mindset - user acceptance is a very important factor and the involvement of healthcare professionals is essential from the design phase itself [2][14]. Ehealthcare facilities need to be available in the doctors' offices, training needs to be provided as well as monetary compensation for providing ehealthcare services for user acceptance [11][15]. Possible reasons for physicians being reluctant include being too busy, a perceived loss of control, a lack of conviction in its potential, and not being conversant with ehealthcare [7][9]. An Indian study showed that ehealthcare's clinical usefulness influenced its adoption along with the administrative factors involved [12]. To be able to fully utilize the potential of ehealthcare, healthcare providers will have to be responsive and committed to ehealthcare [2][11].

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As various studies have shown training and organizational support is essential for adoption along with a change agent who is in a position to affect strategy and decision making [16]. Ehealthcare needs to fit into existing work protocols and not function as an add-on. Effective change management will be necessary to overcome resistance to adapting to new ways of delivering healthcare.

The above 10 critical success factors were assessed in terms of their impact on increasing access to and reducing the cost of healthcare delivery.

B. Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) was used to determine the relative importance of the CSF that influences the efficiency of ehealthcare [17]. AHP is a multi-criteria decision making technique that allows relative ranking of both qualitative as well as quantitative information. The information is separated into a hierarchy of alternatives and criteria. The alternatives, i.e., independent variables, are the ten success factors. The objective, i.e., dependent variable, is efficiency of ehealthcare. The criteria, i.e., mediating variables, against which the alternatives are ranked are increasing access to healthcare services and reducing cost associated with healthcare delivery. Based on this objective, two criteria and ten alternatives, a vector ranking the ten CSF was obtained from a group AHP performed on the inputs provided by individual healthcare providers. A Microsoft Excel spreadsheet was programmed to compute the group AHP rank vector. The ranking in this vector denotes the perceived importance of the CSF.

C. Interpretive Structural Modeling

Interpretive Structural Modeling (ISM) was used to determine the relationships between the CSF that influence efficiency of ehealthcare and establish the strategic drivers necessary for success (Sage, 1977) [20]. The ten CSF were assessed with respect to each factor having an impact on another factor. These CSF were used to develop a group ISM based on the inputs provided by the same individual respondents. To develop a group ISM, the majority answer was taken for each question from the individual answers provided by the respondents. ISM software was used to perform the ISM calculations. The ISM directed graph, or digraph, shows whether a factor has an impact on another factor and determines the strategic drivers.

D. Data Collection

An exploratory study was carried out with data gathered using a survey instrument tailored for AHP and ISM and consisting of two sets of questionnaires. The questionnaires were administered to a convenience sample of thirty-one healthcare providers, out of which eighteen responded. These respondents were from the National Capital Territory of Delhi. Eleven of these respondents were doctors from a large government teaching hospital, four were doctors in private practice, one was an ehealthcare manager for a large private chain of hospitals, and two responses were obtained from academics specializing in information technology and healthcare management.

III. RESULTS AND DISCUSSION

The results from both AHP and ISM are presented in the following sections:

A. AHP

An AHP computation was performed on the collective set of inputs obtained from all the respondents. The results, in terms of ranking of the criteria and the CSF, with their relative weights indicating decreasing importance, are given in Tables I, II and III.

Healthcare providers, as a group, perceived increasing access to be more important than reducing cost for increasing the efficiency of ehealthcare as shown in Table I. Keeping in mind the large population of India that is currently under-served in terms of basic healthcare services, any initiative that attempts to provide healthcare services should increase access to the services.

Table II shows the ranks of the CSF with respect to the two performance assessment criteria – increasing access and reducing cost. Healthcare providers rank literacy levels as the most important factor influencing access. Consumer and healthcare provider mindsets along with telecom and power infrastructure follow in close succession as to their importance in increasing access. Without a literate population it is not possible to fully utilize ehealthcare services. The mindsets of people as well as the basic infrastructure issues are important for accessing a larger number of people.

With respect to reducing cost, literacy levels are once again considered the most important factor, with telecom and power infrastructure a close second, and government policies in third place. For ehealthcare to service the country a literate population is desirable. When dealing with an illiterate population greater costs are incurred and this is reflected in ranking literacy levels as the number one factor affecting the cost of ehealthcare. The infrastructure costs also have a bearing on ehealthcare costs and hence they are in second place. Government policies, in third place, also have an impact on the cost of ehealthcare.

In the combined ranking shown in Table III, literacy levels are considered the most important factor influencing the efficiency of ehealthcare. The telecom and power infrastructure is ranked second with consumer and healthcare provider mindsets a close third and fourth. A literate population is a prerequisite for effective ehealthcare delivery both in terms of increasing access and reducing cost. Without telecom and power any ehealthcare initiative will not function properly. The mindsets of both the healthcare providers and consumers are also important for ehealthcare to gain acceptance as a means of giving and receiving healthcare services. The technology aspects of the business such as appropriate IT and biomedical engineering

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technology are ranked the lowest in their impact on ehealthcare.

TABLE I. AHP RANKS OF CRITERIA

Criteria	Relative weights
Increasing access	0.5778
Reducing cost	0.4222

TABLE II. AHP RANKS WITH RESPECT TO CRITERIA

CSF with respect to increasing access	Relative weights	CSF with respect to reducing cost	Relative weights
Literacy levels	0.1951	Literacy levels	0.1644
Consumer mindset	0.1298	Telecom / power infrastructure	0.1537
Healthcare provider mindset	0.1274	Government policies	0.1337
Telecom / power infrastructure	0.1262	Consumer mindset	0.1070
Government policies	0.1042	Healthcare provider mindset	0.1055
Expert systems	0.0703	Healthcare insurance	0.0887
Data access control	0.0665	Data warehousing / data mining	0.0877
Healthcare insurance	0.0644	Expert systems	0.0679
Data warehousing / data mining	0.0632	Biomedical engineering technology	0.0536
Biomedical engineering technology	0.0531	Data access control	0.0378

TABLE III. COMBINED AHP RANKS

CSF	Relative weights
Literacy levels	0.1821
Telecom / power infrastructure	0.1378
Consumer mindset	0.1201
Healthcare provider mindset	0.1181
Government policies	0.1167
Healthcare insurance	0.0747
Data warehousing / data mining	0.0736
Expert systems	0.0693
Data access control	0.0544
Biomedical engineering technology	0.0533

B. ISM

A group ISM was developed from the inputs obtained from all the respondents and is shown in Fig. 1. Government policies are the most important strategic driver having an impact on the other factors as can be seen in Fig. 1. Relevant government policies need to be in place to accelerate the pace of infrastructure development in the country without which ehealthcare cannot hope to achieve any measure of success. Government policies also have a direct impact on the literacy levels in the country that will, in turn, drive changing consumer mindsets.

The telecom and power infrastructure in the country is the second most important strategic driver for ehealthcare initiatives. With an adequate infrastructure in place the healthcare provider mindset will be influenced positively in favor of ehealthcare as a successful delivery mechanism. The information and biomedical engineering technologies are not as critical in ehealthcare delivery.

The results from both tools show that non-technology issues such as government policies, telecom and power infrastructure, and literacy levels in the country are more important than technology issues.

IV. CONCLUSION

We sought to evaluate the ten CSF that influence the efficiency of ehealthcare delivery. AHP was used to rank the CSF and ISM to determine the strategic drivers. Increasing access and reducing cost were the criteria used. To succeed in ehealthcare initiatives the CSF that need to be in place are appropriate government policies, literacy levels, and telecommunications and power infrastructure in the country. The focus should not be on the IT tools and biomedical engineering technology as is most often the case. Instead the non-technology factors such as healthcare provider and consumer mindsets should be addressed to increase acceptance of, and enhance the efficiency of, ehealthcare services.

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REFERENCES

[1] R. Wootton and M. A. Hebert, “What constitutes success in telehealth?” J Telemed Telecare, 2001, 7(6), Suppl. 2, pp. 3-7.

[2] T. H. F. Broens, et al., “Determinants of successful telemedicine implementations: a literature study,” J Telemed Telecare, 2007, 13, pp. 301-309.

[3] P. A. Jennett, et al., “Policy implications associated with the socioeconomic health system impact of telehealth: a case study from Canada,” Telemedicine Journal and e-Health, 2004, 10(1), pp. 77-83.

[4] S. M. Finkelstein, S. M. Speedie, and S. Potthoff, “Home telehealth improves clinical outcomes at lower cost for home healthcare,” Telemedicine and e-Health, April 2006, 12(2), pp. 128-136, doi:10.1089/tmj.2006.12.128.

[5] H. C. Noel, D. C. Vogel, J. J. Erdos, D. Cornwall, and F. Levin, “Home telehealth reduces healthcare costs,” Telemedicine Journal and e-Health, Summer 2004, 10(2), pp. 170-183, doi:10.1089/tmj.2004.10.170.

 ISBN: 978-1-61208-252-3

[6] P. Varkey, K. Schumacher, C. Swanton, B. Timm, and P. T. Hagen, "Telemedicine in the worksite: a study of feasibility, and patient and provider satisfaction," J Telemed Telecare, 2008, 14(6), pp. 322-325, doi:10.1258/jtt.2008.080512.

[7] R. Wootton, "Telemedicine support for the developing world," J Telemed Telecare, 2008, 14(3), pp. 109-114.

[8] C. M. Cusack, et al., "The value proposition in the widespread use of telehealth," J Telemed Telecare, 2008, 14, pp. 167-168, doi:10.1258/jtt.2007.007043.

[9] A. Dasgupta and S. Deb, "Telemedicine: a new horizon in public health in India," Indian Journal of Community Medicine, 2008, 33(1), pp. 3-8.

[10] S. K. Mishra, "E-health initiatives in India," Expert group meeting on regional trends in health service, and their impacts on health system performance in the Asian and Pacific region, Bangkok, October 2007, United Nations Economic and Social Commission for Asia and the Pacific (ESCAP).

[11] P. Whitten and I. Adams, "Success and failure: a case study of two rural telemedicine projects," J Telemed Telecare, 2003, 9(3), pp. 125-129.

[12] R. Gururajan, "Factors influencing the intention to use wireless technology in healthcare: a study in India," J Telemed Telecare, 2007, 13, Supplement 3, pp. 40-41.

[13] E. A. Miller, "Telemedicine and doctor-patient communication: an analytical survey of the literature," J Telemed Telecare, 2001, 7(1), pp. 1-17.

[14] S. Buck, "Nine human factors contributing to the user acceptance of telemedicine applications: a cognitive-emotional approach," J Telemed Telecare, 2009, 15(2), pp. 55-58.

[15] J. T. George, K. S. Rozario, and A. Abraham, "A survey in India of doctors' knowledge, attitudes and practice regarding telemedicine and e-health," J Telemed Telecare, 2007, 13, pp. 322.

[16] M. Tsiknakis and A. Kouroubali, "Organizational factors affecting successful adoption of innovative ehealth services: a case study employing the FITT framework," IJMI, 2009, 78, pp. 39-52.

[17] T. L. Saaty, "How to make a decision: The analytic hierarchy process," European Journal of Operational Research, 1990, 48(1), pp. 9-26.

[18] U. Taneja and Sushil, "E-healthcare in India: critical success factors for sustainable health systems," MEDINFO 2007, Proceedings of the 12th World Congress on Health (Medical) Informatics, Eds. K. A. Kuhn, J. R. Warren and T.-Y. Leong, IOS Press, Amsterdam, The Netherlands, pp. 257-261.

[19] J. E. W. C. Van Gemert-Pijnen, et al., "A holistic framework to improve the uptake and impact of eHealth technologies," J Med Internet Res, 2011, 13:e111-doi:10.2196/jmir.1672 pmid: 22155738.

[20] A. P. Sage, "Methodology for large-scale systems," New York: McGraw-Hill, 1977.

[21] World Health Organization website, www.whoindia.org.

[22] Government of India website, www.india.gov.in.

[23] R. Kumar, "Research methodology," Pearson Education, 2nd edition, 2009.

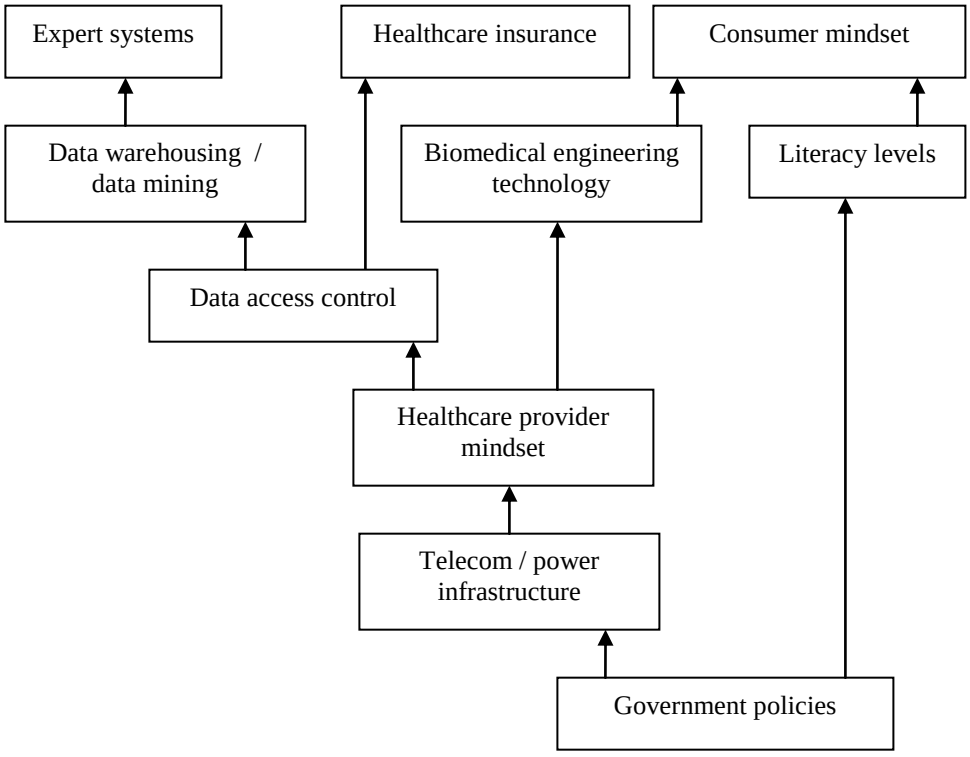

Figure 1. Group ISM digraph