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Adoption of telemedicine system among patients and health care professionals: Prospects and constraints

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Abstract
Telemedicine becoming the future of expanding health care service diversification. The people who were unable to take the proper health care services due to the lack of accessibility for various reasons, are now able to access those through telemedicine. It represents a solution to the medical issues of modern living while taking into account the patient and family pair. Home care is a desirable option because of the transportation issues in large cities and the lack of hospital beds. Telemedicine, though, can change its rhythms. It offers a workable remedy for tele homecare. This study emphasizes a variety of challenges implicated by the usage of mobile patient monitoring devices for healthcare practitioners while also providing a general overview of their technical components. Healthcare professionals can choose the feature sets of potential mobile patient monitoring systems to meet specific healthcare demands by using the framework for comparing mobile patient monitoring systems that has been provided. These systems have proven to be user-friendly, convenient, and successful for both patients and healthcare professionals in several trials. The purpose of this study is to explore and adoption of telemedicine in the Indian healthcare system. It looks to elucidate the relationship between the various variables studied to elucidate adoption strategies and their influence on the strategic implementation of the Health Care Management System (HMS) in the Indian healthcare sector. This paper was created and constructed with the aim of examining the relationship between the dependent variables (Adoption of Tele-Medicine in India's Health Care System) as well as the independent variables (Usage, Utilization, Efficiency, Quality) and then testing the results through Spearman's correlation matrices and multiple regression analysis. The statistical testing of the research variables revealed a statistically significant positive relationship between each independent variable (Ease of Use, Usefulness, Efficiency, and Quality) and the associated dependent variable (adoption of telemedicine in the Indian Health Care System). A research model and its associate hypotheses are proposed and empirically tested using structural equation modelling (SEM) to understand fitting conceptual model.

Keywords: Telephony, tele homecare, telemedicine, mobile patient monitoring system, SEM Model

1. Introduction
As the Information Age brings about a shift in the emphasis of health care, remote health care (Or telemedicine) is becoming increasingly popular. Remote health care is the use of Tele-communications technologies to provide medical information and services at a distance, with the mention ability of electronic signals as a means of transmitting information from one place to another. Telemedicine is a form of healthcare that allows patients to receive second opinion medical advice from consultants or physicians in prominent hospitals or medical centres worldwide. It is also a form of telecommunication that links patients and healthcare providers through live audio and video transmission over long distances, enabling effective diagnosis, treatment and other healthcare activities. Recent advances in technology and telecommunications have led to a renewed interest in this field. The term ‘telemedicine’ is reserved for applications in which the provision of health services is dependent on the use of telecommunication.

In the traditional sense, telemedicine refers to the practice of remotely consulting and remotely diagnosing patients within different fields of medicine. Research, patient monitoring, and patient management as well as education of patients and staff can be carried out through systems that offer ready access to professional advice and patient information, regardless of where the patient is located or what information is relevant to them. Public health services have a long way to go in terms of effectively using telecommunications.

Telemedicine services can be used to bring together the resources of different health sectors in a broad range of telemedicine services. Research shows that the challenge of public health services over the next ten years will be linked to the demographic makeup of the population, especially in developed countries, and thus telemedicine serves as a tool to make better use of resources.

Telemedicine may or may not be a substitute for a physician or other health worker in a patient relationship. On the contrary, it may be an opportunity to enhance the integration of various health care services, thereby contributing to improved care directed towards the patient. Therefore, telemedicine, or telemedicine service, can be a valuable tool for the cost-effectiveness of a country's health sectors. However, numerous Telemedicine schemes have shown to be difficult to implement in an organization. It is therefore essential to seek the views, goals and experiences of users and providers of healthcare services to find and address issues prior to the full implementation of telemedicine.

Information infrastructure is a set of interdependent structural components that, through the exchange of information, can form a framework that supports a whole structure. Establishing or implementing a tele-health tool needs the development of an information infrastructure framework and negotiations. To be successful, it is not enough to rely on a combination of conventional approaches and strategies. All researchers in the field of information technology and health sciences acknowledge the significant role of information technology in healthcare services. Nowadays, patients no longer need to visit physicians directly to treat physical or mental illnesses. Electronic communication with physicians can enable them to receive treatment by sitting in their homes. Information technology plays a critical role in the admission of the patient in the hospital, the treatment provided by the technology while the patient is in the hospital, and the provision of treatment information to the patient if they stay at home after receiving emergency treatment from the hospital. However, the development or implementation of an IT application into health care practices cannot be achieved through the mere application of a modern technology.

2. Theoretical Background

In the past half-century, telehealth has appeared as one of the most innovative IT systems to be incorporated into healthcare services. Wootton (2003) and others have documented the rapid growth of telehealth in the past fifteen years. In recent years, numerous studies have been conducted to evaluate the potential of clinical telehealth applications. However, only a few studies have focused on the social impact of telehealth applications in developing nations.

It has been suggested by Tan *et al*., (2005) that the development of Telemedicine can be divided into three historical periods. The first period was focused on improving clinical care in specialties such as teleradiology, telecardiology, teledermatology, and telepsychiatry. Most of the studies in this phase were conducted using POCs, and the second historical period saw the emergence of digital technology. Computers were becoming increasingly common, and the methods of communication were rapidly converging. It was also suggested that interactive video can be used over WLAN networks at a significantly reduced cost compared to the traditional along television system. Studies in this phase began during the introduction of computer-aided digital teleconferences. The third historic period focused on raising standards, using wireless technologies, and addressing security, confidentiality, and privacy concerns, as well as legal issues related to authority and reimbursement.

Many healthcare institutions are embracing telemedicine for the purpose of improving healthcare services; increasing effectiveness and efficiency; and enhancing competitiveness. The readiness of the healthcare institution and the availability of suitable conditions are driving motivations for telemedicine adoption. However, prior studies have shown that the success of an initiative in telemedicine can be affected by the culture and work processes of the institution (Robinson, 2003) [32]. In short, the term "collaboration" is used to describe any activity that a couple or group of people engage in together. In the context of learning sciences, the various definitions of collaboration emphasize the idea of co-building of knowledge and the mutual involvement of participants. For example, emphasized the importance of shared understanding and defined collaboration as a coordinated, synchronized activity that is the outcome of a continuous effort to construct and sustain a shared understanding of a problem. Collaboration is working together to achieve shared goals; within cooperative activities, individuals seek to achieve outcomes that are helpful to themselves and to all members of the group.

Organizing these fundamental components into group learning contexts eases cooperative efforts and facilitates the disciplined application of cooperative learning principles for long-lasting outcomes (Kaplan; 2000) [24]. The advantages of collaborative learning include the exchange of different perspectives in a collaborative setting and the cultivation of a collective understanding and knowledge. At present, it is widely accepted that collaboration is synonymous with good learning and effective educational technology; in fact, nearly all web-based applications are classified as collaboration.

The increasing cost of health care and the rapid development of knowledge have necessitated the need for health care professionals to collaborate in order to share knowledge and abilities. It is widely accepted that health care teams that operate in a collaborative manner are able to provide health care effectively and efficiently. The collaborative learning process of small groups involves the exchange of ideas, which not only increases the interest of participants in the group, but also encourages critical thinking. To foster collaboration in health care, a platform and governmental role must be established to facilitate the sharing of knowledge and experiences between employees. According to Sherry L. L. *et al*. (2004), collaborative health care teams are commonplace in hospitals and LTCs, however, they are often not accessible to providers in communities where most practitioners work alone. A team-based health care provider could provide support for such community-based providers, as well as facilitate the sharing of information in a more efficient manner. Through collaboration, group members become more flexible and ultimately replaceable, as the group becomes a learning community.

For health care services to foster collaborative learning, it is essential to create an environment that encourages and supports the sharing of knowledge, such as: government policies; IT infrastructure; top management support; and

business process management. To ensure that employees have the opportunity to discuss and reflect, it is important to form a pedagogical point of view. Educators have long recognized discussion as a powerful tool for promoting learning. According to Wessner M. *et al*., (2002), collaborative learning has the potential to facilitate active, constructive, experiential learning; in a collaborative learning environment, learners work together to carry out educational activities, activities, projects, and other activities. Effective communication is essential for the successful functioning of complex healthcare environments; providing optimal patient care necessitates the coordination of multiple teams and services within a health system.

To achieve this coordination, effective communication between and/or within teams is essential. Effective communication can be defined as being clear, comprehensive, precise, timely and necessitates verification from stakeholders. Verification is essential to the process, as stakeholders in the communication act must ensure that the purpose of the message being sent is understood and agreed upon. The healthcare domain is a multi-disciplinary environment in which professionals from multiple fields collaborate to provide care to patients.

Previous research has highlighted the importance of collaboration in healthcare for two reasons. Firstly, due to the increased complexity of patient care due to the implementation of modern technologies, nurses are now performing tasks that used to be the responsibility of doctors, and some tasks that were previously performed by full-time nurses have been delegated to auxiliary nurses or other administrative staff. This includes tasks such as washing, dressing, feeding, and serving meals, as well as requesting medical records from patients' general practitioners or hospitals. Secondly, patient care is not solely medical care, but involves the input of healthcare professionals from a variety of disciplines. Areas of healthcare that experience the most significant shifts towards truly distributed patient care are those in which professionals from different fields have a significant impact on the collective effort to improve a patient's condition, such as in the area of cancer care, where the various needs of cancer patients can only be satisfied through the effective collaboration of professionals from multiple fields.

The Telemedicine Performance Dimensions address the issue of the unequal geographical distribution of healthcare facilities and resources. Developed countries have various levels of healthcare facilities and specialist expertise. The lack of access to healthcare and the increasing cost of healthcare due to the high prevalence of disease continue to be a concern in developing countries. Telemedicine has been identified as one of the strategies to improve health outcomes and reduce healthcare costs. Furthermore, the potential of Telemedicine systems to enhance access to healthcare and its efficiency can be anticipated.

Telemedicine is expected to address four major research and practitioner concerns: first, it will facilitate access to healthcare for remote, isolated, and confined patients by reducing geographical barriers, thus having a positive impact on organization learning. Secondly, it will promote human resource development, and thus have a positive impact on physician recruitment and retention in rural areas. Thirdly, it will improve quality of care by providing clinicians with more up-to-date information regarding the patient, thus positively impacting patient satisfaction. Fourthly, it will provide healthcare staff with valuable information through the internet that may be essential for patient care, thus reducing misdiagnosis of patients and enhancing the professional experience of local physicians. Finally, from an economic point of view, the adoption of telemedicine may improve efficiency and effectiveness.

3. Problem Statement

The Indian health care system still has a manual record keeping system, which presents several challenges. The primary challenge that medical personnel may encounter is that records for all patients must be maintained manually in the default document format. This makes it difficult for healthcare providers to access medical records within the system, as each file must be reviewed individually. Furthermore, the manual record keeping system does not offer a practical backup of records. In the event of a loss or damage to records due to an unfortunate incident, the records will be irrevocably destroyed. The shift from analogue to digital communication methods has sparked global interest, including in India, for healthcare-care providers to implement telehealth. This has opened new and more effective ways for healthcare-care organizations to anticipate and implement new and innovative ways to deliver care. When records are maintained manually, it can make it difficult or even impossible for providers to share information or provide care to the patient, as they would not be able to access the valuable insights that a patient's health history can provide.

In the past, hospitals and other healthcare providers were eager to incorporate innovative technology into medical procedures and treatments. However, innovation in networking and communication has been less prominent due to security and privacy concerns. This is because healthcare has traditionally been delivered locally and in-person. For example, in India, many hospitals and healthcare facilities still use paper-based systems. This has over time resulted in delays in the transfer of medical test results, as well as a high level of human error due to most essential processes and routines still being performed manually. The issue of medical errors was highlighted in 2002 by the Association of Clinical Chemistry and is likely to receive greater attention in the future. This article aims to explore the potential implications of an automated healthcare management system that could be used as a platform to improve the quality of healthcare by utilizing telemedicine.

3. Research Objectives

1. Determine the most common elements or variables that affect the uptake of telemedicine in India's healthcare system.
2. To find whether there is any meaningful positive link between each of the independent variables-Ease of Use, Usefulness, Efficiency, and Quality-and the dependent variable-the adoption of Telemedicine in the Indian health care system.

4. Data

The five processes that made up the methodical aspect of the research process-information gathering, analysis, and interpretation-were all part of the research process. The research technique consisted of the steps used to discover the answers to the study questions.

Fig 1: Process of Study

4.1. Hypotheses

The major hypotheses of this study are:

H_1: Organizational role is positively associated with telemedicine transfer.

H_2: Governmental role is positively associated with telemedicine transfer.

H_3: Collaborative platform is positively associated with telemedicine transfer.

H_4: Telemedicine performance is positively associated with efficiency & effectiveness.

H_5: Telemedicine performance is positively associated with organizational learning.

H_6: Telemedicine performance is positively associated with patient satisfaction.

H_7: Telemedicine transfer is positively associated with telemedicine performance.

4.2. Sample

The Non-Probability Conventional Sampling (NPCS) method was highly beneficial in this study, as it enabled the researcher to select samples that were easily accessible to them. This method is the simplest, most cost-effective, and least time-consuming approach, as rapport and trust with respondents is established, and the insider's perspective is obtained. Furthermore, it allows for thorough investigation of causes and information, and does not involve a high cost. However, the disadvantage of this approach is the potential for bias in the selection of the sample. The sample consisted of national Hospitals operating in various fields, with the primary criteria being the type of hospital in different areas and states, with a particular focus on Kolkata, and suburbs. The number of employees employed by the hospitals was also taken into consideration, ranging from under 150 to over 400, and the financial strength was also taken into account. To prevent the introduction of bias, the sample size was determined to be sufficiently large to ensure the reliability of the data collected. Prior to the selection of the sample size, parameters such as accuracy and reliability, population size, and time were considered. The Roscoe's rule of thumb for sample size was 30 to 500.

4.3. Data Collection Process

Several resources were employed for the research's purposes, which facilitated the comprehension and in-depth knowledge of secondary data as well as the analysis of primary data.

5. Data Analysis and Results

5.1 Descriptive Analysis (Demographic Information)

Using frequencies and cross tabulations, the first section's objective was to create a generic profile of the respondents by adding descriptive data on the following traits. Therefore, the following analyses were done to check on the characteristics of the respondents.

Table 1: Demographic results

Highest level of education	No.	%
Highest level of education	No.	%
Bachelor	158	75.24%
Master	47	22.38%
High diploma	3	1.43%
PhD	2	0.95%
Total	210	100
Specialty	No.	%
Physicians	119	56.67%
Nursing	91	43.33%
Total	210	100
Type of organization	No.	%
Private	108	51.43%
Public	81	38.57%
NGOs	21	10.00%
Total	210	100
Telemedicine knowledge	No.	%
Somewhat knowledgeable	102	48.57%
Knowledgeable	56	26.67%
Very knowledgeable	11	5.24%
Not knowledgeable	41	19.52%
Total	210	100

Source: Author's own calculation from SPSS

5.2 Confirmatory Factor Analysis

Informal factor analysis is a technique used to evaluate a set of measured variables. The primary applications of factor analysis are data reduction and structure detection. Generally, EFA (Experimental Factor Analysis) and CFA (Confirmatory Factor Analysis) are conducted by evaluating the pattern of correlation between the measures observed. EFA is a procedure for determining the structure of a set of variables. CFA, on the other hand, is a procedure for testing the hypothesis of the structure formed by a prior basis. In practice, the EFA procedure and CFA procedure tend to converge, indicating differences in degree. EFA is employed to identify the number of general factors influencing a collection of measures, as well as the strength of relationships between each of the factors and each of the measures observed. CFA is employed to evaluate the fitability of a pre-defined factor model to an observation set. CFA guarantees that, when a factor analysis is performed on

all items in the tool, each element is loaded onto the construct that it is supposed to be assigned to.

In Hair *et al*. (1998), EFA analysis was found to be most suitable for the initial stages of model formation, while CFA was found to be a more effective tool in the later stages of research, once a model is established. The results of the confirmatory factor analysis were used to evaluate the measurement. Factors can be used to define indicators of construct, to define dimensions underlying measurement instruments, to determine which items or scales to include or exclude from a measure, and to analyze scale items of ten research constructs. The construct validity of a measurement scale was also examined. The suitability of the data analysis was assessed by using Bartlett's Test of Sufficient Variables, which found that the Inter correlation Matrix contained sufficient common variance for factor analysis to be worthwhile, as well as using a KMO measure of Sampling Adequacy (KMO).

KMO is a measure of the degree to which the variables of a construct are homogeneous. McCallum (1996) suggested that values higher than 0.50 are acceptable, and that values below this should either lead to more data collection or re-evaluation of the variables to be included. Other acceptable values are 0.5 to 0.7, 0.7 to 0.8, 0.8 to 0.9, 0.9 to 0.10, and 0.05 to 0.11. Low factor loading is defined as factor loading less than 0.50, and any low factors should be removed from the analysis to identify underlying factors that account for the joint variation of the items measured. The principal components are extracted in the unrounded factor solution with an Eigenvalue of more than one, and the Varimax rotation method is used to matrix the factor loading of each variable to each factor. These principal components are used to identify the primary subfactors for the critical factors of the telehealth transfer and telehealth outcomes.

The factor analysis for each construct of the research model is presented below. Statistical Cronbach's alpha is an important measure of reliability for a psychometric instrument. As correlations between items increase, Cronbach's alpha tends to increase, which is why the coefficient is also referred to as internal consistency. Internal consistency is the degree of homogeneity of a scale and is typically related to the interrelationship between items on the scale for all respondents to the item. It is important to note that the degree of reliability depends on the instrument used. For example, some professionals, generally, require 0.70 reliability or higher before using an instrument. However, caution should be exercised when calculating Cronbach's alpha from items that systematically breach its assumptions. Cronbach's alpha was analyzed using Statistical Polynomial Statistics version 17. As summarised in Table 3 and Table 4, all values were within the acceptable range of 0.70.

Table 2: Results of factor analysis (Independent variables)

Item frequency	Factor loadings	Variance explained (%)	Cronbach's Alpha	KMO
Governmental role		52.9	0.73	0.7
The government influences the demand of telemedicine transfer (for training; example: by providing skill and providing programs for telemedicine awareness and promotion).	0.76			
The government influences the supply of telemedicine transfer (for example: by funding telemedicine research and innovation; by providing educational and training and services; and subsidizing telemedicine development).	0.75			
Government ICT policies specifically create awareness and promote use of telemedicine.	0.83			
Government ICT policies focusing on safeguard and ensure on the security, and privacy, standard, confidentiality of telemedicine transfer.	0.78			
Collaborative platform		0.62	0.73	0.71
Using wireless devices in telemedicine such as PDA or mobile technology indicate good performances on both patient discovery and wireless monitoring.	0.79			
Combining the use of Bluetooth technology with a personal digital assistant (PDA) allows easy access to hospital database and to communicate with external medical devices.	0.86			
Using e-mail and intranet facilitates communication and discussion with other professionals.	0.85			
Health care professionals, administrators, patients, and other stakeholders are actively involved in the design and development of the telemedicine system.	0.89			
Organizational role		0.39	0.7	0.71
The organization generally supports and actively promotes the structural change when introducing telemedicine.	0.78			
The organization is generally aware of the concept and benefit of and willing to allocate new telemedicine responsibilities (technical and administrative personnel, etc).	0.75			
The significance and prevalence of the problems to be addressed, the needed information being available on a timely basis, burden of illness (e.g., mortality, quality of life), variability across regions or population subgroups.	0.87			
Top managers support the project by word and action.	0.74			

Source: Author's own calculation from SPSS

Table 3: Results of factor analysis (Independent variables)

Item frequency	Factor loadings	Variance explained (%)	Cronbach's Alpha	KMO
Organizational learning		0.48	0.78	0.73
Telemedicine performance can facilitate the group's discussion	0.78			
Telemedicine services will increase communications among health professionals.	0.83			
Telemedicine could improve continuity of care for patients.	0.85			
Telemedicine services will enhance alliances among healthcare organizations	0.84			
Patient satisfaction		0.48	0.71	0.77
Telemedicine service enhances patient satisfaction.	0.69			
Telemedicine is based on the need of the patient & practitioner (For example limit access to health care, travel long distances for specialized services, isolation of practitioners)	0.75			
Those of my colleagues who have used telemedicine have been satisfied with their patient outcomes.	0.81			
I am satisfied with the quality of telemedicine and outcomes which reflected on patient satisfaction.	0.78			
Patients are likely to receive better quality care by using telemedicine technology.	0.76			
Effectiveness and efficiency		0.51	0.77	0.63
It is easy to recover from mistakes when using telemedicine technology.	0.75			
Patients are likely to receive better quality care at time by using telemedicine technology.	0.92			
The significance and prevalence of the problems to be the needed information being addressed, available on a timely basis, burden of illness (e.g., mortality, quality of life), variability across regions or population subgroups.	0.9			
The likelihood of the impact of telemedicine on cost reduction affects the decisions about adoption of telemedicine and integration into routine operations	0.89			

Source: Author's own calculation from SPSS

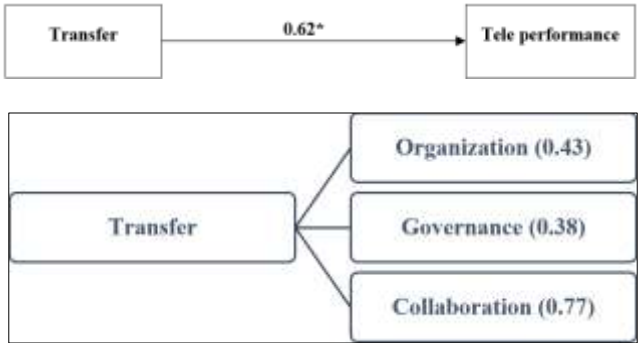
6. Discussion of Results

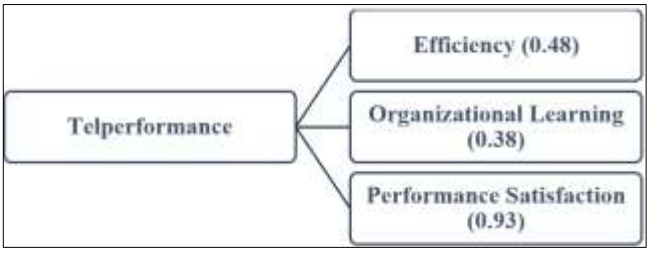
This study presents the conclusions drawn from a valid and reliable instrument for the purpose of the current study. The measurement tools comprise six constructs: Organizational role; Governmental role; Collaboration; Organizational learning; Patient satisfaction; and Efficiency. All these constructs have been tested using statistical methodologies such as Key Measurement (KMO), Convergent Analysis, Discriminant Analysis, and Confirmatory Factor Analysis. All the scales meet the required reliability and validity criteria, and the development of such scales will significantly stimulate and facilitate theoretical development in this area. The supporting results allow the researcher to confirm the main hypotheses; the conclusion is drawn as presented in Table 4.

Table 4: The supporting results allow the researcher to confirm the main hypotheses

The main hypotheses	T Value	Standardized solution (Direct effect)	Result
H_1: Increasing of organizational role is positively related to telemedicine transfer.	2.10*	43	Supported
H_2: There is a direct positive relationship between governmental role and the telemedicine transfer.	2.03*	0.38	Supported
H_3: There is a direct positive relationship between collaborative platform and telemedicine transfer.	3.16*	0.77	Supported
H_4: Telemedicine performance is positively to efficiency and related effectiveness of health services.	2.34*	0.48	Supported
H_5: Telemedicine performance is positively related to organizational learning of health services.	2.08*	0.38	Supported
H_6: Telemedicine performance is positively related to patient satisfaction.	3.69*	0.93	Supported
H_7: Telemedicine transfer is positively associated with telemedicine performance.	2.86*	0.62	Supported

Source: Author's own calculation





7. Conclusion

Finally, with respect to the study conclusions there are many other strategic issues that influence on telemedicine adoption in India such as:

- To effectively serve most rural areas, telemedicine must primarily focus on primary care, where most issues can

be resolved by obtaining a second opinion, including radiological, dermatological, pathological, and ophthalmic services.
- The implementation of telemedicine systems needs the dedication of all stakeholders, particularly governmental support.
- It is essential for physicians to be involved in the creation and implementation of telehealth services, as they must have access to the system to be accepted.
- For telemedicine to be effective, it is essential that the technology is user-friendly and that the users are provided with the necessary training and support to enable them to perform their duties.
- It is essential that medical schools are provided with the necessary instruction and that seminars and workshops are organized for those who specialize in the use of technology.

8. Conflict of Interest
Not available

9. Financial Support
Not available

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