

# INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATION & MANAGEMENT

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# CONTENTS

| Sr. No. | TITLE & NAME OF THE AUTHOR (S)  | Page No.  |
|---------|---|-----------|
| 1.      | PERFORMANCE MANAGEMENT SYSTEM IN A POWER PSU: A STUDY OF T.H.D.C. INDIA LIMITED<br><i>SHANTANU KUMAR BISWAS, ADITYA GAUTAM &amp; ASHUTOSH KUMAR ANAND</i>                                       | 1         |
| 2.      | PEDAGOGICAL INNOVATIONS IN THE TEACHING LEARNING PROCESS<br><i>DR. AMARDEEP KAUR</i>  | 9         |
| 3.      | CRITICAL SUCCESS FACTORS IN ERP IMPLEMENTATION: A REVIEW<br><i>SANGRAM SINGH, VIRAT REHANI &amp; DR. J. K. DHAMI</i>  | 11        |
| 4.      | EFFECT OF INTERNAL BRANDING FACTORS IN DEVELOPING ORGANIZATIONAL COMMITMENT WITH SPECIAL REFERENCE TO HOTEL INDUSTRY IN INDORE CITY<br><i>VARUN KUMAR, DR.SANJAY SHARMA &amp; DR. A K SINGH</i> | 15        |
| 5.      | PROFITABILITY ANALYSIS OF HINDUSTAN PETROLEUM CORPORATION LIMITED<br><i>DR. C. K. BUTTAN &amp; RAANA SHAHWAL</i>  | 21        |
| 6.      | E-COMMERCE AND CONSUMER RIGHTS: A STUDY ON CONSUMER PERCEPTION WITH SPECIAL REFERENCE TO AHMEDABAD<br><i>NITA SOLANKI, DR. PARAMJEET SINGH &amp; DR. MEHUL SHAH</i>                             | 30        |
| 7.      | RELATIONSHIP BETWEEN OBJECT ORIENTED DESIGN CONSTRUCTS AND DESIGN DEFECTS<br><i>PAWAN KUMAR CHAURASIA &amp; R A KHAN</i>  | 35        |
| 8.      | IMPORTANCE OF STUDENT SUPPORT SYSTEM IN PROFESSIONAL INSTITUTES: TRENDS AND CHALLENGES<br><i>ANURAG DILRAJ &amp; DR. ASHOK JHAWAR</i>   | 39        |
| 9.      | LIQUIDITY STRUCTURE OF WORKING CAPITAL – TESTING OF THE HYPOTHESIS DEVELOPED BY VAN HORNE<br><i>DR. PRADIP KUMAR DAS</i>  | 42        |
| 10.     | RURAL CONSUMER SATISFACTION TOWARDS ONLINE SHOPPING<br><i>DR. N. BAGYALAKSHMI</i>   | 46        |
| 11.     | TELEMEDICINE: RECENT ADVANCES IN INNOVATIVE HEALTHCARE<br><i>DR. PANKAJ KUMAR VARSHNEY &amp; DR. MOHD FAISAL KHAN</i>   | 52        |
| 12.     | IMPACT OF GLOBALIZATION ON INDIA<br><i>PAWAN SHARMA &amp; DR. SHISH PAL HARDU</i>   | 56        |
| 13.     | DEMONETIZATION IMPACT ON TEXTILE INDUSTRIES IN BHIWANDI, THANE<br><i>DR. RASHMI SONI &amp; SHEBAZBANO</i>   | 58        |
| 14.     | A STUDY ON STRESS MANAGEMENT AMONGST FEMALE BANK EMPLOYEES IN TAMIL NADU DURING DEMONETIZATION<br><i>DR. J. RAMOLA PREMALATHA &amp; PRIYADARSHINI.SR</i>  | 62        |
| 15.     | THE CONTENTS OF WOMEN EMPOWERMENT IN SOLAPITH CRAFT PRODUCT: A CASE STUDY OF DHUBRI DISTRICT<br><i>JAHDUL ISLAM</i>   | 66        |
| 16.     | CONSUMERS PERSPECTIVE TOWARDS SOLAR PANEL PRODUCTS<br><i>S. DEVI PRIYA &amp; DR. N. RAJA</i>  | 68        |
| 17.     | DETERMINANTS OF ENTREPRENEURIAL DECISION-MAKING AMONGST FINAL YEAR STUDENTS IN TERTIARY INSTITUTIONS: A QUALITATIVE STUDY<br><i>MARIJKE A. ADOBEA OKYIREH &amp; REXFORD OWUSU OKYIREH</i>       | 74        |
| 18.     | A STUDY OF BENEFITS OF GST OVER INDIRECT TAX SYSTEM USING KNOWLEDGE DISCOVERY PROCESS OF DATA MINING<br><i>SAVITA MOHURLE</i>   | 78        |
| 19.     | FOREIGN DIRECT INVESTMENT POLICIES IN THE LIBERALIZED TELECOM SECTOR OF INDIA - A REVIEW<br><i>SAKSHI SHARMA</i>  | 81        |
| 20.     | APPLYING A COMPREHENSIVE CREDIT RATING FRAMEWORK TO THE TRANSPORTATION AND LOGISTICS INDUSTRY IN INDIA<br><i>T. SAI HARISH KUMAR</i>  | 84        |
|         | <b>REQUEST FOR FEEDBACK &amp; DISCLAIMER</b>  | <b>92</b> |

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**TELEMEDICINE: RECENT ADVANCES IN INNOVATIVE HEALTHCARE****DR. PANKAJ KUMAR VARSHNEY****ASSOCIATE PROFESSOR****DEPARTMENT OF APPLIED BUSINESS ECONOMIC & RESEARCH****FACULTY OF COMMERCE****S V (P G) COLLEGE****ALIGARH****DR. MOHD FAISAL KHAN****ASST. PROFESSOR****DEPARTMENT OF HEALTH & HOSPITAL MANAGEMENT****SCHOOL OF MANAGEMENT AND BUSINESS STUDIES****JAMIA HAMDARD (HAMDARD UNIVERSITY)****NEW DELHI****ABSTRACT**

*Telemedicine is the use of telecommunication and information technology to offer clinical health care from a distance. It has been used to defeat distance barriers and to improve access to health care services that would frequently not be consistently available in distant rural areas. It is the instant solution to increasingly complex healthcare issues. It is also referred to as telehealth or e-health. It is the use of "connected" medical devices in the evaluation, diagnosis and treatment of patients who are located at distant geographical locations. It offers the inborn advantage of distantly accessing the best of health services without the need to travel distances to reach an expert medical practitioner. It is also used to save lives in critical care and in emergency. There have been path-breaking advances in information technology, which has led to the incredible achievement of linking doctors and patients who may be thousands of miles away. Ground-breaking innovations in the field of telecommunications have turned the world into a global village.*

**KEYWORDS**

tele-health care, tele-education, telemedicine offerings, models of telemedicine.

**HISTORY**

In the early 1900s, people living in remote areas of Australia used two-way radios, powered by a dynamo driven by a set of bicycle pedals, to communicate with the Royal Flying Doctor Service of Australia.

The first interactive telemedicine system, operating over standard telephone lines, designed to remotely diagnose and treat patients requiring cardiac resuscitation (defibrillation) was developed and launched by an American company, Med Phone Corporation, in 1989. A year later under the leadership of its President/CEO S Eric Wachtel, Med Phone introduced a mobile cellular version, the MD Phone. Twelve hospitals in the U.S. served as receiving and treatment centers (<https://en.wikipedia.org/wiki/Telemedicine>).

Attempts to apply telecommunications technology to enhance and provide healthcare over dispersed geographic locations date back to the early 1960s (Garshnek & Hassell, 1999).

**INTRODUCTION**

"*Tele*" is a Greek word meaning, "distance" and "*mederi*" is a Latin word meaning "to heal". Time magazine called telemedicine "**healing by wire**".

Telemedicine has a variety of applications in patient care, education, research, administration and public health. Worldwide, people living in rural and remote areas struggle to access timely, good-quality specialty medical care.

Residents of these rural and remote areas often have substandard access to specialty healthcare, primarily because specialist physicians are more likely to be located in areas of concentrated urban population. Telemedicine has the potential to bridge this distance and facilitate healthcare in these remote areas (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2782224/>).

Telemedicine is the use of "connected" medical devices in the evaluation, diagnosis and treatment of patients who are situated at other locations. It refers to the use of web-enabled technology in the medical processes of diagnosing and treating patients who may otherwise be miles away. Telemedicine has emerged as a combination of telecommunications and medical information sciences (Mishra, 2003).

Telemedicine Information Exchange (1997) has defined telemedicine as the "use of electronic signals to transfer medical data (photographs, x-ray images, audio, patient records, videoconferences, etc.) from one site to another via the Internet, Intranets, PCs, satellites, or videoconferencing telephone equipment in order to improve access to health care." Reid (1996) defines telemedicine as "the use of advanced telecommunications technologies to exchange health information and provide health care services across geographic, time, social, and cultural barriers."

**Key drivers for telemedicine projects are:**

Huge rural population, the time-lag factor, cost effectiveness, technological innovations, breaking geographical boundaries and knowledge enhancement (e-Health, 2007).

**APPLICATIONS**

1. **Tele-health care:** It is the use of information and communication technology for prevention, promotion and to provide health care facilities across distance. It can be:

- Teleconsultation
- Telefollow-up

2. **Tele-education:** It should be understood as the development of the process of distance education (regulated or unregulated), based on the use of information and telecommunication technologies, that make interactive, flexible and accessible learning possible for any potential recipient. (<http://www.aiims.edu/aiims/telemedicine/tepage.htm#Applications>)

**Telemedicine Facility**

Patients have access to medical practitioners through computer networks. The two parties can see and talk to each other through teleconferencing or videoconferencing facilities over the network. Medical data like reports, pictures, figures, samples, heartbeat, pulse rate, blood pressure all can be transmitted over the network by connecting medical devices to computers.

**Telemedicine Centres**

There are two types of centers viz. consulting center (local/nodal site on the patient's end) and specialty center (the central hub at the specialist's end).

- 1. Telemedicine Consulting Center:** Here video-conferencing equipment, diagnostic equipment and software are integrated onto one platform which allows capture of patient EMR (Electronic Medical Record) data such as patient history, diagnosis, vital signs, etc.; capture of diagnostic images like X-rays, CT scans, etc.; scheduling of appointment with the specialist; transfer medical records and diagnostic images to the specialist.
- 2. Telemedicine Specialty Center:** The software on this side enables the specialist to confirm appointments; download EMR sent from local site; view diagnostic data and slice, flip, magnify, measure etc. while viewing output of CT-Scans etc. via video conferencing and send specialist comments to the local site.

**Telemedicine Media**

Connectivity between the specialty and local centers can be provided through the use of the following media:

- **Internet:** The most popular media for telemedicine is the Internet. The Internet, which is one big web that connects people across the globe, is used to hold videoconferencing sessions, chats, mails and other such online exchanges of data, sound and image.
- **Intranet:** The intranet is a private network that is located inside an organization's building, premise or campus and works just like the Internet. Intranets can be used for quick exchange of data between two different departments or practitioners in a large medical facility without the need of moving between rooms and corridors.

**Telemedicine Offerings**

Five major types of services may be provided by way of telemedicine:

- 1. Diagnosis-** Doctors can examine patients through their video footage on computer screens. Suitable measuring devices can be connected to the computer to access heartbeat, blood pressure etc.
- 2. Prescription-** Through online examination, the practitioner can evaluate a patient's problems and prescribe the necessary drugs and dosages.
- 3. Consultancy-** Medical practitioners dispense with professional advice and can hold counseling sessions over the network.
- 4. Virtual Treatment-** Advances in IT are today helping medical practitioners to hold online surgeries, operations, amputations and such other forms of treatment.
- 5. Information Dissemination-** Health care service providers can use the net to share views and provide information to present and prospective clients about healthcare benefits, facilities and developments.

The **applications** involved in providing above services are:

- **Teledermatology:** Physical examination of the patient for skin ailments.
- **Teleradiology:** Reading still and full motion radiographic images.
- **Telepathology:** Analysis of tissue histology samples.
- **Telemedication:** Prescribing the necessary medicines.
- **Telemonitoring:** Guiding surgical and other clinical procedures.

**Categories of Telemedicine Services**

Two major categories of telemedicine services can be:

- 1. Live:** Real time transmission where the consulting professional participates in the examination of the patient while diagnostic information is collected and transmitted.
- 2. Store and forward:** A transmission mechanism where the medical professional reviews data asynchronously and extends his advice.

**Advantages of Telemedicine**

Blakeslee *et al.* (1998) concluded the following as advantages of telemedicine:

- Increasing access to specialty consultants.
- Increasing information exchange among physicians
- Enhanced patient-doctor relationship.
- Enhanced continuity of care.
- Less indirect cost to the patient and physicians.
- Increasing ability to network among physicians participating in new health care delivery organizations.

**Models of Telemedicine**

Three major models:

- 1. Access Model:** Telemedicine provides service accessibility to remote and distant areas by linking people through the use of telecommunication devices. It helps improve access to specialty services without the need for the patient to travel a long distance to a facility where those services are being actually provided.
- 2. Competition Model:** Telemedicine helps improve the competitive position of health-care service providers by helping them leverage their potentials far and wide. It helps enlarge market and thus capture profitable business opportunities. Customarily, the market zone of a health care service provider has been limited to the distance a patient is willing to commute. It helps export medical expertise to any location, which is equipped with the requisite infrastructure.
- 3. Cost Saving Model:** Telemedicine involves huge initial outlays, the resulting benefits far outweigh the costs. Costs are lowered in the long term due to increase in service usage rate. Such cost savings accrue to service providers due to reduction in variable cost of telemedicine implementation.

**IMPLICATIONS FOR MANAGERS**

Three major categories of managerial issues can be identified:

- 1. Implementation Functions**
- 2. Implementation Procedure**
- 3. Implementation Barriers**

- 1. Implementation Functions:** Important implementation issues result from the requirements of different functional areas of management.

**Production Technology:** Technology is the spirit of telemedicine. It involves the heavy task of choosing the right technology mix that optimizes the returns.

Technology mix would involve crucial decisions on three fronts:

- **Hardware requirements-** Telemedicine involves the use of hybrid technology incorporating elements of television, telecommunications, computers, and engineering. Clinical details of patients located in remote area including his ECG, X-Rays, CT scan and other diagnostic images are transmitted through telephone lines to a doctor located at a specialist hospital. The doctor analyses the data and transmits back his diagnosis and advice to the remote center. Commonly used telemedicine equipment are:

- E-scope
- General Examination Camera
- Videophone
- Illumination and Imaging System
- Auscultation System

- **Software requirements-** Development of integrated telemedicine system involve a number of software issues:

- Application Software
- Device Interfaces

- **Networking requirements-** Two major types of networking requirements can be identified depending on "live" or "store-and-forward" typologies:

- Live telecommunication option
- Store-and-forward telecommunication option

**Marketing:** Telemedicine service provider has to be clear about the following aspects related to marketing:

- *Product:* Product mix may include diagnosis, prescription, consultancy, virtual treatment and information sharing.
- *Pricing:* An appropriate pricing strategy will have to be evolved.
- *Placement:* Service provider needs to determine the reach, extent, scope and coverage.
- *Promotion:* Appropriate promotional tools along with informative communication need to target the intended beneficiaries.

**Human Resource Initiatives:** For smooth implementation of the programme, the management will have to provide for effective design of the Human Resource System and practice for the same.

- *Human Resource Planning:* Four broad classes of manpower requirements can be identified in the context of telemedicine
- *Managers:* There would be need for *Programme Managers* for overall general management, *Functional Managers* for managing different functional area activities, *Clinical Managers* for liaison between different units and centers and *Site Managers* for overseeing the individual telemedicine sites.
- *Administrators and programmers:* These would involve network specialists, programmers, system analysts, network administrators and managers of information systems.
- *Service Dispensers:* The programme would require doctors, consultants, nurses and other medical professionals both at the local site as well as the specialist centers.
- *Support Staff:* A number of varied services will be required to support the programme. Support staff would dispense with necessary administrative, technical and advisory function related to finance, marketing, human resource, etc.
- *Training:* Appropriate training will have to be given to the personnel for effective and efficient management of technology and technological devices for quality assurance.
- *Remuneration:* Suitable compensation packages will have to be designed for the different categories of personnel.

**Finance:** Financial implications may be considered in two categories:

- *Capital Budget:* Implementation of the programme would require capital expenditure in site setup, equipment, software, networking and other infrastructure.
- *Operating Budget:* Management of day-to-day operation of the telemedicine programme would involve routine expenses like compensation and training of staff, systems maintenance, telecommunications costs etc.

## 2. Implementation Procedure

Following steps may be involved in the implementation procedure:

- *Spell out* the programme needs and objectives
- *Specify* the nature of service to be offered
- *Analyze* the likely costs and benefits of the investment
- *Lay down* activating strategy in terms of required resources
- *Specify* site location and site design
- *Set up* the initial infrastructure and equipment
- *Undertake* step-by step implementation of the programme
- *Establish* monitoring and review mechanism for smooth working
- *Measure* success using access, competition and cost-saving models
- *Rectify* any shortfall and follow-up the progress

**3. Implementation Barriers:** Often a number of barriers obstruct the flow of the implementation procedure

- *Educational barriers:* Lack of training and technical sophistication on the part of both users as well as service providers.
- *Legal barriers:* Regulatory restrictions on programme and procedural implementation from the government.
- *Social barriers:* Ignorance and xenophobia towards new technology and practices.
- *Financial barriers:* Resource constraints and financial stringency with respect to huge initial cost outlays.
- *Technical barriers:* Cost and availability of technical infrastructure for service delivery.
- *Emotional barriers:* Perceptual problems and non-acceptance of distance healing.

## TELEMEDICINE IN INDIA

Healthcare in India is not accessible to almost 80 per cent (620 million) of the population living in the rural areas that are deprived of quality healthcare. While in developed countries, there is one doctor for every 500 persons in India this ratio is one to 15,500. Medical specialists are mostly restricted to urban areas. Difficulty is also posed by India's vast geographical spread. In this odd situation, only a modern innovation like telemedicine can bridge the geographical distances. Rural patients can be prevented from travelling huge distances, and thereby avoiding significant expenses by being offered the same treatment by a local doctor with advice from a specialist living elsewhere (Srikanth, 2003).

Some studies (Mukherjee and Dhawan, 1999 & Lobo 2001; Brindha, 2013; Cherian, 2016) give a detailed idea of the type of activities that are going on in the field on telework in India and telemedicine is cited as one major emerging area. There have been quite a few efforts to use telemedicine at the initiative of the private parties. One can see a small but encouraging movement across the Indian landscape. Several initiatives have been made in different parts of the country (Radhika, 2001; Srikanth, 2003; Assocham, 2016):

- National Telemedicine Technology Project was launched involving the three premier Medical Institutions of the country i.e. Post Graduate Institute of Medical Education & Research, Chandigarh, All India Institute of Medical Sciences, New Delhi & Sanjay Gandhi Post Graduate Institute of Medical Education & Research, Lucknow.
- Private hospitals such as Apollo Hospital Group, Fortis Escorts Heart Institute and Research Centre, Escorts Heart Alert Service and Fortis Healthcare have made commendable strides in this sphere. Apollo Hospitals Group is a pioneer in the field of Telemedicine in India and is credited with being the first to set up a Rural Telemedicine Centre (March 2000) in the village of Aragonda in the state of Andhra Pradesh. The Group now has an extensive network of 32 Telemedicine Centres linking places like Chennai, Hyderabad, Calcutta and New Delhi with remote areas of the country like Kohima, Guwahati, Aragonada and Sriharikota.
- Asia Heart Foundation and Research Centre (Bangalore) has successfully been practicing telecardiology between Bangalore and cities in eastern India. Paramedics are guided to save the patients suffering from acute Myocardial Infarction (MI) by performing life-saving procedures as per directions from doctors over video conferencing. Recently, the Institute in association with the Cleveland Clinic Foundation, United States of America, has spelled out in its new initiatives the introduction of phased telemedicine facility linking all districts of Maharashtra through use of its sophisticated IT infrastructure.
- The Pune district administration has teamed up with doctoranywhere.com (India's first ISO 9002-certified telemedicine company) and Tata Council for Community Initiatives (TCCI) to launch a telemedicine service from a government Primary Healthcare Center.
- Ahmedabad based Online Telemedicine Research Institute (OTRI) provided telemedicine links for teleconsultation, thereby establishing 750 sessions in a period of 30 days in Bhuj after the earthquake in January, 2001. During the Kumbh Mela festival, which drew over 25 million pilgrims to the banks of river Ganga, the OTRI transferred data (cardiology and radiology data) of over 200 ailing pilgrims, besides sending microscope images of microorganisms to monitor levels of cholera-causing bacteria in the river.

- Indian Space Research Organization's decision to launch an exclusive satellite to service healthcare in 2004 has provided a major boost to the growth of the telemedicine industry in India.
- A pilot project is being carried out at IIT, Kharagpur, supported by the Ministry of Information Technology, in association with Institute of Tropical Disease (Howrah), in which an attempt is being made to treat patients at local telemed centers in remote areas.
- The Telemedicine Technologies Centre (Mumbai) is providing telemedicine services in India and Bangladesh, through expert opinions from specialist tele-consultants in the United States of America — saving both time and money.

It is heartening to note that the government has taken a series of steps to make telemedicine a success story. For instance, recently, the Ministry of Information Technology has framed guidelines for telemedicine. The framing of the guidelines has given a boost to an industry, which is seen by many as the only practical solution to India's healthcare problems. The government has also reduced import tariffs on infrastructure equipment. India's healthcare industry is worth over \$16 billion, and is expected to grow by 13-15 percent annually. Whatever the outcome, the age of telemedicine has arrived in India. India is expected to become a hot destination for telemedicine.

### CHALLENGES IN IMPLEMENTING TELEMEDICINE

- Identification of a Suitable site and preparation of site for Telemedicine facility.
- Synchronization of civil, electrical and equipment related works.
- Identification of a nodal officer for coordinating Telemedicine activities in the hospital.
- Sensitization and repeated hands-on training of concerned Doctors, Technicians and Nurses.
- Coordinating with referral centers to fix mutually convenient tele-consultation sessions on a regular basis.
- Ensuring trouble free and smooth connectivity ("Telemedicine Projects in West Bengal", 2006).

### WAY FORWARD

- Hand-holding support to Hospital administration for 3-4 years for stabilization of telemedicine services.
- Integration of Telemedicine activities with Health Management Information System for regular reporting (preferably web-based).
- Including Telemedicine activities in the performance appraisal of individuals and institutions.
- Introducing Telemedicine (concept, technical aspects and implementation arrangements) as part of medical education & continuing medical education (CME) ("Telemedicine Projects in West Bengal", 2006).

### TELEMEDICINE FACILITIES FOR ARTHUR ROAD JAIL INMATES

The Arthur Road Jail in Mumbai has equipped itself with telemedicine facilities for ailments like skin infections, which over 2500 jail inmates suffer from (Yadav, 2017). This activity, has been launched in co-ordination with the state-run JJ Hospital. It is expected to decrease the burden on the local police escort staff that accompanies a prisoner every time he is taken to a hospital. The risk of a prisoner running away in transit will also be taken care of.

Prior to Arthur Road Jail, certain prisons like Nashik had been equipped with the telemedicine facility for basic problems that the inmates suffered from, like cold and cough.

### CONCLUSIONS

Telemedicine seems to be just the right answer to increasingly complex healthcare issues. It is the use of "connected" medical devices in the evaluation, diagnosis and treatment of patients who are situated at distant geographical locations. It offers the inherent advantage of remotely accessing the best of medical services without the need to travel distances to reach a specialist medical practitioner.

Revolutionary innovations in the field of telecommunications have turned the world into a global village. It has become possible for people to get "virtually" treated by doctors through a communications network.

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