# A Prospective Study of Technological Aspects in Discrete Telemedicine Networks and its Impact based on Telemedicine

[1]**Virender Sorout,**
Department of Management, Jagannath University, Jaipur
Mail ID: kishanhospital@gmail.com
Co-Author
[2]**Prof. (Dr.) Vaishali Sharma**
Director IQAC, Jagannath University Jaipur
Corresponding mail ID: kishanhospital@gmail.com
[3]**Seema,**
Research Scholar, Department of Management, Jagannath University, Jaipur

**Abstract**
**Introduction:**"TELEMEDICINE" (Healing by Wire) has been bestowed to humanity by the growth of ICT, and it has also emerged as a rescuer in the Indian healthcare delivery system. Telemedicine's influence on a nation's ICT (information and communication technology) infrastructure may be seen in the size and form of its ICT infrastructure.
**Aims and objective:**The goal of the research was to see whether distinct networks would have an influence on telemedicine.
**Material and method:**A survey (Questionnaire) approach was used to collect data from Telemedicine Technology Users (Healthcare Professionals) to determine the effects of different technological components on India's Telemedicine capabilities.
**Results:**A seamless transition from traditional technical components to high-speed optical fiber-based broadband connection networks has been made possible in India thanks to the current and future ICT infrastructure there. Our effort gives a rigorous evaluation of the current and prospective leverage of sophisticated technical components imposing the intended impact on Telemedicine Capabilities.
**Conclusion:**Telemedicine's current capabilities have improved significantly, but it also suggests that the technology has the capacity to grow and thrive in the future.

**Keywords:** Discrete networks;ICT infrastructure; Telemedicine; Capabilities

## 1. Introduction

By combining the Greek word tele, which means "distance," with the Latin word "Medi" which means "to cure," technological improvements have given us Telemedicine. The World Health Organization (WHO), on the other hand, 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." [1,2] In this manner, Telemedicine in the form of synchronous and asynchronous transmissions has allowed mankind to break free from geographical, temporal, social and cultural restraints throughout the world.

Many developing and impoverished nations' suburban and rural regions have little or nonexistent access to healthcare services, making information and communication technology -based healthcare applications like Telemedicine a valuable resource. Even in India, where the medical expertise is dispersed unevenly, where 70 percent of Indians live in rural areas and 75 percent of qualified doctors practice in cities, where 23 percent of Indians are living at or below the poverty line on an average monthly income of Rs. 2160, it has become a protagonist.Telemedicine technology, on the other hand, offers the potential to lower healthcare costs while simultaneously improving quality and accessibility for patients [3]. As a result, patients and healthcare practitioners will be able to communicate more effectively, regardless of any preexisting prejudice.

Due to both physical and economic inequalities in the nation, India confronts a greater difficulty in bridging the gap between its rural and urban healthcare delivery systems [4]. In rural and remote areas, the problem persists due to a lack of high-speed transmission networks and several other obstacles, such as the absence of communication media,

reliable and tested state-of-the-art software solutions in accordance with international standards for data, video, in additionimage transmission. Aside from a dearth of healthcare workers with the proper training, these communication systems have little to no dependability [5].

While landline and wireless broadband technology is still in its infancy, it is becoming more popular in rural regions. Many Telemedicine programs used ISDN, VPN, and VSAT-based communications technologies before Broadband technology emerged. ISDN is analogue technology that uses existing Plain Old Telephone (POT) communication lines, but it is extremely expensive and time consuming to operate. Aside from that, the use of such a system needs specialized personnel. As a result of the widespread availability of ordinary telephone lines, which may be exploited to great effect for the introduction of new technologies, this technology does have one advantage: it can be used almost everywhere [6].

Wireless broadband is growing popularity worldwide. Very few new mobile applications concentrate on Telemedicine or healthcare. VPN technology is better, but not frequently utilized in telemedicine. It's less safe and accessible than you assume. This network requires authorization. Traffic slows the network. Over 50% of India's Telemedicine initiatives utilize VSAT. Most Telemedicine pilot programs are handled by the Indian Space Research Organization's GRAMSAT (rural satellite) program, which uses indigenous satellite technology [8].

## 2. Research Methodology

Discrete telemedicine networks and their impact on telemedicine research are the basis for this study's research model, which incorporates all sorts of literature, including workshop outcomes,research papers, and conference proceedings. Dexterous and well-validated Questionnaires from a few earlier research was used to build our survey instrument after a thorough review of the questionnaires. Several workshops were held by the researcher to discuss the contents of the Questionnaire [5, 7]. When doing this research study in India, it was also considered how to get in touch with enough people to obtain empirical data. After the meeting, the Questionnaire was sent out, and a total of 62 percent of the 340 people who took part in it responded. Due to the small number of participants (205), the data collected from them was deemed to be the most useful for the research. It was necessary to reject eight (8) entries because the information they gave was either incomplete or unintelligible.

## 3. Result

Two types of information were obtained by distributing the carefully constructed Questionnaire: descriptive and demographic. The Demographic data was extensively evaluated before looking at the actual model's data.

## 4.1 Demographic Data Results

The study's questionnaire was disseminated across India's healthcare facilities, including those participating in Telemedicine initiatives. The data obtained from 205 respondents was chosen from a total of 213 respondents since the data they supplied seemed to be relevant to the research. Because of a lack of knowledge or a lack of understanding, eight (8) were rejected.

- **Age and Age groups:**

47 (22.9 percent) of the 205 respondents were female, 158 (77.1 percent) were male, and they were utilizing Telemedicine software produced by various manufacturers and delivered over separate networks. More than seventy-six percent of user replies were in the 36-45-year-old age range, according to the findings of the study (37.1 percent). There were 57 people (or 27.8%) who fell within the age range of 26-35. More than two-thirds of the total participants were in the age range of 46-55, while only a small percentage were in the age range of less than 25 years. Only eight people in the age range of more than 56 years replied.

| Table 1: Demographic details | |
| --- | --- |
| **Gender** | **Percentage** |
| **Male** | 77.1 |
| **Female** | 22.9 |
| **Age** | **Percentage** |
| **15-25** | 8.3 |
| **26-36** | 27.8 |
| **37-46** | 37.1 |

| | |
|---|---|
| **47-55** | 22.9 |
| **Above 56** | 3.9 |

- **Experience of medical practice:**

There were 46 (or 22.4 percent) of the 205 responders who were either not doctors or had no previous medical expertise. One in ten responders had less than a year of experience, while the other twenty-four had been practicing medicine for one to two years. However, there were 66 individuals who had worked in the medical field for more than two years but less than three years, and 47 people who had worked in the field for more than three years.

- **Respondent's Organization:**

Most of the 205 respondents were in the public sector, with 147 (72.7%), followed by 16 (7.5%) in the commercial sector, 5 (2.4%) in non-profit organizations, and 35 (17.1%) in other categories.

- **Awareness of ICT:**

Most of the people who took the survey have enough computer knowledge to get the job done. Of the 205 responders, 102 (49.8%) had been using the product for more than 5 years, and 9 (14.1%) had been using it for 3 to 5 years. One in every ten (10.1 percent) respondents had been using computers for more than a year; one in every eleven (11.7 percent) had been doing so for two years; 26 (12.7 percent) had been doing so for less than a year; and only three (1.3 percent) participants said they had barely used a computer at all during their time on the survey. These data showed that people's understanding of ICT was rather high, which was heartening to see (table 2).

| Table 2: awareness of using ICT. | |
|---|---|
| **Experience** | **%** |
| **Hardly used** | 1.5 |
| **Less than 1year** | 12.7 |
| **1-2 year** | 11.7 |
| **2-3 year** | 10.2 |
| **3-5 years** | 14.1 |
| **More than 5 years** | 49.8 |

- **Use of Internet:**

A favorable outcome was found even though India's ICT infrastructure, particularly internet access and capacity, falls short of international standards. 2.0% of the respondents had never used the internet, 19.6% had used it for less than a year, and 8.3% had used it for more than a year, but not more than two years, in the study However, 10.7% of those polled had used the internet for at least two years, 14.6 percent had used it for three to five years, and 45.4 percent had used it for more than five years, indicating that almost half of those polled had some familiarity with it.

- **Knowledge of Telemedicine**

Gender disparities in Telemedicine application use were evident in the data. Telemedicine technologies were deemed extremely competent by 34(16.6 percent) of the 205 respondents, which was a positive sign. Only 18/18 (8.8%) of those polled had heard of telemedicine or had no idea what it was even about (table 3).

| Table 3: Knowledge of telemedicine | |
|---|---|
| **Telemedicine knowledge** | % |
| **Very knowledgeable** | 16.6 |
| **Knowledgeable** | 40.5 |
| **Somewhat knowledgeable** | 34.1 |
| **Not at all knowledgeable** | 8.8 |

- **Discrete network**

In India, like in other developing nations, the implementation of Telemedicine projects is centered on the use of discrete networks of communications technologies, for both synchronous and asynchronous Telemedicine applications. All the communications technologies accessible are used in this study's respondents, who were selected from Telemedicine initiatives. Maximum of 48.8% utilized VPN-based communications networks for Telemedicine projects, while 6.3% used VSAT and 4.4% used Wireless Broadband connection (table 4).

| Table 4: communication technology used | |
|---|---|
| **Technology** | **Percentage** |

| VSAT | 11.2 |
|---|---|
| Wireless | 4.4 |
| ISDN | 6.3 |
| VPN | 29.3 |
| Broad band | 48.8 |

### 4.2 Descriptive Data Results

The following stage is to establish the link between the three components of healthcare readiness,Telemedicine Technology, Telemedicine Capabilities, and human resource readinessafter classifying the responders based on distinct ways of communication (TMC).

Study participants who utilized Broadband Communication mode suggested a 58.67 mean value that formed a "+" association between TMI and TMC, whereas 60 respondents who used VPN Technology revealed a slightly higher mean that established a "-" relationship between TMI and TMC. Users of the ISDN method (N=13) had a mean of 54.85, which was lower than the overall mean as shown below in table 5, showing a negative relationship among TMI and TMC. Cellular internet is still latest in India, and few people use it for telemedicine. They had no opinion. They have no view on wireless broadband and telemedicine (N=6). The mean value (57.10) was close to the overall mean value (57.18). Telemedicine infrastructure and capabilities are seen highly by VSAT-based project teams (Mean=58.04>57.18).

**Table 5: A comparison of participant answers to questions on the influence of various components on telemedicine capabilities is shown in the table below, along with the means and standard deviations for those replies**

| Technology | TMI | TMC | HRR | HCR |
|---|---|---|---|---|
| VSAT | 58±11.9 | 81.6±16.1 | 109.3±18.2 | 77.3±18.2 |
| WIRELESS | 57.1±14.7 | 85.8±17.8 | 117.6±20.5 | 82.9±17.9 |
| ISDN | 54.9±5.4 | 78.4±13.8 | 106.2±21 | 74±14.9 |
| VPN | 57.3±11.7 | 80.8±15.1 | 107.9±20.5 | 77.1±13.1 |
| BROAD BAND | 58.7±9.9 | 86.2±12.5 | 111.6±17.6 | 83.6±11.4 |
| TOTAL | 57.2±10.7 | 82.5±15.3 | 111.4±19.5 | 79.1±15.6 |

HRR, the third component of Telemedicine technology, had a mean score of 111.40. Regardless of the method of communication employed by the respondents, the positive and negative replies were practically identical. With the Broadband user respondents reporting a higher mean value (116.60) than the overall means, there was a significant link among HRR and TMC (111.40). Projects using VPN and ISDN technology did not have a significant impact on HR readiness or Telemedicine skills. As a result of a small sample size of just six persons, the survey's mean score of 117.56 was much higher than the national average of 111.40. In other words, Wireless technology users believed that better Telemedicine infrastructure will lead to more Telemedicine capabilities. As seen by its lower mean value than the overall mean of survey participants, VSAT respondents (n=23) clearly believed that HR preparation was negatively connected with telemedicine abilities (111.40). As long as ISRO provided the requisite technology, personnel, and training, clients didn't expect HR readiness to develop Telemedicine skills for these particular projects.

Telemedicine's capacity to work is affected by three factors: Preparation for (HC). As compared to the general mean, Broadband [22,24] users had a considerably higher mean (83.62) of support for the association between HC readiness and Telemedicine capabilities (79.01). Respondents' lack of excitement and a mean score below the overall average (77.25) suggest that HR preparation is negatively connected with Telemedicine skills when it comes to VPN technology (79.01). According to respondents who utilized the ISDN communication channel, HR preparation is highly connected with Telemedicine abilities. The local mean (74.40) differed significantly from the global mean (79.01). Despite its fast rise in India, wireless technology has yet to make much headway in the healthcare industry [21,22]. It's unable to make definite conclusions about the association between HC Readiness and Telemedicine skills since just six participants were questioned. VSAT communication users found that Healthcare readiness was negatively linked with TMC. All investments, technical issues, and healthcare policies are handled centrally in India, according to those working on VSAT initiatives there.Users aren't involved in the decision-making process very much. User answers have shown that Telemedicine capabilities are affected by a variety of communication routes. The data clearly shows that broadband (landline) customers are more comfortable and have a greater faith in the technology than any other communication technology users, which implies that broadband users are more at ease than any other communication technology users. There were just six persons who

took part in this poll, but they were unanimous in their support of Wireless Broadband. According to the replies of VPN technology users, Telemedicine capabilities and VPN technology have a poor association (see chart below). In the case of ISDN users, the relationship between TMC and ISDN technology was significantly negative. Those that use VSAT [21,22] communication have also voiced a negative assessment of the technology's prospective use in telemedicine, as has been documented.

## 4. Discussion

By using different approaches and methodologies, the data acquired in this study is studied to arrive at a conclusion on the influence of discrete networks on Telemedicine's capabilities. Broadband (landline), Wireless, ISDN, VSAT, and VPN are the top five most often used communication technologies in India for establishing Telemedicine projects, according to the findings of a survey of users who participated in these Telemedicine initiatives. According to these findings it has been demonstrated that Broadband Networks (landlines) improve Telemedicine's overall capabilities [9-11] not simply because they are a more widely adopted technology that affects each of the three components independently. This finding is consistent with previous research and literature. Although Broadband Wireless Communication (BWC) is a preferable choice, just six respondents (N=6) employed it in Telemedicine projects. In contrast, the VSAT network user replies are somewhat negative in claiming that it has no impact on Telemedicine Capabilities at all. Because of the expensive startup and implementation costs, data transmission delays caused by the weather, and the fact that this technology's speed is band-restricted yet still not widely available [12,13], it is not widely recognized despite its superiority as a form of communication. VPNs and ISDNs are both kind of virtual private network. Due to drawbacks like as technical complexity, a requirement for specialized knowledge for setup, upkeep, and operation, and a tendency for lengthy downtime, communication is often seen as a negative aspect of Telemedicine. ISDN, on the other hand, is very sluggish due to bandwidth restrictions (64kbps to 128kbps).

## 5. Conclusion

With Telemedicine Capabilities, it is vital that large quantities of digitized information (data) be securely and thoroughly sent at a very fast speed so that the medical workforce may examine any medical condition in a more thorough manner and then make a quicker decision. As a result, it is essential to have a means of communication with enough bandwidth for sending data, photos, video, and live, continuous video conferences. A comparison of the capacities of several current Telecommunication networks to create, deploy, and maintain Telemedicine capabilities has been offered in this research study as an instance of comparable performances, or relative performances. When it comes to infrastructure projects like India's National Optical Fiber Network (NoFN), the lowest level of administration in the country, there is a push to increase bandwidth to 10100mbps, which would link all Panchayats. For example, efforts like telemedicine in the healthcare delivery system will be more effective and sustainable if ICT infrastructure is bolstered by these initiatives.

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