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# Telepathology: Bridging the Gap in Remote Healthcare Services

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## Abstract

The aim of the research is to determine Telepathology related to Bridging the Gap in Remote Healthcare Services. Digitalizing pathology slides promotes collaboration among pathologists in various places and allows for second opinions and real-time consultations. This helps to enhance patient outcomes and speed up the diagnosis procedure. The smooth exchange of information throughout the healthcare system is ensured by integrating telepathology with electronic health records, which expedites communication. For measuring, the research used smart PLS software and generated results, including descriptive statistics, correlation coefficients and smart PLS Algorithm models between them. Beyond diagnosis, telepathology has a significant influence on medical education and training. It provides a forum for ongoing professional growth, especially when qualified pathologists are scarce. Additionally, telepathology is a potent tool for democratizing access to pathology services due to its low cost and capacity to reach underserved and rural places. This research acknowledges the potential advantages of telepathology but also discusses data security, standardization, and technological uptake issues. Overall result found that telepathology significantly related to bridging the gap in remote healthcare services. Telepathology is a scalable and affordable approach with great potential to improve global healthcare outcomes as technology progresses.

**Keywords:** Telepathology (TT), Bridging Gap (BG), Remote Healthcare Services (RHS)

## Introduction

Humans live in a world full of wonders. These wonders are because of the advancement and achievement of science and technology, which seem like miracles in the world. This science and technology have bridged the gap between distances and time to ensure instant and swift communication. This science and technology has also done wonders in mankind's health through different aspects such as automated systems, efficient instruments, effective management, optimized workflow, and others. In this study w, it is explained about the use of Telepathology in modern ways of diagnosing and treating different diseases in Healthcare centers[1]. The term "Telepathology " can be discussed as "a telecommunications network for better practice of remote pathology by using digital images of pathology. "[2].

As we all know, pathology is an important aspect of medical science because it is related to diagnosing, treating, and preventing diseases by providing information about types of pathogens, their structure, and ways of transmission. There is no doubt that pathology has greatly improved by using science and technology, but advancements in this field of pathology can also be seen in the form of telepathology. Telepathology has many benefits, such as in-depth knowledge, better diagnosis, second opinion and consultation, assurance of quality, educational purposes, research, and others[3].

Telepathology is a branch of telemedicine that involves the electronic transmission of pathological data, like images of tissue samples, to get remote consultations, diagnosis, or education. This allows pathologists to analyze and interpret pathology slides from a distance, often using digital image technology and telecommunication infrastructure[4]. Telepathology can enhance or improve access to pathology experiences facilitate second opinions and support medical education and research in areas where on-site pathology services are limited.

Telepathology can enhance efficiency and quality of diagnostic pathology services, particularly in remote or underserved regions. The basic principle of Telepathology is transmitting data related to pathology using different electronic devices [5].

The most important technique used in telepathology is television microscopy. This technology can be defined as the use of microscopy, which does not include a pathologist's involvement in data transmission. This kind of microscope is used for Qualitative and quantitive studies. It can also be used to display any slide to a large audience. It can also be used for any examination under regions of ultraviolet or infrared range. Three major types of systems are used in telepathology. These systems are called static image-based systems, real-time systems, and the system of virtual slides[6]. The first system is the static image system, Telepathology's most popular and used system.

This system can be used to share static images taken from a microscope with other systems, but there are some drawbacks related to using a static image system. The most important drawback is that this static image system can only provide surface-based evaluation[7]. The second system of Telepathology is a real-time robotic microscopy system in which there is an in-depth evaluation for diagnosis. A controlled microscope is used in this type of system, and the consultant can easily evaluate, operate, integrate, and analyze these kinds of slides using robot systems. Distance does not affect the operation of such robotics-based systems. In these kinds of microscopes, video cameras, which transmit data from the microscope to the consultant device, can be used. An echo-cancelling microphone is also installed on both ends to minimize interruption by moving slides[8].

The third type of system, Telepathology, is a virtual slide system in which fully automated digital scanners are used. These scanners can create the knitted images as a single image. This technique is called whole slide imaging, which is abbreviated as WSI. This kind of whole

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slide image data can be easily transferred from one system to another using the internet. There is more demand and use of digital imaging for virtual imaging. These virtual slide systems are more accurate because they can also be easily understandable by large audiences because of their virtual nature.

This system can also explain such systems not accessible by light microscope. As we know, the light and compound microscope range is small compared to the television microscope. In television microscopy, small components can also be seen that are not visible in a range of visible light[9]. Because in real-time and virtual reality systems, there is the use of robotics-based systems, there is very little chance of human error.

As mentioned, Telepathology has many positive aspects in the medical field. For example, if the examination of any cancer patient is done and the treatment needs consultation from more than one physician, this data transfer system is reliable and swift for transferring data to other systems[10]. The second benefit is that results obtained by telepathology have a higher accuracy than results obtained by traditional pathology tests. Thirdly, it can also be used in educational institutes because when data is collected from any pathology lab, it can also be transmitted to educational institutes[11].

This system will not only enhance the understanding of medical students but will also increase students' engagement in studies. The next benefit is that it can be used for research purposes because research may enlighten new ways for better diagnosis and effective treatment of diseases. This system can also be used to display any important information related to pathology to a large audience, no matter what the distance of the audience from that pathology lab[12].

Telepathology can also store data for a long time using the electronic health records system, abbreviated as EHR. However, there are some problems related to the installation and implementation of Telepathology in each healthcare centre. The first challenge is the high cost of using Telepathology. Because it is based on fully automated systems, installation requires high cost, which is presently inaccessible by the common man[13]. The second challenge is the need for a suitable and stable internet connection for data communication. Still, this kind of stable connection is not working in a few remote areas such as village areas, distant areas, and others. Thirdly, it is based on artificial intelligence, which replaces human intelligence, thus decreasing the value of human labour and increasing reliance on machinery for every task[14].

## Research Objective

The main objective of this study is to understand the importance of Telepathology for the betterment of the Healthcare sector. This study has also effectively explained the pros and cons related to the use of Telepathology for diagnosis and treatment of different diseases. The research determined that Telepathology relates to Bridging the Gap in Remote Healthcare Services. The research is divided into five sections. The first portion represents the introduction and objective of research related to healthcare services and telepathology.

The second portion represents the literature review, and the third section presents the research methodology. The fourth portion presents those results and its descriptions of Telepathology related to Bridging the Gap in Remote Healthcare Services. The last portion summarized overall research and presented some recommendations about Telepathology related to Bridging the Gap in Remote Healthcare Services.

## Literature Review

Researchers predict that Telepathology is a branch of pathology that uses telecommunication links to manage the transmission of related image data for enhanced remote diagnosis. The term telepathology was first used in 1986, and its practice has been continuing since 1996 and 1989 in the United States and Europe, respectively. Before telepathology, the concept of video microscopy was being used, and it was different from telepathology because, in video microscopy, the telepathologist had no control over magnifications and histopathology fields[10]. The concept of telepathology allows remote diagnosis over the computer screen instead of using microscopic arrangements.

Therefore, studies have been made that propose the idea of interoperative consultation using telepathology[15]. Studies reveal that by the year 2000, telepathology became much more significant among the public, and remote sessions of telepathology were also available in different countries. The field of telepathology was on the radar of the WHO as well, but at that time, the limitations, like the digitization of glass slides, were much lower in speed compared to current times[16]. Studies related to whole slide imaging and its application as telepathology have been introduced, which allows the sharing of images remotely among different pathologists. This helps provide faster pathology evaluation among different observers, remotely and has also influenced pathology study and research-related evolution[17].

The Discovery of Computational horse powers, digital scanners, hardware related to multi-spectral imaging, and, fluorescent-based slide scanners have been the reason that recent pathologists are showing interest in implementing telepathology as a remote diagnosis tool. Today, complexity in software systems has become an important element in making telepathology a part of the advanced diagnosis tool[18]. Researchers claim that the validated use of telepathology can help enhance remote analysis quality and thereby help provide accurate and timely diagnosis results. For better performance, clinical laboratories' needs, budgets, and applications should be supervised to promote remote analysis by healthcare systems[19]. Some studies have related telemedicine and telepathology by stating that telepathology is the evaluation of telemedicine providing digital images in the field of diagnosis. However, using telepathology for remote analysis needs the organizations, infrastructure, and related data analysis so that a more successful approach can be made[20].

In California, a domestic telepathology network has been introduced that studies the application of telepathology at the hub and spoke sites and concludes that this type of technology needs expensive setups and trained staff that can work and evaluate through telepathology-based systems[21]. In an Italian region called South Tyrol, the cost of pathological services is fairly higher because of larger travelling routes. Researchers have conducted studies in this area and proven the application of telepathology as a remote method of treatment despite challenges like poor standardization and management of e-health records[22]. Similarly, studies in China have shown the use of telepathology in the frozen section of diagnosis. These studies show that telepathology in this type of diagnosis section can help improve patient health care by managing the unevenly scattered

data on pathology present in different resource centres in China[23]. In Canada, Researchers applied the use of telepathology by introducing a project named Eastern Quebec Telepathology Network to put forward the applicability of remote telepathology in colder sections of Canada so that the diagnosis process can be made easier and hustle-free for both the patients and healthcare givers[24].

Recent studies have also proposed the concept of decentralized pathology at a larger level. In this research, the continuous coverage of pathologist consultations was observed without having pathologists present on the hospital site to cover the inefficiencies of a remote system. 18 hospitals were included in this research, making this project the world's biggest network of telepathology[1, 25]. Advanced studies have been made on a real-time telepathology technique according to which, along with integrated visuals, a real-time, online session between the pathologist and the patient can be made possible, which can, in turn, support the remote healthcare services possible and effective[26].

In Africa, there are a very low number of pathologists available in contrast to the population of it. Therefore, technological innovation can help cover the gap in providing pathological services to low-resource settings in Africa. Still, digital images are used in these areas as they are smaller and easier to store[12]. Also, the Armed Forces Institute of Pathology was involved in revealing the study of telepathology during the early era of 1996-1997. This institute analyzed the consultation data for this year's range and helped in sorting the harmony between the analysis of telepathology and glass slides[27].

Similarly, studies have been made in Sub-Saharan Africa to use telepathology techniques to treat cancerous diseases by improving research and diagnosis development capacity[28]. The studies in this region are made because the care coordination among healthcare systems and staff training models are much more efficient and can make remote analysis more effective[3]. In 1997, the telepathology concept was introduced in the Philippines, where the first telepathology consultation was made between the Institute of Armed Forces and the University of Manila, which faced challenges like infrastructure instability, human incapability, and connectivity. Still, recent advancements can make a more conducive environment for telepathology applications[29].

Researchers have also suggested that telepathology in intraoperative consultations can be effective and helpful with the requirements of project managers and new work processes[30]. Telepathology studies in Nigeria have been made as it requires a high-cost pathology facility to be operated there. Therefore, by reducing the need for an on-site session with the pathologist, remote consultation is proven to be cost-effective and can ensure the quality of a well by permanently storing image-related data[31]. Moreover, the study of telepathology consultation between China and the USA has been made to ensure the effect of patient management on treatment effectiveness. Therefore, providing a less burdened session through telepathology can easily reduce the cost and enhance the ratio of successful diagnostic outcomes, with the help of which the gap between patients and healthcare centres can be overcome[32, 33].

## Methods Of Research

The study determined that telepathology is related to bridging the gap in remote healthcare services. The research based on the primary data analysis to determine the research used smart PLS software and generate results included descriptive, correlation coefficient and smart PLS Algorithm model between them and for measuring the research used specific research questions related to Telepathology related to the Bridging the Gap in Remote Healthcare Services.

### Significance of bridging gaps

Bridging gaps in remote healthcare services is important because it can improve access to healthcare for people who may not have access to traditional healthcare services. This is especially important for individuals living in rural or remote areas, where access to healthcare services may be limited. Telepathology can help bridge these gaps by providing remote access to healthcare services, including pathology care. Bridging the gap in remote Healthcare services helps reduce the unevhealthcare access between regions, especially high-income countri-es and low and middle-class countries.

It facilitates Global collaboration education and training in healthcare, allowing to exchange information and knowledge between healthcare professionals from different regions. Bridging gaps in remote healthcare services using technology can provide cost-effective solutions and increase access to quality healthcare, especially in resource-limited settings. The expected increase in the burden of cancer for bridging the gap in remote healthcare services becomes crucial for providing sufficient cancer care, research, and education.

### Principal of Pathology

Telepathology is the practice of Pathology afar, Pathologist can view and interpret pathology slides remotely using digital imaging technology. This enables the sharing of experts and consultation between pathologists in different locations, ultimately improving access to pathology services, especially in underserved areas. The principle of telepathology includes ensuring that the digital images Used for telepathology are of high quality and accurately represent the original pathology slide. They are sticking to regulatory standards and guidelines for the practice of telepathology, including issues related to license, privacy, and security.

Ensure that the Tally pathology systems and technology are interworking with existing healthcare information systems to facilitate smooth integration and data exchange. Providing enough education and training for pathologists and laboratory staff on telepathology systems and interpretation of digital pathology images. Ethical issues related to telepathology, including patient consent confidentiality and the responsible use of digital pathology data. Principles are essential for the successful implementation and practice of telepathology ensuring that it needs high standards of quality, safety, and ethical act.

### Telepathology Technology:

The use of digital imaging and communication(DICOM) in pathology, also known as telepathology, Involves the transmission of digitized images of pathological specimens for remote interpretation and diagnosis. This technology can improve access to pathology services, particularly in deprived areas, and for a successful collaboration between pathologists in different states.

There are two main types of telepathology: Static and dynamic. Static telepathology involves the transmission of still images, while dynamic pathology involves the transmission of live video. Telepathology has been used for a variety of applications, including primary diagnosis, second opinions, quality assurance, and education

and collaboration, but there are also challenges to implementing telepathology, such as the need for standardized protocol and quality control measures.

### Role of distant medical services

The following are some essential facets of telepathology and their role in providing distant medical services:

1. Digital Imaging: Glass slides containing tissue samples are inspected under a microscope in conventional pathology. Digital imaging technology takes the role of this laborious method in telepathology. Pathologists may now do remote analysis by seeing high-resolution photographs of slides on computer displays.

2. Real-time Consultations: Pathologists and healthcare professionals may have real-time consultations due to telepathology. Pathologists can work with colleagues in diverse places, assess cases remotely, and give prompt comments. This is especially helpful in places with a need for more pathologists or other specialists.

3. Second Opinions: Pathology slides may be easily shared for second opinions due to telepathology. This is helpful in complicated circumstances since it guarantees that patients get the most thorough and accurate diagnoses. Healthcare services are better when they may be accessed remotely via a network of professionals.

4. Education and Training: The use of telepathology in medical education and training is beneficial. For educational purposes, various cases, including uncommon conditions, are available to pathology residents and students. All healthcare workers, no matter where they work, benefit from this ongoing professional development.

5. Quicker Turnaround: The time required for sample transportation is reduced due to the digital picture transmission capability. As a result, pathology reports are completed more quickly, expediting patient treatment decision-making.

6. Improved Accessibility: Telepathology opens up pathology services to underprivileged and rural places where there may be a scarcity of qualified pathologists. This is particularly important for areas with poor infrastructure for healthcare.

7. Integration with Electronic Health Records (EHR): By integrating telepathology systems with EHRs, interoperability across various healthcare system components is guaranteed. This integration achieves Better overall patient care by streamlining the diagnostic procedure.

8. Cost Efficiency: By eliminating the requirement for sample transportation in person and enabling centralised pathology services to service several healthcare locations remotely, telepathology can result in cost savings. Although telepathology offers many advantages, there are drawbacks as well.

These include the need to protect patient privacy and security, standardise digital imaging procedures, and handle problems with network connectivity and technological adoption. Telepathology is anticipated to become increasingly important in enhancing the quality and accessibility of pathology services in distant healthcare settings as technology develops.

## Smart PLS Algorithm Model

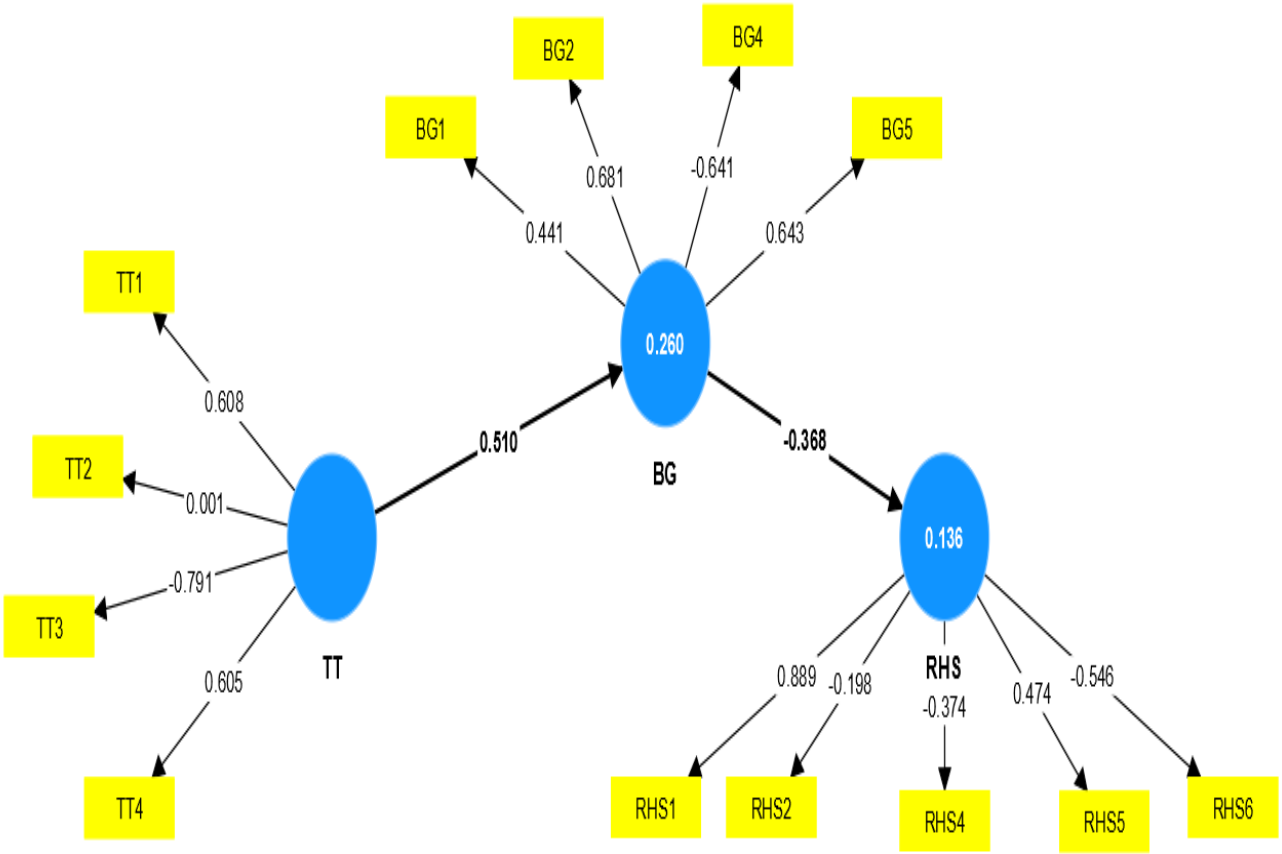


Figure 1

The above model describe that smart PLS Algorithm model related to the TT and BG also RHS according to the above analysis TT present 0.608, 0.001, -0.791, 0.605 shows that 60%, 100%, 79% and 60% significantly level.

The BG present that 0.441, 0.681, -0.641 and 0.643 describe that 44%, 68%, 64% respectively values of each mediator variable. the RHS is dependent variable result present that 88%, 19%, 37%, 47% and 54% significant rates between them the TT shows 51% positive link with BG the RHS shows negative link with BG its rate is -0368 level.

The percentages associated with each coefficient (e.g., 60%, 100%, etc.) likely represent the significance level or the amount of variance explained by the respective variables.

## Descriptive statistic

**Table 1**

| Name | No. | Mean | Median | Scale min | Scale max | Standard deviation | Excess kurtosis | Skewness | Cramér-von Mises p value |
|---|---|---|---|---|---|---|---|---|---|
| TT1 | 0 | 1.755 | 2.000 | 1.000 | 4.000 | 0.770 | -0.034 | 0.741 | 0.000 |
| TT2 | 1 | 1.510 | 1.000 | 1.000 | 3.000 | 0.610 | -0.305 | 0.794 | 0.000 |
| TT3 | 2 | 1.510 | 1.000 | 1.000 | 3.000 | 0.576 | -0.554 | 0.621 | 0.000 |
| TT4 | 3 | 1.653 | 2.000 | 1.000 | 4.000 | 0.716 | 0.946 | 0.986 | 0.000 |
| BG1 | 4 | 1.592 | 2.000 | 1.000 | 3.000 | 0.603 | -0.589 | 0.496 | 0.000 |
| BG2 | 5 | 1.429 | 1.000 | 1.000 | 3.000 | 0.571 | -0.006 | 0.967 | 0.000 |
| BG3 | 6 | 1.347 | 1.000 | 1.000 | 2.000 | 0.476 | -1.628 | 0.664 | 0.000 |
| BG4 | 7 | 1.531 | 1.000 | 1.000 | 3.000 | 0.610 | -0.404 | 0.716 | 0.000 |
| BG5 | 8 | 1.490 | 1.000 | 1.000 | 3.000 | 0.576 | -0.453 | 0.703 | 0.000 |
| RHS1 | 9 | 1.490 | 1.000 | 1.000 | 3.000 | 0.610 | -0.184 | 0.874 | 0.000 |
| RHS2 | 10 | 1.592 | 2.000 | 1.000 | 3.000 | 0.569 | -0.756 | 0.312 | 0.000 |
| RHS3 | 11 | 1.327 | 1.000 | 1.000 | 2.000 | 0.469 | -1.479 | 0.763 | 0.000 |
| RHS4 | 12 | 1.449 | 1.000 | 1.000 | 3.000 | 0.537 | -0.806 | 0.618 | 0.000 |
| RHS5 | 13 | 1.694 | 2.000 | 1.000 | 4.000 | 0.706 | 0.911 | 0.888 | 0.000 |
| RHS6 | 14 | 1.531 | 1.000 | 1.000 | 3.000 | 0.575 | -0.634 | 0.541 | 0.000 |

The above result describes that descriptive statistic result included mean values, median values, minimum rate, skewness values, probability values of each indicator. The TT1, TT2, TT3, and TT4 represent that mean values are 1.755, 1.510, and 1653 shows the positive average values of each variable. the standard deviation rates are 77%, 61%, 57%, and 71%, deviate from the mean skewness values are 74%, 79%, 62% and 98% skewness rates. The overall probability value is 0.000, showing 100% significant rates of each indicator. The BG1,2,3,4 and 5 are considered as mediator variables according to the result Their mean values are 1592, 1.429, 1.347, 1.531 and 1.490. These are described as positive average values of mediator variables. The standard deviation rates are 60%, 57%, 47%, 61%, and 57%, which deviate from mean values. The standard deviation rate represents 57%, 47%, 61%, and 57% deviation from the mean. The overall minimum value is 1.000, the maximum value is 4.000, also the median rate is 2.000 respectively. Similarly, the RHS1,2,3,4,5 and 6 represent that mean values are 1490, 1.592, 1.327, 1.449, 1694 and 1.531. These are all present the positive average rates of each dependent variable. the standard deviation rates are 61%, 56%, 53%, 70%, and 57%, deviate from the mean skewness values are 31%, 76%, 61%, 88% and 54%, respectively.

## Advantages of telepathology

Overcoming geographic barriers to Healthcare access in remote areas requires innovative solutions and a multi-faceted approach, like utilizing telepathology and telehealth technologies to provide remote consultation diagnosis and treatment, enabling patients to access healthcare services without needing physical travel to healthcare facilities and establishing mobile health units equipped with medical professionals and essential healthcare services to reach remote communities and provide on-the-ground care and preventive services. Training and placing community health workers who can provide basic healthcare services and health education and facilitate others about healthcare. Exploring the use of drones for the delivery of medical supplies, diagnostic samples, and telecommunication equipment to remote areas overcoming logistical challenges. Utilizing telepathology technology to enable remote consultation and interpretation of pathology slides by specialized psychologists enables patients in remote areas to access specialized pathology services without the need for physical travel to healthcare facilities. Elaborating with private sector organizations to establish pathology Laboratories and telepathology services in remote areas, authorized resources, and expertise. Implementing that helps in the sharing of pathology data and images between healthcare organisations, enabling remote consultation by specialized pathologists. It is possible to improve access to specialized pathology services in remote areas using telepathology, enabling accurate diagnosis and effective treatment of many diseases, ultimately improving outcomes for an underserved population

## Correlation coefficient

**Table 2(a)**

| | TT1 | TT2 | TT3 | TT4 | BG1 | BG2 | BG3 | BG4 | BG5 | RHS1 | RHS2 | RHS3 | RHS4 | RHS5 | RHS6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BG1 | 0.092 | 0.122 | 0.012 | 0.003 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| BG2 | 0.238 | -0.042 | -0.230 | 0.164 | 0.271 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| BG3 | -0.047 | 0.234 | -0.125 | 0.114 | 0.280 | 0.129 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

**Table 2(b)**

| | TT1 | TT2 | TT3 | TT4 | BG1 | BG2 | BG3 | BG4 | BG5 | RHS1 | RHS2 | RHS3 | RHS4 | RHS5 | RHS6 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BG4 | 0.059 | 0.150 | 0.275 | -0.420 | 0.034 | -0.184 | -0.001 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| BG5 | 0.317 | -0.130 | -0.446 | 0.165 | -0.012 | 0.168 | 0.050 | -0.333 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| RHS1 | -0.179 | 0.261 | -0.014 | 0.109 | -0.510 | -0.192 | -0.093 | 0.124 | -0.102 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| RHS2 | -0.088 | -0.164 | 0.013 | 0.254 | 0.109 | -0.090 | 0.222 | -0.023 | 0.050 | -0.188 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| RHS3 | -0.344 | -0.083 | 0.366 | 0.155 | 0.183 | -0.141 | -0.142 | 0.108 | -0.290 | -0.202 | 0.194 | 1.000 | 0.000 | 0.000 | 0.000 |
| RHS4 | -0.178 | -0.139 | 0.183 | 0.140 | 0.188 | -0.162 | -0.290 | -0.042 | -0.051 | -0.360 | 0.066 | 0.715 | 1.000 | 0.000 | 0.000 |
| RHS5 | 0.125 | 0.505 | -0.269 | -0.251 | -0.102 | -0.181 | 0.073 | 0.188 | 0.118 | 0.206 | 0.197 | -0.130 | -0.230 | 1.000 | 0.000 |
| RHS6 | 0.109 | 0.043 | -0.078 | 0.348 | 0.330 | 0.177 | 0.148 | -0.046 | -0.107 | -0.217 | 0.163 | 0.417 | 0.154 | -0.103 | 1.000 |
| TT1 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TT2 | 0.049 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TT3 | -0.409 | -0.334 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| TT4 | -0.006 | -0.155 | -0.165 | 1.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

The above result represents that correlation coefficient analysis related to the independent and dependent variables. the overall result presents some positive and some negative correlation between the independent and dependent.

### Challenges in providing healthcare

Life of Healthcare services in remote areas presents separate challenges and significant gaps, remote areas often lack reasonable healthcare infrastructure including hospitals clinics, and medical professionals leading to Limited access to essential healthcare services. In remote areas frequently there is a shortage of skilled healthcare professionals including doctors, nurses, and specialists resulting in challenges in delivering broad care. Remote areas may have limited access to advanced medical technologies, diagnostic equipment, and a reliable internet connection, slowing down the delivery of modern healthcare services including telepathology and telehealth. Geographical isolation and challenging ground can make it difficult for patients to reach healthcare facilities and for healthcare professionals to travel to remote areas to provide care. Princess in Healthcare access and outcomes between remote areas and urban centers contribute to unequal health outcomes and complicate existing health disparities. Addressing these challenges in providing healthcare services in remote areas is important for promoting health equity and improving health outcomes. Innovative approaches, including the use of Telepathology, mobile health units, and community health worker programs can help bridge these gaps and improve access to healthcare in remote areas.

## Conclusion

To sum up, telepathology is a game-changing innovation in the field of medicine, especially when it comes to reducing distances and improving access to pathology services. Telepathology enables speedier diagnosis, better patient care, and real-time cooperation by using digital technology to transmit pathological data and pictures. Beyond diagnosis, the advantages affect training, education, and the infrastructure of healthcare as a whole. A more thorough and accurate knowledge of complicated medical issues is made possible by the capacity to offer second views, conduct remote consultations, and exchange expertise across geographic boundaries. In addition, telepathology is essential in addressing the lack of qualified pathologists in underprivileged regions, hence democratizing access to top-notch pathology services. It will be crucial to solve issues with data security, standardization, and technology adoption as technology develops further. However, the continued progress in telepathology presents a bright future for medical treatment, providing a scalable and economical means of providing pathology services to a wide range of geographically dispersed and isolated populations.

The research determine that Telepathology related to the Bridging the Gap in Remote Healthcare Services. For measuring the study used smart PLS software and generate results included descriptive statistic, correlation coefficient also that smart PLS Algorithm model between them. The combination of pathology and telemedicine not only increases accessibility and efficiency but also highlights how technology may have a beneficial influence on global health outcomes. Telepathology, a key element of telemedicine, uses digital technology to provide pathological data and pictures for remote analysis and diagnosis, revolutionizing the way pathology services are delivered. The overall study concluded that direct and significantly Telepathology related to the Bridging the Gap in Remote Healthcare Services. This study examines the various ways that telepathology may improve access to high-quality pathology services, break down geographical boundaries, and change the way that healthcare is delivered. The role of telepathology in overcoming healthcare is inconsistent and crucial in addressing the gap in access to specialized healthcare services, particularly in destitute and remote areas. By using telepathology healthcare providers can extend their experiences to areas where there is a shortage of specialized pathologists, in doing so improving access to timely and accurate diagnosis. telepathology can facilitate collaboration between healthcare professionals, enabling the sharing of knowledge and experts across geographical boundaries and improving healthcare equity. Within the field of telemedicine, telepathology is concerned with digitally transmitting pathological data, such as photographs of tissue samples, for remote diagnosis and interpretation. By allowing pathologists to examine and diagnose patients remotely, it is essential in closing the gap in distant healthcare services.

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