



Teleradiology Service is Indispensable in the Indian Healthcare Sector

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ABSTRACT

Teleradiology is an indispensable service in the healthcare sector, offering numerous benefits to healthcare providers, patients, and radiologists. An ideal teleradiology service provider is one with a sturdy infrastructure and technology provisions with a plethora of highly qualified board-certified radiologists who would cater to the needs of accurate, secure, quality, and timely radiologic interpretations with 24/7/365 coverage for small hospitals, clinics, diagnostic imaging centers and emergency rooms. The aim of the article is to give perspective on teleradiology service as an indispensable service in the Indian healthcare sector. The article also emphasizes the key elements an ideal teleradiology service provider should have.

Keywords: Teleradiology service, Key elements, Healthcare.

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INTRODUCTION

The Indian healthcare system has been initially designed with the aim of delivering equitable and sustainable access to healthcare facilities to all its people irrespective of location, socioeconomic status, or caste. It has a well-defined three-tier structure consisting of primary, secondary and tertiary care services.¹ At rural, district and regional levels, healthcare is facilitated by primary and community health centers (PHC and CHC), district and sub-district hospitals and regional-level institutions or super specialty hospitals, respectively. Despite these provisions by the government, the availability of healthcare in rural and remote areas are few and far between. The prominent deterrents are affordability and accessibility.

A total of 70% of the Indian population lives in rural areas, primarily depending on public healthcare facilities, which are limited diagnostic services (legacy analog imaging machines available in the primary care setting) and insufficient clinicians. Further, the available on-site radiologists are burdened with a large number of images to be interpreted. Some rural centers lack on-site radiologists; thus, the referring clinicians interpret the images themselves. In case of absenteeism of a radiologist or the need for a second opinion from subspecialists, a patient needs to travel from their village to taluk or even sometimes district headquarters, which not only take time but also result in travel costs. Moreover, the high and rising out-of-pocket expenditures on diagnostic tests and medicines are other challenges faced by the patients.²

There is a major shortfall of qualified and skilled healthcare professionals. In India, there are less than 20000 radiologists for a 1.3 billion population i.e., one radiologist for approximately 100000 population, that too are concentrated in large cities.^{3,4} Moreover, radiologists would suffice an international standard in their expertise to read multiple modalities, interpret and identify all possible abnormalities in the patient's body, and be educated at an internationally renowned institution, are quite a few.

It is paramount to speculate beyond the obvious and promote telehealth services. Teleradiology, a subset of telehealth service, involves acquiring and transmitting images of diagnostic imaging studies such as X-rays, CT scans, and MRIs from the patients and interpretation by radiologists located at remote sites.⁵ Primarily emerged to balance the demand and supply of diagnostic services, teleradiology can be implemented to ameliorate the shortage of expert radiologists, obviate the expense of patient transfer and enhance outcomes of patient care solutions. Thus, it will be a game changer in the Indian healthcare system by providing state-of-the-art healthcare facilities. The digitization of the legacy analog images of the patients from rural healthcare centers and cost-effective router technology for proficient image transmission to a cloud-based system would further strengthen teleradiology services.

The benefits of teleradiology for patient care has been well documented by numerous studies,^{2,6-8} and the current

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study aims to give perspective on teleradiology service as an indispensable service in the Indian healthcare sector. The article also emphasizes the key elements an ideal teleradiology service provider should have.

During the COVID-19 pandemic, there was a significant impact on healthcare globally. Millions of individuals were affected by the global spread of the coronavirus, which also claimed thousands of lives. Medical practices of all sizes were put under a great deal of stress. Due to the cancellation or postponement of elective surgeries, medical treatment volumes were drastically decreased at the start of the pandemic, which hurt the market. Teleradiology services has contributed greatly in maintaining healthcare services during the COVID-19 pandemic. Healthcare practitioners have embraced teleradiology technologies to read diagnostic findings and treat patients. Teleradiology technologies not only increased the accuracy of radiology reads and reduced human errors, which enhanced diagnostic imaging efficiency, but also helped minimize physical interaction with patients, which aided in decreasing the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), especially in healthcare settings.^{9,10}

Though the Government of India has started various healthcare programmes for its people, those initiatives alone are unworthy to bring out transformation. Thus, the public-private partnerships would aid in narrowing the gaps and their puissance would be leveraged in improving the service delivery at the maximal level. Teleradiology Solutions is India's first and leading teleradiology service provider and has been delivering teleporting services to hospitals globally since 2002.¹¹ Recently, Teleradiology Solutions has launched a center in the Pyramed complex of Andhra Med Tech Zone (AMTZ), Vishakhapatnam, Andhra Pradesh with the aim of collaborating with the Government of India to provide access to teleradiology services to its rural health missions, public sector units and state government health departments. The center provides high-quality reporting by skilled diagnostic imaging professionals. Moreover, the center also furnishes access to a large network of medical technology and device companies to make a transformational impact in India's healthcare sector.

To bring out effectiveness into radiology practice, it is crucial to bring out change in the mindset of the stakeholders: the patients, physicians and hospital administrators. Some of the factors which can enhance the value of radiology practice are:

- Education and training: Training of medical personnel, beginning at the medical school level, should be done to generate a highly qualified medical professionals with high diagnostic skills. Conduction of various higher medical education programs in various subspecialties and modalities periodically could increase the knowledge and skills of practicing radiologists and to gain proficiency and experience in one or two subspecialties.⁴ Further, clinicians should also join training programmes for diagnostic skill development, augmenting communication skills, and highlighting the importance of empathy

and relationship building.¹² Moreover, regular training programs on teleradiology software should be organized for the radiologists, technical and clinical staff.

- Artificial intelligence: Developing and deploying diagnostic artificial intelligence/deep learning algorithms and pathways by specialist societies is the key to ensuring appropriate diagnostic triage.
- Quality practice: Constant quality improvement should be an intrinsic component of teleradiology services. The use of evidence-based medicine is a key initiative in improving the quality of healthcare delivered and ensuring the maintenance of standards of practice in healthcare. This involves periodic review and incorporation of the latest scientific developments into medical practice, which requires close collaboration between research institutions and healthcare institutions.
- Value-based medicine: The focus on value-based medicine is irrevocably linked with efficiency. In teleradiology, for example, the use of creative scheduling solutions, workflow technologies and artificial intelligence/deep learning algorithms allows for optimal and efficient utilization of radiologist time, which is a highly precious resource today, and allows for the value thus created to be passed on to the healthcare system in the form of improved quality with more rapid and efficient service delivery.

Further, it is crucial to evaluate the effectiveness of teleradiology practices by tracking various parameters and metrics such as:

- Report turnaround time (TAT) and report quality metrics.
- Peer review scoring system developed by the American College of Radiology
- Data security

Key Elements of an Ideal Teleradiology Service Provider

An ideal teleradiology service provider must sustain hardware infrastructures and imaging equipment, workstations and platforms, telecommunication networks, and network management and data transmission system, data security, financial, and other prerequisites by the key stakeholders: the patients, physicians and hospital administrators who would expect excellence from the comprehensive imaging solution.¹³ The following are the key elements that an ideal teleradiology service provider should have (Figure 1):

- Infrastructure: A provision of technologies and a strong infrastructure are the basic requirements for the successful implementation of teleradiology services. A private data center, public cloud, or on-premise infrastructure is required to deploy the services. Teleradiology IT infrastructure is a typical combination of physical infrastructures such as computers, server, networking hardware and facilities. High-configuration desktop/laptop would be required for backend operations. Physical Servers or virtual machines with high-speed internet and bandwidth are required to deploy the teleporting solution. The standard server room should also be equipped with alert systems. For compliance, physical

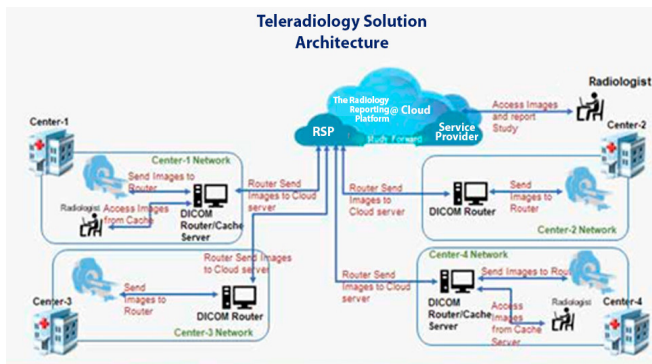


Figure 1: Configuration of the workstation and a basic diagram of IT infrastructure of an ideal teleradiology service provider

or virtual storage is required for data storage and data retention. Physical or Virtual network would fulfill the requirement for high-speed data transfer. The other major infrastructure component is software i.e. Digital imaging and communications in medicine (DICOM) compatible (RIS) and picture archiving and communication system (PACS) would be a vital element to manage image archives, record-keeping and billing.¹⁴ Deployment of AI integrated radiology workflow platform with an integrated RIS-PACS radiology information system would support adjustable radiology requirements with robust workflows (the distribution of the images to the reporting radiologists as well as the archival of the reporting data), enabling seamless delivery across borders. The proficiency of RIS and concierge automation & automated workflow attributes such as the automatic assignment of studies to the radiologists, simple consolidation of EMR/EHR/HIS, patient portal, modality worklist etc., would curtail the human assistance and augment radiologist's productiveness by 30 to 40%. Thus, online workflow platform would allow sharing of information between healthcare professionals located at geographically diverse places, bringing out efficacious preservation of time and resources and enhancing clinical effectiveness and quality of patient care.

- **Clinical Staff:** A teleradiology provider with a fulcrum of board-certified radiologists educated from finest institutions with multiple state licensure and subspecialty training would read, interpret and deliver quality radiology reports to hospital and healthcare centres across world. This would alleviate workforce shortages from retirements or staffing changes and would provide night-time coverage to the client hospitals. The implementation of the process of peer reviewing, an evaluation of the accuracy of a report issued by a radiologist, by peer feedback system is essential for promoting good clinical practice and assessing of radiologist performance in clinical practice.¹⁵
- **Nonclinical Support staff:** A strong line of communication should be in place to confer the findings and results to the referring physician and imaging rules to technologists. Thus, 24/7/365 support from the communications,

Operations, IT team is required for the smooth and effective functioning of the teleporting service.

- **Quality Assurance Program:** A dedicated and stringent Quality Assurance (QA) Program should be followed, which includes peer-reviewing, dual review of cases, tracing and notifications of all flaws and discrepancies to radiologists, organizing quality assurance audit with statistics every month, regular symposiums with radiologists, the revelation of quality assurance specifics to clientele, standardized assessment of quality metrics, and training of QA team and most importantly, a culture of quality throughout teleradiology practice.¹⁶
- **Security Policies and Protocols:** A strong security mechanisms should be installed to provide data security. Web Application Firewall (WAF) is required for layer 7 security for RIS and PACS applications. VPN: Site to Site IPsec tunnel is required to build secure data transfer communication between client and service provider networks. The data centre and infrastructure should comply with HIPAA, ISO27001, and SOC2. Enforcing user authentication systems and encrypting the programs containing patients' information would ward off unauthorized access and ensure patient information privacy and safety. Designing safety strategies and enforcement of computer crime laws would further add a layer of security.¹⁷
- **Innovative Approach:** Developing and deploying diagnostic artificial intelligence/deep learning algorithms in teleradiology workflow would magnify automated diagnostic triage, lowering the average turnaround time. An AI algorithm would also help identify the lesions or other findings that a human radiologist might overlook.^{18,19}
- **Cost and economic factors:** The availability of a sustainable budget by a private teleradiology service provider or the funds provided by the government is essential to successfully implement teleradiology.
- **Collaborative approach:** Integrating and collaborating with ongoing governmental programmes and with other Med-Tech companies, ideally within an ecosystem such as AMTZ, would allow teleradiology services to be leveraged proficiently in sync with telemedicine networks.

Provisions at Client Hospitals/Clinics

In order to ensure accurate, secure and timely delivery of the radiology reports, the infrastructure and technology provisions at client hospitals and clinics should be at par with that of the service provider, especially the internet speed for image/data transfer and storage capacity of computers. The metadata is saved in a local cache on the client computer system and is auto-installed when the system is used at first. This cache put down solely in Java, the H2 Database, is enforced as a relational database for sustaining portability. Since physicians access the system from diverse computers from different workplaces, the security and confidentiality of the information is important. Thus, some features such as (SSL) secure sockets layer (TLS) transport layer security are installed for protection.²⁰

Looking ahead to future perspectives, an integrated approach by teleradiology services and artificial intelligence would improve diagnostic interpretation speed and accuracy and take patient care to the next level. Additionally, the creation of a health cloud by government, semi-government or public sector units to centrally store patient data would aid in research, development, and policy formulation.

CONCLUSION

Notably, teleradiology is not a replacement for in-person radiological examinations and consultations. It is intended to complement on-site radiology services and support healthcare providers in delivering timely and accurate diagnoses. Teleradiology has proven to be an indispensable service in India's healthcare sector, especially in areas with a shortage of radiologists and even in the face of unprecedented challenges. An ideal teleradiology service provider is one with a sturdy infrastructure and technology provisions with a plethora of highly qualified board-certified radiologists who would cater to the needs of accurate, secure, quality and timely radiologic interpretations with 24/7/365 coverage for small hospitals, clinics, diagnostic imaging centers and emergency rooms.

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