THE ROLE OF TELERADIOLOGY IN EMERGENCY RADIOLOGY PROVISION

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Teleradiology is today a word, which epitomises innovation in healthcare, symbolises efficiency in healthcare delivery, and represents a significant success story within the overall spectrum of telemedicine. From its early and fledgling days not much more than a decade ago, it has grown into a billion dollar industry which has been the subject of business case studies at academic institutions while simultaneously providing significant value to patients, physicians, radiologists and entire healthcare systems.

Nowhere has teleradiology made greater impact than in the setting of emergency care, and it is this aspect that forms the focus of this article.

Impact of Teleradiology on Decreasing Report Turnaround Times and Improving Service Levels in the Emergency Setting

The primary value proposition offered by emergency teleradiology is in the outsourced setting. A significant number of hospitals utilising teleradiology services in the United States (the first and to date the largest adopter of teleradiology) are small to midsized community hospitals. In these emergency rooms, prior to the adoption of emergency teleradiology, the scan often remained unreported until the next day, which could result in significant delays in treatment of critical conditions. Alternatively, the practice required the technologist to perform the CT scan and then wake up a radiologist at home in the middle of the night who had to come in to the hospital each time to review the scan (and then work the next day). With the implementation of teleradiology systems the benefits have been dramatic. In the early days of our teleradiology practice, we repeatedly received feedback from emergency room physicians who commented on how much more preferable it was to work with a cooperative radiologist who was awake and desirous of providing support, in comparison with the previously existing model. The service mindset of professionally run teleradiology companies has also led to higher service levels. Tight service level agreements between the hospital and the teleradiology service ensure very rapid report turnaround that benefits both the patient and the treating emergency physician. Thus, teleradiology has raised the bar for clinical service within the area of emergency care.

Clinical Role of Emergency Teleradiology

The clinical entities which are most greatly impacted by emergency teleradiology include the most life threatening conditions, such as pulmonary thromboembolism, aortic dissection, ruptured aortic aneurysm, and acute stroke, in all of which the cost of delayed diagnosis can be catastrophically high. By creating a framework whereby all emergency scans are reported within a 30 minute time frame, with further electronic prioritisation of critical examinations as STAT (i.e., immediate) priority, teleradiology has allowed for immediate diagnosis of such conditions, which in turn facilitates early intervention and superior patient outcomes.

In the setting of acute stroke, teleradiology plays a critical role. The development of stroke centres at community hospitals across the US has allowed for early treatment of acute ischaemic stroke in keeping with the dictum 'Time is brain'. Teleradiology plays an important role in minimising the time to thrombolysis by allowing for immediate detection and communication of the earliest changes of acute ischaemia on CT scan within a few minutes of post scan completion. The teleradiologist can simultaneously define the patient subgroup wherein thrombolysis is contraindicated and further guide therapy. In emergency teleradiology practices such as our own, stroke examinations form an interesting and challenging subset. By reporting stroke examinations performed halfway across the world within a 10-15 minute timeframe, practices such as ours allow for continued success of hospital stroke programmes allowing them to meet their time compliances consistently and reliably.

Technology Advances

Technology advances, such as the use of mobile devices, have further extended the reach and improved the efficiency of teleradiology, especially in acute stroke. Today, teleradiology is used by neurologists to view head CTs on their tablet devices and smartphones in the setting of acute stroke. The obvious corollary is that emergency teleradiology is now not restricted to radiologists' reading rooms, and can be accessed by physicians and radiologists while on the move, thereby enhancing their availability and productivity and decreasing time to diagnosis in the emergency setting.

Other technology paradigm shifts, such as the use of wifi and the Internet cloud have further strengthened teleradiology practice by allowing efficient image distribution that

Dr Arjun Kalyanpur, CEO, Teleradiology Solutions

Rahil Shah, CEO, NM Medical

2. NM Medical has a chain of 15 diagnostic imaging centres.

radiology and pathology.

Today the group has 15 high-end imaging centres spanning the cities of Mumbai, Pune and Bengaluru. Except for five centres that do not offer MRI and CT, all others offer both high-end pathology and imaging services. Their investment per centre with only imaging and pathology is around Rs 20 crore, while without MR and CT ranges from Rs 5 crore to Rs 6 crore. Most of the centres are standalone, except two within hospitals at Sancheti Hospital, Pune, and Cloudnine Hospital, Bengaluru.

The Indian imaging market has made rapid strides over the last one decade. There has been proliferation of diagnostic imaging centres in private hospitals, growth in tele-radiology utilisation, growth of refurbished equipment sellers and focus of major imaging vendors on value segment imaging with a focus on emerging markets. Says Dr Arjun Kalyanpur, CEO, Teleradiology Solutions, "The growth in the sector is related to the overall growth in the Indian healthcare industry which is spurred by an increase in availability of capital for investment in the sector, rising consumer expectations, and an increase in healthcare imaging needs arising from increasing prevalence of the big three diseases, namely cancer, heart disease and stroke, all of which require repeated imaging as part of the initial diagnosis and subsequent follow up."

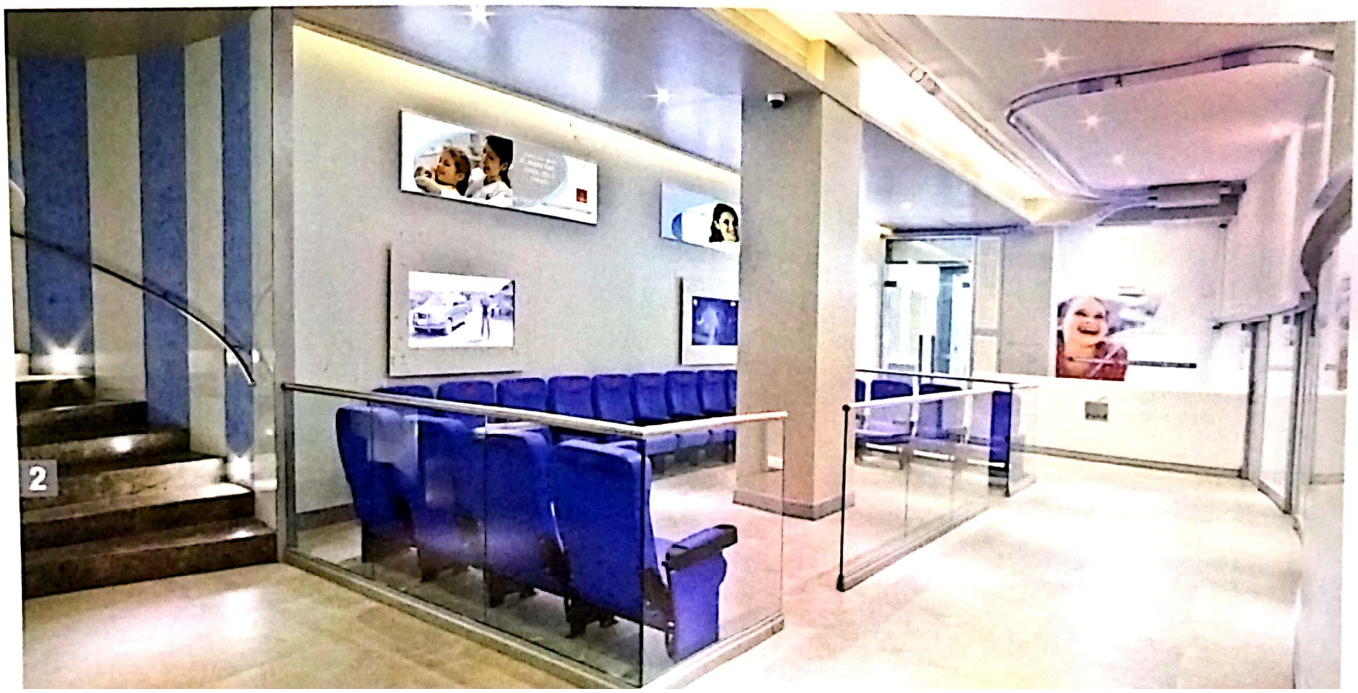
High-end imagining continues to find inroads into the hospitals where there are captive customers and where a minimum number of patients is assured. "Imaging is auguring well for the hospitals as the capex get justified through the assured patient base," says a market pundit.

Below are a slew noticeable trends in diagnostic imaging market:

Boom in tier II and III towns

The proliferation of imaging centres is mostly being witnessed in tier II and tier III towns, as most of the metro cities are over saturated markets. "While more centres would come up in tier II and III cities, the leading brands in tier I cities need to focus on specialised imaging like cardiac or neuro imaging to be key differentiators," says Rahil Shah, CEO, NM Medical.

A good example of a group capturing the tier III market is HealthMap Diagnostics Private Limited, which is a SPV that Manipal Health Enterprises Private Limited has started with Philips India Limited. The group is providing radiology services in Haryana and Jharkhand under the PPP model. All the centres managed by HealthMap are in tier III towns, except for Panchukla, Gurgaon. Ranchi and



Top 10 Interventions Positively Affecting Cancer Care in India

These new interventions are setting in the next big wave of change in cancer care

FROM IMAGE processing to liquid biopsies to on-demand digital pathology, these interventions have the potential to change the way cancer care is delivered in India. We spoke to innovators, oncologists and researchers to find the interventions that are at the fore-front of cancer care in India.

AI and Image Processing

Artificial Intelligence techniques are being used by the image processing researchers and industry to solve a wide range of previously intractable problems in cancer management. Mammo Assist launched by Telerad Tech is an intelligent AI algorithm developed using Deep Learning and Image Processing approach in the field of radiology which analyzes Mammograms for early stage breast cancer detection. It identifies critical clinical findings including BI-RADS Categorization, in turn, enhancing the ability of a radiologist to accurately report cases with High Accuracy and E ciency. It provides Standard Interface with Healthcare Systems through industry standard protocols in addition can generate fully automated preliminary analysis report. MammoAssist can integrate and processing any DICOM images and providing annotation for breast cancer detection with a Structured Report. The algorithm and tool can be plugged into any existing radiology workflow (RIS-PACS) and 2D DICOM Viewer.

"In breast cancer, early detection is of paramount importance in terms of improving patient outcome and reducing healthcare costs. Today, in India, most breast cancer cases are unfortunately diagnosed at a late stage, in part due to the shortage of radiologists required for interpretation of mammograms for the early detection of breast cancer. The availability of an Artificial Intelligence solution such as MammoAssist has the potential to be a game changer in terms of assisting radiologists and

"Cancer treatment has been phenomenally transformed due to ProtonTherapy. It helps in treating tumors located especially in difficult to access areas such as in head, neck, pancreas and prostrate. It is most effective considering the possibility of giving higher doses of radiation to control and manage cancer while reducing damage to vital organs and healthy tissues"

Dr Rakesh Jalali, Medical Director, Apollo Proton Cancer Centre

facilitating early detection of breast cancer," explains **Dr. Arjun Kalyanpur, Founder & Chief Radiologist of Teleradiology Solutions &Telerad Tech.**

Another notable mention here should be made of Predible Lung a solutions to enable hospitals carry out lung cancer screening from low dose CT imaging at scale using artificial intelligence. Being small, subtle findings – lung nodules, which are sign of early cancer have a propensity of being missed by reporting radiologists. Usage of AI can help ensure such errors do not occur and ensure high-quality of care for the screening population. The usage of AI can also be extended to help establish if the detected nodules are malignant or not, helping prevent unnecessary biopsies or warrant quicker follow-up scans to confirm the cancer.

Proton Therapy

ProtonTherapy is the most advanced and targeted cancer treatment due to its superior dose distribution and minimal side effects that helps treat cancer more effectively and efficiently.Standard radiation therapy comprises of X-ray beams that deposit their energy along the path of the beam, to the tumour and beyond, resulting in radiation being delivered not only to the tumour but also to the healthy tissues around the tumour. This causes damage to the normal tissue or organs near the tumour. With protontherapy, it is possible to control the location of the release of the energy and precisely target the tumour, causing the most damage to the targeted tumour cells, while sparing healthy tissues and organs. A proton beam is just millimeters wide and allows the effective treatment of complex tumours in the eye, brain, prostate, as well as cancers in children with the advantage that healthy tissue and critical organs are not harmed. It gives the patient a better quality of life during and after treatment. The Apollo Proton Cancer Centre (APCC) in Chennai is South East Asia's first ProtonTherapy Centre with a capacity of 150 beds.

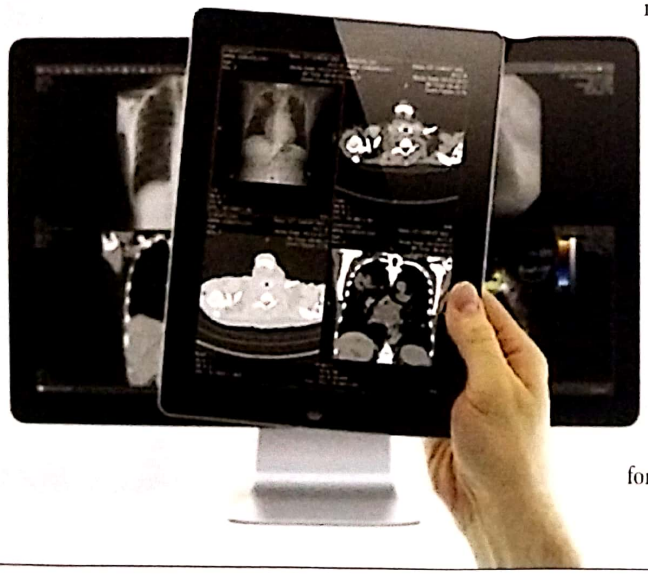
Dr Rakesh Jalali, Medical Director, Apollo Proton Cancer Centre said, "Cancer treatment has been phenomenally transformed due to ProtonTherapy. It helps in treating tumors located especially in difficult to access areas such as in head, neck, pancreas and prostrate. It is most effective considering the possibility of giving higher doses of radiation to control and manage cancer while reducing damage to vital organs and healthy tissues."

Be Future Ready, Invest in AI

Teleradiology Solutions is investing heavily in AI, Dr Arjun Kalyanpur, CEO, Teleradiology Solutions tells us why

Teleradiology Solutions is investing heavily in AI algorithms for imaging. PIs can you tell us more about the same?

Teleradiology Solutions has since its inception been focused on its mission of addressing the issue of radiologist shortages, and the use of technology to alleviate these. We recognize that the global radiologist shortage is so profound that there is a need to use technology to assist radiologists to be more efficient and productive and at the same time remain accurate, in order to meet the clinical needs of the healthcare industry. The use of AI or Deep Learning represents a paradigm shift in this regard. Through our technology division Teleradtech, we are currently focused on developing our own algorithms/IP in this space, particularly in the screening and emergency environment in which we practice. In addition we have partnered with other companies and institutions with the same ecosystem. Through our research division Image Core Lab we provide organizations that are involved in developing AI algorithms with a service and a workflow that allows them to validate these efficiently and cost-effectively. And our Teleradiology workflow Radspa provides a platform for AI companies to connect with their end-users, ie the radiologists, and to deploy their algorithms on scale. Given our 17 year experience in teleradiology and image data transfer/management we are able to support the AI ecosystem with best practices and economies of scale.



Do you think AI could replace radiologists some day?

Radiologists are doctors and therefore this is analogous to asking whether AI could replace doctors one day. Perhaps one day in the future the AI technologies could evolve to a point where every single aspect of a radiologists work could be performed. However today, AI is able to provide solutions primarily in the area of lesion detection, which itself is a tremendous benefit in reducing radiologist workload. The additional roles that a radiologist performs in the form of analysis of the imaging findings, correlation with clinical history, and discussion with clinicians still very much require human intervention at this point. Radiologists spend 5.5 years in medical school before they become radiologists and the clinical knowledge gained in that time frame, which is what puts radiologic images into their clinical context, is what makes radiologists difficult to replace by technology, however advanced. The value of AI however lies in its limitless ability to accumulate information and analyse patterns, and therefore while radiology learning is currently finite and is passed on from generation to generation, AI presents us with the possibility of it preserving it for perpetuity.

Precision and technology has been the mainstay in radiology, but they come with a price tag. How will we pay for AI then?

AI algorithms will ultimately pay for themselves in terms of cost savings by improving radiologist efficiency and productivity. Radiologists are currently a rare and a valuable resource and therefore optimizing their time utilization results in great cost savings to the healthcare enterprise. Additionally radiologic errors are a major cost to the healthcare industry, and by improving radiologist accuracy and preventing errors, AI can certainly help reduce costs.

Will AI deliver on its promise of potential cost-saving and effective healthcare? On what level AI will have to be implemented to get this to happen?

AI is currently in its infancy. In the future, I believe AI can certainly help with cost reduction due to the factors outlined previously. Obviously to demonstrate impact, such changes would need to be implemented at a health system or preferably at a national level. For example, a TB screening program that incorporates AI technology into its detection can save significant radiologist time, and cost and benefit the public health system as a whole.

What challenges do you foresee for clinical implementation of AI in India?

The challenges are many like lack of research depth in the healthcare industry and a rush to create algorithms without detailed validation. Besides there are too many algorithms but not all are in one place, making it difficult for the doctor to decide which algorithm to use when and where and how.

Other challenges are:

- Poor data management and archival
- Cost cutting, and short term perspective by consumers
- Relative lack of regulation in healthcare

How will this segment shape-up in the coming years?

In terms of AI in healthcare we are at the same stage in the aviation industry when the Wright brothers made their initial flights. There is huge excitement and some hype with a large number of players entering the fray but at the same time there is substance in the value proposition and once the dust settles, I believe that the true results will be revealed. More and better algorithms will be released into the market, much like apps on a smartphone. In this context, I seeteleradiology workflow such as Radspa as being the Operating system or the connector that enables these apps to reach the consumer. In this regard, I feel optimistic that teleradiology will be the enabler that ultimately unleashes the incredible potential of AI in diagnostic imaging.