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How AI is Propelling Radiology & Medical Imaging Capabilities

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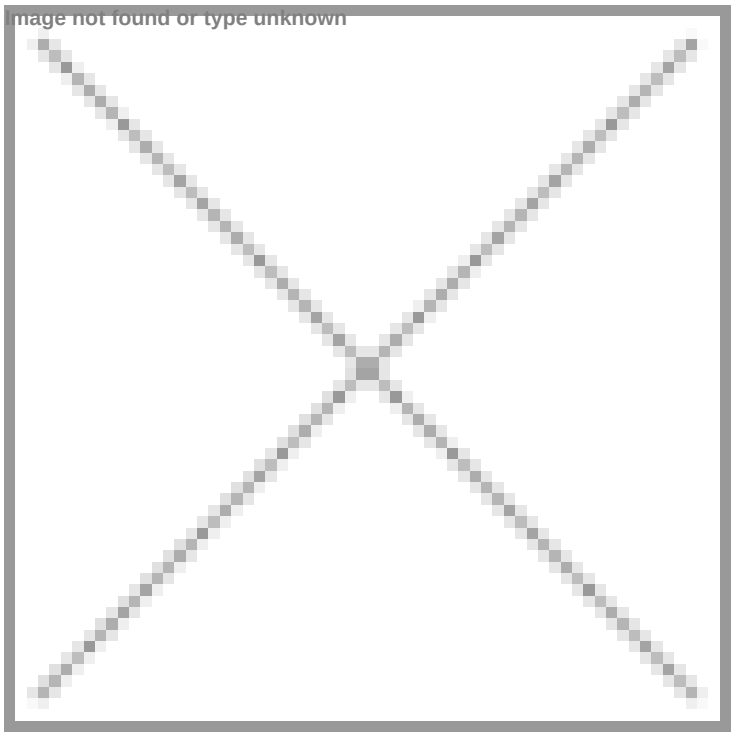
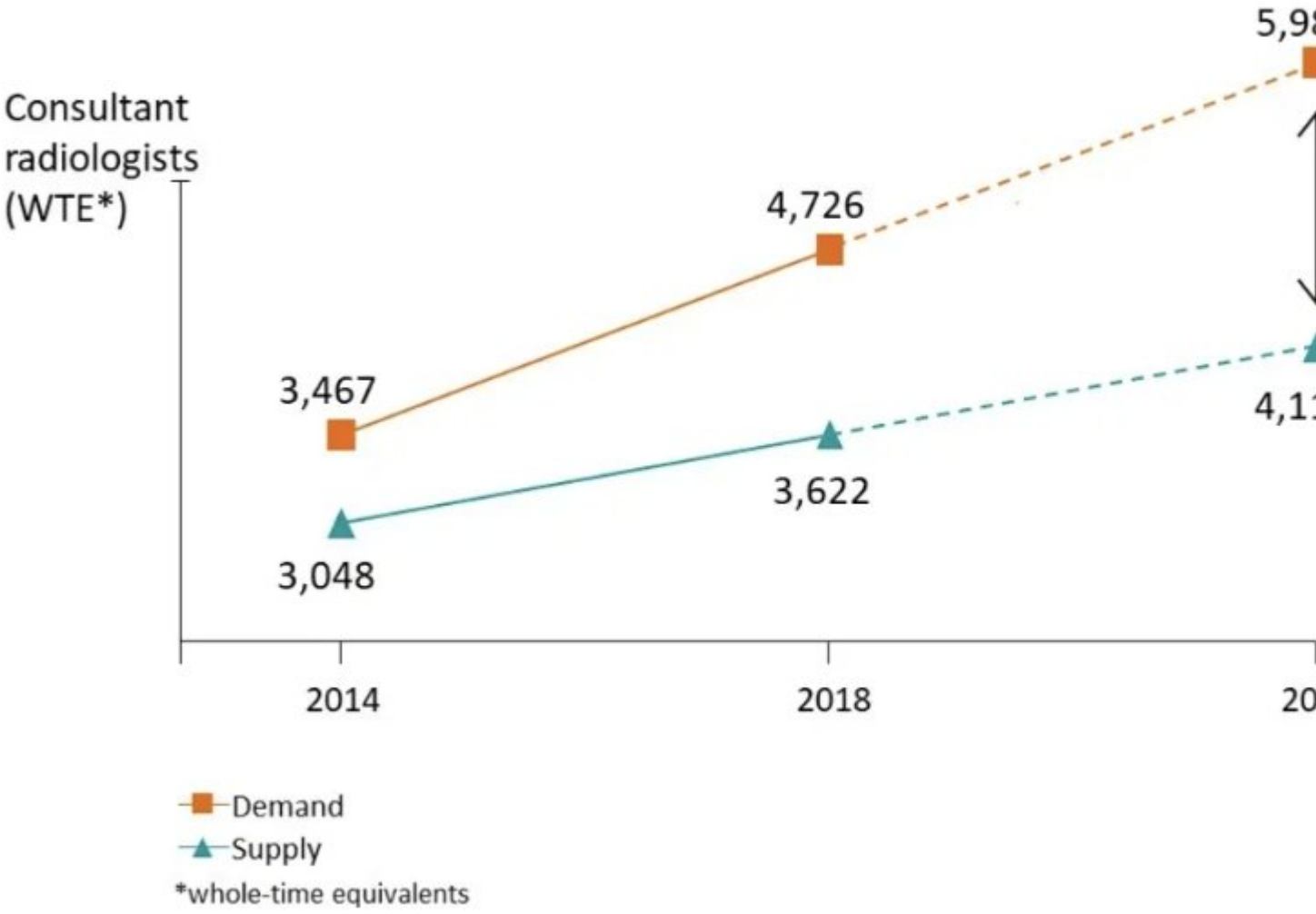
Medical imaging has been used extensively for early diagnosis of various diseases. Be it computed tomography (CT), mammography, ultrasonography, magnetic resonance imaging (MRI), and nuclear medicine tests, radiologists and pathologists have relied on these images to analyse the condition of patients. However, most of the analysis has been manual, heavily depending on the skill sets of the radiologists or pathologists to identify anomalies in the images. The challenge has been the enormous volumes of patient samples to be analysed and the limited number of radiologists or pathologists. Let's take an in-depth look at the impact and possibilities of AI and new applications in the Indian context.



In India, there is only one radiologist for every one lakh patients, which translates to one radiologist for every 100 scans performed each day. There is a severe shortage of radiologists in tier 2 and 3 cities as well. As the number of scans keeps rising and new high-resolution imaging technologies enter the market, it has become highly imperative to develop faster analytical techniques to assist pathologists and radiologists.



Demand- Supply mismatch for radiologists

Enter AI, ML

Artificial intelligence (AI), using machine learning (ML) and deep learning (DL) algorithms has provided interventions in this direction. Machine learning and deep learning algorithms have been used for the past decade to interpret and analyse medical images and aid radiologists and pathologists in screening and diagnosis. Today AI has extended its capability to the entire radiology world, which includes digitising the devices, aiding in diagnosis and finally collating all the data and information into a digital assistant. Image analysis can be broken down into computer-aided detection, diagnosis, and image segmentation. Computer-aided detection and diagnosis involves the use of AI algorithms to analyse medical images and detect abnormalities and diseases.

On the other hand, image segmentation uses AI algorithms to identify and label various parts of a medical image as organs, blood vessels, or tumours. This can help radiologists locate abnormalities and design surgeries more accurately. For example, around 3.5 billion chest X-rays are performed annually worldwide, which require timely and accurate interpretation. AI solutions categorise X-rays based on suspicions of diseases which can be prioritised by radiologists for faster diagnoses boosting efficiency by 30-50 per cent.

On the digital assistant front, traditional Picture Archiving and Communication Systems (PACS) are used for managing the medical images. However, the growing volume of these images is a huge challenge. Novel AI platforms are aiding PACS by optimising radiology workflows. These platforms use cutting-edge AI and enhance reporting and overall productivity. Some of these platforms act as a virtual assistant, intelligently prioritising worklists and efficiently sorting the scans. They highlight important cases and catch hold of abnormalities with precision by carefully scrutinising each image. Further, they also offer click-generated reports, saving radiologists' time, and fostering seamless collaboration between technicians, radiologists, and referring physicians.

Major Pros & Cons

Machine learning has in many cases, been shown to perform on par with medical experts. However, despite the high promise and comparisons with benchmark data, conversion into clinical data and problem-solving has been lacking. A recent review of 62 AI models developed to detect COVID-19 using X-ray and CT images showed that none could be translated into clinical use due to methodological flaws. The "non-explainability", or the inability of the algorithm to explain the diagnosis through evidence, discourages and deters clinicians from adopting AI systems.

Secondly, there are challenges in data availability and collection. Medical datasets are typically small in size, on the order of hundreds or thousands. These datasets come with inherent biases, around various demographics, spectrum of patients and symptoms, which also feed into the algorithms. The test data must be an actual representation of the actual population, rather than being a subset of the training dataset, the latter being the prevailing practice. In medical imaging, dataset bias has been demonstrated in chest X-rays, retinal imaging, brain imaging, histopathology, or dermatology. Sometimes images capture medical interventions as well, which create unnecessary errors during the analysis. Finally, labelling-related errors also exist which need to be avoided. Generating high-quality data sets for very specific use cases and collecting these data sets without any biases will go a long way in improving the clinical outcomes of the use of machine learning in medical diagnosis.

In March 2024, Google partnered with Apollo Radiology International to advance the use of AI in healthcare. The Google Health AI team has been working on various disease conditions such as tuberculosis, and breast and lung cancer and through this partnership, Apollo Radiology will provide them access to high-quality medical data.

Startup Pioneers and Future Prospects

In India, startups such as Niramai, Qure.ai, and Sigtuple were the first set of companies focused on using machine learning for disease diagnosis and reporting. These startups have deployed their solutions pan-India, and they collect more real-world unbiased data and constantly improve their algorithms. Sigtuple has raised more than $40 million during its journey in digitising the pathology and radiology labs and claims to have a portfolio of 21 granted patents. Qure.ai raised a $40 million round in 2022 to scale its medical imaging diagnostics AI services globally. Niramai received the US FDA approval for its breast cancer screening system SMILE-100 in 2022 and boasts a portfolio of more than 25 patents. Some new-generation startups are also using Gen AI to generate synthetic medical images that resemble real patient data, to aid the training and validation of machine-learning models. Gen AI solutions are also automating the radiology report generation, thereby reducing the burden on radiologists and creating a fast and seamless experience for patients.

The advancements in Gen AI and machine learning to understand complex medical images and provide precise diagnoses in the fastest time possible will shape the future of radiology across the world.

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