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Issue Highlights

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Future of radiology in developing countries

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The association between technical breakthroughs and human well-being in terms of life expectancy has been well established through the past several centuries. Since its development in the 19th century, radiology has expanded swiftly to improve diagnosis and thereby treatment of disease for hundreds of millions of patients all over the world. The medical sector has been revolutionized by the introduction of cutting-edge technologies and methods that have increased productivity, decreased costs, and increased patient safety. Radiology, in conjunction with pathology, has become an essential component of both the diagnostic and treatment processes utilized for a wide variety of diseases.

Radiology services are now a crucial component of every hospital, including in small hospitals and nursing homes, to find the root cause of illness in patients. It includes X-rays, Ultrasonography, Computerized Tomography (CT) scans and Magnetic Resonance Imaging (MRI) scans, Positron Emission Tomography (PET), Ultrasound etc. There are around 50,000 MRI[1] and over 300,000 CT systems installed worldwide. Furthermore, there are roughly 1,600 PET/CT systems in use worldwide. Access to modern imaging systems like CT is restricted in low- and middle-income countries (LMIC), with most available models being 16-slice or less, although a trend to higher-end imaging systems is emerging. The current standard for magnetic field strength in LMIC is 1.5T MRI. 3T MRI access is considerably more limited. Japan has the largest per capita number of MRI (55.21 per million population) and CT systems among developed nations, followed by the United States and Germany. For LMICs like South Africa, India, Mexico, and the Middle East, the MRI systems per million population are 0.23, 1.50, 2.57, and 1.90, respectively[2].

According to a survey, there are currently about 30,000 CT systems and 3,500 MRI[3] systems in India. Now, multi-detector CT systems are commonly seen in use and 64- and 128-slice systems have become a reality. It will not be surprising if the figure doubles in the next ten years. The next decade will be dominated by molecular imaging worldwide, and developing nations are quickly catching up. There are currently 222 PET/CT[4] systems in India performing around half million PET/CT scans annually.

The International Agency for Research on Cancer (IARC) estimates that 18 million new cases of cancer and 10 million cancer deaths were reported in 2020. The load may increase in the future because of a number of factors, including sedentary lifestyles, unhealthy diets, and fewer births in nations that are transitioning economically. We are currently observing good trends in developed countries; the expansion of healthcare facilities will undoubtedly promote the expansion of radiology services, which can aid Radiologists in the diagnosis of life-threatening disease like cancer. However, many developing and underdeveloped nations experience difficulties in effectively implementing sub-specializations of radiology. These difficulties include a lack of money, inadequate infrastructure and equipment, a lack of knowledge, politics, the emigration of radiologists, perfectionism, and others. The other two problems are a) accessibility and b) awareness, both of which are equally crucial. Access to hospitals is another concern, as people from remote areas may have to travel for several days to reach a city hospital. This, along with the high cost of care, causes many people to visit hospitals only as a last option, resulting in poor outcomes for many diseases.

[1]Ogbole GI, Adeyomoye AO, Badu-Peprah A, Mensah Y, Nzeh DA. Survey of magnetic resonance imaging availability in West Africa. Pan Afr Med J. 2018 Jul 31;30:240. doi: 10.11604/pamj.2018.30.240.14000. PMID: 30574259; PMCID: PMC6295297.
[2]Qin C, Murali S, Lee E, Supramaniam V, Hausenloy DJ, Obungoloch J, Brecher J, Lin R, Ding H, Akudjedu TN, Anazodo UC, Jagannathan NR, Ntusi NAB, Simonetti OP, Campbell-Washburn AE, Niendorf T, Mammen R, Adeleke S. Sustainable low-field cardiovascular magnetic resonance in changing healthcare systems. Eur Heart J Cardiovasc Imaging. 2022 Jun 1;23(6):e246-e260. doi: 10.1093/ehjci/jeab286. PMID: 35157038; PMCID: PMC9159744.
[3]https://www.indianradiologist.com/index.php/review/made-in-india-mri
[4]Tharma AR. Nuclear Medicine in India: A Historical Journey. Indian J Nucl Med. 2018 Nov;33(Suppl 1):S5-S10. doi: 10.4103/0972-3919.245053. PMID: 30533977; PMCID: PMC6243721.

Over the past few years, Artificial Intelligence (AI) has attracted immense attention in the field of medicine, particularly in radiology. In the next ten years, the use of AI in radiology will be a significant advancement that will result in a massive paradigm shift in how radiology is managed globally. We believe that the introduction of AI into clinical practice is the only way to bend the current demand-supply mismatch between the number of scans that need to be read and the Radiologists available to read them. With vast amounts of data now readily available, and a new wave of AI algorithms which are much more sophisticated and holistic than before, it is clear that the radiology department of the future will run hundreds of AI systems in tandem. AI will contribute to the global development of personalized precision medicine and provide individualized treatment alternatives. Radiologists around the world must understand these potential AI areas of application and should be strongly encouraged to help shape the future of Radiology and medicine by becoming the driving force behind the development and implementation of AI in clinical practice. India is uniquely positioned in this AI race for two key reasons. First, India has highly skilled physicians that are trained in challenging clinical settings. Secondly, India is extremely heterogenous in terms of the diseases / patient-base – with the presence of both western and eastern diseases in a single country. This combination allows for India to be best suited for AI implementation in the clinical setting.

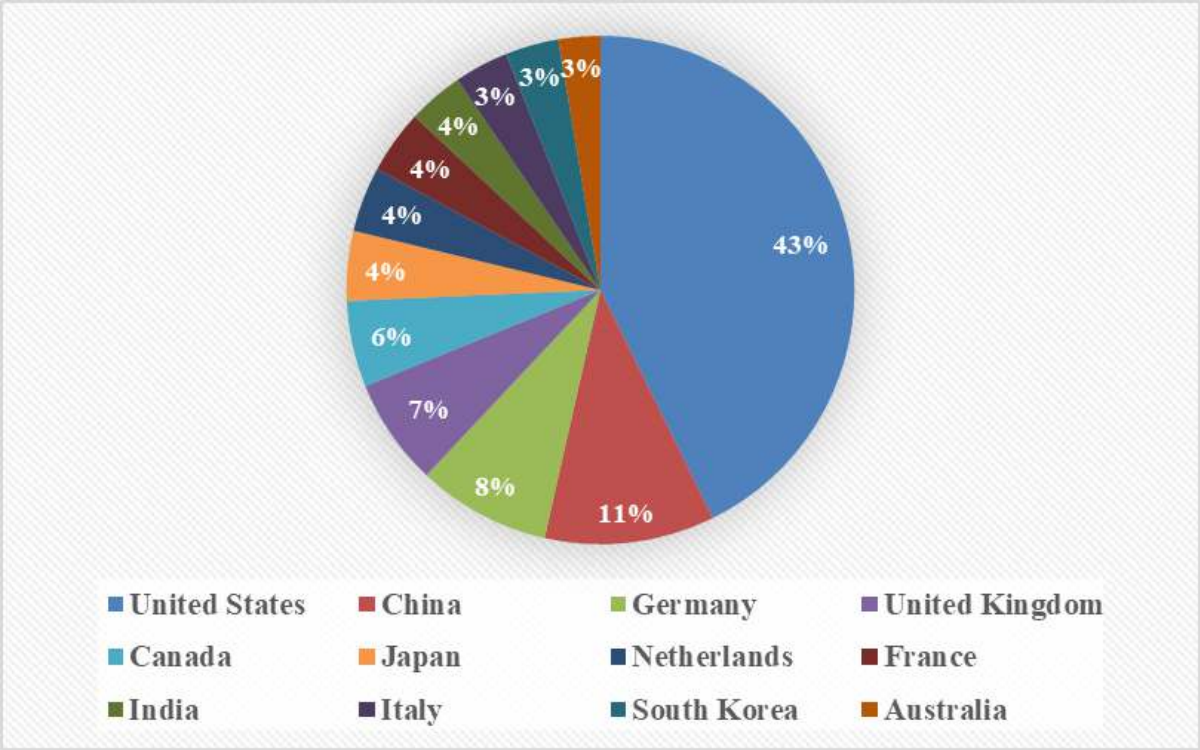


Figure 1. Graph of number of AI in Radiology based publications by country from year 2000 to 2019.

The market size[5] for AI in healthcare surpassed USD 4.2 billion in 2020 and is predicted to expand at a CAGR of approximately 33.7% between 2021 and 2027. In 2020, the medical imaging & diagnosis market sector held around 24.6% market share. The uses of AI in modern healthcare practices continue to grow.

[5]https://www.gminsights.com/toc/detail/healthcare-artificial-intelligence-market

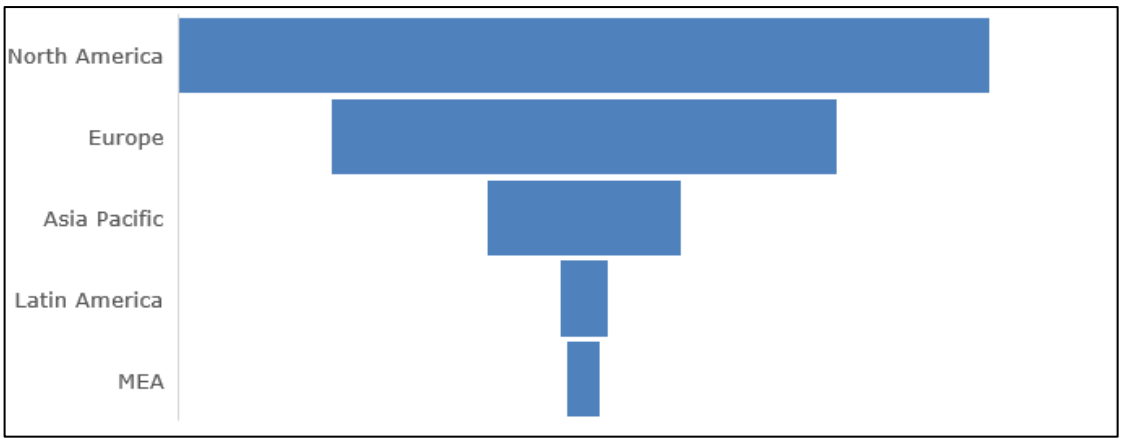


Figure 2. AI in the Radiology market, 2022 (million USD) by region, based on usage and growth.

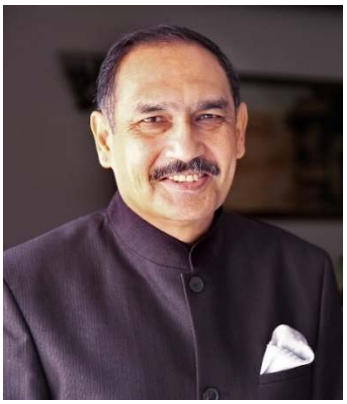
Healthcare is expensive, and cost is widely regarded as the industry's most significant impediment worldwide. This major impediment can be overcome by lowering scanning and operational expenses without compromising system quality. The training of more imaging specialists to fulfill the excessive demand, the transformation of existing Radiologists into subspecialty Radiologists, and the reduction of the high operating, scanning, and equipment expenses of MRI and CT scans are a few potential solutions. New solutions can be achieved by expanding exchange programs among Radiologists and residents from various countries and sharing their expertise. In less developed nations, the availability of subspecialist radiology training is limited. To overcome this shortcoming, cost-effective and innovative training methods are required. MRI systems that can detect diseases and injuries presently cost up to $3 million and have monthly operating costs of roughly $15,000, making them inaccessible for 70% of the world's population[6]. The image quality resulting from earlier attempts to create more economical scanners has not been sufficient to be used for medical applications. However, technical improvements in the last two years have raised the prospect of "generating brain images with low-cost hardware[7]."

Current CT systems with 32 or 64 slices are up to four times faster than earlier models[8]. Machine learning has created the great potential to advance medical imaging, specifically CT scanning, by reducing exposure to radiation and by harnessing the power of AI. Newer digital technologies, including voice recognition and structured formatted reporting, also improve Radiologists' workflow, productivity, and reporting accuracy. Over the next decade, we will see more and more imaging departments across the world recognize the need to embrace digital technologies and profit substantially as a result. Tele-Radiology will be increasingly implemented in less developed nations, allowing for three changes: increased reach of high-quality radiologic services to remote regions, more sub-specialization within the field of radiology, and increased availability of emergency radiology services.

The time has come for developing countries to implement continuing medical education programs for professional Radiologists, and improve access to imaging equipment, workforce capacity, digital technologies, and PET radiopharmaceuticals. In recent years, a growing number of similar programs have emerged in low- and middle-income nations to produce substantial health and economic benefits and reduce the cancer burden globally. In fact, United Imaging's entry into India with the latest technology is testament to the fact that India is now ready to receive attainable innovative imaging systems. We have been using their PET/CT (uMI® 550) system for the past year and everyone – from patients to clinicians to Nuclear Medicine Physicians – is amazed at the quality of images, and reduction in ^{18}F-FDG dose and scan time.

[6]https://www.natureasia.com/en/research/highlight/13913
[7]Liu, Y., Leong, A.T.L., Zhao, Y. et al. A low-cost and shielding-free ultra-low-field brain MRI scanner. Nat Commun 12, 7238 (2021).
[8]https://www.neurologica.com/blog/advances-ct-scan-technology

Author's Biography



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Dr. Vidur Mahajan is the Chief Executive Officer of CARPL.ai – the world's first end-to-end platform for testing and deployment of medical imaging AI solutions. CARPL works with more than 60 partners across the world spanning leading research groups in academia, industry and startups. In the past, he ran Mahajan Imaging, India's leading Radiology chain and has published more than 120 academic and conference papers in the field of AI and imaging. He has done an MBA with dual majors in finance and healthcare management from the Wharton School of Business and studied medicine from Sion Hospital, Mumbai.

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