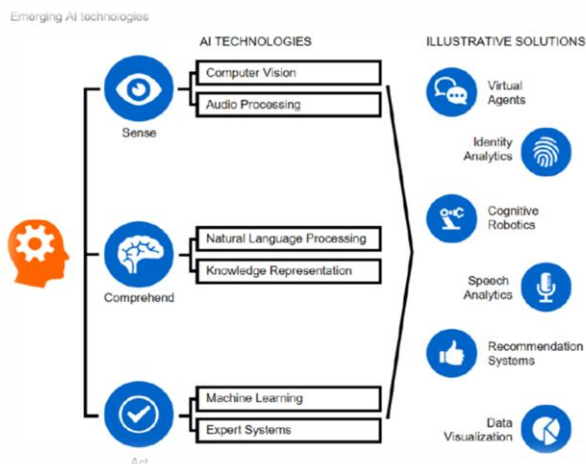


## Cancer diagnosis by AI based approaches

Cancer is the second leading cause of global mortality after CVD's. Patients with cancer generally have a poorer diagnosis in low-income and middle income countries, including India, because of relatively low cancer awareness, late identification, and the inequitable access to affordable curative services compared with patients in high-income countries. In the era of personalized and precision medicine, informatics technologies utilizing artificial intelligence (AI) and quantitative imaging are witnessing a rapidly increasing role in medicine in general and in oncology in particular.

In this lieu, essential steps have been taken by leading government institutions like National Brain Research Institute (NBRC), Advanced Centre for Treatment, Research and Education in Cancer (ACTREC) to introduce AI in cancer research for rapid screening at early stage of its perturbation. Moreover, NITI Aayog is in an advanced stage for launching a programme to develop a national repository of annotated and curated pathology images. The components of such a repository include a move towards "Digital Pathology", which entails data sources from day-to-day patient care. Another related project under discussions is an Imaging Biobank for Cancer, which will be used by expert radiologists to detect cancerous nodules for non-invasive imaging techniques like MRI, PET.

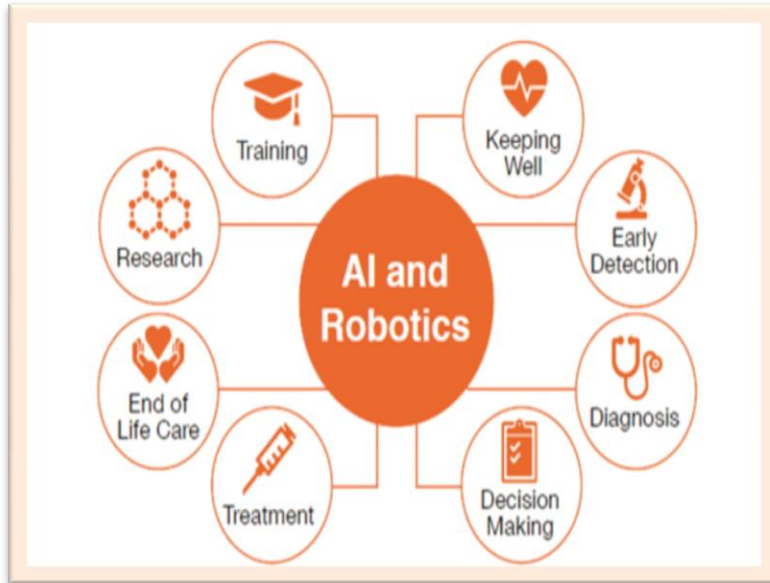
### Emerging AI Technologies



Source NITI Aayog

AI is a constellation of technologies that enable machines to act with higher levels of intelligence and emulate the human capabilities of sense, comprehend and act. Computer vision, audio processing, natural language processing, knowledge representation, expert systems are AI attributes that are being used in its various use cases.

## Potential use cases of AI in Healthcare

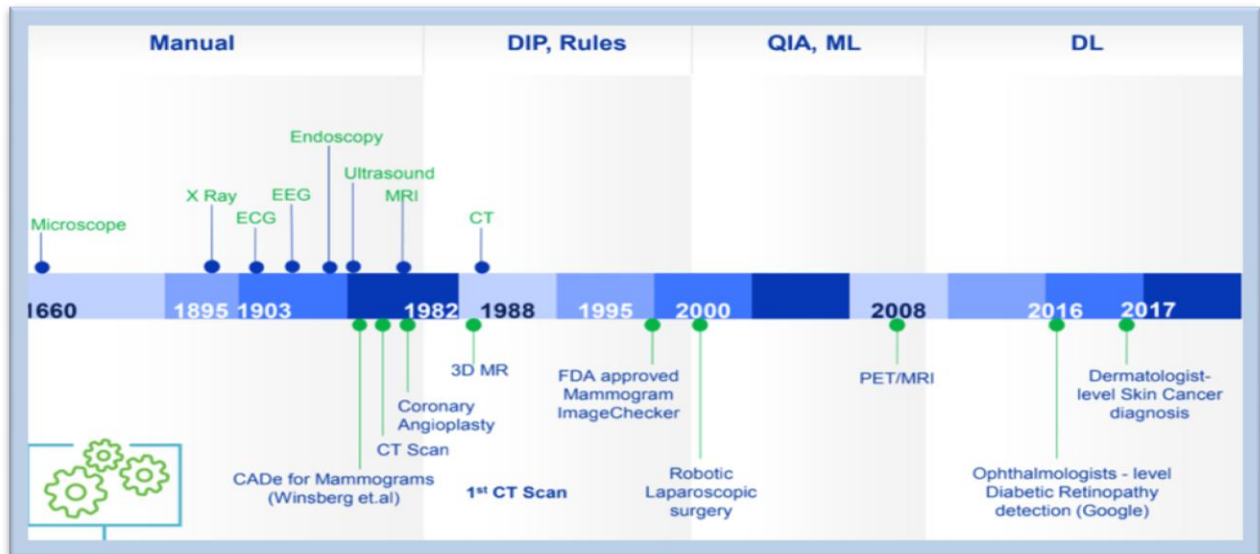


Internet of Medical Things (IoMT) could potentially be the new nervous system for healthcare, presenting solutions to address healthcare problems and helping the government in meeting several objectives via:

- AI driven diagnostics
- Personalized treatment
- Early identification of potential pandemics
- Imaging diagnostics

Source NITI Aayog

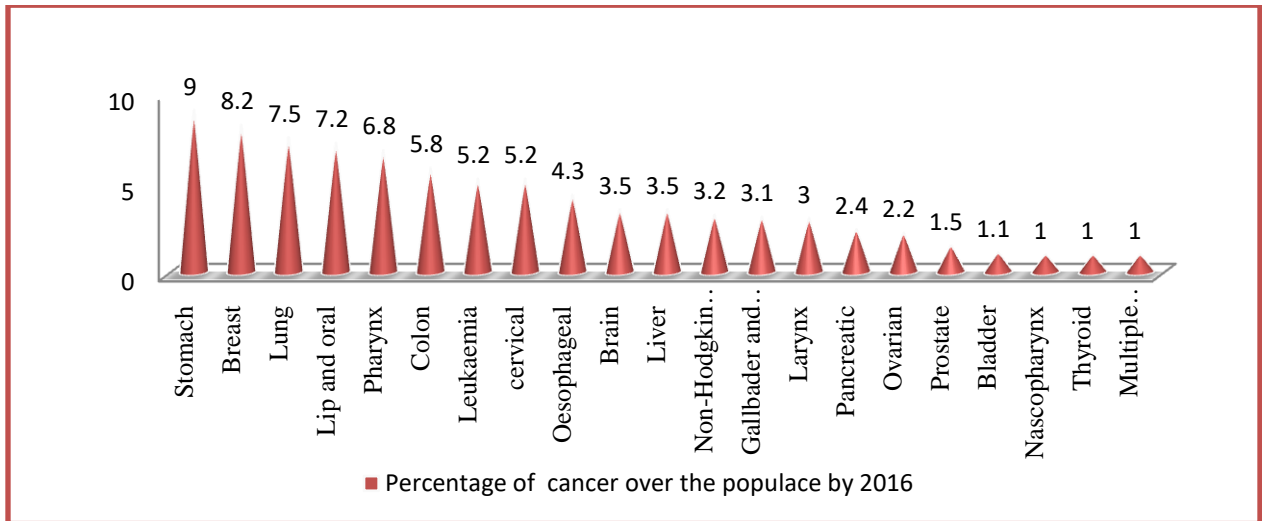
## Timeline: Evolution of AI based healthcare over the decades



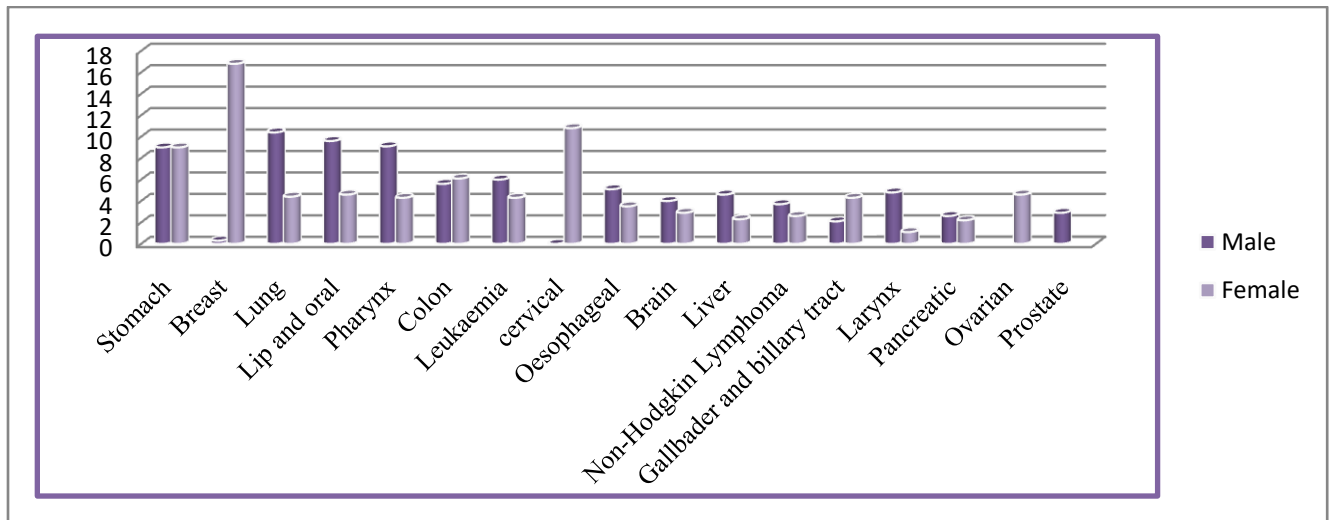
Since its inception the dimension of technology has changed significantly. In 1960's the technology has its very limited say in healthcare, critically restricted to microscopes only. However from early 2000 to late 2000 its contribution has evolved drastically. Nowadays, the comprehensive deep learning (DL) networks are being used to detect and diagnose the critical diseases like cancer.

There is a significant increase in the number of cancer patients in India from 1990 to 2016, as per the report published in the Lancet. The crude cancer incidence rate in India has been increased by 28.2% owing to various environmental and genetic factors. Therefore, the government of India has started developing technical diagnosing methods for cancer diagnosis using AI-based approaches.

### Percentage of Cancer variants over the populace

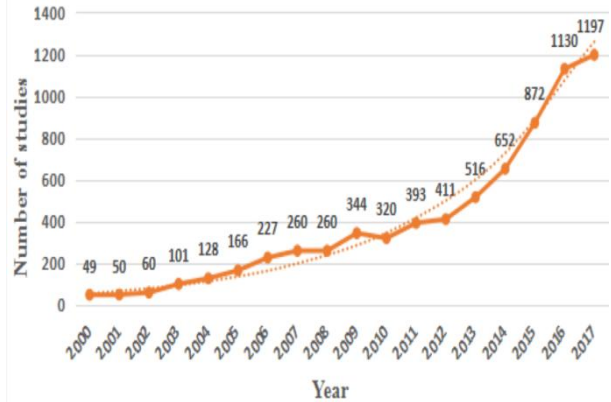
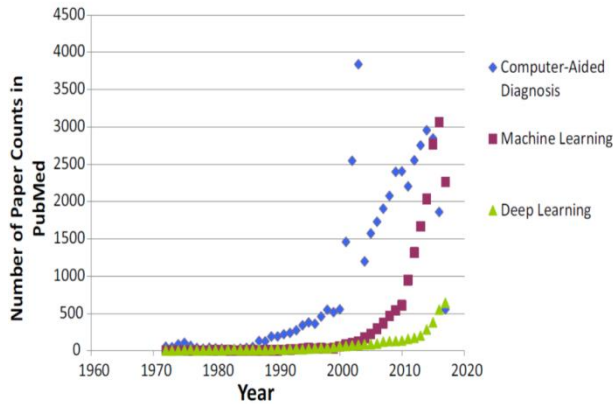


### Critical cancer variants across the gender



The graph shows the percentage of the variants of critical cancer cases among different sexes in India over the years 2000-2016. In females, the number of breast cancer cases accounts for the maximum, and in males, the number of cases for lung cancer is the largest.

## Use of AI based techniques in Cancer Research



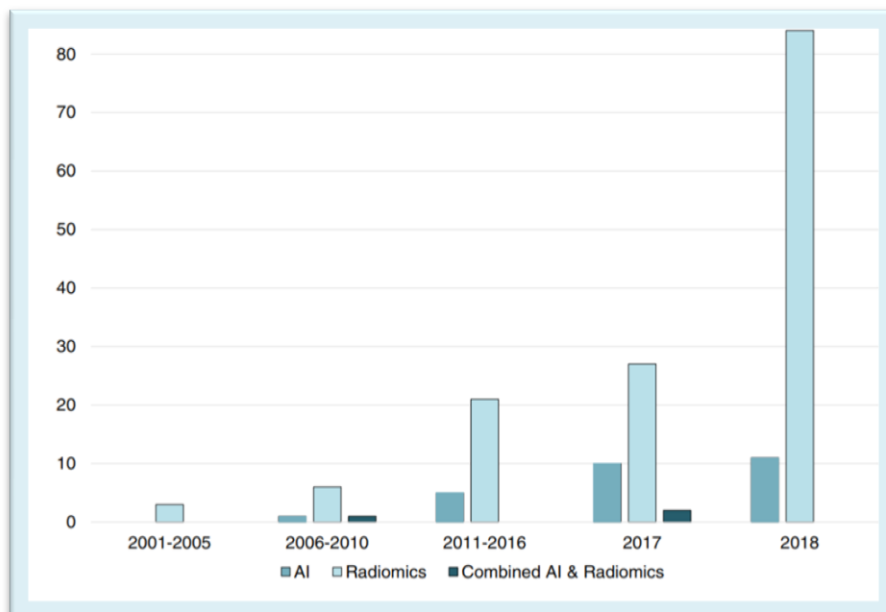
Research using AI based approaches has been significantly effective over the past 15 years.

Published articles using machine learning has been increased from 1000 to 3500 from 2010 to 2018.

Articles incorporating deep learning as research technology have been increased by 500 from 2010 to 2018.

In 2000, only 49 articles were published in this research field. However, annual volume of literature has been growing exponentially as represented in the graph.

## Perspective: Combined AI & Radiomics

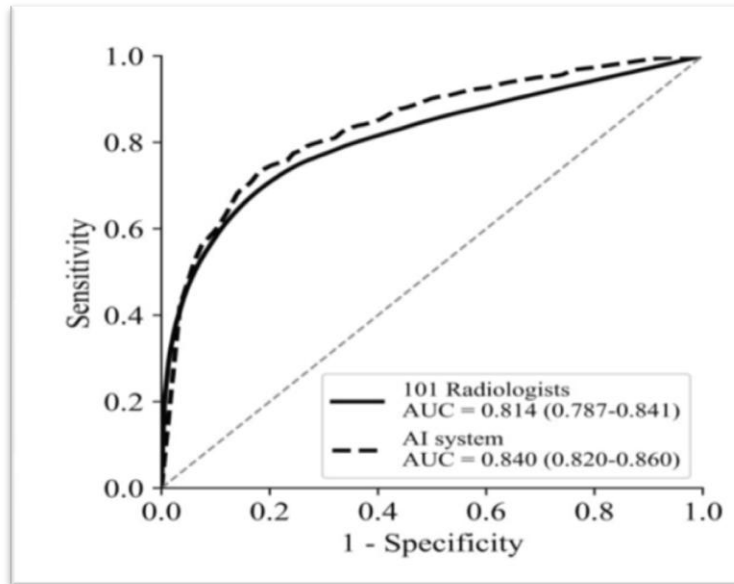


Bar graph elucidating trend for use of the artificial intelligence (AI), radiomics and the combined approaches radiomics/AI in cancer research

Between, 2000-2005 there is hardly any use of AI approaches, however in 2018 its impact have been substantially increased.

## AI for breast cancer diagnosis

Mammograms are the effective tool for AI based breast cancer detection. As these are read by two specialists, which can lead to potential delays in diagnosis if there is a shortfall in expertise. The researchers have been looking at introducing AI systems at the time of the screening.



Receiver operating characteristic (ROC) curve comparison between the reader-averaged radiologists and the artificial intelligence (AI) system in terms of area under the curve

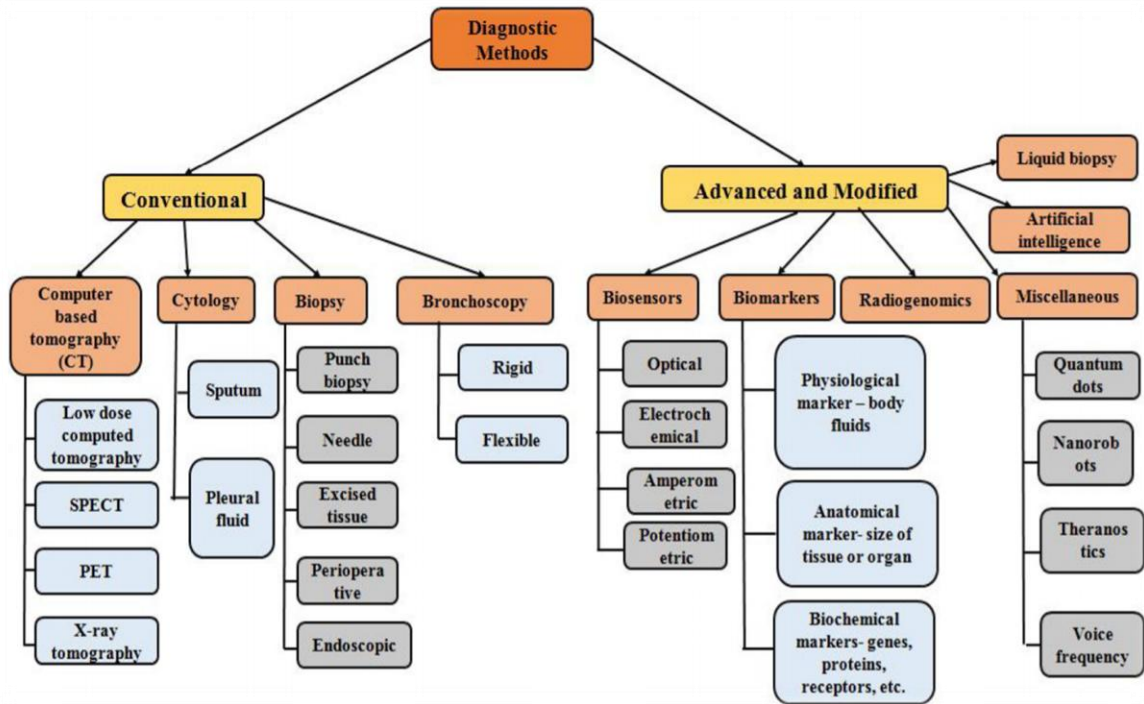
Where, the ROC curve is created by plotting the true positive rate (sensitivity) against the false positive rate (specificity).

Also, the area under an ROC curve is a measure of the usefulness of a test in general i.e. a greater area means a more useful test.

AI has already made substantial strides in cancer image recognition. As per the study published on *Journal of the National Cancer Institute*, The evaluated AI system achieved cancer detection accuracy comparable to an average breast radiologist in this retrospective setting as shown in ROC curve.

## AI For lung Cancer diagnosis

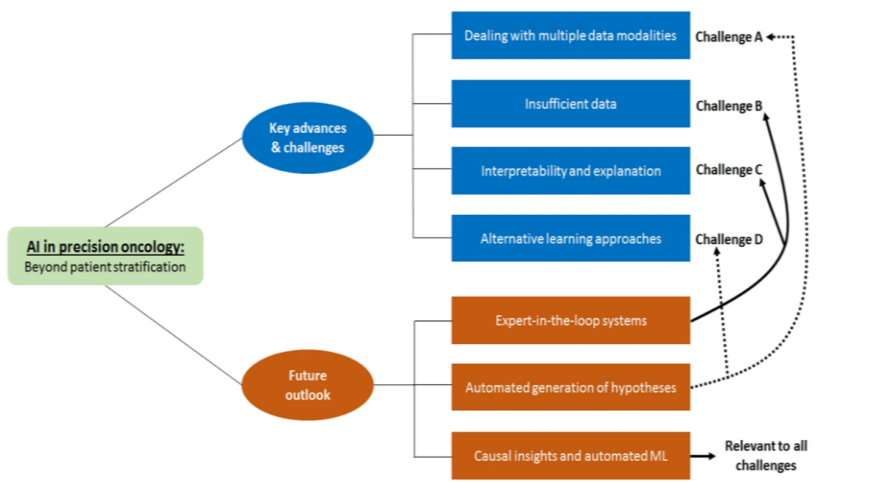
Lung cancer is a leading cause of death among smokers and it has been emerging in non-smokers due to passive smoke inhalation by non-smokers. The mortality rate of patients with lung cancer is very high due to the change in lifestyle and environmental factors. It is found in maximum number of males in India and overall ranks at 3 among total percentage of other cancer variants.



Source Elsevier

Over the years, since the introduction of cutting edge technology, various novel and emerging diagnostic tools like biomarkers and biosensors, radiogenomics and artificial intelligence are being used with the various conventional techniques like CT-imaging, sputum cytology, biopsy and bronchoscopy for better sensitivity and accuracy.

### Current challenges and future outlook



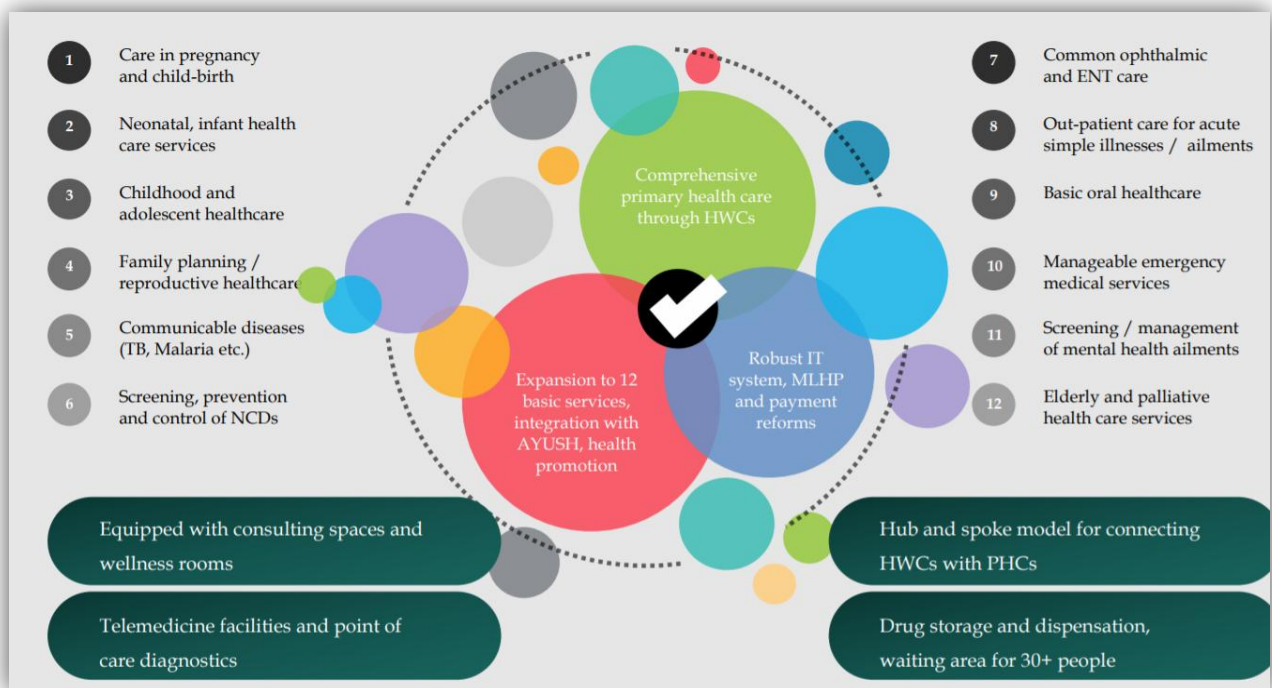
Source Nature

Despite AI's prudent contribution for fast and rapid cancer diagnosis, yet it is argued that its scope and depth of research need to be expanded to achieve ground-breaking progress in precision oncology in the near future as depicted in the figure.

## Leveraging technology for Health and Wellness Centers (HWC)

As per National health Policy the government aims at leveraging technology such as AI to improve healthcare facilities through the:

- a) National eHealth Authority (NeHA)
- b) Integrated Health Information Program (IHIP)
- c) Electronic Health Record Standards for India



This provides an unprecedented opportunity to use artificial intelligence to improve decision-support in cancer treatment at low cost especially in countries like India. AI based Radiomics is an emerging field that refers to the comprehensive quantification of tumor phenotypes by applying a large number of quantitative imaging features.

It has resulted in improvement to existing biomarker signature panels by adding imaging. The potential of AI in public health is being explored in our country. The Ministry of Health and Family Welfare (MoHFW) is working towards using AI in a safe and effective way in public health in India.