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Leveraging Early Cancer Detection Tech

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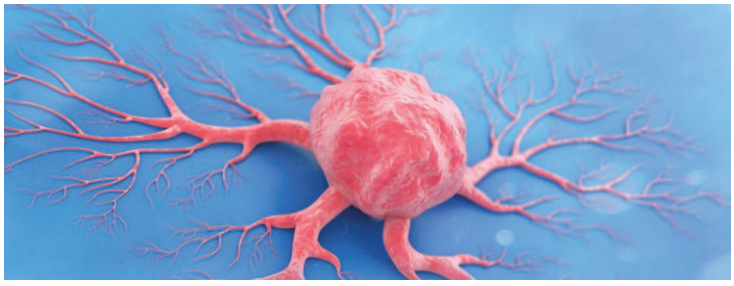
Cancer is fast turning into an 'epidemic' and is the second leading cause of death globally. As per the Globocan Report of 2020, the annual global burden of cancer in 2020 in the country had hit the 1.93 crore mark with an annual death of 1 crore. Let's explore some notable new technologies and also try to uncover the challenges in the fight against cancer.



Cancer is associated with stigma, fear and anxiety. Apart from a cancer patient who has to undergo a host of tests and treatments like chemotherapy and radiation, the relatives accompanying the patients also suffer mental agony. India has a

huge burden of cancer and according to Indian Council for Medical Research (ICMR) estimates on the 'Burden of Cancers in India', seven cancers accounted for more than 40 per cent of the total disease burden: lung (10.6 per cent), breast (10.5 per cent), oesophagus (5.8 per cent), mouth (5.7 per cent), stomach (5.2 per cent), liver (4.6 per cent) and cervix uteri (4.3 per cent). As per biomedcentral.com, the highest incidences of cancer are in the North (2,408 patients per 100,000) followed by the North East (2,177 per 100,000). Incidences of cancer are going to show an upward trend with lung and breast cancer being common among males and females and it is a worrying sign.

Cancers of the oral cavity and lungs in males and cervix and breast in females account for over 50 per cent of all cancer deaths in India. As a large proportion of cancers are diagnosed at the advanced stage, it leads to poorer survival, drainage of economic resources, along with loss of socio-economic productivity. Cancer prevention and early detection remain critical goals worldwide.

According to **Keith T Flaherty, Director of Clinical Research, Massachusetts General Hospital Cancer Center**, new methods that can be taken into primary care and remote care environments are not yet on the market, but are rapidly progressing in clinical validation studies. The biggest area of investment of development has been in blood-based methods for detecting DNA shed by cancer cells.

He goes on to add, "The ability of these methods to detect smaller and smaller quantities of circulating tumour DNA, now make it feasible to detect a single copy of tumour DNA in a 10 ml tube of blood, which is the needed level to detect cancers at an early stage. Those tests also incorporate techniques for determining the 'cell of origin' in a way that suggests the cancer type that is developing. This is an important feature and it remains to be determined as to whether these tests will be equally useful across the spectrum of common cancers."

Early screening

The key to preventing cancer is early screening. Screening helps to locate early signs of cancer or precancerous conditions. This leads to the treatment being more likely to be successful and the chances of survival are much better. New technology developments such as Artificial Intelligence (AI), liquid biopsies, genome editing, telehealth, robotics and gene therapies amongst others are powering better diagnosis and helping accelerate progress against cancer. While global cancer incidence is on the rise, rapidly increasing medical evidence coupled with numerous innovations in cancer diagnosis and treatment is improving how cancer is getting identified.

Liquid biopsy is the analysis of tumours using biomarkers circulating in fluids such as blood for early detection of cancer. Multi-cancer early detection (MCED) test is now available that offers the detection of the presence of multiple different types of cancers using a simple blood sample. It is an Next Generation Sequencing (NGS)-based test that uses AI algorithms to analyse methylation patterns of cell-free DNA (cfDNA) in blood.

AI-based algorithms are also available for screening cervical PAP smears to facilitate early detection of cervical cancer with higher accuracy. Theranostic markers are offered to the oncologists to guide targeted therapies and immunotherapy of their patients. A fully automated genomics laboratory for advanced molecular and genetic testing of cancers helps in detecting cancer. Real-time PCR, digital PCR, MLPA, Fragment Analysis, Sanger Sequencing, Pyrosequencing and Next Generation Sequencing are some of the methods being adopted in early cancer detection.

For breast cancer, self-examination, yearly mammography above the age of 40 years and targeted biopsies can detect a large proportion of cancers in the early stage. For cervical cancers, yearly PAP smear and human papillomavirus (HPV) testing followed by cervical biopsies for high-risk cases are helpful. Monitoring serum PSA levels can help triage men in need of early biopsy to detect prostate cancer. For oral cavity cancers, early consultation for non-healing ulcers, white patches, growth etc. will detect oral cancers early.

Other forms to screen cancer are advanced immunohistochemical markers on biopsy or excision specimens which serve as surrogates for molecular testing, as well as molecular testing by fluorescence in situ hybridization (FISH), polymerase chain reaction (PCR), next-generation sequencing (NGS) are modalities we offer. These tests help to treat physicians in making informed decisions for patients to avail precision and targeted medicine.

However, **Dr Jay Mehta, President & Head, Neuberg Oncopath** mentions, "We are somewhere between developed and developing countries in the sense that we don't have as many extensive screening programmes as needed for a population our size, however, we have progressed in terms of increased awareness among common people, offering affordable screening tests so the people can access healthcare earlier than they would have."

Breakthrough technologies

Experts at the Imperial College London have recently developed a surgical knife capable of identifying tumours that can detect endometrial cancer within seconds. The surgical knife could aid the treatment strategies for cancer by enhancing the diagnosis time and giving the go-ahead for treatment. Dubbed Rapid Evaporative Ionisation Mass Spectrometry (REIMS), the surgical intelligent knife (iKnife) can rapidly identify human tissues in real time and is a form of ambient mass spectrometry. The intelligent surgical knife can locate the presence of endometrial cancer using standard electrosurgical methods. It is known to identify different tissue types, including lung, colon and liver.

Innovation-driven company PredOmix with its cost-effective cancer detection blood test called OncoVeryx-F is capable of detecting early-stage cancers in women with 98 per cent accuracy. Backed by metabolomics-based technology, the new age innovation enables the screening for early-stage cancers. Designed for women, the screening tool accurately diagnoses cancer before tumour development begins with high specificity.

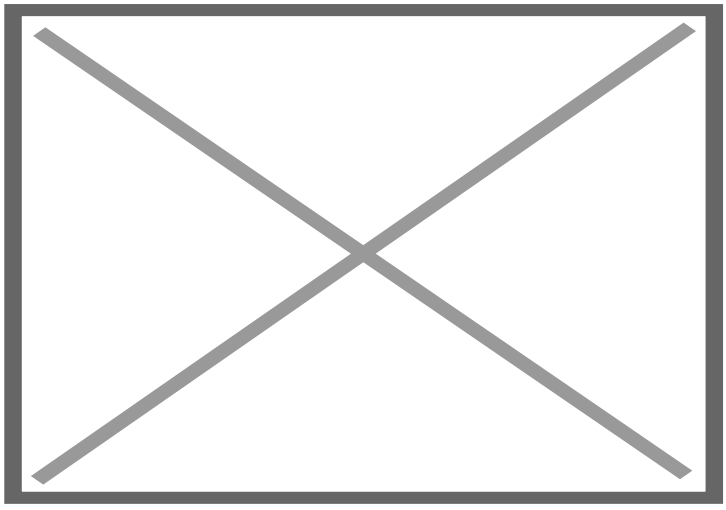
Says **Dr Kanury VS Rao, Co-Founder & CSO, PredOmix**, "While global cancer incidence is on the rise, rapidly increasing medical evidence coupled with numerous innovations in cancer diagnosis and treatment is improving how we identify, perceive, comprehend, and treat cancer. What once seemed impossible in the field of cancer research is now a reality. Accelerating progress against this disease may be possible if these technologies are further investigated and used."

The current cancer screening solutions at Datar Cancer Genetics are CE accredited, with the US Food and Drug Administration (FDA) having granted 'Breakthrough Device Designation' for the early-stage breast and prostate cancer detection tests.

Says **Dr Vineet Datta, Executive Director, Datar Cancer Genetics**, "Genetic research over the past few years has rapidly increased the incorporation of such solutions in clinical practice. With the benefits of genetic testing getting increasingly established, efforts must be made to increase access to genomic services for all who can benefit. India is at the cusp of a revolution in biotech innovation, and genetic tests offer diverse purposes, including screening and diagnosis of genetic disorders, prediction of drug responses and identifying therapies that provide personalised cancer care."

Apart from this, Virtual Tumour Board's (VTB) National Cancer Grid (NCG) initiative aims to provide standardised care to individuals across the country. Different centres from across India join this virtual tumour board to discuss the management of oncology cases.

Mention can be made of Karkinos Healthcare which aims to significantly enhance access to cancer care services by creating a technology-enabled data-driven platform and distributed cancer care model (DCCM), wherein the knowledge architecture is centralised and the delivery systems are democratised and distributed. The DCCM encompasses a 'hub-and-spoke and further spoke' hospital infrastructure on the back of robust technology and clinical decision support systems.



Dr Moni Abraham K, Co-Founder, Medical Director and CEO, Karkinos Kerala mentions, “We have a technology platform where a patient can assess whether there is an elevated risk of particular cancer or not. When somebody is diagnosed or suspected as a highly elevated risk, we need to send them to what we call a community cancer centre. We aim to significantly enhance access to cancer care services by creating a technology-enabled data-driven platform and DCCM, wherein the knowledge architecture is centralised, and the delivery systems are democratised and distributed. The DCCM encompasses a ‘hub-and-spoke and further spoke’ hospital infrastructure on the back of robust technology and clinical decision support systems.”

Bengaluru-based Mestastop has created three proprietary platforms, both in vitro and in vivo, along with patient tumour translational validation, to unravel the complexity of metastasis drug discovery and early predictive diagnostics. These platforms are ready to be used for novel drug discovery, drug repurposing and profiling current anti-cancer leads or candidates for their anti-metastatic effect. About 9.6 million people died of cancer globally in the year 2016 and 90 per cent of those deaths were due to metastasis, i.e. spreading of the primary tumour to other parts of the body.

Mestastop is not into the early detection of cancer but in the early detection of the metastatic probability of cancer, i.e., of solid tumours. According to Mestastop, a minimum of 10^9 (^ refers to the power of) cancer cells are needed to be recognised by a PET scan, and 10^5 cells are required to be detected by liquid biopsy. PET scan is the gold standard, as a liquid biopsy can still have false negatives. This means that even if one has 90,000 cancer cells in the body, the person will be clinically undetected. This highlights the importance of increasing the sensitivity of detection, or in other words, early detection, even when the cancer is small.

Arnab Roy Chowdhury, Founder, Mestastop Solutions opines, “90 per cent of cancer deaths are due to metastasis, and once the tumour metastasises, i.e., spreads, there is almost no curative treatment. Clinicians use the node status of primary tumour patients to understand their metastatic probability, but it has a lot of variations and could be better. METSCAN can take a primary patient tumour and then predict its metastatic probability, thereby empowering clinicians in their decision-making ability.”

Medical diagnostics company Harae Dx Corp has developed a next-generation automated multi-cancer early detection system to revolutionise current methods of cancer screening with liquid biopsies. The non-invasive portable rapid cancer diagnostic system can offer reliable test results in as little as 30 minutes. The system is based on a multi-application platform using a proprietary lab-on-a-disc centrifugal microfluidic technology.

Says **Dr Nitin Malekar, Director, Harae Dx Corp**, “The primary goal of the screening programme is to detect cancer at an early stage, especially when an individual is asymptomatic and may have a family history. If detected early, the cure rates are better and the treatment is also not expensive, thus helping doctors and patients to accomplish the best results. Additionally, it reduces the morbidity, mortality and disease burden in the society at large.”

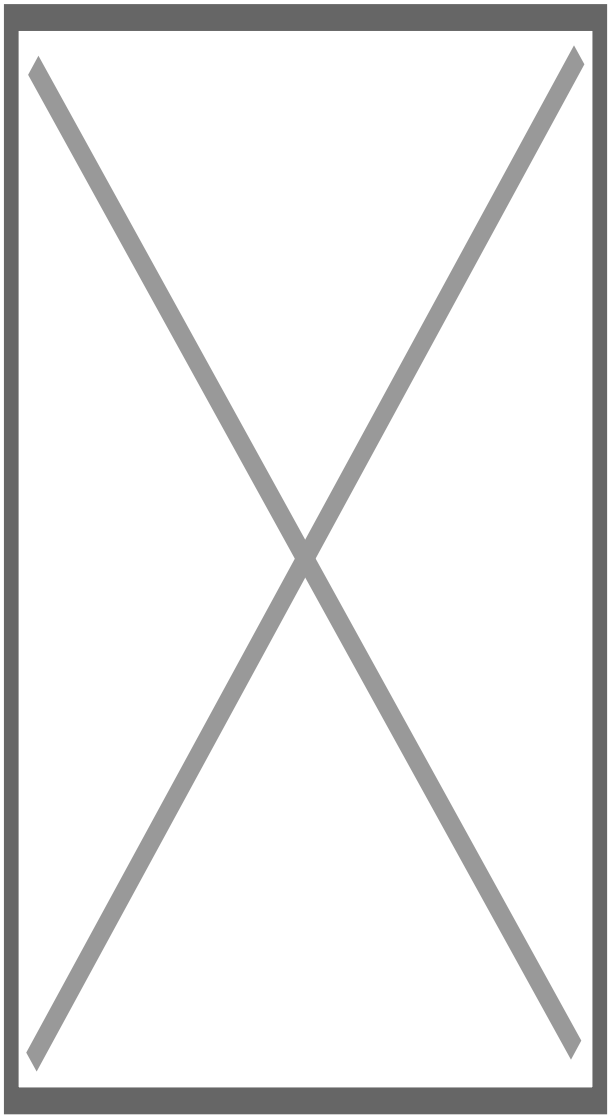
Apollo Hospitals Navi Mumbai recently launched Apollo Genomics Institutes to provide comprehensive care to patients and families with genetic disorders. Genomic medicine is a new medical discipline that deals with genetic disorders and helps in the diagnosis and treatment of rare and inherited diseases. This move is likely to help in the early detection of cancer.

Genetic research over the past few years has rapidly increased the incorporation of such solutions in clinical practice. With the benefits of genetic testing getting increasingly established, efforts must be made to increase access to genomic services for all who can benefit. India is at the cusp of a revolution in biotech innovation, and genetic tests offer diverse purposes, including screening and diagnosis of genetic disorders, prediction of drug responses and identifying therapies that provide personalised cancer care.

Referring to enhancing survival rates, **Manikandan Bala, Managing Director, India & SA, Senior Vice President, Direct Sales Strategies &, TIMEA & Asia Pacific, Elekta** says, “Cancer survival increases with early detection. Unfortunately, when cancer is diagnosed, about 50 per cent of cases are already at advanced stages. Early intervention is made possible by early diagnosis of cancer or precancerous changes.**”**

Elekta has launched innovative cancer treatment solutions. One such solution for radiation therapy is Elekta Harmony, a state of the art linear accelerator. It was unveiled on World Cancer Day. This technology is critical for curative cancer treatments.

All the above technologies, among others, are likely to become game changers in early cancer detection and will indeed bring hope to the medical fraternity and patients. However, there remains a host of challenges while going in for early detection of cancer.



Underutilised facilities

General awareness about cancer including its risk factors and early symptoms is relatively low in India. Fewer people seem to be concerned about developing cancer in their lifetime in India compared to the global average. The natural outcome is that fewer people go in for screening tests like pap smears, and mammography as a routine practice.

Dr Rajiv Tangri, Technical Director of Histopathology and Cytopathology, Dr Lal PathLabs opines, “Despite the availability of cancer screening programmes and excellent clinical diagnostic facilities in India, the services are mostly under-utilised. Major challenges that we face in our war against cancer include – a low level of awareness amongst the general public about cancer, late detection of cancer, poor access to specialised cancer care especially in rural and remote parts of the country and high cost of treatment.”

Almost 75-80 per cent of patients have advanced disease (Stage 3-4) at the time of diagnosis. This is mostly due to the late diagnosis which in turn is due to a low level of awareness in the population and among community physicians, lack of screening programmes, lack of diagnostic facilities locally and the requirement to travel long distances to reach a major tertiary cancer centre, financial constraints and stigma associated with the diagnosis. The situation is even worse in rural areas which constitute almost 70 per cent of the total population. This is further compounded by factors like limited finances, language and cultural differences etc.

A large proportion of cancers are diagnosed at an advanced stage which leads to poorer survival, drainage of economic resources, along with loss of socio-economic productivity. Cancer prevention and early detection remain critical goals worldwide. India is still lagging in terms of the sensitivity and efficiency of liquid biopsy. However, on the brighter side, image-based detection, e.g., lung cancer has improved due to artificial intelligence.

The way forward

Government bodies should evaluate the performance of the innovations to traditional techniques in mass screening programmes, following which certain tests/technologies can be incorporated into routine screening guidelines.

Dissecting the economics of cancer screening is key to ensuring the equitable distribution of resources and appropriate interventions to improve cancer outcomes via early detection. Early diagnosis can reduce the cost of treatment, with estimated cost-savings in the disease course to be two to four times less than those diagnosed at later stages, including the adverse financial impact on the patient and their family.

Early diagnosis of key individual risk factors is crucial for improved prevention of serious illness. The cancer burden will continue to increase over the next 15-20 years, with much of this increase seen in parts of the world where the health systems are already struggling. The proportion of patients receiving genetic tests will only increase as more data points enumerate the benefits of such solutions. However, additional factors like regular cancer screening, healthy eating, vaccination, and avoiding tobacco and alcohol consumption remain critical strategies for not just preventing cancer, but also reducing the detrimental effects of cancer.

The Government of India has taken proactive steps over the past decade in the prevention and early detection of cancer and has launched various schemes to strengthen cancer control activities. Expanding the ambit of the National Cancer Registry could halt morbidity and mortality rate.

As **Dr Sundeep Jain, Founder GI & HPB Surgeon Abdominal Cancer Foundation, Jaipur,** rightly points out, “While India has recently established the National Cancer Grid to promote the use of digital technologies and tools to improve cancer care across the country, the increased fund allocation would facilitate in tracking the clinical care and outcomes of a large sample space of the defined patient population. The data from the registry can also help device public health interventions to create awareness about prevention and early detection of these cancers.”

Cancer cannot be treated by building cancer centres alone. Currently, one in eight of us will develop cancer in our lifetime and the numbers are only going to increase. As with most health related dictums, everyone must adopt a ‘Forewarned is forearmed’ outlook to put a stop to cancer.

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