Call for Action: Making quality cancer care more accessible and affordable in India

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FICCI HEAL 2022
HEALTH + ENTERPRISE + LEARNING

Azadi Ka Amrit Mahotsav

EY
Building a better working world

Prevent, screen and spread awareness with least anxiety, low cost and avoiding unnecessary stigma of cancer.

Treat with goal of the basic choice, early access and modest cost.

Dr. Rajendra A Badwe
Director, Tata Memorial Centre

Cancer care has significantly evolved over the years — not just in terms of tech-enabled therapies and multidisciplinary innovation, but also in terms of the advancement in cancer prevention and early detection strategies and methods. Given better outcomes in terms of high-precision treatments and good survival rates, the fear of cancer gripping the patient's minds has considerably reduced over the years and we have leapfrogged to a way higher level of cancer care matching the best of centers worldwide. The focus is clearly on how we can manage cancer the right way the first time. We are now making rapid progress in areas like molecular imaging and genomics which will reflect in better outcomes based on proper diagnosis and targeted therapies, such that cancer recurrence can be minimized to the extent possible, and cancer can be brought down to the level of a chronic disease.

Dr. B. S. Ajaikumar
Executive Chairman, Healthcare Global Enterprises Limited (HCG)

The myriad types of cancer threatening human lives today need a multilateral strategy plan to fight the disease. Initiatives have to be categorized for prevention, screening and treatment of each cancer type. But at a broader level, there are some vital aspects to be considered. On the prevention front, awareness campaigns stressing on lifestyle, food habits and physical activity are necessary. Then at a secondary level, massive screening drives for various cancers in high potential age groups need to be conducted. With this regard, technology could be of great help. Advanced wireless, cloud-AI based and portable Point of Care (POC) devices can help reach the remotest part of the nation and help in rapid diagnosis. Finally, at the tertiary level, the diagnosed patients need to have access to the best of healthcare facilities and services for treatment. In addition, each stakeholder- government, private and community, needs to come together to create an ecosystem for furthering cancer care's accessibility, affordability and assurance in the nation.

Gautam Khanna
Chair, FICCI Health Services Committee & CEO, P D Hinduja Hospital & MRC

It is an indisputable fact that India faces an epidemic of non-communicable diseases and cancer cases continue to grow at an alarming rate. Moreover, as compared to other countries, cancer is diagnosed at later stages in India, and consequently the mortality rates are higher and recovery rates lower. Education of society at large, and doctors in particular, can play a major role in diagnosing cancer early, thus ensuring better treatment outcomes and cures. Predictive and precision medicine have come to the fore globally in the past few years and are helping to ensure that diagnostic and therapeutic procedures lead to early diagnosis and targeted treatment, reducing morbidity and mortality and improving quality of life of cancer survivors. Integrated diagnostics, where lab medicine, pathology, radiology, nuclear medicine, and genomics come together, aided by artificial intelligence algorithms and clinical data along with human expertise and experience, is also increasingly being recognized as the future of the fight against cancer. While the cost of diagnostics may currently appear prohibitive, if one evaluates the cost versus benefit ratio, it is weighed decisively in favor of benefit, leading to overall lower costs of treatment. As these tests come into mainstream and a large number of patients start using them, the costs in absolute terms are certain to come down based on the economies of scale. Many more screening programs need to be systematically started, based on cancers more prevalent in India, so as to diagnose cancers in the early stages. These also need to be focused more specifically to those individuals having higher risk factors. Digital health initiatives being encouraged by the Government of India can play a major role in identifying and screening those at higher risk of developing cancer. The move toward a unique health identity, EHRs and transportability of data across the nation will also help in this endeavor. A lot more needs to be done to fight the burgeoning burden of cancer, and if the public and the private sector work in tandem, then we can certainly conquer cancer as well as other non-communicable diseases.

Dr. Harsh Mahajan
Co-Chair, FICCI Health Services Committee and Founder & Chief Radiologist, Mahajan Imaging

Cancer has been a pandemic in making and today there is hardly any family that is not impacted by it. Fear and cost associated with the disease cripples the family's health in more ways than one. Indians, irrespective of where they live, should have access to advanced cancer treatment, thereby building hope and confidence to win over the disease. Progressive policy measures, new forms of investment, as well as multi-stakeholder partnerships are needed to improve the country's cancer care infrastructure at the grass root level. The EY FICCI paper on cancer care aims to address some of these issues that can transform cancer care in India.

Ashok Kakkar
Chair, FICCI Task Force on Cancer Care and Managing Director, Varian Medical Systems International India Pvt. Ltd

Comprehensive and integrated approach by a multidisciplinary team is the key to deliver best outcome for cancer treatment. What works for a patient will work for the nation. Collaboration among all stakeholders is imperative to effectively address India's growing cancer burden.

Raj Gore
Co-Chair, FICCI Task Force on Cancer Care and CEO, Healthcare Global Enterprises Limited (HCG)

Foreword

Given the backdrop of a growing burden of cancer across India, the Report by FICCI Task Force on Cancer Care Infrastructure, in collaboration with EY, on "Call for Action: Making quality cancer care more accessible and affordable in India" is a timely initiative to highlight the need for more effective policy measures aimed at proactive cancer prevention and treatments. This knowledge paper will serve as a beacon of light to strengthen India's strategy for cancer care and help it serve as a model for other non-communicable diseases. The detailed epidemiology of various types of cancer in every state of India and global comparisons described in this report highlight the substantial variations between the states for different types of cancer and serve as a useful reference for more targeted planning of cancer control, commensurate with the trends of different cancers in each state of India.

It is crucial that cancer prevention and early diagnosis are prioritized by society, governments, and the healthcare ecosystem, given the nature of the disease as a sign of physical, emotional, financial, and social distress that affects not just an individual but the entire family. Since awareness aims to educate and teach individuals about previously unknown subjects by imparting knowledge, changing attitudes or beliefs, and forming healthy practices or behavior, awareness frequently precedes prevention. An essential component of prevention is changing current behaviors, which can only be accomplished by creating sufficient public awareness.

This report highlights how cancer screening helps in early identification for down-staging the disease as well as in achieving a reduction in mortality and morbidity. Even though there is an established cancer screening program rolled out across the country, it still has many challenges to deal with. Capacity constraints in terms of physical infrastructure, talent, lack of training in the methods used for cancer screening, and deficiencies in the referral mechanism are some of the roadblocks to the success of this program. Quality data capture, data sharing, and timely referral are the keys to ensuring a continuum of care and are critical to the success of a screening program. The successful implementation of cancer screening programs depends heavily on education and awareness.

Some of the most cutting-edge cancer treatment methods and technology are available in our country. However, we have a long way to go before we can ensure that cancer patients from every socioeconomic background receive the best possible care. In addition to treatment, we must also take into account leveraging technology to close the care gaps associated with accessibility and affordability. Telemedicine, electronic patient records, robotics, AI-backed upskilling methods, daycare chemo, home care etc., are some of the strategies that are already in place to address these care gaps.

Additionally, capacity and capability building, resource stratification around models of care, and workforce planning have been popular themes for discussion and analysis. India has to further expand its complete cancer care infrastructure, including prevention, care delivery, skilled workforce, technology, and equipment, in order to increase its capacity and capabilities for treating and managing cancer. This report goes into great detail about the various approaches that care entities can employ in order to break the barriers that exist in cancer management.

To make cancer care more effective and affordable for the entire population, we must improve workflow efficiency and treatment outcomes. Using its trademark ingenuity and frugality, India has an opportunity to find innovative solutions to bridge the existing care gaps for her citizens and to guide other developing and developed nations.

FICCI contributes to the healthcare sector as a change agent to catapult policy and regulatory reforms through recommendations and knowledge papers for the betterment of the sector. We are confident that the FICCI Task Force on Cancer Care Infrastructure will create a conducive environment for the formulation of effective policy measures and purposeful collaborations between the various stakeholders, which will in turn help create India's cancer moonshot and ground-shot approach.

The FICCI-EY Report on 'Call for Action: Making quality cancer care more accessible and affordable in India', will be released during the 16th edition of FICCI's annual healthcare conference- FICCI HEAL 2022, scheduled on Oct 10-12, 2022 on the central theme 'Healthcare Transformation: Driving India's Economic Growth'.

This report is a genuine attempt to comprehend the existing cancer management scenario in India. There are some interesting discussions and opinions on various strategies that can change the way our healthcare community treats and manages cancer. We believe that these insights have the full potential to bring in the necessary push for the healthcare sector to make cancer management more effective and seamless. This effort by FICCI will strengthen our resolve to develop policy suggestions and promote partnerships for making cancer care more accessible and affordable in India.

Mr Ashok Kakkar

Chair, FICCI Task Force on Cancer Care and Managing Director, Varian Medical Systems International India Pvt. Ltd

Mr Raj Gore

Co-Chair, FICCI Task Force on Cancer Care and CEO, Healthcare Global Enterprises Limited (HCG)

Preface

The untamed growth in incidence of various types of cancer over the years is a brewing health crisis that India must contain, control, and correct. Perhaps no other disease is comparable in its devastating impact on the life of patients and families given the scale of incidence, mortality rate, affordability of treatment and the quality of a survivor's life. Over the years we have certainly witnessed recognition of the issue by policy makers, endeavors to create awareness and progress in both quality and quantity of care supply but the highly undesirable situation of low awareness, late-stage discovery and consequent high mortality and prohibitive levels of out-of-pocket expense for availing care, continues unabated. While there has been a reasonable degree of understanding of risk factors related to physical health factors and lifestyle, understanding of the nature of science of the disease is still at an early stage and hence, constant endeavor to explore new territories for study is imperative for evolving an effective and efficient care and control program. In this regard, one area that may need focused study and could prove transformative in managing the disease is the causative relationship between mental health and cancer. Additionally, given the psycho-socio- physiological impact of the disease on the patient, post incidence counseling can be a potent tool in effective management of the disease which is severely lacking now. The robustness of cancer registry continues to leave a lot to be desired, though there has been progress over the years.

Given the rising incidence and mortality pattern, it is imperative that the country focuses on effective prevention, targeted screening, and large-scale awareness as the primary response to addressing the disease burden by avoiding the unnecessary stigma attached to cancer. The key is to manage the disease in the right way, the first time and at the last mile. This calls for a holistic and comprehensive approach with the patient at the core through multi-stakeholder partnerships, frugal innovation by the providers, and progressive policy measures underpinned by technology, which is predictive, personalized, and precise.

Insurance will play a key role in mitigating out-of-pocket expenditure challenges families face owing to the disease. However, insurance is essential but not sufficient condition for making cancer care affordable for all because without an efficient healthcare system no economy can afford sustainable healthcare funding. Hence cost effectiveness catalyzed by a culture of continuous improvement mindset, will be an essential tenet of future healthcare delivery model for the policy makers and providers.

The report is a follow up to two previous reports Call for Action: Expanding cancer care in India (2015) and FICCI-EY Call for Action: Expanding cancer care for women in India (2017). The report is an attempt to understand the state of cancer care in India - demand situation, supply situation and outcomes and experiences, in an intimate way to set clear imperatives and action plan to achieve them, at the levels of policy makers, public health system, private players and the public. The report has followed an approach of limited primary research, extensive secondary research to gather credible data points around disease and management at local and global level supplemented by extensive discussions with stakeholders including policy makers, public health experts, oncology specialists, private providers, health insurance companies and NGOs to facilitate discovery of ground level situations and challenges and develop meaningful recommendations that are potent, practical and progressive.

We are grateful to FICCI for this opportunity to partner with them on developing this report and the excellent support provided by them in facilitating the discussions with industry stakeholders and providing valuable inputs from time to time. We are also deeply grateful to everyone who gave us time to deliberate on various aspects of this report and share their valuable views, insights and experiences, which has positively shaped the form and content of this report.

It has been an enriching experience for us to work on this report and we sincerely hope it further strengthens the aspiration, agenda, and actions for a cancer health system in India that can be an example to the world for demonstrating that true cancer care for all is more than just a rhetoric.

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Executive Summary

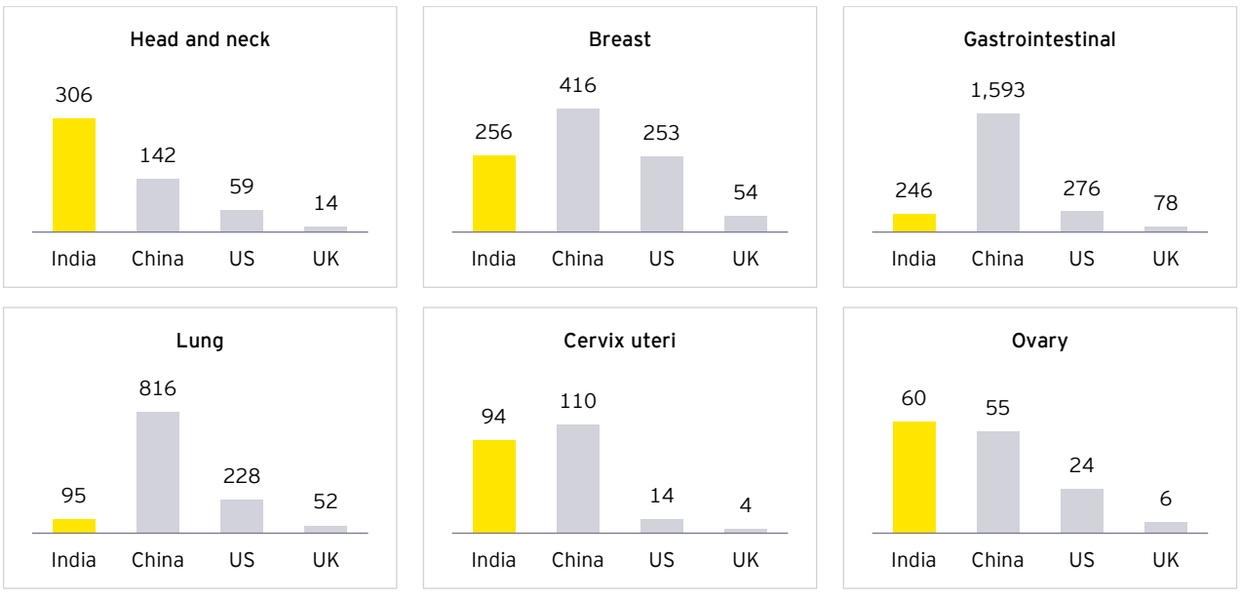
Estimates indicate India's reported cancer incidence in 2022 to be 19 to 20 lakhs, whereas real incidence is 1.5 to 3 times higher than the reported cases.

India faces significant challenge of a sizeable cancer incidence burden, which continues to grow further. The 2020 WHO ranking on cancer burden in terms of new yearly cases being reported, ranked India at the third position after China and the US, respectively.

Of the reported cases in India, head and neck, gastrointestinal and lung contribute to 50% of incidence among males and breast, cervix uteri and gastrointestinal organs contribute to 50% of incidence in case of females.

Among these, cancer of the head and neck are found to be progressing at a CAGR of 23%, prostate cancer at 19%, ovarian cancer at 11% and breast cancer at 8% which is faster than the overall growth rate of incidence.

Chart A: 2020 Organ-wise Incidence ('000)



Source: SEER cancer statistics, Cancer research UK, Zeng at al 2021, NCRP Annual report 2020

High proportion of cases continue to be detected at late stages for major cancer types in India

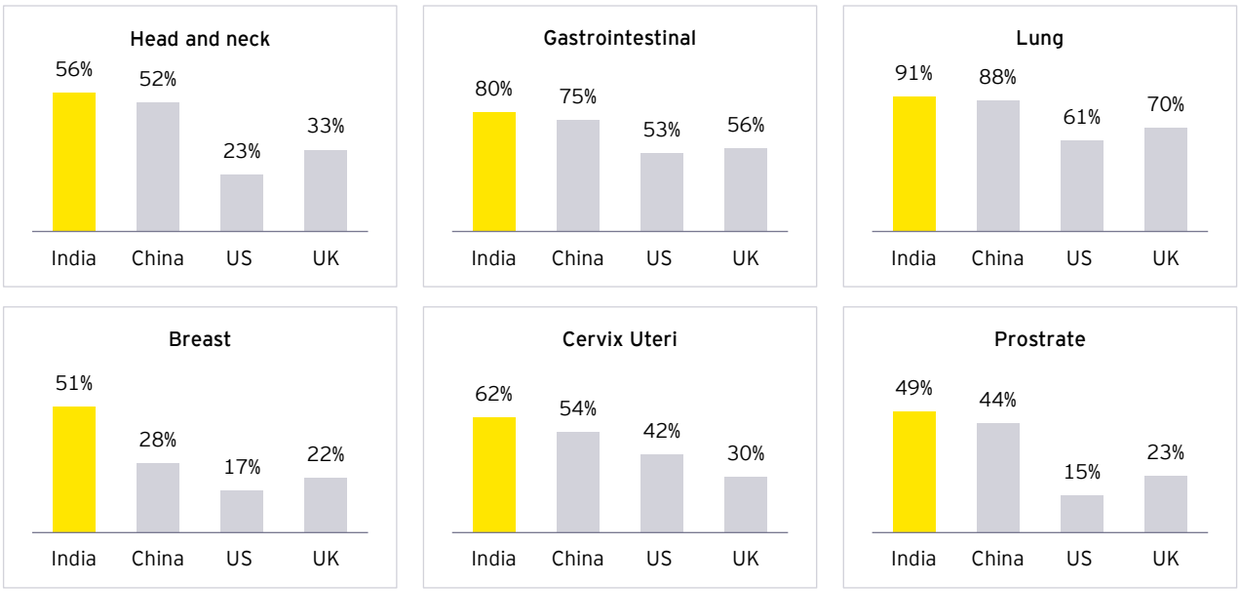
The issue of high disease burden is compounded with late-stage detection caused mainly due to lack of awareness and low penetration of screening programs.

India has a poor detection rate across major cancer sites with 29%, 15% and 33% of breast lung and cervical cancers being diagnosed in stages 1 and 2, respectively, which is significantly lesser than that in China, the UK and the US.

The challenge of rising disease burden is further compounded by poor outcomes compared to global counterparts across all major organ types

While at one hand incidence is rising, deaths due to cancer has remained among the top 5 causes of deaths in India over the last decade. Estimates indicate that the total deaths due to cancer have been ~8 to 9 lakh in 2020, causing the mortality to incidence ratio for different cancer types in India being among the poorest compared to global counterparts.

Chart B: Mortality to Incidence ratio comparison across countries



Source: NCRP Annual report 2020, Global Cancer Observatory, 2020

Six states, which represent 18% of India's population, have 23% share of the country's reported incidence burden and have the highest crude incidence rates

13 out of the 17 states covered by population-based cancer registries (PBCRs), exhibit a rising cancer burden. Kerala, Mizoram, Tamil Nadu, Karnataka, Punjab, and Assam report the highest overall crude incidence rates of cancers (above 130 cases per lakh population).

High burden of cancer incidence in India is resulting in a high economic burden on account of productivity losses and premature mortality

Based on reported cancer incidence and mortality across age groups and years of potential productive life lost (YPPLL) due to the same, estimates indicate that the economic burden in terms of GDP losses is in the range of US$11B. (0.4% of national GDP) in 2020.

The same is projected to increase to US$36B to US$40B by 2030, driven by a projected increase in mortality (considering increasing cancer incidence partly offset by an improvement in mortality to incidence ratio), improvement in life expectancy and increase in GDP per capita.

Given the current state of rising cancer disease burden and sub-optimal quality of outcomes, there is a significant need to understand the current challenges and tailor make interventions across the different stages of disease management with a deep focus on:

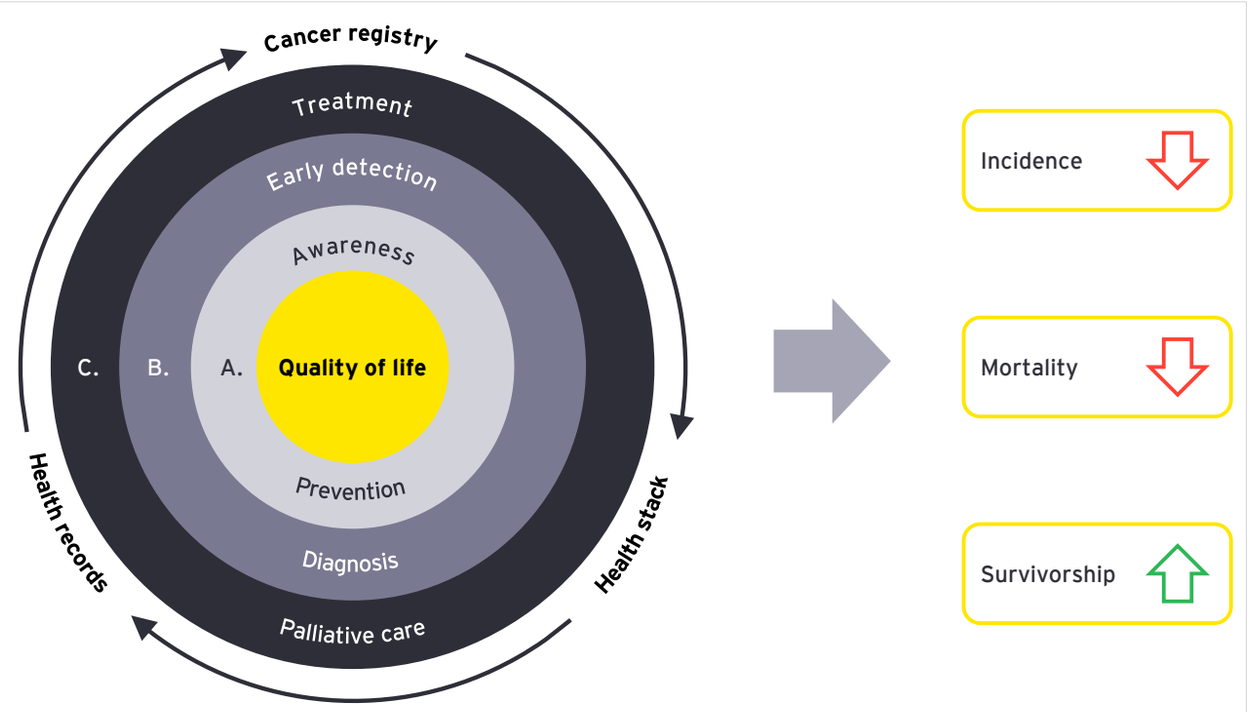
A. Awareness and prevention – Modifying exposure to risk factors that potentially lead to cancer

B. Detection and diagnosis - Ensuring early detection and accurate staging of the disease

C. Treatment including palliative care - Driving multidisciplinary approach to treatment with focus on affordability, equitable access, quality of outcomes and palliative care

While the above represent core levers to drive cancer control by reducing incidence and improving quality of outcomes, expanding cancer registries and health information systems for collecting standardized and comprehensive data for informed and evidence-based policy decisions and research will form the foundation for enabling the levers to drive change.

Figure A: Cancer control framework



Source: EY analysis

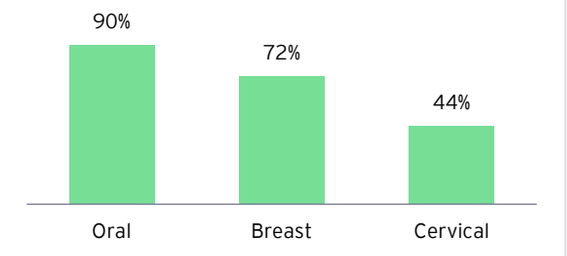
A. Awareness and prevention

Awareness

Knowledge: Awareness landscape in India is dominated by tobacco and tobacco-related cancers. Knowledge of other common cancers such as cervical is low.

Attitude: Few people in India seemed to be concerned about cancer compared to other countries, implying a general attitude of indifference towards cancer. As per the UICC global survey, only 43% respondents in India indicated that they were concerned or somewhat concerned about developing cancer in their lifetime compared to a global average of 58%.

Chart C: Awareness level across organs (Based on multiple localised studies in India)



Source: Localized surveys, EY analysis

Practice: Uptake of screening for breast, cervical and oral cancer and HPV vaccination is very low despite moderate levels of awareness.

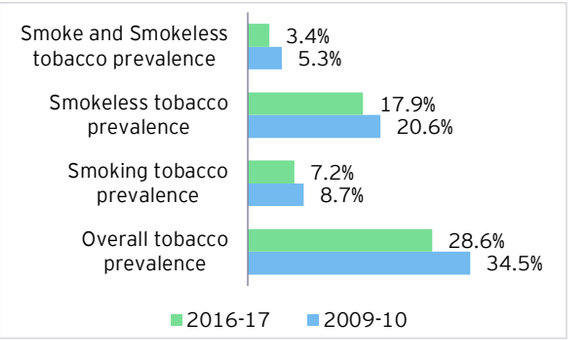
Prevention

Primary prevention involves limiting exposure to carcinogenic risk factors. While there are several carcinogenic risk factors, modifiable risk factors such as tobacco, alcohol, obesity, infectious and environmental factors are amenable to prevention. While India undertook several policy measures to reduce exposure to risk factors, there is still significant progress required.

Enforcement of tobacco restrictions: Tobacco is associated with a large number of cancers such as lip, tongue, mouth, oropharynx, larynx, esophagus, lung, urinary bladder all of which together contribute to high mortality at present. Despite relatively high awareness compared to other risk factors, tobacco usage continues to be a major public health challenge in India. While the government undertook measures for tobacco control under the aegis of the National Tobacco Control Programme and implemented the Cigarettes and Other Tobacco Products Act, the current prevalence of adult tobacco users continues to remain at 28.6% which is higher than the global prevalence of 23.4%.

As per NFHS 5 (2019-20), % of men > 15 years of age using tobacco was > 40% for all north-eastern states, Madhya Pradesh, West Bengal and Gujarat which is significantly alarming.

Chart D: Tobacco prevalence among adults in India



Source: GATS 2009-10 & GATS 2016-17

Enabling inclusion of HPV vaccination in the National Immunisation Program: Infectious risk factor mainly includes HPV causing cervical cancer, which is easily preventable through vaccination. India has made remarkable progress through the launch of indigenously developed HPV vaccine which is priced 10 times lower than the erstwhile available vaccines in the market[32].

Despite achieving major milestones in indigenous HPV vaccine launch, India is still to include the HPV vaccine as part of its Universal Immunization Program. As of October 2019, 100 countries around the world had already introduced the HPV vaccine as part of their national immunization schedule. Given the decade-old debate around the efficacy and safety of the HPV vaccine in India, there is a need to conduct regular studies to establish evidence for the same. There is also a continuous need to ensure accessibility to hygienic toilets for all women.

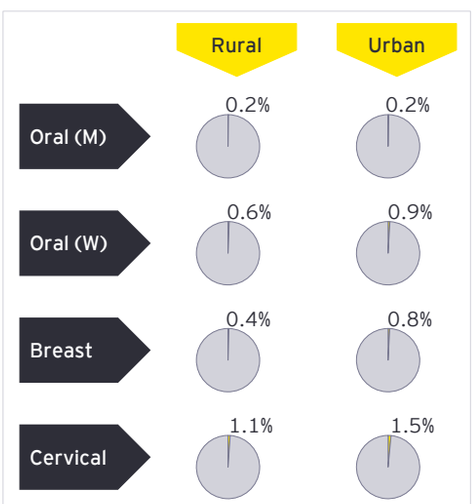
Encouraging healthy behaviors: Obesity is associated with several cancers such as breast, colorectal, esophagus, stomach, etc. which contribute to high incidence and mortality. Nearly one in four Indians is obese as per the NFHS-5. Similarly, alcohol is another major risk factor which is associated with several cancers such as liver, breast, stomach, larynx, etc. Almost one in five men consume alcohol in India with an increase in per capita consumption of alcohol from 2.3 liters in 2005 to 5.5 liters in 2018.

B. Detection and diagnosis

Screening

Despite the proven benefits of early identification for downstaging the disease as well as in achieving a reduction in mortality and morbidity, screening penetration of key cancers in India is very low: Across focus cancers being screened under the NPCDCS programme, screening coverage is less than 5% of population which is negligible when compared with global peers. Oral cancer has the lowest screening coverage at 0.2% of the population. Capacity constraints in terms of physical infrastructure and workforce, lack of training of the methods for cancer screening among healthcare workers and deficiencies in referral mechanism are key roadblocks to the success of the programme. Additionally, lack of data capture to maintain longitudinal health records of population right from screening stage and ensuring tracking and follow up with patients for effective referrals is a key deterrent in the expansion and penetration of screening programs.

Chart E: Screening coverage in India by population % (NFHS-5)



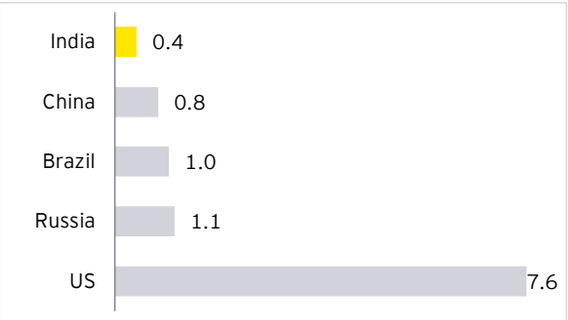
Source: NFHS-5

C. Treatment including palliative care

Access to treatment

Significant geographic skew in the presence of comprehensive cancer centers in the country: Only ~175 districts in the country covering 40-45% of the population have Comprehensive Cancer Centres (CCCs)[44]. Of the 470 to 480 CCCs available in the country ~40% are concentrated in metros and state capitals. **Severe gap continues in access to radiotherapy (RT) treatment in the country with RT per million population of 0.4 vis-à-vis WHO recommendation of 1 RT per million population:** Penetration of RT equipment is low with ~640 installations against the requirement of ~1,400 to 1,500 in the country[59].

Chart F: Penetration of RT equipment per million population across countries

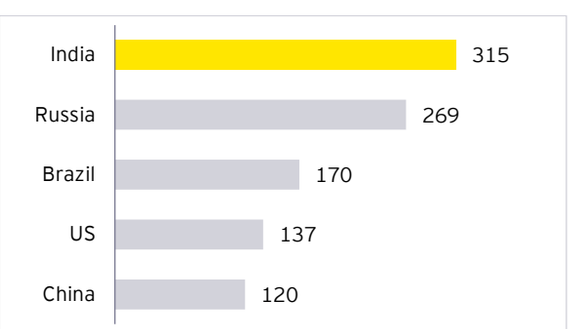


Source: "World population", worldpopulationreview.com, "Directory of radiotherapy centres", Dirac.iaea.org, EY analysis

Availability of screening, diagnostic and treatment planning equipment is low in India: Penetration of PET-CT is low with ~360 installations against the requirement of ~480 in the country[67]. Also, there are ~5 CT scanning machines per million population compared to ~40 in high-income countries and ~13 in upper middle-income countries[64].

Access to specialized care of oncologists is significantly constrained in India with incidence per clinical oncologist (medical and radiation oncologist) at 315 compared to 120 in China and 137 in the US: India requires 2,500 to 3,000 additional medical oncologists and 700 to 800 surgical oncologists to cater to current incidence while radiation oncologists are adequate[87].

Chart G: Incidence per oncologist across countries



Source: "Global survey of clinical oncology workforce", Journal of Global Oncology, 2018, EY analysis

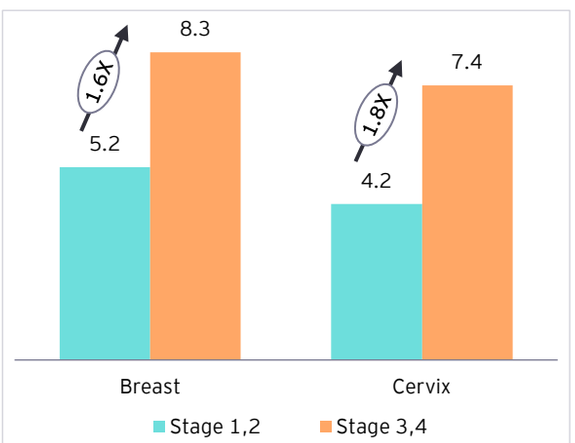
Only 1% to 2% population who need palliative care have access to it in India compared to a global average of 14%[101]: Most states in the country do not have an enabling legislation and policy structure that supports integration of palliative care with public and private healthcare set ups treating cancer patients.

Affordability of treatment

Financial burden of cancer care treatment is the highest compared to other diseases.

Treatment cost for cancer care is financially prohibitive and is almost 3x that of other non-communicable diseases (NCD). Additionally, treatment cost has been increasing with cost of a single cancer hospitalization (in public or private facility) exceeding average annual expenditure of 80% population in 2017 vis-à-vis 60% population in 2014.

Chart H: Baseline cost of comprehensive cancer treatment (INR lakhs)



Source: EY analysis

Cost of complete baseline multi-modal treatment varies significantly depending on organ and stage of detection: For common cancers such as breast, cervix, ovary and gall bladder cost of treatment in mid-tier private hospitals escalates by 60 to 75% between Stage 1/2 vs. Stage 3/4 patients. The cost escalates further with adoption of advanced therapies.

With an increase in population coverage under some form of insurance/ government sponsored health coverage programs to ~54%, there is a need to ensure adequate coverage under these programs based on uniform standards of care that offers right treatment and quality of outcomes for patients: Variation among state government and PMJAY schemes is to the extent of 40-275% for select surgical and medical procedures with key schemes also not covering diagnostic interventions/therapies such as PET-CT, biopsies, genomics, targeted therapy and immunotherapy. Additionally, high level study of cashless claims made by patients covered under retail health insurance policies indicates 25 to 30% of their expenses are still made out-of-pocket, indicating the need to ensure design of comprehensive care plans based on uniform standards of care.

The complex challenges of the cancer control landscape in India are further worsened by the lack of

comprehensive data w.r.t to incidence and mortality which is representative of the Indian population. The population and hospital-based cancer registries set up four decades ago, have so far been able to cover only 10% of the population of the country with several states such as Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Rajasthan, Telangana and Orissa having inadequate presence and penetration of registries[122].

The challenges in the current system of cancer disease management in the country have been further corroborated by a survey carried out with 154 cancer patients and care givers. Gaps in the patient journey were characterized into seven key themes which need to be addressed to improve experience and satisfaction of cancer patients in the country:

Table A: Gaps in patient journey across seven key themes

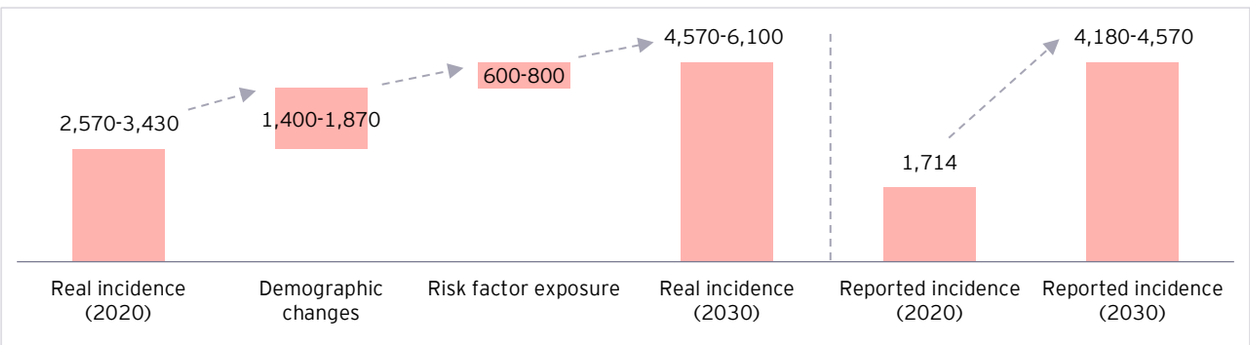
Theme 1	Theme 2	Theme 3	Theme 4	Theme 5	Theme 6	Theme 7
Delay in accessing care	**Absence of single source of comprehensive and authentic information**	**Inefficiencies in hospital processes**	**Lack of frequent, transparent and effective communication**	**High cost of treatment and lack of quality care facilities locally**	**Gaps in post treatment care**	**Psychological burden of cancer**
58% patients had their initial diagnosis based on symptom	39% patients rely on information from family physician/ specialist doctor and 33% rely on family friends and relatives to gather information for selecting cancer center for treatment	78% patients expressed low satisfaction with long wait times	> 75% of patients expressed low satisfaction with promptness and courteousness of communication by clinical and non-clinical staff	64% patients did not have any form of insurance/ scheme coverage	48% indicated lack of awareness or no response when asked about rehabilitation centers	62% patients used words like 'tough', 'bad', 'stress', 'pain' to describe their quality of life during treatment
61% patients were diagnosed in Stage 2 and 3				49% patients travelled >50 kms for their treatment	Only 20% had positive views about availability of facilities for long term care	20% patients who were cured or under remission used words like 'not normal', 'weak', 'average', 'neutral' when asked about quality of life post treatment
49% patients had their initial diagnosis done by GP				> 50% patients spent > INR 5 lakhs on their treatment		56% patients did not have access to any support group
52% patients undertook >5 tests and more than one consult to confirm diagnosis						
51% patients took more than 1 week to conclude the diagnosis						
46% patients who undertook second opinion cited lack of confidence in initial diagnosis and suggested treatment						

Source: EY survey of 154 cancer patients, EY analysis

While there are debilitating challenges in the current state of cancer control in the country, the problems may further exacerbate in the future with an increase in the disease burden due to intensification of risk factors and ageing of the Indian population unless the government plans for appropriate action. Estimates indicate that the reported cancer incidence will reach 250 to 280 per lakh population by 2030 from the current level of 120 per lakh closely mirroring the incidence of other countries such as China, Brazil and Thailand.

Estimates indicate that with expectations of improvement in early diagnosis of cancers, in 2030 the projected reported incidence will reach 40 to 45 lakhs (crude rate: 250 to 280 per lakh population) with 50 to 60% of cases being diagnosed in stage 1 and 2.

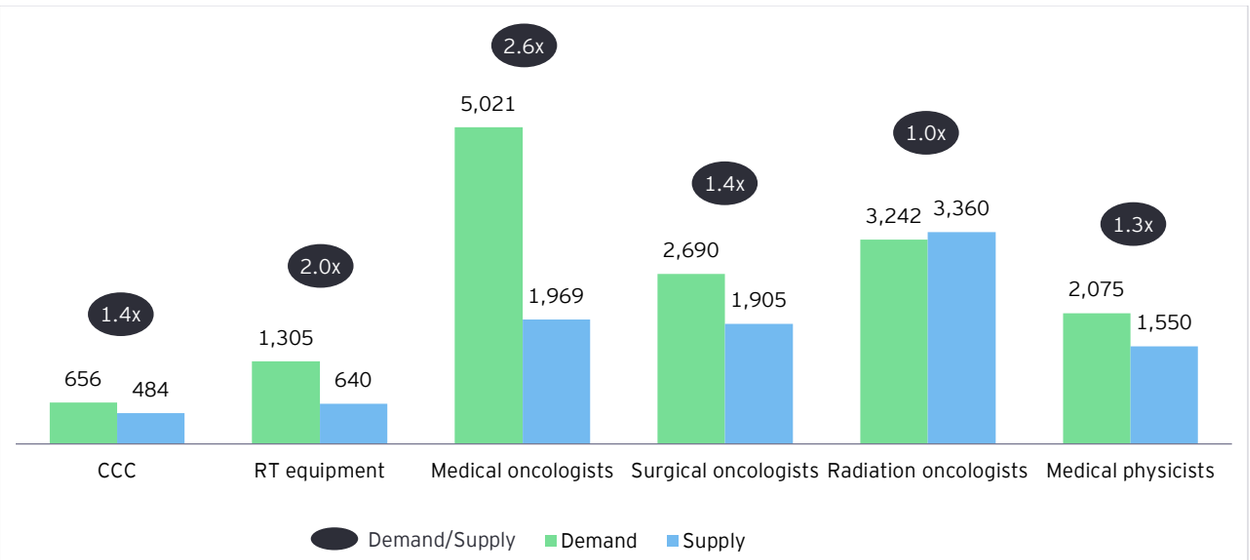
Chart I: Projections of real and reported incidence in 2030 ('000)



Note: Refer <Annexure 3> for framework for projection of overall crude incidence adjusting for demographic and risk factor exposures and prevalence

With the expected increase in disease burden the demand supply gap in physical and medical infrastructure will further widen if no significant intervention is undertaken by the government.

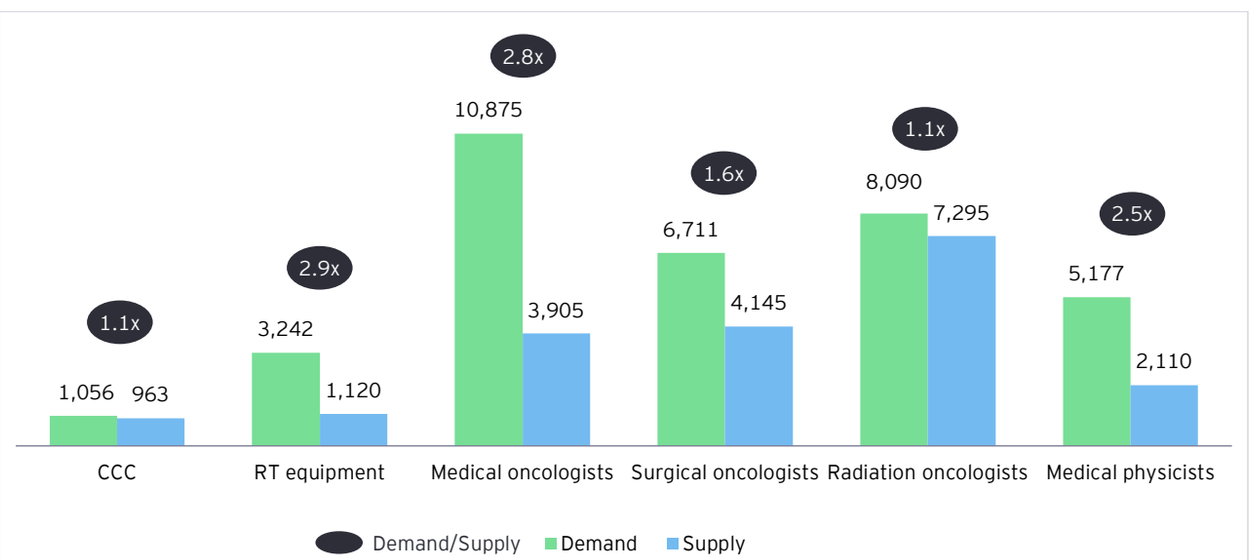
Chart J: Demand supply gap in medical infrastructure and workforce in 2022



Note: Cancer incidence estimated in 2022: ~19-20 lakhs

Source: "List of cancer treatment centres licensed by AERB", aerb.gov.in, "Call for Action: Expanding cancer care in India" EY report, 2015, nmc.org.in, Accr.natboard.edu.in, EY analysis, Refer <Annexure 5 - 9> for assumptions

Chart K: Demand supply gap in medical infrastructure and workforce in 2030



Note: Cancer incidence estimated in 2030: ~42 to 45 lakhs. With conservative cancer incidence estimate of ~29 to 30 lakhs in 2030, the demand supply ratio for CCC, RT equipment, medical oncologists, surgical oncologists, radiation oncologists and medical physicists stands at 0.9x, 2.0x, 2.3x, 1.1x, 0.8x and 1.7x, respectively.

Source: Accr.natboard.edu.in, nmc.org.in, EY analysis, Refer <Annexure 5 - 9> for assumptions

Given below are the key challenges and the actions that different stakeholders can undertake for strengthening the cancer control and management landscape in the country:

	Key challenges	Proposed actions	Actions by
1	Awareness and Prevention		
1.1	High tobacco prevalence which is the cause of ~30 % cancers in the country.	▶ Drive stringent implementation of COTPA amendment bill proposing stricter measures completely banning smoking in public places, implementing warning labels on all forms of packaging and bans on all forms of direct and indirect advertising of smoking and smokeless tobacco. ▶ Increase tobacco taxation (currently 50 to 60% as against WHO recommendation of 75%). ▶ Evaluate gradual banning of smoking and smoke-less tobacco– undertake pilot projects to support farmers to switch from tobacco to alternate crops. ▶ Evaluate learnings from global peers to update legislations and policies in India w.r.t tobacco use. Examples of learnings from the latest bill proposed in New Zealand: ▶ Reduce nicotine content in tobacco ▶ Reduce outlets selling tobacco ▶ Prohibit lifetime sale of tobacco to anyone born after a certain year	Government Government Government/Private players/NGOs Government
1.2	Higher incidence of cervical cancer compared to developed nations.	▶ Speedy decision on inclusion of HPV vaccine as part of Universal Immunization Schedule. ▶ Conduct focused research and post-marketing surveillance to establish scientific evidence of safety and efficacy of HPV vaccines. ▶ Conduct effective roll-out of low-cost indigenous HPV vaccine 'Cervavac' through mass vaccination drives leveraging experience from recent COVID-19 vaccination program. ▶ Raise awareness of genital and menstrual hygiene through initiatives such as building toilets in under-developed regions. ▶ Evaluate learnings from global peers who have significantly reduced cervical cancer incidence such as Australia to guide policy decisions. Examples of learnings from Australia include: ▶ Introduction of self-collection for cervical screening tests ▶ Specific budget allocation towards cervical cancer elimination ▶ Clinical trials for producing evidence on the interactions between HPV vaccination and HPV-based screening	Government Government, research institutes, vaccine companies, private providers Government, healthcare workers, residential societies, community support groups, NGOs Government, local healthcare workers Government, research institutions
1.3	Increasing incidence of cancers attributable to lifestyle related factors such as alcohol, obesity.	▶ Implement stricter regulations on alcohol availability through taxation and prohibition. ▶ Advance and enforce strict measures for drunk driving. ▶ Improve urban and rural planning to incorporate adequate walking spaces, parks and cycling paths. ▶ Discourage consumption of fast-food and sugary drinks through taxation slabs, restrictive advertising.	Government
1.4	Need for recognition of non-tobacco risk factors such as exposure to harmful UV	▶ Drive greater focus of awareness campaigns to educate the general population about non-tobacco	Government, Non-government stakeholders (Private

	Key challenges	Proposed actions	Actions by
	radiation, air pollution, asbestos, alcohol, obesity etc., is low.	risk factors through traditional and social media platforms. ► Leverage the right channel of communication to ensure reach through local newspapers, radio advertisements, local cable network, posters and banners in post offices and banks, involving village panchayat, religious or political leaders, local celebrity influencers.	providers, NGOs, Healthcare startups, Pharmaceutical and medical device companies, Corporates, Related brands e.g., skin creams for UV rays, etc.) Media (news networks, newspapers, social media websites)
1.5	Need for change in general attitude of indifference towards cancer or deep-rooted religious, social or customary practices causing greater cancer risk.	► Introduce early health education and active health promotion in the curriculum of school students to shape young minds. ► Leverage big data to find cancer patterns and identifying 'at risk' populations which can help to develop focused awareness and screening initiatives with precise resource allocation: ► Creating a health stack linked to cancer registry and population health records which can capture screening information coupled with application of AI algorithms, can help identify patterns by geography based on which the government can take targeted awareness efforts. ► Conduct studies to establish the relationship of mental health factors, stress, anxiety etc., with cancer incidence. ► Evaluate incentivization or gamification of positive healthy behaviors.	Government, educational Institutions Government, health tech players Technology companies (Fitness apps, smartphones, e-commerce websites), insurance players
2	Detection and Diagnosis		
2.1	~1,17,000 HWCs operationalized in India as of Sep 2021 compared to the aspired target of 1,50,000 HWCs. These centers are the first point of contact for NCD screenings.	► Central government to encourage state government to not only adequately establish HWCs but also equip them with adequate staff. ► Deploy female ANM/ staff nurse or female MO/CHO at each HWC so that women feel safe and confident while attending breast and cervical cancer screenings. ► Private players to partner with state government under PPP model to improve screening coverage. An enabling PPP environment with a focus on improving cancer related outcomes in the long term for select villages/ cluster of villages/ sub-districts etc., need to be ensured by different state governments to drive increased participation of private organizations and use their infrastructure and workforce to increase the momentum of screening coverage and timely referrals.	Government Government Government, Private providers
2.2	Vacancy of ~2 to 9% female ANMs at HWCs mainly due to shortfall in Gujarat, Himachal Pradesh, Rajasthan, Tripura, and Kerala. Similarly, shortfall of 4% MOs exists in centers at Orissa, Karnataka, and Chhattisgarh.	► Adequate and timely pay-outs with incentives to deliver beyond expectations will motivate the staff to perform their duties and curb attrition.	Government

	Key challenges	Proposed actions	Actions by
2.3	23% of the staff deployed at HWCs are untrained. States such as Andhra Pradesh, Manipur, Rajasthan, Tamil Nadu, and UTs such as Andaman and Nicobar Islands and Ladakh have the lowest number of trained HCPs.	▶ Training and CMEs for CHOs/ MOs who are the first point of contact in HWCs, will be critical for the success of the program. Similarly, local GPs are also critical in the ecosystem as they act as the first point of contact to several patients and should be part of these trainings. ▶ CHOs along with other HCPs should be armed with checklist capturing information on: 1. Risk factors 2. Benefits of screening 3. Treatment options available 4. Names, address, and contact details of referral centers 5. Treatment costs and financing options ▶ Database of nearby diagnostic centers to be maintained and made available to HCPs as well as local GPs to get confirmatory tests done. ▶ Technology platforms like e-sanjeevni to be used to help in driving remote training by experts and doctors from private/ public institutions. Interactive e-modules clubbed with quick assessments rendered periodically to the workforce can help assess the training level of the field force and ensure mitigation of gaps in knowledge appropriately.	Government/ CHO at HWCs/ Private players Government/ Private players
2.4	Gaps in implementation of the NPCDCS program and lack of adequate workforce, technology, or equipment to enable specialists at CHCs and District hospitals to make a diagnosis. As part of a survey done by GoI, 27% CHCs and 13% of DHs had not implemented NPCDCS till 2017-2018.	▶ Adequate workforce planning and timely recruitment at CHC and DH will help meet gaps in the workforce. ▶ Timeline should be set by the government for implementation of the NPCDCS at CHC and DH and appropriate measures should be taken in case of deviations. Surprise audits by authorities to ensure functioning of this program in higher centers is a key requirement.	Government
2.5	Paper based non- standard data capture and transfer regarding referral to a higher center, leading to gaps in communication and delays across the referral stream and reduced interoperability of vital patient health information.	▶ Drawing learnings from the latest Arogya Setu and CoWIN experience and leveraging the ongoing initiatives under the NDHM to create a single health identity (Health ID/ AB ID), implement a standard platform to undertake screening and track a patient till treatment linked to the Health ID/ AB ID/Aadhar ID of population. Using a standard tech platform across all states will ensure that data is interoperable across states. This data can further be linked with the incidence data generated by registries and correlated to identify patterns and draw meaningful insights for cancer control interventions. ▶ Use of mhealth and robust data collection software or apps will also empower the ASHAs, ANMs, MOs and specialists with data regarding the patient. ▶ A clinical decision support tool for ASHAs can help in ensuring proper data collection as well as support ASHAs with standard screening guidelines and triaging of patients according to risk level, promoting the most appropriate next steps. ▶ Additionally, using AI based triaging and imaging tools to be used to support CMOs and radiologists across centers to address workforce capacity issues.	NHA/ Government NHA/ Government

	Key challenges	Proposed actions	Actions by
2.6	Low population coverage (<2% in India) for all three cancers due to lack of awareness of cancer screening. KAP studies done across HCPs in different cities reveal low rates of information on screening importance, methods, and even self-practicing. Rate of oral cancer screening across men is low.	▶ Identify a brand ambassador (a national celebrity) to generate awareness regarding cancer screening and create an impactful campaign like the polio eradication campaign 'Ek boond zindagi ki'. ▶ Use various cancer months to drive a focused screening campaign every year for a particular cancer. For example, every October, all private and public providers ensure a huge emphasis on breast cancer screening. Similar activities should be undertaken for oral and cervical cancer as well. ▶ Create health check days in HWCs, e.g., Women health day (once a week). As a part of women health check or targeted tobacco smoker screening camp, people should be screened for respective type of cancers. This will help eliminate the fear associated with cancer screening. When women come for their health needs, oral, cervical and breast examination can be made a part of the health check and women should be educated about any warning signs associated with the disease. ▶ Conduct focused cancer screening. campaigns in communities or localities where screening coverage is very low, e.g., camps in Gurudwaras to target the Sikh population and encourage them to get screened. ▶ Posters with visual representations of the screening method, signs and symptoms and information should be displayed in the HWCs in vernacular language. ▶ Men have shown low screening participation across all communities, as well as in urban and rural areas. Targeted and inclusive education and information dissemination for men will help improve screening uptake for themselves as well as their families. ▶ Corporates and multinational companies can host cancer screening camps in their offices to educate and provide easy access to their staff to cancer screening. They can also support NGOs who promote cancer screening program through outreach activities as a part of their CSR initiative.	Healthcare providers/ community workers/ HWCs/ NGOs/ Corporates
2.7	Lack of coverage/ inclusion of screening under the various national/ state government schemes, employee schemes and retail health coverage plans limiting demand and uptake of screening in the country.	▶ Policy level changes and budget earmarking to include cancer screening as a part of various state and central government health initiatives like the Chiranjeevi scheme in Rajasthan or PMJAY should be evaluated. CGHS and ECHS schemes can include diagnostic tests for cancer screening so that private sector infrastructure can be utilized effectively. 50% of the patients use government schemes in private hospital for their treatment in Rajasthan. Inclusion of screening under various government health coverage schemes could ease out the burden on public infrastructure and improve efficiencies of the program. Additionally, in the case of retail health insurance plans, policyholders undertaking screening should be incentivized through premium discounts etc., to motivate them to undertake cancer screening. ▶ Also, to ensure adequate focus and budget allocation for cancer detection, the disease should be dealt with separately and not merged with other lifestyle diseases, such as diabetes and cardiovascular diseases.	Government/ Health Insurance Providers

<table>
<tr><th></th><th>Key challenges</th><th>Proposed actions</th><th>Actions by</th></tr>
<tr><td>2.8</td><td>Several cancers other than oral, breast and cervical are having a high incidence and in certain cases also witnessing a high growth in incidence e.g., lung cancer, gastrointestinal cancer, prostate cancer.</td><td>▶ Studies and research on low-cost early detection methods for cancers such as lung, gastrointestinal and prostrate are critical to be evaluated for assessing their impact on downstaging the disease and consequently improving outcomes. Leveraging technology tools such as AI in reviewing X-ray reports and shortlisting high risk potential targets from a confirmatory screening perspective are relevant use cases which need to be evaluated for improving early detection of lung cancer at a Pan-India level.
▶ Based on findings from such studies and availability of low-cost screening methods, decision on expanding coverage of the national screening program to include other key cancers need to be taken.</td><td>Government/ Private research and health tech players</td></tr>
<tr><td>3</td><td colspan="3">Treatment- Access to quality care</td></tr>
<tr><td>3.1</td><td>Comprehensive Cancer Centres (CCCs) are available only in 175 districts with each CCC covering a population of ~3 million.
<table><tr><th>State</th><th>% Districts with CCC</th><th>Population (Mn) per CCC</th></tr><tr><td>UP</td><td>18%</td><td>6.1</td></tr><tr><td>BH</td><td>8%</td><td>22.2</td></tr><tr><td>MH</td><td>57%</td><td>1.8</td></tr><tr><td>WB</td><td>37%</td><td>4.6</td></tr><tr><td>MP</td><td>12%</td><td>4.7</td></tr><tr><td>TN</td><td>50%</td><td>1.6</td></tr><tr><td>RJ</td><td>21%</td><td>4.7</td></tr></table>Source: “List of Cancer Treatment Centres licensed by AERB”, aerb.gov.in, February 2021, EY analysis
Current state → proposed state:
CCCs in 175 districts in 2022 → CCCs in every major district with 1 center for 5000 new cases by 2030</td><td>▶ Adopt a distributed hub and spoke cancer care model with levels of care varying depending upon the hierarchy of the centers:
▶ Level 3 centers could offer diagnosis and care delivery for common cancers (Day care chemotherapy, radiation therapies such as IGRT, IMRT, 3D CRT, lesser complex surgeries and basic lab services) closer to the home of patients. Government and private medical colleges/ district and sub- district hospitals in the public sector and centers in Tier 2 cities of private oncology/ multi-specialty chain can act as spokes.
▶ Level 2 centers could offer comprehensive cancer care in a geographic area and act as a tertiary cancer referral center. Large super specialty hospitals attached to medical colleges and centers in Tier 1 cities/ metros of private oncology/ multi-speciality chain can act as a Level 2 centers.
▶ Level 1/ Apex centers should offer the most advanced therapies for common as well as rare cancers. (Immunotherapy/ targeted therapy, cyber knife, robotic surgeries, genomics). Flagship hospitals and centers of Excellence in private and public sector, such as TMH/ AIIMS, SCIs and TCCCs, can act as a hub.</td><td>Government/ Private healthcare providers</td></tr>
<tr><td></td><td></td><td>▶ Expedite the process of approval of projects and release of funds under various VGF schemes available currently with central and state governments. Viability gap funding under these schemes can cover up to 40% of project costs while facilitating unencumbered land allotment and approvals/ clearances within a specific timeline:
▶ Capital outlay of Rs 10,500 to 14,000 crores (excluding land and medical technology such as LINACs and PET-CT) is required to add ~40,000 incremental day care and surgical beds for servicing increasing cancer incidence.</td><td>Government</td></tr>
<tr><td>3.2</td><td>Need to improve local access to quality care facilities for general population.</td><td>▶ Address access challenges through hub and spoke model, telehealth, day care chemotherapy centers, etc.</td><td>Government, Private Healthcare Providers</td></tr>
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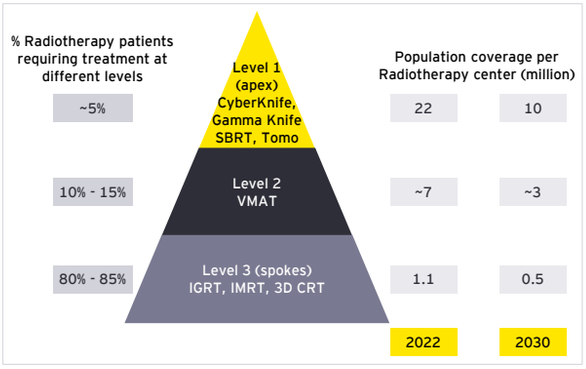
<tr><th></th><th>Key challenges</th><th>Proposed actions</th><th>Actions by</th></tr>
<tr><td></td><td></td><td>▶ Support patients traveling for treatment away from their homes with simple solutions such as daily food vouchers for caregivers, tie-ups with nearby hotels or service apartments, organizing local conveyance from hotel to hospital.</td><td></td></tr>
<tr><td>3.3</td><td>Low penetration of RT facilities in India with 0.4 RT per million against the WHO norm of 1 RT per million[58].

<table><tr><th>State</th><th>RT per million</th></tr><tr><td>Uttar Pradesh</td><td>0.2</td></tr><tr><td>Bihar</td><td>0.1</td></tr><tr><td>Maharashtra</td><td>0.7</td></tr><tr><td>West Bengal</td><td>0.3</td></tr><tr><td>Madhya Pradesh</td><td>0.3</td></tr><tr><td>Tamil Nadu</td><td>0.8</td></tr><tr><td>Rajasthan</td><td>0.3</td></tr></table>
Source: “List of Cancer Treatment Centres licensed by AERB”, aerb.gov.in, February 2021, EY analysis

In developed countries such as the US, Japan, Germany, Italy, France, RT equipment penetration is in the range of 2.6 to 7.6 RT per million population while in fellow BRIC nations – Brazil, Russia, China penetration is in the range of 0.8 to 1.1.

~60% of RT centers are located in districts with predominant urban population in India

Current state → Proposed state: 0.4 RT per million in 2022 → ~2 RT per million by 2030</td><td>▶ Adopt a tiered approach in offering radiotherapy treatment to patients closer to their home.

▶ To attain population coverage as mentioned in the above chart, there is a need to add ~890 RT equipment immediately and ~3,200 RT equipment by 2030 with a capital outlay of INR40,000 to 45,000 crores.

▶ Achieve the above model of distributed and equitable access to radiotherapy treatment by mandating oncology program and specifically radiotherapy department creation across all public and private medical colleges and in select district hospitals.

▶ Additionally, hubs and COE centers should provide central physics services to their spokes to enable uniform treatment planning under the guidance of expert clinical resources available at such centers.

▶ While the government introduced Production Linked Incentive (PLI) scheme for domestic manufacturing of oncology equipment and other medical devices in 2020 with an outlay of Rs 3,420 crores offering incentive of 5% on incremental sales of goods manufactured in India, the impact of it needs to be studied during the tenure of the scheme. The lessons drawn from the scheme must be used to plug in gaps and identify other critical components of the oncological ecosystem which need to be promoted. Considering both these aspects, the government should bring back the scheme to facilitate “Make-in-India” efforts to meet the demand of devices, drugs, and equipment for cancer treatment in India.

▶ Given there is a substantial need to add 275 to 400 RT equipment per annum, volume commitments from public and private sector can enable medical device companies to fast track their decision of setting up manufacturing/ assembly line set up in India. The domestic manufacturers of various oncological devices may make the best use of upcoming medical devices and pharmaceutical drugs parks to expand their operations in the country.

▶ Domestic manufacturing alone cannot meet the demand for cancer care equipment in India, especially of the capital expensive equipment such as</td><td>Government/private healthcare providers

Government

Government/private healthcare providers

Government

Government/ Private healthcare providers/ Private medical device manufacturers

Government</td></tr>
</table>

	Key challenges	Proposed actions	Actions by
		radiotherapy equipment required by the industry. The same scenario has been witnessed in the aviation and shipping industry, wherein facilitating imports of capital-intensive equipment opens up an avenue for employment in the service sector. By the same logic, the government must provide with relief in custom duties and GST for critical capital-intensive equipment in cancer treatment in India. Reduction in custom duties can effectively reduce the price of treatment to the end consumers reducing the out-of-pocket expenses. ► Current Custom duty and IGST together add a cost of ~30% over the cost of radiotherapy equipment imported and therefore, government can be consider revising the same.	
3.4	Low penetration of PET-CT machines in India with 0.25 PET Scanners per million population[67] while the developed countries such as the US, Australia and many West European countries have 3 PET-CT scanners per million population[68]. **Current state → Proposed state:** 0.25 PET Scanners per million to 0.75 PET Scanner per million by 2030	► Improve supply of trained nuclear medicine physicians by increasing number of post graduate nuclear medicine seats to ~3X of current seat count of 67 MD and 35 DNB.	Government
		► Include PET-CT as a separate procedure for reimbursement across all the state government schemes ► As of today, select state schemes such as MJPJAY, Telangana Arogyashri, Arogya Karnataka, Swasthya Sathi which represent populous states such as Maharashtra, Telangana, Karnataka and West Bengal do not cover PET-CT as a reimbursable intervention/ procedure ► Inclusion of PET-CT in these schemes will spur demand which will attract investments in setting up Nuclear medicine facilities across more locations	State governments
3.5	Low access to advanced therapies and genomics ► ~75% oncologists using NGS tests in the US[83] to guide treatment decision vs. significantly low penetration in India.	► Reduce custom duties on a broad range of reagent/ consumables used for cancer diagnostics and anti-cancer drugs used in advanced chemotherapy to effectively reduce the price of treatment to the end consumers, thereby also reducing the out-of-pocket expenses.	Government
		► Bring advanced cancer diagnostics and therapies such as gene panel for precision oncology, liquid biopsies, immunotherapy etc., under reimbursement schemes of government as well as private insurance plans.	Government/ Health Insurance providers
		► Create an ecosystem to encourage innovation and research by sharing data on Indian patients such as in the case of genomics. Currently gene panels are developed mostly based on Caucasian gene pool data as against Indian gene pool data required for developing India specific gene panels.	Government
3.6	High incidence per oncologist at 315 in India compared to 120 in China and 137 in the US ► Demand for number of medical oncologists and surgical oncologists is 2.6 times and 1.4 times of current availability.	► Increase the number of medical oncology seats and surgical oncology seats by ~4X to 5X and 1.5X to 2X respectively by increasing DNB seats to the extent feasible. This can be enabled by: ► Accreditation of multiple hospital units against individual hospital unit for the program. ► Relaxing 2-year clinical establishment criteria and minimum prescribed beds for DNB commencement.	Government

<table>
<tr><th></th><th>Key challenges</th><th>Proposed actions</th><th>Actions by</th></tr>
<tr><td></td><td>▶ Demand for number of medical physicists is 1.3 times that of current availability.
The demand-supply gap is expected to widen further as annual addition of medical oncologists and surgical oncologists is lower than expected requirement driven by incidence and population growth.
<table><tr><th></th><th colspan="2">Demand supply gap (Demand/ Supply)</th></tr><tr><th></th><th>2022</th><th>2030</th></tr><tr><td>Medical oncologists</td><td>2.6</td><td>2.8</td></tr><tr><td>Surgical oncologists</td><td>1.4</td><td>1.6</td></tr><tr><td>Radiation oncologists</td><td>1.0</td><td>1.1</td></tr><tr><td>Medical physicists</td><td>1.3</td><td>2.5</td></tr></table>Source: “List of cancer treatment centres licensed by AERB”, aerb.gov.in, “Call for Action: Expanding cancer care in India” EY report, 2015, nmc.org.in, Accr.natboard.edu.in, EY analysis, Refer <Annexure 5 - 9> for assumptions</td><td>▶ Increasing number of specialties per unit bed (5 specialties against 3 specialties for 150 to 200 bedded hospitals; 4 specialties against 2 specialties for 100 – 150 bedded hospitals).
▶ Encouraging senior practitioners to teach by provision of honorary degrees and stipends.</td><td></td></tr>
<tr><td></td><td></td><td>▶ Provide platforms for continuing medical education to enhance knowledge and skillsets of Oncologists. Additionally, ensure that research contribution by clinicians is considered as a key criteria for accreditation/ qualification of centers for eligibility under reimbursement programs offered by government and private insurance players.</td><td>All ecosystem players (Private and Public)</td></tr>
<tr><td></td><td></td><td>▶ Introduce oncology as a subject as part of the MBBS curriculum such that general physicians also acquire basic skillsets required to recognize cancer symptoms, conduct screening and initial diagnosis and refer patients to the right specialists/ referral centers</td><td>Government</td></tr>
<tr><td>3.7</td><td>Lack of coordinated care, variability in diagnosis and consultations leading to delay in accessing care.</td><td>▶ Empower GPs and upskill specialists (dentists, ENT, OBG, pulmonologist etc.) to play an effective role as gatekeepers
▶ Impart training so that they recognize relevant symptoms and signs for streamlined referrals.
▶ Develop and implement pathways that help identify high-risk patients for faster movement through the stage-gates.
▶ Provide access to structured referral database.
▶ Enforce standard protocols for diagnostic tests across different organs so that clinicians, providers and diagnostic centers all follow uniform practices.
▶ Build diagnostic facilities in day care centers through tie-ups or setting up collection points.</td><td>Government, medical colleges, private and public healthcare providers, oncologists, diagnostic companies, providers</td></tr>
<tr><td>3.8</td><td>Less than 2% of people requiring palliative care have access to it in India against the global average of 14%[101].</td><td>▶ All state governments should develop and roll out policy structure encompassing capacity building, access to essential medicines, strengthening palliative care facility at primary, secondary care level and developing palliative care facility at tertiary care level.
▶ Currently, only three states in India (Kerala, Karnataka and Maharashtra) have a palliative care policy</td><td>Government</td></tr>
<tr><td></td><td></td><td>▶ Mandatorily integrate palliative care services with care delivery at the PHCs, CHCs and district hospitals in the country and also link with referral database to ensure tracking and follow up with patients.</td><td>Government</td></tr>
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	Key challenges	Proposed actions	Actions by
		▶ Train auxiliary nurses and Asha workers to provide counseling to cancer patients.	
		▶ Undertake efforts to include palliative care packages under reimbursement schemes of government as well as private insurance plans.	Government/ Health Insurance providers
3.9	Lack of standard care delivery to patients ▶ Lack of coordinated care often leads to varied outcomes, misdiagnosis and miscommunication between providers, patients, and caregivers. ▶ Second opinion leads to change in diagnosis and treatment. recommendations in 12% to 69% of cases ▶ 60% to 150% variability exists in reimbursement tariffs under schemes. ▶ 25% to 30% of medical treatment costs are not covered by private insurance schemes based on limited study conducted.	▶ In similar lines as that of NCG, the NHA needs to establish/ formalize an Apex body which develops and implements standard treatment protocols for cancer care. The government should mandate Cancer centers across the country to adopt either standards provided by the Apex body or alternate standards which are available for audit and review by such Apex body. Multidisciplinary Tumor Boards need to be a key feature of the treatment guidelines and efforts should be undertaken to recognize and authorize multiple MDT Boards across the country which can offer case review and opinion services to smaller centers and spokes as envisaged to be set up in point 3.1 above. Compliance with the treatment guidelines going forward should be considered as key criteria by the government and private insurance players to decide eligibility for reimbursements /empanelment.	Government/ Private providers/ Health Insurance providers
3.10	Need for single source of authentic cancer information including platform for second opinion for expert review of suggested treatment plans.	▶ Develop and implement national helpline or 'Arogyasetu' like app providing support to patients diagnosed with cancer, including connecting patients with expert doctors for second opinion. ▶ Provide access to a regularly updated public database listing specialists along with their medical credentials and accredited hospitals specializing in cancer care. ▶ Hospital websites could evaluate providing information on patient feedback, contact details of survivors treated in same hospitals, treatment cost, technology, and outcomes in addition to doctor profiles and locations where facilities are available.	Government Private healthcare providers
3.11	High wait times and amount of paperwork in administrative processes causing patient dissatisfaction.	▶ Adopt digital interventions such as automated messages to patients informing them of delays, online appointment systems, online insurance approvals, etc. ▶ Publish reports displaying adherence to waiting time standards to reassure patient that continuous process improvement efforts are being undertaken.	Private providers, insurance companies, startups, technology players Private healthcare providers
3.12	Need for frequent, transparent and effective communication with patients and caregivers.	▶ Deploy dedicated nurse navigator or care coordinator programs in hospitals. ▶ Drive usage of technology to provide administrative updates electronically through mail or text. Provision for patient to login to access their health information at any time to see their progress will be a critical enabler for ensuring timely communication with patients/caregivers.	Government, Private healthcare providers, technology companies, startups
3.13	Extreme psychological distress for patient and caregiver often needing professional intervention.	▶ Drive integration of psycho-oncology in treatment plans.	Psycho-oncologists, mental health expert, private healthcare providers

<table>
<tr><th></th><th>Key challenges</th><th>Proposed actions</th><th>Actions by</th></tr>
<tr><td></td><td></td><td>▶ Care for caregiver– need to provide adequate counseling for caregivers also.
▶ Training at every level from doctors, nurses, front office and housekeepers on cultural sensitivity and patient dignity.
▶ Redesign all processes to ensure empathy at every step of treatment to reduce anxiety for already vulnerable patients and their families.</td><td></td></tr>
<tr><td>4</td><td colspan="3">Treatment – Affordability of quality care</td></tr>
<tr><td>4.1</td><td>Non uniform reimbursement rates and rigid coverage limit per annum for the government sponsored schemes
▶ Wide variation in coverage of oncology procedures observed currently- e.g., 851 procedures covered by TN CMHIS vs. 189 procedures covered by MJPJAY.
▶ PMJAY provides fixed coverage of up to INR5 lakhs per year per family. Some of the state government schemes such as MJPJAY, Telangana Arogyashri, Mukh Mantri Punjab Cancer Raahat Kosh scheme provides only INR1.5 to 2.0 lakhs of coverage much lower than cost of multi-modal treatment.

Current state → Proposed state: Non-Standard, non-uniform reimbursement rates with rigid cover → Standardized, uniform reimbursement rates in line with quality of healthcare delivered with flexible cover.</td><td>▶ Given that typical baseline comprehensive cancer treatment cost often exceeds INR5 lakhs, which is also corroborated by the survey of 154 patients, there is a need for the government to make reimbursement limit for cancer care under government schemes flexible to cover end-to-end treatment for cancer patients.
▶ Determine uniform reimbursement rates across all state government schemes and PMJAY following a structured approach keeping in mind a uniform standard of care and treatment plan developed by the Apex Body as recommended in point 3.9 above.
▶ Additionally, a mechanism for accreditation of healthcare facilities both public and private delivering cancer care, needs to be developed and implemented based on which eligibility for reimbursement and tariff benefits can be determined. Endeavors in this regard have been made by TMH in developing a 5-star rating based system for accreditation of facilities and determining eligibility for reimbursement. The rating mechanism developed has been illustrated below for reference:

<table><tr><th>Rating scale</th><th>Process and reporting requirements</th></tr><tr><td>*1</td><td>Captures and reports patient information by site and stage of disease.</td></tr><tr><td>*2</td><td>Additionally captures and reports complication rate.</td></tr><tr><td>*3</td><td>Additionally captures and reports compliance to pre-defined and approved treatment guidelines.</td></tr><tr><td>*4</td><td>Additionally captures and reports five-year survival data.</td></tr><tr><td>*5</td><td>Additionally conducts research either to change current treatment processes/ protocols or to improve outcomes.</td></tr></table></td><td>Government</td></tr>
<tr><td>4.2</td><td>Lack of comprehensive insurance coverage by retail health insurance players.

Current state → Proposed state: 70% - 75% of medical expenses covered through insurance to 100% coverage</td><td>▶ As highlighted in point 4.1 above, retail health insurance players should develop their care plans ensuring comprehensive coverage across all stages of patient journey based on treatment protocols developed/ approved by proposed Apex Body. Additionally, accreditation as mentioned in point 4.1 above, should be a key criterion for these insurance players to determine reimbursement levels for cancer care facilities.</td><td>Health Insurance providers</td></tr>
<tr><td>4.3</td><td>Need for innovative ways to raise capital and optimize costs
▶ The cost of emerging oncology diagnostics and therapeutics such as precision oncology,</td><td>▶ Encourage innovative financing models such as impact bonds that can help improve access to these emerging diagnostics and treatment modalities.</td><td>Government</td></tr>
<tr><td></td><td></td><td>▶ Drive efficiencies across material, workforce and medical equipment utilization to lower cost and</td><td>Private healthcare providers</td></tr>
</table>

	Key challenges	Proposed actions	Actions by
	immunotherapy and proton therapy are on the higher side and is out of reach for 94% to 97% of Indian population[116].	thereby sustainably service the government scheme patients. ► A structured program can help unlock efficiencies by 15%- 30% across major cost heads.	
4.4	High cost of treatment often leading to non-adherence of full course.	► Evaluate expansion of PMJAY scheme coverage to include middle class population. ► Strengthen processes on financial counseling of patients about insurance or schemes, philanthropic funding, patient assistance programs and complete billing transparency. ► Provide complete visibility about costs of treatment during finalization of treatment plan.	Government Private healthcare providers
5	Treatment - Cancer health records		
5.1	Limited coverage under Population Based Cancer Registries (PBCR) ► Only 38 PBCRs covering ~10% of the population with most of them being urban[122]. Only 1% of rural population is covered under PBCRs[123] ► Several states such as Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Rajasthan, Telangana and Orissa having inadequate presence and penetration of registries.	► Improve coverage from the current 10% of population with special focus on rural areas. ► Add population registries in states which do not have one currently.	Government
		► Make cancer a notifiable disease to strengthen the data availability with respect to cancer related mortality.	Government
5.2	Limited coverage under Hospital Based Cancer Registries (HBCR) ► Only 268 HBCRs registered under NCDIR –NCRP[124]. With more than 43,486 private hospitals and 25,778 public hospitals in India[1], the coverage under HBCRs is meagre	► Make it mandatory to register hospital-based cancer registry under NCDIR – NCRP for all hospitals with >50 beds.	Government

[1] Private Healthcare in India: Boons and Banes, www.institutmontaigne.org, November 2020

Table of Contents

1 Cancer disease burden

Chapter 1 – Cancer disease burden

India faces a grave challenge of high cancer incidence, which is growing at a faster pace as compared to other developing countries

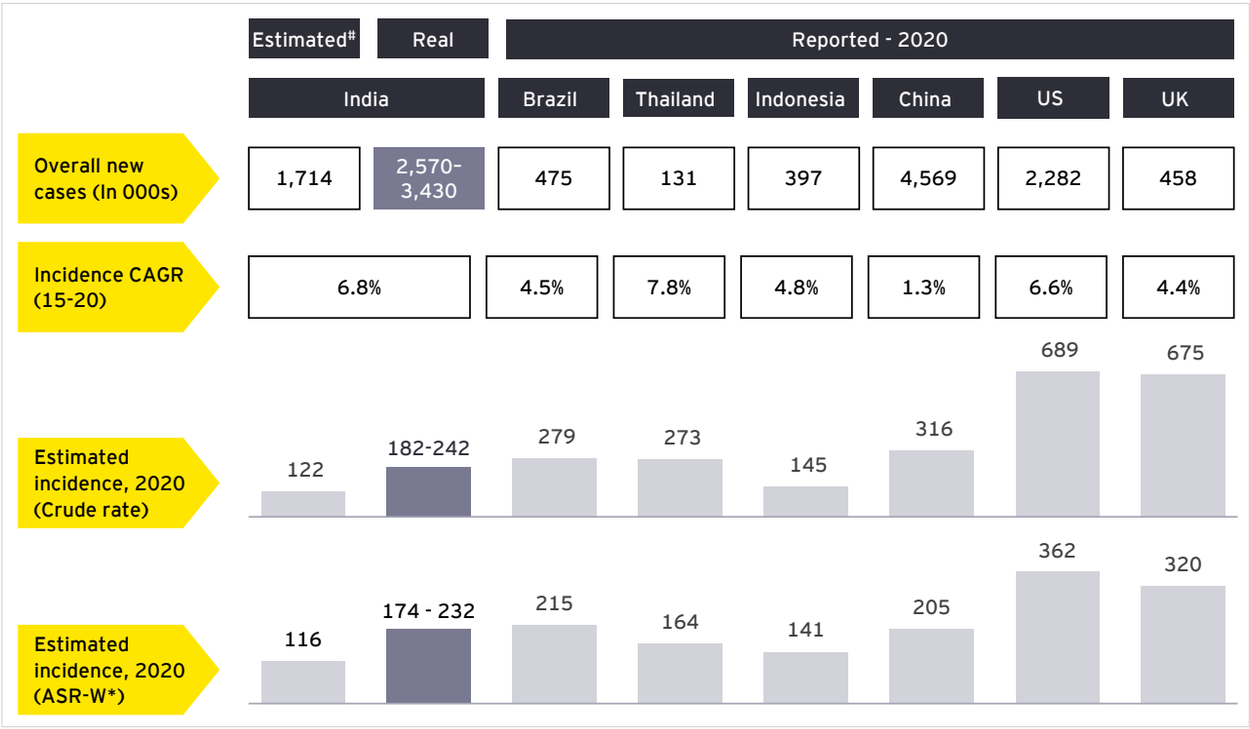
According to the 2020 WHO ranking on cancer burden, India ranks at the third position after China and the US, respectively, in terms of new yearly cancer incidence being reported.

Based on the historical growth in reported cancer incidence (CAGR of 5% between 2012 to 2016), India's cancer incidence crude rate is estimated to be 122 per lakh population and age-specific incidence (ASR-W*) rate is estimated to be 116 per lakh population in 2020. While the estimated age-specific incidence rate (ASR rate) for India is lower compared to other geographies, India's real ASR rate is expected to be higher than Thailand and Indonesia, and comparable with China and Brazil (refer Chart 1).

Despite the crude rate of incidence not being amongst the highest in India compared to other geographies, the total incidence burden is high due to the large population size of the country. Considering growth in population and crude rate, India's cancer incidence is estimated to be growing at a CAGR of 6.8% (2015 to 2020) which is significantly higher than other developing countries such as China (1.3%) (which has a comparable population size), Brazil (4.5%) and Indonesia (4.8%) as well as developed countries such as UK (4.4%).

In 2022, around 19 to 20 lakh new cancer cases are estimated to be reported in India. However, the real incidence of cancer is conservatively estimated to be 1.5 to 3 times higher than the reported incidence from cancer registries.

Chart 1: Estimated incidence in 2020



Source: NCRP 2020 Annual report, Global cancer observatory for Brazil, Thailand, US, UK, China and Indonesia

#Estimated incidence considering only population growth and crude rate CAGR, without considering impact of changes in risk factors and improvement in diagnosis

*ASR-W is a weighted mean of the age-specific incidence rates. The weights are taken from the population distribution of the 'World Standard Population 'defined by WHO, and the estimated incidence rate is expressed per lakh population for comparisons between different geographies.

+CAGR: Compound annual growth rate, measures the annual growth over multiple years by compounding over the time period.

Real incidence for cancer in India is expected to be 1.5 to 3x of reported incidence, mainly due low population coverage of cancer registries and significant under diagnosis

Some indicators for the gap between real and reported cancer incidence in India are:

1. **Differences in incidence data when compared between cancer registry and randomized screening studies**
   - Studies that compared incidence data from cancer registries and large randomized screening trials at Mumbai, Osmanabad and Trivandrum demonstrated the real incidence to be around **1.5 to 3 times higher** than the reported incidence.

> Cancer care demand will be increasing globally and especially in India, and we have to modernize our care across all respects in our country. India should campaign to increase exponentially the awareness of prevention, early detection and treatment, automation in diagnostics, application of precision medicine and personalized care which can make it more affordable.
>
> **Dr. M I Sahadulla**
> Chairman & Managing Director, KIMS Health – India and GCC

Table 1: Gap between study and registry incidence

Study Organization	Location of study	Site	Reference year	Study incidence (per 1,000 pop)	Registry incidence (per 1,000 pop)	Gap between study v. registry incidence (No. of times)
Tata Memorial Hospital	Mumbai	Breast	1998-2018	0.64	0.21*	3.0
	Mumbai	Cervix	1998-2015	0.25	0.11*	2.3
	Osmanabad	Cervix	1999-2007	1.35	0.42#	3.2
Sankaranarayanan R et al 2021	Trivandrum	Oral	1996-2014	0.37	0.17^	2.2

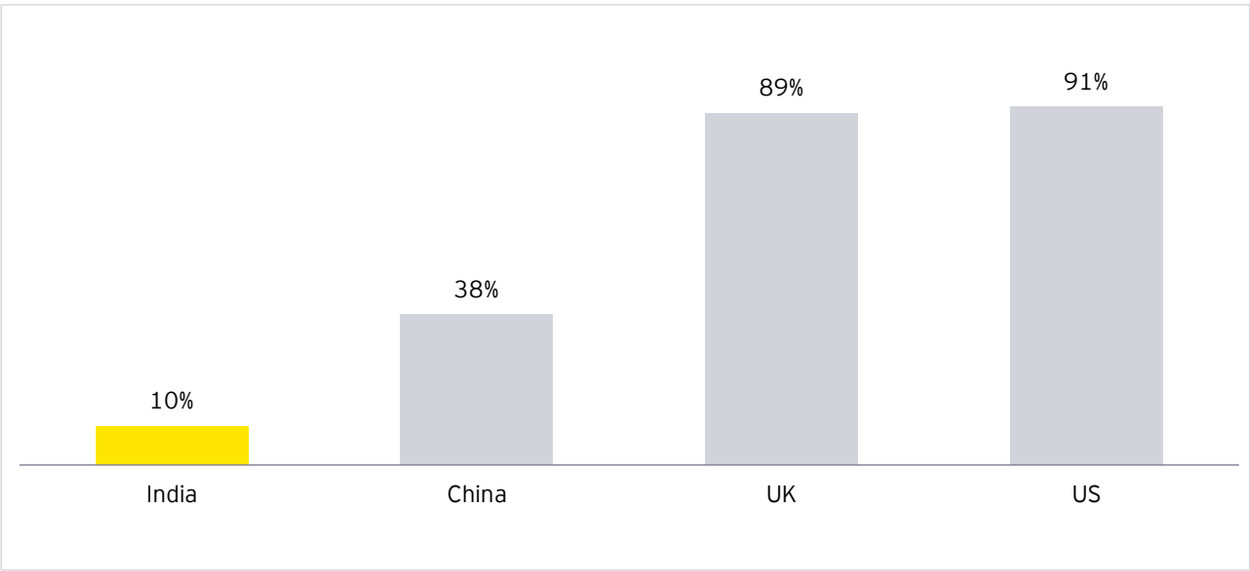
*pooled crude incidence based on population-based cancer registry data for respective time periods for Mumbai

pooled crude incidence based on population-based cancer registry data 1999-2007 for Barshi

^For oral cancer, incidence for lip, tongue and mouth have been considered from PBCR data, Thiruvananthapuram 1996-2014

2. **Low population coverage of the Indian cancer registries**
   - Indian cancer registries cover **only ~10% of the population** vis-à-vis >90% in the US and the UK and ~40% in China. Estimates of cancer incidence at a population level are extrapolated from the reported incidence in cancer registries and India's very low coverage could potentially lead to a high margin of error.

Chart 2: Global population coverage by national cancer registries



Source: NCRP Annual report, 2020, respective national PBCR registries

3. High under diagnosis

- Leading oncologists believe that the under-diagnosis could be to the tune of more than 50% due to lack of diagnostic infrastructure and low patient awareness. A research on stages of diagnosis with around 500 breast cancer patients from south India, 2006, revealed that almost 53% of patients had delayed diagnosis due to low awareness and lack of organized and regular screening programs.[2]
- The ongoing COVID-19 pandemic has impacted the speed of national cancer screening programs, decreased visits to hospitals/general practitioners, reduced referrals to specialist and lower diagnostic tests, further accentuating the underdiagnosis and delayed diagnosis situation since March 2020[3].
  - Cohort studies reported a 38% reduction in pathological diagnostic tests and 43% reduction in radiological diagnostic tests at 41 cancer centers across India during March-May 2020 period as compared to the corresponding period in 2019.

Head and neck, gastrointestinal and lung contribute to 50% cancer incidences in males and breast, cervix uteri and gastrointestinal organs in case of females. Head and neck, prostate and ovarian cancer are growing at a faster pace than other cancers

- Out of ~14 lakhs cancer cases in 2016, males contributed to 49% (47% in 2012) and females contributed to 51% (53% in 2012).
- Cancers of the head and neck and gastro-intestinal organs constitute 21% and 18% respectively for males and 6% and 11% respectively for females out of the total incidence across the respective genders (refer chart 3 below for gender wise and organ wise incidence).
- Cancers of the head and neck are growing at the highest overall CAGR (12-16) of 23% (CAGR of 25% in males vs. 16% in females). In males, it is followed by prostate cancer at 19% while in females by ovarian and lung cancer at ~11%.
- Breast cancer may be considered as a threat with this organ type becoming the highest contributor (29%) to total incidence among females in India in 2016 and incidence rising

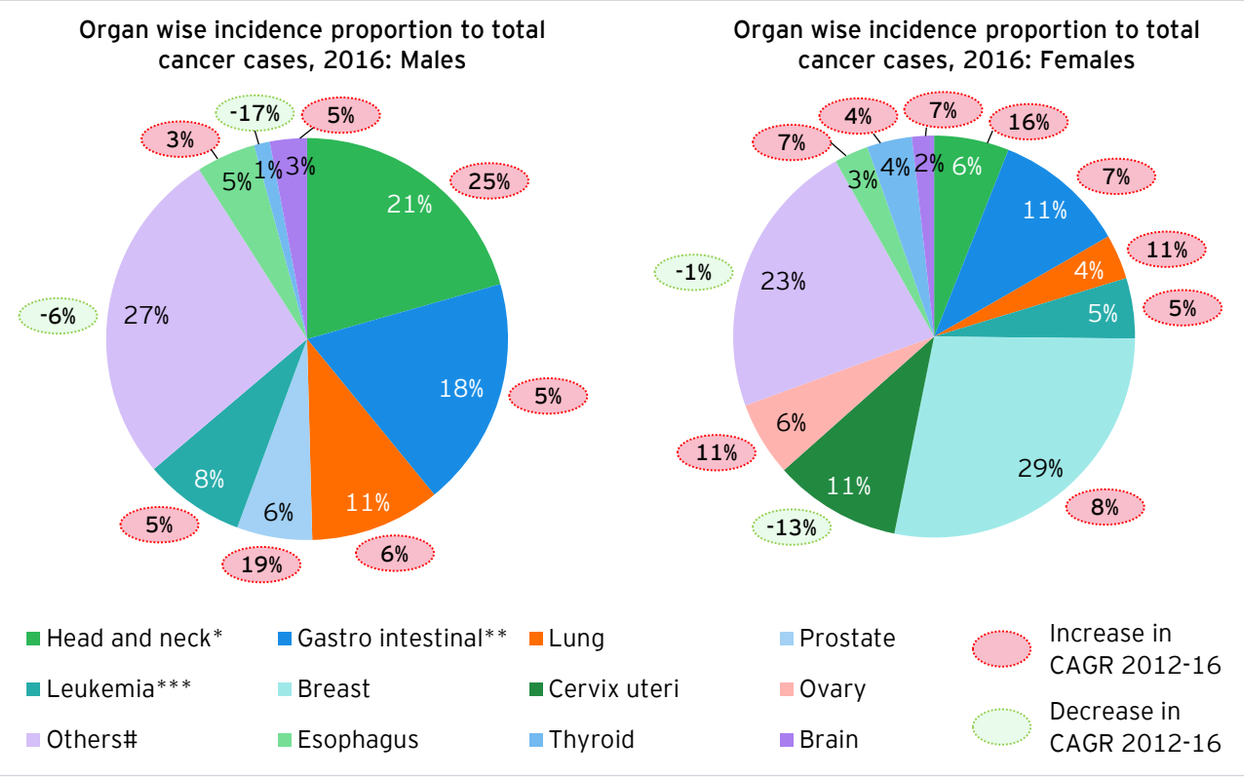
[2] Ali R, Mathew A, Rajan B. Effects of socio-economic and demographic factors in delayed reporting and late-stage presentation among patients with breast cancer in a major cancer hospital in South India. Asian Pac J Cancer Prev. 2008 Oct-Dec;9(4):703-7. PMID: 19256763

[3] Ranganathan P et al. National Cancer Grid of India. Impact of COVID-19 on cancer care in India: a cohort study. Lancet Oncol. 2021 Jul;22(7):970-976. doi: 10.1016/S1470-2045(21)00240-0. Epub 2021 May 27. PMID: 34051879; PMCID: PMC8159191.

among women at high CAGR of 8% during 2012 to 2016.

- Cervix uteri, which was one of the top contributing cancers in females (23% in 2012 compared to 11% in 2016) has seen a significant reduction with a negative CAGR of 13% (2012 to 2016).

Chart 3: Organ-wise incidence proportion to overall cancer incidence



*CAGR for Leukemia, Thyroid, and Brain are from 2015-16

Source: NCRP annual report, 2020, Globocan 2012

*Head and neck includes tongue, mouth, hypopharynx and larynx

**Gastro-intestinal organs include stomach, rectum, colon, liver and gall bladder

***Leukemia includes NHL, Lymphoid and Myeloid Leukemia

Others include cancers of the urinary tract, corpus uteri, etc.

Disease burden for head and neck, breast and ovary cancers is higher / on par with other countries

- Top three organs contributing to 43% of reported incidence in India in 2020 (estimated) are head and neck (~3 lakhs), breast (~2.6 lakhs) and gastrointestinal cancers (~2.5 lakhs).
- In 2020, India is estimated to have the highest incidence and incidence CAGR across head and neck and ovarian cancers in comparison with China, the US and the UK (refer Table 2 below).
- China and the US have higher cases of gastrointestinal, lung, prostate and thyroid cancers than India (these cancers contribute to 60% cases in China and 34% in the US).
- There has been a significant increase in breast cancer cases in India and China between 2015 to 2020 (CAGR of 14% and 6% respectively), while the UK has shown a decline in incidence.
- While the incidence of brain cancer has increased in India, the US and the UK, China has managed to achieve a significant reduction in brain cancer cases (by 6%).
- Against the increasing trend in incidence, cases of thyroid, leukemia, lung and cervix uteri cancer cases are estimated to have declined by 14%, 6%, 2% and 1%, respectively.

Ovarian cancer in India has grown by a CAGR of 6% as against 1-2% CAGR for China and US, while UK has managed to achieve a 3% reduction. The same has resulted in India having the highest incidence of ovarian cancer as compared to China, the US and the UK.

Table 2: Global comparison for organ-wise crude incidence in 000s and CAGR (2015-20)

Organ\Country	Incidence 2020 ('000)				CAGR (2015-20)			
	India	China	US	UK	India	China	US	UK
Head and neck	**306**	142	59	14	8%	2%	4%	4%
Breast	**256**	416	253	54	14%	6%	3%	-1%
Gastrointestinal	246	1,593	276	78	4%	4%	2%	3%
Lung	95	816	228	52	-2%	1%	7%	3%
Cervix uteri	94	110	14	4	-1%	0%	3%	4%
Esophagus	83	324	18	10	11%	6%	5%	--
Leukemia	64	85	61	11	-6%	0%	5%	2%
Ovary	**60**	55	24	6	6%	1%	2%	-3%
Prostate	45	115	210	57	1%	10%	3%	3%
Brain	41	80	25	6	6%	-6%	3%	2%
Thyroid	27	221	53	6	-14%	2%	1%	9%

Data for stage of diagnosis: US is for 2012-18, UK for 2019 & China is from 2009, India from 2016.

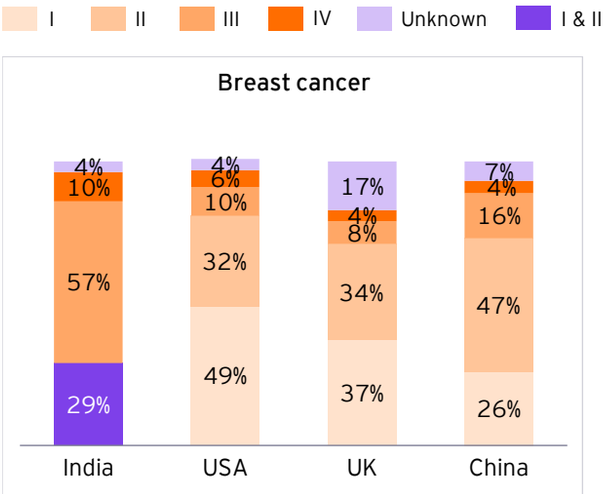
Source: SEER cancer statistics, Cancer research UK, Zeng at al 2021, NCRP Annual report 2020

The issue of high disease burden is compounded with late-stage detection caused mainly due to lack of awareness and poor screening programs

India has a poor detection rate across major cancer sites with only 29% and 15% of breast and lung cancers being diagnosed in stages 1 and 2, respectively, which is significantly lesser than that in China, the UK and the US (refer chart 4).

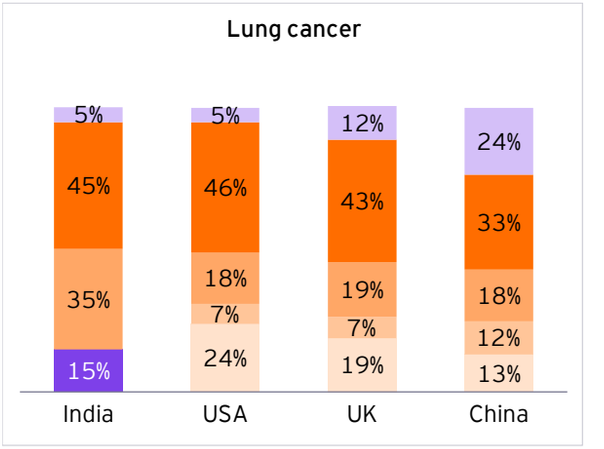
This is one of the reasons for high mortality rate for cancers in India when compared to developed countries such as the US and the UK, where early diagnosis has been a key reason for reduced mortality.

Chart 4: % of cases diagnosed at the following stages:



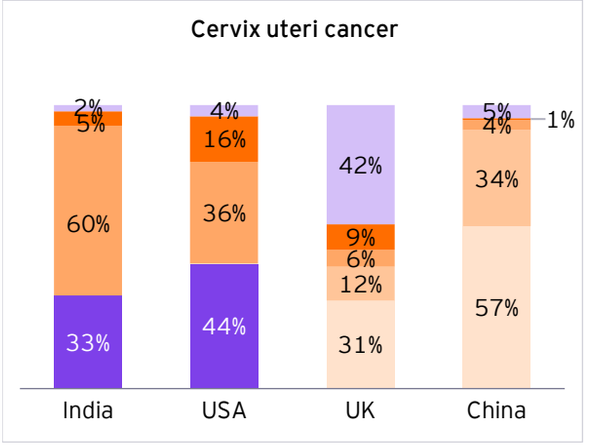
Country	Year of initiation of screening program	Participation rate*
US	1995	94%
UK	1988	88%
China	2009	43%
India	2016	7%

*Percentage of eligible women (30 to 69 years) who have a screening mammogram at least once in 24 months. Data for the UK for 2019 and the US, China for 2016 to 2017; and India for 2016. WHO's screening programs short guide for UK, SEER registry for US, Chinese national cancer registry for China and International Cancer Screening Network, Ministry of Health and Family Welfare. 2020-21 Annual Report for India



Country	Year of initiation of screening program	Participation rate*
US	2011	32%
UK	2013	30%
China	2012	22%
India	Yet to start at country level	~

*Percentage of eligible population (50 to 80 years) who have LCDT screening. Data for the UK for 2019 and the US and China for 2016 to 2017; and India for 2016. Source: National Library of Medicines for the UK, Centers for Medicare and Medicaid Services for the US, Disparities in stage at diagnosis for five common cancers in China: a multicenter, hospital-based, observational study



Country	Year of initiation of screening program	Effective Coverage^	Crude Coverage#
US	1991	74%	91%
UK	1988	71%	89%
China	2009	~23%	~55%
India	2007	~1.2%	~30%

^Effective coverage: The proportion of eligible women (15-49 years) who report having had a pelvic exam and Pap smear in the past three years; #Crude coverage: The proportion of women (15 to 49 years) who report having had a pelvic exam (regardless of when the exam occurred).

India is witnessing a rapid increase in burden of NCDs (including cancer) with the contribution of NCDs to total deaths rising from 38% in 1990 to 57% in 2017

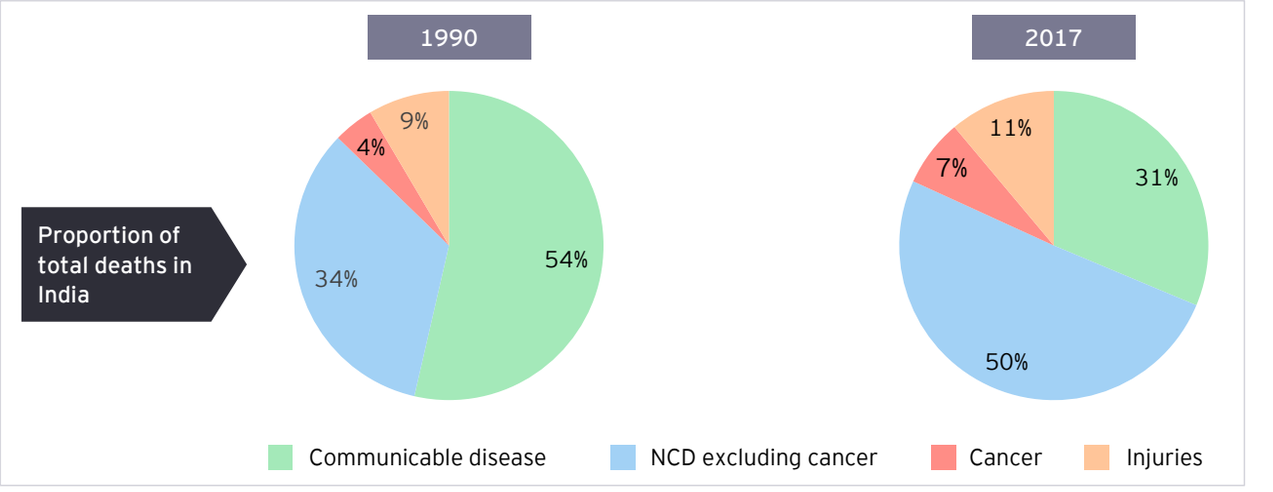
Fast-growing population coupled with rapid urbanization in India has led to an overall economic rise, however with certain associated challenges, such as changes in lifestyle, unhealthy eating habits, tobacco smoking and rise in alcohol intake. As a result, the country is witnessing a shift toward higher proportion of non-communicable diseases (NCDs).

In 2017, NCDs contributed to 50% (24.2 crore) of the overall disability adjusted life years' (DALYs) (48.6 crore)[4], a significant increase in comparison to 31% (~16.0 crore) in 1990. Cancer alone contributes to 4% (2 crore) of overall DALYs in 2017, which represents an increase of 65-70% from 2.3% DALYs (~1.2 crore) contributed by cancer in 1990.

While the contribution of NCDs to total deaths has been increasing (from 38% in 1990 to 57% in 2017), contribution of cancer deaths has almost doubled during the same period (4% in 1990 to 7% in 2017).

- As per ICMR reports, among overall cancer mortality in India for 2016, stomach and lung cancer contribute the most (9%) to the total cancer deaths. It is followed by breast and oral cancer contributing to 8% and 7%, respectively, to the total cancer-related deaths.

Chart 5: Proportion of total deaths in India over time



Source: India: Health of Nation's state 2017, India-global burden of disease study 2017, World Bank death rate indicator

Given the above, India has an adverse mortality to incidence ratio worse than other countries

- India leads the organ wise mortality to incidence ratio across all countries, except in the case of esophageal cancer where it is at par with China.
- In comparison with other countries, India has a significant journey to bridge w.r.t improvement in outcomes specifically for Head and neck cancer (M/I ratio of 56% in India vs. 23% in the US and 33% in the UK), prostate cancer (M/I ratio of 49% in India vs. 15% in US and 23% in the UK), Breast cancer (M/I ratio of 51% in India vs. 17% in the US and 22% in the UK). For these cancer types, developed countries have been able to nearly halve the M/I ratio compared to India, highlighting the need to draw learnings from these countries and contextualize them in the Indian context for improved outcomes.

[4] India: Health of Nation's States, The India State-Level Disease Burden Initiative, Indian Council of Medical Research
Public Health Foundation of India
Institute for Health Metrics and Evaluation, 2017

Table 3: Global comparison for organ-wise mortality to incidence ratio

Organs	India (M/I)	China (M/I)	US (M/I)	UK (M/I)
Head and neck	56%	52%	23%	33%
Gastro-intestinal	80%	75%	53%	56%
Lung	91%	88%	61%	70%
Prostate	49%	44%	15%	23%
Leukemia	73%	72%	39%	48%
Breast	51%	28%	17%	22%
Cervix uteri	62%	54%	42%	30%
Ovary	70%	68%	60%	68%
Brain	85%	82%	74%	78%
Esophagus	92%	93%	89%	84%
Others	57%	31%	15%	29%

Source: NCRP Annual report 2020, Global Cancer Observatory, 2020

Within India, out of the 17 states covered by population-based cancer registries (PBCRs), 13 states exhibit a rising cancer burden

Among all states and UTs covered by population-based cancer registries (PBCRs), Kerala, Mizoram, Tamil Nadu, Karnataka, Punjab, and Assam report the highest overall crude incidence rates of cancers (above 130 cases per lakh population) and have 23% share of the total cancer burden of the country.

Tamil Nadu, Karnataka, Punjab, and Maharashtra are the states where the crude incidence rate among females is significantly higher than male cancer incidence. Conversely, for Assam, Meghalaya and Nagaland, the crude incidence among males is much higher than female cancer incidence.

Figure 1: Map of India with top organ cancer types and crude rate

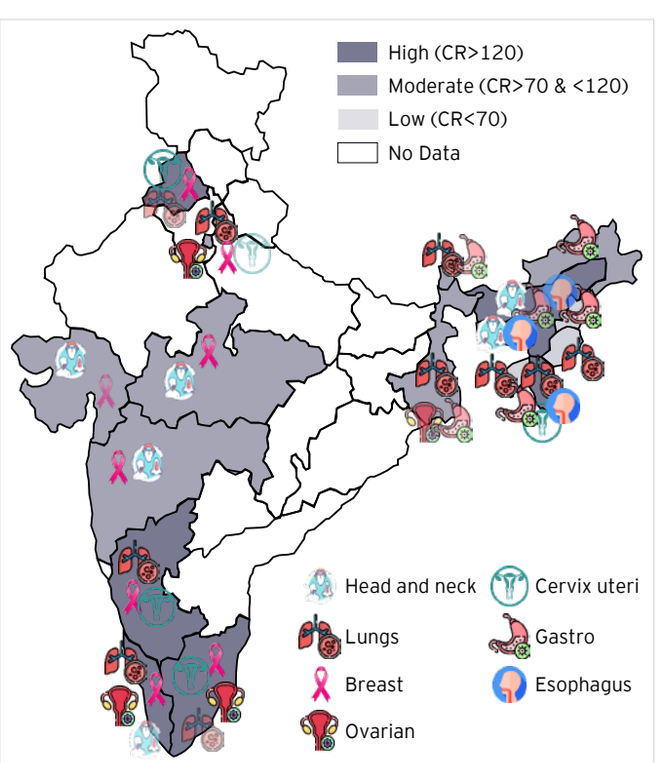


Table 4: Key state wise projected crude Incidence per lakh population (2020) and CAGR trend

State/UT (No. of Registries)	Crude rate per lakh population		
	Overall	Male	Female
Kerala (2)	↑ 181.6	↑ 188.7	↑ 175.4
Karnataka (1)	↑ 151.7	↑ 132.3	↑ 172.6
Tamil Nadu (1)	↑ 148.6	↑ 135.4	↑ 161.5
Punjab (1)	↑ 144.0	↑ 126.4	↑ 163.7
Mizoram (1)	↑ 141.7	↓ 143.5	↑ 139.9
Assam (3)	↑ 138.6	↑ 151.6	↑ 125.8
Delhi (1)	↓ 113.5	↓ 111.7	↓ 115.5
Maharashtra (6)	↑ 97.2	↑ 88.8	↑ 106.2
Arunachal Pradesh (2)	↓ 94.1	↓ 91.0	↓ 97.1
West Bengal (1)	↓ 87.9	↓ 94.1	↓ 81.4
Madhya Pradesh (1)	↑ 87.8	↑ 85.3	↑ 90.4
Gujarat (1)	↑ 85.8	↑ 92.6	↑ 78.2
Meghalaya (1)	↑ 79.5	↑ 100.7	↑ 58.4
Sikkim (1)	↓ 70.5	↓ 67.8	↓ 73.5
Tripura (1)	↑ 68.5	↑ 76.7	↑ 60.0
Nagaland (1)	↑ 68.2	↓ 74.1	↑ 61.9
Manipur (1)	↑ 56.2	↑ 50.8	↑ 61.6

Source: NCRP annual reports, EY analysis. Refer <Annexure 1> for state-wise population and cancer registry coverage in 2016

While there is a significant variation among states in cancer incidence for different organs, cancers of breast, ovaries and cervix uteri among females have a high incidence among most key states

- Head and neck: Madhya Pradesh, Gujarat and north-eastern states of Assam, Meghalaya and Mizoram have a significantly high incidence of mouth, tongue and hypo-pharynx cancers, as compared to other states.
- Lung cancer: Mizoram has the highest incidence of lung cancer among females (37 per lakh population) and among the highest for males (22 per lakh population). Kerala and West Bengal also have a high incidence of lung cancer, particularly among males.
- Breast and ovarian: Most key states in regions, excluding north-east, have high incidence of breast and ovarian cancer among females, with southern states of Karnataka, Kerala and Tamil Nadu having the highest incidence followed by northern states of Punjab and Delhi.
- Cervix uteri: Almost all key states have a high incidence of Cervix uteri cancer with Mizoram having the highest crude rate (38 per lakh population) followed by Karnataka and Tamil Nadu (29 per lakh population).
- Esophagus and Stomach: Meghalaya and Mizoram have the highest incidence of esophagus and stomach cancers, both among males and females.

Table 5: 2020 Organ wise crude rates of key states for male

States\Organs	2020 Crude rates Organ wise (Male)								
	Lung	Mouth	Tongue	Hypo-pharynx	Pharynx	Larynx	Eso-phagus	Stomach	Urinary Bladder
Delhi	11	8	7	NA	NA	5	5	NA	5
Punjab	7	4	4	NA	NA	4	10	NA	4
Madhya Pradesh	9	14	8	3	NA	4	4	NA	NA
West Bengal	22	7	6	NA	NA	5	NA	5	5
Arunachal Pradesh	NA	NA	NA	4	NA	NA	5	16	NA
Assam	9	8	7	12	NA	4	16	7	NA
Manipur	9	NA	NA	NA	NA	1	3	3	NA
Meghalaya	6	5	7	9	2	6	32	6	NA
Mizoram	22	3	1	9	NA	4	26	27	NA
Nagaland	4	3	NA	5	NA	4	7	9	NA
Sikkim	5	3	NA	NA	2	2	5	12	NA
Tripura	11	4	4	3	NA	4	5	4	NA
Gujarat	7	18	9	2	NA	2	4	NA	NA
Maharashtra	6	9	5	NA	NA	3	4	3	NA
Karnataka	10	4	4	NA	NA	NA	5	7	NA
Kerala	25	9	8	NA	NA	7	2	7	3
Tamil Nadu	12	10	8	NA	NA	5	4	10	NA

Source: EY Analysis, 2012, 2014 and 2016 cancer registries

Table 6: 2020 Organ wise crude rates of key states for female

States\Organs	2020 Crude rates organ wise (Female)									
	Lung	Mouth	Tongue	Hypo-pharynx	Eso-phagus	Stomach	Gall Bladder	Breast	Ovary	Cervix uteri
Delhi	7	NA	5	NA	5	NA	10	59	15	21
Punjab	5	NA	NA	NA	15	NA	3	69	12	25
Madhya Pradesh	5	8	6	NA	6	NA	5	50	12	19
West Bengal	13	6	NA	NA	NA	5	9	49	15	19
Arunachal Pradesh	5	NA	NA	NA	6	15	NA	27	11	NA
Assam	6	8	2	1	16	8	8	31	11	19
Manipur	15	NA	NA	NA	NA	3	3	18	6	11
Meghalaya	4	9	2	2	27	8	3	9	2	10
Mizoram	37	NA	NA	NA	10	24	NA	35	8	38
Nagaland	4	NA	NA	NA	NA	11	NA	12	4	16
Sikkim	9	NA	NA	NA	6	10	5	17	7	14
Tripura	5	5	2	NA	5	3	5	14	5	16
Gujarat	4	6	6	NA	5	NA	2	40	7	12
Maharashtra	4	7	1	NA	2	NA	NA	55	11	17
Karnataka	9	9	NA	NA	8	8	NA	67	15	29
Kerala	11	NA	NA	NA	NA	NA	NA	82	15	17
Tamil Nadu	8	8	NA	NA	6	10	NA	84	16	29

Going forward, India is also witnessing worsening of risk factors contributing to cancer

An effective way to tackle the rising cancer burden is by focusing on preventable cancer cases. According to studies, approximately 70% of the Indian cancers are caused by potentially modifiable and preventable risk factors[5].

Table 7: Risk factors by various cancer types

	Cancer types → / Risk factors ↓	Measuring parameters and trends	Breast	Head and neck	Lung	Cervical	Ovarian
Modifiable	Reproductive activity	Median Age of Marriage ↑ Median age of 1st Childbirth ↑	✓	X	X	✓	✓
Modifiable	Sexual habits and poor hygiene	Usage of sanitary napkins ↑	X	X	X	✓	X
Modifiable	Infection and immunity level	India Prevalence of HPV >Global average	X	✓	X	✓	X
Modifiable	Specific medical condition/disease	--	X	X	X	X	✓
Modifiable	Obesity and physical inactivity	% of Obese and overweight population ↑	✓	X	X	✓	✓
Modifiable	Tobacco use	% of population using tobacco ↓	X	✓	✓	✓	X
Modifiable	Alcohol consumption*	% of population drinking alcohol ↓	✓	✓	X	X	X
Modifiable	Environmental pollution	Pollution levels ($PM_{2.5}$) ↑	X	X	✓	X	X
Non-Modifiable	Family history		✓	X	X	X	✓
Non-Modifiable	Genetic disposition		✓	X	X	X	✓
Non-Modifiable	Gender		X	X	X	✓	✓
Non-Modifiable	Age		✓	✓	✓	✓	✓

Modifiable factors: the behaviors and exposures that can raise or lower a person's risk of cancer, and which can, in theory, be changed.

Non-modifiable factors: factors which, in theory, cannot be changed or adjusted

*Recorded consumption of alcohol has increased by a CAGR of 2% over six years, whereas unrecorded consumption has increased by 10%, evidencing the behavioral habits of Indians with regard to illegal consumption of alcohol, or not providing data for the consumption patterns

Refer <Annexure 2 > for major risk factors associated with different cancer types and their trend in the recent past in detail

A review of the trends in risk factors across different states vis-à-vis trends in cancer incidence for those states highlight that there is an intensification of key risk factors which are potentially causing an adverse effect on the disease burden for those states. Tobacco and alcohol consumption, obesity and physical inactivity and pollution are among the key risk factors which are potentially impacting cancer disease burden across states.

[5] NCRP 2020 report

Table 8: Correlation between various risk factors with cancer burden by organs in key States

Risk Factor	Trends in Key states/Union Territory (KS/UT)	Potential effect in disease burden in the state/UT
Tobacco consumption National average consumption ► Men – 38.0% ► Women – 8.9% Smoking Tobacco is a risk factor for: ► Lung cancer ► Head and neck cancer ► Cervix uteri cancer Smokeless Tobacco is a risk factor for: ► Head and neck cancer ► Esophageal cancer ► Stomach cancer ► Urinary bladder	Mizoram: Highest consumption of tobacco in India across both genders (Men – 73.1%, Women – 61.7%)	► Mizoram has overall crude incidence per lakh population (CR) of 156.9 which is the 2nd highest among all the KS ► Expectedly, the CR for lung cancer is the highest among all KS for women (36.8) and 3rd highest among men (21.7) ► And women in Mizoram have the highest CR (40.0) among all KS for cervix uteri cancer
	Meghalaya: Tobacco consumption by men is 57.8% (2nd highest among men in India)	► The CR (2.14, 9.17) for Pharynx unspecified and hypopharynx (part of Head and neck) among men is the highest and 2nd highest across all KS ► The CR (31.9) for Esophagus among men is the highest across all KS ► The CR (5.35) for larynx among men is the 2nd highest across all KS
	West Bengal: Consumption of tobacco among men is 48.1% (26.6% higher than national average of tobacco consumption among men)	► The CR (22.4) for lung cancer among men is the 2nd highest across all KS
	Manipur: Consumption of tobacco by women is 43.3% (5 times of the national average)	► The CR for lung cancer among women is the 2nd highest across all KS (14.7)
Alcohol consumption National average consumption ► Men – 22.4% ► Women – 0.7% Risk factor for: ► Breast cancer ► Head and neck cancer	Tamil Nadu: Consumption of Alcohol by men is 48.1% (more than twice the national average)	► The CR (8.4) for tongue cancer (Part of H&N) among men is the 2nd highest across all KS
	Delhi: The only state where the consumption of alcohol has grown in the last five years across both the genders (2% and 18% increase for men and women respectively)	► Although the overall as well as gender wise CR for the UT has come down slightly from 2014 to 2020, the CR for breast cancer for women has increased by 69% (from 34.8 to 58.8) during 2014-20
Obesity and physical inactivity % of population with greater 15yrs and BMI>25 India average – 24% Risk factor for: ► Breast cancer ► Cervix uteri cancer ► Ovarian cancer ► Gall bladder cancer	Punjab has 40.8% of obese women of age 15 years and above and BMI>25	► Women in Punjab have the 4th highest CR (25.3) among all KS for cervix uteri cancer and 3rd highest CR (68.85) among all KS for breast cancer
	Kerala has 38.2% of obese women of age 15 years and above and BMI>25	► Women in Kerala have the 2nd highest CR (15.3) among all KS for ovarian cancer and 2nd highest CR (81.5) among all KS for breast cancer
	Tamil Nadu has 40.2% of obese women of age 15 years and above and BMI>25	► Women in Tamil Nadu have the highest CR (15.7) among all KS for ovarian cancer, 3rd highest CR (28.6) among all KS for cervical cancer and highest CR (83.6) among all KS for breast cancer

Risk Factor	Trends in Key states/Union Territory (KS/UT)	Potential effect in disease burden in the state/UT
Air Pollution Standard of $PM_{2.5}$ satisfactory air quality Index - <60µg/m^3 Risk factor for: ► Lung cancer	West Bengal: West Bengal had a $PM_{2.5}$ concentration of 78.2µg/m^3	► Men in West Bengal have the 2nd highest CR (22.4) among all KS for lung cancers
Working women National average – 25.2% Risk factor for: ► Breast cancer	Tamil Nadu: Proportion of employed women in Tamil Nadu is 37%	► Women in Tamil Nadu have the highest CR (83.6) among all KS for Breast cancer
	Karnataka: Proportion of employed women in Karnataka is 35%	► Women in Karnataka have the 4th highest CR (66.8) among all KS for Breast cancer

A comparative trend in key risk factors across states highlight that most risk factors are demonstrating a worsening trend across states highlighting the need for strong intervention at a policy level to encourage population to adopt more health appropriate behavior.

> In India, non-communicable diseases are growing and so are incidences of cancer. Many such occurrences could be attributed to lifestyle disorders and established risk factors. Targeted measures on prevention of cancer and its early diagnosis could substantially curtail the growing disease burden in our country. It must start with collective efforts on building awareness for early warning signs and symptoms. Followed by population-based screening programs and cancer registries for early diagnosis and appropriate interventions. Improving cancer care affordability, accessibility and research capabilities would enable improved outcomes. Making cancer, a notifiable disease across India would ascertain its actual prevalence; establish comprehensive cancer registries and enable targeted interventions.

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MD, Group Head – Medical Strategy and Operations Group, Fortis Healthcare Limited

Table 9: Comparison of various risk factors metrics by key states

State/UT	% household population > 15yrs of age using tobacco (2019-21)		% household population > 15yrs of age drinking alcohol (2019-21)		% of population >15yrs with BMI>25 (Overweight/ Obese)		$PM_{2.5}$ (Measure for air quality[1]) 2019	% of women currently employed	Mean age of marriage for women
	Women	Men	Women	Men	Women	Men	(µg/m3)		
India	9%	38%	1% ↓	22% ↓	24% ↑	23% ↑	83.2 ↑	25% ↑	22.1 ↑
Delhi	2%	26%	1% ↑	28% ↑	41% ↑	38% ↑	86.7 ↑	23% ↑	23.7 ↑
Punjab	0.4%	13%	0.1% ↓	28% ↓	41% ↑	32% ↑	73.4 ↑	22% ↑	23.5 ↑
Madhya Pradesh	10%	46%	0.4% ↓	20% ↓	17% ↑	16% ↑	60.3 ↑	28% ↓	21.4 ↑
West Bengal	11%	48%	1% ↓	26% ↓	23% ↑	16% ↑	78.2 ↑	19% ↓	21.2 ↑
Arunachal Pradesh	19%	50%	18% ↓	57% ↓	24% ↑	28% ↑	25.9 ↑	30% ↑	NA
Assam	22%	52%	6% ↓	27% ↓	15% ↑	16% ↑	48.4 ↑	18% ↑	22.3 ↑
Manipur	43%	58%	2% ↓	48% ↓	34% ↑	30% ↑	36.1 ↑	40% ↓	NA
Meghalaya	28%	58%	1% ↓	36% ↓	12% ↑	14% ↑	49.9 ↑	42% ↑	NA
Mizoram	62%	73%	1% ↓	30% ↓	24% ↑	32% ↑	42.3 ↑	25% ↓	NA
Nagaland	14%	48%	1% ↓	31% ↓	14% ↑	24% ↑	37.9 ↑	34% ↑	NA
Sikkim	12%	42%	15% ↓	36% ↓	35% ↑	36% ↑	29.4 ↑	31% ↑	NA
Tripura	51%	57%	4% ↓	36% ↓	22% ↑	24% ↑	48.6 ↓	22% ↑	NA
Gujarat	9%	41%	0.1% ↓	6% ↓	23% ↑	33% ↑	63.4 ↑	33% ↑	22.5 ↑
Maharashtra	11%	34%	0.2% ↓	17% ↓	24% ↑	20% ↑	58.1 ↑	37% ↑	22.5 ↑
Karnataka	9%	27%	0.3% ↓	23% ↓	30% ↑	45% ↑	51.3 ↑	35% ↑	22.3 ↑
Kerala	2%	17%	0.3% ↓	26% ↓	38% ↑	31% ↑	51.1 ↑	23% ↑	23.2 ↑
Tamil Nadu	5%	20%	0.1% ↓	33% ↓	41% ↑	41% ↑	47.2 ↑	37% ↑	23.0 ↑

[1]< 30 ug/m^3 – good AQI, >30 ug/m^3 and <60ug/m^3 – satisfactory AQI, >60ug/m^3 – Poor AQI

Source: Use of Tobacco, use of alcohol, obesity, currently employed and mean age of marriage from NFHS 5 (2019-2021) & NFHS 4 (2015-2016)

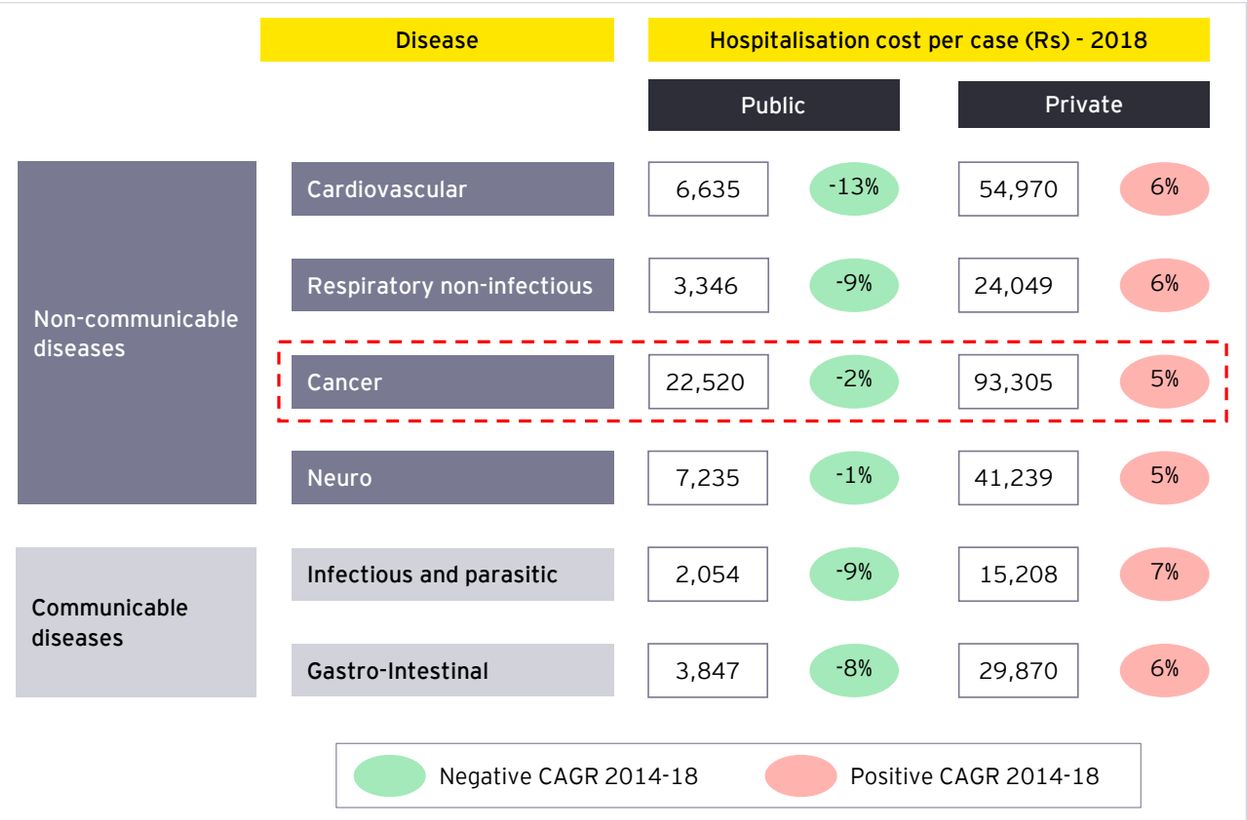
Financial burden for cancer treatment is highest compared to all diseases, making it unaffordable for >80% of population; Cost of single hospitalization for cancer care is 3x of any other NCD

As the contribution of cancers to death and hospitalization in India continues to grow at an alarming rate, it is a ticking time bomb that is increasingly affecting not just the health but the economy of the country as well.

The high cost of cancer care (the highest among all NCD disease types) along with usually lengthy treatment which results in loss of income, quickly drains household resources and forces population into poverty.

In 2018, the average cost of single hospitalization for cancer was Rs 22,520 in public hospital and Rs 93,305 in private hospitals, which was significantly higher than all other NCDs and communicable diseases. Further, the cost of hospitalization in private hospitals has shown an increasing trend at 5% CAGR since 2014, similar to other NCDs.

Chart 6: Hospitalization cost for key non-communicable and communicable diseases across public and private facilities in 2018.



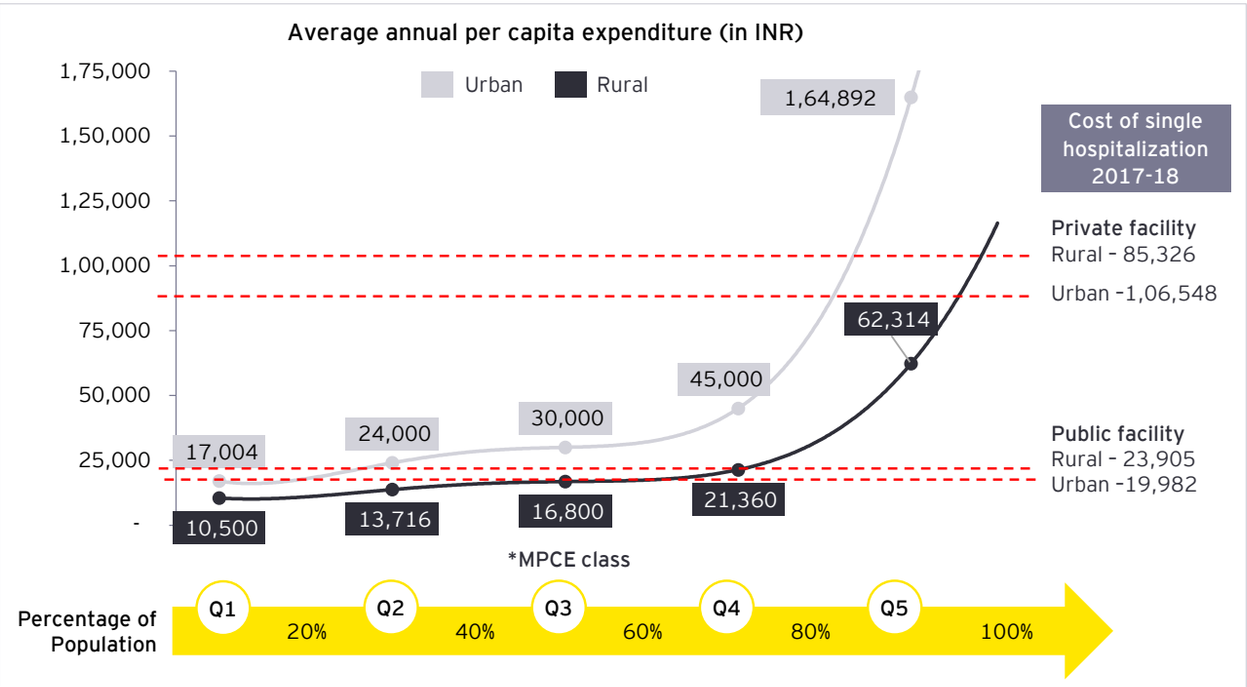
Source: NSS 75

Cancer treatment remains unaffordable for the majority of quintile 1 and 2 population as their annual per capita expenditure is lower than even the public cost of single hospitalization.

For rural sections, the cost of single hospitalization in a public hospital is higher than average household expenditure for ~80% of the population.

Single cost of hospitalization at private hospitals is around four times compared to hospitalization at a public hospital, which makes it unaffordable for any section of rural population and affordable only for the last quintile of urban population.

Chart 7: Affordability of cancer care by quintile populations in rural & urban areas across public and private facilities



Source: NSS 75, NSS 72

* Quintile class of Monthly Per Capita Expenditure (MPCE) refers to the 5 quintile classes of the rural/Urban all-India distribution (estimated distribution) of population by UMPCE.

Some key facts in India demonstrating high cost of cancer care in comparison to other NCDs are as follows:

- Mean out of pocket expenditure (OOPE) for cancer hospitalization is ~**three times** the mean OOPE of all NCDs.
- Cancer has contributed to **70.3%** in overall cases of NCD related catastrophic health expenditure (CHE). CHE for a household is when the household spends on health amount which exceeds household consumption expenditure by 10%.

Table 10: Mean OOPE and CHE for NCDs and cancer (the values in the above table for all NCDs is calculated basis overall hospitalizations due to NCDs in 2017)

Disease	Mean OOPE (In Rs.)	% of household with CHE
All NCDs	21,131	47%
Cancer	**61,299**	**33%**

Source: Geetha R Menon et al, Burden of non-communicable diseases and its associated economic costs in India, 2020, NCRP 2020, EY Analysis

While the cost of cancer treatment is on the rise, it is expected that cancer incidence will demonstrate double digit growth over the next 10 years driven by worsening of risk factors and improvement in timely diagnosis and detection

The reported cancer incidence in 2030 is expected to increase to 253 to 277 per lakh population, representing a high CAGR of 9 to10% over the next 10 years expected to be driven by improvement in screening and diagnosis of cancers of certain organs such as breast, cervix and head and neck in line with developed countries such as the US and the UK.

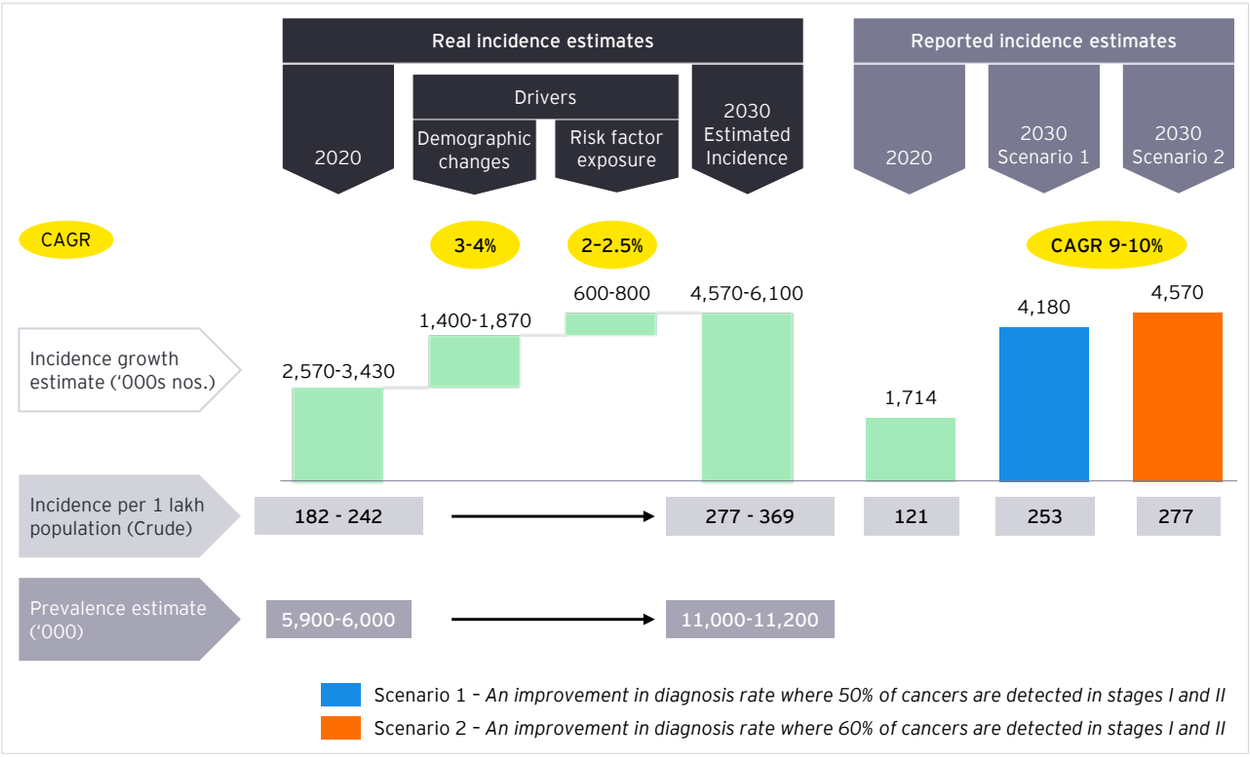
- Scenario 1: If 50% cases are detected at stage 1 and 2, then there would be 42 lakhs incidences in 2030

- Scenario 2: With a further improvement in detection rate to 60%, reported incidence is estimated to be around 46 lakhs in 2030

Prevalence of all types of cancers for the year 2020 is estimated to be around 59-60 lakh cases. With real incidence of cancer estimated to grow at a CAGR of 5-6%, cancer prevalence in the year 2030 is expected to reach 1.1 crores.

- Demographic changes, including an increasing proportion of aged population, are estimated to contribute at 3 to 4% CAGR to the increase in overall real incidence during 2020 to 2030
- Risk factor exposures are estimated to contribute at 2 to 2.5% CAGR to the increase in overall real incidence during 2020 to 2030

Chart 8: Projections of overall real incidence across two scenarios during 2020-30



Note: Refer <Annexure 3> for framework for projection of overall crude incidence adjusting for demographic and risk factor exposures and prevalence

High burden of cancer incidence in India is accompanied by a high economic burden on account of productivity losses and premature mortality

When individuals exit the workforce temporarily or permanently due to cancer, this represents loss of productivity for the society. Understanding of economic burden of cancer in the form of productivity losses can provide a valuable context to inform population-based resource allocation decisions for cancer prevention and control.

Based on reported cancer incidence and mortality across age groups and years of potential productive life lost (YPPLL) due to the same, the economic burden in terms of GDP losses is estimated in the range of US$ 11 B. (0.4% of national GDP) in 2020.

The same is projected to increase to US$ 36-40 B by 2030, driven by projected increase in mortality (considering increasing cancer incidence partly offset by an improvement in mortality to incidence ratio), improvement in life expectancy and increase in GDP per capita.

Chart 9: Calculation of estimated economic burden

		2020	CAGR	2030
Reported Incidence	'000s nos.	1,714	9-10%	4,180-4,570
✖				
M/I ratio	% of incidence	43%	-5.4%	25%
=				
Mortality	'000s nos.	738	3-4%	1,027-1,125
Life expectancy	Years	70	0.4%	73
YPPLL	Years	5,814	4.4%	8,956
✖				
GDP per capita	INR 000 p.a.	142	8%	307
=				
Economic burden	US$ billion	US$11b	13-14%	US$36-40b

Source: Pearce et al. BMC Cancer (2016), Estimation of economic burden of COVID-19 using DALYs and Productivity Losses in Kerala state, India, RBI estimates, Worldbank.org, UN.org, IARC (WHO)

Notes:

1. A study published in 2018 on productivity losses due to premature mortality from cancer in Brazil, Russia, India, China, and South Africa (BRICS countries) estimated combined annual losses of US$46.3B. in 2012, which was 0.33% of combined GDP of these countries.
2. Studies on productivity losses as a % of GDP due to premature cancer-related mortality in US and Europe estimated the same to be 0.7% (2020) and 0.6% (2008) of GDP, respectively.

2 | Maturity of India's cancer control

Chapter 2: Maturity of India's cancer control landscape

Chapter 2A: Awareness and Prevention

The adage 'prevention is better than cure' holds unequivocally true in the context of cancer. Given the nature of the disease as a harbinger of severe social, financial, physical, emotional, and psychological distress which impacts not just an individual but the entire family, it is crucial that the society, governments, and the healthcare ecosystem prioritizes cancer prevention and early diagnosis.

As per the 2020 WHO report on cancer, approximately one-third to one-half of all cancers are preventable globally. Primary prevention involves interventions that minimize exposure to carcinogens such as tobacco cessation, limiting alcohol consumption, maintaining a healthy diet, increased physical activity, reduced exposure to radiation and HPV vaccination. Secondary prevention involves screening techniques which can detect cancer before the appearance of symptoms such as pap smear, mammography, colonoscopy, etc.

Awareness often precedes prevention since it seeks to educate and inform people about topics which are hitherto unknown to them by imparting knowledge, influencing attitudes or beliefs, and shaping healthy practices or behavior. Modification of existing behaviors is an important aspect of prevention, which is achievable only by raising adequate awareness among the public.

While there have been many technological and medical advancements in cancer treatment transforming it from a 'fatal' to a 'curable' disease, the journey from diagnosis to treatment is a long and arduous process that affects quality of life. Also, in a developing nation like ours, equitable distribution of advanced treatment modalities is a complex challenge given the high socio-economic disparity on the demand side and resource limitations in terms of healthcare financing and trained medical professionals on the supply side.

Early investments in cancer awareness and prevention therefore seem to be a cost-effective measure to help achieve reduced cancer incidence in the long run.

An integrated approach to cancer management will always include prevention strategies. Increased awareness will lead to more cases being diagnosed at early stages, which will in turn necessitate increased capacity for treatment. Prevention also calls for a multi-stakeholder approach involving governments, healthcare workers, NGOs, community support groups and most importantly the public who need to engage in healthy behaviors for their own wellbeing.

One cannot help but draw parallels with the recent COVID-19 pandemic when it comes to awareness and prevention of cancer. Notwithstanding the obvious differences in nature of both diseases with COVID-19 being highly communicable and spreading rapidly while cancer being non-communicable where symptoms take time to manifest, the governments across the world can replicate similar coordinated response strategies for cancer as implemented for COVID-19. Cancer is by all means an impending pandemic likely to explode. Starting with robust data capture of testing and cases, raising awareness among people to make them engage in healthy behaviors like washing hands, practicing social distancing and wearing masks, conducting mass vaccination drives as well as development of indigenous vaccines — all of these initiatives are highly relevant even in the context of cancer awareness and prevention. While COVID-19 was an unprecedented event that took the world by storm, cancer is still a known devil and with the lessons learned from COVID-19 management, government and society should now proactively plan and act toward cancer prevention thereby building a healthy future for the nation.

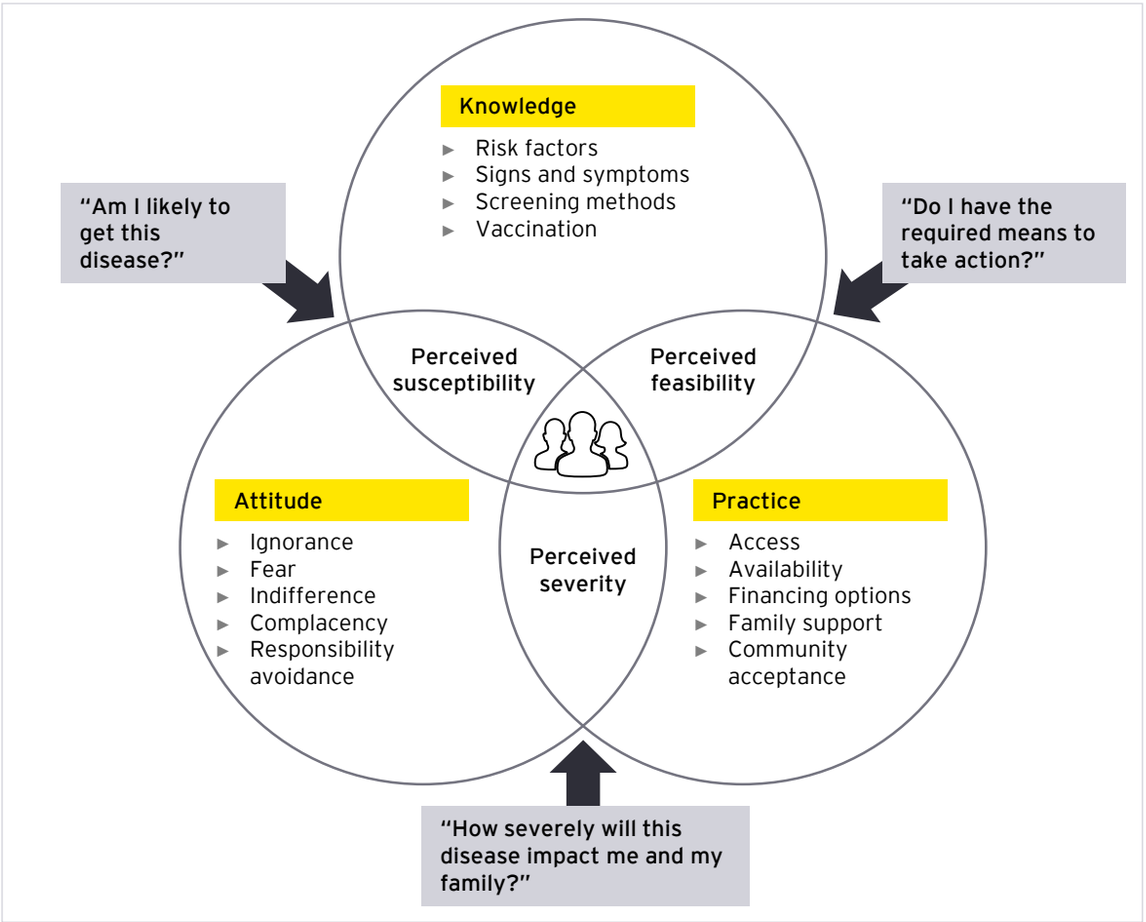
> Advanced cancer care begins with creating increased awareness, early diagnosis and an emphasis on preventive healthcare. That brings into play, among other things, predictive and personalized health checks, genomics, and integrated technology. Alongside, we need to also address the issue of affordability and access to treatment and ensure that all stakeholders of the healthcare ecosystem - hospitals, pharmaceutical companies, insurance providers, technology services and homecare work collaboratively to ensure this.

Dilip Jose
Managing Director and CEO, Manipal Health Enterprises Private Limited

Awareness

Questionnaire-based surveys covering three key elements – Knowledge, Attitude, and Practice (KAP)– can typically measure awareness in the healthcare context. A modified framework based on KAP theory[6] in the context of cancer awareness is illustrated below.

Figure 2: Modified framework based on KAP theory in the context of cancer awareness



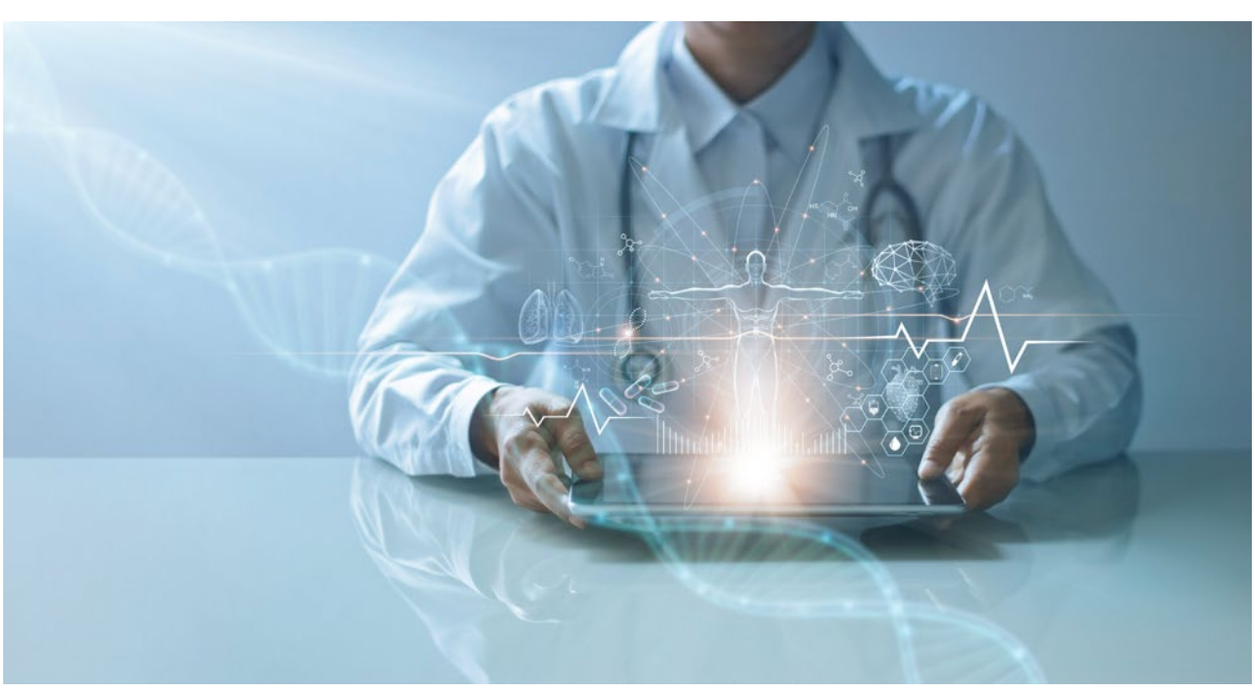
[6] Roelens, Kristien & Verstraelen, Hans & van Egmond, Kathia & Temmerman, Marleen. (2006). A knowledge, attitudes, and practice survey among obstetrician-gynaecologists on intimate partner violence in Flanders, Belgium. BMC public health. 6. 238. 10.1186/1471-2458-6-238.

An effective awareness intervention should prompt the target individual to seek more information or *knowledge*, question existing beliefs or *attitudes,* and think about how to overcome barriers to *practice* healthy behavior. Once there is enough conviction about *susceptibility* to the disease, the *severity* or impact should they contract the disease, and *feasibility* of the action needed, there may be a favorable shift toward healthy behaviors.

The subsequent section attempts to derive qualitative insights from various awareness surveys across the three elements of Knowledge, Attitude and Practice (KAP) as per above framework. This is followed by exploration of reasons and implications pertaining to the particular insight.

Over the years, researchers in India have conducted several localized surveys for awareness of common cancers, out of which 20 surveys have been studied for this report.[7] For a global perspective, the report also considers insights from the International Public Opinion Survey on Cancer 2020 led by the Union for International Cancer Control (UICC). Additionally, as part of research for this paper, EY conducted an online survey among its professionals with over 1000 respondents to get a perspective on awareness among today's urban workforce. Going forward, the report refers to them as 'localized surveys', 'global survey' and 'professional's survey'.

> The Indian Council of Medical Research (ICMR) predicts a 12% increase in cancer diagnosis in India over the next five years. The most common forms of cancer are breast cancer, cervical cancer, and oral cancer. Despite enhanced medical research and progressive transformation in this field, we need to strengthen initiatives that improve access to high-quality care, including screening, early detection, treatment, and cancer care continuum. Increasing awareness, extending holistic knowledge, and promoting a healthy lifestyle can contribute to the fight against cancer.
>
> **Anurag Yadav**
> CEO, IHH Healthcare India



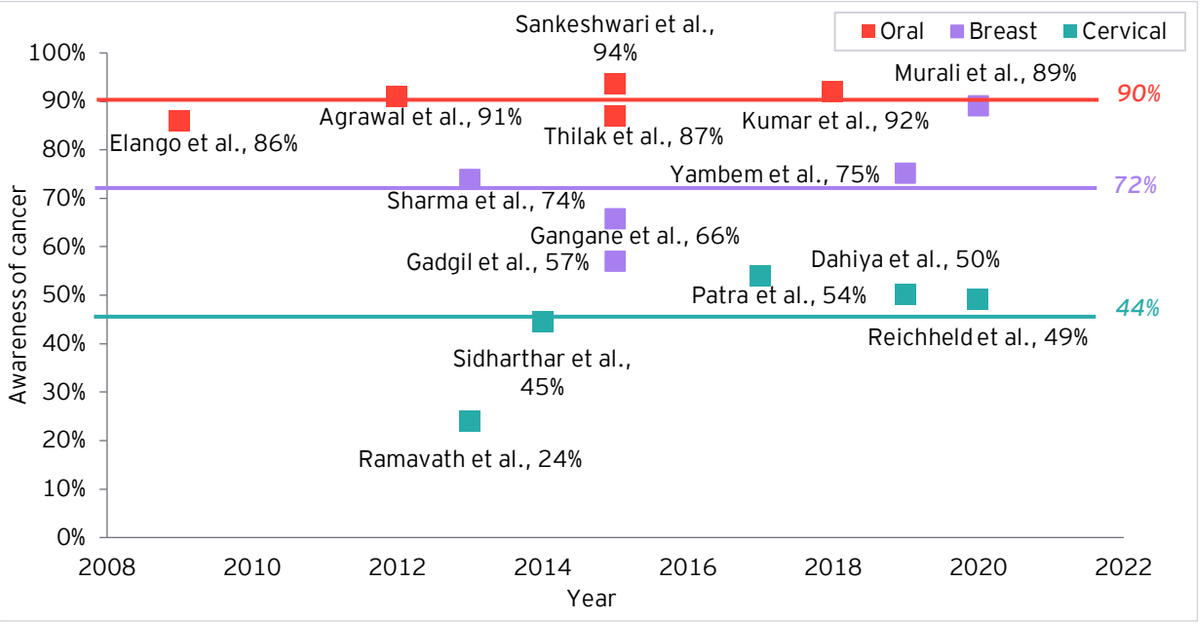
[7] Refer Annexure for list of localized surveys

Knowledge

Tobacco and tobacco-related cancers dominate the awareness landscape in India. Knowledge of other common cancers such as cervical is low. Recognition of non-tobacco risk factors, such as exposure to harmful UV radiation, is weak.

- Compilation of responses from localized surveys to the basic question '*Are you aware of this cancer*?' indicated that less than half the respondents were aware of cervical cancer

Chart 10: Compilation of responses from localized surveys to the question 'Are you aware of this cancer?'



Greater awareness of oral cancer is partly attributed to the role of government and media in transmitting information on harmful effects of tobacco through warning labels on packaging and advertising campaigns. Government guidelines for warning signs on tobacco packaging have evolved from a subtle scorpion sign to graphic imagery of mouth cancer with unambiguous messaging of 'Tobacco causes painful death'. Graphic advertisements narrating cancer patient stories such as the 'Mukesh' campaign, which was run before every movie, also relayed information about ill effects of tobacco. Such campaigns, however, run the risk of desensitizing the target audience while being aired repeatedly which led to various memes on social media featuring Mukesh.

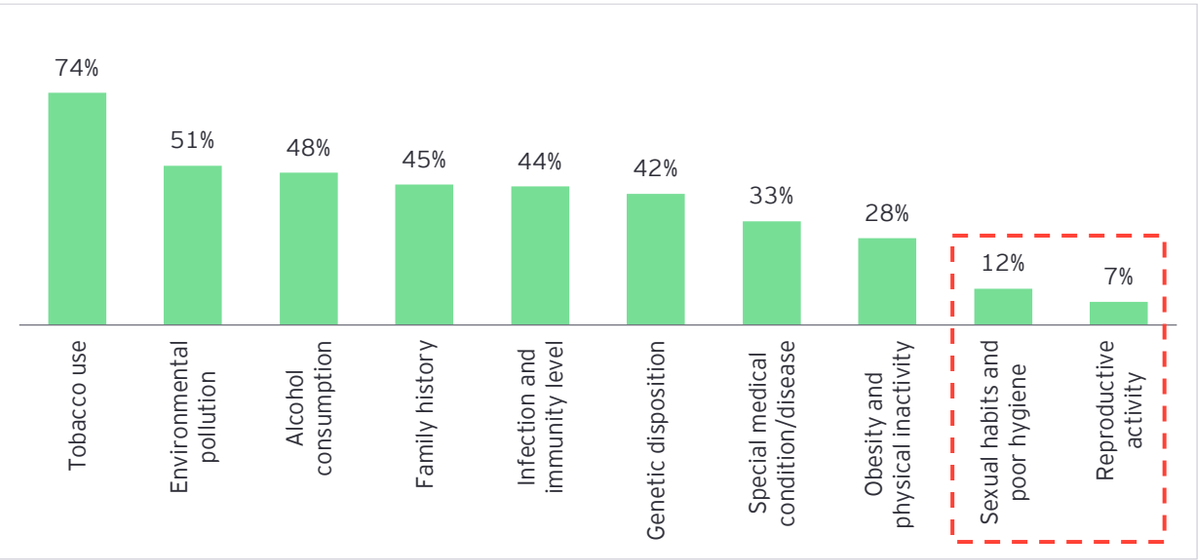
Social media campaigns popularizing cancer awareness events have led to a natural association of the 'pink ribbon' with breast cancer in the minds of people. Rising incidence of breast cancer in urban cities has led to a powerful community of women survivors actively sharing their experiences on social media which in turn encourages more women to get screened.

Given its popularity as the most common information source, it is crucial that media engage in responsible content generation. While the government has been regulating media through mandatory warnings on smoking scenes in films and banning direct advertisements for cigarettes and tobacco-based products, surrogate advertising is still widely prevalent with top celebrities endorsing mouth fresheners, 'elaichi' and paan masala brands which have same brand names and similar packaging as their company's tobacco products. The proposed Cigarettes and Other Tobacco Products Act (COTPA)[8] amendment bill seeks to implement stronger measures to ban all forms of indirect advertising.

[8] Ministry of Health and Family Welfare website https://main.mohfw.gov.in

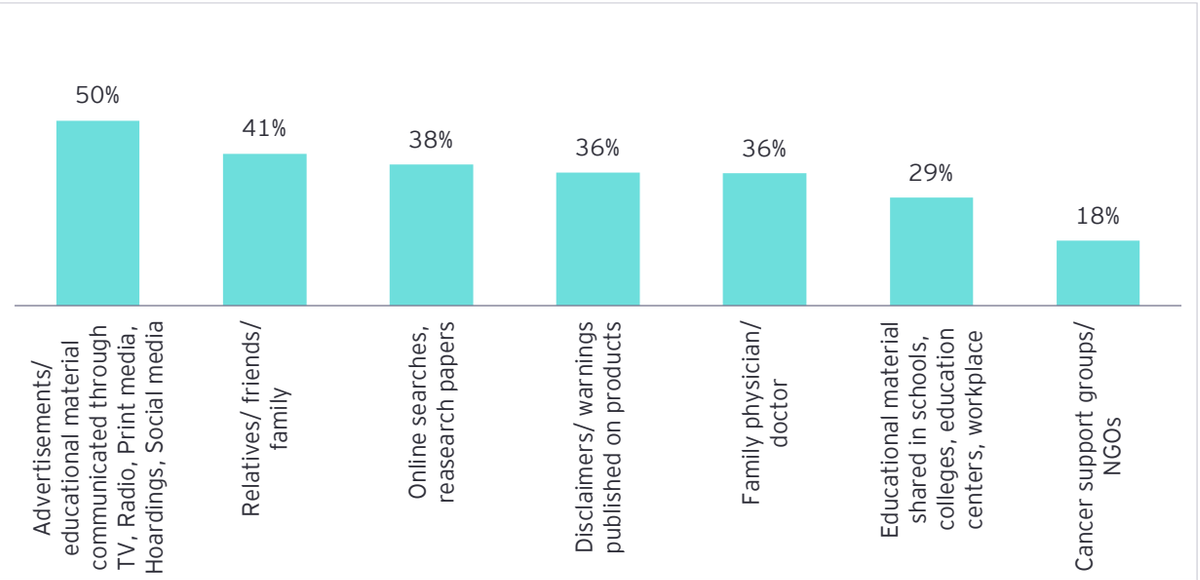
The lack of coverage in popular media can partially explain lower levels of awareness of cervical cancer. It also has some level of stigma surrounding it since the culture of India does not encourage open conversations about sexual practices. The professional survey also reflects a similar situation, where very few respondents identified sexual habits and reproductive activities as a risk factor (indicated in the chart below). In such a scenario, family physicians, primary healthcare workers, local GPs, RMOs can educate their patients about the importance of genital and menstrual hygiene, sexual practices, encouraging open conversations about stigmatized cancers such as cervical.

Chart 11: Respondents who recognized the risk factor among their top 5 choices



The following chart indicates responses from the professional's survey and illustrates how online search is also a popular source of information in urban areas alongside relatives, friends, and family.

Chart 12: Respondents who indicated the source as one from which they obtained information on cancer risk factors



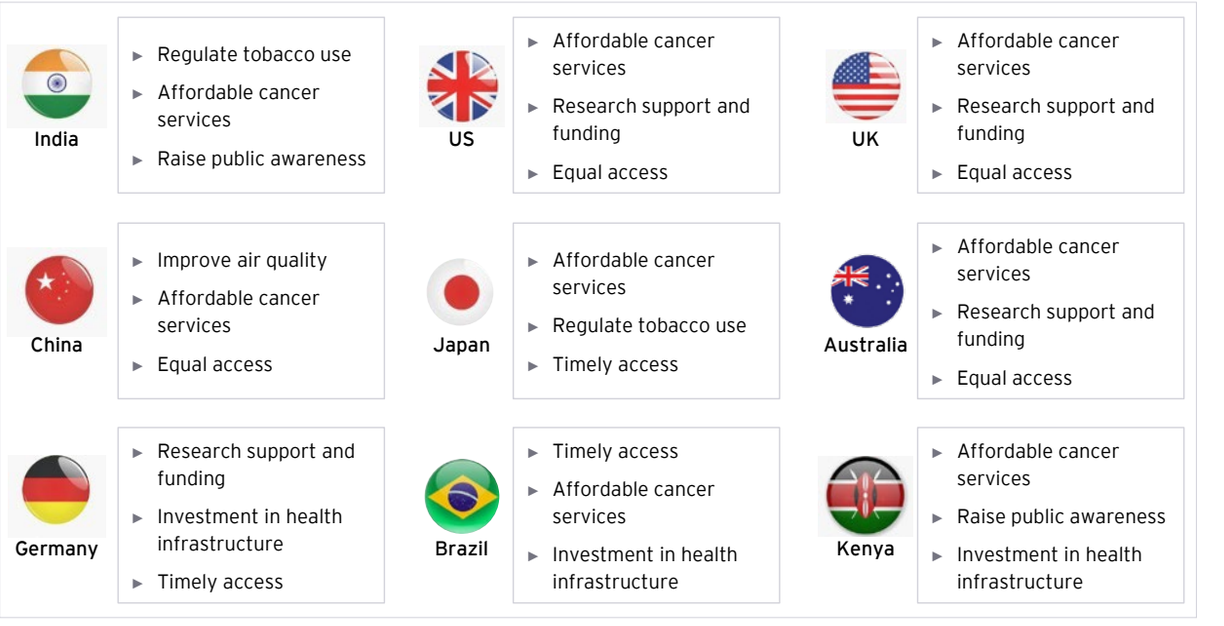
In disadvantaged groups with low education and income levels, online searches may not be a popular source due to access limitations. In such cases, leveraging the right channel of

communication to ensure reach through local newspapers, radio advertisements, local cable network, posters and banners in post offices and banks, involving village panchayat, religious or political leaders, local celebrity influencers, becomes extremely important in creating awareness.

- In the UICC global survey, danger posed by exposure to UV rays was the second most globally recognized risk factor after tobacco. However, in India, fewer than half identified it as a risk factor.

In the same global survey, when asked about what according to them should their government be doing to prevent cancer, Indians believed that regulating tobacco usage should be the top priority. Most other countries seem to have moved on from tobacco and indicated access and research funding as key expectations from their governments.

Figure 3: People's views on the most important government actions by country



At present, tobacco dominates cancer awareness in India, efforts need to be undertaken to raise awareness about non-tobacco risk factors such as alcohol, obesity, and environmental carcinogens. Given that some of these risk factors like obesity are also causes of other NCDs like diabetes and cardiovascular diseases, it is important to focus on educating people about its harmful effects for overall well-being of the nation.

Attitude

Fewer people in India seemed to be concerned about cancer compared to other countries, implying a general attitude of indifference towards cancer

- The UICC global survey indicated that only 43% of respondents in India indicated that they were very concerned or somewhat concerned about developing cancer in their lifetime, which was lower than the average of 58% globally.

Kenya represented the highest levels of concern for cancer, with 82% respondents indicating that they were worried about cancer. Cancer as a subject has drawn severe public ire due to a high number of deaths in Kenya. Media coverage of cancer related news stories also led to widespread awareness. In 2019, Kenyans spearheaded protests to call on the government to declare cancer a national emergency after three prominent public figures succumbed to the disease. The Government of Kenya in 2020 announced a new program to vaccinate every girl who reaches 10 years of age against HPV. This serves as an interesting case study to illustrate how a strong public voice is a powerful means for enforcing governments to act.

- Society and family, which propagates a certain manner of thinking in individuals, often shape attitudes and beliefs at an early age. For example, cultural association with certain carcinogens like use of areca nut in several religious and social customs in India, which is a known risk factor for oral cancer, could impede its recognition as a harmful substance. The belief that these customs have been prevalent for ages and there has not been any adversity in the family often discourages people from modifying their behaviors. Similarly, improper methods used in preservation of processed meat through curing and smoking is seen as one of the reasons for the high incidence of stomach cancer in North-East India. Therefore, targeted campaigns focused on regions or cultures where a specific custom or practice is linked to cancer, such as educating about harmful effects of areca nut and improper meat preservation techniques, can help modifying long rooted existing behaviors.

  Leveraging big data to identify 'at risk' population for specific cancers can drive targeted screening initiatives. The parliamentary standing committee on health and family welfare has recently submitted a report on cancer to Rajya Sabha[9], wherein the committee has highlighted the importance of collecting data by setting up population-based cancer registries in under-represented areas to and integrating this data with real time health information. Such data can be used to identify incidence patterns to drive targeted prevention initiatives. For patterns which are already available, such as the high incidence of GI cancers in North-East India mentioned earlier, focused investments around screening can help in early detection.

- Health promotion and education in schools to shape young minds could be one of the ways to build positive health attitudes. This could also lead to children becoming effective 'change agents' for the society. Large number of school children in Delhi participating in awareness drives about air pollution is an example that illustrates this concept.

- Targeted campaigns in colleges such as education about harmful effects of tobacco, importance of safe sex, genital and menstrual hygiene, sanitation can also help shape positive attitudes of the youth when they are at their most vulnerable to prevent indulgence in unhealthy behaviors.

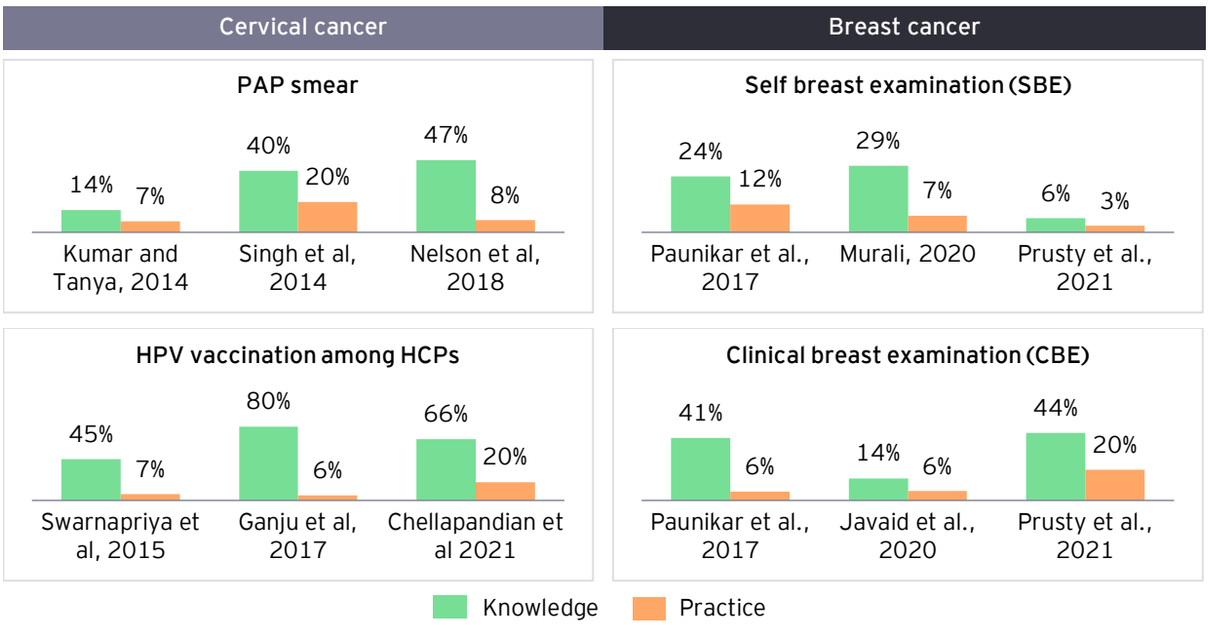
Practice

Uptake of screening for breast and cervical cancer and HPV vaccination is low despite fair awareness and a positive attitude. Tobacco continues to be one of the leading causes of cancer despite awareness levels being high.

- Compilation of responses from localized surveys indicates a gap between the number of people who have knowledge of screening techniques and those who undergo screening as indicated in the chart below

[9] Department-related parliamentary standing committee on health and family welfare, 139th report on Cancer care plan & management: prevention, diagnosis, research & affordability of cancer treatment

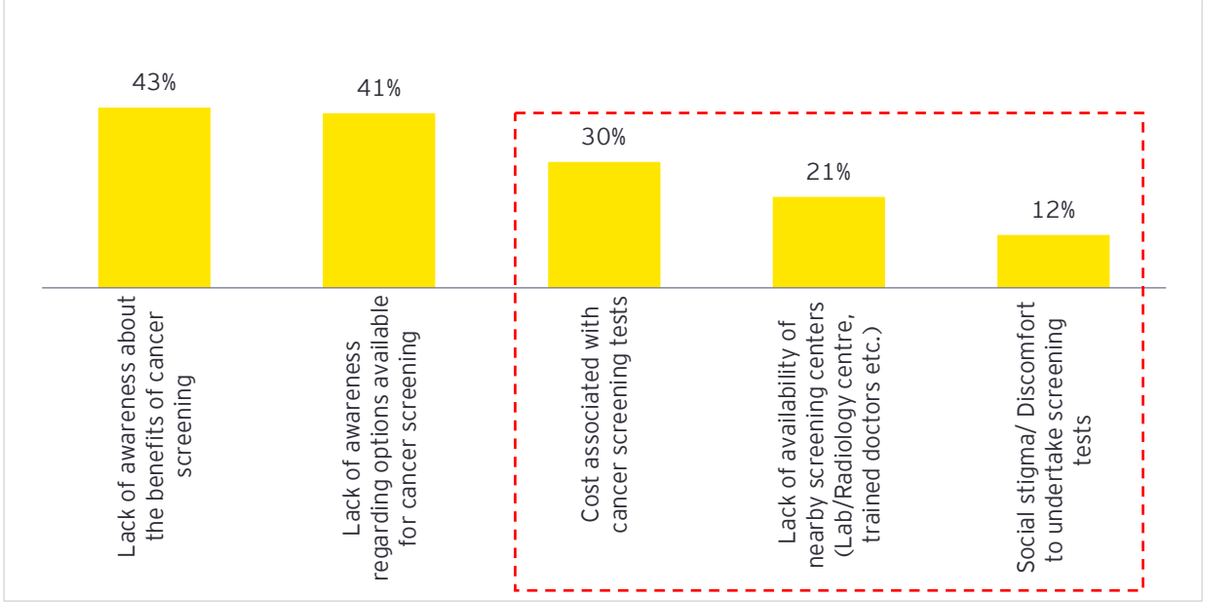
Chart 13: Responses from localized surveys indicating a gap between the number of people who have knowledge of screening techniques and those who undergo screening



Data capture and management are essential to ensure awareness initiatives are being tied to practice outcomes. The government should institute a structured referral mechanism for directing positive screened cases toward district hospitals or other tertiary care centers for treatment. Currently, the cancer registry only captures incidence data basis confirmed diagnosis. With the introduction of unique health ID or ABHA number, well-integrated systems can enable linking of screening data to overall personal health records of an individual.

- The following chart provides common reasons cited for not undertaking periodic screening tests for cancer detection in the professional's survey. Besides lack of awareness, respondents have also highlighted affordability, access, and social stigma as barriers to screening.

Chart 14: Respondents indicated below reasons for not undertaking periodic screening tests for cancer detection



These challenges are perhaps more prominent in rural areas and villages, where traveling to a center in the city for screening or accompanying their child for vaccination implies losing their livelihood for the day which seems excessive for someone who is asymptomatic and dealing with more acute day-to-day problems. Also, given the strong patriarchal social structures in some communities where the male head of the family makes decisions, obtaining permission to undergo screening for breast or cervical cancer is not an option that many women choose to exercise.

While society largely perceives cancer care as a tertiary care intervention with specialized oncologists and treatment being delivered in hospitals with state-of-the-art technology, it is predominantly primary healthcare which drives awareness and screening. Training of frontline ASHA workers to deliver services like family health counseling along with screening and vaccination is therefore critical for uptake in practice.

- Availability of facility and reputation among population largely influences the awareness of centers for cancer treatment in the state.[10] For example, cities with a reputed cancer center such as PGI in Chandigarh, Regional Cancer Centre in Trivandrum see a greater number of people opting for public hospitals for cancer treatment. When it comes to awareness of financing options, the major source of expenditure is either family savings or borrowings[11]. This reflects low awareness of schemes and cancer insurance, which is driven by low penetration. With the inclusion of cancer treatment packages under Ayushman Bharat, this might change with a greater number of people opting for schemes.

  Despite high awareness levels, tobacco usage continues to be highly prevalent in India. While practice through lifestyle changes has fewer external barriers compared to screening, an individual requires self-motivation and support from family and friends to modify existing behaviors and perceptions. For example, the association of smoking with being 'cool' especially among urban youth and 'smoke breaks' being a popular means for employee bonding in corporate cultures may discourage people from giving it up, fearing non-acceptance by peers. Despite there being a ban on smoking in public places, several workplaces, airports, restaurants have designated smoking zones. The proposed Cigarettes and Other Tobacco Products Act (COTPA) amendment bill seeks to ban these designated smoking areas to curb public smoking in its entirety.

Examples of awareness initiatives

- The National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Disease and Stroke (NPCDCS) covers awareness initiatives taken by the Government of India. The NPCDCS organizes media campaigns such as National Cancer Awareness Day, World Diabetes Day etc., for raising awareness on risk factors, prevention, management of NCDs and promotion of healthy lifestyle through use of print, electronic and social media for continued community awareness. Under the program, NCD Clinics are also being set up to provide services for common NCDs, including screening for common cancers such as oral, breast and cervical. The Indian Council of Medical Research (ICMR) has designed a web portal to disseminate information on prevalent cancers to the general public.[12]
- Non-government stakeholders such as private healthcare providers, community support groups and startups can also play a role in raising cancer awareness. Examples of some such initiatives being undertaken in India are:
  - Fortis Healthcare organizes various activities and camps with the public for cancer awareness. Fortis hosted the Pink

[10] Raj S, Piang LK, Nair KS, Tiwari VK, Kaur H, Singh B. Awareness regarding risk factors, symptoms and treatment facilities for cancer in selected states of India. Asian Pac J Cancer Prev. 2012;13(8):4057-62. doi: 10.7314/apjcp.2012.13.8.4057. PMID: 23098516.

[11] Nair, Kesavan & Raj T.P, Sherin & Tiwari, Vijay & Piang, Lam. (2013). Cost of Treatment for Cancer: Experiences of Patients in Public Hospitals in India. Asian Pacific journal of cancer prevention: APJCP. 14. 5049-54. 10.7314/APJCP.2013.14.9.5049

[12] https://www.icmr.gov.in/pdf/press_realease_files/Newsletter_English_March_2022.pdf

Walkathon– a 4 km walk for cancer survivors, RWAs and schoolgirls for breast cancer awareness. Other initiatives include organizing pink and purple runs, free cancer screening camps at various locations. The Department of Haematology, Haemato-Oncology and Bone Marrow Transplant at Fortis Memorial Research Institute regularly does blood screening camps for early detection of cancers.

- CAPED[13] – Cancer Awareness, Prevention and Early Detection is a registered trust which specifically focuses on raising cancer awareness and screening for female cancers in the Delhi NCR region. As per its website, CAPED has conducted awareness workshops in over 20 corporates, 26 educational institutions, and 6 townships across the region. It has also organized screening camps in villages across Gurgaon and rural Haryana as part of its 'Cancer Mukt Gurgaon' initiative.
- Onco.com[14] is an online platform that acts as a one-stop shop for people to access cancer information. The start-up also organizes events and campaigns to raise awareness of cancers. Individuals and families impacted by cancer diagnosis can also refer to the platform for planning out their treatment options, second opinion, financing options, etc.

Social media has emerged as a powerful platform, especially for breast cancer campaigns. Example of one such campaign by leading healthcare provider Acibadem in Turkey[15]:

"Prevention is better than cure" is an old adage. It applies very well to Cancer. As an NCD, the growth of cancer in India is a terrible tragedy and contributes to destitution, poverty, illness of not just the patient but an entire family. Whilst rapid strides have been made in detection and management of cancer, it still casts a massive burden on the society and the healthcare burden of our nation.

Timely detection through screening and education along with preventing the population from consumption of cancer causing agents such as tobacco and related products, vaccination against some cancers, is the way forward. Research in this field must continue to be supported and pollution of air and ingestibles related to cancer causing substances must be reduced.

Dr. Narottam Puri
Principal Advisor-QCI; Board Member & Former Chairman- NABH; Advisor- FICCI Health Services; Advisor- Medical Operations, Fortis Healthcare Ltd.

[13] CAPED website https://www.capedindia.org
[14] Onco,com website https://onco.com
[15] https://www.ihhhealthcare.com/newsroom/our-stories/power-of-pink

Acibadem Healthcare in Turkey, part of the IHH Healthcare group, ran a global 'Pink Scarf' campaign by enlisting key opinion leaders, NGOs, celebrities and social media influencers. The campaign uses a traveling 'pink scarf' as a motif with ambassadors across seven countries, including Russia, Romania, Serbia, Croatia, Kenya, Dubai and Jordan, taking turns to upload daily videos. Acibadem Healthcare also collaborated with an NGO to put together a gift box for actors, actresses, artists and sportswomen. The themed box contained a brochure that explained self-examination, a token gift for female health check-up, a mug and a "favor necklace" designed and created by famous journalist Ayşe Arman.

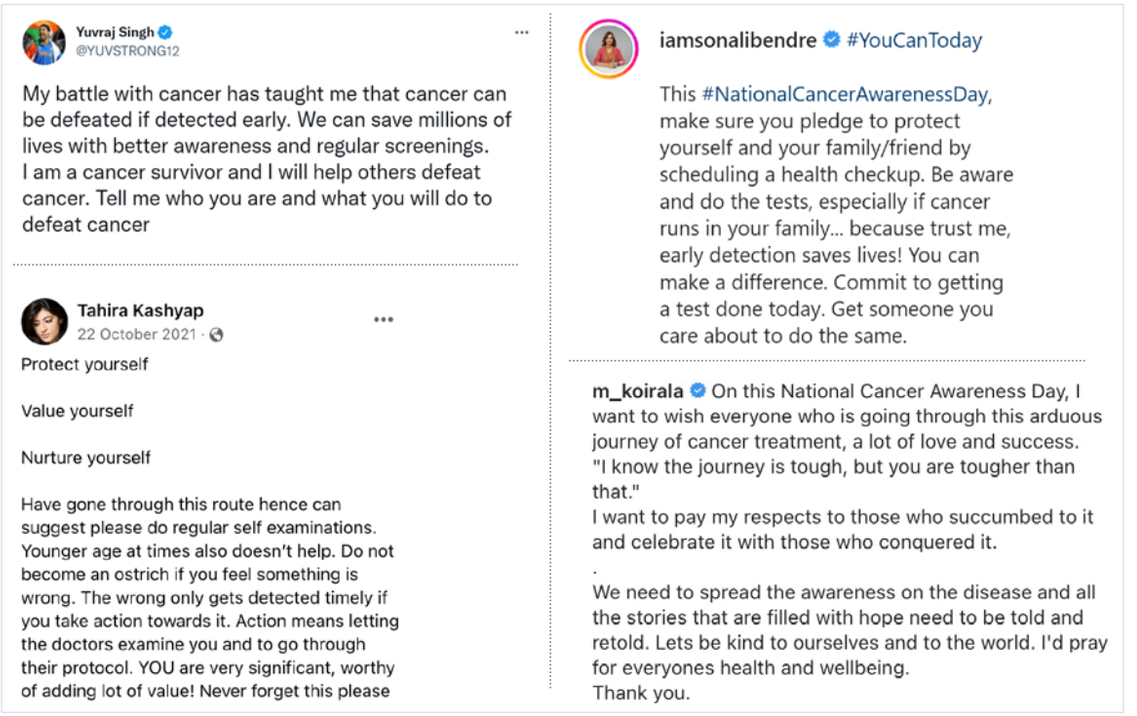
- Celebrity role-models can act as important influencers when it comes to raising awareness. Several instances have been seen globally when celebrity news of cancer diagnosis or their personal decisions on cancer treatment has led to an unprecedented increase in screening and referrals, some of which are[16]:
  - News story about Angelina Jolie's decision to have genetic testing for the BRCA1 gene broke in 2013 and she subsequently underwent risk reducing mastectomy (RRM). Data collected from 12 family history clinics and 9 regional genetics services in the UK showed a 2 to 2.5-fold increase in referrals, doubling of demand for BRCA1/2 testing and an increase in the number of enquiries for RRM in the immediate months following Jolie's media story.
  - Jade Goody, a reality star, was diagnosed and died of cervical cancer between mid-2008 and mid-2009. 4,00,000 extra women were screened for cervical cancer in England in the same period
  - American Journalist Katie Couric, who lost her husband to colorectal cancer and later co-founded an organization 'Stand Up to Cancer' which focuses on raising awareness and funding for cancer research. Couric famously underwent a colonoscopy on air in 2000, which increased the number of colonoscopies in the US from 15 to 18.1 per month.
  - News around Kylie Minogue's diagnosis led to 40% increase in breast screening in Australia
  - Nancy Reagan's decision not to have breast-conserving surgery in 1987 led to 25% increase in mastectomy for breast cancer

Closer home in India, the polio eradication program involving superstar Amitabh Bachchan as the face of the campaign was a huge success. His 'do boond zindagi ki' catchphrase, which resonates in every Indian's mind today, led to more mothers traveling to Pulse Polio camps in rural India to get their children vaccinated soon after the advertisement was aired. The government can evaluate similar campaigns involving influencers such as local and national celebrities, respected religious, political or community leaders, to spread cancer awareness. Posters and banners in public places like post offices or banks, advertisements

[16] Evans et al.: The Angelina Jolie effect: how high celebrity profile can have a major impact on provision of cancer related services. Breast Cancer Research 2014 16:442.

on local cable network are some of the ways to achieve the required reach in smaller towns and villages.

In a welcome recent trend, a number of celebrity cancer survivors in India have started sharing their cancer stories on social media urging people to undergo screening. These inspiring stories also influence attitudes of their social media followers who now perceive cancer as something that they can defeat, compared to few decades ago when cancer was depicted as the most powerful brand of death in mainstream media.



Prevention

As highlighted earlier, primary prevention involves limiting exposure to carcinogenic risk factors. Nature of intervention usually depends on type of risk factor and its associated burden.

Risk factors can be broadly categorized into behavioral (tobacco, alcohol, diet), infectious (HPV, hepatitis), environmental (UV rays, air pollution, occupational exposures) and others (genetic or hereditary, age, gender). Of these, modifiable risk factors, such as tobacco, alcohol, obesity, infectious and environmental are amenable to prevention. While hereditary causes of cancer are non-modifiable risk factors, the early diagnosis for the same is possible through genetic testing.

The measurement of associated burden of risk factor is possible through 'population attributable fraction (PAF)', which is the estimated proportional reduction in population disease or mortality that would occur if exposure to a risk factor were reduced to an alternative ideal exposure scenario[17].

The chart below plots the PAF[18] of these modifiable risk factors against the mortality[19] associated with the different cancers[20] that they lead to in order to identify various cancer prevention strategies.

[17] WHO Report on Cancer, 2020

[18] WHO Cancer Country Profile 2020 India

[19] Cancer Today (iarc.fr)

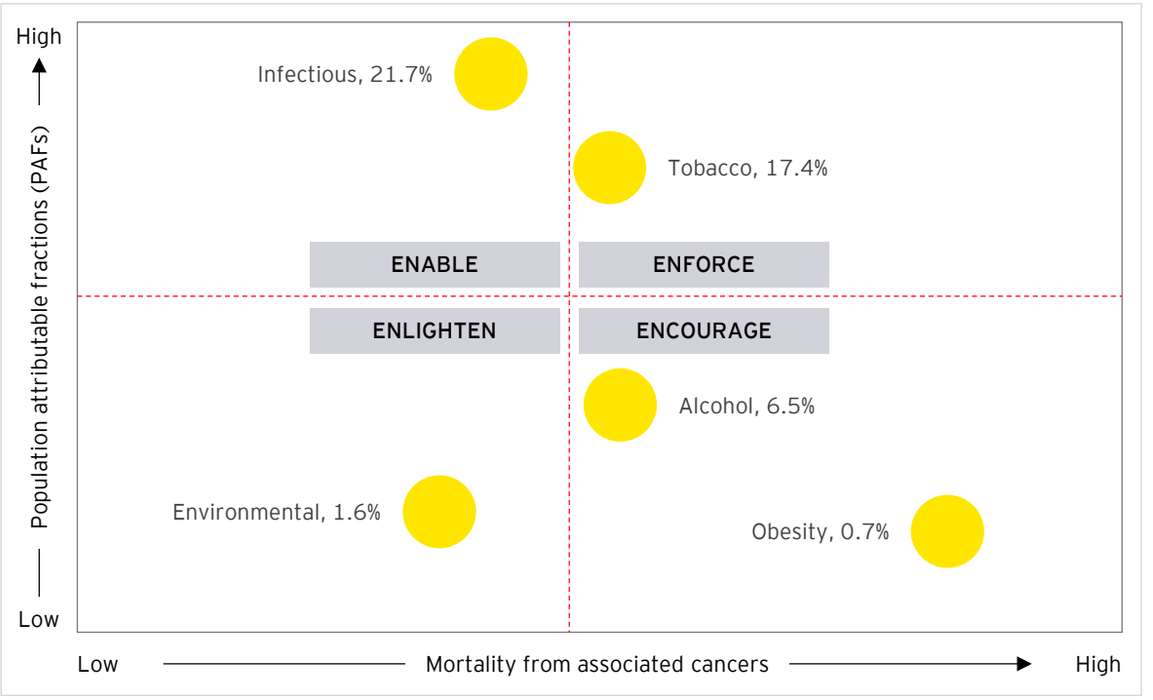
[20] https://ncdirindia.org

https://www.cancer.gov/about-cancer/causes-prevention/risk/alcohol

https://www.cancer.gov/about-cancer/causes-prevention/risk/obesity

Parsa N. Environmental factors inducing human cancers. Iran J Public Health. 2012;41(11):1-9. Epub 2012 Nov 1. PMID: 23304670; PMCID: PMC3521879.

Chart 15: PAFs of modifiable risk factors against the mortality associated with the different cancers



- **Enforce tobacco restrictions**: Tobacco is associated with a large number of cancers such as lip, tongue, mouth, oropharynx, larynx, esophagus, lung, urinary bladder, all of which together contribute to high mortality at present. Despite relatively high awareness compared to other risk factors, tobacco usage continues to be a major public health challenge in India, which faces the unique dual burden of smoke and smokeless tobacco. Prevention of tobacco therefore requires stringent 'enforcement' by the government through various measures such as taxation, curbs on public smoking and bans on indirect advertising.
- **Enable HPV screening and vaccination**: Infectious risk factor mainly include HPV causing cervical cancer, which is easily preventable through vaccination. There is a disproportionate burden of cervical cancer in developed and developing countries, mainly due to lack of screening and vaccination practices. Prevention of cervical cancer therefore requires 'enablement' by improving access to screening, making low-cost vaccines available and destigmatizing conversations around sexual health.
- **Encourage healthy behaviors**: Obesity is associated with several cancers such as breast, colorectal, esophagus, stomach, etc., which contribute to high incidence and mortality. However, the burden of risk from obesity is not as significant as tobacco or HPV. Obesity is a common risk factor for other NCDs such as diabetes and cardiovascular diseases and therefore it is important to manage obesity for overall health of the nation. 'Encouraging' people to engage in healthy diets and regular exercise through active health promotion could be a possible intervention.

  Alcohol is another major risk factor which is associated with several cancers, such as liver, breast, stomach, larynx, etc. It also has a relatively higher risk burden compared to obesity and therefore a combination of 'encouraging' people to abstain and 'enforcement' through taxation, bans on promotion and advertising and policies such as reduced hours of sale could be some of the preventive strategies.
- **Enlighten about ill effects of environmental carcinogens**: Environmental risk factors include air pollution, exposure to UV radiation, radon, asbestos, and other carcinogens associated with lung cancers and melanoma. As seen in the previous section, awareness of these risk factors is presently low, and the

immediate need therefore is to 'enlighten' people about risks of exposure to these carcinogens. Policy interventions such as environmental standards and regulations, robust energy policies could be other areas of primary prevention which may gain traction in the near future, given that we are already seeing unprecedented levels of air pollution in our major cities.

Given that tobacco control and HPV vaccination emerge as the two most actionable and priority interventions, the following sections cover these in further detail.

Tobacco control

What has been done?

- The Government of India has undertaken several measures when it comes to tobacco control starting with instituting the National Tobacco Control Programme (NTCP) in 2007 - 2008 to raise awareness, implement tobacco laws and provide cessation services to tobacco addicts. The NTCP is being implemented in 677 districts across 36 states/ UTs presently[21].
- The government has been actively discouraging use of tobacco products through implementation of the Cigarettes and Other Tobacco Products Act (COTPA 2003), which banned sale to persons below 18 years of age, sale within hundred yards of educational institutions, promotion and advertisements of products and smoking in public places. The government also recently implemented new specified health warnings on tobacco product packs which cover 85% of the display area with graphic health warning image and messaging along with quit line number for supporting users willing to quit.
- India also took the bold step of banning all forms of Electronic Nicotine Delivery Systems (ENDS)[22] such as e-cigarettes and vapes across the value chain prohibiting production, manufacturing, sale, import, export, stocking, distribution, and transfer. Initially marketed by the tobacco industry as a means to drop the smoking habit, addiction to 'vapes' has become a new crisis that is unfolding in some countries like the US with its sales rapidly increasing among the youth.
- Many state governments have implemented laws banning the sale, manufacture, and distribution of gutkha, khaini, paan masala containing tobacco under the Food Safety and Regulation Act.

The government has recently drafted the COTPA amendment bill which was put in public domain for comments. The proposed amendment calls for stricter measures including:

- Eliminating designated smoking areas from workplaces, airports, and restaurants to achieve complete ban on smoking in public areas
- Ban on all forms of indirect advertisement including using of brand name, trademark, colors, layout and presentation for marketing or advertising other goods, services, and events
- Raising the age of sale allowed to persons from 18 years to 21 years
- Prescribing minimum quantity to eliminate the sale of loose cigarettes
- Increasing radius where sale is disallowed from 100 yards to 100 meters of educational institutions

While it is still to be seen whether this bill will get passed in the parliament, it is a progressive legislation by the government which could motivate more users to quit. The proposed bill has already drawn flak from farmers, traders and retailer associations actively led by tobacco industry lobbies who claim the harsh amendments would impact the livelihood of farmers and increase illicit trade.

What has been achieved?

- As per the Global Adult Tobacco Survey (GATS), overall prevalence of tobacco among adult population has reduced by six percentage points between 2009 - 2010 and 2016 - 2017. While this is most certainly an achievement, the current prevalence of 28.6%

[21] Ministry of Health and Family Welfare, Annual Report, 2021-22

[22] Chakma JK, Kumar H, Bhargava S, Khanna T. The e-cigarettes ban in India: an important public health decision. Lancet Public Health. 2020 Aug;5(8):e426. doi: 10.1016/S2468-2667(20)30063-3. PMID: 32768432.

is still higher than the global prevalence of 23.4%, indicating that there remains more to be done.

- The government has also conducted four rounds of the Global Youth Tobacco Survey (GYTS), which is a school-based survey for students between ages 13 to 15 years. While the prevalence has shown a declining trend of tobacco users from 16.9% in 2003 to 8.5% in 2019, it is still an alarming statistic considering the young age at which children are being exposed to tobacco.

Table 11: Change in prevalence: GATS 2009-10 & GATS 2016-17

Year of GATS	Total adult population in crore (Age 15 and above)	Number of adult tobacco users in crore	Type of tobacco users (in Cr)		
			Smoke only	Smokeless only	Both smoke and smokeless
2016-17	93.2	26.7	6.7	16.7	3.2
Prevalence		*28.6%*	*7.2%*	*17.9%*	*3.4%*
2009-10	79.6	27.5	6.9	16.4	4.2
Prevalence		*34.5%*	*8.7%*	*20.6%*	*5.3%*
Change in prevalence		5.9%	1.5%	2.7%	1.9%

What further needs to be done?

- To counter the global challenge of tobacco, WHO launched the MPOWER[23] policy package in 2008 to assist country level implementations. MPOWER comprises the six key interventions to discourage use of tobacco:
  - M- Monitor tobacco use and prevention policies
  - P- Protect people from tobacco smoke
  - O- Offer help to quit tobacco use
  - W- Warn about the dangers of tobacco
  - E- Enforce bans on tobacco advertising, promotion, and sponsorship
  - R- Raise taxes on tobacco

  Since its launch, 146 countries have adopted at least one of the MPOWER measures. India has also started implementing MPOWER measures, such as offering help to quit tobacco use through its mCessation program, which utilizes mobile technology for tobacco cessation. The passing of the COTPA amendment bill may further strengthen four other MPOWER initiatives like monitoring tobacco usage through GATS and GYTS, completely banning smoking in public places, implementing warning labels on all forms of packaging and bans on all forms of advertising.

  However, when it comes to taxation, India falls below the WHO minimum recommendation[24] of 75% tax share of retail price of tobacco. Currently, India levies 28% GST, which is the highest tax slab. Additional taxes such as National Calamity Contingent Duty (NCCD) and compensation cess take the incidence up to 50-60%[25]. Government has set up an expert group in 2021 with a mandate of suggesting various tax rate models for consideration in preparation of FY23 and future Union budgets[26]. Tax rates, however, remained unchanged in this year's budget. There is a need to further explore tax reforms to meet WHO recommendations and discourage tobacco sale.

- The proven harmful effects of tobacco often beget the question on why not abolish tobacco altogether with a complete ban on production. Not many countries have ventured on this path but for Bhutan, which enacted a national tobacco ban in 2004.

  The most common reasons for not abolishing tobacco are the impact on government

[23] https://www.who.int/initiatives/mpower

[24] https://www.who.int/europe/activities/promoting-taxation-on-tobacco-products

[25] https://www.dailypioneer.com/2022/columnists/raise-tobacco-tax-to-heal-economy-and-people

[26] https://www.livemint.com/news/india/government-sets-up-expert-panel-on-tobacco-tax-policy

revenue collection, livelihood of tobacco-producing farmers, increase in smuggling and black marketing, and a broader societal question on whether governments should enforce personal choices of people.

Alternate farming could be a possible option to protect the livelihood of tobacco farmers. Towards this effect, India's largest cancer care provider, HealthCare Global Enterprises Ltd (HCG) is successfully steering an alternate farming project in Hunsur, which is a tobacco belt in Karnataka by supporting farmers to shift from growing tobacco to sandalwood. The government could consider piloting similar projects across the country by empowering tobacco farmers to switch to other crops.

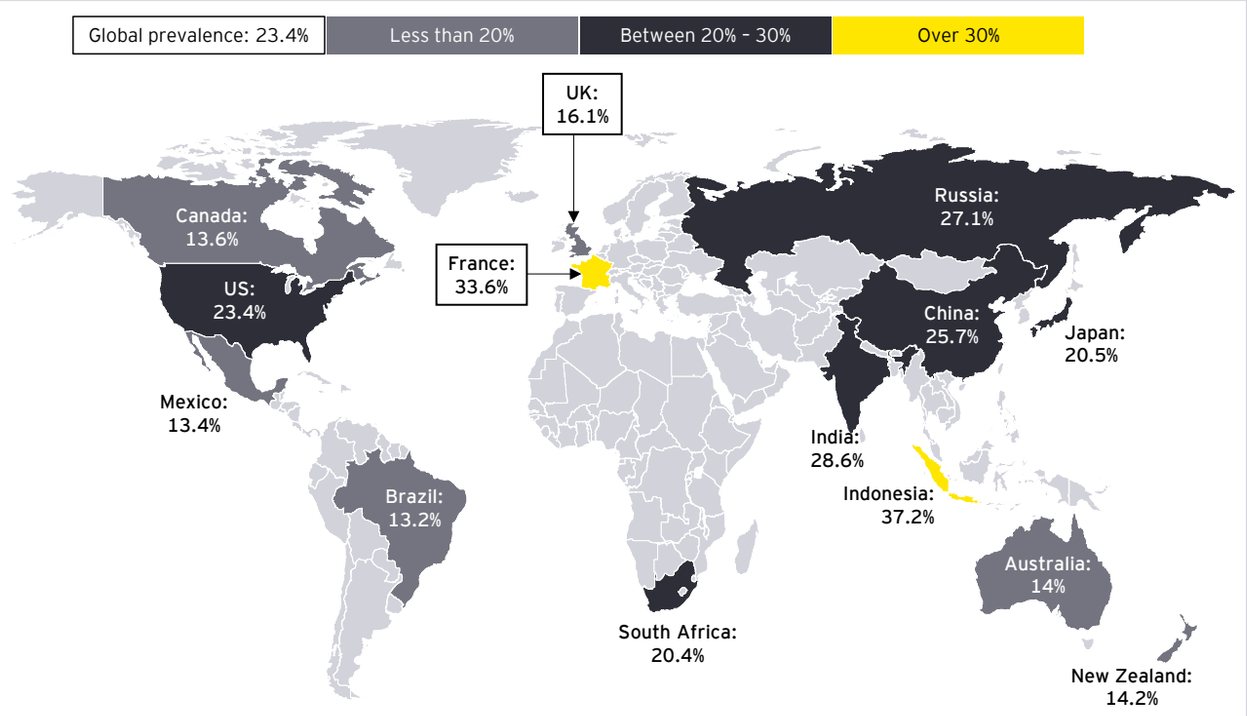
As per a WHO study[27], India loses up to 1% of its GDP every year due to diseases and deaths caused by tobacco, including cancer and other NCDs. The economic cost attributable to tobacco considering medical costs and mortality costs of premature death was estimated to be US$27.5 billion, as per the study. The average annual revenue collection from tobacco products stands at approximately US$7 billion[28]. Therefore, in theory, the cost of tobacco seems to far outweigh its earnings when considering the costs of premature deaths.

Bhutan[29] was perhaps the only country which abolished domestic production and sale of tobacco with 100 percent tax on specified small amounts of tobacco legally imported for personal use. The government imposed a fine on illegal users, which was later amended to constitute a fourth-degree felony with three to five years of imprisonment. However, the WHO tobacco survey indicated that usage of smokeless tobacco among Bhutanese youth had gone up from 9.4% in 2009 to 22% in 2019. Despite the stringent measures imposed, demand for tobacco continued to remain strong, leading to vigorous smuggling from across the border. Following the COVID-19 outbreak, when cases started to increase due to smugglers crossing the border without any testing protocols, the Bhutan government repealed the ban on import of tobacco for commercial purposes while continuing the ban on domestic production and sale. The government has pledged to engage in awareness campaigns and nicotine replacement approaches towards its tobacco cessation efforts. This case study from Bhutan shows a possible downside of increase in smuggling across the border if strong vigilance is not maintained to curb illicit trade.

- The below chart indicates[30]several countries such as Canada, Mexico, Australia, the United Kingdom, New Zealand have less than 15% prevalence of tobacco users. Many of these countries are moving toward 'endgame' goals aimed at reducing prevalence to less than 5%.

[27] https://www.who.int/india/news/detail
[28] https://www.business-standard.com/article/economy-policy
[29] https://www.moneycontrol.com/news/trends
[30] https://data.worldbank.org/indicator

Chart 16: Prevalence of current tobacco use (% of adults) – World Bank data 2018



New Zealand recently announced some drastic measures in a bid to become 'smoke-free' by 2025[31]. The final legislation which is expected to pass in December 2022 sets out the following three measures:

- Drastically reducing nicotine content in tobacco to make it less addictive
- Reducing number of outlets selling tobacco by 90 to 95%
- Prohibiting lifetime sale of tobacco to anyone born from 2009 onwards

The third measure effectively means anyone born from 2009 cannot take up smoking, in contrast to interventions in most countries which mandate a minimum age of say 18 or 21 years after which they are allowed to smoke. The US town of Brookline adopted a similar strategy, where they introduced a bylaw in September 2021 that forever prohibits anyone born after 1999 from purchasing tobacco and vape products.

HPV vaccination and screening

What has been done?

- India has recently announced the launch of its first indigenously developed HPV vaccine expected to hit the market by end of the year. The vaccine 'Cervavac' developed by Serum Institute of India and the department of biotechnology is expected to be priced at INR200 to 400[32] vis-à-vis INR3,000 price of the two vaccines presently being marketed by Merck and GSK. Launching the vaccine at 10 times lower price is a significant milestone which if rolled out effectively has the potential to accelerate India's fight against cervical cancer.
- Government has rolled out population-based prevention and screening initiatives for common NCDs, including cervical cancer under Ayushman Bharat Health and Wellness Centres. Recommended method for cervical cancer screening is Visual Inspection through Acetic acid (VIA). These services are being provided through trained frontline workers (ASHA, ANM, MPWs).

What has been achieved?

- The 2020 report of the National Cancer Registry Programme observes a significant decrease in cervical cancer incidence rates in 10 PBCRs between 2012 to 2016. These

[31] https://www.dnaindia.com/world

[32] India's first indigenously developed vaccine for cervical cancer: All you need to know", indianexpress.com, Sept 2022

statistics are however prior to the launch of NCD screening program by the government.

What further needs to be done?

- India is still to include the HPV vaccine as part of its Universal Immunization Program. As of October 2019, 100 countries around the world had already introduced the HPV vaccine as part of their national immunization schedule. Few states, such as Delhi and Punjab, have introduced vaccination programs from 2016 onwards.
- With the expected launch of the indigenous vaccine 'Cervavac' by end of the year, there is a need to ensure effective roll-out through mass vaccination drives similar to what the government recently implemented for COVID-19. A 'Cowin' like app can be an effective measure to streamline the vaccination process.
- Given the decade-old debate around the efficacy and safety of the HPV vaccine in India, there is a need to conduct regular studies to establish evidence of the same. In the past, the government halted the HPV vaccine trial in Gujarat and Andhra Pradesh after seven girls who had received the vaccine reportedly died during the trial. While the government enquiry concluded those deaths were unrelated to the vaccine later, the unfortunate event raised several questions around the safety of the HPV vaccine, which requires scientific evidence to allay any fears. Post-marketing surveillance linking vaccination to reduced incidence is also critical as visible impact of HPV vaccination will take several years.
- The government should continue to focus on initiatives such as accessibility to hygienic toilets for all women. Education regarding genital and menstrual hygiene is also important, as indicated earlier in the awareness section.

Australia[33] has pledged to be the first nation to eliminate cervical cancer by 2035. Some initiatives undertaken by the Australian Government include:

- Early inclusion of HPV vaccination in 2007 as part of the national immunization program. As per WHO country profiles for cervical cancer, among girls turning 15 years in 2020, 7 in 10 girls in Australia have received their final HPV vaccination dose. Australia reported a drop in incidence from 7.4 cases per 100,000 females in 1982 to 3.7 cases per 100,000 females in 2018, predominantly driven by vaccination[34].
- National cervical screening program using HPV test as primary screening method. Under the program, 8 in 10 women have been screened in the last five years. In 2017, the Australian government changed the frequency of testing from every two years to a five-yearly test.
- Introduction of self-collection for cervical screening tests in 2021 to encourage many more women to take the test by making the process easier, more comfortable, and less invasive.
- Spending of close to US$386 million on HPV vaccines and distributing around 6.4 million doses since 2012 – 2013. In 2021, government announced additional funding of US$5.8 million to develop National Cervical Cancer Elimination Strategy.
- The funding shall support Australia's largest clinical trial, the Compass Trial, for producing evidence on the interactions between HPV vaccination and HPV-based screening. Outcomes of the trial will be used to improve screening to ensure participants continue to receive the right care.

[33] https://www.health.gov.au

[34] https://www.canceraustralia.gov.au/cancer-types/cervical-cancer/statistics

> With an increase in the incidence and prevalence of cancer, it is important to spread awareness and hasten early detection through scalable screening programs at the grassroot level whilst improving access to high quality affordable treatment options. At Fortis, we focus on enabling access to the entire spectrum of cancer care, ranging from preventive Oncology to precision medicine and high-end radiation treatment. With focus on early detection and adoption of vaccines like HPV vaccine, cancer survival rates can be improved and collaborative programs with Public Private partnerships will be of immense help.
>
> **Dr. Ashutosh Raghuvanshi**
> Managing Director & CEO, Fortis Healthcare Limited

Other risk factors

Alcohol

- Excessive alcohol consumption not just causes cancers like breast, liver and pharynx, but is also responsible for several social issues such as domestic violence, poverty, increase in crime and drunk driving.

  Similar to WHO's MPOWER policy package for tobacco control, WHO recommends guidelines known as SAFER[35] to reduce alcohol consumption across countries. The SAFER interventions involve:

  - S- Strengthen restrictions on alcohol availability
  - A- Advance and enforce drink driving counter measures
  - F- Facilitate access to screening, brief interventions, and treatment
  - E- Enforce bans or comprehensive restrictions on alcohol advertising, sponsorship, and promotion
  - R- Raise prices on alcohol through excise taxes and pricing policies

  Alcohol policy in India is a state subject. While some state governments such as Gujarat, Bihar, Manipur have prohibited alcohol and are 'dry states', easy access to illicit liquor is thriving. The Ministry of Social Justice & Empowerment has instituted a scheme[36] which provides financial assistance up to 90 to 95% to voluntary organizations for running Integrated Rehabilitation Centre for Addicts (IRCAs), Regional Resource and Training Centres (RRTCs), for holding Awareness-cum-de-addiction camps (ACDC) and Workplace Prevention Programmes, etc.

  Around 14 countries[37] in the world have enacted prohibitionary measures for alcohol consumption, a vast majority of them being Islamic countries such as Yemen, UAE, Pakistan, Saudi Arabia, Bangladesh, etc.

Obesity

- Earlier seen as a rich nation problem, obesity rates have seen an increase across all countries in the past decade due to physical inactivity and unhealthy diets.

  In today's world, awareness of healthy diet and regular exercise seems to be higher than what it was a decade ago, especially in urban areas. It is not uncommon to see people tracking their daily 'steps' and 'calories', which have been driven by multiple digital apps and smartwatches in the market. However, sustaining these healthy behaviors requires a lot of self-motivation and an enabling environment such as access to walking areas, time to engage in physical activity such as sports, gym, yoga, etc.

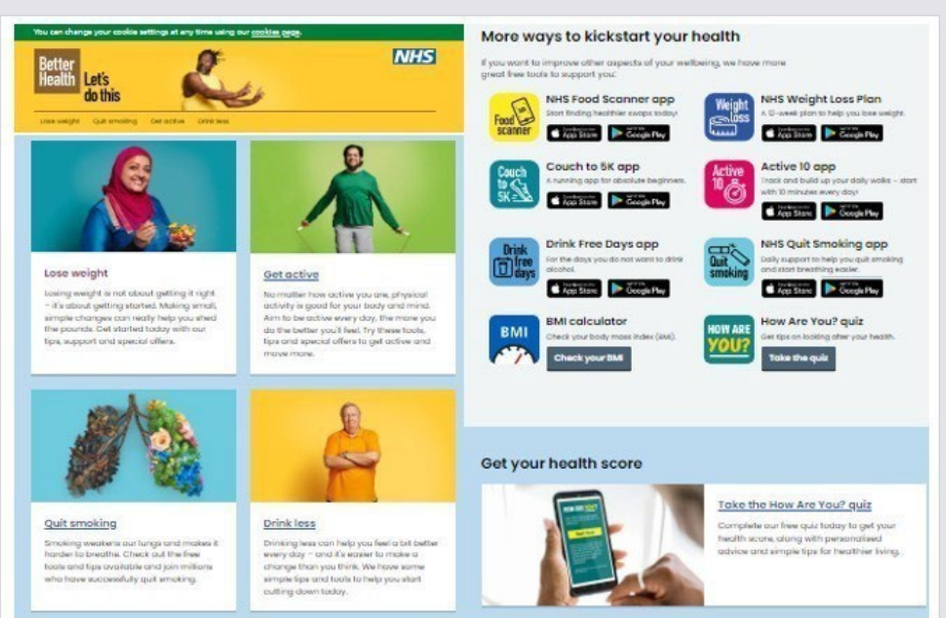
  Incentivizing or gamification of positive health behaviors can also drive a person's motivation to engage in healthy behavior. Fitness apps and various smartphone games provide badges, reward points and leader boards to celebrate a milestone achievement and motivate individuals to reach this milestone. Creating an ecosystem of rewarding health behavior by linking insurance companies and e-commerce players to use this information can be evaluated as illustrated below.

[35] https://www.who.int/initiatives/SAFER
[36] https://socialjustice.gov.in/schemes
[37] https://www.worldatlas.com/articles

Similarly, sporting events and promotion of events such as yoga day by schools, colleges, corporates, residential societies etc., can be used to raise awareness and encourage people to adopt healthy lifestyles.

Mandatory labels on food packaging providing nutrient and calorie details of ingredients can also make people aware of what constitutes their diet, which might prompt them to make healthier food choices. Events such as yoga day, sporting competitions organized by schools, colleges, universities, corporates, residential societies could also encourage people to take up some form of physical activity.

The UK recently announced a 'Better Health' campaign[38] which reveals a set of measures relating to the government's obesity management strategy. Some of the measures include:



- Banning advertisement of foods high in fat, sugar, salt on television and online media before 9 pm when children are most likely to see them. Consultations are being held by the government on whether to extend these bans at all times of the day.
- Ending 'Buy one Get one Free' offers on foods containing high salt, sugar, fat
- Calorie content labels to be added to food items being sold by restaurants, cafes and takeaways with more than 250 employees. The UK government has already implemented front-of-pack nutritional labeling using 'traffic light' scheme.
- Expansion of NHS services to include weight management services through self-care apps and online tools. The government will offer incentives to doctors and primary care staff for supporting obese people in their weight loss journey and becoming 'healthy weight coaches'. The government has also encouraged GPs to prescribe exercise and more social activities to help people keep fit.

[38] https://oen.org.uk/2020/08/21/a-summary-of-the-uk-governments-tackling-obesity-strategy/

Some of the prohibitionary measures adopted by countries include high taxes on fast- food chains and manufacturers of sugary beverages. For example, Japan in 2008 introduced 'Metabo' law which fined employers if their employees failed to meet specified goals in an annual waist measurement check-up. Denmark introduced a 'fat tax' in 2011 on processed food containing more than 2.3% of saturated fat. However, the government of Denmark repealed the same law in 2012 since people started crossing the porous EU borders to Sweden and Germany in order to shop for butter, milk, cheese, oil, meat etc., which impacted Danish retailers putting jobs at risk. The Kerala government in India also proposed a similar measure in 2016 of imposing 14.5% fat tax on burgers, pizzas and other junk food served by branded restaurants. The UK implemented a 'sugar-tax' in 2018, which created slabs for taxation depending on the sugar content in drinks to motivate businesses to reduce the amount of sugar in their beverages[39].

Environmental risk factors

Exposure to chemicals and other substances in the environment can also cause cancer. For example, second-hand tobacco smoke, asbestos and outdoor air pollution are risk factors for lung cancer. Drinking water that has large amounts of arsenic can cause skin, bladder and lung cancers.

Regulations by ministries engaged in environment protection, food safety etc., play an important role in reducing exposure to hazardous chemicals. Monitoring Air Quality Index (AQI) and quality of drinking water are simple but important steps to avoid exposure to hazardous chemicals.

Indian government has banned some harmful substances in pesticides, some of which are known carcinogens. Few examples of carcinogenic chemicals banned by other countries are listed below.

- Poland and the US prohibited indoor tanning salons for people under the age of 18 to reduce risk of exposure to UV rays, which is a risk factor for melanoma.
- In April 2022, EU published a 'Restrictions Roadmap' to regulate hazardous chemicals including carcinogens such as formaldehyde[40].
- In US, the Environmental Protection Agency (EPA) bans[41] carcinogens such as dioxins, asbestos, hexavalent chromium, etc.

Hereditary risk factors

Certain cancers are caused by inherited gene mutations which suggests that individuals who have a family history of such cancers have an increased likelihood of developing the cancer in their lifetime.

Genetic testing can help identify the inherited gene mutations. For example, women who have a family history of breast cancer could consider getting themselves tested for BRCA1 gene. People who test positive for this gene have higher chances of developing breast cancer. In addition to breast cancer, genetic testing is also available for other type of cancers such as ovarian, colon, thyroid, prostate, pancreatic, melanoma, sarcoma, kidney and stomach cancer. [42]

Knowledge of a higher likelihood of acquiring cancer could lead to some preventive actions such as chemoprevention or surgical interventions such as prophylactic mastectomy. Chemoprevention involves the use of certain drugs to lower the risk of cancer. Some examples of chemoprevention include the use of tamoxifen or raloxifene, which reduces the risk of breast cancer and finasteride which reduces the risk of prostate cancer. Chemoprevention is, however, an emerging science and is not very commonly used for cancer prevention at present. Surgical interventions for cancer prevention include mastectomy and salpingo-oophorectomy for removal of breasts, ovaries and fallopian tubes in women diagnosed with positive gene mutation for breast or ovarian cancer[43].

However, genetic testing has certain limitations. A positive genetic test does not mean that the individual will develop the cancer for sure, it just indicates higher chances. Similarly, absence of a gene mutation or a negative result does not mean the person will never develop cancer, as there are

[39] https://medium.com/illumination-curated

[40] https://www.packaginglaw.com/news

[41] https://www.businessinsider.com

[42] https://www.cancer.net/navigating-cancer-care/cancer-basics/genetics

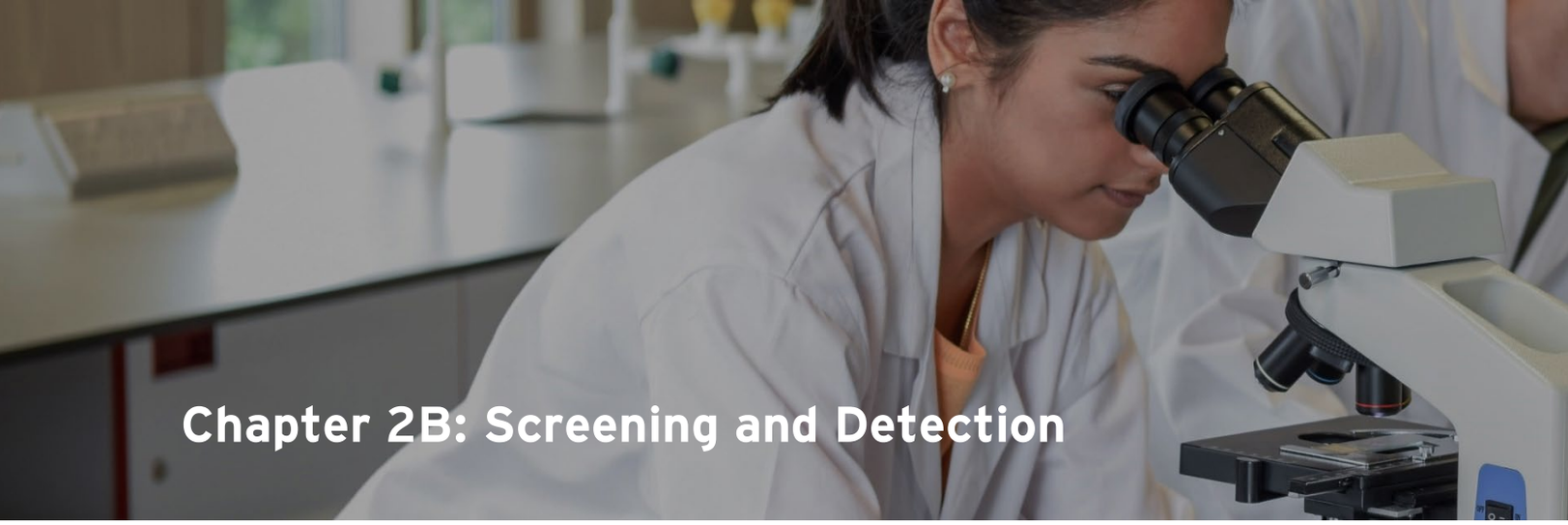
[43] https://www.cdc.gov/genomics/disease/breast_ovarian_cancer

multiple risk factors which can cause cancer as seen in the preceding sections. Genetic testing is also expensive and therefore not a viable option for everyone with a family history of cancer. Other related social aspects such as depression, anxiety, guilt, family tensions are associated with a positive test outcome.

The Cancer Genetics Clinic at Fortis Healthcare, managed by experienced genetic counselors, evaluates people with a personal or family history of cancers that may have genetic links. This includes conditions such as hereditary colon cancer and colon polyps, hereditary breast and ovarian cancer, gastric cancer, endocrine tumor and cancers (adrenal cancer, pheochromocytoma and paraganglioma, thyroid cancers), renal cancer, melanoma, pancreatic cancer, sarcoma and additional rare cancers.

The goal of the genetics clinic is to provide a personalized cancer risk assessment, counseling on the process and results of any genetic testing, determining whether other family members need genetic evaluation methods to minimize the risk of cancer through surveillance, management and in some cases prophylactic surgery or oral medication.

Common reasons for considering evaluation at The Cancer Genetics Clinic include - diagnosis of cancer at an earlier than average age (less than age 50 for common cancers like colon or breast cancer), more than one relative with the same or related cancers in the family, individuals with more than one primary cancer and individuals with rare or unusual cancers.



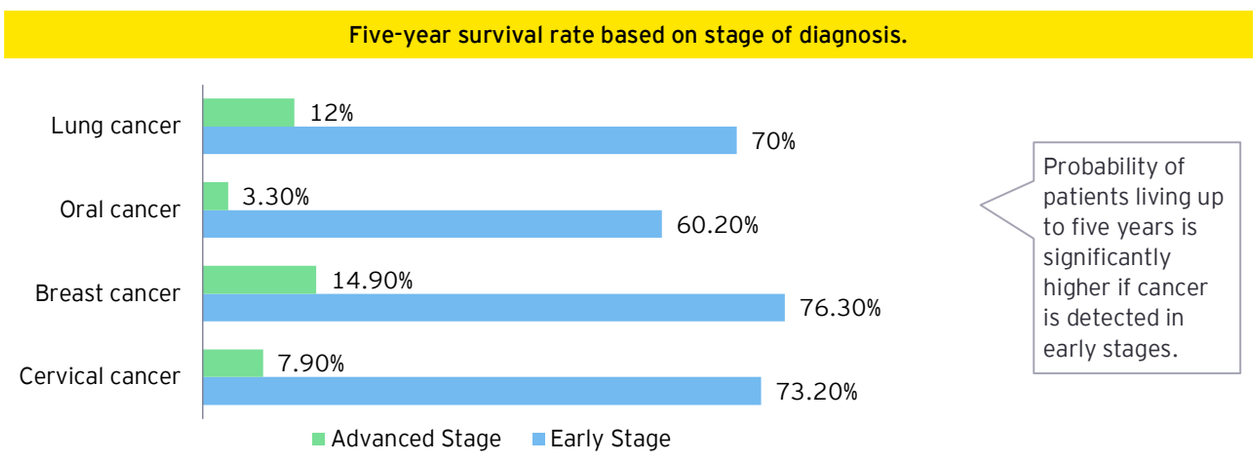
Chapter 2B: Screening and Detection

Cancer screening helps in early identification for downstaging the disease as well as achieve reduction in mortality and morbidity

Screening helps in identifying an unrecognized disease by application of a test to people who are asymptomatic but may have the disease or early signs of the same. Most countries have initiated and implemented cancer screening programs in cancers with a high incidence and high propensity of downstaging or high probability of reducing mortality if detected early.

Oral, breast and cervical cancers are three major cancers that qualify as pre-requisites to implement a country wide screening program. Some developed countries with high GDP spend on healthcare also focus on screening of colorectal, lung and prostate cancers.

Chart 17 – Five-year survival rate based on stage of diagnosis



The World Health Organization (WHO) estimates that between 30 and 50% of cancer deaths can be prevented by avoiding risk factors, early detection via screening, and proper treatment

Source: WHO.int

With an increasing incidence of cervical and breast cancer and the possibility of improving mortality and clinical outcomes due to early detection, WHO recommends undertaking measures to eliminate cervical cancer by 2030 and reduce breast cancer mortality globally by 2040.

Chart 18: WHO recommendations for cervical and breast cancer

Cancer Type	Recommendation
Breast cancer 	Reduce global breast cancer mortality by 2.5% per year by 2040 and prevent 2.5m deaths using the 3 pillars: 1. Health promotion for early detection 2. Timely Diagnosis 3. Comprehensive Breast Cancer Management
Cervical cancer 	Eliminate cervical cancer globally by 2030 1. Fully Vaccinate 90% girls by age 15 years 2. Screen 70% women with high performance test (PAP/ VIA) by 35 years and 45 years of age 3. Treat 90% of women identified with cervical disease In terms of screening coverage, WHO recommends a PAP test for all women above 21 years every 3 years till 65 years if age. In countries with low resources, WHO recommends to use VIA with 5% acetic acid for mass screening and PAP as confirmatory test.

5 years survival rate			
World wide	High income countries	India	South Africa
5/6	9/10	6/10	4/10

Source: WHO.int

In addition, various countries have implemented screening programs for other cancer types with high incidence and found that early identification of disease has improved outcomes in terms of survival rates and quality of life.

Chart 19: Learnings on screening for other cancer types

Cancer Type	Learnings on screening
Oral cancer 	In India, visual inspection provides the opportunity to screen all negative patients for any oral lesion with the help of a trained healthcare worker or a community health worker. Treatment of patients with early-stage oral cancer indicates improved rates of survival and quality of life.
Lung cancer 	International Early Lung Cancer Action Program (I-ELCAP) results in the US have shown a 10-year survival of 88% in patients with stage I lung cancer, which were identified during screening. The result further saw a reduction of 20% in deaths due to lung cancer in the National Lung Screening Trial (NLST) with low dose computed tomography in comparison with chest radiograph. NLST conducted three annual CT scans.
Colorectal cancer 	High resource developed countries like US and Canada use colonoscopy once every 10 years to screen patients. A low-cost model used by countries like Japan, China, the UK is to do a fecal immunological test or fecal occult blood test

Source: WHO.int; govt websites

> The biggest challenge today in India is that all major cancers get detected at advanced stages. This affects the clinical outcomes, cost of treatment and overall mortality and morbidity. The most effective way to change the outcomes in cancer is through combination of awareness, prevention, early detection, and comprehensive care. Once we all join our hands together at every level to provide integrated cancer care, we can change the outcomes in next 3 to 5 years.

Dr. Raajiv Singhal
Managing Director and CEO, Marengo Asia healthcare

While India's cancer screening program aims to comprehensively cover oral, cervical and breast cancers, the coverage achieved to date is very low compared to other countries

Based on the prevalence and increasing numbers of cancer cases in India, Government's focus has been to screen for cervical, breast and oral cancers as part of population-based screening under National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS). While the government launched the NPCDCS in 2010 as part of the wider National Health Mission, it started population-based screening for cancers in 2016 under the NCD screening agenda.

Table 12: Cancer screening coverage and guidelines in India

Type of Cancer	Age of screening	Method of Screening	Frequency of Screening	Referral mechanism
Oral cancer	30-65 years	Oral visual examination (OVE)	Once in 5 years	Positive cases referred to CHC or DH for confirmation or biopsy
Cervical cancer	30-65 years	Visual inspection with Acetic acid (VIA)	Once in 5 years	Positive cases referred to PHC/CHC/DH for further evaluation and management of pre-cancerous conditions where gynecologist/ trained lady officer is available
Breast cancer	30-65 years	Clinical Breast examination (CBE)	Once in 5 years	Positive cases referred to Surgeon at CHC/DH for confirmation using a breast sound probe followed by biopsy as appropriate

Source: Operational framework, management of common cancers, MoHFW, GoI report

Along with breast and cervical cancers, most other countries have also covered colorectal cancer as part of their screening programs.

Further, few developed countries like the US, Canada, Japan, and Malaysia have also included lung cancer as part of their screening program.

Table 13: Country wise national cancer screening programs in the world

Organ	India	China	Canada	Germany	Japan	Malaysia	UAE	UK	USA	Singapore	Thailand	Australia	Sri Lanka
Breast	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cervical	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Oral	✓												✓
Colorectal		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Lung			✓		✓	✓			✓				
Skin				✓									
Liver		✓											
Head and Neck		✓											
Gastric		✓			✓								

Source: Country websites

Limited resources and absence of a low cost, effective and safe diagnostic tool for colorectal and lung cancer are the main reason for their absence from the national screening programs. Further, private healthcare providers opportunistically screen prostate cancer with an increasing incidence in urban India. India's inclusion of oral cancer under the cancer screening program as compared to other countries is due to the high incidence of oral cancer across men and women being witnessed in the country.

> Recent advancements in Oncology combined with breakthrough technology have remarkably improved patient outcomes. Yet a significant number of cancer patients come late to hospitals either because of poor understanding of symptoms or late screening. The need of the hour remains regular mass screening camps and awareness sessions across strata.
>
> **Dr. Abhinay Bollineni**
> CEO, KIMS Hospitals

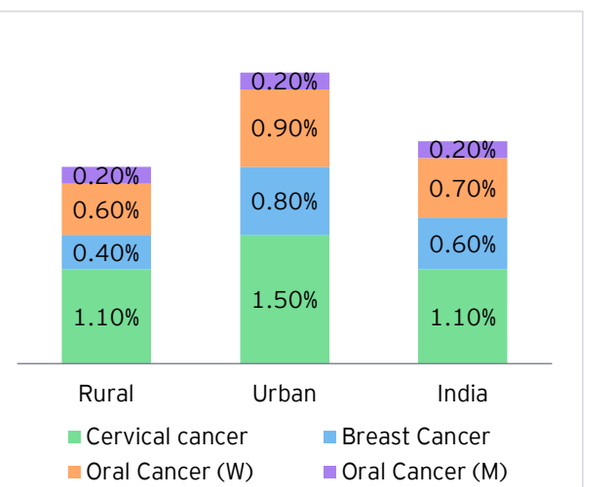
India's performance on cancer screening

India's national cancer screening program has been running since November 2016, however penetration in terms of population coverage has been very low. India made progress since 2018 when cancer screening became a part of the larger NCD screening program under National Health Mission

India has so far been able to screen only 1.1% of their population for cervical cancer and less than 1% for breast and oral cancer. The screening coverage in urban areas is slightly better than rural areas, primarily due to easy access to screening facilities, opportunistic screenings offered in private hospitals as well as increased awareness amongst the population. However, oral cancer screening coverage amongst men across urban and rural areas is equally very low.

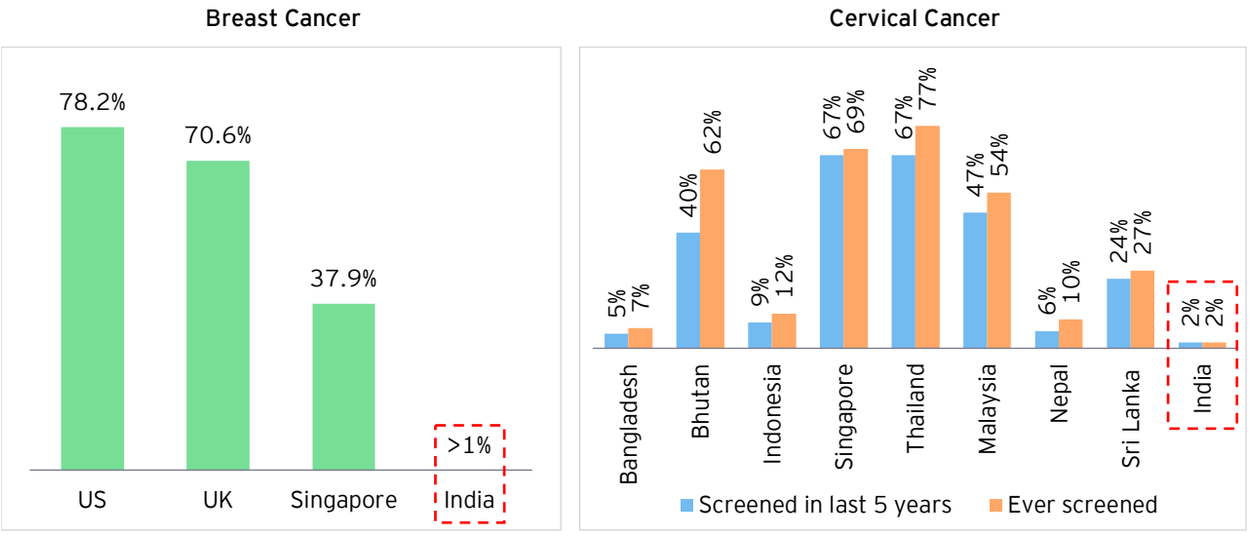
Other countries, including low-income ones like Sri Lanka, Indonesia, Bangladesh, and Nepal, have been able to achieve a higher screening coverage than India for cervical cancer. For breast cancer, the UK and the US have been able to cover over 70% of their population, Singapore continues to see an improvement in their screening coverage as India lags significantly.

Chart 20: Screening coverage in India by percentage of population



Source: NFHS-5

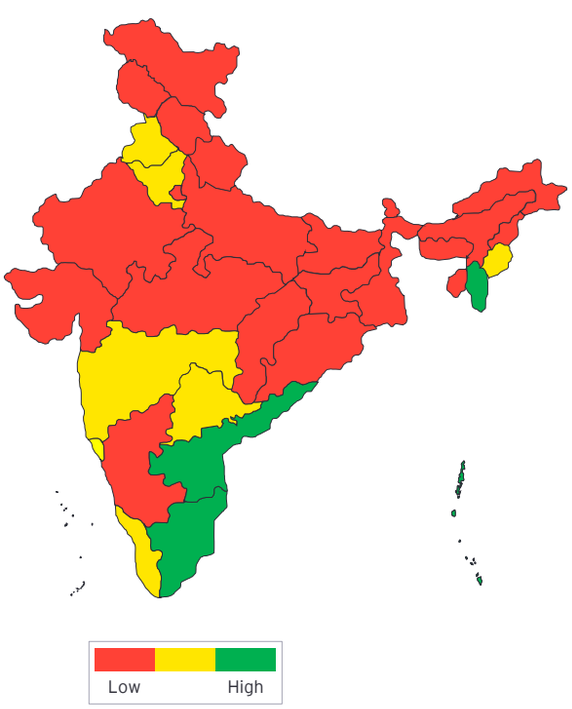
Chart 21: India vs. other countries – cervical and breast cancer screening penetration (% of population covered)



Source: govt websites

India's diverse terrain and population across states, maturity of existing healthcare infrastructure and spending capacity of each state dictates the screening coverage of these cancers across states.

Chart 22: Percentage of population screened in India for top 3 cancers till 2021



State/Union territory	Cervix	Breast	Oral cavity women	Oral cavity men
India	1.2%	0.6%	0.7%	0.2%
Chandigarh	0.9%	0.0%	0.2%	0.1%
Delhi	0.4%	0.2%	0.7%	0.1%
Haryana	0.5%	0.2%	0.3%	0.2%
Himachal Pradesh	0.7%	0.3%	0.3%	0.1%
Jammu & Kashmir	0.3%	0.2%	0.6%	0.1%
Ladakh	0.2%	0.2%	0.1%	0.0%
Punjab	1.9%	0.3%	0.4%	0.1%
Rajasthan	0.3%	0.1%	0.2%	0.1%
Uttarakhand	0.3%	0.1%	0.3%	0.1%
Chhattisgarh	0.3%	0.2%	0.2%	0.2%
Madhya Pradesh	0.7%	0.5%	0.7%	0.1%
Uttar Pradesh	1.0%	0.3%	0.6%	0.2%
Bihar	0.5%	0.2%	0.3%	0.2%
Jharkhand	0.4%	0.1%	0.2%	0.1%
Odisha	0.7%	0.1%	0.2%	0.1%
West Bengal	0.1%	0.1%	0.1%	0.1%
Arunachal Pradesh	0.7%	0.3%	0.4%	0.2%
Assam	0.2%	0.2%	0.2%	0.3%
Manipur	1.3%	1.0%	0.6%	0.1%
Meghalaya	0.4%	0.3%	0.4%	0.1%
Mizoram	3.8%	1.6%	0.7%	0.1%
Nagaland	0.2%	0.2%	0.3%	0.1%
Sikkim	0.5%	0.2%	0.6%	0.3%
Tripura	0.4%	0.3%	0.4%	0.0%
Daman & Diu	0.4%	0.1%	0.1%	0.1%
Goa	0.9%	1.0%	0.5%	0.3%
Gujarat	0.2%	0.1%	0.2%	0.1%
Maharashtra	1.7%	1.0%	1.0%	0.1%
Andaman & Nicobar Islands	1.9%	1.3%	9.5%	0.7%
Andhra Pradesh	3.2%	0.6%	5.0%	0.8%
Karnataka	0.5%	0.2%	0.4%	0.1%
Kerala	2.3%	1.5%	0.5%	0.1%
Lakshadweep	1.2%	0.3%	0.2%	0.1%
Puducherry	5.3%	2.9%	1.2%	0.2%
Tamil Nadu	7.0%	3.8%	0.9%	0.2%
Telangana	2.1%	0.3%	1.8%	0.4%

Source: NFHS 5; Towards universal health coverage April 2018- Nov 2020, EY analysis

> With advancements in medical sciences, mortality and morbidity associated with cancer can be largely prevented. We need mass scale campaigns to increase awareness, de-stigmatize cancer and universal screening of common cancers, especially in rural areas where two-thirds of our population lives. Apart from the routine tests and markers, for those who are at high risk and those diagnosed with cancer, advanced diagnostics like genetic testing can significantly improve outcomes through personalized interventions and precision medicine.

Dr. Vandana Lal
Executive Director and Chief Technical Officer, Dr Lal PathLabs Ltd

Given the availability of strong public health infrastructure, Tamil Nadu and Andhra Pradesh are leading among the larger states in cancer screening coverage, more specifically for cervical and breast cancer.

Among other states, Kerala, Mizoram, and Puducherry are progressing in the screening coverage for both cervical and breast cancer. Additionally, Manipur is progressing in the screenings for breast cancer.

For oral cancer screening in both men and women, while the overall coverage remains very low across most states. Andhra Pradesh, Telangana, Maharashtra, and Andaman & Nicobar are progressing better that other states in terms of screening coverage.

In FY 2021-22, GoI ranked all the states and UT's based on criteria like availability of stipulated trained HR, initiation of screenings, availability of diagnostic tools and medications, utilization of telemedicine services, conducting wellness activities, etc. The government ranked Karnataka, Chhattisgarh, Andhra Pradesh, Gujarat, and Maharashtra as top five states and Chandigarh, Pondicherry and Daman and Diu as top three UTs on the above parameters. Jharkhand, Manipur, Rajasthan, Tripura, and Bihar were the worst performing states and Andaman & Nicobar Islands, Ladakh and Lakshadweep, the worst performing UTs. Delhi has opted out of the AB-HWC program.

Key challenges in cancer screening leading to low coverage

The government has included and prioritized screening of the three cancers as a part of the NPCDCS and is working toward achieving the set target of opening 1,50,000 health and wellness centers (HWCs) across India by December 2022 to run this program under the umbrella of universal primary health coverage. However, multiple challenges remain which are impacting the achievement of desired objectives of the screening program.

Table 14: Key challenges in enforcement of the screening program

Area	Target	Status	Comment
Capacity - Physical infrastructure	1,50,000 HWCs by December 2022 within 30 min distance for the covered population with appropriate infrastructure for cancer screening	1,17,000 HWCs set up as of March 2022	Availability of adequate number of HWCs across the country remains a challenge. Further, even at existing HWCs, not all have the availability of dedicated space for cervical or breast examination, considering privacy and infection control requirements.
Capacity - Workforce availability	Each sub-center is supposed to be manned by 1 CHO, 5 ASHA and 2/3 multi-purpose workers and at PHC level 1 Medical officer and other staff as per IPHS norms.	As of March 2021, there is a shortage of 2.9% of female health worker/ ANM mainly due to shortfall in Gujarat, Himachal Pradesh, Rajasthan, Tripura, and Kerala. In medical officers, there is a shortage of about 4% MO's as against those proposed at the PHC level mainly in Orissa, Karnataka, and Chhattisgarh.	Along with physical infrastructure, having trained and adequate staff to cover the population for the HWC is equally important. Lack of female health worker directly impacts the screening coverage for breast and cervical cancer screening due to social and privacy reasons. Lack of adequate workforce at higher referral centers also limits the success of any screening program as confirmed diagnosis and thereby treatment is delayed, defeating the purpose of early detection.
Capacity – Training	100% of workforce at HWCs trained for cancer screening	23% of the staff currently deployed in these HWCs are untrained.	With an untrained workforce, conducting screening is a big challenge. Mere availability of personnel does not guarantee a successful screening campaign.
Capacity - Referral network	Refer all 'at risk' cases to higher center	27% CHCs and 13% of DHs had not implemented NPCDCS till 2017-18.	One of the main features of Health and Wellness Centers is to triage and refer patients to the appropriate referral centers. However, readiness of these referral centers to accept these patients is a challenge. At the district hospital where NPCDCS was implemented by the government, less than 10% of the facilities had all tools for cancer screening.
Capacity - Data capture and transfer	Central government to deploy robust IT software for data capturing and referral management; ASHAs to have smartphones, MPWs a tablet and CHOs a handheld device and desktop for MOs	Paper-based data capture and transfer in regard to referral to a higher center	No use of technology to capture all relevant information of the patient with regards to high-risk behavior, risk factors or screening method and result. States which are using their own software pose the risk of interoperability when trying to align to a national data repository
Awareness	Aim is to use different techniques of information, education, and communication to make everyone aware about cancer screening	Low awareness levels among healthcare workers and the community about cancer screening based on various studies	Awareness, knowledge, and attitude toward cancer screening also become important in a national screening program.
Affordability and financing	Screening and treatment post diagnosis at government center is free of cost for the patient	~55% of cancer patients are required to rely on private healthcare facilities for treatment. Limited coverage provided by Ayushman Bharat and state healthcare schemes and only ~10% -12% private insurance penetration.	Cancer, being the disease with highest cost of treatment among NCDs, has a significant impact on financial condition of those impacted.

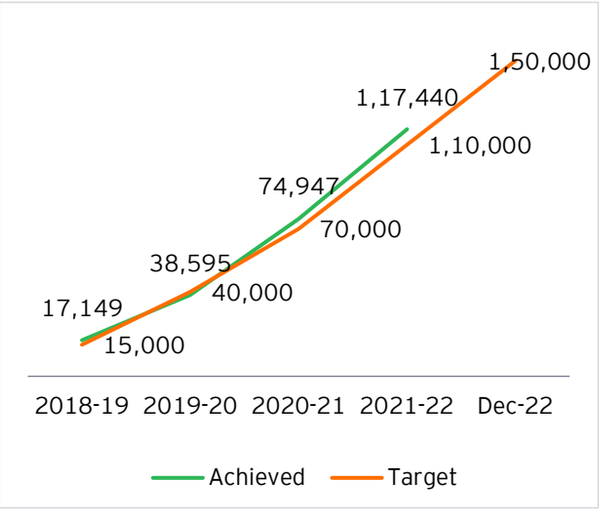
Source: National Non communicable disease monitoring survey; AB-HWC survey report 2021

1. Lack of physical Infrastructure

While the aspiration is to open 1,50,000 HWCs across India by Dec 2022, around 1,17,440 HWCs were operationalized as of March 2022. However, availability of dedicated space for cervical or breast examination, considering privacy and infection control requirements, has been a challenge in the execution of cancer screening. The AB-HWC assessment done in 2021 pointed that 15% of the HWCs visited were in a rented space and were very small to be an HWC. To have separate space for cervical and breast examination in these centers would be impossible.

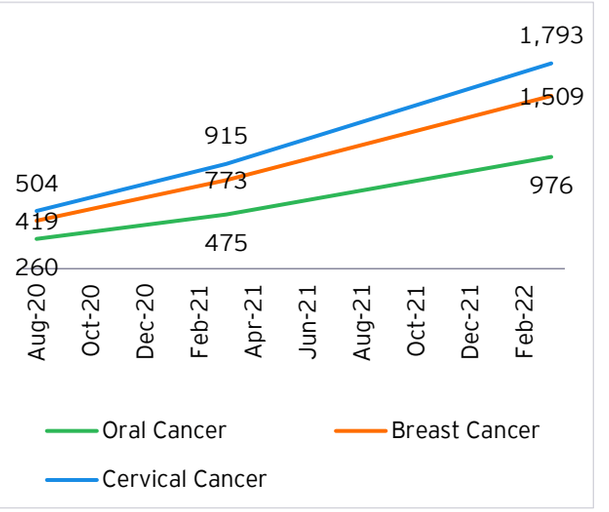
States like Maharashtra, Punjab, and Chandigarh exceeded their targets of operationalizing HWCs achieving 104%-189% of their targets as of September 2020. On the other hand, states like Rajasthan, Bihar, Orissa, Haryana, Ladakh and Tripura could not achieve more than 45% in 2020.

Chart 23: Number of HWCs operationalized vs. targeted across India as of September 2021



Source: Operational framework, management of common cancers, MOHFW, India

Chart 24: Number of patients screened (in lakhs) in HWCs in India for top three cancers



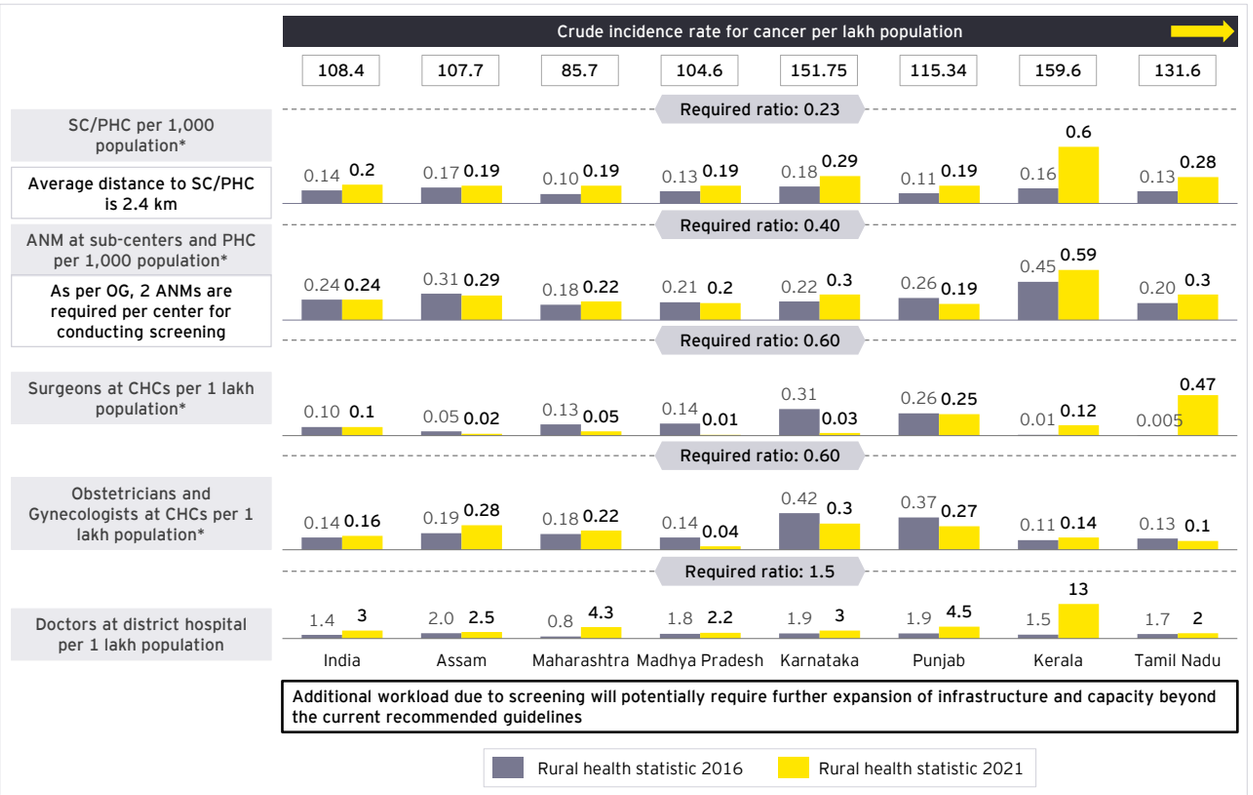
Source: Report by MOHFW on Ayushman Bharat health and wellness centres 2022

So far in the last two years, despite the lockdown imposed and other challenges across the nation due to COVID-19, a steady increase in screening numbers across the three cancers at the HWCs is worth noting. However, the target set in the operational guidelines for screening, detection and prevention of hypertension, diabetes and common cancers, is to cover a total population of 50% in the first year, cumulative 65% of population in the second year and a cumulative 80% population in the third year in each SC and PHC.

2. Lack of capacity of workforce:

According to rural health statistics report, 2021, as of March 2021, there is a shortage of 2.9% of female health worker/ANM due to shortages in states like Gujarat, Himachal, Rajasthan, and Tripura. Lack of female health worker directly impacts the screening coverage for breast and cervical cancer screening due to social and privacy reasons. In medical officers, there is a shortage of about 4% MO's as against the proposed at PHC level.

Chart 25: Human resource gap in Indian public healthcare ecosystem



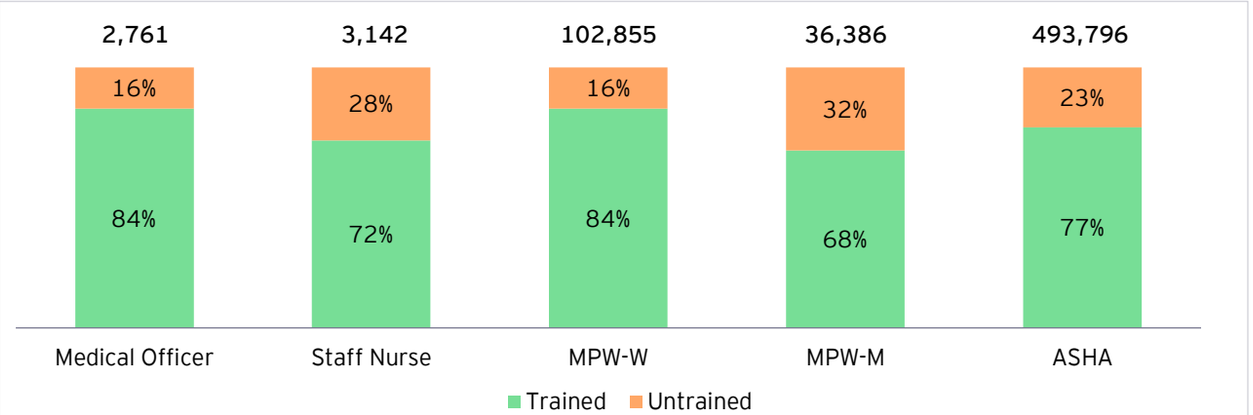
Source: Rural health statistics, 2020-21; EY analysis

Lack of adequate training of workforce

A trained healthcare professional can perform cancer screening methods that are recommended for all three cancers in India. Since these screening tests are based on observation, they have a high reliance on the skill set of the healthcare professional. Training of healthcare workers, therefore, becomes extremely important in ensuring effective screening. Of the existing workforce deployed at HWCs across the country, 26% remain to be trained to conduct screening tests.

Amongst the ASHA workers who form the core of the public health program in India, at least 23% need to be trained for screening patients for NCD's including cancers. Of the 2,761 medical officers posted in these centers, almost 16% need to be trained with regards to the screening program and methods of screening.

Chart 26: No. of trained HWC staff for prevention, screening, and management of NCDs including cancer



Source: Towards universal health coverage, report by MoHFW April 2018- Nov 2020

Challenges in the referral network

The two pillars of a screening program —early diagnosis and fast commencement of treatment — can help improve the outcomes. The referral network thus becomes an important part of the program. Any delays at this level, defeats the purpose and efforts put into screening and early detection. In India, CHCs and district hospitals need to have the available staff and technology to confirm a diagnosis and start the treatment for positive cases. Gaps in implementation of the NPCDCS program and lack of adequate technology or equipment to enable the specialists to make a diagnosis are all limiting factors that need to be addressed.

Table 15: Implementation of NPCDCS program at CHC and DH

	CHC		DH	
	NPCDCS Implemented (n=281)	NPCDCS Not implemented (n=105)	NPCDCS Implemented (n=290)	NPCDCS Not implemented (n=44)
Availability of NCD clinic (including cancers)	49.5%	1.9%	60.3%	61.4%
Routinely undertaking Screening for				
Oral cancer	38.1%	23.8%	60.3%	52.3%
Breast cancer	39.1%	22.9%	58.3%	59.1%
Cervical cancer	34.9%	20.0%	52.8%	59.0%
Availability of technology to screen cancer	NA	NA	9.7%	13.6%

Source: National non-communicable disease monitoring survey 2017-18

Diagnostic infrastructure gaps at CHC and DH level are worrying. ICMR, MoHFW and National Center for Disease Information and Research, Bengaluru conducted the National Non-Communicable Disease Monitoring Survey from 2017 to 2018 with 415 CHCs and 335 district hospitals across the country. As per survey results, 27% CHCs and 13% of DHs had not implemented NPCDCS. The implementation of NPCDCS at the district hospital level highlighted that less than 10% of the facilities had all tools for cancer screening.

Knowledge, Attitude and Awareness

One of the major shortcomings in the healthcare ecosystem is the lack of understanding, acceptance, and practice of cancer screening regime within the healthcare practitioners (HCPs).

Table 16: Knowledge and Practice (KAP) of breast cancer signs, symptoms, risk, and practice of Breast Self-Examination (BSE) study done in HCPs across Indian cities

Study	Year	Knowledge and practice of BSE by HCP	Knowledge of risk factors	Signs and symptoms	Knowledge of BSE	Practice BSE
Kalliguddi et al.	2017	Bengaluru, Karnataka	58%	60%	18%	10%
Dahiya et al.	2018	New Delhi	60%	66%	59%	49%
Singh et al.	2018	Chhattisgarh	60%	40%	19%	10%
Yambem and Rahman et al.	2019	Gangtok, Sikkim	39%	29%	46%	41%

Such low percent of HCPs knowing and practicing BSE reflects the need to educate and train HCPs as well and address the social taboo associated with BSE.

Even for cervical cancer, a high number of healthcare professionals cited various reasons — fear of detecting a disease, perception of pain incurred during examination, being uncomfortable during an internal examination — for hesitating to get an examination done on themselves.

Table 17: KAP study done in HCPs across India for cervical cancer

Study	Year	State	Knowledge of Pap Smear as screening method	Knowledge about VIA as screening method	Never undertaken an exam for self
Gedam JK and Rajput DA. (study done in nurses)	2017	Mumbai	65.60%	11.01%	74%
Narayana G, Suchitra MJ, Sunanda G, et al. (study done in OBGY dept)	2017	South India	2%	52.10%	86.6%
Khanna D, Khargekar N and Budukh A. (study done in CHWs)	2019	Varanasi	46%		92%

Awareness and screening coverage in community

The government conducted a baseline survey in Assam, India, as part of the Detect Early and Save Her/Him (DESH) program, a mobile screening program for breast, oral, and cervical cancer. Data were collected on participants' cancer knowledge, and attitudes towards screening, diagnosis, and treatment.

Table 18: Findings of DESH program

Findings	%
Not aware of cancer screening facility or undergone screening	92.9%
Consumption of beetle nut	90.0%
Aware that beetle nuts cause cancer	46.90%
Negative stigma about Cancer diagnosis	42%-57%
Believed that Cancer is punishment from God	<30%
Fear of Cancer screening	<20%

Source: Cancer screening program in low and middle income countries -Strategies for success

These results highlighted the stigma behind cancer and misconceptions about the disease and screening practices. It highlights actionable targets for intervention in cancer education with a large rural community. Education to address preventable causes of cancer and to correct misconceptions and stigma is a critical component in ensuring the successful implementation of cancer screening programs.

Oral cancer remains the least diagnosed cancer amongst the three, even though factors associated with privacy for screening and socio cultural taboos, which are generally associated with breast and cervical examination, are absent when it comes to oral cavity examination. The discussions with clinicians regarding oral cancer highlighted that men do not come forward for oral cancer screening due to fear of not being accepted in the society on account of disfigurement caused by surgeries, inability to afford treatment including plastic surgery as well as fear of loss of income. Another study suggests that ignorance and lack of positive attitude towards cancer screening could also be a reason for low number of women turning out for cancer screenings, who live and seek permissions from the men in their household to step out of the house.

As per NFHS-5, screening behavior does not change much across various wealth percentiles, caste, or religion. However, Sikh and Muslim women tend to be reluctant to get breast and cervical cancer screening done. On the other hand, men and women from the highest wealth percentile and in older populations have better cancer screening practices. In men, however, oral cancer screening practices are low across all parameters, therefore indicating that affordability is not the only reason for low screening numbers.

Affordability and financing related challenges

All states have relied largely on the funds provided through the National Health Mission, and some states have mobilized funds from other pool like State Funds, District Mineral Funds, Panchayati Raj Institutions Funds etc., to operationalize HWCs. However, mobilization of funds from state

to district was quite often delayed, as per the AB-HWC evaluation report 2021.

For affordability standpoint, while the screening and treatment in government hospital is free or at a minimal cost, this isn't the picture in the private sector. About 51% of the population in India prefers to get treatment done in a private institution. With the high cost of diagnostics and cancer treatment in India in the private sector and only 10-12% private insurance penetration, the proportion of OOPE incurred for cancer treatment is huge. This is also a limiting factor for some families to avoid screening tests for cancer unless the symptoms start appearing. This leads to late-stage diagnosis and poor outcomes in terms of mortality and morbidity.

NOTE: In a survey conducted by EY, 62% of the people incurred OOPE for a screening test. 20% (300 people out of 1,500) respondents who did not undertake a screening test said that high OOPE was the reason for not getting screened for cancer.

Findings of EY survey on cancer screening

We conducted a survey to understand the knowledge of people regarding cancer screening methods and their willingness to get screened. EY conducted the survey across Tier 1 (53%), Tier 2 (43%) and Tier 3 (4%) cities, where the total number of respondents was 1,034, of which 90% were between 20 to 40 years of age.

Chart 27: Are you aware of any specific cancer screening test?

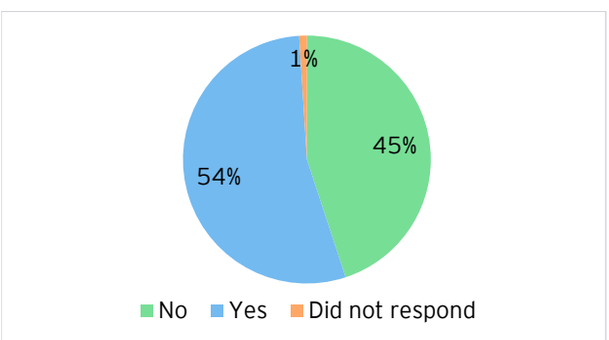
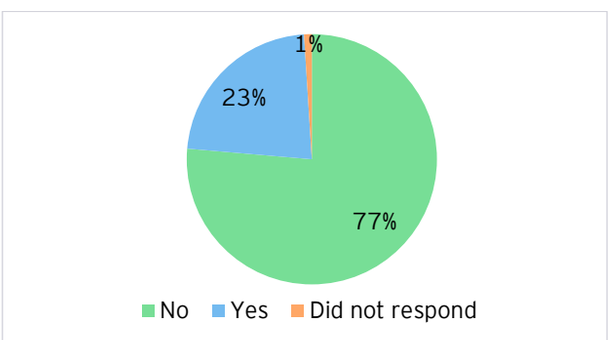


Chart 28: Have you or your family undertaken any cancer screening test?



Out of 804 people who responded, 45% of the respondents were not aware of any cancer screening tests and 77% of the responders said they or their families have never undertaken any cancer screening test so far. Respondents mentioned about tests like PAP smear, colonoscopy, mammogarphy, PSA and self breast examination as possible screening tests that they were aware of.

This not only indicates lack of awareness but also lack of willingness to undertake any screening test. Out of the 23% people who had taken any cancer screening test, 62% said that they incurred out-of-pocket expense to get the screening done. Out of the 21% repsondents who did not incur any out-of-pocket expense, 65% got screening done under the government screening program and the rest of them used their private insurance to get the test done.

Chart 29: Did you incur out-of-pocket expense for screening tests?

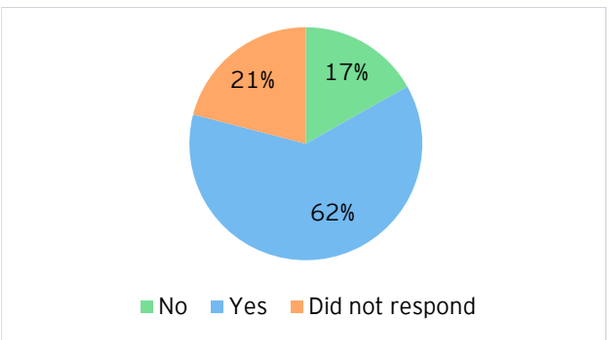
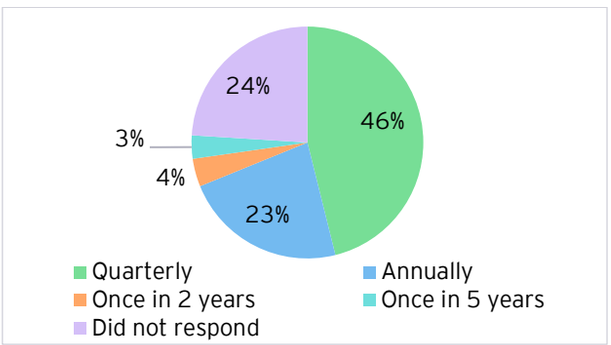


Chart 30: How frequently did you undertake screening?



We also explored the reasons for not undertaking any screening tests. Lack of awareness about the benefits of cancer screening was the major reason cited by 38% of the responders and 11% saying they did not know about possible options available for screening. Only 5% people did not undertake a test because of lack of availability of nearby screening center. High cost associated with OOPE for these test was a reason for 16% people, and 4% said that social stigma associated with cancer screening tests de-motivated them to get a screening done.

Learnings from around the world

Challenges	Learnings from around the world
Infrastructure and capacity restraint 	**Increasing demand for screening programs:** One of the key areas of concern for India is the lack of utilization of primary care and early detection services. To be effective, the population needs to be actively engaged in understanding the benefits of early detection. There is scope to use multiple channels to address this — in the UK, the NHS and local GPs send out regular reminders to registered patients for screening tests e.g., mammography. **Robust data collection on screening and incidence:** Most developed countries like US and UK have a very robust mechanism to monitor and track patients screened for cancers. This not only helps in providing continuous health support to patients who have tested positive, but the data can be used to re-iterate strategies and ensure focused programs in areas with low compliances. **M health in cancer screening:** CMC Vellore, WCMC New York, medic mobile, Mumbai and Center for Population Health Sciences, UK, conducted a pilot study in three poor, low health literacy communities, RUHSA, Mungeli (Chhattisgarh) and Padhar (MP) from 2016 to 2018, screening 8686 patients by 25 community health workers and supported by 9 nursing staff at VLHC and sub centers. Each of the community health workers was given a mobile device with low-cost SIM card-based application to collect demographic information, symptoms, behavior, and tests undertaken (either screening or confirmatory) along with the results. Out of 8686 people screened, majority were screened for oral cancer (98%). The positivity rate for cervical cancer was 28% and 5% for Oral cancer. Out of these, 37% and 31% patients came for follow up for the respective cancers. *Benefits of mhealth:* 1. More credibility to CHW 2. End-to-end tracking of respondents at CHW and nursing level from screening to confirmation to treatment initiation and adherence 3. Data collected and traced back to patients who did not appear for confirmatory tests 4. App had a provision to document demographics, symptoms, and risk behaviors along with tests and reports both screened at CHW level and confirmatory at secondary/tertiary care hospital, thereby giving full information access to healthcare providers 5. ASHAs and ANMs used the app for monitoring screening participation, loss of follow up and treatment protocols. The app helped identifying and bridging gaps in community awareness regarding these cancers
Awareness about Cancer screening 	**Overcoming informational barrier and stigma by presenting screening as a health check** The targeted lung health check program in the UK was a pilot project that screened lung cancer patients by framing it as a one stop-lung health check rather than cancer screening. The program registered people aged between 55 to 74 who were smokers in one of the 14 participating GP clinics and invited them for a lung health check at convenient community venues. Mobile CT scanners were kept nearby shopping centers, to minimize transport cost and increase accessibility. Participants were provided information at an early stage. This strategy could also work for women's cancer and breast screening purpose. Providing women, a generic health check on specific days, such as gynecology day once a week/ month will encourage women to report their health issues. The health check for women should include both breast and cervical screening for cancer. Healthcare workers should also educate women about warning signs and symptoms of the disease as well as teach self-breast examination.

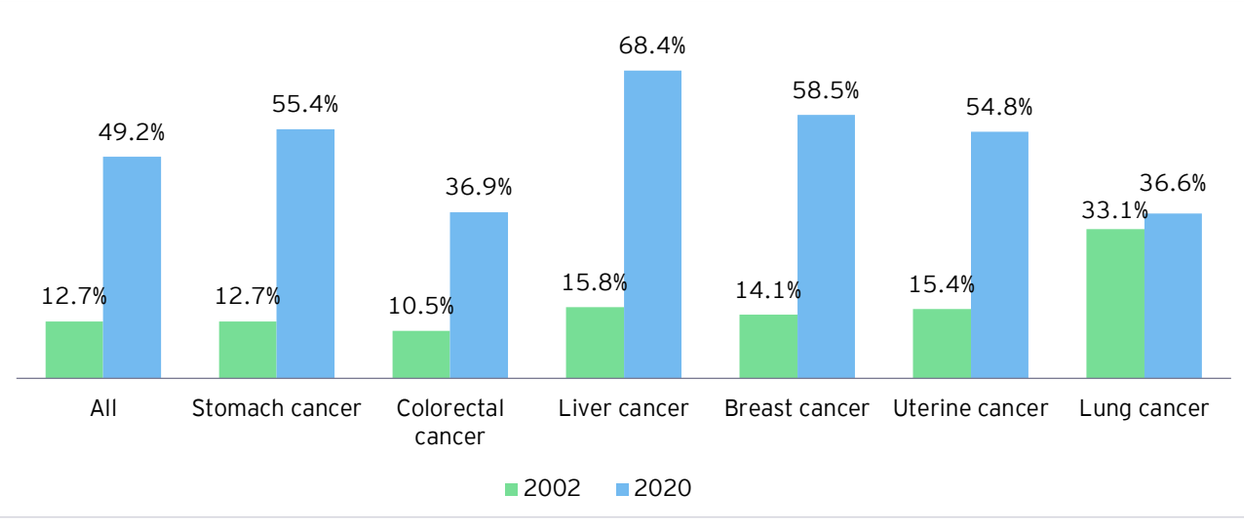
Challenges	Learnings from around the world
Affordability and financing	In 2004, the UK's primary care practices began receiving financial incentives for achieving certain standards in clinical indicators related to chronic disease conditions, showing improvements in several clinical outcomes, especially in diabetes. In the UK, the GP Quality Outcomes Framework (QOF) was used to incentivize primary care screening. In the US, the Affordable Care Act sets out additional incentives/payments to providers to focus on the wellness and prevention agenda.

Sources: Mobile technology and cancer screenings – A lesson from India; govt websites

Learnings from the Korean National Cancer Screening Program:

Korean national cancer screening program is one of the successful screening programs that has shown significant improvement across all cancers in the country. The program started with covering public servants and private school staff in 1980, led to uniform increase in coverage with almost 50% of the people in the bottom of population being covered by national health insurance premiums by 2005. Gradually, the program helped include various communities in the cancer screening program and reduce out-of-pocket expenditure to provide free screenings. Various studies done on the model clearly highlight the importance of national free/insurance led cancer screening program.

Chart 31: Population % screened across South Korea from 2002 to 2020 showing stark improvement in screening penetration across cancers



Source: Cancer screening in Koreans – A focused group approach, Shin young Lee and Eunice E. Lee

Recommendations

Challenges	Recommendations
Infrastructure and Capacity restraint	1. Using the allocated budget for not only opening all 1,50,000 HWCs by December 2022 but ensuring that the centers hire fully trained staff along with adequate representation of trained female staff to educate the people regarding cancer screening and early warning signs. 2. Instituting financial model at the grass root level to incentivize CHO and their teams to conduct effective screenings in their respective areas. 3. Hospitals must leverage technology across the patient journey for effective tracking and monitoring of the screening program. Use of mhealth and robust data collection software or apps empowering the ASHAs, ANMs, MOs and specialists with data regarding the patient. A clinical decision support tool for ASHAs can help in ensuring proper data collection as well as support ASHAs with standard screening guidelines and triaging of patients according to risk level, promoting the most appropriate next steps.

	4. Using AI based triaging and imaging tools to support CMOs and radiologists across centers to address workforce capacity issues. 5. Use of software and IT system to create a seamless referral mechanism highlighting any dropouts or deviations from the pathway to take appropriate actions.
Awareness about Cancer screening 	1. Conduct-focused cancer screening campaigns in communities or localities where screening coverage is very low. For instance, to-do camps in Gurudwaras targeting the Sikh population and encourage them to get screened. 2. Vernacular language should be used in all posters while visually representing various screening methods, signs and symptoms and information regarding different cancers in HWCs. 3. Men have showed low screening participation across all communities as well as in urban and rural areas. Targeted and inclusive education and information dissemination for men will help improve screening uptake for themselves as well as their families. 4. Encourage corporate hospitals to adopt villages to enhance awareness and perform screenings. 5. Corporates and multinational companies can host cancer screening camps in their offices to educate and provide easy access to their staff to cancer screening. They can also support NGOs who promote cancer screening program through outreach activities as a part of their CSR initiatives.
Affordability and Financing 	1. Policy level changes and budget earmarking to include cancer screening as a part of various state and central government health initiatives like the Chiranjeevi scheme in Rajasthan or PMJAY. Inclusion of diagnostic tests for cancer screening as a part of CGHS and ECHS schemes can help utilize private sector infrastructure effectively. Estimates indicate more than 50% of the patients use government schemes in private hospital for their treatment in Rajasthan. This could ease out the burden on public infrastructure and improve efficiencies of the program. 2. Government to encourage private insurance players to cover cancer screening as a part of their offerings.

Use of technology in Cancer screening:

India has seen a major leap in the use and adoption of digital technology in healthcare during the pandemic. From barely using HIS to using a mobile device to capture patient information and make interventions to using AI for diagnosis, innovation in digital health has taken a front seat in the last two years. There are many use cases where technology was used to combat the pandemic around the globe. India also successfully created a track and trace eco-system to ensure the safety and curb the infection rates. There has been enough research and development on the use of technology as an aid to support national programs. Many new startups and innovative companies have designed tools that can help reduce the time for screening of various diseases and provide accurate results. Some companies have worked on seamless pathways for screening, early detection, and treatment of diseases such as cancers to ensure continuum of care. Some such examples are illustrated below to highlight how technology can help resolve challenges regarding accuracy, timeliness and workforce constraints while undertaking a population based national screening program.

Case study on Qure.ai

Qure.AI, an Indian startup, has developed an AI-based lung disease screening tool, which can detect up to 30 abnormal indications in a chest X-ray. They tap into deep learning technology to provide automated interpretation of radiology exams like X- rays, CTs and other imaging techniques. They conducted two studies, one in India and one in Philippines, that significantly improved the case identification of TB patients in the area and reduced the time taken to enroll these patients into a care pathway.

Year/Duration	Location	Sample size	Results
2018 / 18 months	Baran, UP, India	13,000	► Within two months of deployment, TB notification rates went up from 67.8 to 90.14 ► Increase in new TB patient enrolment from 62% to 85% ► Screening turnaround time >2 min ► Reduction in enrolment in treatment by 2.5 days ► Decrease in drop out of presumptive patients to TB enrolment from 72% to 53%
	Philippines	2,00,000+	8,700 TB patients diagnosed were put under TB regime. TB screening results shared in less than 1 min resulted in same day confirmatory test, which otherwise spanned from 0-2 weeks.

Qure.ai has trained this AI algorithm on 35 lakh patient scans to identify at least 30 abnormal lesions including malignant lesions in a chest X-ray. It is now used to screen patients for lung cancer who have already got a chest X-ray done.

Qure.AI in collaboration with AstraZeneca has screened over 46,000 X-rays in 90 countries to identify 8% nodules incidentally.

With diagnostic labs doing huge no. of X-rays in the country for preventive health checks in private hospitals and for TB screening at government level, just having an AI-algorithm screen these X-rays for Lung Cancer can act as a screening tool to investigate further.

Country	Institute	Usage
Malaysia	Qualitas medical group- a GP practitioner- chain	Uses the AI algorithm to triage all chest X-rays taken of local workers, trying to identify incidental lung nodules indicative of cancer.
India	Assam Cancer Care Foundation, Assam	Suspicious nodules are detected though the AI algorithm in chest X-rays taken for individuals screened during door-to-door screening program
India	VPS lakeshore hospital, Kerala	Facilitating early lung cancer changes in all Chest X-rays taken in the hospital

Case study on learnings from CoWIN/COVID-19

To combat COVID-19, government bodies across the world quickly adopted to digital technology to track, trace, and prevent covid infections from spreading. Arogya Setu was a good example of 21.7 crore people downloading the app to be a part of India's mission to fight against COVID-19. It not only tracks and traces the infected patients but also provides information about signs and symptoms, prevention, and treatment protocols to follow. During the first phase of pandemic when there was a lack of understanding about the disease, the app helped people to be informed about their risk status and even undertake an assessment if you felt you had some symptoms. This is the first time we witnessed end to end digitization of the diagnostic players, both public and private, and becoming part of the digital ecosystem developed and monitored by the Indian government.

To fight with the upcoming cancer epidemic, we will need to leverage the penetration of mobile phones to our advantage. Creating a longitudinal, multi-stakeholder platform for registration, screening, treatment, and monitoring will be vital in this process.

Chart 32: Illustrative patient pathway using technology

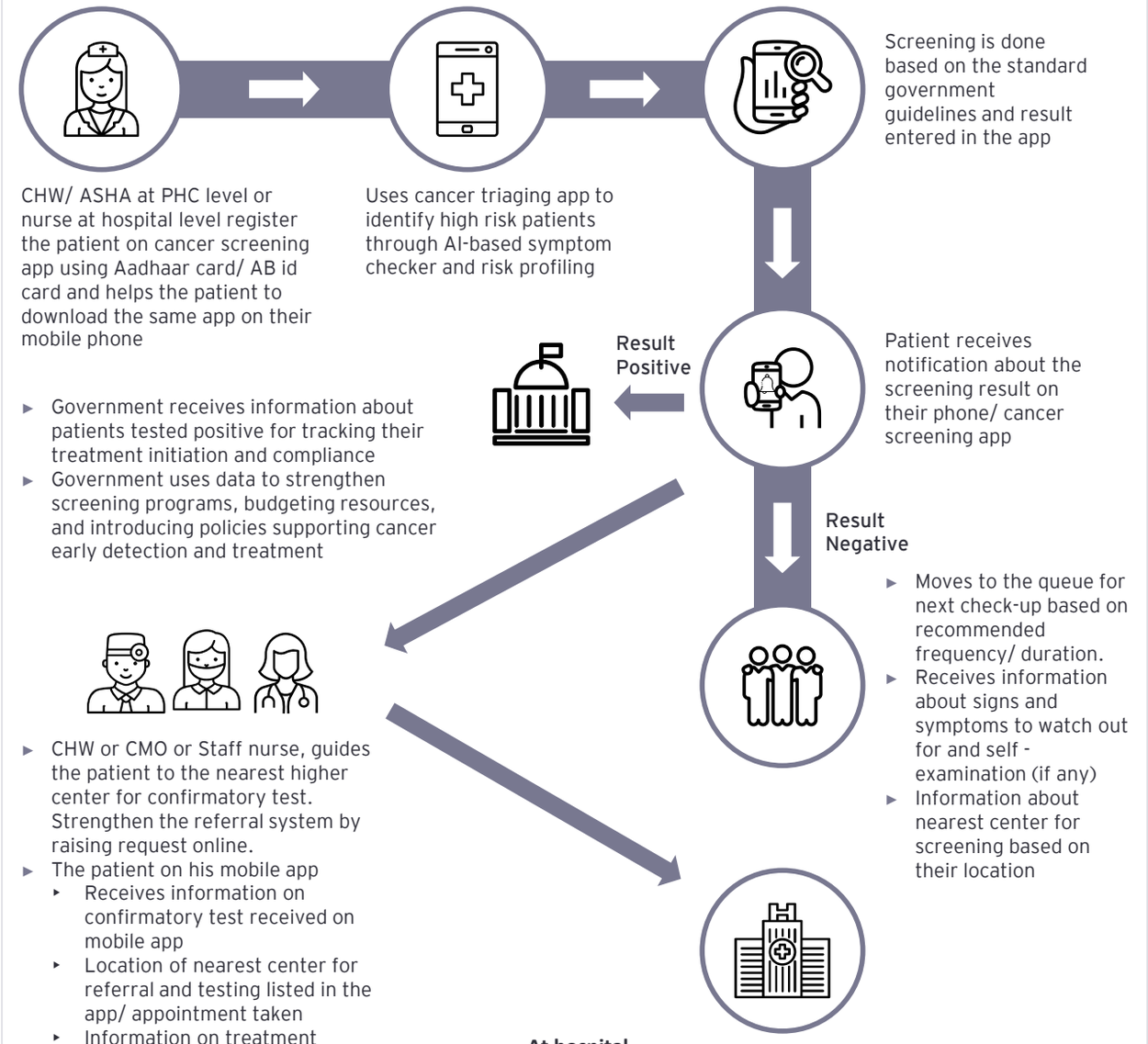


Table 19: Possible technology interventions in the patient journey to make cancer care affordable and accessible

	Challenges	Solution	Technology	Impact	Illustrative examples
 Awareness	Significant gap in awareness about cancer risks, symptoms and warning signs	Awareness generation through targeted messaging	Digital , AI	Patients	**Saathhealth** – adoptive AI powered platform to improve health outcomes **CancerU**- An online membership platform for **cancer** patients and **cancer** caregivers to educate, empower, and engage them to become advocates for their healthcare.
 Screening Method	Absence of testing in screening program	Point of care devices for easy and faster screening	AI, ML	Patients, providers and Community programmes	**Nirmai.AI** – Handheld and home care point of care device used for breast self examination to screen for breast Cancer. **Zilico** – Handheld point of care device for screening cervical cancer, that delivers result in minutes with the quality of a Pap Smear
 Diagnosis	Lack of trained specialists for diagnosis, e.g., radiologist	Machine learning algorithms and clinical decision support tools that can help reduce the specialist's burden	CDSS and ML	Providers	**Qure.ai**- Imaging based AI algorithm that can help identify abnormal lung finding indicative of malignant changes
 Second Opinion	Lack of access to quaternary care settings or expert oncologists across the country	Use of technology for information sharing and second opinion	Digital pathology and telemedicine platform	Providers	**Onward Assist**- AI-based digital pathology **Mfine; eSanjeevni**- Video teleconsultation platform to take a second opinion from renowned oncologist
 Clinical Pathways	Lack of clinical pathway to track the patient journey from screening, diagnosis and treatment	App/ digital platform	Digital platform that cuts across all patient touchpoints	Community programme and providers	**Karkinos** – technology-led platform for oncology that can help patients take a self assessment, supports the patient through the journey of confirmed diagnosis to helping in finding the nearest treatment centers and doctor.
 Patient health record	Lack of a standardised platform not record patient details and medical records to be used across care settings	Automation of patient records, including clinical data and findings	AI	Proivders	**Simbo.AI** – AI-based dr assistant using speech to text technology for intelligent record keeping **Augnito.Ai**- AI-based speech to text technology
 Training	Adequate training for HCP's	Use telemedicine platform to initiate training from experts across public and private organisations	Telemedicine	HCP's	**eSanjeevni** – Video consultation platform used during Covid to train doctors in Tier 1 and 2 cities on covid treatment protocols. Can be used to train ASHA, ANM's and CHO's at HWC's

Chapter 2C: Treatment

(i) Treatment - Access

To provide optimal treatment to patients, there is a need for centers which provide holistic and multidisciplinary treatment options to patients across treatment modalities such as medical, radiation and surgical oncology. Typically, "Comprehensive Cancer Centres" provide all these treatment modalities under one roof and are often supported by robust diagnostic services including radiology services, advanced lab services, such as immunohistochemistry, molecular diagnostics etc., and nuclear medicine facilities.

Comprehensive Cancer Centres in India are skewed towards the Southern, Western and Northern parts of India.

An analysis of centers providing all three modalities of cancer treatment in India highlights that there are 470 to 480 Comprehensive Cancer Centres (CCCs) in India out of which ~200 also provide PET-CT services[44]. Around 25 to 30% of the CCCs are government-owned while the rest are either private or trust-based facilities. Additionally, only 135 - 160 of 681 medical colleges (60% of these 135 - 160 medical colleges are government-owned)[45] offer comprehensive cancer care in India. While there has been an increase in the number of CCCs over the last five to six years at a CAGR of ~8% (in 2016, 275 to 325 CCCs were present in India)[46], there still exists significant geographic skew in access of patients to multi-modal treatment options.

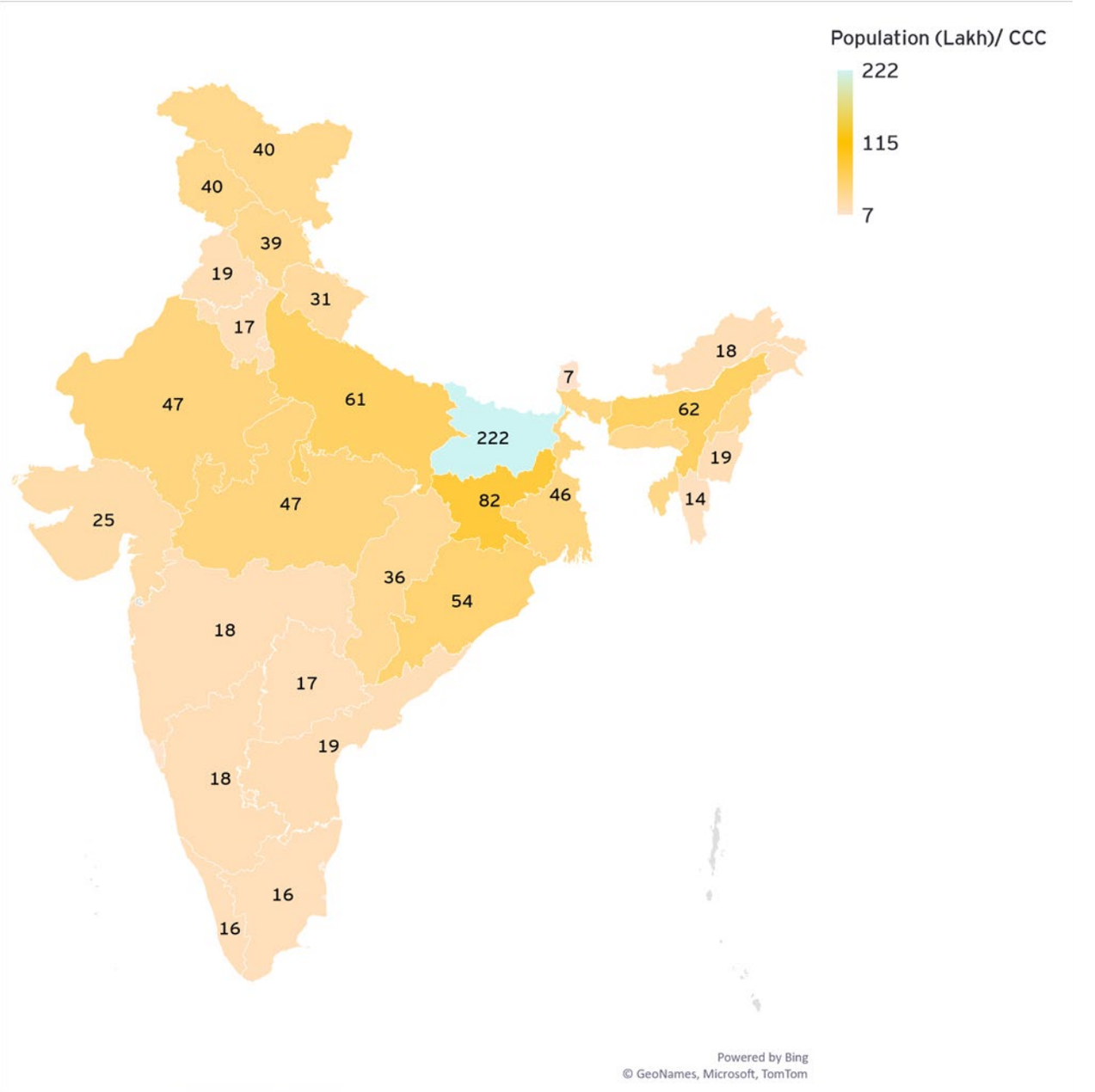
70% of the CCCs are in Western, Southern and Northern India, which has 43% of population. Northeast with 4% of population has around 3% of CCCs. The most underserved areas are Central and Eastern India with 54% of the population but with only 27% of CCCs[47].

Bihar, Jharkhand, Uttar Pradesh, Odisha and **Assam** are the top five states with least penetration of CCCs in India.

> Cancer care in India needs to see penetration in many underserved areas of the country. This area of clinical care is rapidly becoming a strong need for early diagnosis and effective prevention.
>
> **Dr. Nandakumar Jairam**
> Advisor, Sheares Healthcare and independent consultant

[44] "List of Cancer Treatment Centres licensed by AERB", aerb.gov.in, February 2021, "List of Nuclear Medicine Facilities licensed by AERB", aerb.gov.in, March 2021, EY analysis
[45] nmc.org.in, EY analysis
[46] "Call for Action: Expanding cancer care for women in India" FICCI (FLO) EY report, 2017
[47] Census 2001, Census 2011, EY analysis

Figure 4: Map depicting state-wise penetration of CCCs



Source:

1. "List of Cancer Treatment Centres licensed by AERB", aerb.gov.in, February 2021
2. "List of Colleges teaching MBBS and PG Courses", National Medical council, NMC.org.in
3. "Population of India as per census 2011", Censusindia.gov.in, Census2011.co.in
4. EY Analysis

Zone	States
Central	Chhattisgarh, Madhya Pradesh, Rajasthan, Uttar Pradesh
East	Bihar, Jharkhand, Odisha, West Bengal
North	Delhi, Haryana, Himachal Pradesh, Punjab, Jammu and Kashmir, Ladakh, Uttarakhand
Northeast	Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura
South	AP, Kerala, Karnataka, Pondicherry, Tamil Nadu, Telangana,
West	Maharashtra, Gujarat, Goa

The penetration of CCCs is skewed toward metros and state capitals leading to travel and temporary relocation requirement for getting comprehensive cancer treatment.

The top eight major metros (Delhi, Mumbai, Bangalore, Chennai, Hyderabad, Kolkata, Pune and Ahmedabad) contribute to ~30% of CCCs and the rest of the state capitals further contribute ~10% of CCCs. Of the 640 districts in India as per Census 2011, only ~175 districts have CCCs. These 175 districts cover 40% to 45% of the population, thereby necessitating balance ~55% to 60% of population to travel outside their districts for comprehensive cancer care treatment[44].

> Focus needs to be on rapid increase in cancer care infrastructure outside of the top 20 cities in India. Government has good health insurance schemes for the needy. Proper reimbursement rates and prompt payment cycle will encourage private players to set up the infrastructure in the required geographies.
>
> **Rushank Vora**
> Director (Partner), ICICI Venture

With significant growth in incidence and with 40% of new cancer patients[48] requiring comprehensive cancer treatment across all three modalities, it is necessary that India add another 572 CCCs by 2030 for seamless cancer treatment[49]. Considering all reported cancer patients are currently being able to avail treatment, the incremental load forecasted will require an additional 10,000 to 15,000 day-care beds and ~25,000 surgical beds[50]. This will add further pressure on availability of hospital beds, which is ~1.3 per 1,000 people[51] against 2.9 per 1,000 in the US, 4.3 per 1,000 in China and 13.0 per 1,000 in Japan[52]. Industry average capital expenditure per bed 50 to 80 lakhs in metro/Tier 1 cities and 30 to 35 lakhs in Tier 2 cities[53, 54]. Assuming bed addition requirement mainly in Tier 2 cities total capital expenditure for addition of 35,000 to 40,000 beds would range from INR10,500 crores to 14,000 crores[55]. This estimate excludes the cost of land and cost of high value medical equipment such as radiotherapy machines and PET-CT machines. The above estimate is based on cancer incidence crude rate CAGR of ~10%, which considers the impact of increase in screening and diagnosis. At a conservative 5% growth in incidence crude rate, there will be an additional requirement of 7,000 to 10,000 day-care beds and ~12,000 surgical beds requiring an outlay of INR6,000 to 11,000 crores by 2030.[55]

Private sector has made rapid strides in improving access by setting up network of Comprehensive Cancer Centres across different cities in India.

> Cancer incidence across various forms is ballooning. This is happening across age groups. Given the lifestyle patterns this is likely to be one of the biggest focus areas for healthcare. Private investments in helping build diagnosis and treatment capabilities will go a long way in providing better quality lives for cancer patients. Multi-specialty hospitals building cancer care capabilities through linear accelerators, and medical and surgical oncology programs are key to both early detection and treatment.
>
> **Puncham Mukim**
> Managing Director, Everstone Capital

[48] "Call for Action: Expanding cancer care in India", EY, July 2015

[49] EY analysis. Refer Annexure 9 for assumptions

[50] EY analysis. Refer Annexure 7 for assumptions

[51] Protecting India: Public Private Partnership for vaccinating against COVID-19, FICCI EY report, 2020, EY analysis

[52] Hospital beds (per 1000 people), data.worldbank.org

[53] "JST investments- KIMS Hospital – IPO – Review", JST Investments.com, June 2021

[54] "Re-engineering Indian healthcare 2.0", FICCI EY, August 2019, EY analysis

[55] EY analysis

Table 20: Comprehensive cancer network by key players in the private sector

Hospital	Cities	Comprehensive Cancer Centres	Geographical coverage
HCG	19	21 (31 LINAC)	Andhra Pradesh, Gujarat, Jharkhand, Karnataka, Maharashtra, Odisha, Rajasthan, West Bengal
Apollo	12	13 (23-25 LINAC)	Andhra Pradesh, Chhattisgarh, Gujarat, Maharashtra, NCR, Odisha, Tamil Nadu, Telangana, UP, West Bengal
NH	9	10	Chhattisgarh, Jammu and Kashmir, Karnataka, NCR, Telangana, West Bengal
Fortis	7	8	Karnataka, Maharashtra, NCR, Punjab, West Bengal
Manipal	6	6	Andhra, Goa, Karnataka, NCR, Rajasthan,
Max	5	9	NCR, Punjab
Sterling	4	4	Gujarat
Aster	2	2	Karnataka, Kerala
Medanta	1	1	NCR
KIMS	1	1	Kerala

Source: "List of cancer treatment centres licensed by AERB", aerb.gov.in, HCG Investor presentation, August 2022

> Comprehensive cancer care requires early detection infrastructure, leveraging Tumour boards for personalized and effective treatment, and digital interventions geared towards holistic patient engagement. CVC's investment in HCG is towards promoting this philosophy and delivering high quality cancer care at affordable prices. CVC remains keen to play a broader role in India's healthcare sector development.

Amit Soni
Partner, CVC Capital Partners

HCG's Hub & Spoke model

Oncology focused healthcare chain, HCG serves a population base of 64 crore with presence in 9 states and 19 cities through its network of 21 Comprehensive Cancer Centers. Two-third of its Centers are in Tier 2/3 towns. Their flagship unit in Bangalore acts as the hub while the facilities in smaller cities, Tier 2/3 towns act as spoke. This hub and spoke model not only lower the physical movement of patients but also helps transfer the knowledge gained through groundbreaking work done at its Center of Excellence to the spokes. HCG started entering Tier 2/3 cities almost two decades ago and has gradually strengthened all its centers with upgraded technologies, thereby making all its centers comprehensive as cancer care requires a multi-disciplinary approach to treatment. HCG is a pioneer in making Linear Accelerators available in smaller cities, and with total 31 LINAC installations it has established the largest base of LINACs in the country provided by any private hospital chain benefiting large number of cancer patients across the country. To address standardization of cancer care, HCG established central Multi-Disciplinary Tumor Board at its Hub in Bangalore. HCG organizes Multi-Disciplinary Tumor Board reviews every week to discuss difficult and complex cases where over 250 oncologists across India participate. The Centers in Tier 2 cities provide treatment locally with the central medical physicist team in the hub performing the radiation treatment planning. Remote reporting of PET-CT through RIS PAC leverages the talent in the Center of Excellence to provide quality diagnosis and treatment at the spokes. To further ease patient inconvenience of regular travel to seek treatment, HCG is setting up chain of day-care chemotherapy centers. It currently has total of 9 day-care centers in the states of Karnataka, Gujarat and Odisha. The company is expected to launch first day care center with radiation facility in Bangalore in the fiscal year 2025.

Figure 5: HCG's Multi-Disciplinary Treatment (MDT) approach that ensures better outcomes for each patient

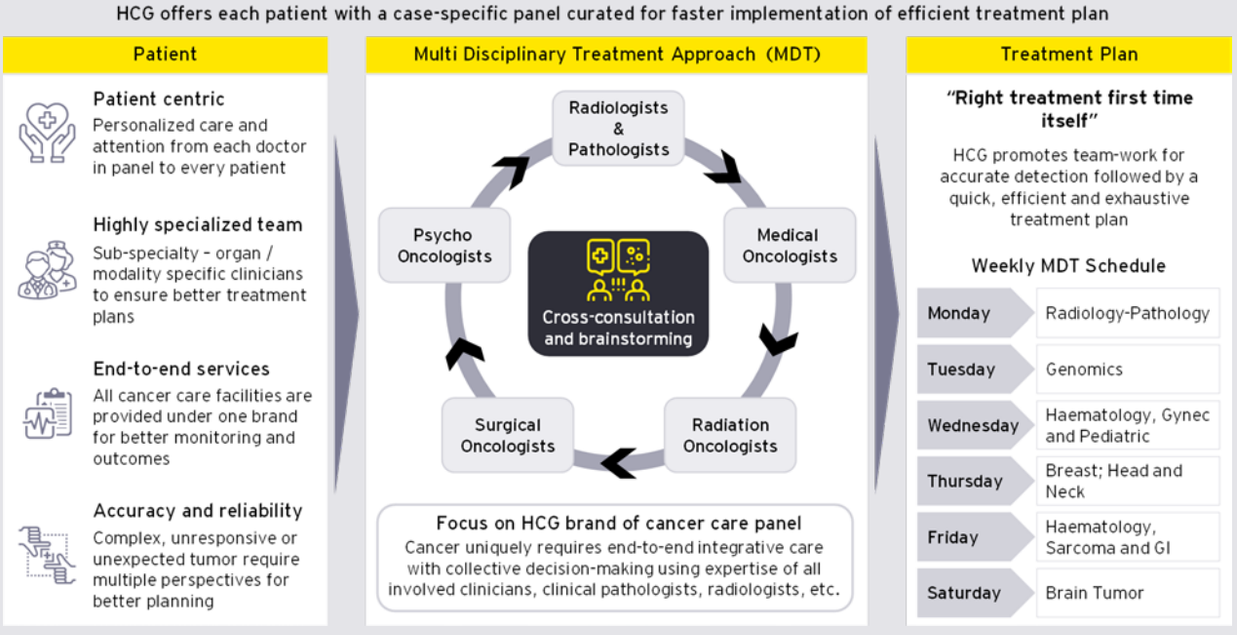
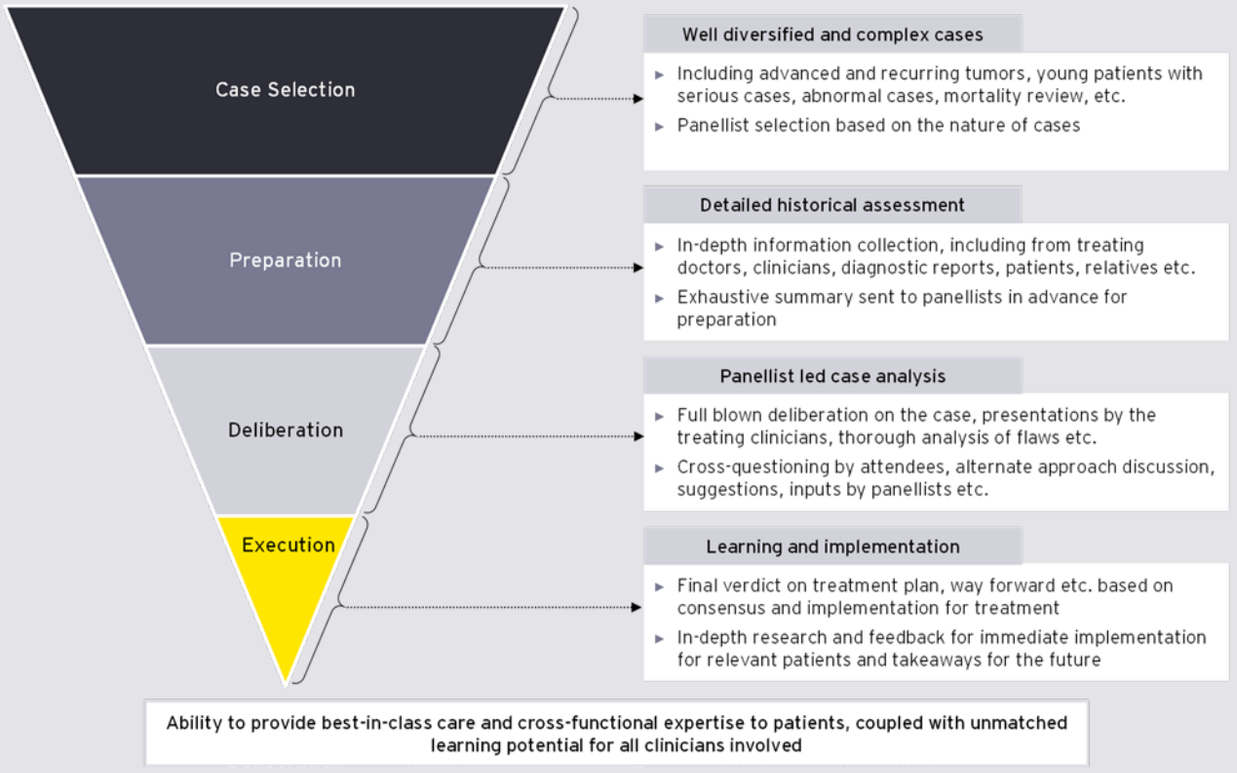


Figure 6: HCG's class leading Multi-Disciplinary Tumor Board – planned, programmed and result oriented



Medanta's cancer care model

Medanta's Multi-disciplinary Care (MDC) model of cancer treatment extends beyond the usual definition of combining surgical oncology, medical oncology, and radiation oncology. The model builds and increases inter-departmental synergy to optimize treatment for each cancer case through a Disease Management Group, or DMG, that comprises experts from the Cancer Institute and other super-specialties. This mix of clinician changes from case to case depending on the patient's unique needs that are defined by disease progression, co-morbidities, underlying conditions, genetics, and other vulnerabilities.

A typical treatment team includes oncologists, site-specific cancer surgeons, radiation experts, transplant surgeons, reconstruction surgeons, radiologists and pathologists, supported by physicians, super-specialty nurses, dieticians, rehabilitation therapists, psychologists and pharmacists. The DMG draws up the most optimal, holistic treatment plan and ensures 100% execution under one roof thanks to the availability of high-end diagnostics, advanced therapies and cutting-edge robotic surgical technologies.

Medanta's patient-first approach also reflects in its unique architectural planning that places all facilities on the same floor increasing convenience by minimizing patient movement. The hospital also assigns a Case Manager who handholds the patient throughout their treatment journey at every touch-point. The goal is to deliver the best possible end-to-end cancer treatment while also empowering patients to maintain their quality of life.

> Transformation in cancer care will only happen when the government notifies cancer as a notifiable disease, this will help realise the actual magnitude of the burden. The paradigm shift in oncology practice is taking place, one that was technology and clinician dependent, to now a patient centric one, the future is an oncologist for your cancer type. The cancer management teams for your cancer type is a reality today and this ensures superior outcomes, one that enables patients to win over cancer, Apollo Cancer Centres is emblematic to this.

Dinesh Madhavan
President- Group Oncology and International, Apollo Hospitals Enterprise Ltd

To enable the private sector to further access, the government should provide required capital support through Viability Gap Funding (VGF) / Public Private Partnership (PPP).

Odisha government in 2018 launched an affordable healthcare project with an aim to set up 100 to 200 bedded hospitals in 25 identified locations through PPP model[56]. The private players will design, finance, build and operate the hospital for period of 32 years before transferring the asset to the government. The Government in turn will provide unencumbered land, facilitate approvals, and provide viability gap funding support for the first 5 years of operations.

- For 100 bedded spokes, a fixed viability gap fund of INR14 crores, Maximum additional viability gap fund of INR79 crores and fixed grant of INR6 crore at attainment of operational capacity
- For 200 bedded hubs, a fixed viability gap fund of INR51 crores, maximum additional viability gap fund of INR118 crore and fixed grant of INR15 crore at attainment of operational capacity

Similarly, to encourage private investment in Tier 2 and Tier 3 cities and to treat patients under PMJAY, the Indian government launched a Viability Gap Funding (VGF) scheme[57] under which private players will be incentivized with land allotment, facilitated with various clearances within specific timelines and 40% VGF of project costs. Under the scheme, private players are expected to build, design, finance, manage, operate, and maintain the facilities with quality standards and provide services under PMJAY.

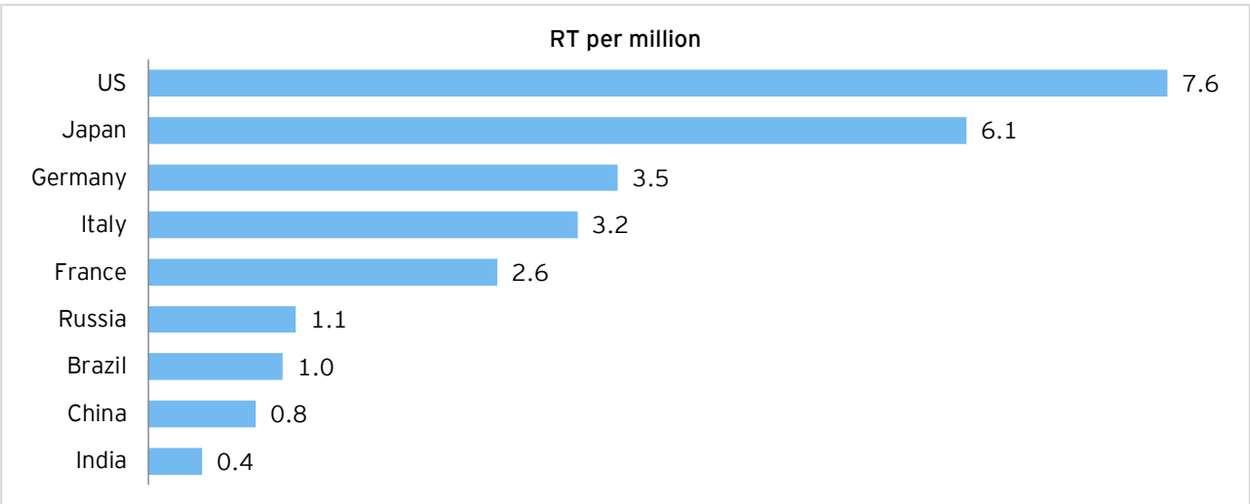
While these VGF schemes seem to incentivize private players to invest in Tier 2 and Tier 3 markets, we are yet to see success stories emerging out and there has been no notable mention of project completions under the schemes till date. Faster decision making by government authorities in granting approvals under the schemes would be a key enabler to drive capacity creation at the last mile.

Penetration of Radiotherapy (RT) equipment closely follows that of CCC distribution. As of 2021, the number of RT per million population stands at 0.4 against the WHO recommendation of 1 per million.[58]

Developed countries such as the US, Japan, Germany, Italy, France have RT equipment penetration of 2.6 to 7.6 RT per million population while fellow BRIC nations – Brazil, Russia, China are in the range of 0.8 to 1.1 indicating significant need for addition of Radiotherapy equipment in India given that 50 to 60% of cancer patients require radiotherapy treatment as per International Atomic Energy Association (IAEA) guidelines.

[56] "Affordable Healthcare Project" Odisha.gov.in, September 2019
[57] "Broad Guidelines for Private Investments in setting up of Hospitals in Tier 2 and Tier 3 cities subsequent to PMJAY", Press Information Bureau, Pib.gov.in, January 2019
[58] Munshi A, Ganesh T, Mohanti BK. Radiotherapy in India: History, current scenario and proposed solutions. Indian J Cancer. 2019 Oct-Dec;56(4):359-363. doi: 10.4103/ijc.IJC_82_19. PMID: 31607709, EY analysis

Chart 33: Penetration of RT equipment across different countries



Source: "World population", worldpopulationreview.com, "Directory of radiotherapy centres", Dirac.iaea.org, EY analysis

While WHO recommends a norm of 1 RT equipment per million population[58], an assessment of factors, such as current and future cancer incidence projection of India, typical RT equipment productivity (i.e., number of patients to be treated per machine) and minimal distance required to be traveled by patients to avail treatment also highlights that 1 to 2 RT equipment would be required per million population.

Chart 34: Framework for assessment of optimal RT requirement basis machine capacity, number of fractions per patients and incidence of cancer

2022	2030
On average, 70 -100 fractions are done in each RT per day	On average, 100 fractions are done in each RT per day
@25 fractions per patients, 560 - 800 new patients can be treated per annum	@20 - 25 fractions per patients, 800 - 1000 new patients can be treated per annum
With 60% of new patients eligible for RT. 950 – 1,350 cancer patients can be addressed	With 60% of new patients eligible for RT. 1,300 – 1,700 cancer patients can be addressed
With incidence of 120 per lac, 7.5 - 11 lakhs population can be addressed	With incidence of 260 per lac, 5 – 6.5 lakhs population can be addressed
~1 per million	~1.5 – 2.0 per million

Source: EY analysis

With availability ~640 RT installations in the country currently, **there is a requirement of ~850 to 900 additional RT installations in the current state**[59] to meet the population coverage criteria which is expected to further grow given the expected increase in the number of cancer cases in the next decade.

Even with newer technologies enabling quicker methodologies to treat the patients with 20 fractions against 25 fractions with the same equipment[63], the number of RT equipment/ million requirement will still move from 1 per million to 1.5 to 2.0 million in the next 8 to 10 years.

[59] EY analysis. Refer Annexure 5 for assumptions

In absolute terms, we need to add another 890 RT equipment immediately and ~3,200 RT equipment by 2030[59] considering ease of access to patients, optimal utilization of equipment, and operational life of the equipment. The addition of 50 to 60 RT per annum[60], which is the current trend, will not address the wide gaps that the country is facing today or expected to face going forward. There is a need for an **average addition of ~400 equipment every year**[59] for the next eight years to bridge the demand-supply gap. It is pertinent to note that if all 681 medical colleges in the country add LINACs to the tune of 500 to 550 installations, there will be availability of RT equipment in ~334 districts out of 640 districts[59] in the country which is a near two-fold increase in the district coverage of RT equipment vis-à-vis current state (currently ~175 districts are being covered by RT equipment).

Further basis discussions with key radiation oncologists, therapies such as IGRT, IMRT, 3D CRT (Level 3) can manage 80 to 85% of RT cases while another 10% will require therapies such as VMAT (Level 2) and only 5% of cases require advanced therapies, such as CyberKnife, Gamma Knife, SBRT, and Tomotherapy (Level 1). Therefore, in order to drive effective utilization of installed equipment, efficient capital management, efficient deployment, and utilization of available skilled clinical resources, the government can consider a three-tier model, wherein they ensure level 3 LINAC in each district cluster with >10 lakh population and a level 2 equipment for three such clusters and Level 1 equipment in state capitals and key cities such that it forms 5% of the total installed capacity.

The addition of equipment, even in a tiered model, requires huge capital outlay, which is estimated in the range of ~INR40,000 to 45,000 crores with LINACs costing anywhere between INR12 to 20 crores[61, 62] depending on its features and functionalities. The capital outlay covers the cost of the imported equipment and associated 30% import duty. Additionally, the healthcare service provider needs to invest in physical infrastructure to house the equipment in line with AERB requirements.

Table 21: Summary of RT Equipment and capital outlay requirement

Type of RT Equipment	2022		2030	
	Count required	Capital Outlay (INR Cr)	Count required	Capital Outlay (INR Cr)
Level 3 (IGRT, IMRT, 3D CRT)	750-800	9,300-10,000	2,650-2,700	33,100-33,700
Level 2 (VMAT)	65-70	1,050-1,150	300-320	5,000-5,300
Level 1 (CyberKnife, Gamma Knife, SBRT, Tomo)	55-60	1,150-1,250	170-175	3,500-3,650
Total	850-900	11,500-12,400	3,100-3,200	41,500-42,650

Source: EY analysis

The count required can be further optimized by ~20% if we are able to treat patients with lesser number of fractions (@20 against the current @25)[63]. The count required has been computed assuming complete utilization of LINAC with ~100 patients getting treated per day. Underutilization of equipment with ~50 patients getting treated per day would take the LINAC requirement to twice of what has been estimated in the above table.

The above estimate is based on cancer incidence crude rate CAGR of ~10%, which considers the impact of increase in screening and diagnosis. At a conservative 5% growth in incidence crude rate, there will be an additional requirement of ~2,200 RT equipment by 2030 mandating an average

[60] EY analysis

[61] "In Pune, Rotary International's first woman president says India is now a 'help-giving nation'", ww.indianexpress.com July 2022

[62] "Kamakshi Hospitals gets radiotherapy facility", www.hindu.com, August 2021

[63] Tibdewal, Anil et al. (2022). Impact of the First Wave of COVID-19 Pandemic on Radiotherapy Practice at Tata Memorial Centre, Mumbai: A Longitudinal Cohort Study. JCO Global Oncology. 8. 10.1200/GO.21.00365

annual addition of ~275 equipment every year with a minimum capital outlay of ~30,000 crores.[59]

> Early screening, access to high-quality advanced diagnostics coupled with personalized healthcare (precision medicine) can help in delivering equitable and better patient treatment outcomes in cancer patients. Precision Oncology Diagnostics will play a pivotal role in guiding physicians/oncologists to make effective treatment decisions at the right time, increasing the chances of patients' survival, and reducing the economic burden of patients on treatment costs. Besides, we need to address the lack of awareness among masses on the diagnosis and treatment front. Collaboration between government stakeholders and private healthcare players across the ecosystem can help in addressing this critical gap. 'Affordable' cancer diagnostics and treatment is another crucial area which needs to be looked upon, as this has been a bottleneck in delivering quality cancer care for all.
>
> **Ameera Shah**
> MD, Metropolis Healthcare Limited

The availability of screening, diagnostic and treatment support equipment, such as CT, PET-CT and Mammography, is also highly under-penetrated in India requiring significant ramp up.

There is a wide usage of CT for cancer detection and treatment in many ways. It is helpful in cancer screening, diagnosing the presence of tumor, cancer staging, guiding biopsy procedures, guiding local treatments, such as radiofrequency ablation, planning external beam radiation therapy/ surgery and determining response to treatment. India has ~5 CT scanners per million population compared to 40 in high-income countries and ~13 in upper middle-income countries[64]. Further, there is a skew towards Top 8 Metros contributing to ~23% and state capitals another 10%.[65]

PET-CT can help in making more accurate diagnosis, thereby helping in better treatment planning leading to improved outcomes and survival rate. Unlike CT and MRI, which show anatomic detail, PET images show biochemical or physiologic phenomena. PET can often distinguish between benign and malignant lesions which CT and MRI cannot. Studies typically have indicated 4% to 15% improvement in overall accuracy of staging/restaging and a 30% to 50% improvement in the confidence of lesion localization[66]. India has 0.25 PET-CT scanners per million population[67] while the developed countries such as the US, Australia and many West European countries have 3 PET-CT scanners per million population[68]. While high capital expenses are a major inhibitor in equipment addition, operational challenges and expenses are a barrier to scale up as follows:

- AERB regulation mandates trained staff for nuclear medicine facilities operating PET-CT equipment. With limited medical colleges having a PET-CT, trained staff are in short supply. 14 colleges offer 67 MD-nuclear medicine seats and 13 colleges offer 35 DNB – nuclear medicine currently[69].
- With not all the PET-CT service providers having in-house cyclotron for isotopes (there are only 19 medical cyclotron facilities[70] in the country), extensive air connectivity becomes key, as isotopes need to be supplied within 3 to 4 hours. Given the low half-life of the FD-G (~110 minutes)[71], wastage is on the higher side.
- Radiopharmaceuticals were part of Schedule K of Drugs and Cosmetics Act and Rules (As amended up to the 31 December 2016)[72]. The

[64] "Computed tomography (CT) scanners", data.oecd.org

[65] "List of Licenced X-ray facilities", aerb.gov.in, Aug 2022, EY Analysis

[66] Griffeth LK. Use of PET/CT scanning in cancer patients: technical and practical considerations. Proc (Bayl Univ Med Cent). 2005 Oct;18(4):321-30. doi: 10.1080/08998280.2005.11928089. PMID: 16252023; PMCID: PMC1255942

[67] "List of Nuclear Medicine Facilities licensed by AERB", aerb.gov.in, March 2021, EY analysis

[68] PET Scanner (per 1 million) humanhealth.iaea.org

[69] Accr.natboard.edu.in, nmc.org.in

[70] Sharma 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

[71] Fludeoxyglucose F 18 Injection, www.accessdata.fda.gov

[72] "Drugs & Cosmetics rules, 1945 (As amended up to the 31st December,2016)" Ministry of Health and Family Welfare

act exempts the items under Schedule K from measures covered in the Chapter IV. The treatment of radiopharmaceutical items in the Drugs, Medical devices and Cosmetics Bill, 2022[73] will be clear with the introduction of the new bill in parliament. If the new bill makes batch controls and drug licenses mandatory, it will further impact the operating cost incurred by nuclear medicine facilities.

- While PMJAY covers PET-CT, some of state insurance schemes (MJPJAY, Telangana Arogyashri, Arogya Karnataka, Swasthya Sathi) have no provision to cover PET-CT related expenses as part of the scheme reimbursement separately[110, 109, 112, 107]. Consequently, often centers providing treatment under these schemes do not offer PET-CT scanning as part of the diagnostic protocol, which not only inhibits demand and hence investment in capacity creation but it also likely to impact clinical decisions on right treatment protocols and hence outcomes. Also, while private health insurance policies, with provision of claiming pre and post hospitalization expenses, might cover for PET-CT but in most cases, the insurers do not provide cashless coverage for PET-CT services. Additionally, patients covered under private insurance policies are in most cases unable to claim for PET-CT services if the hospitals do not admit them as IP patients.

On a conservative basis, if we assume 50% of new cancer patients require PET-CT with each one of them requiring three scans for staging, interim response evaluation, and response evaluation at treatment completion[74], we require a total of 480 PET-CT systems currently and ~1,200 PET-CT systems by 2030. With ~360 installed PET-CT facilities[67], this will translate to incremental requirement of 120 PET-CT systems immediately and 840 PET-CT systems by 2030[75] at a capital outlay of INR700 to 850 crores[76] immediately and INR5,000 to 6,000 crores by 2030. While this estimate is based on cancer incidence crude rate CAGR of ~10%, even at a conservative 5% growth in incidence crude rate, there will be an additional requirement of ~460 PET-CT equipment by 2030 requiring a capital outlay of ~3,200 crores[75]. Coverage of PET-CT service as a separate procedure for reimbursement under all government sponsored schemes as well as inclusion of PET-CT in OPD setting with cashless reimbursement under private health policies will be one of the key enablers to attract investment in PET-CT capacity creation for the country.

Mammography, another equipment, used for screening and diagnosing breast cancer can help reduce deaths from breast cancer among women aged 40 to 74 years at who are at average risk of breast cancer, with the evidence of benefit being strongest for women aged 50 to 69 years[77]. India has ~1.7 mammography equipment per million[65] population compared to 70 in the US, 65.1 in Korea, 33.8 in Japan and 20 in Australia[78]. While penetration at the overall level is low, there is a huge skew toward metros, with top eight metros contributing to 35%[65].

Advanced diagnostic tests such as flow cytometry, IHC, cytogenetics and molecular diagnostics, are highly skewed toward the North and Western India having 60% revenue share while East and Northeast being lowest with 18% revenue share. Top 7 metros contribute to 70% to 80% revenue from these tests. Digital pathology is yet to take off in a significant way with the current share being negligible. Huge capital requirement upwards of INR1 to 1.25 crores for scanners is acting as an impediment for adoption of digital pathology[79].

[73] "New Drugs, Medical devices and Cosmetics Bill, 2022", prsindia.org

[74] Khan SH. "Cancer and positron emission tomography imaging in India: Vision 2025", Indian Journal of Nuclear Medicine, Volume 31, Issue 4, Page 251 – 254, 2016

[75] EY analysis, refer Annexure 6 for assumptions

[76] "Cancer imaging using PET-CT: Genesis and current state in India", Express healthcare, Jan 2018, EY Analysis

[77] Elmore JG, Armstrong K, Lehman CD, Fletcher SW. Screening for breast cancer. JAMA. 2005 Mar 9;293(10):1245-56. doi: 10.1001/jama.293.10.1245. PMID: 15755947; PMCID: PMC3149836

[78] "Mammography machines", data.oecd.org

[79] EY analysis

Improving access to cost effective and accurate diagnostics for Tier 2 cities — Dr Lal

Dr Lal PathLabs (LPL) has a strong network of 277 labs, 4,700+ patient service centers and 10,000+ sample pickup-up points covering more than 1,500 cities. LPL offers a wide menu comprising 250 different tests in oncology, of which 190 tests are genomic tests.

Hub and Spoke model: Hub lab with expanded test menu cover all immunoassay and cancer screening tests and services tier 2 cities with quality diagnostics at cost effective pricing.

Digital Histopathology: LPL processes up to 1,400 samples a day at its histopathology center in its National Referral Lab. Histopathology centers are operational at eight different locations.

LPL led the path in 'Digital Histopathology', as the first lab in India to install a high throughput whole slide image digital scanner. This tele-pathology platform holds the key to making histopathology future ready, more efficient, and scalable. The labs across the country can train themselves and prepare histopathology slides and upload these images on the digital platform which the specialists and experts in LPL's histopathology centers can analyze.

Preventive screening for cancer as part of common panels: Test panel includes Prostate-Specific Antigen (PSA) Test, Pap smear, cervical screen, etc., which addresses screening requirement of high-risk group.

Leveraging AI for better accuracy: LPL has partnered with Ibex Medical Analytics to offer a Prostate TRUS Biopsy AI Panel with reflex to IHC that eliminates the need for a second opinion. LPL also utilizes AI for Digital Breast Cancer Panels with quantitative measurements of biomarkers and microphotographs in the report.

Precision oncology, an emerging field which involves molecular profiling of tumors to identify targetable alterations, and which is realized through advancement in genomics and data science, is advisable for all advanced stages of cancers. For 60%+ cases in India, the detection happens in late stages[80, 81], where surgery alone will not help in cancer cure. Of the patients on whom the precision medicine is done, targetable mutation is identified in 30% to 40% of cases for which treatment is available. 80% of these patients who undergo targeted treatment realize excellent outcomes[82].

4basecare is a precision oncology company with a vision to make technology accessible and affordable. The company endeavors to offer the gene test panel at the rate of PET- CT scan, which is about 1/10th cost of gene panel available in the market. It has so far succeeded in reducing the price by 1/4th of market which it has achieved through import substitution of consumables and machinery used in the process and by process and protocol optimization. 4basecare has been able to indigenize part of the process while it still relies on the imports for DNA extraction and sequencing.

75% of the oncologists in the US use genomics as a tool of treatment wherein In India[83], genomics is leveraged only on 1% of eligible population. Insurance companies and the government should play a role in including these advanced tests in their panel and offer coverage. With more information and data being generated on the Indian genome, kind of mutation, treatment and outcome, the treatment decisions in the future could be more data based rather basis empirical evidence as it is today.

With high levels of under penetration, there should be a focus toward encouraging investment towards CT, PET-CT, MRI, mammography and molecular diagnostics. Further, these tests need to be brought under insurance schemes such that

[80] Cancer prevention and control in India, https://main.mohfw.gov.in/

[81] Mathur P, et al. Cancer Statistics, 2020: Report from National Cancer Registry Programme, India. JCO Glob Oncol. 2020 Jul;6:1063-1075. doi: 10.1200/GO.20.00122. PMID: 32673076; PMCID: PMC7392737

[82] Discussions with industry stakeholders

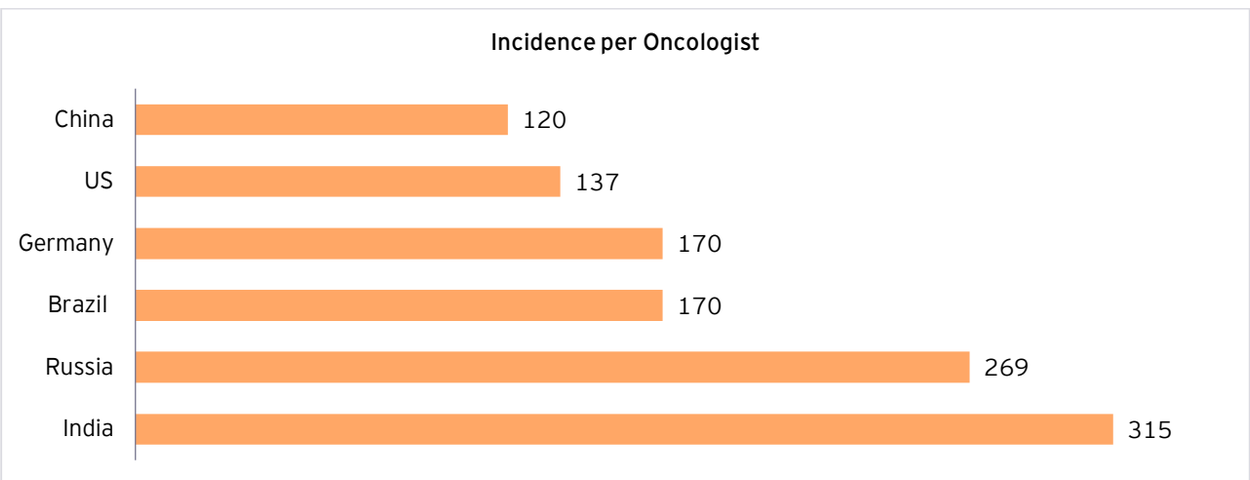
[83] Freedman AN, et al. Use of Next-Generation Sequencing Tests to Guide Cancer Treatment: Results From a Nationally Representative Survey of Oncologists in the United States. JCO Precis Oncol. 2018 Nov;2:1-13. doi: 10.1200/PO.18.00169. PMID: 35135159

patient can avail these services in outpatient setting through inclusion of these services as part of a National Consensus based Standard Treatment Protocol/ Standard of Care.

Incidence per clinical oncologists at 315 is high compared to 120 of China and 137 of the US. While there are adequate radiation oncologists, huge gap is seen in current count of medical and surgical oncologists against the requirement.

With 15 lakh doctors[84] registered with the state and the National Medical Commission, the doctors per 1000 in India are ~1, which is aligned with the WHO norm of 1 per 1000[85]. With the Indian medical education system able to successfully double the number of MBBS positions during the recent decades to 91,927 MBBS seats[86], India shall meet and maintain the WHO norm in the next few years, although geographical skew in the availability of doctors is likely to continue. However, the situation with the availability of oncologists is not encouraging. As per our estimates, there are 3,500 radiation oncologists, ~2,000 medical oncologists and ~1,900 surgical oncologists which is low when compared with global counterparts.

Chart 35: Comparison of incidence per clinical oncologist (radiation + medical oncologists)



Source: "Global survey of clinical oncology workforce", Journal of Global Oncology, 2018, EY analysis

High-level estimates indicate that while current availability of radiation oncologists is adequate, we require additional 2,500 to 3,000 medical oncologists and an additional 700 to 800 surgical oncologists to cater to current incidences[87]. With incidence increasing at a CAGR of 10% to 12% for next eight years, the annual addition of ~240 DM/ DNB medical oncologists and ~280 MCH/ DNB surgical oncologists[69] will be insufficient to address the demand-supply gap. The organ specific fellowship programs offered by RGUHS, RGCI, HCG, NH, Apollo, Tata, Adyar cancer Institute, etc., will help address part of this demand-supply gap.

The demand-supply gap is as acute in medical physicists as in oncologists. There are ~1,550 medical physicists in India, while the requirement is upwards of ~2,100[88]. The gap in demand and supply will widen in the next few years, with demand expected to grow by ~200 per year while effective addition to be at around ~70 per annum[87].

[84] "Protecting India: Public Private Partnership for vaccinating against COVID-19" EY FICCI report, December 2020

[85] Kumar R, Pal R. India achieves WHO recommended doctor population ratio: A call for paradigm shift in public health discourse! J Family Med Prim Care. 2018 Sep-Oct;7(5):841-844. doi: 10.4103/jfmpc.jfmpc_218_18. PMID: 30598921; PMCID: PMC6259525

[86] With 91,927 MBBS seats, 612 medical colleges operative in India: Health minister gives breakup, medicaldialogues.in, July 2022

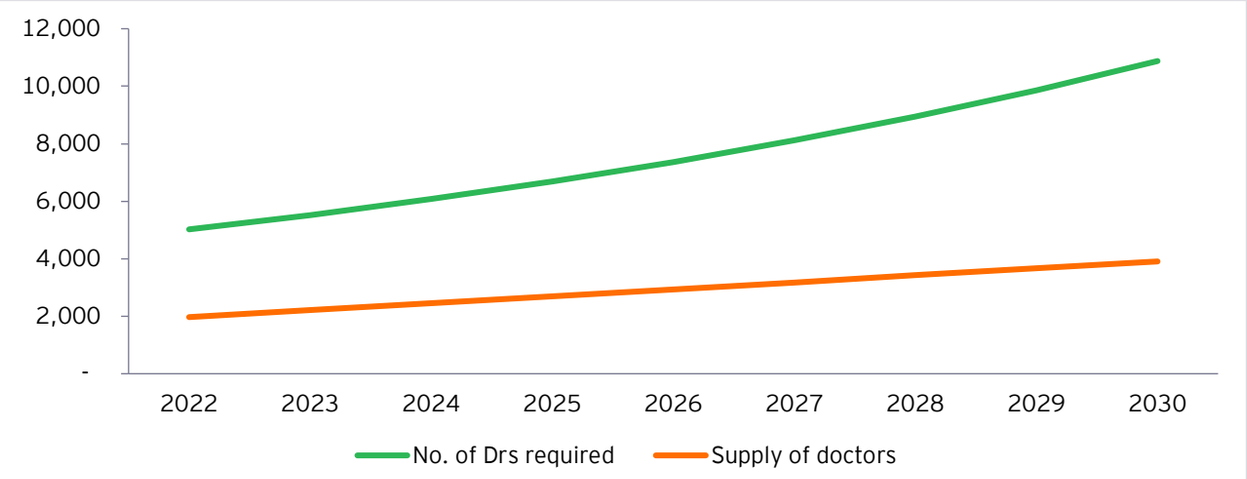
[87] EY analysis, refer Annexure 8 for assumptions

[88] "Radiation therapy sources, equipment and installations", AERB safety code, aerb.gov.in

> While cancer care in India has focused on developing infrastructure, it is equally important to develop skilled specialists and allied doctors such as psychologists, pain specialists, physiotherapists, and patient navigators to help run these units. A space largely ignored in cancer care is the prevention and screening aspect as well as palliative care and rehabilitation. Cancer patients in India deserve the whole spectrum of care, irrespective of affordability and where they live.

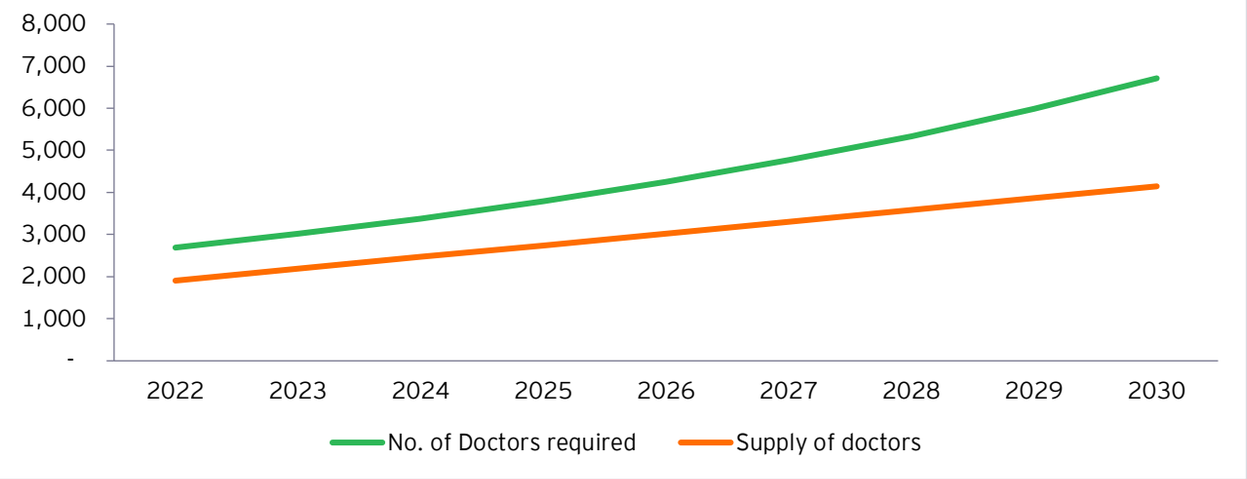
Dr. Shona Nag
Sr. Medical oncologist and Director oncology department, Sahyadri Hospitals Private Limited

Chart 36: Demand-supply gap of medical oncologists



Note: The supply includes only DM and DNB medical oncologists and does not include organ specific fellowship programs
Source: EY Analysis, nmc.org.in

Chart 37: Demand-supply gap of surgical oncologists



Note: The supply includes only MCH and DNB Surgical oncologists and does not include organ specific fellowship programs
Source: EY Analysis, nmc.org.in

The government is trying to ramp up the availability of doctors across specialties by increasing the number of seats through[86]

i. Upgrading district/ referral hospitals to medical colleges (157 such colleges approved).
ii. Strengthening/ upgradation of existing state government/central government medical colleges to increase MBBS and PG seats. Upgradation of government medical colleges by construction of super specialty blocks. In this regard, the government has approved a total of 75 projects.
iii. Setting up the new AIIMS. The government has approved 22 AIIMS and Undergraduate courses have started in 19 AIIMS.
iv. Relaxation in the norms for setting up of a medical college in terms of requirement for faculty, staff, bed strength and other infrastructure.

While these have resulted in 75% increase in UG seats and 93% increase in PG seats from 2014[89], the significant gap and a growing demand in medical and surgical oncologists requires further concerted efforts to bolster access to doctors.

> Over the next 25 years of India's economic growth, we will experience increasing lifespans, high levels of exposure to environmental carcinogens, and unchecked tobacco/narcotics use, all of which will contribute to an explosion in cancer incidence. We must take this opportunity to build a safer future for our children by increasing the number of healthcare professionals and clinical researchers to 10 times from current levels. By doing so, India will be able to replicate the success of the software industry and become a healthcare provider for the world.
>
> **Viren Prasad Shetty**
> Whole-time Director & Group COO, Narayana Hrudayalaya Limited

While it is critical to add more PG seats for medical and surgical oncologists, it is also critical to continuously enhance their skillsets in line with the advancements in technology and emergence of new treatment regimes.

J&J Medical has attempted to enhance access to skilled surgical clinical talent by imparting hands-on training to budding and practicing doctors and mentoring them to clinical perfection with an aim to enhance their surgical skills. To achieve this, J&J Medical established the Ethicon Institute of Surgical Education (EISE) in 1993[90] and currently are present in two locations: Chennai and Mumbai. In 2018, J&J launched the first of its kind institute on wheels to address India's needs in surgical education by reaching doctors at their doorsteps across different Tier 1 and Tier 2 towns. The company is furthering its cause for surgical skill building in the country by investing and partnering with Proximie, a technology platform that uses a combination of AI/ML and augmented reality to allow clinicians to virtually 'scrub in' and collaborate with each other. It further aspires to roll out a tele mentorship program with an algorithm scoring of surgeries w.r.t clinician performance while providing access to mentors and recommendations on improvement areas.

Similar collaborative efforts are required by all the stakeholders involved in providing core or allied oncology services to upskill clinical talent specially in Tier 2 and Tier 3 cities, given the rapid strides in oncology treatment regimens and technology over the last two decades. Some of recent advancement in oncology treatment are illustrated below[91, 92]:

- Targeted therapies becoming part of standard treatment for many cancers in the 2010s
- Minimally invasive and robotic surgeries have become standard for more and more cancers in the past ten years

[89] UG medical seats increased by 75%, PG medical seats by 93% since 2014: Govt, indiatoday.in, March 2022
[90] Ethicon Institute of Surgical Education Commemorates Two Decades of Advancing Medical Education in India", J&J.in, February 2013
[91] "Top 10 medical advancements in cancer research history", Proclinical.com, February 2021
[92] "A Decade of Progress in Cancer Care, and What's Next", Memorial Sloan Kettering Cancer Center, February 2020

- Significant progress made in immunotherapy with the approval of first checkpoint inhibitor in 2011 by USFDA
- Approval of Chimeric antigen receptor (CAR) T cell therapy by FDA in 2017 to treat some kinds of lymphomas and for certain patients with relapsed or advanced leukemia
- Approval of first human cancer treatment vaccine by USFDA with Sipuleucel-T in 2010 and BCG Live and Talimogene laherparepvec subsequently
- Use of liquid biopsies (blood test) in the place of more complicated tissue biopsy
- Dawn of a new era of precision medicine (Personalized medicine) with the first DNA-sequencing test getting approved by the FDA in 2017
- Increasing use of Particle Beam Therapy and SBRT

Continuing medical education platforms need to be provided by ecosystem players to ensure that the large pool of oncologists in the country have an active environment to enhance their knowledge and skillsets.

Oncologists should come forward and upskill specialists especially those who are first port of call for some of key cancers — dentist, ENT (oral cavity cancer), OBG (cervical, breast cancer), pulmonologist (lung cancer) etc., such that they identify cancer symptoms accurately and refer to oncologists at the right time. There is also a need for introduction of oncology as a subject as part of the MBBS curriculum such that general physicians also acquire basic skillsets required to recognize cancer symptoms early on and direct patients to oncologists. Upskilling primary care physicians such that they identify high-risk candidates or red flags and refer them for appropriate screening programs will result in early diagnosis and treatment.

In order to deliver safe, appropriate and efficient care with improved patient outcomes, there is a need for uniform standards for prevention, diagnosis, and treatment of cancer across India enabled by evidence-based management guidelines. India with vast variation in resources, infrastructure and expertise requires guidelines which are not only rigorously developed but also feasible, applicable in real world and acceptable to all stakeholders.[93]

NCG (National cancer Grid), spearheaded by TMH and with a network of 255 cancer centers, research institutes, patient advocacy groups, charitable organizations and professional societies[94] has developed guidelines for management of cancers based on best available international and local evidence considering the above key factors. Further, the guidelines are resource stratified, dividing the guidelines into optional (State of art), optimal (value driven) and essential (value with access to resources). The NCG evaluates adherence to these guidelines by conducting institutional peer reviews.

NCG furthers access by having training, extending medical education and collaborative research under its ambit. NCG also works on improving affordability by bringing down the cost of drugs, consumables, and equipment for small and medium-sized cancer centers through group negotiations and web enabled e-tendering platforms.

Given that there is a significant geographic skew in the availability of physical and human infrastructure for cancer care and there is a significant need to provide care closer to the home setting of patients, the need for a tiered distributed care approach is of prime importance. To enable this agenda, industry participants such as Tata trusts are playing a major role. Tata Trust is not only setting up cancer research and treatment centers in Tier 1/2 cities such as Varanasi, Tirupati, Bhubaneshwar, Ranchi, Allahabad, and Mangalore but is also partnering with State governments to build state- wide cancer facilities.

[93] NCG Guidelines manual 2021, tmc.gov.in

[94] "Cancer care plan & management: prevention, diagnosis, research & affordability of cancer treatment", Department-related parliamentary standing committee on health and family welfare, September 2022

Distributed model of cancer care – Assam

The Assam Cancer Care Foundation, which is a joint partnership between the Government of Assam and Tata Trust, spearheads this initiative set up in 2017.

As against one apex cancer care center handling the cancer patient's journey end-to-end, the 'Distributed Cancer Care Model' is conceptualized with different level of centers closer to the patients' homes interlinked with the apex centers, handling diagnosis and care delivery, thereby shifting the load away from apex hospitals and providing high-quality cancer care closer to home and reducing out-of-pocket expenses for patients.[95]

Table 22: Overview of capabilities at different levels

	Oncology services			Allied facilities			
	Radiation	Medical	Surgical	Nuclear Medicine	Lab Services	Research / Academics	Community outreach
Level 1 (Apex centers)					High end		
Level 2					Advanced		
Level 3					Basic		
Level 4							

Source: "Distributed Model of Cancer care", Assamcancercarefoundation.org

The network will have 17 different hospitals catering to 50,000 patients per year[96] (@ incidence of 138.6 per lakh will cover 3.1 crore population and @344 per lakh will cover 1.45 crore population assuming 10% growth as per the projection model in the Chapter 1 of this report) with a potential to eventually cover 35% to 50% of cancer patients in Assam over the next 8 to 10 years[97].

As Phase 1, a network of 10 hospitals is being developed with 1 apex institute, 4 level 2 and 5 level 3 institutes across Assam. Seven hospitals were inaugurated in April 2022 and the remaining three will be completed by Dec 2022. The seven inaugurated hospitals will cover 30,000 patients annually. As part of the next phase, foundation has for seven centers was laid out and they are expected to be operational by 2024.

Telehealth services would be provided by the network of hospitals which will consist of a central hub at Guwahati as DiNC (Digital Nerve Center) and other hospitals with Tele-radiology and Virtual Tumor Board (VTB) services.

[95] M. Kuriakose et al. Developing a Model of Distributed, Decentralized Digitally Connected Cancer Control Program, Journal of Global Oncology 2018 4: Supplement 2, 240s-240s

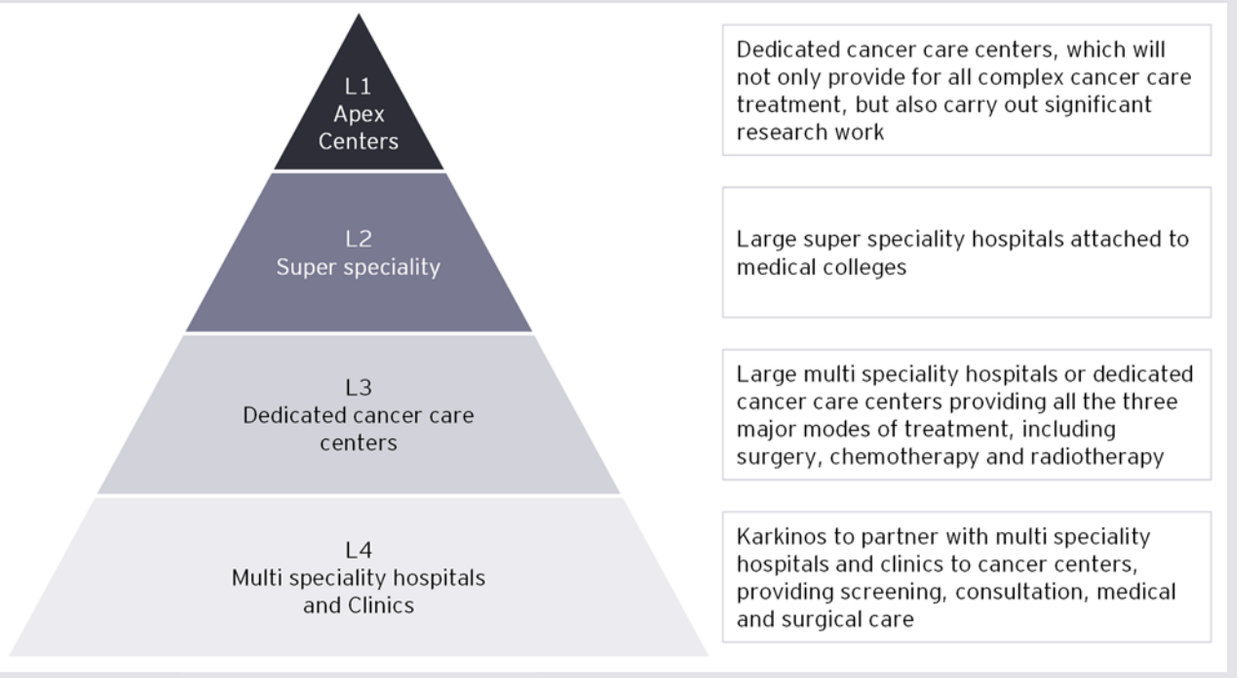
[96] "'Largest' network of hospitals under Tata Trusts' cancer control model coming up in Assam", The Print, April 2022

[97] "Cancer care gets major fillip in Assam", indiglobalmedia.com, August 2022, EY analysis

Distributed Cancer Care Network by Karkinos

Technology-led oncology platform, Karkinos is trying to disrupt the way oncology treatment is provided in India and is working towards setting up a distributed cancer care network to provide quality care closer to home at affordable prices. The platform provides a comprehensive platform for patients w.r.t their oncology care needs that can be availed across multiple locations across the country and is enabled by proprietary technology tools which are powered by clinical intelligence and interoperability.

Figure 7: Karkinos model of distributed cancer center by partnering with existing healthcare providers



Source: "Building Capacity with distributed cancer care network", Karkinos.in

Karkinos employs a proprietary digital platform for seamless management of oncology cases across the entire ecosystem while providing curated and peer reviewed oncology clinical protocols, workflows, and processes, and access to panel of senior oncologists via the Virtual Tumor Boards, and specialist opinions. It employs an array of digital technologies such as telemedicine, tele oncology, interoperable digital health records to enable management of cancer cases in non-metro/ rural areas.

Karkinos helmed by a strong team with clinical and business background offers a capital efficient model to address the key barriers patients face with respect to access and affordability. Expansion of entities offering such a distributed cancer care model is a critical need given the current constraints on resource availability for oncology care in the country.

Note: Refer Annexure 9 for Karkinos's approach to management of patient journey.

Sahyadri's efforts to enable access

While plenty of tertiary care hospitals exist, all patients do not have access to them, mainly due to economic grounds. Tertiary hospitals could partner with smaller clinics around them and up skill the doctors for early diagnosis and referrals. Sahyadri Hospital has made strides toward such an effort. They have launched an online certification program called OncoPro online, which is an oncology basics course for general practitioners educating them in a three-hour interactive module, three months ago. On completion of the module, doctors receive a basic certification. It has received a great response and over 1,000 doctors have signed up. Sahyadri plans to develop a module for caregivers and nurses in the future.

Sahyadri also has a strategy to conduct cancer screening camps in partnership with smaller clinics around their cancer center at the clinic itself. This will help gain the confidence of practicing doctors and involve the community in cancer screening as well.

Sahyadri oncology unit regularly conducts Multi-Disciplinary Tumor (MDT) boards where cases get discussed and the best management options are decided. The aim is to make the MDT available through the internet to all other Sahyadri units — even those outside Pune and make it virtual.

One of the USPs of the Sahyadri Group is to make medical care more affordable. To fulfill this purpose for cancer patients, Sahyadri, in partnership with Rotary International, has put up a Linear accelerator and will from September 2022 offer free radiotherapy, chemotherapy and cancer surgery to eligible patients under the Ayushman scheme at Surya hospitals.

Data management, especially for outcome analysis, is extremely important. Sahyadri is working toward this by incorporating new software for data capture. They have data managers currently and there are plans to develop a cancer registry as well.

Precision oncology is the future of cancer care. Sahyadri is making efforts in this direction by establishing the city's first bio bank along with a molecular tumor board with international experts.

Just 1% to 2% of people who need palliative care in India have access to it, far below the global average of 14%. Kerala is one exception in India where 26% of people needing palliative care have access to it.

Palliative care meant to improve quality of patient's life, when integrated with standard oncology care, has proven clinical benefit by helping alleviate symptom burden, enhance illness and prognostic understanding, improve both the quality of life and overall survival for patients. Multiple studies have shown lower depression and higher length of survival for palliative care groups.[98, 99]

More than 54 to 60 lakh Indians require palliative care every year, but only 1% to 2% of them have access to it[100]. In addition to the challenge of access to palliative care, strict regulations on opiate supply had left morphine and opioids largely unavailable for use in pain relief till 2014.

With the passage of amendment to the NDPS Act in 2014, there has been an improvement in availability of such medicines. To address the availability of qualified physicians, the Medical Council of India recognized palliative care as a postgraduate specialty in 2010. As of 2019, Tata Memorial Hospital, Mumbai; GCRI, Gujarat; and AIIMS, Delhi; offer postgraduate courses. Further, palliative medicine has been part of the M.B.B.S. curriculum since 2019. These steps are in the right direction and should be further augmented with integration of palliative care service along

[98] Nickolich MS, El-Jawahri A, Temel JS, LeBlanc TW. Discussing the Evidence for Upstream Palliative Care in Improving Outcomes in Advanced Cancer. Am Soc Clin Oncol Educ Book. 2016;35:e534-8. doi: 10.1200/EDBK_159224. PMID: 27249764

[99] Oliver D. Improving patient outcomes through palliative care integration in other specialised health services: what we have learned so far and how can we improve? Ann Palliat Med. 2018 Oct;7(Suppl 3):S219-S230. doi: 10.21037/apm.2018.05.05. Epub 2018 May 28. PMID: 29860858

[100] Bag S et al. Palliative and End of Life Care in India - Current Scenario and the Way Forward. J Assoc Physicians India. 2020 Nov;68(11):61-65. PMID: 33187039

with care delivery at the PHCs, CHCs and district hospitals in the country.

Kerala's community-based palliative care services supported by state policies and CanSupport's home based care have been successful in providing a reliable, cost-effective palliative care to patients that can serve as a model for building palliative care capacity in India.

Kerala has over 1,550 palliative care unit and the community-based organization and NGOs run 450 of them[101]. Kerala's community-based model is driven by the massive involvement of public and civil society. The model supported by a huge number of volunteers with skeletal staff of doctors and nurses not only helps in taking care of patients at the institute but provides a robust homecare. Kerala is one among the three states (Karnataka and Maharashtra being the other two) with Palliative care policy. The focus of Kerala state policy on palliative care is on training providers and volunteers and establishing palliative care programs, especially in the primary care setting, and providing funding for community-based palliative care services. As a result, approximately 90% of India's palliative care service providers are in Kerala, a state that has only 3% of the country's population.

CanSupport runs India's largest free home-based palliative care program catering to patients in NCR since 1997. Presently, CanSupport palliative care teams care for 2,600 cancer patients and their families with a help of trained and multidisciplinary teams which consist of a doctor, a nurse, and a counselor. Referrals come from several hospitals that treat cancer in the city, as well as from past beneficiaries and through the helpline.

Each team cares for 50 to 60 patients at any given time[102].

- The nurses are the coordinators and decide which patients are to be visited in consultation with the doctor and counselor. Apart from nursing needs, they also educate caregivers on nutrition, oral/wound/ostomy care, and prevention of bedsores.
- Psychosocial support is provided mainly by counselors who are trained to listen and address patients and caregivers' emotional, social, financial, and spiritual concerns. They help them come to terms with the prognosis of the disease, advise patients on practical matters, and assist patients to mend relationships with parents, siblings, or children.

With the support of CanSupport's homecare teams, patients and their families are able to come to terms with the reality facing them and manage most of the problems associated with a terminal illness within the comfort of their homes.

Key enablers for improving provision and access to palliative care services in the country are an enabling policy structure across the country and integration of palliative care services with public and private healthcare set ups through an institutionalised set up.

[101] "Palliative care in Kerala: a success story", www.thehindu.com, March 2020

[102] Yeager A et al. CanSupport: a model for home-based palliative care delivery in India. Ann Palliat Med. 2016 Jul;5(3):166-71. doi: 10.21037/apm.2016.05.04. PMID: 27481319

Cancer continues to be a persistent and very permanent part of most families these days. Whilst the incidence and diagnosis has improved, we remain at Aster even more optimistic about the management and quality of life of our cancer survivors.

Aster International Institute of Oncology (AIIO) is a network of hospitals providing easily accessible and affordable cancer care in India and Gulf Council countries. The motto of our international cancer grid is "Complete cancer care. With you - Every step of the way".

The multidisciplinary team approach integrates all clinical services including surgical oncology, medical oncology, radiation oncology, nuclear medicine therapy, head and neck oncology, breast surgery and oncoplasty, gynec oncology.

The services will be by DMG (Disease Management Group) focusing on therapy as well as prevention, screening, diagnosis, treatment, survivorship, and palliative end-of-life care under one roof and ensures uniform care. A robust joint MDT discussion of each and every patient's treatment and it's application to individualised patient decision making, makes it truly personalised for each patient with most recent evidence based oncology guidelines and protocols. This will result in highest standard of care and QOL (quality of life).

AIIO is equipped with latest iteration of daVinci Robot. Minimal access robotic oncology surgeries has revolutionized oncological surgeries allowing surgeons to perform complex surgical procedures with minimal pain and faster recovery hence benefitting the patient tremendously.

AIIO has been certified as Centre of Excellence to treat peritoneal surface malignancies, one of the deadliest group of cancers. Therapeutic procedures like cytoreductive surgery with Hyperthermic Intraperitoneal Chemotherapy (HIPEC) and Pressurized Intraperitoneal Aerosol Chemotherapy (PIPAC) has been a boon to patients, making a palliative condition into a curative one.

Complex combined micro vascular plastic surgeries coupled with major oncosurgery resections gives best quality of life and cosmetic and optimal functional outcomes.

Immunotherapy is referred to as a "miracle in the making" by several oncologists. AIIO has adopted immunotherapy including ambulatory chemo port based pump based chemotherapy.

We are proud to acquire the latest technological advancements in the field of radiation therapy in the form of Intraoperative Radiation Therapy (IORT) and Image-Guided Radiation Therapy (IGRT). Both these machines incorporate imaging techniques to provide highly accurate modulated gamma radiation with minimal side effects while reducing the cancer treatment duration.

The clinicians at AIIO are motivated by the credo of providing value based health care without compromising on clinical outcomes.

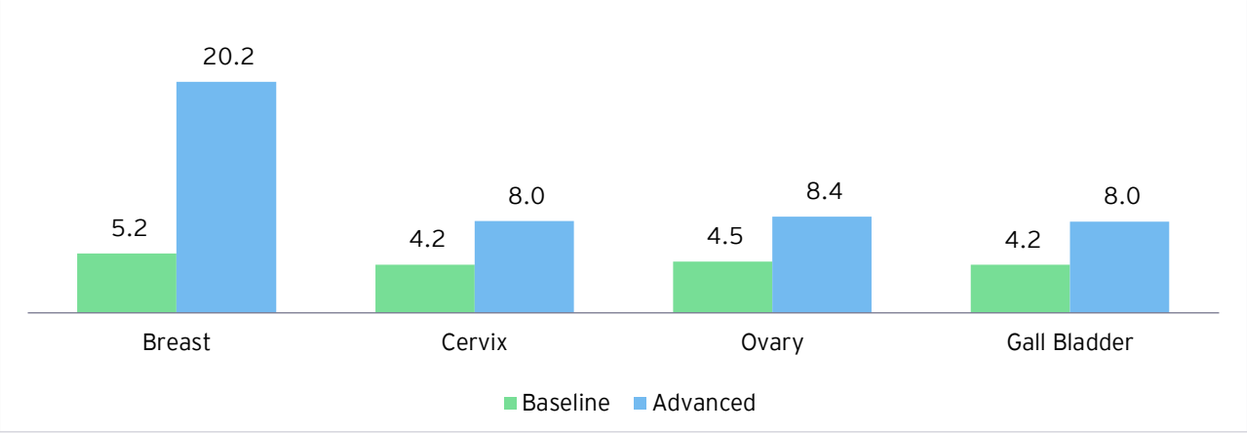
Coupled with MDT team of nutritionist and Onco counsellors and Rehabilitation specialists all available under one roof in AIIO truly makes it most unique and state of art complete cancer center and International Institute of Oncology.

Alisha Moopen
Deputy MD, Aster DM Healthcare LImited

(ii) Treatment - Affordability

Cost of complete multimodal treatment varies depending on the stage of detection and treatment plan and often is upwards of INR4 lakhs. Cost goes beyond INR5 lakhs if cancer is diagnosed at Stage 3 or 4[103].

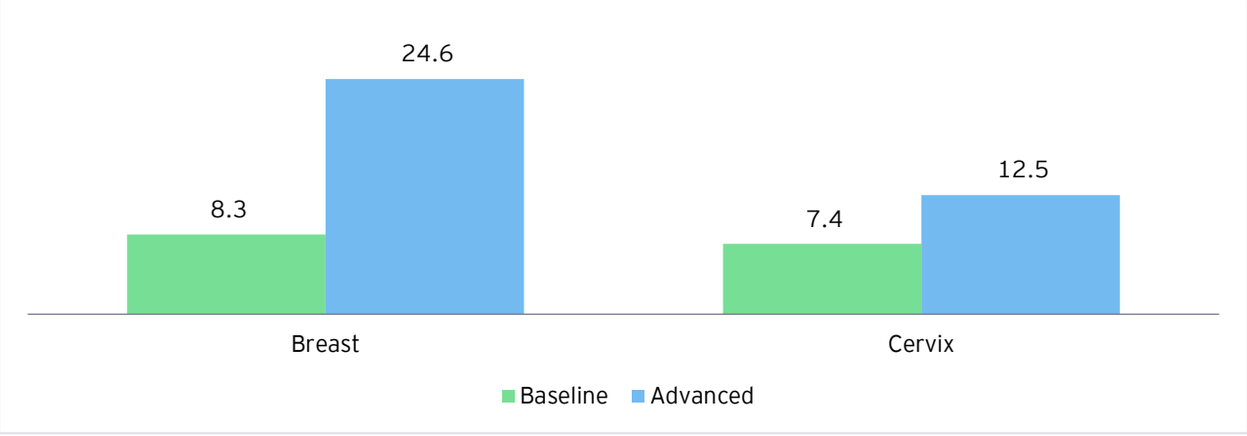
Chart 38: Baseline and advanced treatment cost of common cancer types detected at Stage 1 or 2



Source: EY analysis

Baseline treatment is the basic minimum treatment required to treat cancer at a private non-COE setup in a Tier 1 city. The treatment cost can increase by more than 80% if the patient avails advanced treatment, such as targeted therapy, IGRT, IMRT, robotic surgeries and molecular diagnostics at Centres of Excellence in metros. Baseline cost of common cancers such as breast, cervix, ovary, gall bladder range from INR4.2 to 5 lakhs if the cancer is detected at Stage 1 or 2 and upwards of INR5 lakhs if detected at Stage 3 or 4, indicating a minimum cost escalation of 20% driven by increase in radiotherapy costs.

Chart 39: Baseline and advanced treatment cost of common cancer types detected at Stage 3 or 4

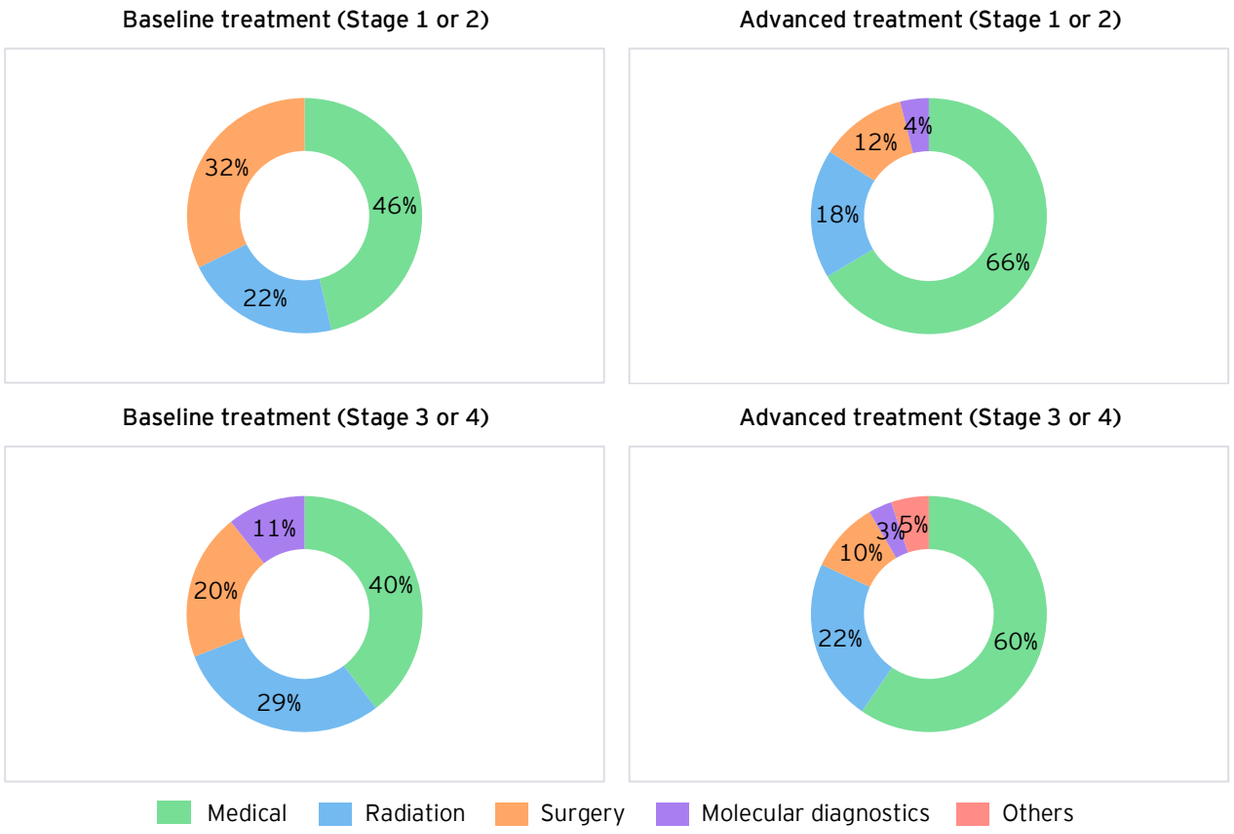


Source: EY analysis

Contribution of chemotherapy in the overall cost of cancer care drastically increases for patients choosing advanced treatment. Contribution of surgery in the overall cost of cancer care is lower for patients diagnosed with advanced stages of cancer.

[103] EY analysis

Chart 40: Contribution of cost of different treatment modality for breast cancer

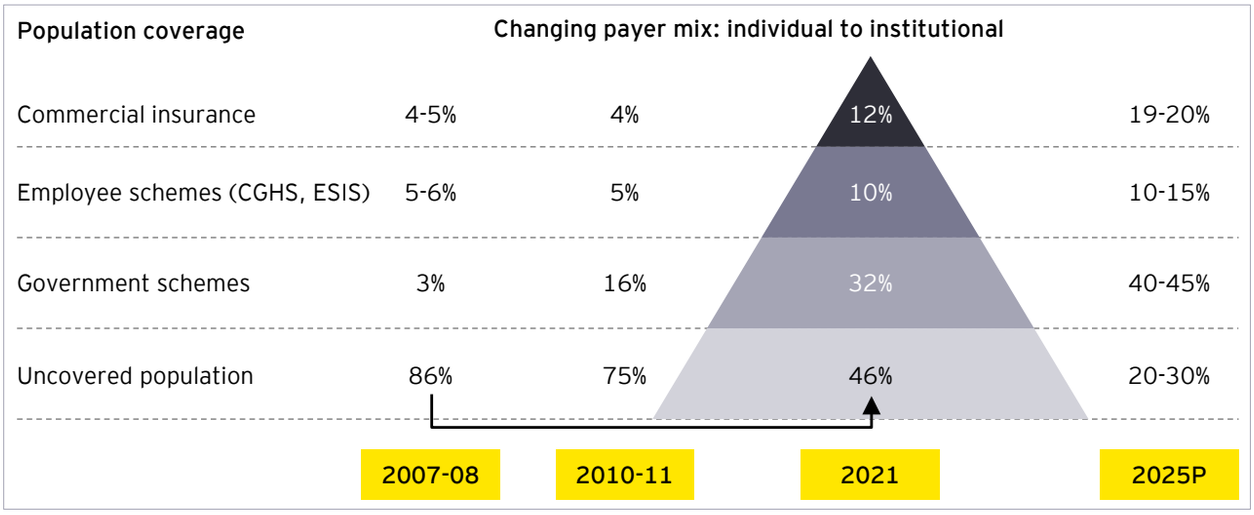


Source: EY analysis

A survey of ~90 patients treated in private / trust-based hospitals corroborates the above estimates with 70% of them confirming that they are spending >INR5 lakhs for comprehensive treatment.

While 46% of the population in India continues to remain uncovered currently, there is a significant shift toward financing of care by private and public payors and hence an adequate coverage and reimbursement linked to the right quality of care and outcomes is a critical need.

Chart 41: Changing payer mix: individual to institutional



Source: EY analysis, IRDAI annual report 2020 -21, Irdai.gov.in, "Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB-PMJAY)", pib.gov.in, July 2021

While multiple government schemes providing insurance coverage for non-affording population were active since 2007, coverage has significantly increased since the roll out of PM-JAY in 2018 which has been further enhanced by add on coverage provided by state governments over and above the PM-JAY scheme.

Government schemes along with ESI, ESIC and CGHS may cover almost 60% of population eventually over the next three to four years.[104]

Table 23: Overview of key government schemes:

Scheme	State	Year of Inception	Reimbursement Limit	Beneficiary	Coverage (No. of Procedures)	Claim Amount since inception (INR Cr)
Pradhan Mantri Jan Arogya Yojana (PM-JAY)[105]	All India	2018	INR5 lakhs per family per annum	50 Crore Individuals	~1,393	3,483
Dr.YSR Aarogyasri Scheme[106]	AP	2007	INR5 lakhs per family per annum	~1.3 crore families	~2434	2,457
Arogyasri[107]	Telangana	2014	INR2 lakhs per family per annum	~0.85 crore families	~949	1,273
Biju Swasthya Kalyan Yojana[108]	Odisha	2018	INR5 lakhs per family and additional INR5 lakhs for the women members of the family after exhaust of initial limit	~0.9 crore families	~1592	931
Ayushman Bharat-Arogya Karnataka Scheme[109]	Karnataka	2018	INR5 lakhs per family per annum for BPL and RSBY beneficiaries	~1.43 crore families	~1628	NA
Mahatma Jyotirao Phule Jan Arogya Yojana[110]	Maharashtra	2012	INR1.5 lakhs per family per annum (for renal transplant INR2.5 lakhs per annum per family)	NA	~1212	9,319
Chief Minister's Comprehensive Health Insurance Scheme[111]	Tamil Nadu	2009	INR5 lakhs per family per annum	~1.37 crore families	~1150	NA
Swathya Sathi scheme[112]	West Bengal	2017	INR5 lakhs per family per annum	2.3 Crore families	~1502	1,873
Mukh Mantri Punjab Cancer Raahat Kosh Scheme[113]	Punjab	2011	INR1.5 lakhs per Cancer patient	NA	NA	866

[104] "Health Insurance for India's Missing Middle", NITI Aayog, October 2021

[105] www.pmjay.gov.in, "About Pradhan Mantri Jan Arogya Yojana (PM-JAY)", nha.gov.in

[106] ysraarogyasri.ap.gov.in

[107] aarogyasri.telangana.gov.in

[108] bskydashboard.odisha.gov.in

[109] arogya.karnataka.gov.in

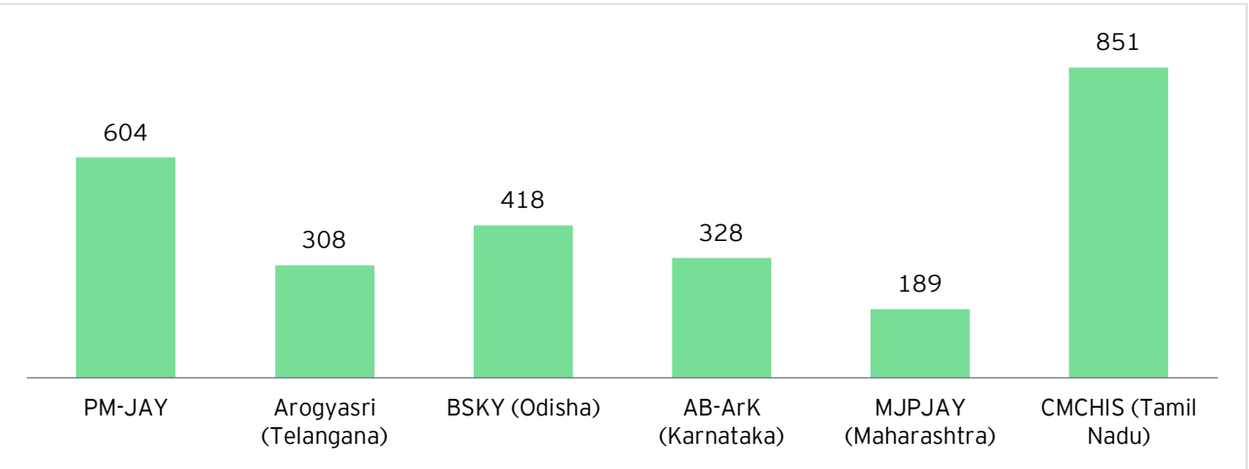
[110] jeevandayee.gov.in

[111] cmchistn.com

[112] swasthyasathi.gov.in

[113] mmpcrk.gov.in

Chart 42: Number of oncology services covered by different government schemes



Source: pmjay.gov.in, aarogyasri.telangana.gov.in, bsky.odisha.gov.in, arogya.karnataka.gov.in, jeevandayee.gov.in, cmchistn.com.
Note: Basis analysis of procedures classified under Medical, Radiation and Surgical oncology

Number of oncology procedures covered varies from 189 to 851 across various government schemes. Coverage of different procedures varies significantly. All government schemes do not cover certain procedures required for comprehensive and advanced treatment such as PET CT, biopsies, NGS, targeted therapy.

Table 24: Coverage of government schemes across different treatment categories

Category	PMJAY	Dr.YSR ArogyaSri	Telangana Arogyasri	MJPJAY	TN-CMCHIS	BSKY	Arogya Karnataka	Swasthya Sathi
Nuclear Medicine (PET-CT)	Yes	Yes	Yes	No	Yes	Yes	No	No
Biopsies	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
NGS	No	No	No	No	No	No	No	No
Targeted therapy	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Immunotherapy	No	No	No	No	No	No	No	No
SBRT/ SRS	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: pmjay.gov.in, aarogyasri.telangana.gov.in, bsky.odisha.gov.in, arogya.karnataka.gov.in, jeevandayee.gov.in, cmchistn.com, swasthyasathi.gov.in

Table 25: Coverage of Govt. schemes across different Chemotherapy medications

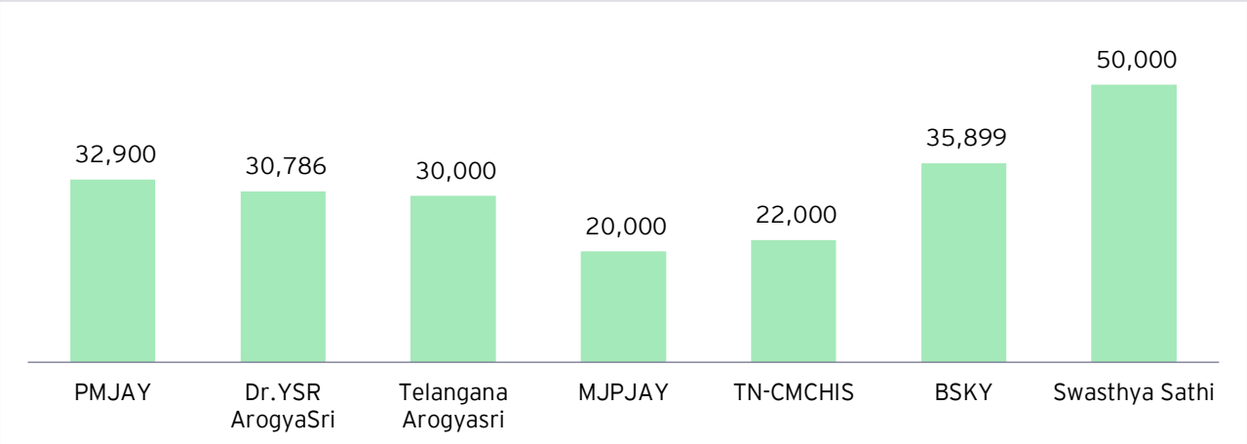
Formulation	Indication	Organ	PMJAY	Dr.YSR ArogyaSri	Telangana Arogyasri	MJPJAY	TN-CMCHIS	BSKY	Arogya Karnataka	Swasthya Sathi	Mukhyamantri Amrutum Yojana
Sorafenib	HCC/ TC/ RCC	Liver/ Thyroid/ Kidney	Y	Y	N	N	Y	Y	Y	Y	Y
Trastuzumab	BC	Breast	Y	Y	Y	N	Y	Y	N	Y	N
Rituximab	NHL, PMBCL, CLL	Blood	Y	Y	Y	Y	Y	Y	N	N	Y
Bevacizumab	RCC, CRC	Kidney	N	Y	N	Y	N	N	N	N	N
Lapatinib	BC	Breast	Y	N	N	N	N	Y	N	Y	N
Geftinib	LC	Lung	Y	Y	N	N	N	Y	Y	Y	Y
Imatinib	Melanoma, GIST, GC, CML, ALL, AML, MM, CLL, Chondroma	Blood, GI, Skin	Y	Y	N	Y	Y	Y	Y	Y	Y
Pazopanib	TC/ RCC	Thyroid/ Kidney	N	N	N	N	Y	N	Y	Y	N
Erlotinib	LC/ RCC/ Chondroma / Pancreatic cancer	Lung/ Kidney/ Bone/ Pancreas	Y	Y	N	N	Y	Y	Y	Y	Y

Source: pmjay.gov.in, aarogyasri.telangana.gov.in, bsky.odisha.gov.in, arogya.karnataka.gov.in, jeevandayee.gov.in, cmchistn.com, swasthyasathi.gov.in, ma.gujarat.gov.in

Based on the limited data available on the claim amount, around INR150 to 200 crores are being claimed under PM-JAY, Arogyasri (AP) per year and INR80 to 100 under MMPCRKS (Punjab) per year for oncology services.

There is a huge variation in the reimbursement rates of different state schemes. Further cost at private hospitals in metros are considerably higher than government schemes.

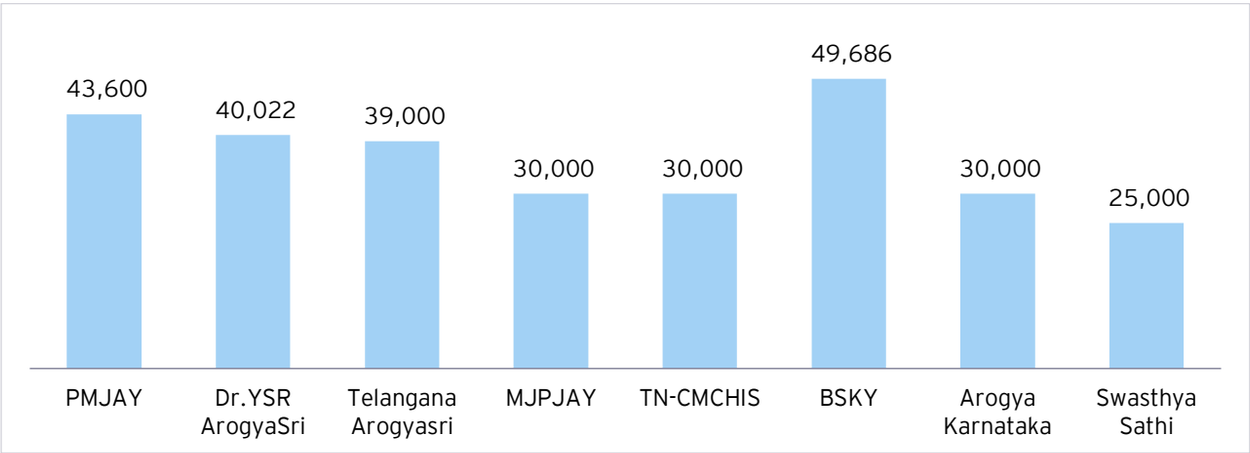
Chart 43: Reimbursement rates for thyroidectomy (Total) – Package



Note: The above rates are Tier 1/ Category 1/ NABH/ Grade A rates

Source: pmjay.gov.in, ysraarogyasri.ap.gov.in, aarogyasri.telangana.gov.in, bsky.odisha.gov.in jeevandayee.gov.in, cmchistn.com, swasthyasathi.gov.in

Chart 44: Reimbursement rates for TURBT – Package



Note: The above rates are Tier 1/ Category 1/ NABH/ Grade A rates

Source: pmjay.gov.in, ysraarogyasri.ap.gov.in, aarogyasri.telangana.gov.in, bsky.odisha.gov.in jeevandayee.gov.in, cmchistn.com, swasthyasathi.gov.in

Chart 45: Reimbursement rates for Gastrectomy (Total/ Any type) - Package

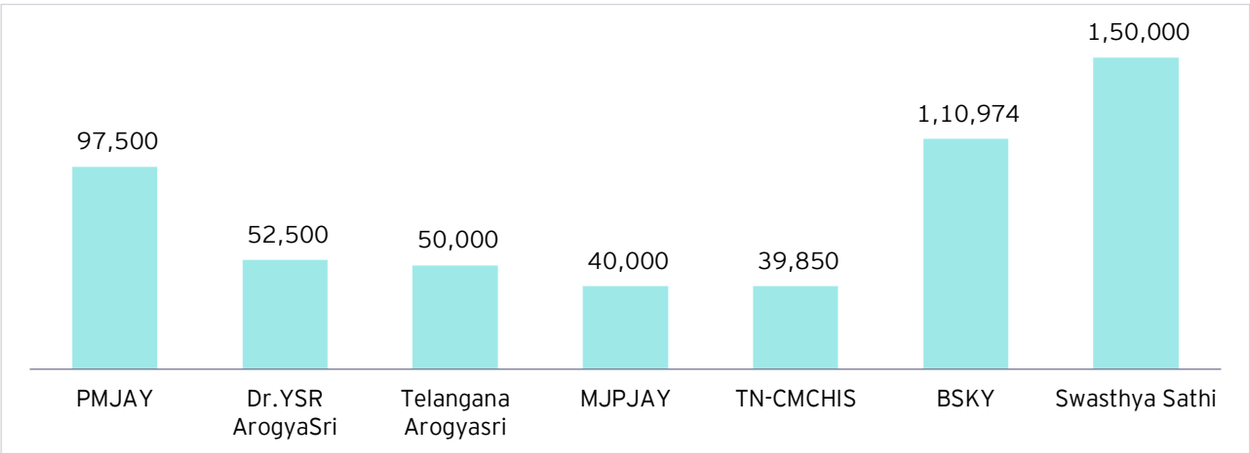
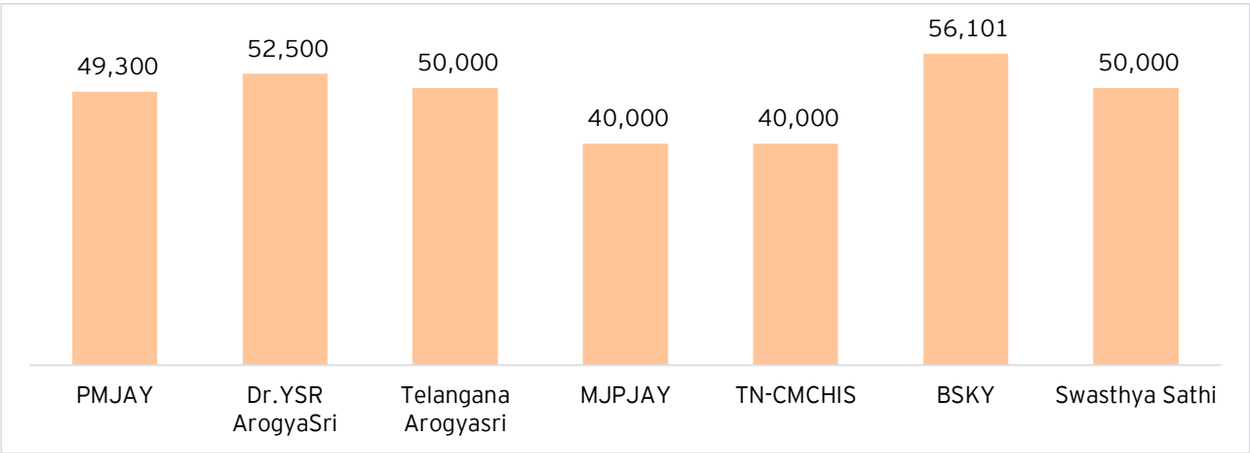
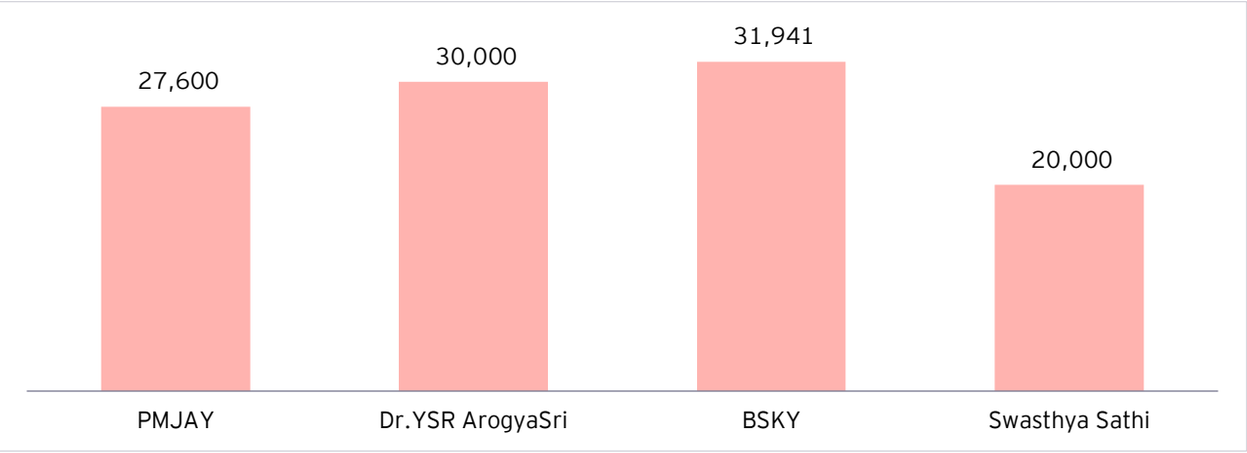


Chart 46: Reimbursement rates for Radical Nephrectomy (Open) - Package



The rates offered by different government schemes varied to the extent of 40% to 275% in TURBT, total thyroidectomy, Gastrectomy (Total/ Any type), Radical Nephrectomy (Open) package. Further, High-level analysis of cost at the private hospitals in metro and Tier 1 cities indicated that thyroidectomy (Total) cost was higher by a minimum of 180% and TURBT cost higher by 30% compared to PMJAY rates[114].

Chart 47: Reimbursement rates for Chemotherapy - Trastuzumab



Source: pmjay.gov.in, ysraarogyasri.ap.gov.in, aarogyasri.telangana.gov.in, bsky.odisha.gov.in jeevandayee.gov.in, cmchistn.com, swasthyasathi.gov.in

~60% differential observed between the rates offered by BSKY and Swasthya Sathi. With drug costs being the major driver of cost of chemotherapy, use of low MRP generic medicines can help manage costs of treatment.

Table 26: Reimbursement rates for radiotherapy package

Therapy/ Procedure	PMJAY (Tier I)	Dr.YSR ArogyaSri	Telangana Arogyasri	MJPJAY	TN-CMCHIS (Category A1)	BSKY (NABH package cost)	Tata Memorial Centre, Mumbai
3D CRT	27,300 (6 Fractions)	74,999 (up to 30 fractions)	21,000 (6 Fractions)	75,000 (up to 30 fractions)	68,000 (28-33 fractions)	31,531 (6 Fractions)	31,500
SRS/ SBRT with IGRT	106,600 (4 fractions)	114,000 (up to 30 Fractions)	89,000 (4 fractions)	75000 (up to 5 fractions)	75,000	130,000 (4 fractions)	90,000

Source: pmjay.gov.in, ysraarogyasri.ap.gov.in, aarogyasri.telangana.gov.in, bsky.odisha.gov.in jeevandayee.gov.in, cmchistn.com, tmc.gov.in

3D CRT and SRS/SBRT cost in a private COE hospital in a metro or in a private non-COE hospital for tier 1 city would cost above 1.2+ lakhs (20 to 33 fractions) and 1.9+ lakhs (20 to 33 fractions) respectively[114]. These are higher by 45% to 60% in comparison to the highest rates offered among the government schemes.

The huge variation in the reimbursement rates of different government schemes among different states and against private hospitals indicate that the reimbursement rates need to be fixed in a structured approach keeping in mind a uniform standard of care and treatment plan which will provide the right quality of outcome.

Further, the government schemes should consider wide variation in cost of treatment by stage of detection, treatment pathway and organs affected and should be flexible with the reimbursable limit per family with the focus on driving clinical outcomes. There should be a thrust from the government to ensure the availability of modern treatment options to the patients. To put this to action, the government, in the short term, can create a multi-disciplinary review board which can review cases and confirm the treatment plan adopted and in medium/ long term, encourage stakeholders to design and align to accreditations. Cancer specific accreditation by American College of Surgeons, National Cancer Institute, American Society of Radiation Oncologists, and American college of radiation oncology in the US have helped improve patient outcomes such as survival rate and quality of life.

The private sector should drive efficiencies across material, workforce and medical equipment

[114] EY analysis

utilization to lower cost and thereby sustainably service the Government scheme patients. Leading players improve workforce productivity by minimizing nonvalue adding administrative activities, improve equipment utilization by operating them for more than 15 hours and lower material costs by structured supplier evaluation and negotiation process. A structured program can help unlock efficiencies by 15% to 30% across major cost heads.[115]

Major insurance companies normally cover oncology under the comprehensive health insurance plans. The extent of services covered under the plan depends on the policy taken by the policyholder and may not cover all cancer treatment related costs. Even if it does, there are conditions for coverage at different stages of cancer. On an average, cancer patients pay 30% of their medical expenses out of their own pocket[114].

Typically, a comprehensive health insurance plan covers treatment modalities approved by government regulatory bodies and for which clinical efficiency is available. Major plans issued by the insurance companies indicate that they cover day care and pre and post hospitalization expenses. Pre and post hospitalization expenses, which includes diagnostics, are generally paid out-of-pocket and then reimbursed with the original bills

Table 27: Brief overview of plans offered by key health insurance players

Insurance company	Key Insurance Plans	Daycare	Pre and Post Hospitalization expense
Star health	Family Health Optima Insurance Plan	Yes	Yes
	Star Comprehensive	Yes	Yes
	Mediclassic	Yes	Yes
HDFC ERGO	Optima Secure	Yes	Yes
	Optima Restore	Yes	Yes
ICICI Lombard	ihealth	Yes	Yes
	Ihealth plus	Yes	Yes
The New India Assurance	Mediclaim	No	Yes
National insurance	National Mediclaim	Yes	Yes
United India assurance	Individual Platinum Plan	Yes	Yes

Source: Joinditto.in

However, high-level analysis of patient bills indicates that insured patients on an average incur ~85% of their hospital visit costs and 25 to 30% of their medical expenses out-of-pocket.

Table 28: Extent of out-of-pocket expense for Insured patients

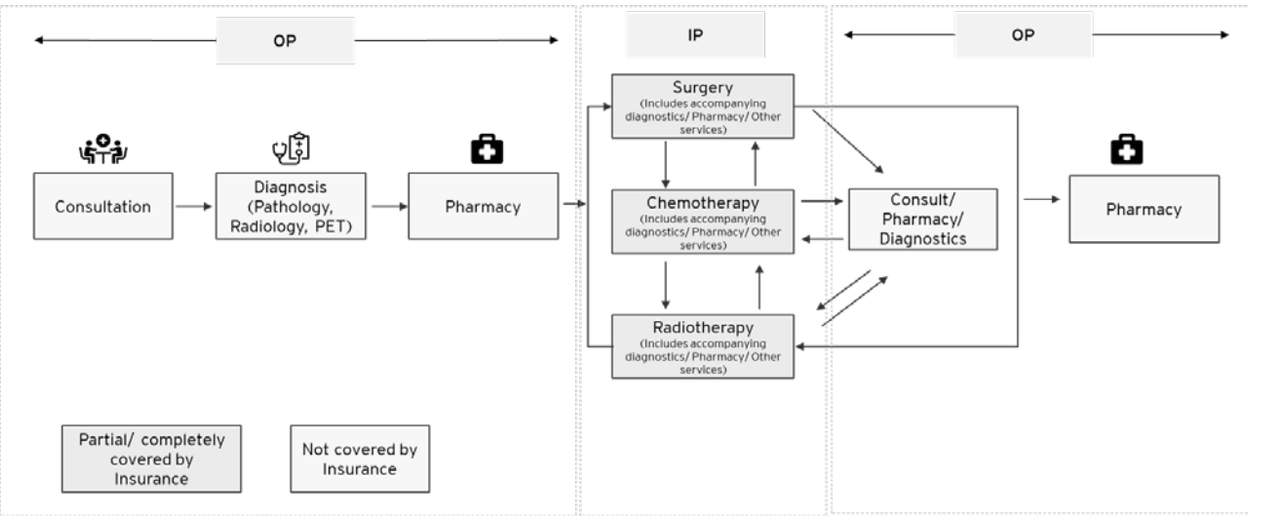
	Spend share	% Out-of-pocket		Major cost heads not covered
		Visits	Spend	
IP	91%	17%	20%	Pharmacy, Radiation therapy
OP	9%	100%	100%	Diagnostics, Pharmacy
Total	100%	86%	27%	

Source: EY analysis

100% of OP visits and 15% to 20% of IP Visits are out-of-pocket. Diagnostics, pharmacy, and radiation therapy are the major contributors of their out-of-pocket expenses across IP and OP.

[115] "Re-engineering Indian healthcare 2.0", EY FICCI report, 2019

Figure 8: Oncology patient flow and areas covered by insurance



Source: EY analysis

While there have been cancer specific plans and fixed benefit policies being introduced in the market, a comprehensive health insurance covering all aspects of treatment is critical to improve affordability. Additionally, a focus on wellness programs with a free annual cancer checkup will help in identifying cancer at early stages and help insurance companies in collaboration with providers to reduce claim payouts through early detection of patients at which stages the cost of treatment is relatively lower.

> A collaboration between various public and private stake holders will help reach quality cancer care to the needy people. Democratizing the resources will drive down cost and speed of delivery. It will also reduce the cost of establishing a cancer center by group purchase of critical equipment.
>
> **Dr. Manivannan Selvaraj**
> Founder and Managing Director, Kauvery Group of Hospitals

The cost of emerging oncology diagnostics and therapeutics such as precision oncology, immunotherapy and proton therapy are on the higher side and is out of reach for majority of Indian population.

- Immunotherapy is highly expensive, costing INR2 to 3 lakhs a month, making it unaffordable for 94% to 97% of the cancer patients who could benefit from it.[116] NLEM has added 63 anti-cancer medicines under the 'essential medicine list', which is typically taken up by NPPA for price control.[117] However, NLEM has not included Immunotherapeutic agents in the list considering factors such as usefulness for the majority of cases of cancer patients, risk-benefit ratio, cost- effectiveness, established therapeutic efficacy and availability in India.[118]

[116] Indicus data, 2014, 1. "Mumbai doctors innovate low-cost cancer therapy", timesofindia.indiatimes.com, June 2022

[117] Nation list of Essential Medicines 2022

[118] National list of Essential Medicines (NLEM) 2022 Report

Table 29: Cost of Immunotherapy drugs

Immunotherapy Drug	Indication	Dose on product	Cost in India (INR)	FDA recommended dose	Cost in US
Keytruda	Melanoma, NSCLC, RCC, HNSCC, UC, cHL, CRC, HCC, MCC, cSCC	100mg/ 4ml	2,36,500	200 mg every 3 weeks	
Opdivo	Melanoma, NSCLC, RCC, cHL, HNSCC, UC, ESCC, CRC, GEJ cancer	100mg/ 10ml	99,500	240 mg every 2 weeks	per infusion
Tecentriq	UC, NSCLC, SCLC, HCC, Melanoma	840mg/ 14ml	2,77,708	840 mg every 2 weeks	(840mg)
Imfinzi	NSCLC	500mg/ 10ml	1,89,585	10 mg/kg every 2 weeks or 1,500 mg every 4 weeks	

Source: "US FDA drug labels (accessed on Sep 7, 2022)", accessdata.fda.gov, "Keytruda list price", Keytruda.com, "Opdivo pricing information", bmspricinginformation.com, "Tecentiq prices", drugs.com, "Imfinzi prices", drugs.com, "Cost of drug prices in India (accessed on Sep 7, 2022)", 1mg.com

- Cancer genome sequencing, which is helpful in treatment for advanced stages of cancer, costs on average between INR2 to 3 lakhs.[119]
- 10% to 15% of the patients receiving radiation therapy would be eligible/ benefit from treatment using proton beams. The approximate cost of one course of proton beam therapy treatment in the US is ~INR1.2 crores[120] and in India it costs around INR25 to 30 lakhs.[121]

Technology adoption at Apollo

Apollo Proton Cancer Centres introduced Pencil Beam Proton therapy for the first time in India and this is the only proton beam therapy center in South Asia, ASEAN and Middle east, commissioned and operated at India's only JCI accredited cancer center. This is the most precise cancer treatment technology that treats the most complex cancers. It provides a ray of hope to 3.5 billion people across 147 countries. Today it has successfully treated over 1,000 patients and is one among the three global training centers.

Apollo Cancer Centres has over 16 robotic units. Through our collaboration with various technology partners, we have ensured that minimal invasive surgery has scaled new heights and recovery is faster with a better quality of life. With the introduction of the latest Cyberknife S7 FIM and Zap X to India, we are redefining the integration of technology and expertise for better outcomes and ensuring that patients are winning over cancer.

[119] "Kerala gets its first cancer genome sequencing machine" Times of India, February 2022

[120] "National Hadron Beam Facility", tmc.gov.in

[121] "Apollo Hospitals inaugurates Proton Cancer Centre", thehindu.com, January 2019

> Addressing cancer care in India will require aggressive focus on all aspects of prevention, early detection, diagnosis, and treatment as well as new financing and payment options. India already provides exceptional cancer care in some leading healthcare centers. We need to increase our focus and investment in innovation around areas like immunotherapy (e.g., indigenous development of CAR T-cells). We also need to address the mental health and support aspects of cancer care not only for patients but also for their families and loved ones.

Pankaj Sahni
CEO, Medanta - The Medicity

KOIS invested in partnership with Roche and TMH has announced a development impact bond in 2017 allowing social investors to fund the transmission of best practices of HER two testing protocols and standardization of cost of breast cancer treatment through biosimilars at six to eight government hospitals. With an overarching goal of early screening, process improvement at partner hospitals and access to targeted therapy, the initiative shall screen 20 lakh women and treat 10,000 to 20,000 breast cancer patients over a period of five years and improve treatment success rate from current from 40% to 70 to 75%. With outlay of $35 to 40 M, the fund will provide support to partner hospitals in conducting screening, provide funding support for necessary bio-marker tests, enable process improvements, and extend financial support to patients unable to pay out-of-pocket or through insurance for HER-2+ breast cancer treatment and care.

This project is at the feasibility stage with the government of Karnataka and Assam showing interest in the model

Source: "Five Things We Learned About Partnerships for Cancer Funding in Asia", accessh.org, July 2019, KOIS CARING FINANCE, Impact report 2017

The Hachioji city government in 2017 launched a social impact bond to fund colorectal screening program for its at-risk residents. The screening for colorectal cancer in the city was lower compared to national average leading to delays in treatment, higher healthcare cost, and suboptimal health outcomes. Project cost for the three-year screening project in Hachioji was ¥8.8 million to 9.7 million, while the anticipated savings from the early detection of this cancer through reduced medical expenses is upwards of ¥16 million. The project led to an increase in cancer screenings in the city from 9% to 27% in the target group and helped detect 84 early stage cases, resulting in significant healthcare savings.

Similar partnerships and innovative models are required for making the modern therapies available to the common population

Source: "The rise of social impact bonds in Japan", Japantimes.co.jp, January 2019, "Hachioji City SIB on Increasing the Rate of Residents Receiving Bowel Cancer Screenings", golab.bsg.ox.ac.uk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(iii) Treatment - Cancer health records

National Cancer Registry Program (NCRP) instituted in 1982, functions through Population and Hospital Based Cancer Registries (PBCR and HBCR) across different states in India.

- There are 38 PBCRs covering around 10% of the population as of now[122]. The registries in high population states UP and Bihar has been only added in 2017 or 2018. Big states such as Andhra Pradesh, Haryana, Chhattisgarh, Himachal Pradesh, Jharkhand, Odisha, and Rajasthan still do not have a single registry. With 10% population being covered, the coverage is inadequate even in states with presence of registries. Rural population is largely uncovered.[123]
- There are 268 Hospital Based Cancer Registries[124] under NCDIR –NCRP as of now with relatively higher presence in southern and northern parts of India.

Population Based Cancer Registries systematically collect data on all new cases of cancer occurring in a well-defined population from multiple sources such as government hospitals, private hospitals, nursing homes, clinics, diagnostic labs, imaging centers, hospices and registrars of births and deaths. As cancer is not a notifiable disease, dedicated staffs need to actively collect the data by visiting the above-mentioned institutions and examining documentations such as death certificates.

While some of the states have made cancer notifiable disease, the Indian Government should declare it as a notifiable disease applicable across India, which will help strengthen the data availability[125] through wider coverage with limited resources and funding. Developed and western countries have made cancer notification mandatory with nationwide cancer registry available in countries such as England and Wales, United States of America, Scotland, the Nordic countries, Canada, Australia, New Zealand and Israel.[126]

Apollo Hospital Based Cancer Registry (AHBCR):

- Apollo Hospital-based Cancer Registry program (AHBCR) has been launched to develop unit level Cancer Registries for clinical outcome improvement, research, and epidemiological studies.
- The AHBCR is an active method of data collection, with the collection of data from hospital records. The data has been used for estimation of the load of the disease for the country, and the incidence rate.
- The availability of data on a continuous basis has its special importance. The uniformly collected long-term data helps in understanding the trends in cancer occurrence.
- To maintain consistency across 14 units developed a hospital-based caser registry template with 146 fields. The AHBCR template has a total of 146 fields which provides details information about records information, demographic details, histopathology, clinical information, patient conversion, diagnosis, treatment, outcome, progression, and follow-up details.
- Apollo HBCR has 46 incremental data fields that will enrich our dataset, impact of that field would be utilized to identify patient cohorts, R&D trails, benchmark clinical outcomes, and treatment modality.
- The AHBCR data abstractor's user manual was developed based on our AHBCR template, which provides brief guidelines on how to curate the data from medical records and IT reports, process timelines, and governance.

[122] https://pbcr.ncdirindia.org/

[123] Report of National cancer registry programme, ICMR – NCDIR, 2020

[124] "Cancer care plan & management: prevention, diagnosis, research & affordability of cancer treatment", Parliamentary standing committee on health and family welfare, September 2022

[125] Vaitheeswaran Kulothungan et al. Burden of cancers in India - estimates of cancer crude incidence, YLLs, YLDs and DALYs for 2021 and 2025 based on National Cancer Registry Program, May 2022, BMC Cancer volume 22, Article number: 527 (2022)

[126] Lakshmaiah KC et al. Cancer notification in India. South Asian J Cancer. 2014 Jan;3(1):74-7. doi: 10.4103/2278-330X.126542. PMID: 24665453; PMCID: PMC3961875.

Progress in Data science and digital technology can be leveraged to derive meaningful insights from the cancer registry and electronic patient records data and guide medical and policy decision making. This will also enable us to design interventions that helps us precisely allocate resources towards awareness, prevention, screening, and treatment.

> Cancer is a growing disease burden in India with more than a million new cases every year. While we scale up awareness and capacity to deal with the disease, with the amount of data we generate, India also has the opportunity to become the key to solving the cancer mystery lock for the world through use of technology and analytical disruption.

Mitesh Daga
Managing Director, TPG Capital

AI powered Digital Twins accelerating research and clinical care in Cancer

NeuranceAI is a Bangalore based healthtech company founded by industry veterans (Dr. Ajay Bakshi, Neurosurgeon – ex CEO Max, Manipal & IHH-India and Dr. Rohit Gupta, Computer Scientist – ex Strand Lifesciences & MedGenome) that has developed an AI powered technology to convert all patient records (e.g., labs, radiology reports, prescriptions, clinical summaries etc.) into structured & standardized digital twins. Originating in aviation, Digital Twin technology creates a digital replica of physical objects (e.g., a jet engine) and enables improved performance by studying advanced computational simulations generated digitally.

In collaboration with one of the most respected Cancer Institutes in India, NeuranceAI is developing Digital Twins for cancer patients. Given possible improvement in survival, most cancer patients end up receiving multiple diagnostics tests and therapies (imaging scans, genetic tests, histochemistry, surgery, chemotherapy & radiotherapy) at multiple sites across several years creating very complex and hard to understand medical records. NeuranceAI powered Digital Twins convert all medical records into an integrated multimodal (clinical, pathological, radiological etc.) and multiscale (from genes to whole body) perspective, which is chronologically sorted and enables doctors and researchers to zoom in or out across time and levels of detail. It is anticipated that once deployed this technology will significantly accelerate research and improve oncologists' ability to deliver high quality care to their patients.

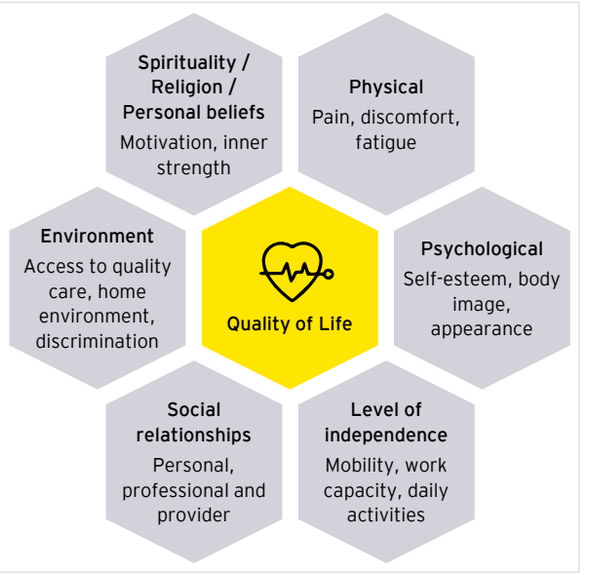
> Our understanding of cancer is improving thanks to large investments in understanding genetics and molecular biology of cancer. More recently Artificial Intelligence technologies have started creating excitement as the next big wave of innovation in Oncology. From AlphaFold's protein structure predictions to faster drug discovery and improved diagnostics- a tsunami of advances are going to happen over next few years.

Dr. Ajay Bakshi
Co-Founder & CEO, NeuranceAI

3 | Improving the cancer patient journey

Chapter 3: Improving the cancer patient journey

The term 'Quality of Life (QoL)' is often used and referenced in the context of cancer care. WHO defines QoL as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns[127].



As illustrated in the figure above, cancer impacts almost every facet of QoL. It is therefore important for providers, governments and society at large to adopt a holistic approach for cancer care, which is not just concerned with eradication of disease or symptom but also incorporates a human element wherein patient's wellbeing is seen as primary goal.

This chapter attempts to explore the various pain-points and challenges faced by cancer patients through their long and arduous journey of care. Key improvement areas have also been highlighted, which providers and other stakeholders can work on and enhance their support to cancer patients in their journey.

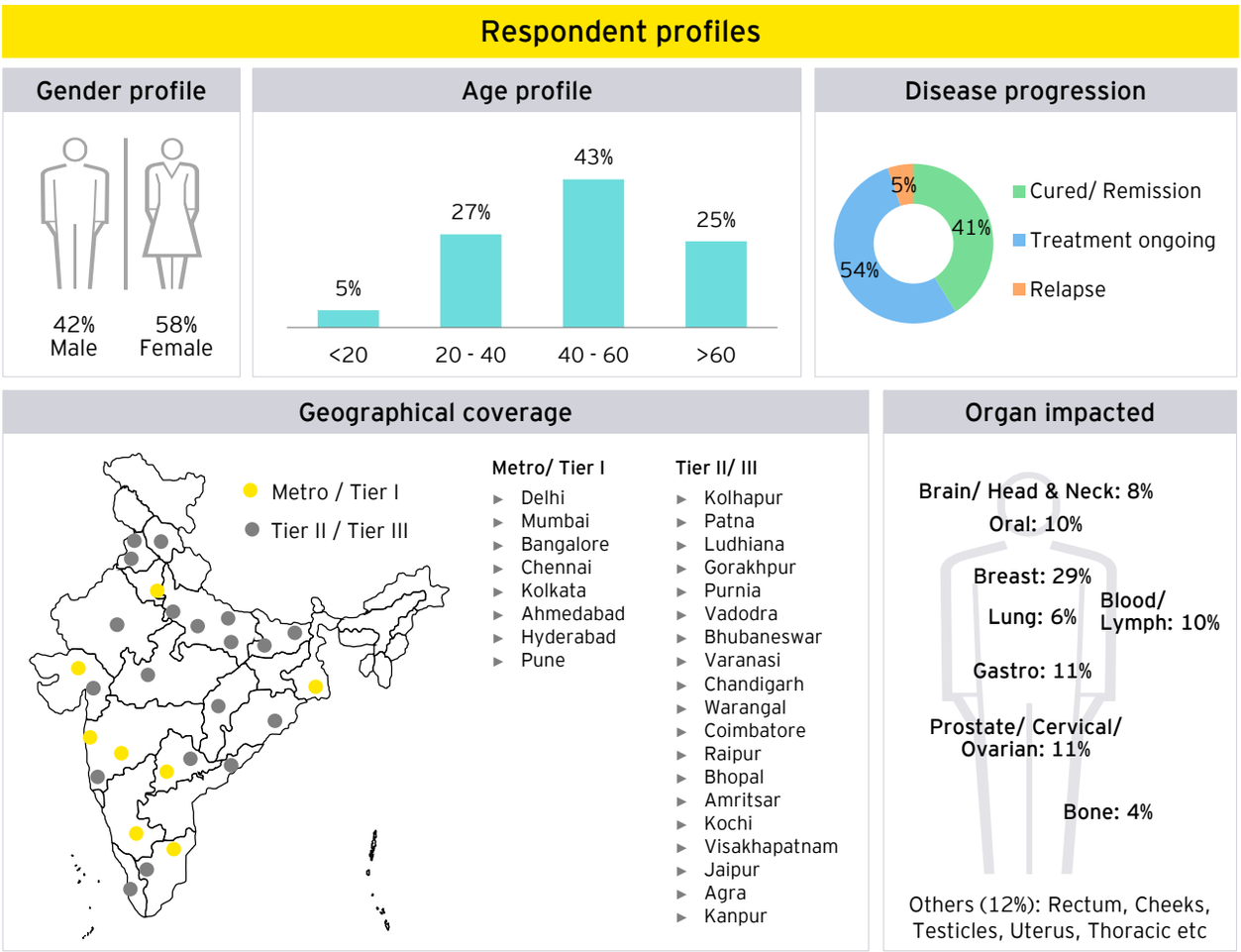
> Time has come for us, to truly integrate the digital power in a patient's journey. At one end, we could use this for screening and early detection and on the other to focus on specialisation, quality standards and to strengthen research
>
> **Dr. Harit Chaturvedi**
> Chairman, Max Institute of Cancer Care

Patient journey mapping

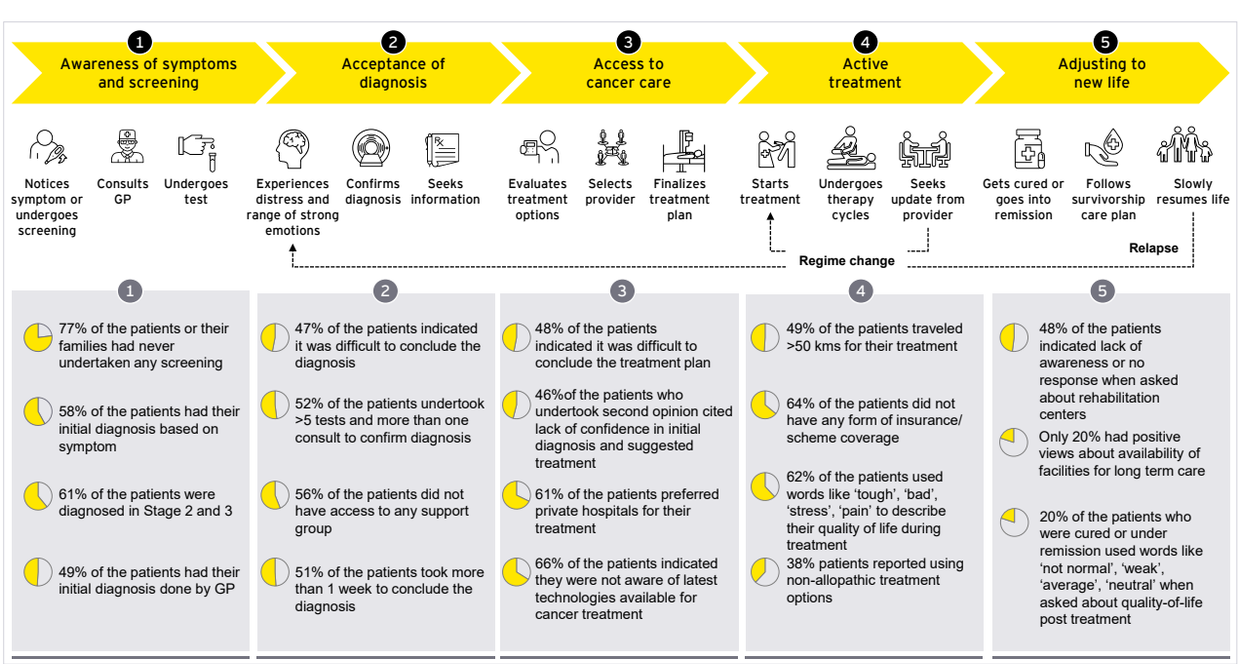
In order to understand what cancer patients feel, think, believe and experience, EY conducted a pan-India survey of 154 respondents comprising cancer patients and caregivers through a third-party agency. The below picture represents the respondent profiles. Results from this survey have been used to map out the patient journey and highlight the gaps across various touchpoints.

[127] https://www.who.int/tools/whoqol

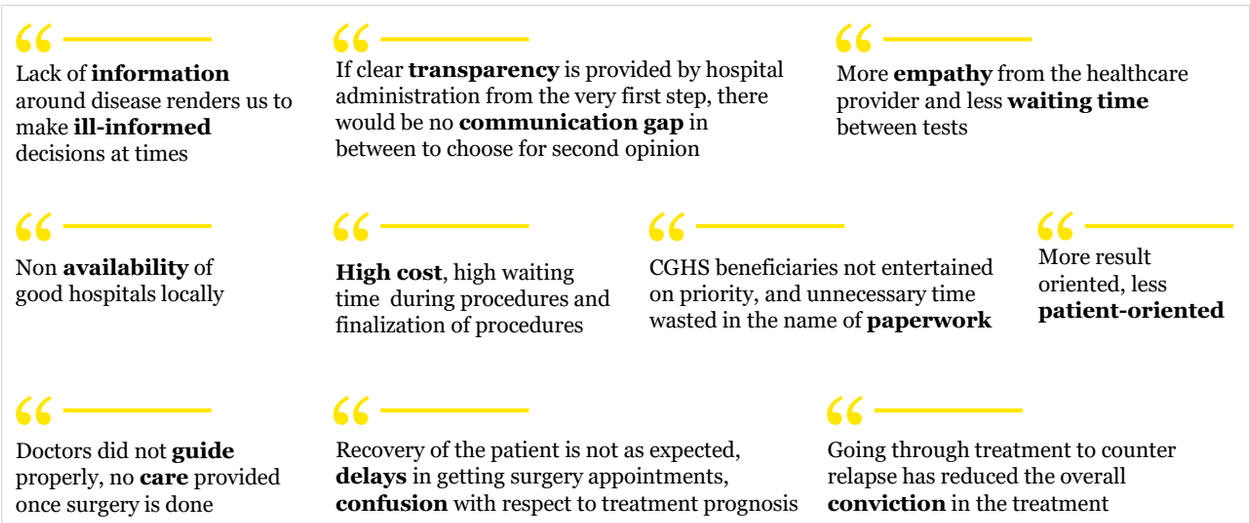
Chart 48: Respondent profiles



The below infographics depict a cancer patient's journey, though characterized by massive variability, summarized into five key stages. It also indicates various insights emerging from the survey against each stage in order to identify the various pain-points experienced by cancer patients through their journey.



Voice of patients:



Following broad themes characterizing various gaps in the patient journey emerge from the insights highlighted above:

Theme 1: Delay in accessing care

- Low prevalence of screening practice implies most people get diagnosed only when there is a noticeable symptom, by which time the cancer may have progressed beyond Stage-1
- The first point of contact is usually GPs who play a critical role in the cancer journey as gatekeepers. It is therefore important that GPs have adequate information about which test to initially prescribe against which symptom. It is also crucial to have a strong referral mechanism so that the right specialists are being tapped by the GP.
- The Government should develop standard protocols for diagnostic tests across different cancers so that clinicians, providers, and diagnostic centers all follow uniform practices. Also, day care centers should either have diagnostic facilities or tie up with diagnostic collection centers to provide greater access to molecular diagnostics, histopathology, genomics etc., to patients
- Patients tend to undergo multiple consults and tests before confirming the cancer diagnosis. Lack of coordinated care at times leads to misdiagnosis with varied test results, miscommunication between doctors and burgeoning costs for the patient who pays for every consult and test, increased anxiety while waiting for every test result. In addition to the delay, the entire process of confirming a cancer diagnosis generates a sense of distrust in the patient if there is a high degree of variation in the test results and medical advice. Treatment sees a similar trend. Cancer patients often seek second opinion before finalizing treatment plan. According to a 2015 literature review[128], a second opinion leads to change in diagnosis and treatment recommendations in 12 to 69% of cases.
- Co-ordinated cancer care with standard guidelines for diagnosis and treatment along with seamless sharing of health information across providers backed by technology is therefore essential to reduce the number of repeat tests and move the patient quickly from diagnosis to treatment. It is also important to restore the trust of the patient since lack of confidence in the diagnosis stage will make the patient sceptical about treatment, which in a disease like cancer has a degree of uncertainty with regimen changes and relapse not being uncommon.

[128] Ruetters, D., Keinki, C., Schroth, S. et al. Is there evidence for a better health care for cancer patients after a second opinion? A systematic review. J Cancer Res Clin Oncol 142, 1521–1528 (2016).

National Cancer Grid (NCG) is an initiative by Government of India which was created in 2012 with the aim of providing uniform standards of patient care across the country, spanning prevention, diagnosis and treatment. The stated objectives also include providing specialized training and education and facilitating collaborative research.

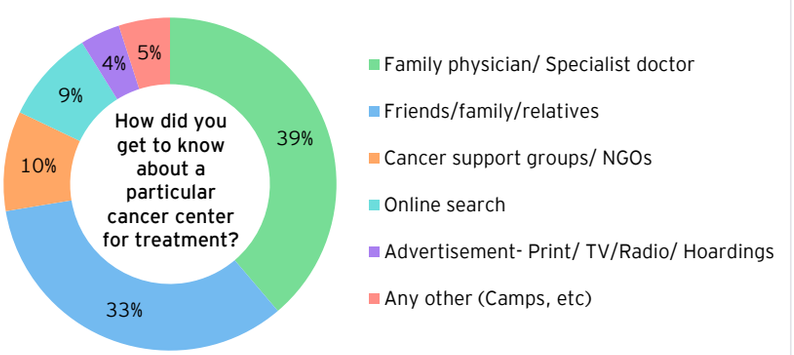
Since 2012, NCG has grown to a large network of ~255 cancer centers in India. While NCG has already developed standard guidelines for various cancers, adherence is not mandatory and is optional for the individual member institution. In order to achieve its objective, robust implementation with periodic review and audit mechanism is essential.

In 2022, the NCG also set up the Koita Centre for Digital Oncology to enable adoption of digital health tools across partner hospitals and drive initiatives like EMR adoption and data interoperability. The center also focuses on digitization of health records and patient registries, with the ultimate goal of transitioning to AI-based care.

The NCG website also provides links to expert second opinion through the 'Navya' portal, which connects patients to specialists from reputed hospitals. Recently, PMJAY has also roped in services of 'Navya' to verify the line of treatment being prescribed by hospitals under Ayushman Bharat in order to arrest any instances of over-treatment.

Theme 2: Need for a single source of comprehensive and authentic cancer information

- Post diagnosis, patients need to take decisions on various aspects such as finalizing treating doctor, hospital, second opinion and treatment plan. The survey revealed that patients usually rely on information provided by doctors followed by friends, family and relatives when it comes to deciding upon the provider. Patients seeking cancer information also use cancer support groups and online searches. Cancer support groups and online searches are also used by patients seeking cancer information. Dependence on multiple information sources sometimes leads to confusion and also increases the probability of encountering incorrect or unauthentic information.



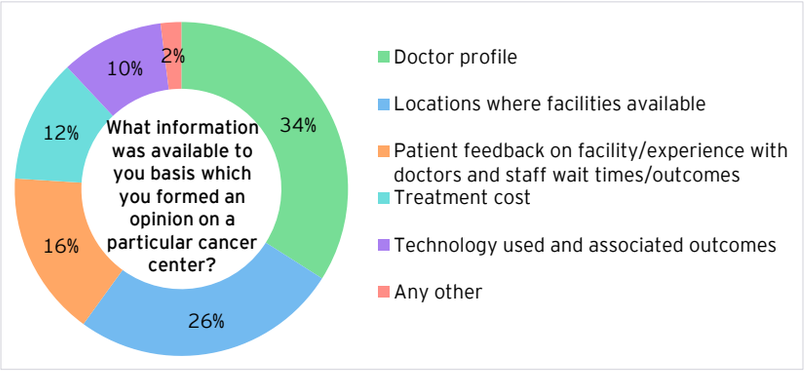
- To counter this, a single reliable source providing all required information is one way which can help reduce the time between diagnosis to treatment. Further, evaluating a government-run helpline or 'Arogyasetu' like app that provides support to patients by addressing their questions may help gain access to timely information.
- Since most patients consider reputation of doctor and hospital as the reason for selection of provider, access to a regularly updated database listing practicing doctors and oncology specialists along with their medical credentials and accredited hospitals specializing in cancer care could aid patients making faster and more informed decisions.

What are the key reasons for selecting a particular doctor or hospital for treatment?

% Of respondents who ranked the criteria among their top 3 reasons

Rank		
1	Reputation of doctor	66%
2	Hospital brand and reputation	66%
3	Reference from other doctor	43%
4	Recommendation by family/relatives/friends	41%
5	Affordable cost compared to other hospitals	30%
6	Close to place of residence	29%
7	One of the first comprehensive cancer centers in the region	18%
8	Previous experience	6%

- Providers can also use these survey insights to update their websites with information on areas which patients seek before finalizing treatment center. As highlighted from the survey, patients want to know about doctor profiles, locations where facilities are available, patient feedback, treatment cost, and technology. While most hospitals provide information about doctor profiles and facilities, access to patient feedback through testimonials, creating a platform of cancer survivors who have undergone treatment in the same hospital to share their experiences and transparent sharing of information on cost and outcomes may also help patients.



Theme 3: Inefficiencies in hospital processes

- The most common reason cited by patients dissatisfied with their experience was high waiting times. From a patient perspective, waiting times between tests and delays in scheduling appointments and surgeries seems like a general sense of indifference from providers, which leads to widening trust deficit between patient and provider. Another area of process inefficiency highlighted by patients was a large amount of paperwork associated with scheme beneficiaries.
- Adoption of simple technology interventions such as automated messages to patients informing them of delays, online appointment systems which patients can themselves access to book consultation slots without depending on receptionist or call center, online form filling and approval process for scheme beneficiaries etc., could be some methods to bridge these gaps. While technology can help in making processes more efficient, it is important to recognize that digital cannot replace the human touch, especially when it comes to a disease like cancer. Comfort with high-level automation is still evolving in India and therefore gradual integration of technology starting only with non-patient facing administrative activities is essential so that patients do not get overwhelmed. Also, given that a large proportion of people in India do not have access to computers or the internet easily, it becomes imperative to respect the interest of all patients from varied socio-economic groups. Similarly, moving form-filling and paperwork to online modules should ensure availability in vernacular languages to cater to all patients.
- Providers could also consider displaying performance statistics on waiting times each month to re-assure patients of hospital's intent to improve efficiency. For instance, in the UK, monthly NHS Performance Statistics reports the provider-wise performance against target on cancer waiting times.

The NHS, UK currently has nine performance standards on cancer waiting times, which are proposed to be streamlined to the following three standards:

1. A 28-day faster diagnosis standard (FDS) ensures the patients urgently referred, or having breast symptoms, or having been picked up through screening, either have cancer ruled out or receive a diagnosis within 28 days.
2. A 62-day referral to treatment standard, meaning patients who receive a cancer diagnosis will start treatment within nine weeks from the date of referral.
3. A 31-day decision to treat to treatment standard, so that cancer patients receive their first treatment within a month of a decision to treat following diagnosis.

The NHS publishes adherence to established standards as part of its monthly performance statistics, which is an important quality indicator. Publishing performance against set targets also provides visibility to patients, assuring them of the provider's intent to bridge the gap on waiting times.

Theme 4: Need for frequent, transparent, and effective communication between provider and patient

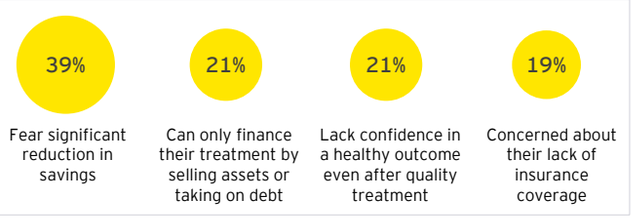
- Any cancer patient's journey is fraught with uncertainties around the effectiveness, duration, and total cost of treatment. In such a situation, patients and caregivers expect regular updates from the provider on their recovery. Cancer treatment is a long process which involves multiple cycles. While the effect of treatment may take time to manifest, patients usually experience side effects almost immediately after a single cycle. This worries patients and their families who start questioning whether the treatment is working, which at times leads to patients to dropping out of treatment.
- Given the large number of patients seen by a specialist in a day, it might not be feasible for the doctor to personally spend so much time with patients and their caregivers. In order to ensure that the patients do not see this as an act of indifference, the provider must provide its patients regular updates electronically through mail or texts. Allowing the patient to access his own file online to check progress at any time is also an option providers can evaluate. Again, while the providers can easily give access to information through technology, interpretation of the information, which would inevitably contain medical terms, needs to be done personally.
- Having a dedicated nurse navigator or cancer care coordinator in such a scenario is an effective solution, which some of the hospitals have adopted. The role of nurse navigator is to help patient navigate the complex treatment journey. In addition to assisting the patient on various administrative processes, nurse navigators also provide regular updates and address various questions and concerns of patients and caregivers. They also help in breaking down complex medical diagnosis information into simpler terms, which allows patients to understand where they are in the treatment process. Given the extreme proximity to patients and caregivers, it is essential that nurse navigator courses and training modules are designed to incorporate cultural sensitivity and patient dignity into their curriculums.

The country of Malta[129] recently introduced nurse navigators to its cancer care services, to make systems more patient centered. The initiative, lauded by the WHO, has demonstrated benefits such as faster diagnosis, shorter time between diagnosis and start of treatment, increased patient and caregiver knowledge, better adherence to recommended care, and reported improvements in quality of life. The roll-out and evolution of the nurse navigator model initially involved collecting and analyzing data to understand where service gaps existed from patient perspectives, and then making the case to the Ministry for Health for investment. The business case demonstrated how the nurse navigator role could benefit the overall health system, not only showing improvements to patient experience and a reduction in service complaints, but also fewer hospital admissions and support for other members of multidisciplinary teams.

[129] https://www.who.int/europe/news/item/15-09-2022-malta--nurse-navigators--embody-patient-centred-care

Theme 5: High cost of treatment and lack of quality care facilities locally

- Affordability continues to be a major area of concern for cancer patients. In the survey, 64% of patients mentioned they did not have any insurance or scheme coverage. More than half of the patients reported spending over INR5 lakhs on their treatment. In a country where annual per capita income (at current prices) is INR1.5 lakhs[130], cancer treatment has the potential of bankrupting entire households. Some key concerns regarding affordability voiced by patients are illustrated below.



  From a provider's perspective, it is important that the provider gives its patients and caregivers adequate visibility about the cost of the treatment during finalization of the treatment plan. Financial counseling informing patients about insurance or scheme cover, philanthropic funding options, patient assistance programs as well as ensuring complete billing transparency are some proactive steps that providers can focus upon to earn patient trust. Also, given that patients highlight low insurance coverage as a key pain point, the government could consider expansion of population coverage under PMJAY to additionally include middle class population under the same.

- Non-availability of local cancer care facilities led to 78% of patients undertaking travel for treatment as indicated by the survey. 42% of patients had to travel more than 100 kilometers. A third of patients who undertook travel did so due to the absence of a treatment center that they could trust in their location. Most patients had to undertake this travel for 3 to 12 months.

  Increased financial burden of indirect costs including travel and stay expenses, along with the social burden of adjusting to a new city whilst being outside the ambit of neighborhood or community support adds a layer of distress for patients and caregivers. Many patients also report feeling guilty about the toll their treatment takes on the lives of their family members and caregivers. Additionally, traveling long distance for treatment often emerges as a barrier to treatment adherence.

  Some simple steps such as providing daily food vouchers or coupons to caregivers, having tie-ups with nearby hotels or service apartments to provide accommodation options at subsidized rates, organizing local conveyance from hotel to hospital, can help in enabling a supportive environment for patients and their caregivers outside the confines of their homes.

  Efforts should be undertaken to deliver care to the patient near or within the comforts of their home. Post-COVID-19, a larger proportion of the population is comfortable with tele-consultation, which is reflected in the survey as well with 37% of patients indicating they would prefer to avail doctor consultation near or at their residence. 25% also indicated that they would prefer to undergo chemotherapy services near their residence.

  A hub-and-spoke model of cancer care wherein the provider delivers common services like chemotherapy to patients through satellite or day care centers can help bridge the gap around access. Details of the current state and recommendations around affordability and access have been covered in an earlier chapter.

[130] https://www.business-standard.com/article/economy-policy

Theme 6: Gaps in post-treatment care

- Cancer is seen as a chronic illness, which means that it never really goes away. Once there is a visible reduction in symptoms, patients take a break from treatment and start coming to terms with the 'new normal' of their life. It is, however, essential they continue monitoring their health, maintain curated diets, regulated activity along with periodic check-ups and follow-up consultations.
- Providers need to engage in continuous follow-up with cancer patients post treatment to ensure their well-being. Providers should train caregivers and empower them to provide basic care at home and ensure immediate access to nurse or doctor for any emergency.
- Facilities for rehabilitation and long-term care need to be made available. Patients and caregivers also need to be made aware of such facilities should they find it difficult to manage by themselves.
- Palliative care should be well-integrated in the overall care plan of a cancer patient post treatment. Community-based models with institutions providing supporting role are the way forward for palliative care.
- Government should integrate alternative medicine such as AYUSH, Yoga, Naturopathy into palliative care, in order to harness their potential benefits. These interventions can play an important role by providing relief from pain while also helping the psychological and spiritual aspects of patient care.

Kerala government has been integrating palliative care with healthcare policy at all levels in a three-tier system. The policy specifies neighborhood networks with trained staff who can identify patient needs and provide home care at the primary level. The next two tiers are community health centers providing in-patient care, taluk hospitals with staff trained to deal with emergencies: then a division of palliative medicine at all medical colleges and general and district hospitals.

Civil society and volunteer groups have also played an instrumental role in the success of the palliative care model in the state. Kerala today has 1,550 palliative care units, 450 of which are run by community-based organizations and NGOs. Just 2% of people who need palliative care in India have access to it, far below the global average of 14%. The figure for Kerala stands above 26%.[131]

Theme 7: Psychological burden of cancer

- Cancer patients tend to experience a range of negative emotions in their journey from 'person' to 'patient[132]'.
- Staring with **fear** of disease, which often manifests as a lack of screening practice, the initial diagnosis results in **shock, disbelief,** and **disappointment**. Acceptance of diagnosis is at times linked to **spirituality** or religious beliefs with people relying on their faith and in God to give them strength to fight cancer, while many people choose to accept the diagnosis as pre-destined. Acceptance then gives way to **anxiety** about how to inform family and friends, how to plan treatment, how to temporarily give up working, how to manage finances, etc. Feelings of **guilt** also prevail with patients thinking of themselves as a source of inconvenience to their family members during the treatment process. Post treatment, constant **worry** and **uncertainty** whether the disease will come back, **low self-esteem** due to body image issues such as loss of hair. Perhaps the patient experiences the most devastating emotion when relapse occurs, causing a sense of **hopelessness**.
- Psychological distress of cancer patients causes a significant difference in their mental and emotional health, which needs professional intervention. Positive mindset and attitude is crucial in keeping up with the journey of cancer treatment, and therefore integration of psycho-oncologists and therapists in the care process is important. Psycho-oncologists can help patients cope with the diagnosis and counsel them through the journey to ensure they are not impacted by mental health issues. They can also help provide support and care to the caregiver, since a cancer diagnosis of a loved one equally devastates families as well.

[131] https://www.thehindu.com/society/palliative-care-in-kerala-a-success-story

[132] ecancer 2022, 16:1342, https://doi.org/10.3332/ecancer.2022.1342

- Cancer support groups can play an important role in supporting the patient through the psychological burden. Having undergone a similar journey, sharing of stories by cancer survivors, along with providing access to relevant information and people, could be a great source of strength for a cancer patient.
- As providers, ensuring empathy at every step by redesigning processes from the point of view of the patient, could be one way to support them emotionally and mentally. The entire eco-system of care, from doctor to nurse to receptionist to pharmacist and right up to the housekeeping staff, should be made to undergo compulsory training on cultural sensitivity, humility and patient dignity.

Annexures

Annexures

Annexure 1

State-wise population and cancer registry coverage in 2016

State/UT	Population (In Crores)	% Population coverage by PBCRs
Kerala	3.4	17%
Mizoram	0.1	97%
Tamil Nadu	7.8	6%
Karnataka	6.6	13%
Punjab	3.0	7%
Assam	3.4	13%
Delhi	1.8	94%
Maharashtra	12.1	23%
Arunachal Pradesh	0.2	64%
Meghalaya	0.3	60%
Madhya Pradesh	8.0	3%
West Bengal	9.7	5%
Gujarat	6.6	9%
Sikkim	0.1	98%
Tripura	0.4	98%
Nagaland	0.2	37%
Manipur	0.3	98%

Source: Census 2001 & 2011, PBCR 2016, EY Analysis

Annexure 2

Following are the major risk factors associated with different cancer types and their trend in the recent past:

Risk factor: Reproductive factors

Key Risk Factor	Reasoning for high propensity to cancer by the risk factors
Reproductive factors **Risk factor for** ► Breast Cancer ► Ovarian Cancer	► Studies have shown that a woman's risk of developing breast cancer is related to her exposure to hormones that are produced by her ovaries. ► Reproductive factors that increase the duration and/or levels of exposure to ovarian hormones have been associated with an increase in breast cancer risk. These factors include increased median age of marriage, delayed childbirth, early onset of menstruation, late onset of menopause and changing breast-feeding pattern

Trends of Exposure	
Delayed childbirth	► The median age of marriage among women age 25-49 in India is 19.2 years in 2021, up from 16.1 years in 1993 ► The median age at first birth among women age 25-49 in India is 21.2 years in 2021, up from 19.4 years in 1993
Early onset of menarche	► Based on studies conducted, average age of menarche varies across India. Across majority of the studies, it has emerged that 12-12.5 years is the typical age for menarche in India in 2017, which is a decrease of 1 year compared to 2005
Declining parity level	► Total fertility rate (TFR), the average number of children that would be born to a woman if she experiences the current fertility pattern throughout her reproductive span (15-49 years), has seen a steady decline from 3.4 in 1992-93 to 2 in 2019-21 ► Women in rural areas have higher fertility, on average, than women in urban areas (TFR of 2.1 versus 1.6 children)
Changing breast-feeding pattern	► While the median duration of exclusive breastfeeding has increased from 2.9 months in 2015-16 to 3.9 months in 2019-21 and the median duration of any breastfeeding has also increased from 29.6 months to 32.1 months during the same period, on an average, children in urban areas are breastfed for shorter duration (median duration of 25.8 months) than their counterparts in rural areas (median duration of 33.5 months).
Increasing oral contraceptive use	► The oral contraceptive prevalence rate among currently married women age 15-49 who use any forms of contraceptives increased from 4.3% in 2015-16 to 5.4% in 2019-21 ► Among currently married women age 15-49, women from Jammu & Kashmir (9.4%), Odisha (10.9%), West Bengal (20.4%), Assam (28.5%), Arunachal Pradesh (15.9%), Mizoram (15.2%), Sikkim (23.3%) & Tripura (32.6%) use higher proportion of oral contraceptives than national average consumption i.e., 5.4% of overall women in 2019-21.

Source: MoHFW: Ministry of Health and Family Welfare, NFHS-5

Risk factor: Sexual habits and poor hygiene

Key Risk Factor	Reasoning for high propensity to cancer by the risk factors
Sexual habits & poor hygiene ► Cervical cancer	► Sexual promiscuity and poor menstrual hygiene are key risk factors linked with cervical cancer

Trends of Exposure	
Menstrual hygiene	► In India, 64% women age 16-24 use sanitary napkins, 50% use cloth, and 15% use locally prepared napkins, as per NFHS-5, 2022, compared to 42%, 62% & 16 % of respective hygienic methods of protection during the menstrual period in 2015-16 ► 73% of rural women use a hygienic method of menstrual protection, compared with 90% of urban women
Poor sexual history	► Reported prevalence of multiple sexual partners and high-risk sexual behavior in India has decreased from 0.7% in 2016 to 0.3% in 2021 among women and 7% in 2016 to 4% in 2021 among men

Risk factor: Infection and immunity level

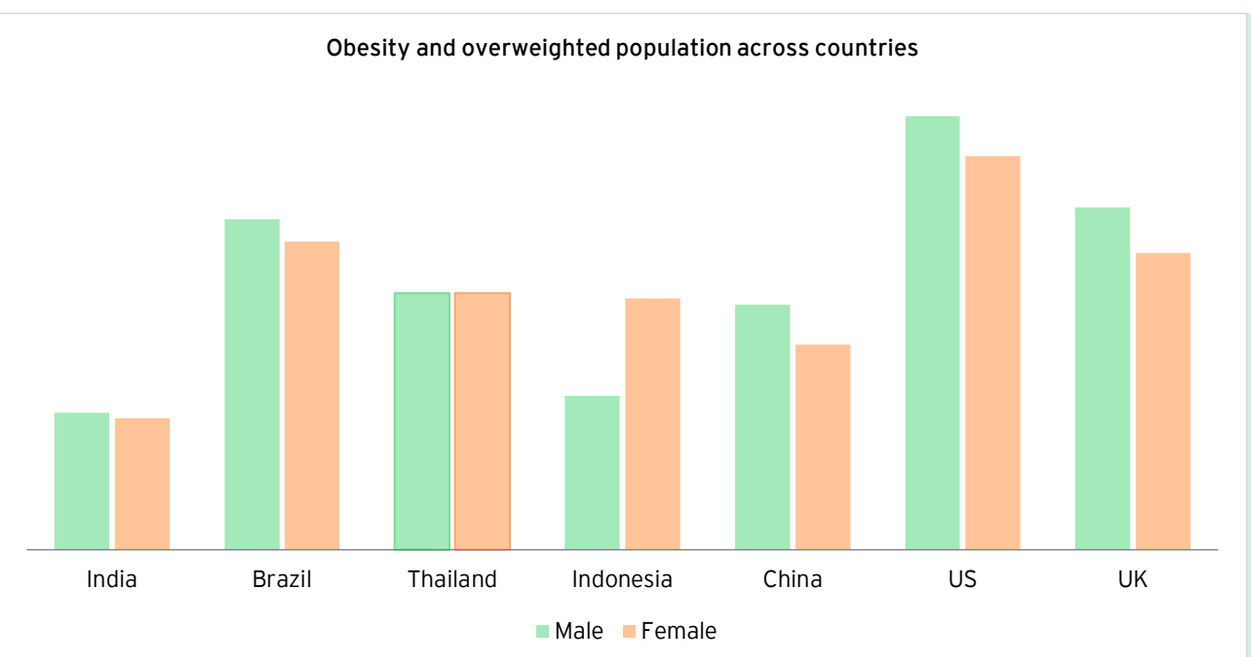
Key Risk Factor	Reasoning for high propensity to cancer by the risk factors
Infection and immunity level ► Cervical cancer ► Gall bladder cancer	► According to studies, HPV types 16 and 18 are responsible for almost 70% of cervical cancers ► Studies on gallbladder cancer revealed consistent associations with chronic bacterial infections, such as S.typhi, S. paratyphi and H. pylori ► Various studies in India have documented presence of gall stone in 70–90% of patients with gall bladder cancer

Trends of Exposure	
HPV Infection	► While the global prevalence of cervical HPV 16/18 among women is 4%, the prevalence in India is 5% ► Studies carried out in India have highlighted higher than national average prevalence rate of HPV in select regional pockets, viz., West Bengal (5.8%), Varanasi (9.7%) and Tamil Nadu (14%)
HIV Infection	► The adult HIV prevalence among males (15-49) years was 0.24% in 2019 and 0.20% for females during the same period ► The states which have adult HIV prevalence higher than the national averages are Mizoram (2.32%), Nagaland (1.45%), Manipur (1.18%), Andhra Pradesh (0.68%), Meghalaya (0.54%), Telangana (0.49%), Karnataka (0.47%), Delhi (0.41%), Maharashtra (0.36%), Punjab (0.27%) and Tamil Nadu (0.23%)
Bacterial Infection	► Helicobacter species has been associated with increased risk of gall bladder cancer ► A systematic review of 37 studies on typhoid and 18 studies on paratyphoid in India between 1950 – 2015, highlighted 9.7% and 0.9% prevalence of typhoid and paratyphoid respectively increasing risk for gall bladder cancer
Gall Stones	► In a study conducted in 2019, out of 213 patients with gallstones across two centers in North India and North East India, metaplasia was present in 86% of routine cholecystectomy specimen for symptomatic gallstone of patients operated.

Risk factor: Obesity and physical inactivity

Key Risk Factor	Reasoning for high propensity to cancer by the risk factors
Obesity and physical inactivity Risk factor for: ► Breast cancer ► Cervical cancer ► Ovarian cancer ► Gall bladder cancer Obesity is a growing concern. It is the leading cause of several non-communicable and progressive diseases, such as hypertension, diabetes and those related to liver and increased risks of stroke	► Overall, there has been a slight increase in the mean BMI for women from 21.9 in 2015-16 to 22.4 in 2019-21. ► The mean BMI for men is the same as that of women (22.4) in 2019-21, a slight increase from 21.9 for women and 21.8 for men in 2015-16 ► Obesity has increased in both men and women in India during the last five years, proportion of overweight/obese women aged 15-49 increased from 21% in 2015-16 to 24% in 2019-21 and that of men increased from 19% to 23% ► The proportion of overweight children grew from 2.1% in 2015-16 (NFHS-4) to 3.4% in 2019-20 (NFHS-5) ► Overall BMI in Delhi (24.25), Haryana (23.2), Punjab (23.9), Sikkim (24.1), Karnataka (24), Kerala (23.5) and Tamil Nadu (24.15) are higher than the national average of 22.4 ► Proportion of population with BMI higher than normal is more in most other countries in comparison i.e., the US, the UK, Brazil, Thailand, China.

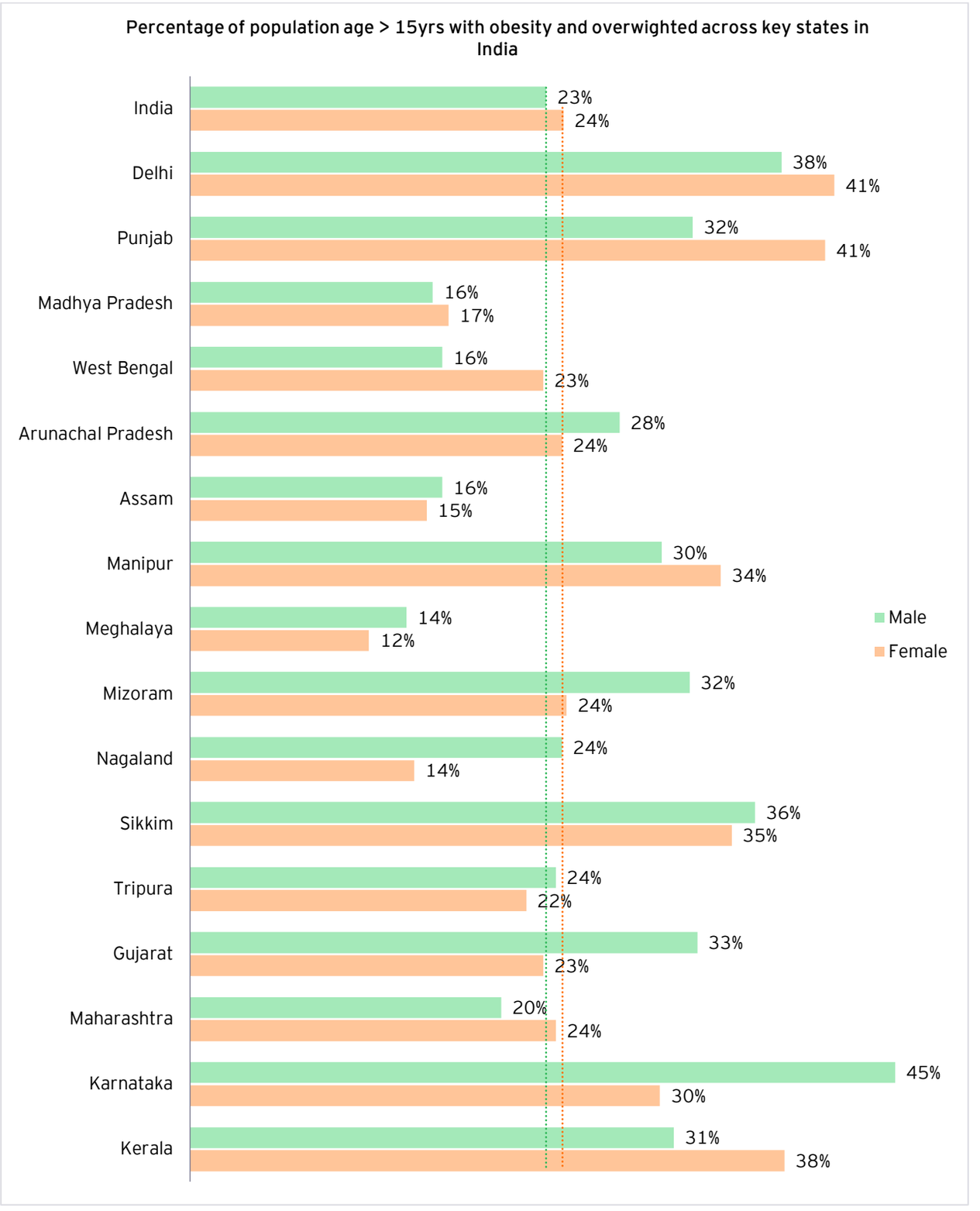
Obesity across countries in 2018



Source: NFHS-5, Global obesity Observatory 2018

*For Thailand breakup between male female not available

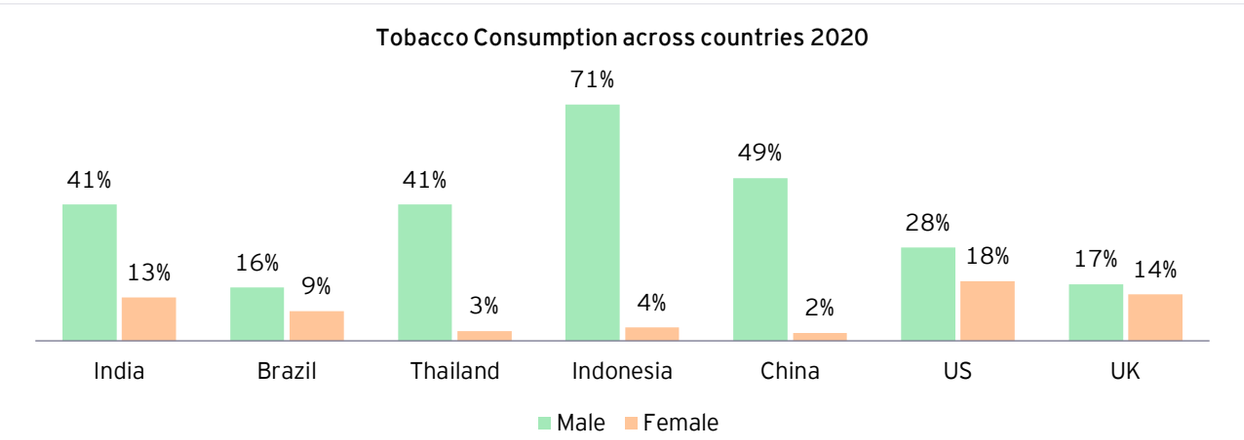
State wise trend – population with overweight and obese BMI (>=25)



Risk factor: Tobacco use

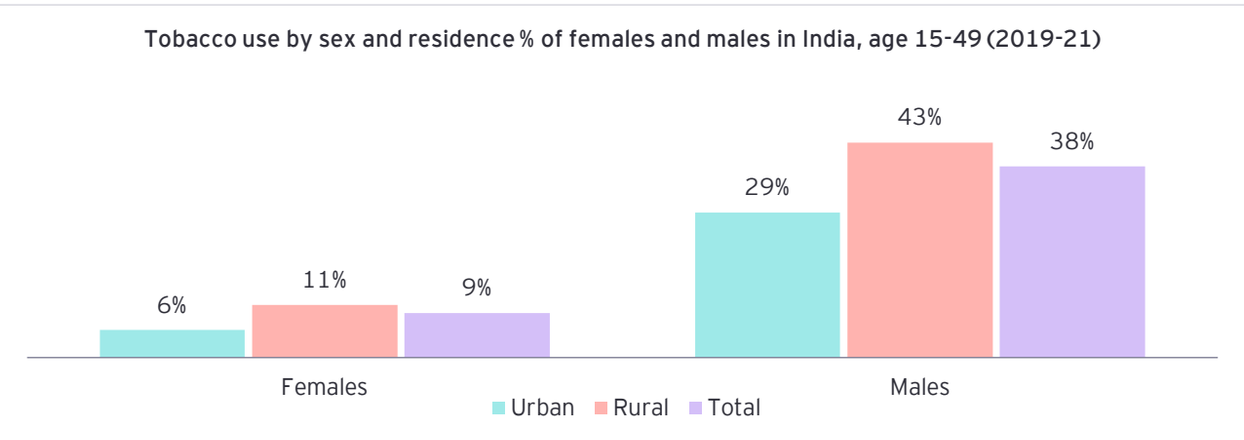
Key Risk Factor	Reasoning for high propensity to cancer by the risk factors
Tobacco consumption Risk factor for: ► Lung cancer ► Head and neck cancer ► Cervical cancer About 3 in 10 Indian tobacco users said they tried to stop using tobacco in any form in the 12 months preceding the NHFS-5 survey 61% female and 54% males who visited a doctor/health care provider in the 12 months preceding the survey were advised to stop	► 38% of men and 9% of women aged 15 and over currently use any tobacco products ► Among men as well as women, the use of tobacco is higher in rural areas (43% for men and 11% for women) than in urban areas (32% for men and 6% for women) ► There is an equally clear and continual decrease in tobacco use with increasing wealth quintiles. Over 21% men in the highest wealth quintile use tobacco, in comparison with 58% of men in the lowest wealth quintile. 17% women in the lowest wealth quintile use tobacco. ► More than 60% men and about 10% of women with no/less than five years of schooling use some form of tobacco ► 46% men smoke an average of five or more cigarettes/bidis each day ► Use of tobacco is significantly higher among men in India (38%) than the US (28%) and the UK (17%) while slightly lower in case of females (US – 18%; UK-14%), while developing nations like Indonesia and China have much higher tobacco consumption for men (Indonesia – 71%; China – 49%) and lower for women (Indonesia – 4%; China – 2%)

Tobacco consumption across countries



Source: World Bank data 2020

Regional tobacco use by gender

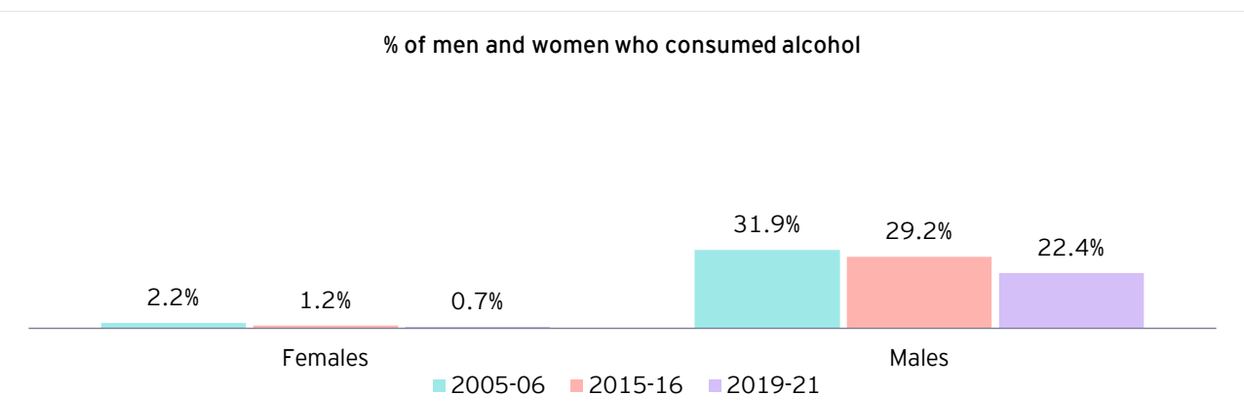


Source: NFHS-5

Risk factor: Alcohol consumption

Key Risk Factor	Reasoning for high propensity to cancer by the risk factors
Alcohol consumption Risk factor for: ► Breast cancer ► Head and neck cancer Alcohol has been shown to permanently damage the DNA strands in the cell, inhibit DNA repair processes from functioning and lead to nutritional deficiencies Even moderate alcohol intake has been shown to increase the risk of developing female breast cancer	► 19% of men and 1% of women aged 15 and over consume alcohol currently ► The proportion of men who drink alcohol decreased, from 29% to 22%, between 2015-16 (NHFS-4) and 2019-21 (NFHS-5). During that period, the proportion of women who consume alcohol also declined from 1.2% to 0.7%. ► Among the women who consume alcohol, 17% drink almost every day and 37% about once a week. Among the men who consume alcohol, 15% drink alcohol almost every day and 43% about once a week

Consumption of alcohol over time across genders



The following table provides a per capita alcohol consumption in India in 2010 vs. 2016

Recorded consumption has increased by a CAGR of 2% over the 6 years whereas unrecorded consumption has increased by 10%, evidencing the behavioral habits of Indians, with regards to illegal consumption of alcohol, or not providing data for the consumption patterns.

The consumption by Indian males over both years has been almost 2x of the WHO South-East Asia Region benchmark

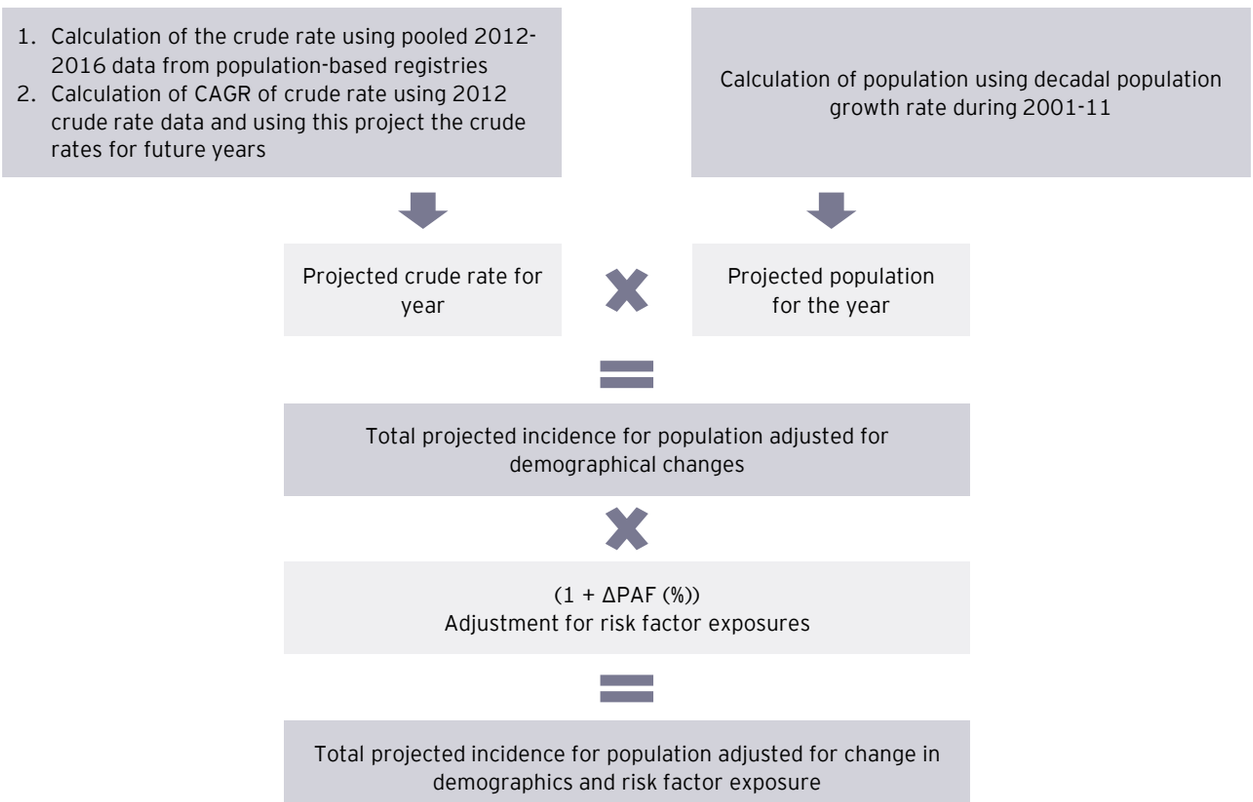
Consumption of alcohol over time across genders

Alcohol per capita (15+) consumption (in liters) in India				
	2010		2016	
Recorded	2.7		3.0	
Unrecorded	1.5		2.6	
Total**	4.3		5.7	
Total males/females	7.1	1.3	9.4	1.7
WHO South-East Asia Region	3.5		4.5	

Source: NFHS-5, WHO: Global status report on alcohol and health 2018

Annexure 3

Framework for projection of overall crude incidence adjusting for demographic and risk factor exposures



Framework for adjusting incidence rates based on risk factor exposure

Risk factor profile¶	India	UK	Population Attributable Fraction (PAF)		Difference
			India	UK	UK v. India
Tobacco prevalence (%, 2019)	8.60	16.10	8.60	16.10	7.50
Alcohol per capita consumption (liters, 2019)	5.61	11.45	1.62	3.30	1.68
BMI >25 kg/m^2 (%, 2019)	19.70	63.70	1.95	6.30	4.35
Physical inactivity prevalence (%, 2016)	34.03	35.86	0.47	0.50	0.03
Cumulative difference in exposure (ΔPAF%)					13.56

Parameter	Risk factor exposure correction
Additional cases expected if PAFs mirror the UK levels	Estimated Incidence $_{year}$ x ΔPAF expressed as a ratio
Incidence adjusted for risk factor exposure	Estimated Incidence $_{year}$ + Additional cases expected if PAFs mirror the UK levels

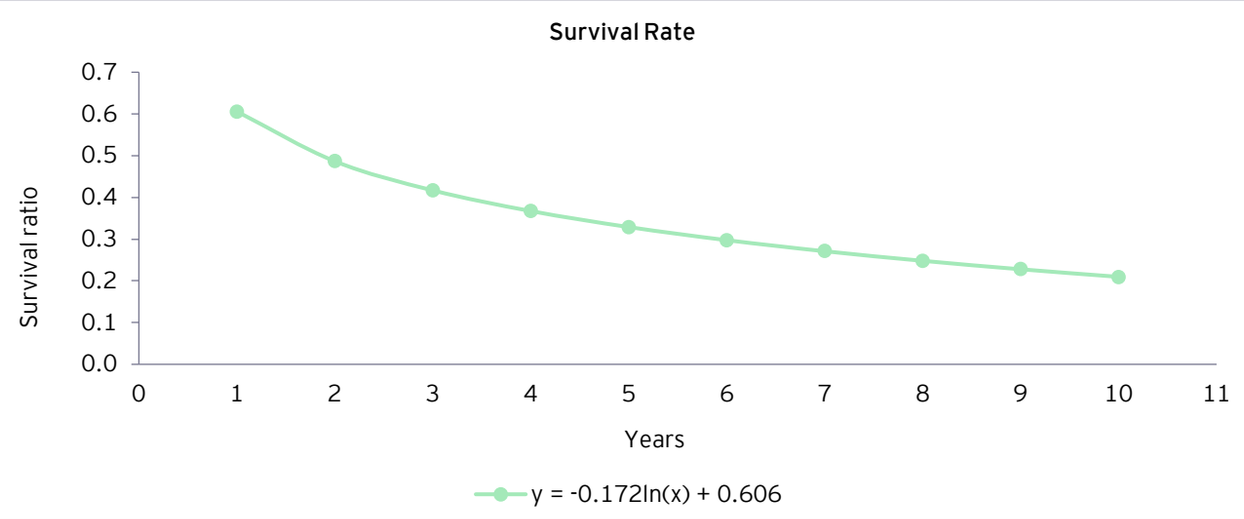
Multiple risk factor exposure is not factored in this calculation, nor are other risk factors for specific cancers such as infectious agents, low fiber diet etc.

Source: WHO Global health observatory; Katrina et al, (2018)

Framework for projection of prevalence: estimation of survival ratio

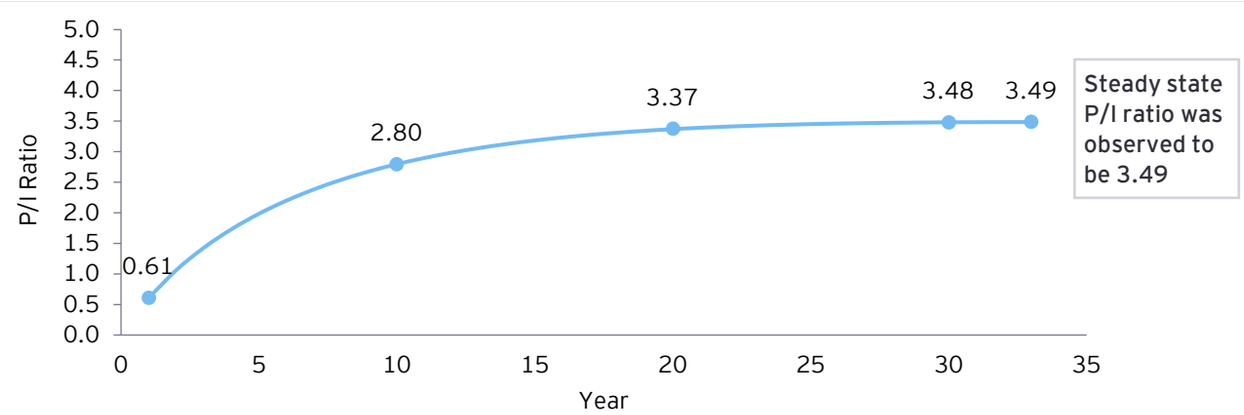
Parameter	Method of estimation
Survival ratio, 2010-14	▶ Pooled five-year survival of solid tumors was calculated from data ▶ Pooled survival data from CONCORD-3 study, for India, was 32.9% which is 5% higher as compared to figure used by Takier et al. for 1999 ▶ Assuming a similar improvement in the one year survival a non-linear regression curve was fitted to obtain survival rates with the two known points ▶ Survival for the projected year was assumed to be unchanged

Curve-fit – non-linear regression	
Survival%	Years
0.606	1
0.487	2
0.417	3
0.367	4
0.329	5
0.298	6
0.271	7
0.248	8
0.228	9
0.210	10



Framework for projection of prevalence: estimation of prevalence to incidence (P/I) ratio

The non-linear regression curve is used to calculate year-on-year prevalence or survival based on the reported incidence level for all cancer types for women. The P/I ratio for the derived prevalence was then plotted till a steady state was reached



Prevalence (all sites)$_{year}$= (Steady state P/I ratio) x (Reported incidence $_{year}$)

Incidence ('000)		1,231	1,313	1,400	1,493	1,592	Prevalence ('000)	Incidence ('000)	P/I (Prevalence/ Incidence)
Survival ratio -0.172ln(x) + 0.606		Year 1	Year 2	Year 3	Year 4	Year 5			
0.606	Yr 1	746					746	1,231	0.61
0.487	2	599	796				1,395	1,313	1.06
0.417	3	513	639	848			2,000	1,400	1.43
0.367	4	452	547	681	905		2,586	1,493	1.73
0.329	5	405	482	584	727	965	3,162	1,592	1.99

Illustrative: Calculation of prevalence to incidence ratio

(Incidence for the year) x (Corresponding survival ratio)

Summation of prevalence for the year

Estimated incidence

Annexure 4

List of localized surveys for awareness insights

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Annexures 5

Key Assumptions in computing RT requirement

No. of people requiring radiotherapy	60%	of total new patients
Incidence of Cancer (Annual) - 2022	120	Per lakh of population
Incidence of Cancer (Annual) – 2030	260	Per lakh of population
Incidence of Cancer (Annual) – 2030 (Conservative) @ 5% crude incidence rate growth	177	Per lakh of population
Number of fractions per patients	25	
Number of Fractions per day (Capacity/ Optimal)	100	
Number of Fractions per day (@50% utilization)	50	
Working days	200	
Equipment requiring replacement (2022)	15	
Equipment requiring replacement (by 2030)	500	
Ratio of Level 3 (Basic LINAC): Level 2 (VMAT): Level 1 (SBRT/Tomo)	1:3:22	

Key steps in computing RT requirement

1. Clustering of districts with population lesser than 10 lakhs
2. Estimation of optimal requirement basis key assumptions detailed out in the assumptions table
3. Mapping of Current RT basis list in AERB website. Increment of 24% added to each district to bridge the gap of actual RT count (640) and count available in the AERB website (537)
4. Incremental requirement for 2022 and 2030 computed at the district level
5. Optimal RT requirement and Current RT is split into multiple levels within each state basis the ratio of Level 3: Level 2: Level 1 assumption in the assumptions table
6. Increment requirement for each level computed at the country level
7. Capital outlay estimated basis cost assumptions for different type of LINAC equipment

Annexure 6

Key Assumptions in computing PET-CT requirement

No. of people requiring PET-CT	50%	of total new patients
No. of scans required per person	3	
No. of scans per day per machine	18	
No. of working days	300	

Note: Same incidence assumptions as annexure 5

Annexure 7

Key Assumptions in computing requirement of Day care and Surgical beds

% New cases requiring/receiving chemotherapy	70%	of total new patients
	20%	of prevalent cases
Number of chemotherapy cycles per patient	4 - 6	
Number of chemotherapy cycles per day care bed/day	3	
% New cases requiring/receiving surgical treatment	70%	of total new patients
Average length of stay for surgeries	5	
No. of operational days	365	

Note: Same incidence assumptions as annexure 5

Annexure 8

Key Assumptions in computing requirement of oncologists and medical physicist

Number of patients treated by medical oncologist per year	480
Number of patients treated by medical oncologist per year	320
Number of surgeries by surgical oncologist per day	1 - 2
Number of days on which surgery is performed per year	300
Number of patients treated by medical physicist per year	500

Note: Same incidence assumptions as annexure 5

Annexure 9

Key Assumptions in computing requirement of CCCs

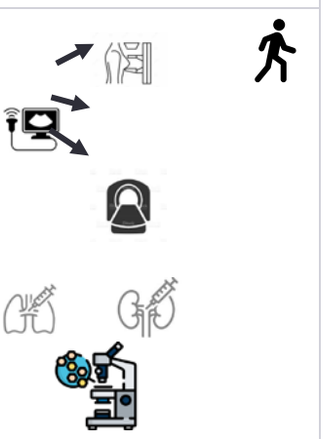
Number of patients treated by a CCC per year	2,000
% Patients receiving multimodal treatment	40%

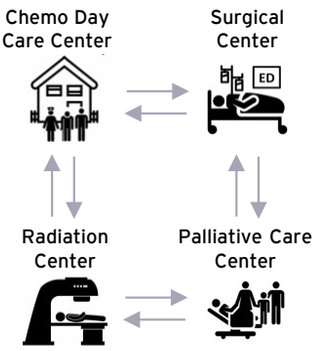
Notes:

1. Each district/ district cluster with sizable new cancer patients per year (>2,500) to have at least one CCC.
2. Requirement computed at district cluster level (Cluster of nearby districts with > 10 lakh population)
3. Same incidence assumptions as annexure 5

Annexure 10

Karkinos's approach to management of patient journey

Key stages of patient journey	Karkinos's approach to management of patient journey	
1. Awareness	▸ Online proprietary risk assessment tool including questionnaire with 64-65 parameters for patients to assess their risk susceptibility for cancer. ▸ Validation of submitted information at command centre by trained team. Call backs to patient by trained nurses to verify and validate information wherever required.	
2. Screening and Diagnostics	▸ Based on risk assessment patient can be guided to undertake screening tests at partner locations near to the patient's home setting. Screening tests could include Clinical Breast Examination (CBE), USG, Mammogram, CT etc., Results of the screening test will be recorded in the health records of patient maintained by Karkinos. ▸ Based on outcomes of the screening test patient can be guided to local health facility for biopsy. Results of the biopsy will be maintained in health records of patient at Karkinos. Depending on the results, the case will be taken forward for evaluation by Virtual Tumor Board.	
3a). Treatment	▸ Karkinos's inhouse team of expert clinicians to evaluate every patient case in Virtual Tumor Board and generate appropriate treatment protocol to be recommended for patient care. Karkinos has currently empanelled ~450 clinicians on board.	

Key stages of patient journey	Karkinos's approach to management of patient journey	
3b). Treatment and Post Treatment	▸ Patient's will be provided option to take up treatment at any of the partner locations of Karkinos. Karkinos has plans to partner with ~50 treatment centers in year 1, ~100 in year 2 and ~400 in year 3. ▸ Patient's can also choose to opt out of the Karkinos network and take up treatment with any other provider of their choice. ▸ Karkinos will be partnering with insurance companies to provide different coverage options for patients such as – ▸ Option 1→ End to end managed care from risk assessment to treatment and post treatment care ▸ Option 2→ Only risk assessment, screening and diagnostics ▸ Option 3→ Risk assessment, screening, diagnostics and treatment protocol/case review by Tumour Board ▸ A key enabler to the entire program will be the end to end health record of the patient which will be maintained and managed across the patient journey. Karkinos's proprietary interoperable EMR system is aimed towards ensuring seamless patient information exchange and clinical decision making a possibility in this program.	 

Abbreviations

Abbreviation	Full form
3D CRT	3-Dimensional Conformal Radiation Therapy
AB	Ayushman Bharat
AB - ArK	Ayushman Bharat-Arogya Karnataka Scheme
ABHA	Ayushman Bharat Health Account
ACDC	Awareness-cum-de-addiction Camp
AERB	Atomic Energy Regulatory Board
AI/ML	Artificial Intelligence/ Machine Learning
AIIMS	All India Institute of Medical Sciences
AHBCR	Apollo Hospital Based Cancer Registry
ALL	Acute Lymphoblastic Leukemia
AML	Acute Myeloid Leukemia
ANM	Auxiliary Nurse Midwife
AP	Andhra Pradesh
APJCP	Asia Pacific Journal for Cancer Prevention
AQI	Air Quality Index
ASEAN	Association of Southeast Asian Nations
ASHA	Accredited Social Health Activist
ASR	Age-specific incidence rates
ASR-W	Age-specific incidence rates – weighted
AYUSH	Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy
BC	Breast Cancer
BMI	Body Mass Index
BPL	Below Poverty Line
BRICS	Brazil, Russia, India, China, and South Africa
BSKY	Biju Swasthya Kalyan Yojana
CAGR	Compounded Annual Growth Rate
CAPED	Cancer Awareness, Prevention and Early Detection
CAR – T Cell	Chimeric antigen receptor T Cell
CBE	Clinical Breast Examination
CCCs	Comprehensive Cancer care Centres
CDSS	Clinical Decision Support System
CGHS	Central Government Health Scheme
CHCs	Community Health Centres
CHE	Catastrophic Health Expenditure
CHL	Classical Hodgkin Lymphoma
CHO	Community Health Officer
CHW	Community Health Worker
CLL	Chronic Lymphocytic Leukemia
CMCHIS	Chief Minister's Comprehensive Health Insurance Scheme

Abbreviation	Full form
CML	Chronic Myeloid Leukemia
COE	Centre of Excellence
COTPA	Cigarettes and Other Tobacco Products Act
CR	Crude Rate
CRC	Colorectal Cancer
cSCC	Cutaneous Squamous Cell Carcinoma
CSR	Corporate Social Responsibility
CT	Computed Tomography
DALY	Disability Adjusted Life Year
DESH	Detect Early and Save Him/Her
DH	District Hospital
DiNC	Digital Nerve center
DM	Doctorate of Medicine
DMG	Disease Management Group
DNA	Deoxyribonucleic Acid
DNB	Diplomate of National Board
ECHS	Ex-Servicemen Contributory Health Scheme
EISE	Ethicon institute of Surgical Education
EMR	Electronic Medical Record
ENDS	Electronic Nicotine Delivery Systems
ENT	Ear, Nose and Throat
EPA	Environmental Protection Agency
ESCC	Esophageal Squamous Cell Carcinoma
ESI	Employees' State Insurance
ESIC	Employees' State Insurance Corporation
ESIS	Employees' State Insurance Scheme
EU	European Union
FD-G	Fludeoxyglucose (18 F)
FDS	Faster Diagnosis Standard
FICCI	Federation of Indian Chambers of Commerce and Industry
FY	Financial Year
GATS	Global Adult Tobacco Survey
GC	Gastric Cancer
GCRI	The Gujarat Cancer & Research Institute
GDP	Gross Domestic Product
GEJ	Gastro Esophageal Junction
GI	Gastrointestinal
GIST	Gastrointestinal Stromal Tumor
GoI	Government of India
GP	General practitioner
GST	Goods and Services Tax
GYTS	Global Youth Tobacco Survey
H&N	Head and Neck
HBCR	Hospital Based Cancer Registry
HCC	Hepatocellular Carcinoma
HCG	Healthcare Global Enterprises Ltd
HCP	Healthcare Practitioner
HER2	Human Epidermal Growth Factor Receptor 2
HIS	Health Information System

Abbreviation	Full form
HNSCC	Head and Neck Squamous Cell Carcinoma
HPV	Human Papillomavirus
HR	Human Resources
HWC	Health and Wellness Centre
IAEA	International Atomic Energy Association
IARC	International Agency for Research on Cancer
ICMR	Indian Council of Medical Research
I-ELCAP	International Early Lung Cancer Action Program
IGRT	Image Guided Radiation Therapy
IGST	Integrated Goods and Services Tax
IHC	Immunohistochemistry
IMRT	Intensity Modulated Radiation Therapy
INR	Indian Rupee
IP	Inpatient
IPHS	Indian Public Health Standards
IRCA	Integrated Rehabilitation Centre for Addicts
IRDAI	Insurance Regulatory and Development Authority of India
IT	Information Technology
JCI	Joint Commission International
KAP	Knowledge, Attitude and Practice
KS	Key States
LC	Lung Cancer
LCDT	Lung Cancer Diagnostic Test
LINAC	Linear Accelerator
LPL	Dr Lal PathLabs Ltd
M/I	Mortality to Incidence
MBBS	Bachelor of Medicine, Bachelor of Surgery
MCC	Merkel Cell Carcinoma
MCH	Master of Chirurgiae
MD	Doctor of Medicine
MDC	Medanta's Multi-disciplinary Care
MDT	Multi-Disciplinary Tumor board/ Multi-Disciplinary Treatment
MJPJAY	Mahatma Jyotirao Phule Jan Arogya Yojana
MM	Multiple Myeloma
MMPCRK	Mukh Mantri Punjab Cancer Raahat Kosh
Mn	Million
MO	Medical Officer
MOHFW	Ministry of Health and Family Welfare
MP	Madhya Pradesh
MPCE	Monthly Per Capita Expenditure
MPW	Medical Peace Work
MRI	Magnetic Resonance Imaging
MRP	Maximum Retail Price
NA	Not Available
NABH	National Accreditation Board for Hospitals
NCCD	National Calamity Contingent Duty
NCD	Non-communicable diseases
NCDIR	National Centre for Disease Informatics and Research
NCG	National Cancer Grid

Abbreviation	Full form
NCR	National Capital Region
NCRP	National Cancer Registry Programme
NDPS	Narcotic Drugs and Psychotropics Substances Act
NFHS	National Family Health Survey
NGO	Non-Government Organisation
NGS	Next-Generation Sequencing
NH	Narayana Hrudayalaya Limited
NHA	National Health Authority
NHL	Non-Hodgkin's Lymphoma
NHS	National Health Service
NISER	National Institute of Science Education and Research
NLEM	National List of Essential Medicines
NLST	National Lung Screening Trial
NPCDCS	National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke
NSCLC	Non-small Cell Lung Cancer
NSS	Nation Sample Survey
NTCP	National Tobacco Control Programme
OBG	Obstetrics and gynecology
OOPE	Out Of Pocket Expenditure
OPD	Outpatient Department
OVE	Oral Visual Examination
P/I	Prevalence/Incidence
PACS	Picture Archiving and Communication System
PAF	Population Attributable Fraction
PBCR	Population-Based Cancer Registry
PET	Positron Emission Tomography
PET-CT	Positron Emission Tomography – Computed Tomography
PG	Post Graduate
PGI	Post Graduate Institute
PHCs	Primary Health Centers
PLI	Production Linked Incentive
PM	Particulate Matter
PMBCL	Primary Mediastinal Large B-cell Lymphoma
PMJAY	Pradhan Mantri Jan Arogya Yojana
PPP	Public private partnership
PSA	Prostate Specific Antigen
QOF	Quality Outcomes Framework
QoL	Quality of Life
RBI	Reserve Bank of India
RCC	Renal Cell Carcinoma
RGCI	Raji Gandhi Cancer Institute
RGUHS	Rajiv Gandhi University of Health Sciences
RIS	Radiology Information System
RMO	Resident Medical Officer
RRTC	Regional Resource and Training Centre
RSBY	Rashtriya Swasthya Bima Yojana
RT	Radiotherapy
RWA	Resident Welfare Association
SBE	Self Breast Examination

Abbreviation	Full form
SBRT	Stereotactic Body Radiation Therapy
SC	Sub Centre
SCI	State Cancer Institute
SCLC	Small Cell Lung Cancer
SEER	Surveillance, Epidemiology and End Results Program
SRS	Stereotactic Radiosurgery
SSKM	Seth Sukhlal Karnani Memorial Hospital
TB	Tuberculosis
TC	Thyroid Cancer
TCCC	Tertiary Cancer Care Centre
TFR	Total Fertility Rate
TMH	Tata Memorial Hospital
TURBT	Transurethral Resection of Bladder Tumor
UAE	United Arab Emirates
UC	Ulcerative Colitis
UG	Under Graduate
UICC	Union for International Cancer Control
UK	United Kingdom
UMPCE	Urban Monthly Per Capita Expenditure
UP	Uttar Pradesh
USA	United States of America
USFDA	U.S. Food and Drug Administration
USG	Ultrasonography
USP	Unique Selling Point
UT	Union Territory
UV	Ultraviolet
VGF	Viability Gap Funding
VIA	Visual Inspection through Acetic Acid
VMAT	Volumetric Modulated Arc Therapy
VTB	Virtual Tumor Board
WHO	World health Organization
YLD	Years of Healthy Life Lost Due to Disability
YLL	Years of Life Lost
YPPLL	Years of Potential Productive Life Lost

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Tel: + 91 80 6727 5000

Ground Floor, 'A' wing
Divyasree Chambers
11, Langford Gardens
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Chandigarh
Elante offices, Unit No. B-613
& 614
6th Floor, Plot No- 178-178A
Industrial & Business Park,
Phase-I
Chandigarh - 160 002
Tel: + 91 172 6717800

Chennai
Tidel Park, 6th & 7th Floor
A Block, No.4, Rajiv Gandhi
Salai
Taramani, Chennai - 600 113
Tel: + 91 44 6654 8100

Delhi NCR
Golf View Corporate Tower B
Sector 42, Sector Road
Gurugram - 122 002
Tel: + 91 124 443 4000

3rd & 6th Floor, Worldmark-1
IGI Airport Hospitality District
Aerocity, New Delhi - 110 037
Tel: + 91 11 4731 8000

4th & 5th Floor, Plot No 2B
Tower 2, Sector 126
Gautam Budh Nagar, U.P.
Noida - 201 304
Tel: + 91 120 671 7000

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THE SKYVIEW 10
18th Floor, "SOUTH LOBBY"
Survey No 83/1, Raidurgam
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Tel: + 91 40 6736 2000

Jamshedpur
1st Floor, Shantiniketan
Building, Holding No. 1
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Jamshedpur – 831 001
Tel: + 91 657 663 1000

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9th Floor, ABAD Nucleus
NH-49, Maradu PO
Kochi - 682 304
Tel: + 91 484 433 4000

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3rd Floor, Block 'C'
Kolkata - 700 016
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14th Floor, The Ruby
29 Senapati Bapat Marg
Dadar (W), Mumbai - 400 028
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5th Floor, Block B-2
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Off. Western Express Highway
Goregaon (E)
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Panchshil Tech Park, Yerwada
(Near Don Bosco School)
Pune - 411 006
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