Call for Action: Expanding cancer care for women in India

September 21, 2017

FICCI flo
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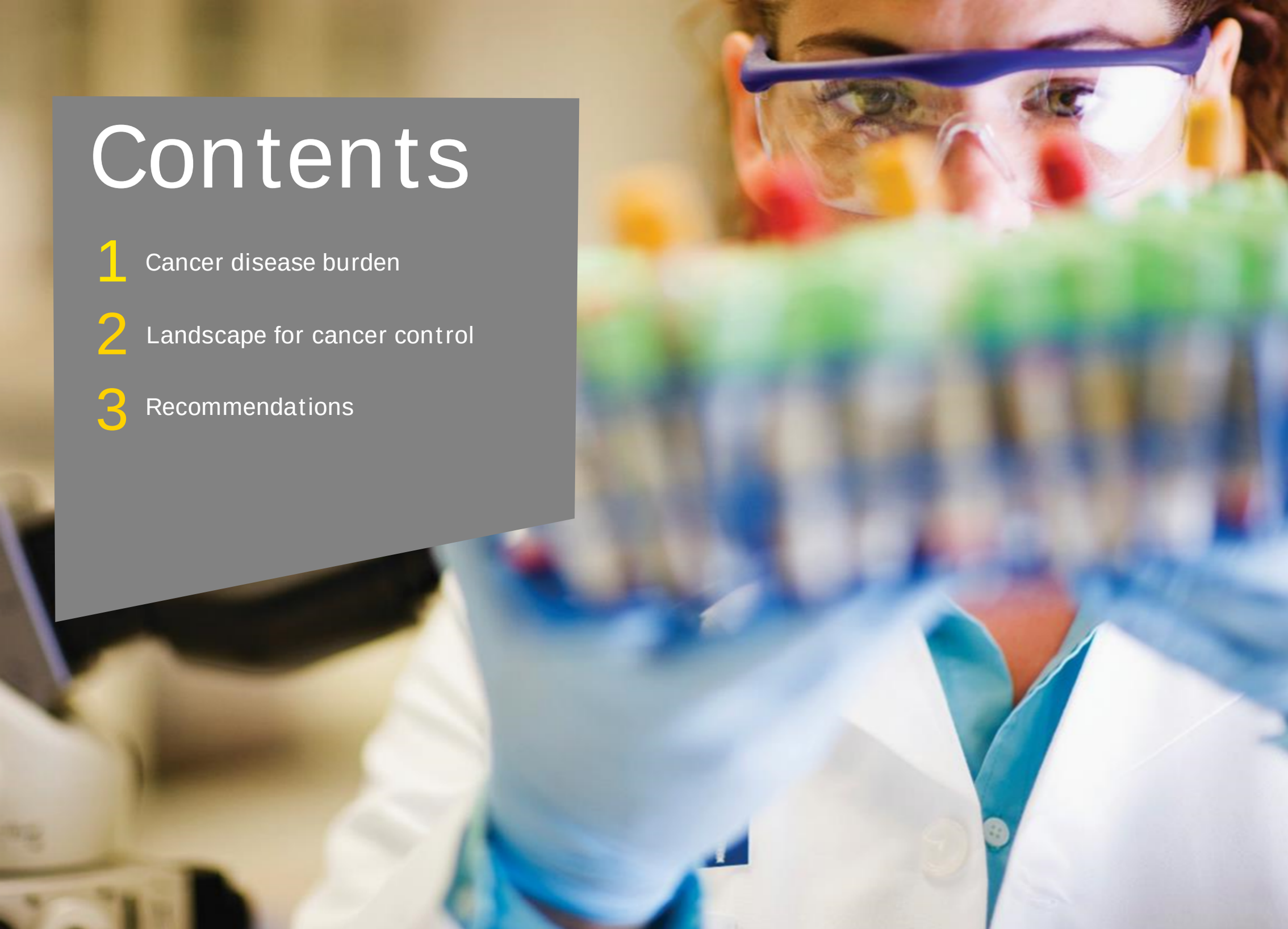

Foreword

American author Harriet Beecher Stowe had rightly said, “A woman’s health is her capital.”

Women are custodians of family health, playing a critical role in maintaining the health and well-being of their communities. In other words, healthy women will ensure healthy families, healthy communities and a healthy nation.

Women's health is of particular concern due to widespread discrimination against women in the world due to socioeconomic factors and gender-differentiated access to medical treatment leaving them disadvantaged.

We, at FLO, envision a nation in which equitable gender norms lead to healthy and empowered women. We plan to address the issue by way of seminars, health camps, white papers etc. over 14 chapters pan India.

India’s real cancer incidence for women is estimated at 1 to 1.4 million per year. In 2015 reported incidence was 0.7 million (third highest after China and the USA) growing at a CAGR of 4.5-5%.

It is alarming that awareness levels of women related cancers is low among the general population and even the medical professionals. Despite the established benefits of screening, coverage in India is low for women (India based studies have confirmed screening improves early detection of cancers by 1.5-2.5 times). Cancers such as breast and cervical can be cured if detected early and treated adequately. They are preventable with regular screening tests and appropriate follow-up care.

In 2015 cancers of the breast (19%), cervix uteri (14%) and ovary (7%) contributed to 40% of all cancer incidence among women with states such as Kerala, Tamil Nadu and Delhi having the highest crude incidence for these cancers.

It is imperative that the menace of growing incidence of cancer among women needs to be addressed with a sense of urgency and in a holistic manner with due emphasis on prevention, timely diagnosis, effective treatment and palliative care.

Health in India is a state subject, but needless to say this will need to be a national agenda, with clear goals to be achieved at national and state levels followed by a focused, coordinated and integrated approach with clearly articulated action plan both at the policy and implementation level.

FLO, as the oldest women business chamber, has contributed significantly over the last 34 years toward economic empowerment of women in India and has taken up the mandate to assess the current state of cancer care for women in India and identify key imperatives and recommendations for industry stakeholders that will enable effective management of the disease over the medium term.

Toward this initiative, FLO has joined hands with EY to bring out this white paper on “Expanding Cancer Care for Women in India.” This thought leadership initiative focuses on women-specific cancers such as of the breast, cervix, ovary, gall bladder, lung, thyroid and mouth.

This paper brings forward a high level summary of the key action points based on the analysis of current gaps, study of successful and relevant global experiences and deliberations with key stakeholders in public and private providers actively involved in the delivery and management of cancer care in India.

We believe that that this paper will be able to act as a catalyst in improving the women healthcare scenario in the country, thereby accelerating women’s participation in the process of economic development and achieving the goal of women empowerment. We also hope to create awareness and arm women with the knowledge that will help them take better care of themselves.

I would like to acknowledge Dr. Sonali Kochhar, Governing Body Member of FICCI Ladies Organisation, for her inputs toward the paper.

I am very grateful to Mr. Rajiv Memani and his team at EY, for supporting FLO to prepare this white paper.

Vasvi Bharat Ram
National President (2017-18)
FICCI Ladies Organization

Preface

Health of the mother is a critical determinant of the overall well being of a family in any society. The critical role a mother plays in shaping the physical, emotional and psychological health of a family and consequently the community and the nation cannot be over emphasized. Hence, it will be fair to say that managing the health of the girl child and women should be a critical imperative for any nation that aspires to build a healthy nation for its future generations.

On the other hand, cancer is a disease that has the potential to debilitate the life of a person, physically, emotionally and economically, in a manner few other ailments can. The very name invokes a sense of dread and anguish, along with all its associated trappings, that not only creates havoc in the life of the patient but in fact unsettles and disturbs the entire family. Even the survivor rarely ever gets back to being normal, acutely aware of his or her mortality and its consequent effect on the emotional and psychological well being.

Hence, the unfortunate reality of a rapidly increasing incidence of cancer among women in India is a matter of grave concern and can potentially become a calamity if not addressed in an effective and urgent manner. This report is a humble attempt to understand the issue at hand in a holistic way and propose an action plan that attempts to correct the gaps in the current state of affairs even while leveraging the learnings from the experience of other countries that have managed to achieve better success in managing the disease.

We are grateful to FLO 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 the various aspects of this report and shared their valuable views and insights, which have 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 mood, motivation and mandate for directing the right focus on cancer care for women in India.

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Executive summary (1/6)

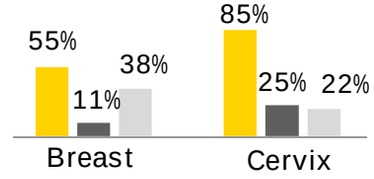
India's real cancer incidence for women is estimated at 1 to 1.4 million per year

- In 2015, reported incidence was 0.7 million (third highest after China and the US), growing at a CAGR of 4.5%-5%, but the real incidence is estimated at 1-1.4 million per year
- In 2015, cancers of the breast (19%), cervix uteri (14%) and ovary (7%) contributed to 40% of all cancer incidence among women with states such as Kerala, Tamil Nadu and Delhi having the highest crude incidence for these cancers

The challenge of high incidence is further compounded by the unfortunate situation of late detection, which has an adverse impact on the cost of care and mortality

- 5-year survival rate decreases by 2.7 times and 17.2 times for breast and cervical cancer, respectively, in case of detections at stage IV as against stage I
- Treatment cost for late stage cancers is 1.5 to 2 times higher than the cost for early stage cancers

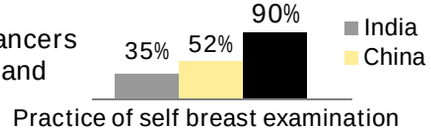
Proportion of cases detected in late stages (III+IV)

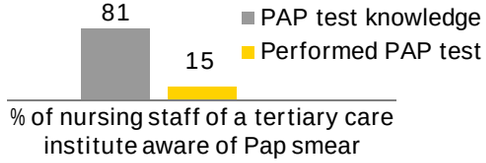


1 High cancer incidence and late detection

A Awareness

Awareness levels of women-related cancers are low among the general population and even paramedical professionals

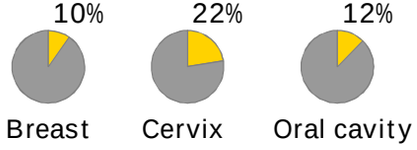




B Screening

Despite the established benefits of screening, coverage in India is low for women (India-based studies have confirmed screening improves early detection of cancers by 1.5-2.5 times)

% of women in India (aged 15-49 years) who have undergone examination of



C Immunization

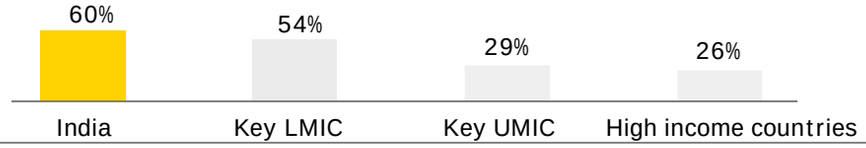
While major global and national organizations such as WHO and IAP advocate the inclusion of HPV vaccine in national immunization programs for prevention of cervical cancer (74 countries have included it till date), its introduction is under evaluation with NTAGI in India

Executive summary (2/6)

Consequently, India ranks among the top two countries globally on mortality for key women-specific cancers

- India has the highest mortality for breast and cervical cancers and second highest for ovarian cancer after China
- The mortality to incidence ratio, which is a key indicator for measuring effectiveness of national cancer control programs, is the worst in India for key women-specific cancers when compared to global peers

Mortality to incidence ratio (for breast, cervical and ovarian cancers)

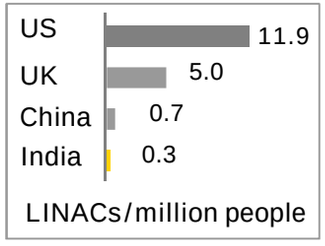


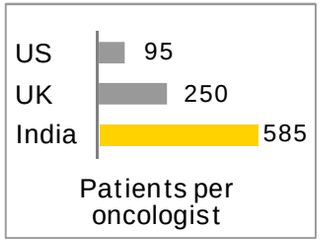
1 High cancer incidence and late detection

Poor access and lack of affordability result in a significant mortality burden

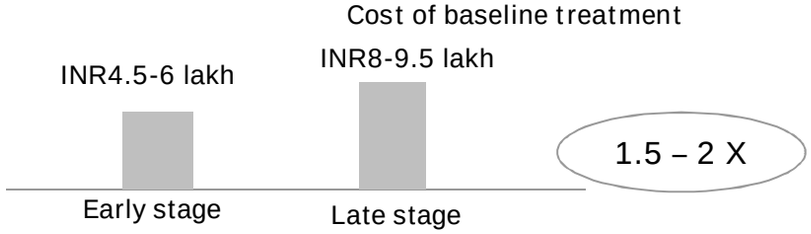
2 Sub-optimal access to multimodal treatment

- ~80% of all districts in India do not have a comprehensive cancer center (CCC) with 40% of all CCCs concentrated in the top six metros
- Penetration of radiotherapy equipment is low in India with only ~400 installed LINACs versus the required figure of 1,900-2,000
- 40%-50% of oncologists are concentrated in the top 10 metro cities





3 High cost of treatment in context of size of pocket



4 Low insurance penetration

- ~<37% covered by insurance

% Population for which treatment cost > annual per capita expenditure

75% - early stage
90% - late stage

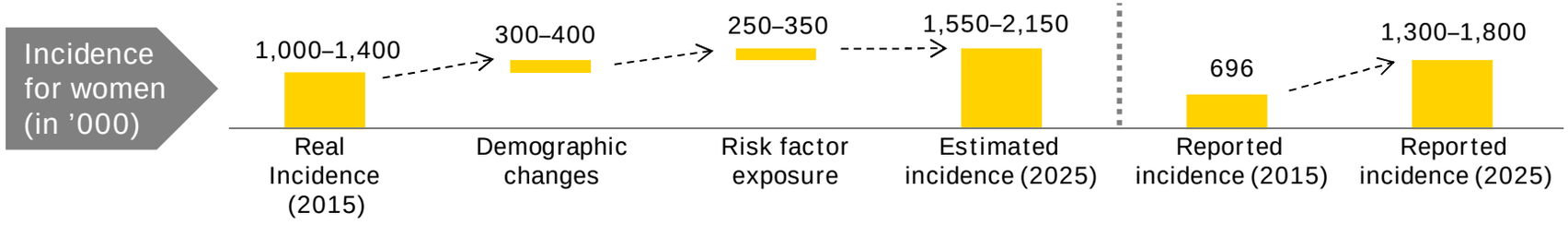
LMIC: Lower middle-income countries, UMIC: Upper middle-income countries

Executive summary (3/6)

Alarmingly, India is witnessing further deterioration of key risk factors that contribute to cancer incidence

- While some of the risk factors such as smoking have been under control, a deterioration has been observed in some other key risk factors such as:
  - Obesity: Proportion of overweight women in India grew at twice the global average growth between 2004 and 2014
  - Alcohol: Alcohol consumption per capita increased 3 times in India between 2000 and 2014
  - Reproductive factors: Westernization of lifestyle manifesting in the form of delayed child birth and changing breastfeeding pattern
  - Ageing: Changing demographics leading to increased ageing of the population; between 2015 and 2025, expected increase in women over 50 years of age by 32%

Reported cancer incidence is expected to increase at an annual rate of 8%-9% aided by increasing focus on early detection and screening efforts



Executive summary (4/6)

It is imperative that the menace of growing incidence of cancer among women is addressed with a sense of urgency and in a holistic manner with due emphasis on prevention, timely diagnosis, effective treatment and palliative care. Needless to say, this will need to be a national agenda, not limited to the subjective focus of individual state priorities, with clear goals to be achieved at national and state levels. It should be followed by a focused, coordinated and integrated approach with clearly articulated action plans both at the policy and implementation levels. Given below is a high level summary of the key action points based on the analysis of current gaps, study of successful and relevant global experiences and deliberations with key stakeholders in public and private provider set ups actively involved in the delivery and management of cancer care in India.

Key themes	Key recommendations
1 Skilling and capacity building for human resources for health	▸ Bridging of human resource gaps (especially ANM at SCs/PHCs and obs/gynaec at CHCs) in focus seven states reporting high incidence of cancer (AS, KL, KA, MP, MH, PU and TN) and populous states (UP, RJ and BH) ▸ Emphasis on training of healthcare workers at PHCs, CHCs and local NGOs to provide continuous education on breast self examination, safe sex and genital hygiene ▸ Creation of robust referral system by leveraging complementary specialties (gynaec, ENT, dental, gastro and GPs) to bridge the severe gap of oncologists ▸ Development and deployment of AI-based systems for enhancing the effectiveness in delivery of primary, secondary and tertiary care

2 Capital investments for capacity creation	▸ Promotion of investment in building CCCs in 10 focus states (i.e., states with <35% districts with CCCs) – TN, KA, MP, AS, GJ, MA, UP, RJ, BH and OD
	  ▸ India needs to add ~200 to 250 CCCs over the next five years implying an investment of INR25,000 crore-INR40,000 crore
	  ▸ India needs to at least quadruple the current number of ~400 LINACS to offer radiotherapy treatment to 50% of new cancer patients reported every year implying an investment of INR23,500 crore-INR27,000 crore

Executive summary (5/6)

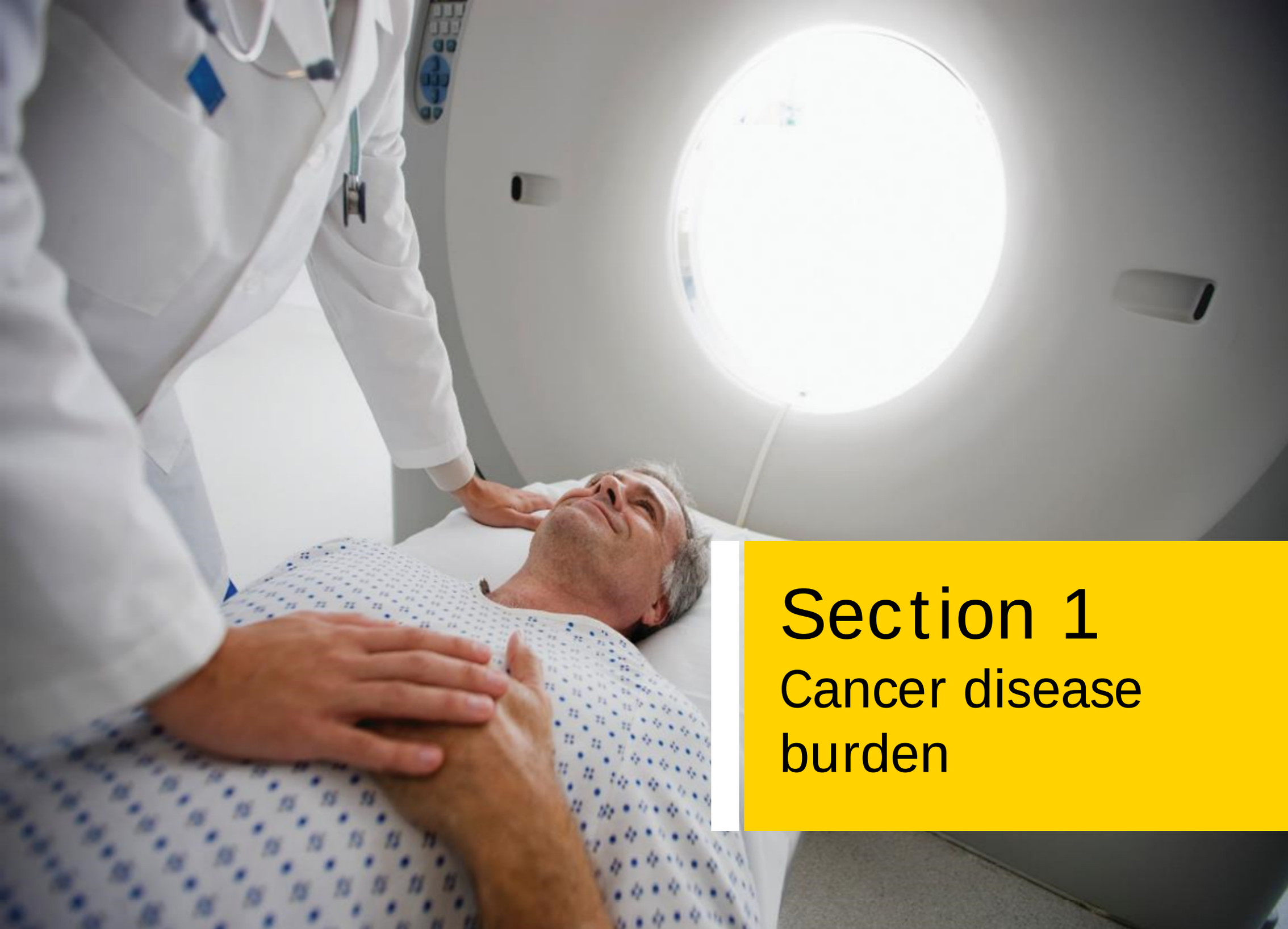
Key themes	Key recommendations

3 Public-private partnerships (PPPs)	▸ PPPs with healthcare providers, medical device, pharmaceutical companies, NGOs in the following areas
	  ▸ Adoption of villages for providing screening facilities, creation of referral models and maintenance of health records of the screened population
	  ▸ Commissioning of CCCs and LINACs in district hospitals and medical colleges in a phased manner (to take cancer care beyond the existing 27 RCCs)

4 Policy	▸ Integration of focus on women-specific cancers as part of the sustainable development goals of India ▸ Evaluation by technical experts of HPV vaccination in Indian context ▸ Strong focus on cost of care through drug pricing policy and calibrated generic- generic adoption ▸ Increased access to beneficial new technologies by skilling, scaling up and engaging the Medical Technology Assessment Board (MTAB) ▸ Promotion of traditional medicine and AYUSH specifically in cancer prevention and palliation through evidence-based research and care guidelines ▸ Formalization of a nodal agency to drive standardization of treatment protocols at a national level (while ICMR has introduced organ-specific consensus guidelines, there is limited acceptance by providers)

Executive summary (6/6)

Key themes	Key recommendations
5 Financing	▸ Appropriate funding and Center/State allocation of budget for the HPV vaccination program ▸ Estimated outlay of INR800 crore-INR850 crore p.a. (INR984 per fully immunized girl) with first phase focus on high incidence states with strong health delivery infrastructure (DL, KA, MH, TN and PU) at an estimated cost of INR150 crore-INR200 crore ▸ Appropriate funding and Center/State allocation of budget for investment in upgrading medical colleges (470) and district hospitals (760) to deliver comprehensive cancer treatment ▸ Reimbursement of NLEM drugs (including targeted therapies) across Central and State health schemes ▸ Design of robust framework for pricing of public procurement of private healthcare services for cancer care delivery based on designed clinical pathways, estimation of true cost of care delivery and expected outcomes
6 Awareness building	▸ Emphasis to promote awareness on health behavior, symptoms, screening practices and financing options: The Government to evaluate setting up a nodal agency within the Ministry of Health to identify, plan and coordinate prevention actions ▸ Expansion of focus to other risk factors, i.e., obesity, reproductive, pollution and infectious agents
7 Surveillance and monitoring	▸ Establishment of population based registries in the twelve states for effective monitoring of cancer incidence and mortality ▸ Coverage to be increased in other eleven states (having <50% population coverage). Inclusion of other metrics such as 5-year survival rates and hospital-based quality parameters in registry reporting



Section 1

Cancer disease burden

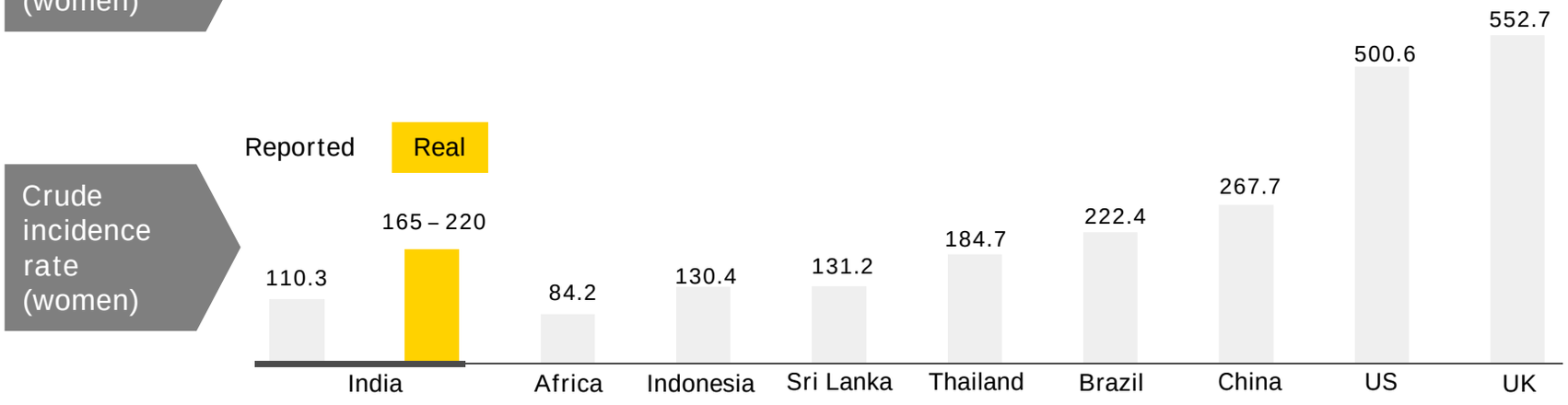
Section 1: Cancer disease burden

1. India faces a serious challenge of high incidence rates growing at a fast pace for major women-specific cancers such as breast, cervical and ovarian cancer
2. The challenge of high incidence is further compounded by late detection which has an adverse impact on cost of care and mortality
3. India is witnessing significantly adverse mortality rates for women-specific cancers, with cervical and breast cancer mortality rates being 1.6 to 1.7 times higher than mortality due to maternal causes
4. Economic burden of cancer care treatment is highest compared to all other diseases, with the cost of a single hospitalization exceeding the average annual per capita expenditure of more than 60% of the population
5. Across states, there is a deterioration of the key risk factors that contribute to cancer incidence among women
6. Reported cancer incidence among women in India is estimated to increase from 110 per 1 lakh population to 190-260 per 1 lakh population by 2025, which will mirror incidence rates of China and other upper middle income countries such as Brazil and Thailand

While reported cancer incidence among women in India is currently 110 per 1 lakh, real incidence is estimated at 165-220 per 1 lakh, which is also growing rapidly

Estimated incidence[1,2] 2015 (in 000)

	India		Africa	Indonesia	Sri Lanka	Thailand	Brazil	China	US	UK
Overall	1388	2,000-2,750	913	314	24	131	476	4,291	1,658	369
Women	696	1,000-1,400	524	167	14	64	232	1,779	810	182
Incidence CAGR (women)	4.6%	4.5-5.0%	4.3%	1.0%	6.8%	0.5%	NA	5.2%	2.0%	1.9%



While the crude cancer incidence rate in India per 1 lakh population is lower than most of its global peers, the total incidence is among the highest due to India's population size

Refer page 15 for factors resulting in gap between reported and real incidence for India

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

Source: NCRP reports, Globocan 2012 , National registries of the mentioned countries, WHO reports, American Cancer Society, Cancer Research UK

The gap in reported and real incidence rate has been estimated and triangulated using the following basis

Real cancer incidence in India is conservatively estimated to be 1.5 to 2.0 times higher than the reported incidence. Some indicators include the following:

01 Differences in cancer registry and randomized screening studies

Studies that compared incidence data from cancer registries and large randomized screening trials demonstrated the real incidence to be 1.5-2 times higher than the reported incidence

(Refer Annexure 1 for comparison between incidence rates as per screening studies and incidence rates as per cancer registries.)

02 High under-diagnosis

Leading oncologists believe that the under-diagnosis could be to the tune of 30%-50% due to lack of diagnostic infrastructure, low patient awareness and low physician awareness

03 Low population coverage of the Indian cancer registries

- Indian cancer registries cover 8.2% of the population vis-à-vis >90% in the US and the UK
- Estimates of cancer incidence at a population level are extrapolated from the reported incidence in cancer registries, resulting in a high margin of error[2]

(Refer Annexure 2 for comparison of cancer registry coverage across countries.)

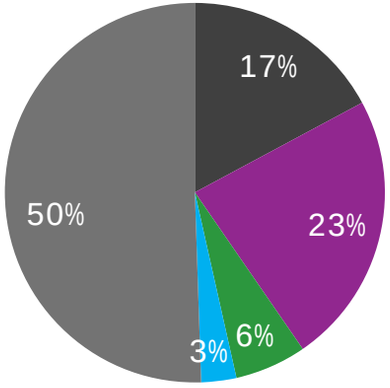
Source: EY analysis

Cancers of the breast, cervix and ovary constitute 40% of the cancer incidence among women in India

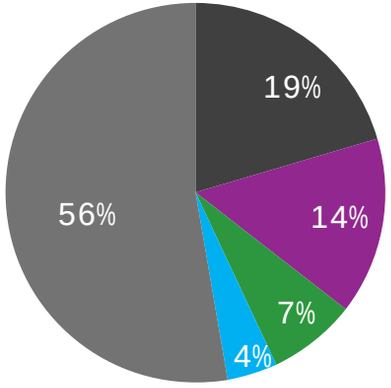
- Breast
- Cervical
- Ovarian
- Lung
- Others

Incidence by cancer type for women in India[3]

2005



2015



Total incidence 2015 (for women in 000)

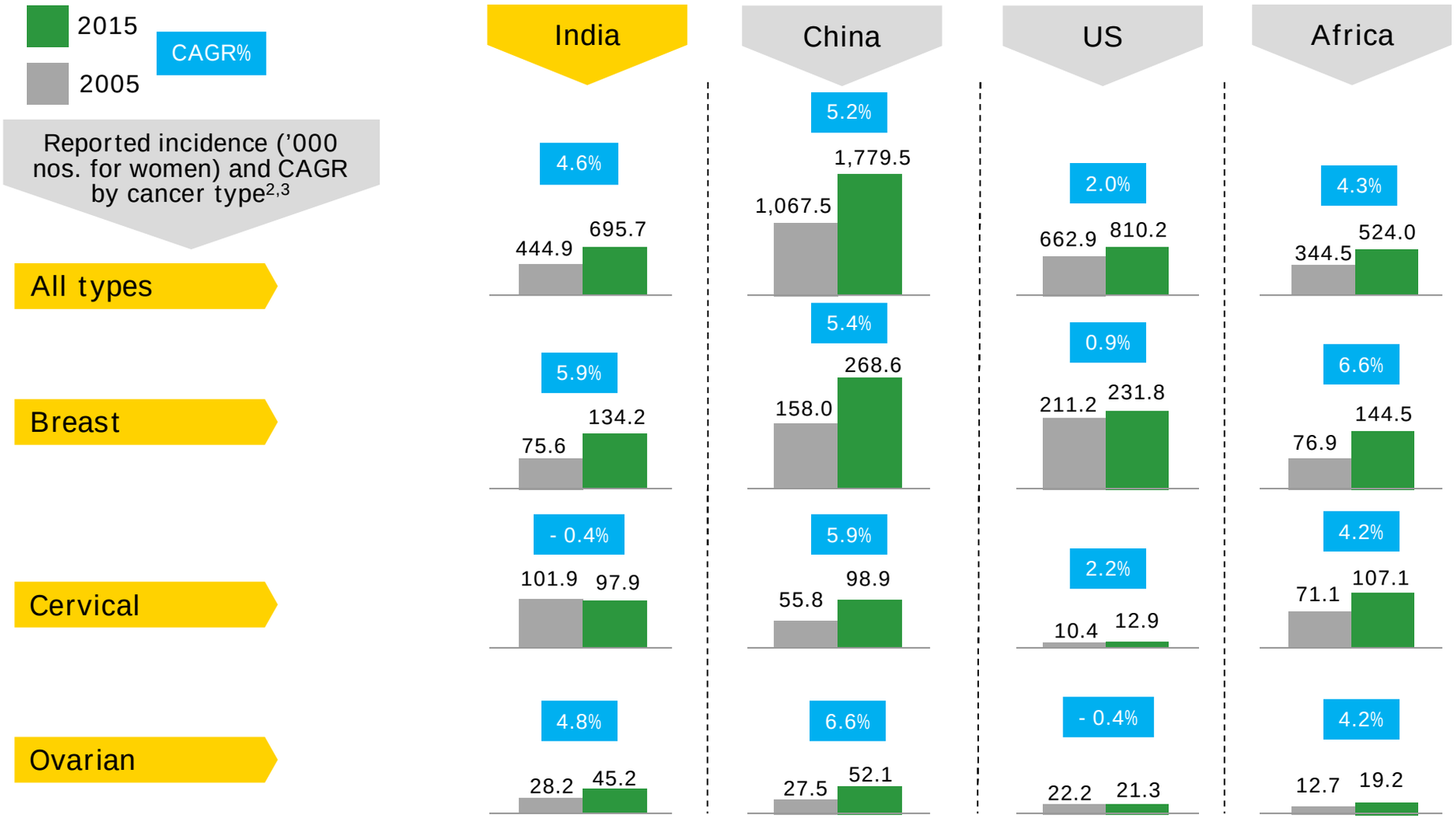
445

696

- Breast cancer (19%) has the highest incidence among women, followed by cervical cancer (14%) and ovarian cancer (7%)
- Since 2005, breast has overtaken cervix uteri as the leading site of cancer incidence in India

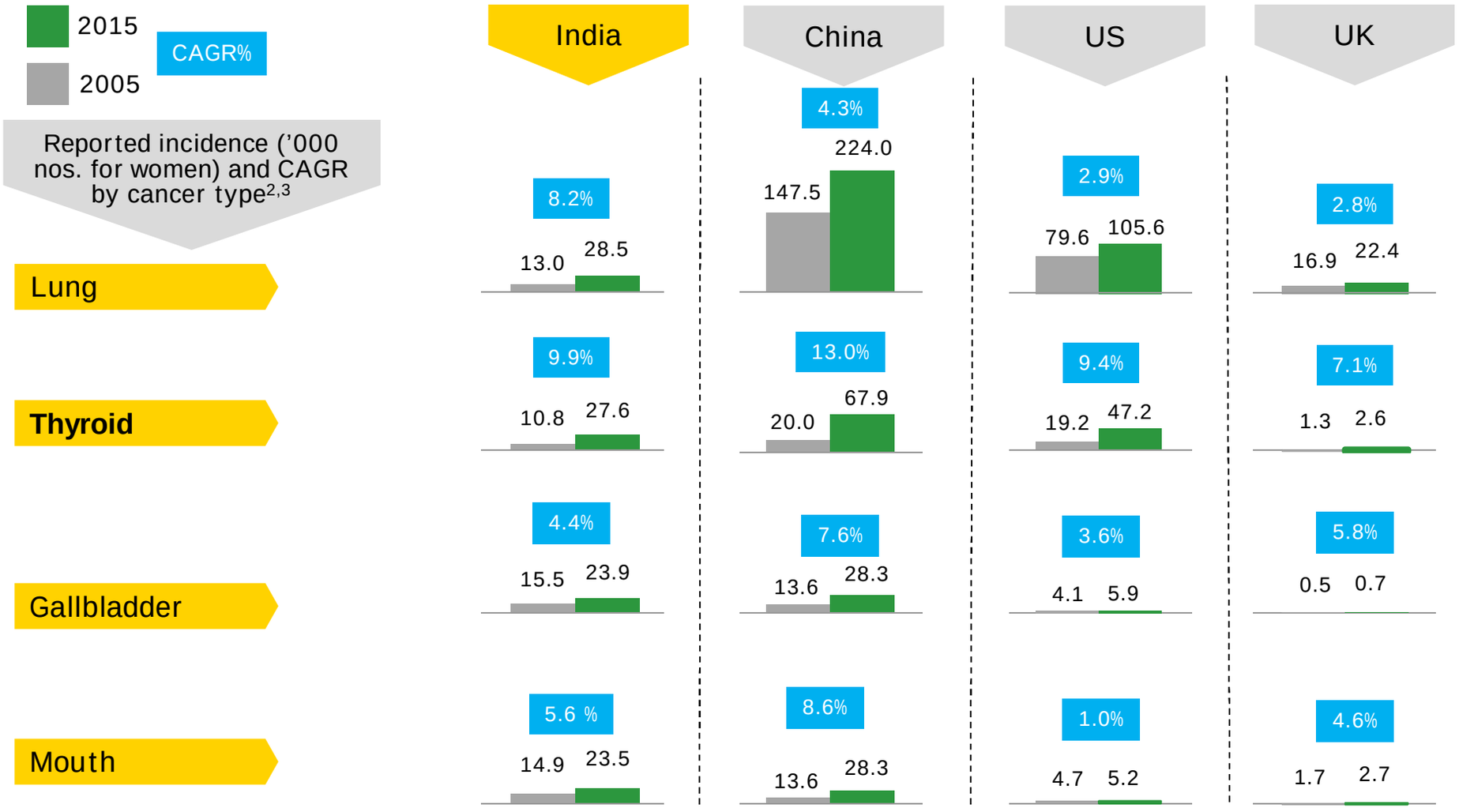
Source: NCRP annual report

When compared globally, India ranks among the top 4 geographies in terms of incidence for breast (rank 4), cervical (rank 3) and ovarian (rank 2) cancers



Source: NCRP reports, Globocan 2012 , National registries of the mentioned countries, WHO reports, American Cancer Society, Cancer Research UK

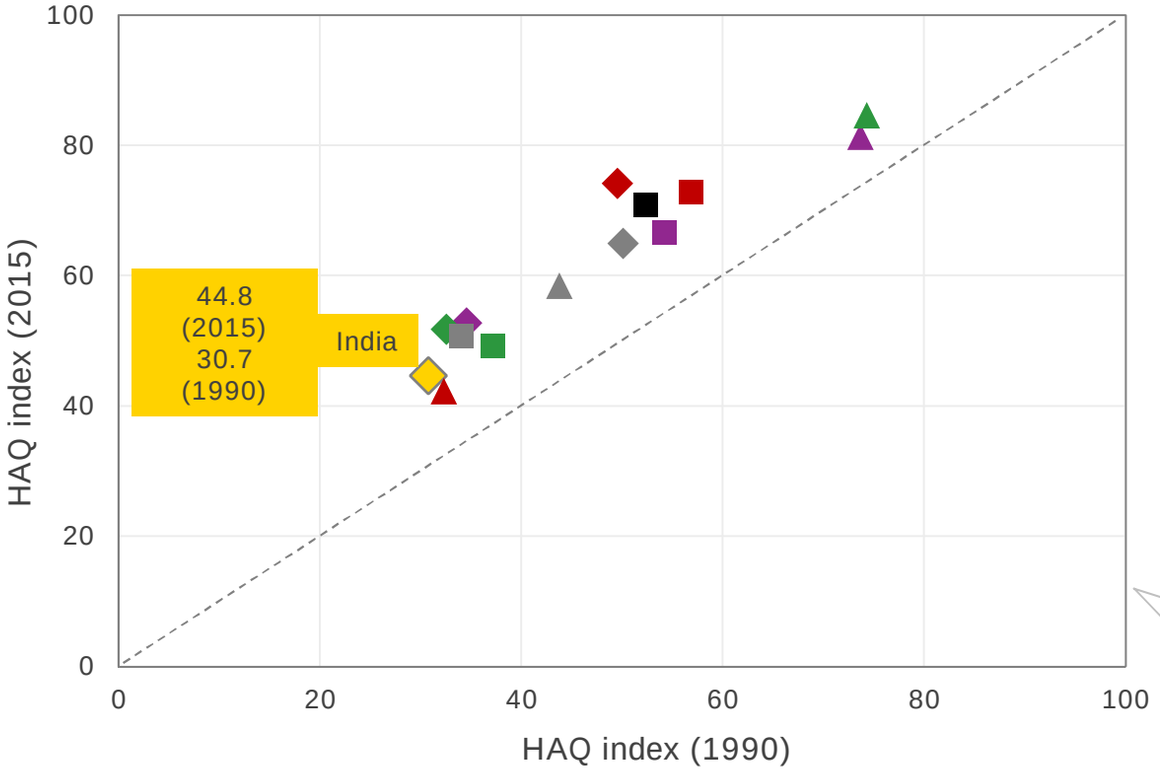
In addition, cancers of the lung, thyroid, gallbladder and mouth also contribute toward the rising incidence of cancer among women in India



Source: NCRP reports, Globocan 2012 , National registries of mentioned countries

India currently ranks 154 among 195 countries on the healthcare access quality index, highlighting the sub-optimal state of personal healthcare access and quality in the country

Healthcare Access and Quality (HAQ) index indicates average levels of personal healthcare access and quality by measuring mortality rates for causes that are considered to be avoidable through healthcare intervention. A low score indicates a lower rate of mortality aversion.



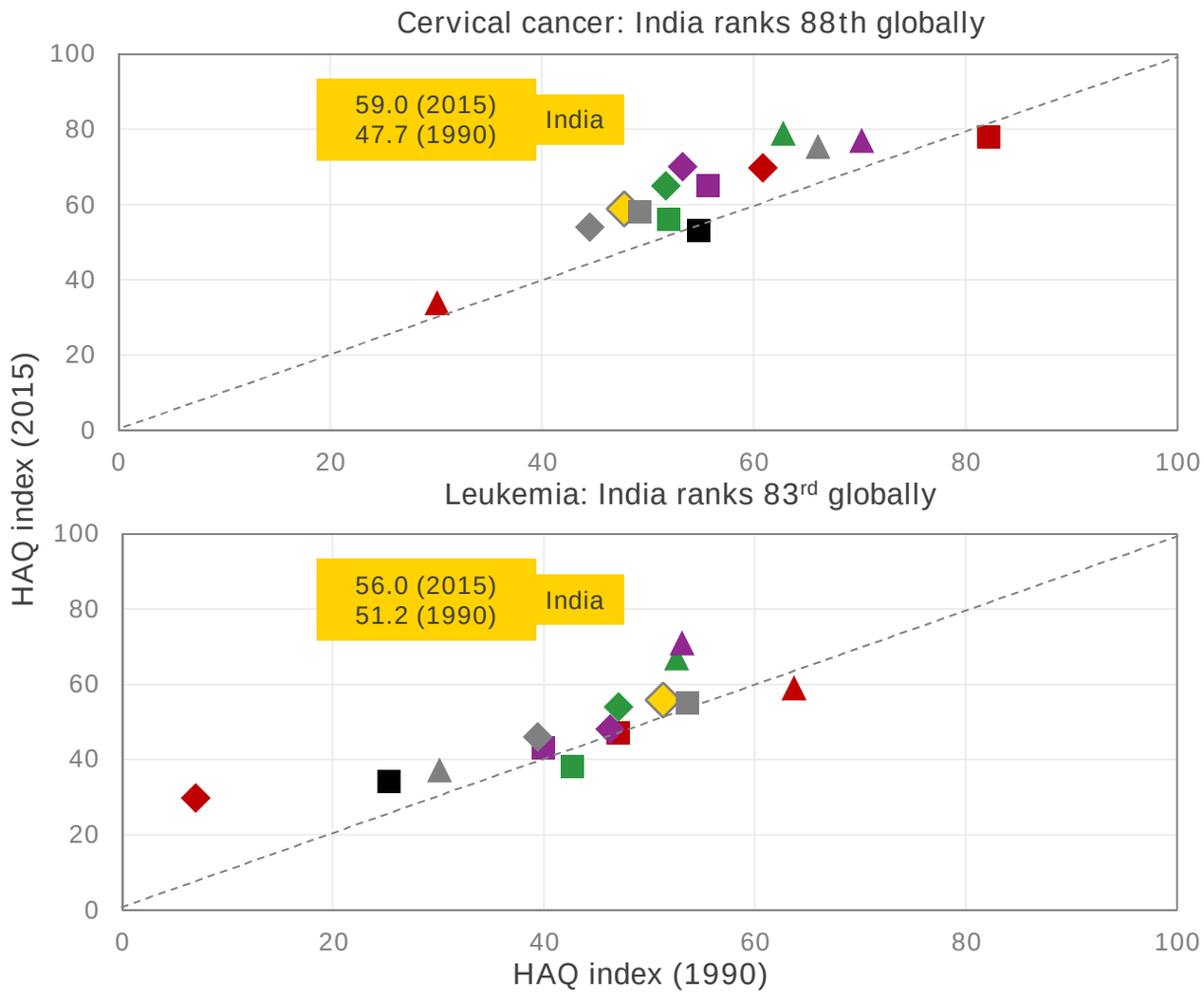
Country	Symbol	Ranking
Bangladesh	◆	134
Bhutan	◆	130
Brazil	◆	89
China	◆	60
India	◇	154
Indonesia	■	149
Malaysia	■	85
Nepal	■	139
Sri Lanka	■	64
Thailand	■	73
UK	▲	30
US	▲	35
North Africa and Middle East	▲	-
Sub-Saharan Africa	▲	-

While HAQ scores improved between 1990 to 2015, India ranked among the bottom quartile countries on HAQ index in 2015[4]

Refer Annexure 3 for HAQ Index computation methodology

Source: Healthcare Access and Quality Index based on mortality from causes amenable to personal health care in 195 countries and territories, 1990–2015, The Lancet, May 2017

For key cancers such as cervical and leukemia, India lags behind majority of the countries, including Sri Lanka, Bangladesh, Bhutan and Nepal, on the HAQ index



Country	Symbol	Cervical Cancer Ranking	Leukemia Ranking
Bangladesh	◆	69	91
Bhutan	◆	55	117
Brazil	◆	105	125
China	◆	54	176
India	◇	88	83
Indonesia	■	98	155
Malaysia	■	68	134
Nepal	■	91	88
Sri Lanka	■	38	119
Thailand	■	107	167
UK	▲	37	33
US	▲	44	23
North Africa & Middle East	▲	-	-
Sub-Saharan Africa	▲	-	-

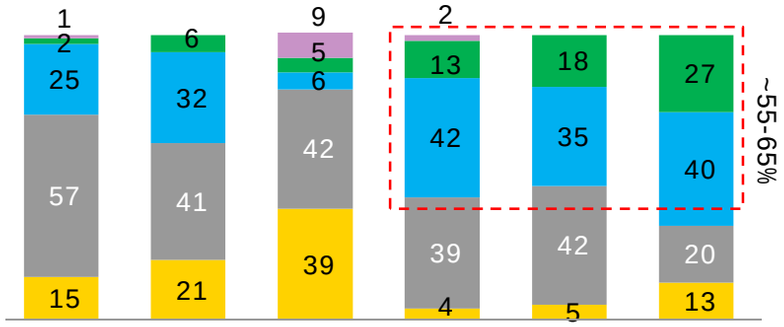
Source: Healthcare Access and Quality Index based on mortality from causes amenable to personal health care in 195 countries and territories, 1990–2015, The Lancet, May 2017

Stage-wise incidence rates reflect a high proportion of patients being detected in stages 3 and 4, highlighting significant detection delays vis-à-vis international geographies

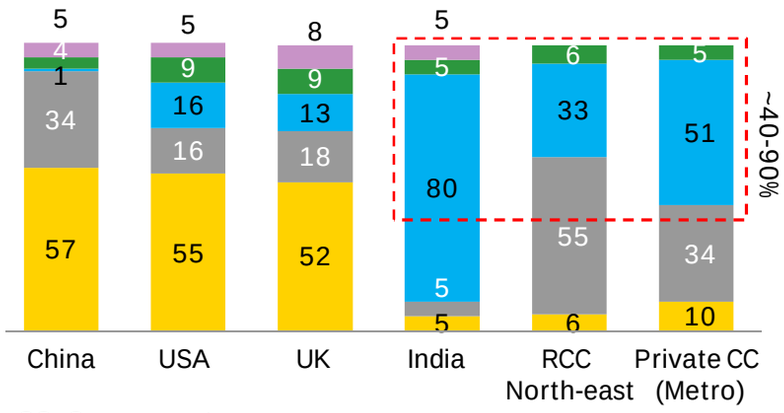
Stage at diagnosis

I II III IV Unknown

Breast cancer stage at diagnosis



Cervical cancer stage at diagnosis



CC: Cancer center

Data for stage of diagnosis - US, UK and China is from 2009-2013; for India from 2009-2012. Note: numbers rounded

Source: SEER cancer statistics, NYCRIS annual report, Wang (2013), Wu (2012), Gao (2009), Li (2013), Agarwal (2008), EY analysis

Country	Year of initiation of screening program	Participation rate*
US	1995	81%
UK	1988	76%
China	2009	30%
India	2016	<1%

*Percentage of eligible women (40-69 years) who have a screening mammogram at least once in 24 months. Data for the UK and the US for 2013; China for 2008-10; and India for 2014. Source: International Cancer Screening Network; Rotary PR, March 2014

- Awareness of screening procedures in a Southern Indian population study (2014) was 16.5%, compared to 40% in the Chinese populations

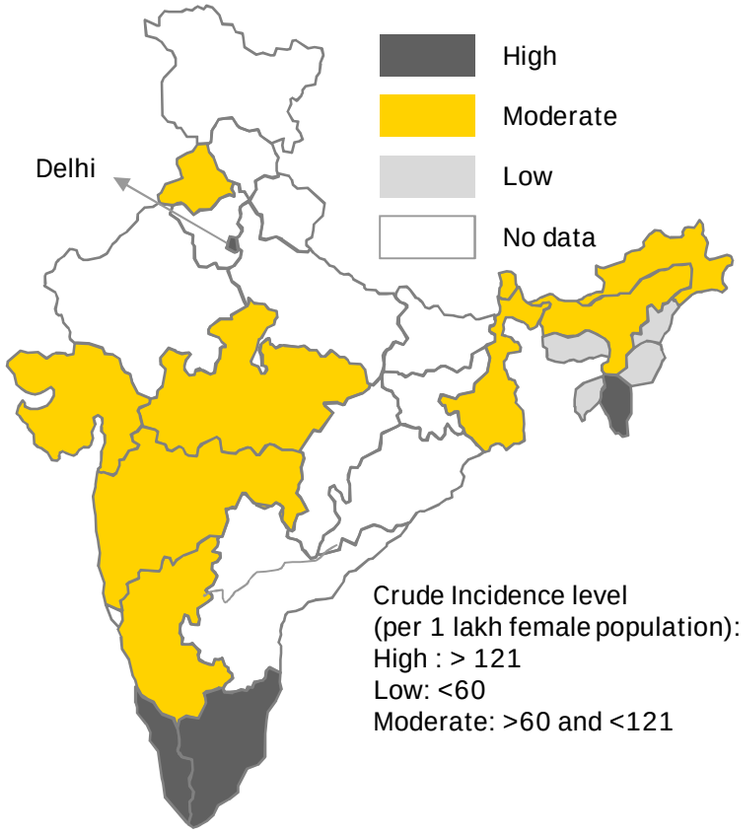
Country	Year of initiation of screening program	Effective coverage^	Crude coverage#
US	1991	78%	NA
UK	1988	85%	NA
China	2009	~50%	~70%
India	2016	~5%	~29%

^Effective coverage: The proportion of eligible women (25-64 years) who report having had a pelvic exam and Pap smear in the past three years; #Crude coverage: The proportion of women (25-64 years) who report having had a pelvic exam (regardless of when the exam occurred). Data for the UK and the US for 2013 and for India and China for 2008. Source: International Cancer Screening Network; Gakidou et al, 2008

Key opinion leaders (KOLs) stated that >70% of cancers diagnosed were advanced cancers, although increasingly, there is a trend of earlier diagnosis with nearly 30%-40% of cancers being diagnosed in stages I and II

Among the 17 states covered by population-based cancer registries, Kerala, Tamil Nadu and Delhi report the highest overall crude incidence rates of cancers among women

Overall crude incidence level for females



Crude incidence rate for female pop.* (per 1 lakh) *(nationwide rank out of 17 states)*				
State	All cancers	Breast cancer	Cervical cancer	Ovarian cancer
States with high levels of incidence				
Kerala	143.4	40.5 *(2)*	9.1 *(10)*	8.1 *(4)*
Tamil Nadu	132.3	40.6 *(1)*	16.7 *(2)*	8.7 *(3)*
Delhi	121.7	34.8 *(3)*	13.2 *(4)*	8.7 *(2)*
States with moderate levels of incidence				
Karnataka	106.5	29.3 *(6)*	13.1 *(5)*	5.6 *(6)*
M.P.	90.4	28.2 *(7)*	11.3 *(8)*	7.0 *(5)*
Assam	88.2	14.7 *(11)*	8.8 *(12)*	5.4 *(8)*
Maharashtra	77.5	19.1 *(9)*	14.4 *(3)*	4.4 *(10)*
Gujarat	73.0	23.0 *(8)*	6.8 *(15)*	3.9 *(12)*
States with low levels of incidence				
Manipur	56.0	8.6 *(13)*	5.1 *(17)*	3.2 *(14)*
Nagaland	53.7	6.8 *(15)*	8.9 *(11)*	1.5 *(16)*
Tripura	48.4	6.6 *(16)*	8.1 *(13)*	2.9 *(15)*

*Only population-based cancer registries were considered for the analysis – Hyderabad registry not included because of lack of credible data

Source: NCRP annual reports, EY analysis

Note: Mizoram (19.4) and West Bengal (9.4) have the highest crude incidence rates for cervical and ovarian cancer, respectively, of the available data

Coupled with high incidence, India faces significantly higher mortality rates for key women-specific cancers

Estimated mortality[2-4] 2015 (in 000)

	India	Africa	Indonesia	Sri Lanka	Thailand	Brazil	China	US	UK
Overall	773	667	214	20	95	223	2,814	603	166
Women	371	345	99	9	40	105	1,004	286	79
Mortality-incidence ratio (M/I) % (women)	53	66	60	65	61	45	56	35	43
M/I ratio % (for breast, cervical and ovarian cancers)	60	54	47	34	44	32	29	26	28

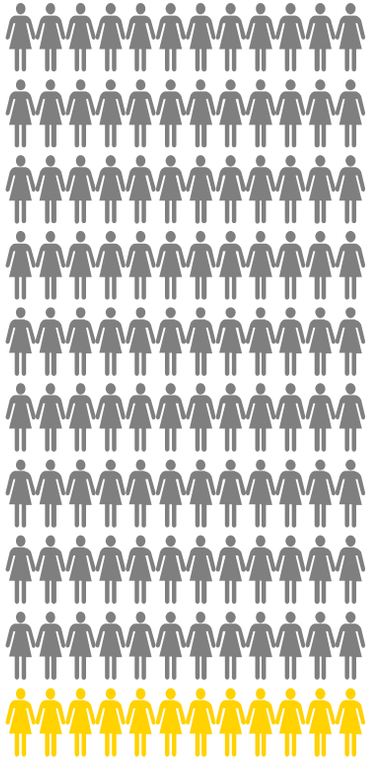
In 2015, mortality due to cervical cancer was 1.6 times and due to breast cancer was 1.7 times higher than maternal mortality in India

Source: NCRP reports, Globocan 2012 , National registries of mentioned countries, WHO reports

While at an overall level India contributes 10% to global burden of cancer-related mortality among women, for cervical cancer India's share in global mortality is as high as 25%

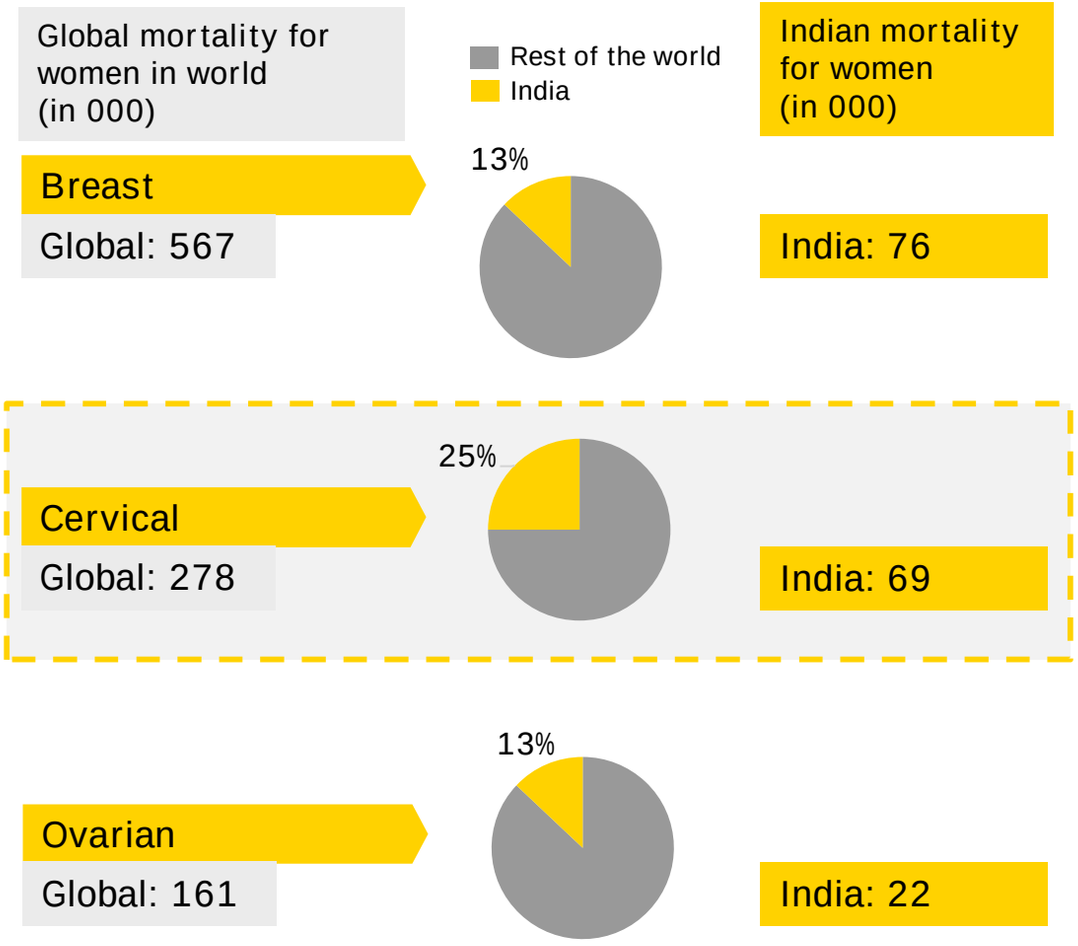
Mortality due to cancer (in '000) for women globally in 2015

World: 3,759



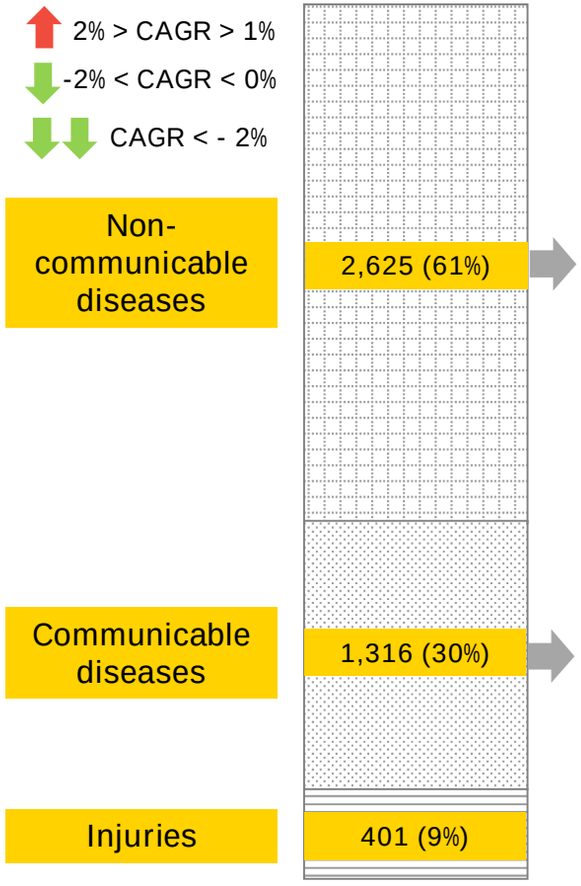
India: 371 (10%)

Mortality by cancer type



In addition to high mortality rates, the financial burden of availing cancer care in India is the highest when compared to all other diseases

Mortality figures (in '000) for Indian females in 2015



Disease	Mortality (in 000)		DALY* (in 000)	Cost per hospitalization case (INR)#	
				Public	Private
Cardiovascular	1,057	↑	27,745	11,549	43,262
Respiratory non-infectious	498	↑	13,303	4,811^	18,705^
Cancer	371	↑	13,338	24,256	78,050
Infectious and parasitic	587	↓↓	31,363	3,007	11,810
Respiratory infectious	359	↓	14,676	4,811^	18,705^
Neonatal conditions	282	↓↓	26,999	2,651	21,626

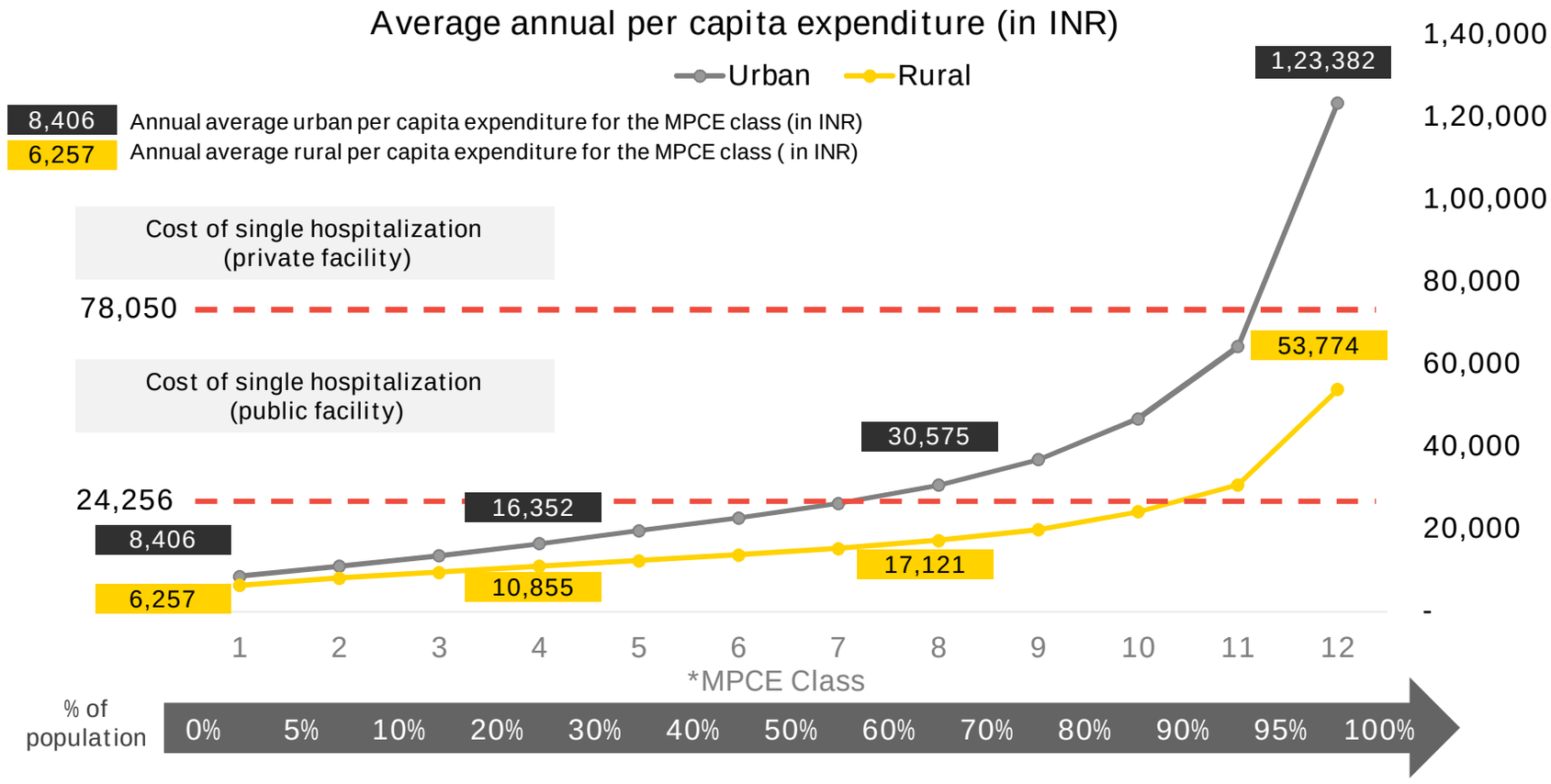
^Includes cost of hospitalization due to respiratory infectious and non-infectious diseases
#Only medical expenditure

#INR: Indian Rupees

*DALY: Disability-Adjusted Life Year is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death

Source: GHE report, WHO (2015), NSSO 71st round 2014

Cost of cancer treatment remains unaffordable with single hospitalization cost at public or private facility exceeding annual per capita expenditure of > 60% of population



Around 70% of households are not covered under any form of insurance and > 90% households depend on savings and borrowings to finance medical expenditure

INR: Indian Rupees, *MPCE: Monthly Per Capita Expenditure

Please note, typically complete multimodal cancer treatment requires > 1 hospitalization episodes and the average cost of complete multimodal cancer treatment in a private hospital ranges from INR5 lakh to INR19 lakh (estimated for breast cancer)

Source: Household consumption of various goods and services in India, NSSO 68th round, Key indicators of social consumption in India – Health, NSSO 71st round 2014, EY analysis

India faces a multitude of risk factors that contribute to cancer

	Risk factors / Cancer types	Breast	Cervical	Ovarian	Gall bladder	Thyroid	Mouth	Lung
Modifiable[5]	Reproductive activity	ü	ü	ü	ü	X	X	X
	Sexual habits and poor hygiene	X	ü	X	X	X	X	X
	Infection and immunity level	X	ü	X	ü	X	X	X
	Specific medical condition/disease	X	X	ü	ü	ü	X	X
	Obesity and physical inactivity	ü	ü	ü	ü	X	X	X
	Tobacco use	X	ü	X	X	X	ü	ü
	Alcohol consumption	ü	X	X	X	X	ü	X
	Environmental pollution	X	X	X	X	X	X	ü
Non-Modifiable[5]	Family history	ü	X	ü	ü	ü	X	X
	Genetic disposition	ü	X	ü	ü	X	X	X
	Gender	X	X	X	ü	X	X	X
	Age	ü	ü	ü	ü	ü	ü	ü

Note: (ü) Ticks indicate that risk factor is potential cause of cancer for the respective organ (X) Cross indicates risk factor is not a potential cause of cancer for the respective organ. These risk factors are applicable to cancer patients in India

Changing trends in reproductive factors are contributing toward increasing burden of breast and ovarian cancers (1/2)

Key risk factor	Trends of exposure	
Reproductive factors Risk factor for ▸ Breast cancer ▸ Ovarian cancer Across multiple studies conducted in different regions of India, reproductive factors have been strongly associated with risk of breast and ovarian cancer[11,12]	Delayed childbirth	▸ Average age of first childbirth among women has been rising, largely attributable to increasing age of marriage and rise in the proportion of working women coupled with improved education levels ▸ Effective age of marriage has increased in India from 17.7 to 20.7 years between 1971 to 2009. A survey conducted in 2013-14 highlighted that average age of marriage has increased to 21.1 years among women married during 5 years preceding the survey ▸ Proportion of women aged 15-19 years who were pregnant or already mothers has reduced to 8% in 2015-16 compared to 16% in 2005-06[7-10]
	Declining parity level	▸ Average number of children born to ever married women has seen a sharp decline from 3.4 in 1981 to 2.7 in 2011[13] ▸ Also, 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 3.9 in the 1990s to 2.2 in 2015-16[8]
	Changing breast-feeding pattern	▸ While India has witnessed improvement in breastfeeding patterns in the last few years due to focus on infant nutrition, the patterns are still sub-optimal ▸ Only ~50% of children below 6 months are exclusively breastfed as per NFHS-4 ▸ As per DLHS-4 , in key urban areas, children aged 12-23 months receiving breast feeding along with complementary feeding is <50% viz. Chandigarh (43.5%), Gurgaon (45%), Faridabad (39.6%), Thiruvananthapuram (48.3%), Mumbai (50%) which highlights that duration of breastfeeding is declining in urban areas

Changing trends in reproductive factors are contributing toward increasing burden of breast and ovarian cancers (2/2)

Key risk factor	Trends of exposure

Reproductive factors

Risk factor for
- Breast cancer
- Ovarian cancer

Menstrual history- Early onset of menarche [7-10]

- Based on studies conducted, average age of menarche varies across India. Across majority of the studies, it has emerged that 11-12 years is the typical age for menarche in India

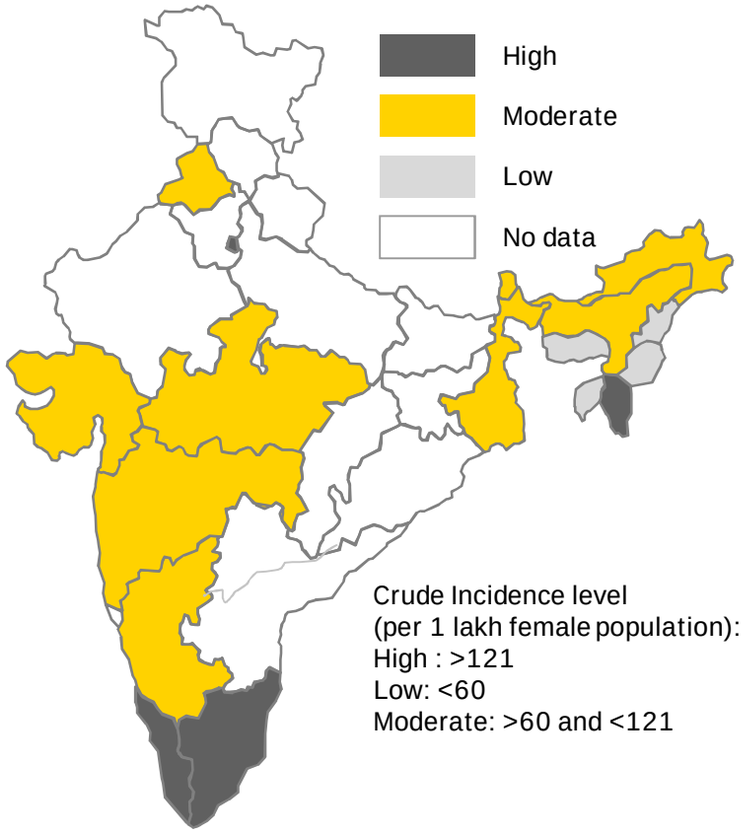
Study location and period	Study sample size (#)	Average age of sample (Yrs.)	Average age of menarche (Yrs.)
Marathwada region (2009-2015)	260	52.6	11.3
Maharashtra (2012)	1,062	22.5	12.8
Tamil Nadu (2016)	350	14.7	12.4
Central India (2009)	1,100	NA	13.5
Delhi (2013)	2,010	12.1	12.4

Increasing oral contra-ceptive use [7-10]

- Use of oral contraceptives by currently married women aged 15-49 years has risen from 2% in 1998-99 to 4% in 2015-16
- Use of oral contraceptives is relatively high in Delhi, Jammu & Kashmir, Uttarakhand, West Bengal and North eastern states

While incidence varies across states, reproductive risk factors are intensifying across all states in India

Crude incidence level among female population for focus cancer types**



Key states	Instances of early pregnancy*	Parity	Breastfeeding prevalence#
Delhi	2.3% ↓	2.6 ↓	45.0% ↓
Kerala	3.0% ↓	2.3 ↓	63.1% ↑
Mizoram	7.2% ↓	3.1 ↓	67.9% ↓
Tamil Nadu	5.0% ↓	2.2 ↓	48.3% ↑
Arunachal Pradesh	10.5% ↓	2.9 ↓	53.6% ↓
Assam	13.6% ↓	2.8 ↓	49.9% ↓
Gujarat	6.5% ↓	2.5 ↓	49.4% ↓
Karnataka	7.8% ↓	2.4 ↓	46.0% ↓
Maharashtra	8.3% ↓	2.4 ↓	43.3% ↓
Madhya Pradesh	7.3% ↓	3.1 ↓	38.1% ↓
Punjab	2.6% ↓	2.5 ↓	41.1% ↓
Sikkim	2.8% ↓	2.7 ↓	61.8% ↓
West Bengal	18.3% ↓	2.5 ↓	52.0% ↑
Meghalaya	8.6% ↑	3.3 ↓	67.4% ↓
Manipur	7.4% ↑	2.8 ↓	78.8% ↑
Nagaland	5.7% ↓	3.4 ↓	70.7% ↑
Tripura	18.8% ↓	2.6 ↓	13.6% ↓
Andhra Pradesh	11.8% ↓	2.2 ↓	56.1% ↓
Uttar Pradesh	3.8% ↓	3.1 ↓	32.6% ↓

**Focus cancer types are breast, cervical and ovarian cancers

Only population-based cancer registry were considered for the analysis – Hyderabad registry not included because of lack of credible data

Source: NCRP annual reports, EY analysis

*Women aged 15-19 years who were already mothers or pregnant at time of survey
#Children between 6 and 8 months receiving breastmilk along with solid or semi-solid food

Poor sexual habits and consequent infections are key contributors for cervical cancer burden in India

Key risk factor	Trends of exposure	
Sexual habits and poor hygiene Risk factor for- ▸ Cervical cancer Sexual promiscuity is a key reproductive risk factor that is linked with cervical cancer	Poor sexual history and hygiene[8,10]	▸ While reported prevalence of multiple sexual partners and high risk sexual behavior is low in India (0.1% among women and 2% among men), the prevalence is higher among select population sub-groups such as unmarried/widowed/deserted populations (4% among women and 12% among men) ▸ Usage of condoms is relatively low in India with only 6% of currently married women between 15 and 49 years reporting usage in 2015-16. In rural areas, usage is even lower at 4% ▸ Use of hygienic means of protection during menstrual period among women aged 15-24 years is low in India specially in rural areas (<50%)
Infection and immunity level Risk factor for- ▸ Cervical cancer *HPV types 16 and 18 are responsible for 70% of cancers in India[15]	HPV infection[15]	▸ 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[16]	▸ HIV prevalence among women aged 15-49 years was estimated at 0.22% in 2015 ▸ States that have higher than national average prevalence rates include Andhra Pradesh, Telangana, Gujarat, Karnataka, Maharashtra, Manipur, Mizoram, Nagaland and Tamil Nadu

*HPV: Human Papilloma Virus, HIV: Human Immunodeficiency Virus

High prevalence of bacterial infections and gall stones is a key factor for gall bladder cancer, while increasing prevalence of polycystic ovarian syndrome (PCOS) is linked with ovarian cancer

Key risk factor	Trends of exposure	
Infection and immunity level ▸ Gall bladder cancer Studies on gallbladder cancer revealed consistent associations with chronic infections such as S.typhi, S. paratyphi and H. pylori Specific medical condition/disease ▸ Ovarian cancer ▸ Gall bladder cancer	Bacterial infections[17]	▸ A systematic review of 37 studies on typhoid and 18 studies on paratyphoid highlighted 9.7% and 0.9% prevalence respectively. S, typhi and S. paratyphi bacteria causes typhoid and paratyphoid respectively ▸ Similarly H. pylori infection, which has also been associated with gall bladder cancers, has a high prevalence of 49.9%-83.3% across various studies conducted in India
	Gall-stones[19,20]	▸ A worldwide prevalence study among female population based on ultrasonography surveys highlights a prevalence of 10%-22% in India, which is similar to the prevalence of 10%-15% observed in developed nations such as the US and European Union ▸ Screening study of ~4,000 female patients from North India (Uttar Pradesh and Bihar) conducted using ultrasonography revealed 5.5% prevalence of gall stones. The study revealed 2.9 times higher prevalence of gall stones among women vis-à-vis men in the same region
	PCOS[18]	▸ Global prevalence of PCOS in women of reproductive age is between 5%-10% ▸ While there is limited data on the prevalence of PCOS in India, a few studies have demonstrated the prevalence rates to range from 3.7% to 22.5% ▸ A hospital-based study in South India demonstrated the PCOS prevalence of 11% in rural vs. 25% in urban adolescent girls, aged 12-19 years

Rapid changes in lifestyle factors such as obesity and physical inactivity are increasing the proportion of population "at risk" of cancer

Key risk factor

Obesity and physical inactivity

Risk factor for-

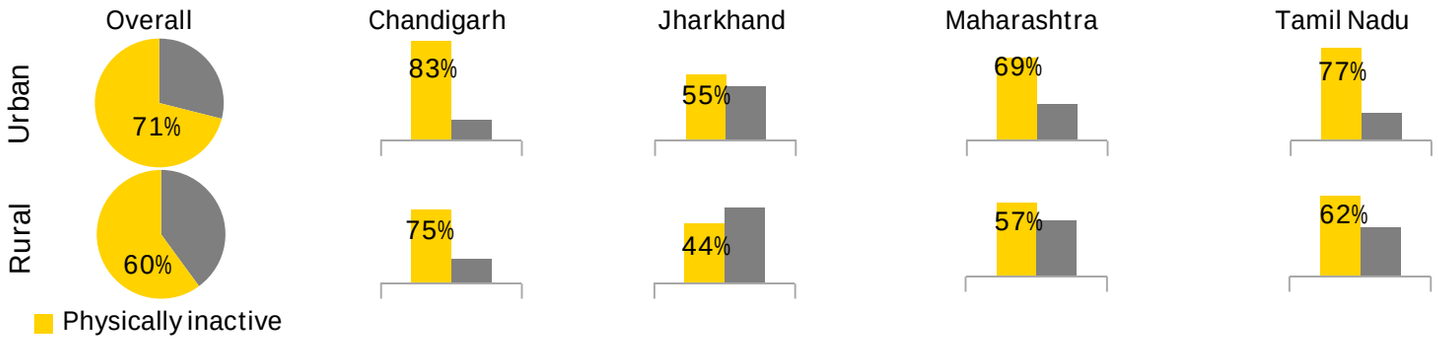
- Breast cancer
- Cervical cancer
- Ovarian cancer
- Gall bladder cancer

India has witnessed 2 times higher growth in the proportion of overweight women than global average and has higher levels of physical inactivity among women compared to China and the US[21]

Trends of exposure

- 22% of women above 18 years had a BMI ≥25kg/m^2 in 2014 compared to 16% in 2004 in India. Between 2004 and 2014, India witnessed two times higher growth in proportion of overweight women than the global average growth[22]
- Based on NFHS surveys, India has witnessed doubling of the proportion of women aged 15-49 years having BMI ≥25kg/m^2 between 2005-06 and 2015-16[7,8]
- ~50% of the states in India had overweight women at a proportion higher than the national average based on NFHS 4 conducted in 2015-16[8]
- A 20-country study on the prevalence of physical inactivity highlighted that the level of low physical activity in women was high in India (24.3%) compared to China (6.4%) and the US (18.2%)[22]
- An ICMR study published in 2014 conducted across 4 regions of India (Tamil Nadu, Maharashtra, Jharkhand and Chandigarh) highlighted that ~ 71% women > 40 years in urban areas and ~60% in rural areas were physically inactive[21]

Physical activity levels in study population (2014 ICMR study)



Source: ICMR study 2014

In select states, tobacco use, which is strongly associated with high risk of cancer, is comparable to levels in the US and UK

Key risk factor

Tobacco consumption

Risk factor for

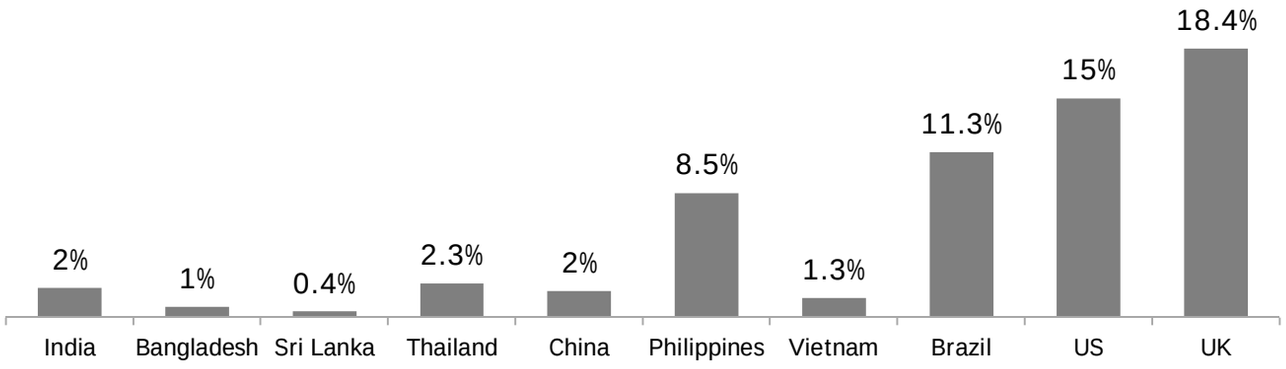
- Lung cancer
- Mouth cancer
- Cervical cancer

Apart from cancers of the oral cavity and lung, clinicians also consider tobacco as a risk factor for breast, cervical and ovarian cancers

Trends of exposure

- Prevalence of all forms of tobacco use in India among women in 2015 was ~2%, which is comparable with most nations in the Asian region that are witnessing rising cancer incidence
- NFHS 4 conducted in 2015-16 highlighted high prevalence rates of tobacco use (>7% India average) among women aged 15-49 years in the northeastern states (17-59%), Assam (19.7%), Chattisgarh (21.6%) MP (10.4%) and Orissa (17.3%)

Prevalence of tobacco use among women (%)



Source: WHO global report on trends in prevalence of tobacco smoking 2015, NFHS-4

Similarly, increasing alcohol consumption in India is resulting in higher risk exposure for certain types of cancer

Key risk factor

Alcohol consumption

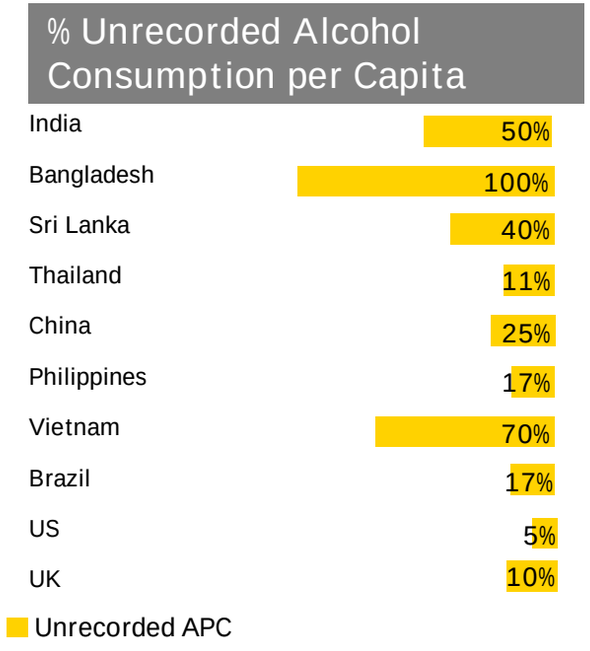
Risk factor for

- Breast cancer
- Mouth cancer

While average per capita consumption of alcohol in India has increased 3 times in the last 15 years to 3.1 liters, WHO estimates this to increase to 4.7 liters by 2020

Trends of exposure

- Alcohol consumption per capita (APC) in adults aged 15 years increased 3 times in India between 2000 (0.93 litres) and 2014 (3.1 litres) as per WHO estimates
- NFHS 4 conducted in 2015-16 highlighted that in 10 states (including all north eastern states), the prevalence of alcohol consumption among women aged 15-49 years was double that of India average (1.2%)
- The proportion of unrecorded alcohol consumption (an indicator of low quality alcohol) is also relatively higher in India



Prevalence (%), 2010*	Alcohol use disorders**	Alcohol dependence†
India		
Males	4.5	3.8
Females	0.6	0.4
Both sexes	2.6	2.1
WHO SEAR average	2.2	1.7

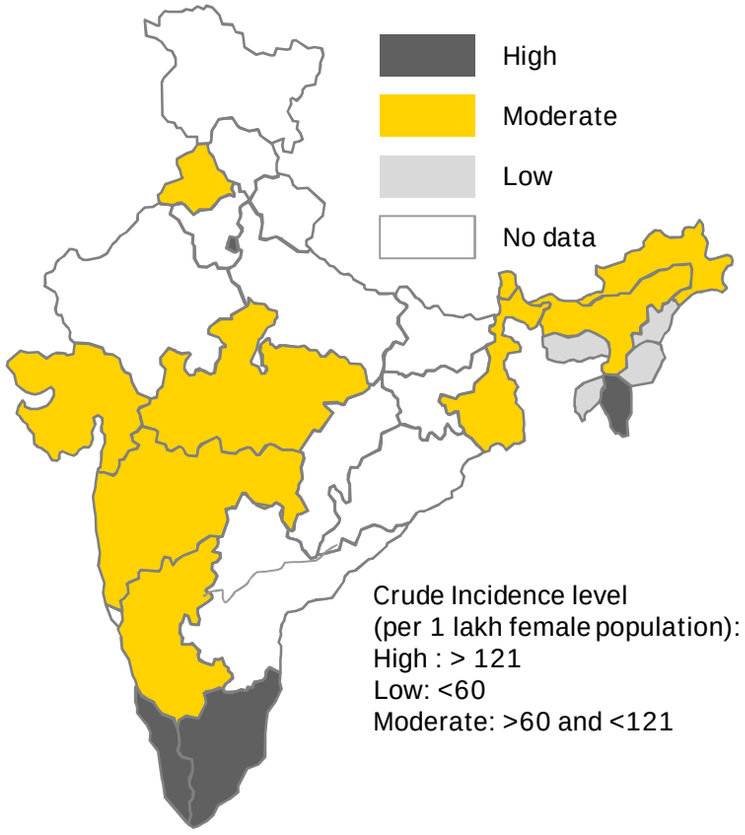
*12-month prevalence estimates (15+) **Including alcohol dependence and harmful use of alcohol. SEAR- South East Asia Region.

† Alcohol dependence (also known as alcoholism or alcohol dependence syndrome) is defined as a cluster of behavioural, cognitive, and physiological phenomena that develop after repeated alcohol use and that typically include a strong desire to consume alcohol, difficulties in controlling its use, persisting in its use despite harmful consequences, a higher priority given to alcohol use than to other activities and obligations, increased tolerance and sometimes a physiological withdrawal state.

Source: WHO Global status report on alcohol and health, 2014

Rising exposure to lifestyle risk factors and to tobacco and alcohol use is expected to result in increasing cancer incidence among women

Crude incidence level among female population for focus cancer types



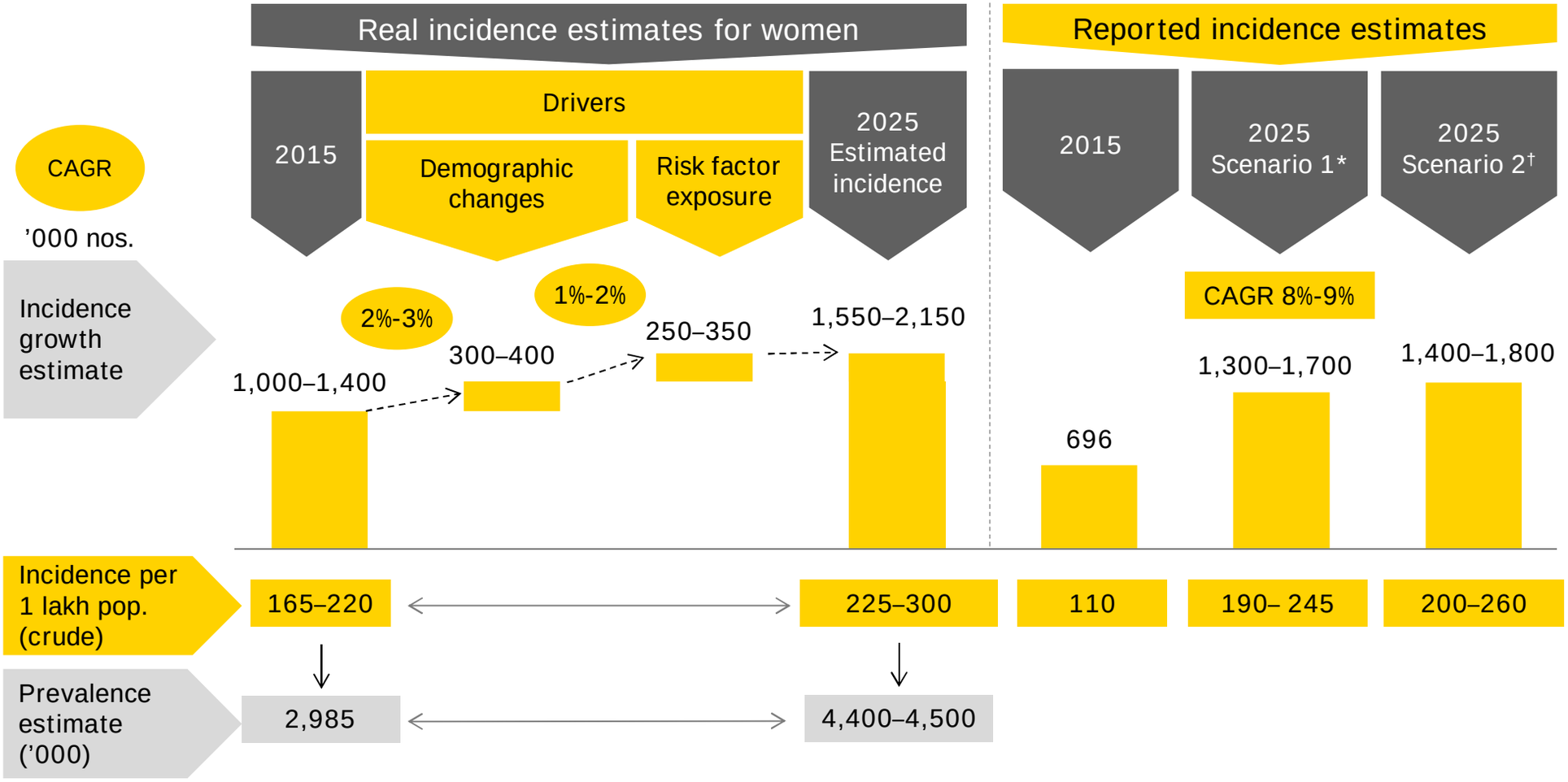
Key states	Lifestyle factors (Women aged 15-49 yrs)		
	% BMI ≥25kg/m	Tobacco use	Alcohol use
Delhi	34.9% ↑	1.8%	0.7% ↑
Kerala	32.4% ↑	0.8%	1.6% ↑
Mizoram	21.0% ↑	59.2%	5.0% ↑
Tamil Nadu	30.9% ↑	2.2%	0.4% ↑
Arunachal Pradesh	18.8% ↑	17.7%	26.3% ↓
Assam	13.2% ↑	19.7%	6.9% ↓
Gujarat	23.7% ↑	7.4%	0.3% ↓
Karnataka	23.0% ↑	4.2%	1.0% ↓
Maharashtra	23.4% ↑	5.8%	0.2% ↓
Madhya Pradesh	13.6% ↑	10.4%	1.6% ↓
Punjab	31.3% ↑	0.1%	0.1% ↓
Sikkim	26.7% ↑	7.3%	23.0% ↑
West Bengal	19.9% ↑	8.7%	0.8% ↓
Meghalaya	12.2% ↑	32.3%	2.1% ↓
Manipur	26.0% ↑	48.8%	6.0% ↑
Nagaland	16.2% ↑	27.5%	3.3% ↓
Tripura	15.9% ↑	42.2%	5.0% ↓
Andhra Pradesh	33.5% ↑	2.3%	0.4% ↓
Uttar Pradesh	16.5% ↑	7.6%	0.2% ↓

Source: NCRP annual reports, EY analysis

Reported cancer incidence is expected to increase mainly due to three key factors – demographic changes, higher risk factor exposures and an improvement in diagnosis

Driver	Effect
Demographic changes	► Increase in population: India's population is estimated to grow at a CAGR of 1.08% and reach 1.45 billion by 2025 ► Age composition: The median age of the population is estimated to rise from 26.9 in 2015 to 29.8 in 2025. India's population over 50 years of age is forecast to increase from ~228 million in 2015 to ~305 million by 2025 ► Sex composition: India's sex ratio is estimated to change from 107.6 in 2015 to an estimated 107.2 males per 100 females in 2025 Population growth, an ageing population and changes in the sex ratio are expected to increase cancer incidence in 2025
Risk factor exposure	► Increasing risk factor exposure: Increasing consumption of alcohol and tobacco, falling levels of physical activity and westernization of lifestyles and dietary habits are expected to increase the risk of cancer
Gap in diagnosis	The gap in early diagnosis in India is expected to show a reduction over the next five years owing to:- ► Increasing shift toward early detection, driven by increased patient awareness, affordability and access to cancer centers in 2025. The trends in these barriers have been discussed in Section 2 of this report ► Increased screening efforts for cancer Considering the above, we have projected reported cancer incidence under two scenarios of an improvement in the diagnosis rate where: (1) 60% of cancers are detected in stages I and II (2) 70% of cancers are detected in stages I and II

The reported cancer incidence for women in 2025 is expected to be 190-260 per 1 lakh population, representing a growth rate of 8%-9% annually over the next 10 years



*Scenario 1 – an improvement in diagnosis rate where 60% of cancers are detected in stages I and II
†Scenario 2 – an improvement in diagnosis rate where 70% of cancers are detected in stages I and II
Refer Annexure 4 for methodology used for estimating incidence and prevalence

Source: EY analysis

Breast, cervical and ovarian cancers are expected to continue as leading cancers in women with 1.3-1.5 times increase in incidence between 2015 and 2025

Cancer type	Real incidence estimates for women (in '000)			Contribution to overall burden of incidence for women	
				2015	2025
Breast	200–270	270–360	310–410	19.3%	19%–20%
Cervical	150–200	175 –230	200–260	14.1%	12%–13%
Ovarian	70–90	80–100	90–120	6.5%	5%–6%
				40.0%	36% – 39%

2015 2020 2025

Source: EY analysis

Section 2:
Landscape for cancer control

Key dimensions considered in our evaluation of the current state of cancer control in India

Stages of disease management

Key drivers for effective cancer control and care

Areas of intervention

Prevention	Diagnosis	Treatment
Modifying risk factor exposure	Early detection and accurate staging of disease	Multidisciplinary approach to cancer treatment with focus on outcomes
▸ Awareness and education ▸ Immunization ▸ Policies to limit risk factor exposure (e.g. taxation) ▸ Surveillance	▸ Awareness and education ▸ Screening ▸ Surveillance	▸ Access and affordability to avail multimodal treatment options ▸ Palliative and supportive care ▸ Monitoring and surveillance

Awareness and education

1. Awareness level of women-related cancers is low among the general population especially for cervical and ovarian cancers. Knowledge of symptoms and screening practices is also low compared to other countries like the US and China

2. Even among paramedical professionals (nursing staff), the awareness and acceptability of screening methods is low indicating an urgent need to educate nurses, primary healthcare/ ASHA workers given their leading role as influencers to the general population

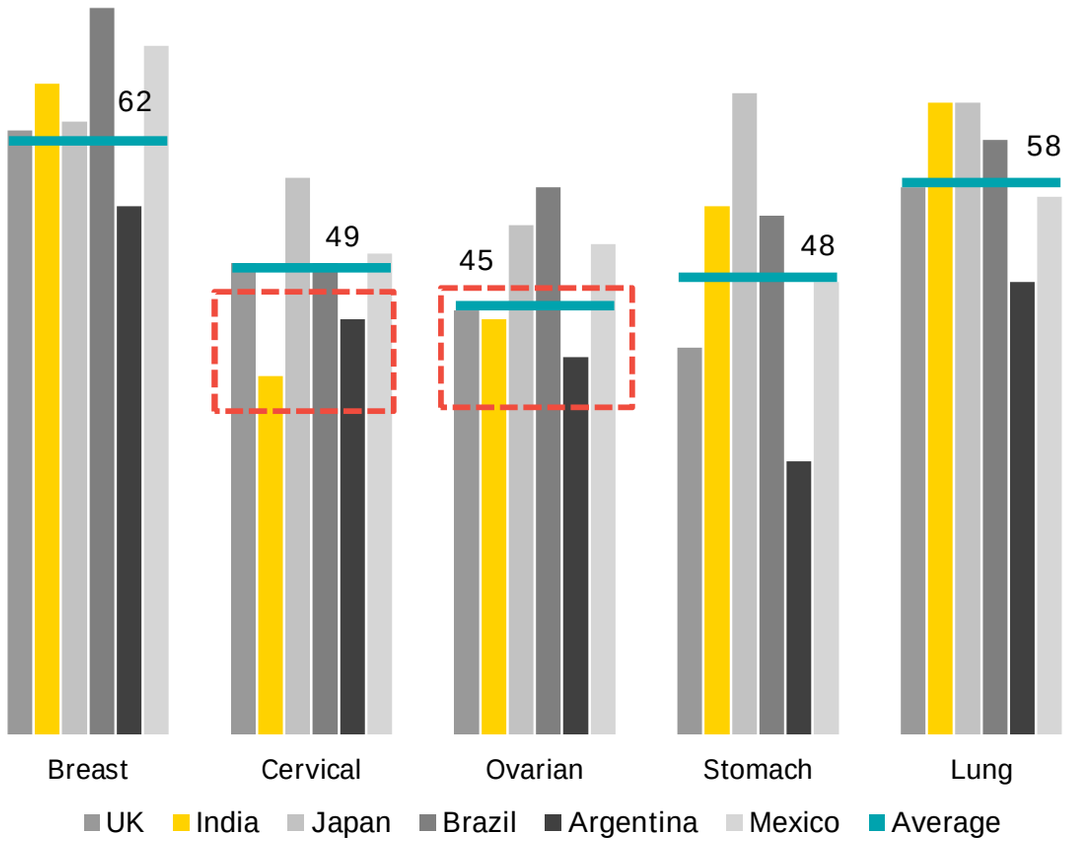
3. Policies and media campaigns in India have mostly been focused on smoking and tobacco prevention, but other modifiable risk factors like obesity and pollution are not being addressed adequately

4. To address some of the socio-economic factors that lead to “stigma” around cancer care, there is an emerging need to “educate, encourage, engage and empower” the Indian population

5. While financial schemes/subsidies are available, these are not being availed by cancer patients due to lack of awareness of these financing options

Awareness on women-specific cancers is generally low in India as compared to the other countries

Familiarity of cancers across countries
(% respondents)



Key observations

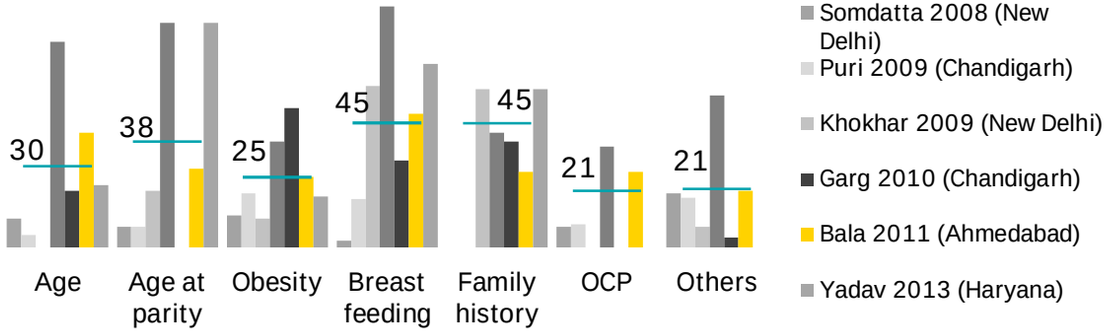
- In a study conducted across 14 countries by the European School of Oncology covering 14,315 adults, India ranks 13th for awareness levels on cervical cancer and 8th on ovarian cancer
- Respondents with good educational background had better awareness of various cancer types

Source: mBC General Population Survey: Insights into the general public's understanding and perceptions of metastatic breast cancer (mBC) across 14 countries

Knowledge of key risk factors for breast and cervical cancer has been low among the general female population in India over the years

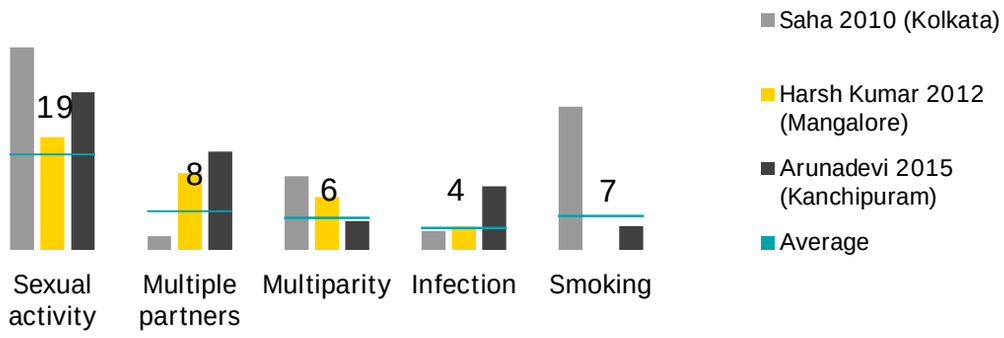
Refer Annexure 5 for study details

Awareness of breast cancer risk factors[23]
Female population (%)



Refer Annexure 5 for study details

Awareness of cervical cancer risk factors[24-26]
Female population (%)



Key observations

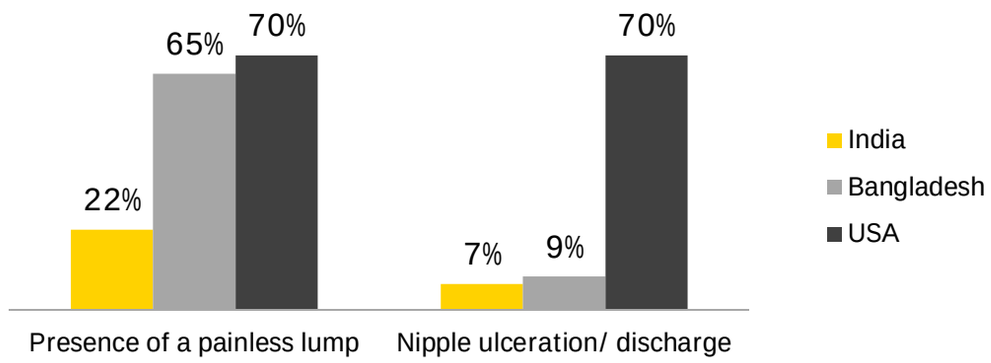
- Breast cancer:

  Consistently low awareness levels over the years on the following risk factors:
  - Obesity
  - Oral contraceptive pills (OCP)
  - Others (age of menarche, age of menopause and age of birth of first child. Women were more aware of breast cancer than men in all countries except Mexico)
- Cervical cancer:

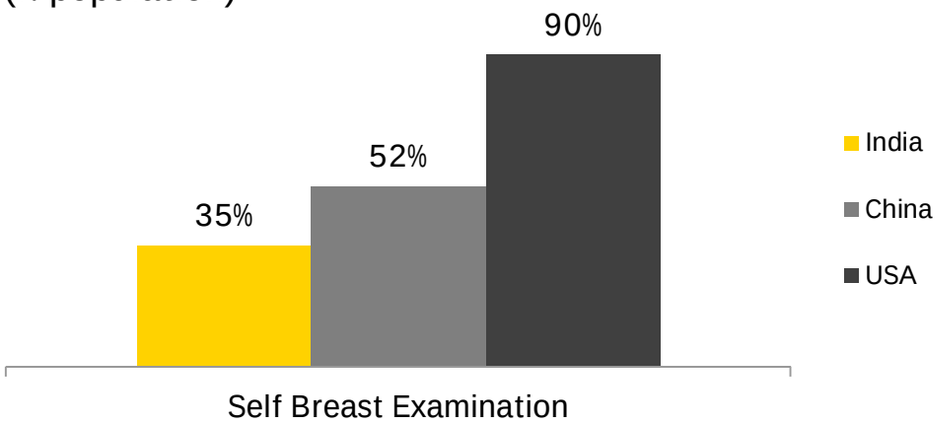
  Consistently low awareness levels over the years on following risk factors:
  - HPV infection
  - Multi-parity
  - Smoking
  - Multiple partners

Similar trends are also observed on awareness of symptoms and screening practices as compared to other countries

Knowledge of symptoms
(% population)



Practice of self-breast examination
(% population)



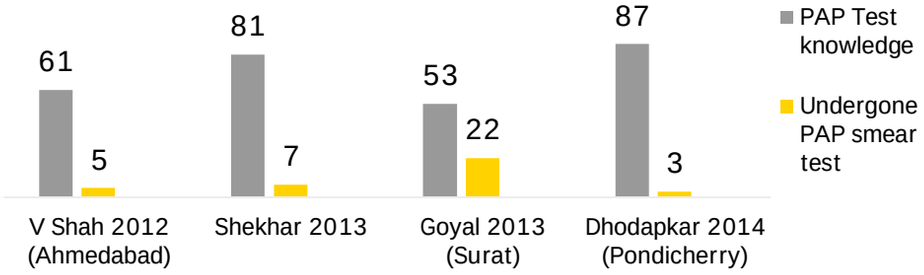
Key Observations [27-32]

- A study conducted by Pfizer, in 2014, revealed that 100% of women surveyed in the US had heard of breast cancer compared to 44% women in India
- A Korean survey reported that 88% women are aware of the practice of self breast examination (SBE) (2012)
- Similarly, studies revealed high awareness levels on select breast cancer symptoms in Bangladesh, and greater practice of SBE in China compared to India

Even among medical professionals (nursing staff), awareness and acceptability of screening methods is found to be low in India

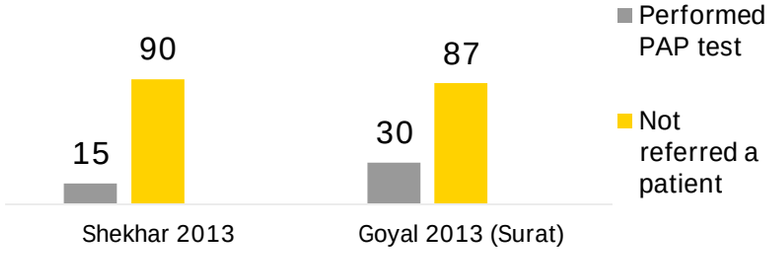
Cervical screening: Health professionals[33-36]

Awareness on PAP smear test
(% nursing staff)



Few nurses have undergone PAP smear test themselves despite being aware it

Conducting / Referring PAP test
(% nursing staff)



Majority of the nurses have not referred any patient to undergo PAP test

Breast Screening: Health Professionals[37-38]

India

74% of health workers are aware of SBE; however, only 24% have practiced SBE

Sri Lanka

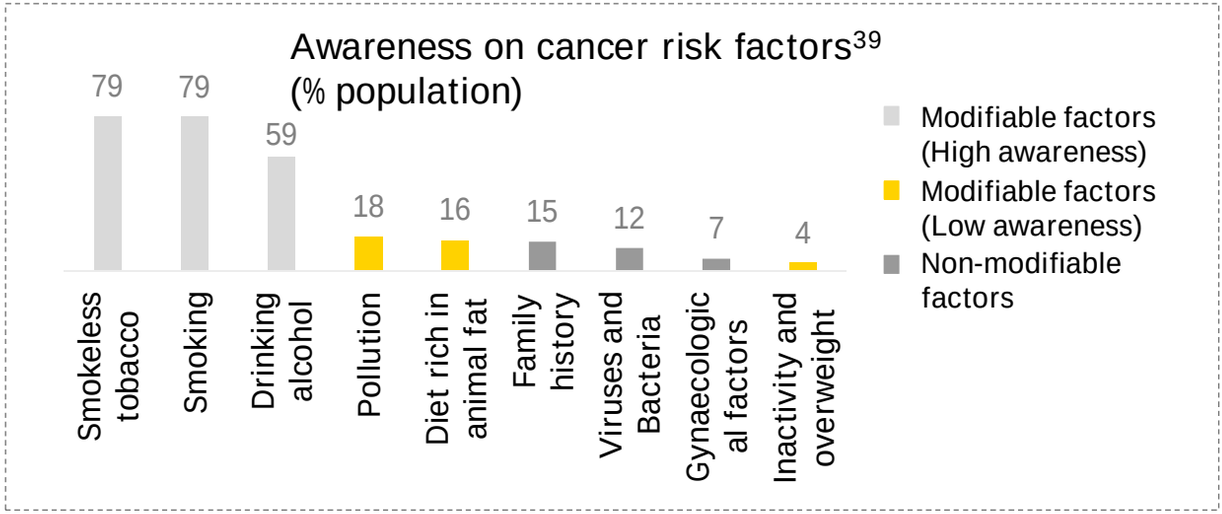
90% + of health workers are aware of SBE and 48% have practiced SBE

Ethiopia

70%+ of health workers are aware of SBE and 36% have practiced SBE

In select SAARC and African countries, both awareness and adoption of screening practices are higher than in India

Mass media campaigns in India are mainly focused on tobacco and smoking prevention – management of other risk factors such as obesity and pollution requires strong focus



- Media campaigns on tobacco, smoking and alcohol have resulted in higher awareness
- Other modifiable factors (obesity, dietary habits, and pollution) have not been focused on in large-scale media campaigns, thus impacting awareness levels

Present focus on other risk factors such as obesity and pollution is low

Obesity[40]	In 2013, Mexico launched National Strategy for prevention and control of overweight, obesity and diabetes, which included: ▸ Media campaign aimed at raising public awareness of obesity and related chronic diseases ▸ New tax levy at a rate of 8% on high calorie content food
Pollution[41]	ILO in Norway lists 92 general and 42 specific laws against occupational hazards related to pollution and workplace safety, compared to 12 and 4 respectively in India

Need to create awareness around symptoms that can directly impact early detection rates

Common symptoms such as nagging cough, bad breadth and persistent indigestion that can be related to cancer tend to get ignored due to the perception of these getting cured with time

Government initiatives on the lines of National Tobacco Control Program (NTCP) are required to increase awareness on other risk factors such as obesity and physical inactivity

Key highlights of NTCP

- NTCP was launched by Government of India in 2007-08 under the 11th Five-Year Plan
- Under NTCP, several mass media initiatives have been undertaken to increase awareness on the ill effects of tobacco
  - Anti-tobacco advertisements on the entire spectrum of tobacco products through radio, television and print media
  - Advertisements on railway properties including tickets, train panels and platforms
  - Radio stations provided free airtime / telecom companies sent mass text messages on ill effects of tobacco as part of CSR
  - Information education and communication material to rural audience through field exhibition and mobile exhibition vans
- Pricing and tax measures
  - Finance ministry has increased taxes on cigarettes from 12% to 70%
  - State Governments are considering adopting a "Comprehensive Taxation Policy" for all tobacco products so that they are taxed at similar rates and incentive to shift to relatively cheaper tobacco products is minimized
- Prohibition of the sale of tobacco products within a radius of 100 yards of educational institutions

There has been a reduction of six percentage points in the prevalence of tobacco during 2010-17[42]

With obesity being a risk factor for major common non-communicable diseases such as cancer, diabetes and hypertension, a focused program to create awareness, encourage physical activity and limit consumption of high calorie food is imminent for India

Learnings from the National Strategy for Prevention and Control of Overweight, Obesity and Diabetes, 2014 adopted by Mexico

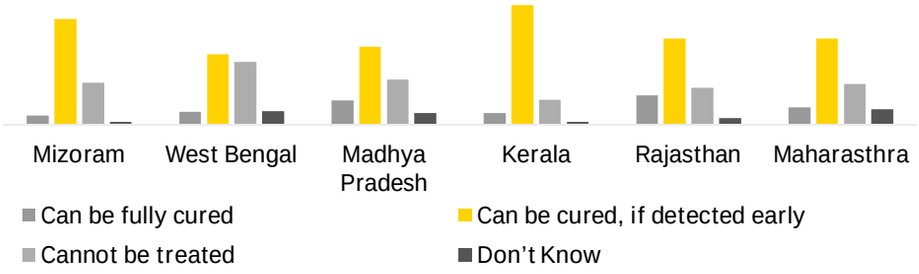
- Objective: To improve the wellbeing of the population and national sustainability by slowing the increase of the prevalence of overweight and obesity and by reversing the epidemic of NCD, specially type 2 diabetes, through the implementation of public health actions, medical care and a comprehensive policy implementation[43]

Three Pillars of National Strategy[43,44]:

- Public health: Aim is to promote healthy lifestyles through extensive education campaigns, monitoring of NCDs and implementation of preventive actions
  - Get checked, measure yourself and move ("CHÉCATE, MÍDETE, MUÉVETE"): A mass media campaign distributed through social media, TV and schools that promotes a healthy lifestyle through promotion of healthy eating habits and physical activity (90% reported that the campaign motivated to change lifestyle)
- Health care in a timely fashion, with the aim of promoting early identification of people with risk factors or previous diagnosis of diabetes or obesity
  - To support the national health system towards early detection
- Regulation and fiscal policy for health, (includes tax on sugary drinks and high calorie food)
  - One peso-per-litre soda tax (~10% of the pre-tax price) and 8% tax on junk food (products that contain 275 kcal or more for every 100 g) (reducing its consumption by 6%)
  - Mandatory front labelling for food and non-alcoholic beverages; quality nutritional seal for foods with low and medium caloric density; and restrictions on the advertising of food and beverages targeted to children on national television, pay television and in movie theatres

While many more people believe today that cancer can be cured, there is still a "stigma" associated with cancer screening and treatment that needs to be addressed

Awareness on curability and early detection (% population) [39]



India-specific findings from Livestrong report [45]

- 53% of people in India believe that people with cancer brought it on themselves
- 29% worry about catching cancer from people who have it

Everyone with cancer dies: cancer is the most powerful "brand" of death in the mainstream cinema

Women are often too shy to seek help when breast lump is discovered

Emerging need to address socio-economic considerations

Social factors	"Permission from husband to undergo screening"	Need to "educate" both women and men on awareness dimensions
	"Embarrassment in undergoing screening"	Need to "encourage" and train more female health workers to conduct screening
	"Fear of being diagnosed" "Pain associated with diagnosis"	Need to "engage" and facilitate sharing of experiences within the community
Economic factors	Daily wage workers à low attendance in free screening camps	Need to "empower" rural women by engaging in micro-financing initiatives

In addition to low awareness about risk factors and symptoms, patients in India have limited knowledge of government schemes for financing treatment

Discussions with select regional cancer centers highlighted that lack of financial support is a key reason for patients to drop out without completing full treatment regime. It was cited that often patients are not aware of finance schemes of the Government that they can avail for treatment

	Scheme specifications	Synopsis of cancer coverage
Aarogyasri[47] (Telangana)	▸ Cover: INR2 lakh per family ▸ 17 cancer care institutes	▸ All modalities are covered. Limited coverage of surgeries for women-specific cancers. Includes advanced radiotherapy (IMRT, SRS, SRT)
MA Yojna[48] (Gujarat)	▸ Cover: INR2 lakh per family ▸ 10 cancer care institutes	▸ All modalities are covered ▸ Includes advanced radiotherapy treatment (Cyber Knife, Gamma Knife, IMRT, IGRT, SRS, SRT), targeted therapy
CMCHIS[49] (TN)	▸ Cover: INR1 lakh per family (INR2 lakh for cancer) ▸ 15 cancer care institutes	▸ All modalities are covered ▸ Includes advanced radiotherapy treatment (IMRT, IGRT, SRS, SRT) ▸ Limited coverage of targeted therapy
Sukrutham[50] (Kerala)	▸ Cover: INR3 lakh ▸ Empanelled hospitals: RCC, MCC and medical colleges in Kerala	▸ All modalities are covered ▸ Includes advanced radiotherapy treatment (IMRT, VMAT, IGRT, SRS, SRT), targeted therapy
Yeshasvini[51] (Karnataka)	▸ Cover: INR1.25 lakh – INR2.50 lakh ▸ 5 cancer care institutes	▸ Surgical and radiation oncology are covered. Excludes chemotherapy ▸ Excludes targeted therapy drugs ▸ Includes advanced radiotherapy (IMRT)

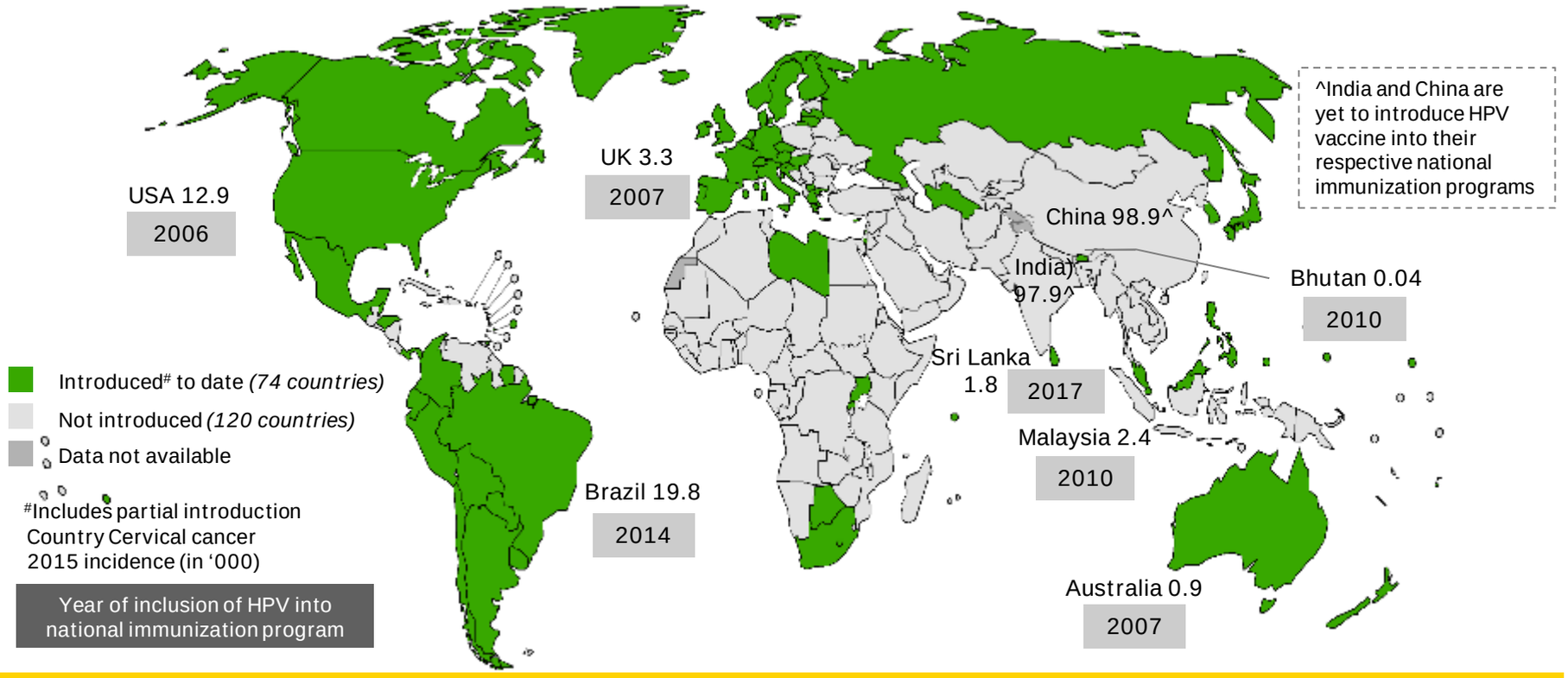
- While several state government schemes have been launched to drive UHC in India, there appears to be a lack of awareness about such schemes corroborated by surveys which revealed the following [46] -
  - Financial barrier highlighted by~ 27% as key reason for delaying decision for treatment
  - Family savings (37%) and borrowings (39%) remained the major source of financing for the patients
  - Although there are a number of schemes for cancer patients in Kerala, only 17% of the patients availed the free treatment due to lack of awareness of the schemes

Immunization

1 HPV vaccination is a critical intervention to be considered for reducing the burden of cervical cancer in the long term

2 For inclusion of HPV vaccination in the national immunization program of India, a holistic review is required by technical experts in terms of medical value proposition, financial and operational implications and socio-cultural barriers for adoption vis-à-vis long-term impact on cervical cancer disease burden

Since its launch in 2007, 74 countries have included Human Papillomavirus (HPV) vaccine in their respective immunization programs

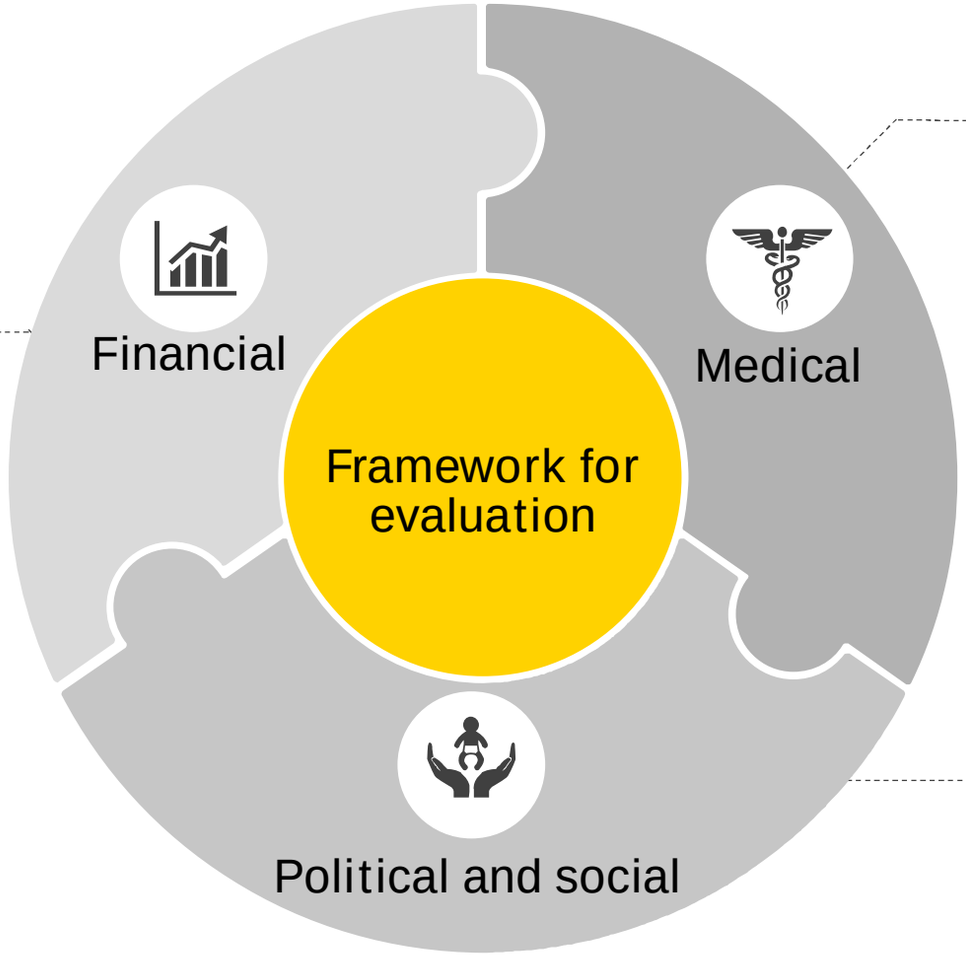


In India, *NTAGI has undertaken a critical appraisal of efficacy and effectiveness of HPV vaccines and to study the economic consequences of HPV disease. Despite the pending status, few states such as Punjab and Delhi have included the vaccine in their respective state immunization programs in 2016

*NTAGI: National technical advisory group on Immunization- Recommends inclusion of vaccines in National Immunization Program

Source: WHO data, National cancer registries

Evaluation of the need for including HPV vaccine in the national immunization program of India to reduce cervical cancer burden in the long term



Cost effectiveness ratio* being lower than per capita GDP

Clinical value proposition in terms of impact on disease burden

Alignment with government agenda for the “girl child”

Socio-economic consequences of female mortality

* Cost effectiveness ratio (in INR): Cost of intervention per year of life saved

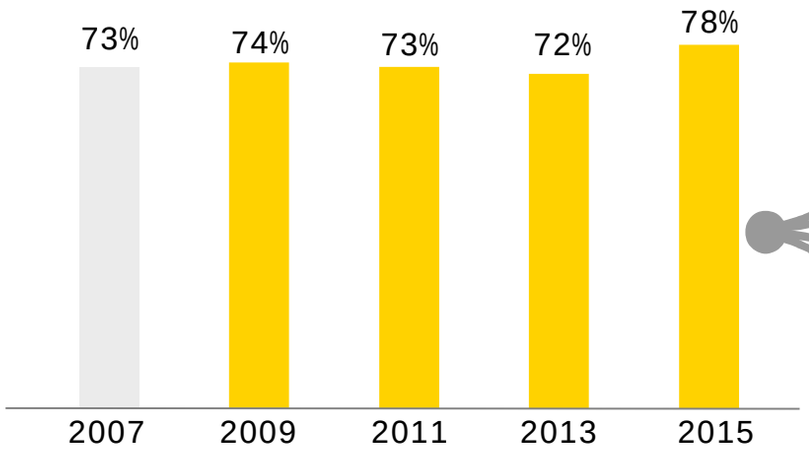
Leading global health and clinician organizations have recommended usage of HPV vaccine since its launch in 2007

Organization	Position on HPV vaccine	Year of inclusion	Members
World Health Organization	Two doses of HPV vaccine recommended for girls aged 9-14 years, prior to becoming sexually active	2009	193 countries
FIGO International Federation of Gynecology and Obstetrics	Deems vaccine to be safe and recommends continued administration of HPV vaccination	2007	130 countries
Indian Academy of Pediatrics	Two doses of HPV vaccines for girls aged 9-14 years	2007	23,000 members
THE FEDERATION OF Obstetric & Gynaecological Societies of India	Recommends HPV vaccination in all adolescents	2008	33,000 members

Australia, one of the first countries to adopt the HPV vaccine, has observed early signs of its success with studies indicating decline in factors associated with cervical cancer

National HPV vaccination program, funded by the Australian government, covers all males and females aged 12-13 years providing HPV vaccine free of charge

Eight-year trend in HPV vaccine coverage for target population and cervical cancer incidence[52-60]



Year of inclusion of HPV vaccine in national immunization program

While a large scale study in Finland is expected to establish efficacy of HPV vaccine against cervical cancer by 2020, Australia is already observing positive impact in reduction of cancer-related factors

- 77% reduction in HPV types responsible for almost 75% of cases of cervical cancer
- 17% decline in pre-cancerous lesions for women aged 25-29 years
- 50% reduction in the incidence of high-grade cervical abnormalities in girls under 18 years of age
- 90% reduction in genital warts in heterosexual men and women under 21 years of age

Australia has a high participation rate (70%*) under the National Cervical Screening Program (initiated in 1991) providing cytology based screening every two years for women aged 20-69 years. From 2017, the program will transition to HPV based testing every 5 years for women aged 25-69 years

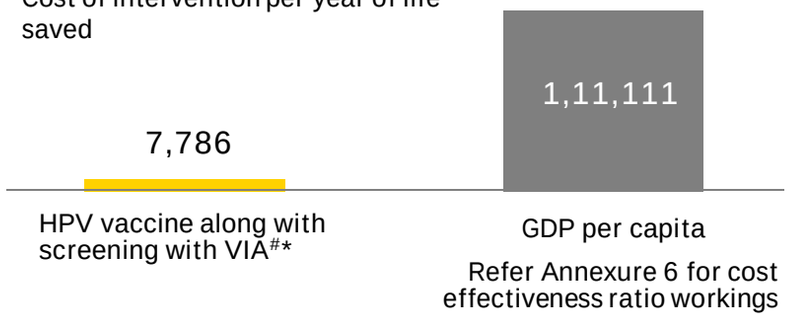
Source: ACCF, Brotherton (2013 and 2017), Ali (2013), Tabrizi (2012) , Lehtinen (2006)

*3 year participation rate

HPV vaccination along with organized population based VIA screening is cost effective with an estimated outlay requirement of INR800-850 crore

Cost effectiveness ratio vis-à-vis GDP per capita for India[61,62]

Cost effectiveness ratio** (in INR): Cost of intervention per year of life saved



Refer Annexure 6 for cost effectiveness ratio workings

Cost effectiveness ratio of HPV vaccination along with periodic VIA screening is well below the per capita GDP of India, confirming its financial viability in line with WHO guidelines*

A study conducted by Prinja in 2017 on inclusion of HPV vaccination in Punjab's immunization program found it to be cost-effective with the cost of intervention being below the willingness-to-pay threshold of INR10,000, which is, less than one-tenth of per capita GDP

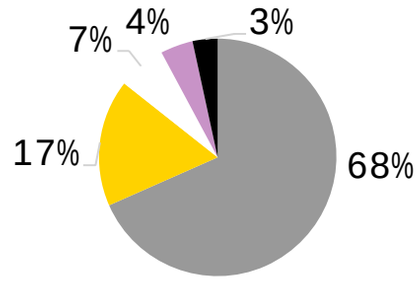
#2 doses of HPV vaccine

*For screening 3 times per lifetime at ages 35, 40 and 45

**As per the WHO, an intervention is considered to be "very cost-effective" if the cost effectiveness ratio is less than per capita GDP

Cost of vaccination per Fully Immunized Girl (FIG)[61]

₹ 984 per FIG



- Vaccine (including wastage)
- Consumables and freight
- Cold chain and operations
- Programmatic and monitoring services
- Administration

₹ 800–850 crore per year for the entire program

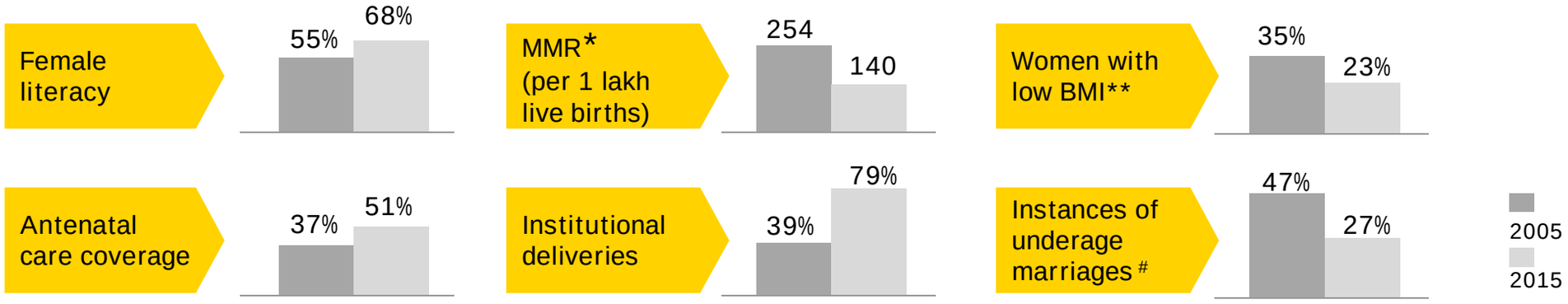
Refer Annexure 7 for key inputs considered for cost effectiveness analysis

Implementation of the program can be phased, with the first phase covering high incidence states with strong healthcare infrastructure such as Tamil Nadu (cervical cancer incidence 16.7 per 1,000 pop.), Maharashtra (14.4), Delhi (13.2), Karnataka (13.1) and Punjab (11.8) with an estimated annual cost of INR150-200 crore

Source: Diaz (2008), Goldie (2005), World bank data

Inclusion of HPV vaccine into National Immunization Program is in line with the Government's agenda of improving the status of women in India

India has been focusing on improving the status of women in India which is reflected as a positive trend across various indicators[63,64]



The Government is further intensifying its focus on women and girl child with several recent initiatives[52]

- Janani Suraksha Yojana: Provides conditional cash transfer to promote institutional deliveries
- Beti Bachao Beti Padhao: Comprehensive package of interventions for the girl child pertaining to improving girl education and child sex ratio
- Maternal benefit program: Protects women from wage loss during the first six months after childbirth
- One-stop crisis centers: Provides integrated support and services like medical assistance, psychological counselling, legal aid, etc. to women affected by violence

Given the focus on women and girl child, inclusion of HPV vaccine in the National Immunization Program to reduce the cervical cancer burden in the long term may well align with the Government's agenda

*Maternal mortality rate. **For women in the age group 15-49 years. #Women aged 20-24 years married before 18 years

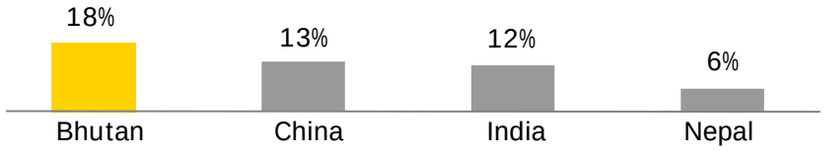
Learnings from implementation of national HPV vaccination program in Bhutan

Cervical cancer incidence

Crude incidence: 10.5 per 1 lakh population

Source: Tshomo (2014)

High risk HPV prevalence among general population



Awareness and advocacy[65]

- Strong endorsement of the campaign by the royal family and Government leaders to bolster advocacy for the campaign
- Collaboration between the Ministry of Health (MOH) and Ministry of Education to create awareness and acceptance of the program among school authorities
- National-level campaigns directed through press, radio and TV
- Multi-stakeholder engagement at district level by health officers - responsible for coordinating advocacy meetings with health workers, school teachers and principals, etc.
- Targeted and simple messages for communication on the benefits of HPV vaccine with emphasis on addressing any concerns on safety

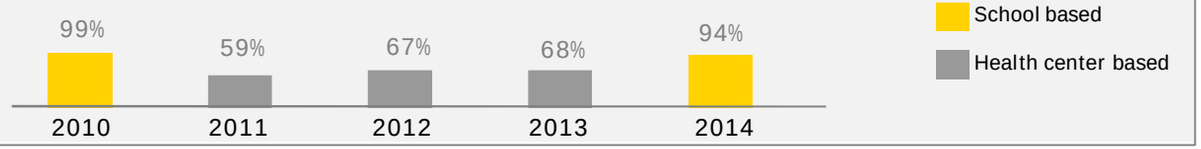
Financing and PPP

- Vaccine provided by MSD free of cost in 2010 and ACCF funded the vaccine cost for 2011-2015. The Bhutan Government was responsible for logistics and administration with the total non-vaccine cost coming to US$7.2 per fully immunized girl
- The Government of Bhutan collaborated with PATH India, MSD and UNFPA for support on education and training

Delivery system[65]

- School-based delivery system proved more effective than health center based system in terms of coverage

Coverage of target population by year and delivery system



Source: Dorji (2015)

Monitoring

- In 2010, IARC, in collaboration with the Bhutan Government, started monitoring the effectiveness of HPV vaccination in reducing the prevalence of HPV infection in Bhutan

MoH: Ministry of Health, Bhutan, ACCF: Australian Cervical Cancer Foundation, PATH: Program for Appropriate Technology in Health
UNFPA: United Nations Population Fund, IARC: International Agency for Research on Cancer

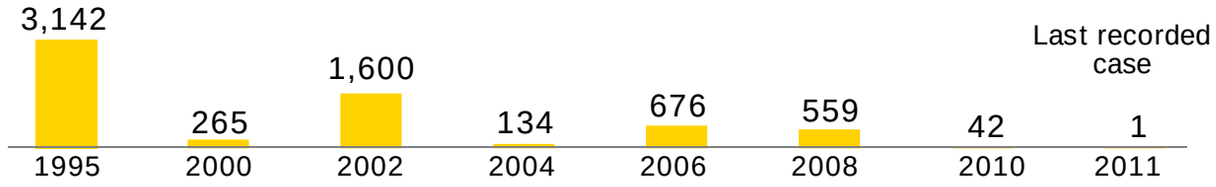
Refer Annexure 8 for further details

Learnings from polio eradication program in India

Number of children vaccinated: 88 million → 172 million

Poliovirus cases (India)[66]

Pulse polio campaign launched



Source: John (2013)

Awareness

- Social mobilization network (SMNet) was launched in 2001 to generate community support for polio immunization activities through extensive utilization of IEC, marketing campaigns and celebrity brand ambassador
- Under-served strategy was launched in 2003 to reach marginalized communities with high polio prevalence in states such as UP and Bihar

Last mile coverage

- To ensure no child is missed, initiatives such as house-to-house vaccination, identification of missed children (using indelible ink) and integration with NRHM were launched. Intensified plans were drawn up to reach difficult-to-reach areas (such as the Kosi river area) through establishment of satellite offices and overnight stay points
- A multi-pronged strategy was launched in 2009 to address polio-associated risk factors in 107 high-risk blocks in states such as UP and Bihar

Vaccine technology

- Constant upgradation of vaccine technology was done with introduction of monovalent and bivalent vaccines in 2005 and 2010

Financing and PPP

- Significant financial support from organizations such as Rotary international (US$158 million), Bill and Melinda Gates Foundation, etc.

Surveillance

- National Polio Surveillance Project (NPSP) launched in 1997 for monitoring polio outbreaks. Over 300 medical officers on ground rapidly detect polio transmission all over the country

IEC: Information Education Communication

Refer Annexure 9 for further details

Screening

1 While early detection can significantly improve clinical outcomes in Indian patients, screening coverage for key women-specific cancers such as breast and cervical cancers is low even in states that report high incidence for these cancers

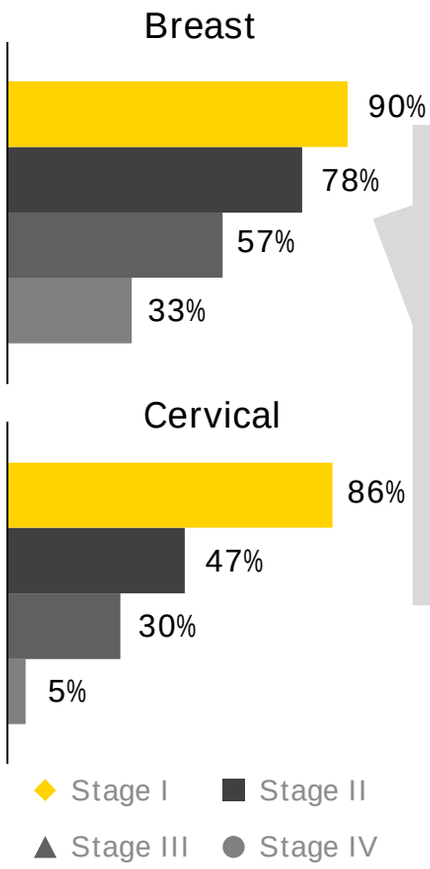
2 The Government rolled out a guideline for organized population based screening for breast, cervical and oral cancer in 2016. However, implementation of the guideline requires ramping up of public infrastructure and human resource capacity, entailing increased budget outlay for screening

3 Effective partnership with the private sector to fill in gaps in public capacity can be a key measure for expanding screening coverage in India

Early detection can significantly improve clinical outcomes in Indian patients

5-year survival rate by stage at diagnosis[67,68]

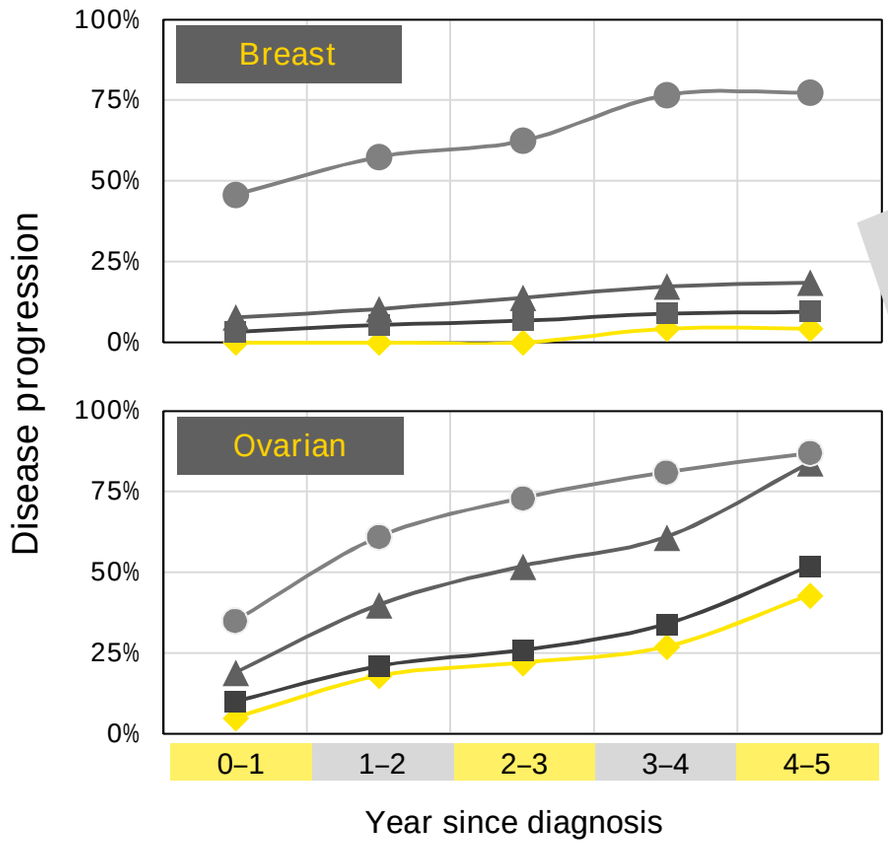
Percentage of treated patients who live at least 5 years after cancer diagnosis



5-year survival rates are significantly better for patients detected with early stage cancers compared to patients detected with stage III and IV cancers

Year-on-year disease progression by stage at diagnosis[67,68]

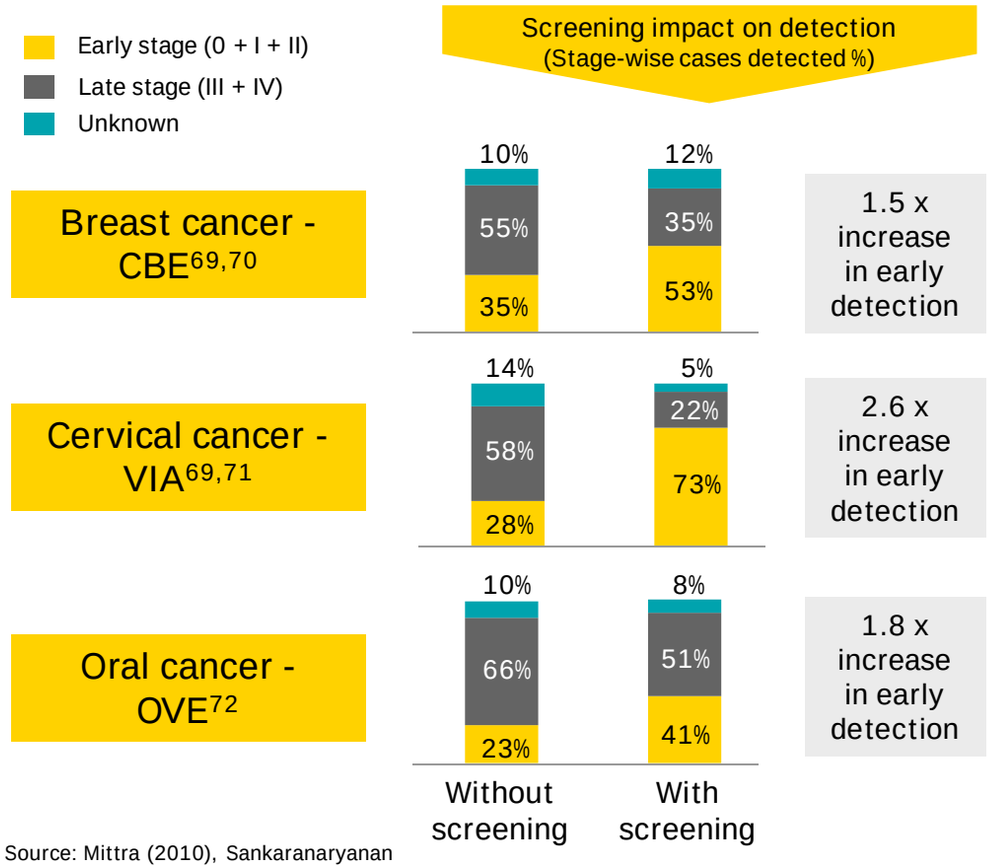
Percentage of treated patients whose cancer will continue to grow or worsen with time



Disease progression with time is observed to be substantially higher for cancers diagnosed at later stages as compared to cases with early stage detection

India has embarked on the path of organized population based screening through adoption of established screening methods for cervical and oral cancers

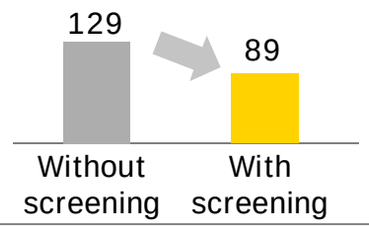
In 2016, MoHFW released operational guidelines mandating population-based screening for breast, cervical and oral cancers using clinical breast examination (CBE), visual inspection using acetic acid (VIA) and oral visual examination (OVE) respectively. Screening for cancer as mandated will form part of the NCD screening agenda of GOI alongwith diabetes and hypertension



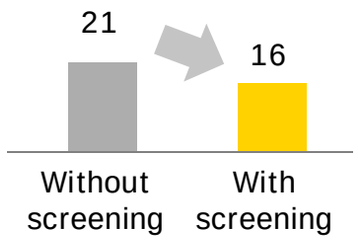
Source: Mittra (2010), Sankaranaryanan (2005, 2007,2009), Shastri (2013)

Screening impact on mortality
(Mortality per 1 lakh persons)

- Efficacy of CBE is yet to be established with two large studies in progress (1.5 lakh and 1.2 lakh women covered)
- However, majority of the Indian private tertiary care providers and international guidelines consider mammography specially in women over 35 years of age as highly effective for screening



31% reduction in cervical cancer mortality over 12 years through biennial screening using VIA[69]

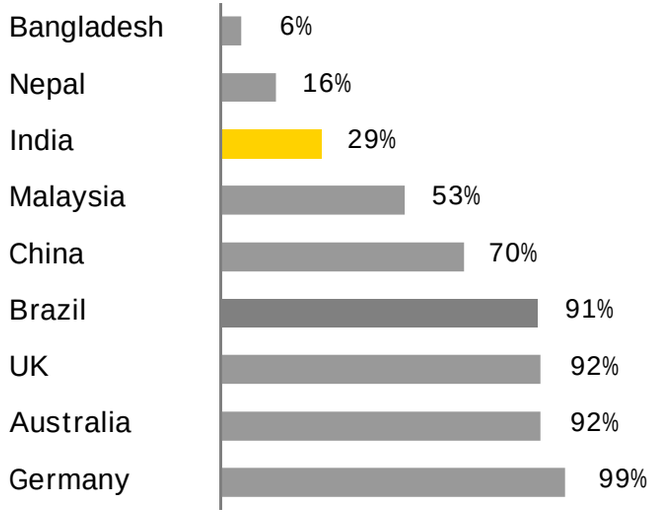


21% reduction in oral cancer mortality over 9 years through triennial screening using OVE[72]

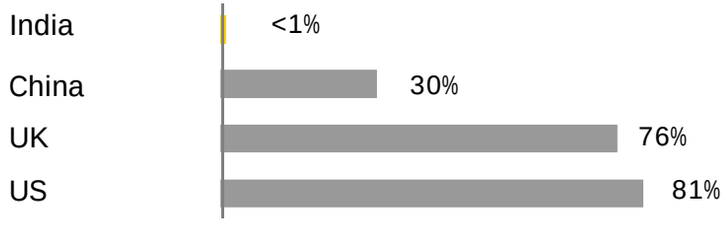
Screening coverage for breast and cervical cancer has been low till date in India even in states with higher incidence rates

India has a low screening coverage vis-à-vis its global peers

Crude coverage of cervical cancer screening for women aged 25-64 years



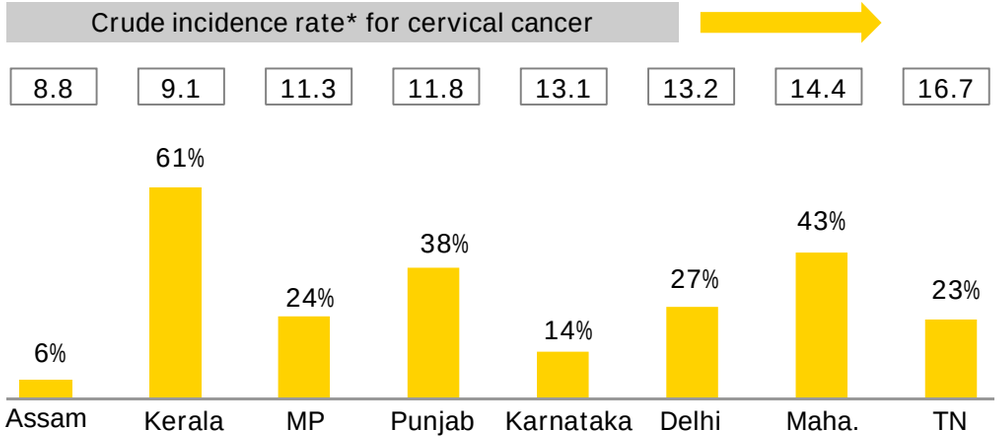
Percentage of women (40-69 years) who had a mammogram at least once in 24 months



Source: NFHS-4, Gakidou (2008), NCRP reports
*per 1 lakh women

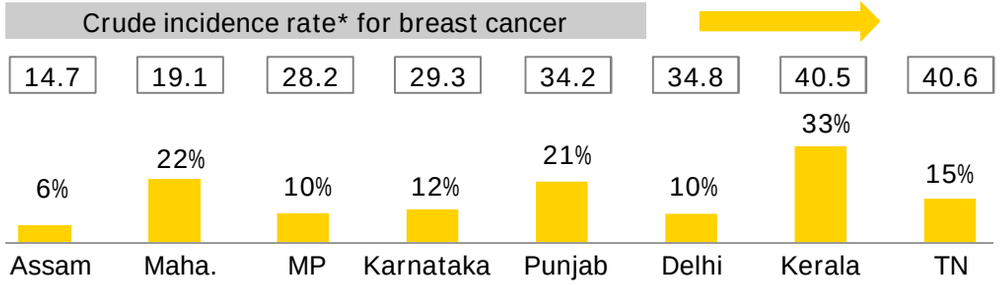
Large disparities exist in screening coverage between the states

Women aged 15-49 years who have ever undergone examination of cervix (2015-16)



MP: Madhya Pradesh, Maha.: Maharashtra, TN: Tamil Nadu

Women aged 15-49 years who have ever undergone examination of breast (2015-16)



GOI rolled out a robust framework for operationalizing organized population based screening for breast, cervical and oral cancers in 2016

Objective Organized population based screening for adults > 30 years of age focusing on common cancers, viz., breast, cervical and oral cancers, on periodic basis[73,74]

Coverage and infrastructure

- Coverage:
  - First phase: 100 districts across 21 states with population coverage of 7.5 crore
  - Program aspires to cover 80% of target population in first 3 years (50% in year 1, 15% coverage growth every year)
- Delivery infrastructure:
  - Sub-centers (SC) and primary health centers (PHC) to act as centers for cancer screening to minimize patient travel time to half hour for screening

Screening method

- Selected methods for screening:
  - Breast cancer - CBE
  - Cervical cancer - VIA
  - Oral cancer - Oral visual examination
- Auxiliary nurse midwives (ANMs) in selected SCs and PHCs to be trained to conduct screening
- Screening once in 5 years for every individual- Weekly screening days to be organized at SCs and PHCs

Referral pathway

- Staff at SC/PHC to ensure timely referrals of positive screened patients to next level of care
- ASHAs to accompany patients to referral centers for guidance through consultation, diagnostic and treatment processes
- DHs to be strengthened as “first referral” point from CHC/PHC/SC with capacity for:
  - Breast ultrasound
  - Colposcopy
  - Cryotherapy
  - Loop electro surgical excision procedure (LEEP)
  - Biopsy

As per MoHFW, to deliver the newly launched screening guidelines, total cost (screening over a 3-year period for all 5 NCDs) is estimated to be INR2.6 lakh/SC and INR10.5 crore per district. This implies an increase in budget allocation for screening by ~INR7 crore under the NPCDCS provisions[73,74]

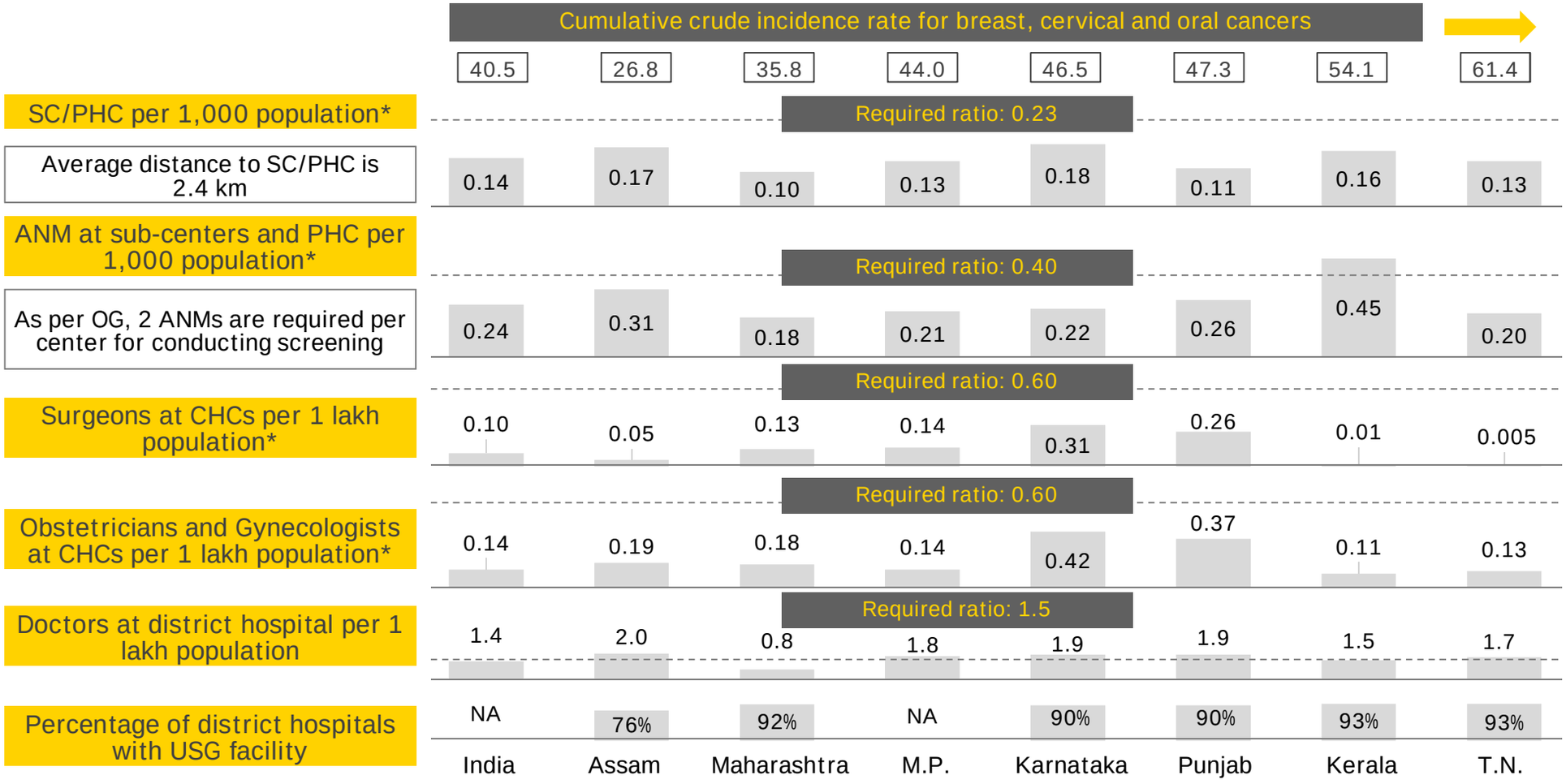
Refer Annexure 10 for additional details of the screening framework

The framework defines a formal referral pathway leveraging public infrastructure spanning across stages of screening to treatment

Level of care and resources	Sub-center (SC)	Primary health center (PHC)	Community health center (CHC)	District hospitals (DH)
	ANM, ASHA, Lady health visitor	Medical officer staff nurse, ANM	Surgeon, Gynecologist, Dentist, Nurse	Surgeon, Gynecologist, Dentist, Nurse, ENT specialist, Pathologist
Breast cancer[73,74]	ANMs/Staff nurses to conduct CBE at SC/PHC for all women above 30 years of age and refer patients with lumps to CHC/DH		Lumps to be examined by surgeons at CHC/DH using ultrasound. Mammography to be done, if available, for women above 35 years of age	Core biopsy to be done at DH for suspicious lumps – if malignancy is found patient to be referred to RCC/TCC
Cervical cancer[73,74]	ANMs/Staff nurses to conduct VIA at SC/PHC for all women above 30 years of age and refer patients with positive VIA results to gynecologists/lady medical officer at PHC/CHC/DH		For eligible lesions, cryotherapy to be done by a trained gynecologist at CHC/DH followed up with VIA a year later	For other lesions, biopsy to be performed at DH followed by Cryotherapy (CIN-1), LEEP (CIN-2,3) or referral to RCC/TCC for cancer
Oral cancer[73,74]	ANMs/Staff nurses to conduct OVE at SC/PHC for all persons above 30 years of age and refer patients with positive screen results to dentist/ENT specialist/ surgeon/medical officer at PHC/CHC/DH		For suspected cancers, detailed intraoral examination and biopsy histopathological reporting to be done at CHC/DH. If malignancy is found, patient to be referred to TCC/RCC	

RCC: Regional cancer center, TCC: Tertiary care center

However, the current state of public infrastructure and human resource capacity is likely to pose a significant challenge to implementation of the program



Additional workload due to screening will potentially require further expansion of infrastructure and capacity beyond the current recommended guidelines

*For rural population

OG: Operational guidelines for NCD screening

Source: Rural health statistic, 2016, NCRP reports, EY analysis

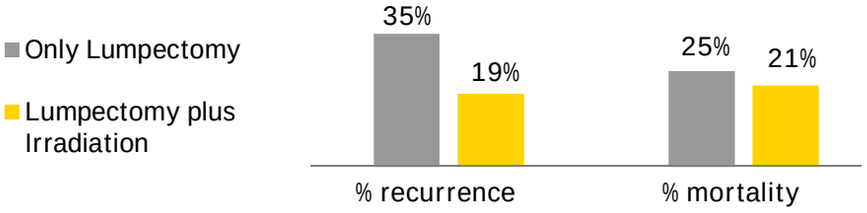
Treatment: Access

1. Despite significant improvement in patient outcomes, only 15%-20% of patients in India, vis-à-vis 50%-60% as per guidelines, have access to radiotherapy as a treatment option for cancer care
2. Significant state-wise skew exists in the distribution of LINAC equipment as well as human resource for delivery of radiotherapy treatment, which does not align with state-wise cancer incidence rates
3. To offer desired level of radiotherapy treatment to cancer patients, there is a need for 1,500-1,600 new LINAC installations at an estimated cost of INR23,500 crore-INR27,000 crore, including import duty of INR3,000 crore-INR5,000 crore as >95% of these equipment are imported into India
4. Multimodal treatment, which has been proven to improve clinical outcomes, cannot be offered to the greater majority of cancer patients in India as only 20% districts in India have comprehensive cancer centers (CCCs)
5. Poor penetration of CCCs results in logistical inconvenience and associated escalation in treatment cost for large majority of patients in India
6. Also, access to specialized care of oncologists is poor in India compared to global levels, with 1 oncologist available for ~600 patients and that too mostly located in metro and tier 1 cities
7. India lacks regulation and control of treatment management offered by cancer centers with no prescribed body to mandate and monitor adoption of guidelines as well as benchmarking and peer review of cancer centers

Multimodal treatment including radiation therapy (RT) significantly improves the patient outcomes, which has led to inclusion of RT in treatment guidelines across the globe (1/2)

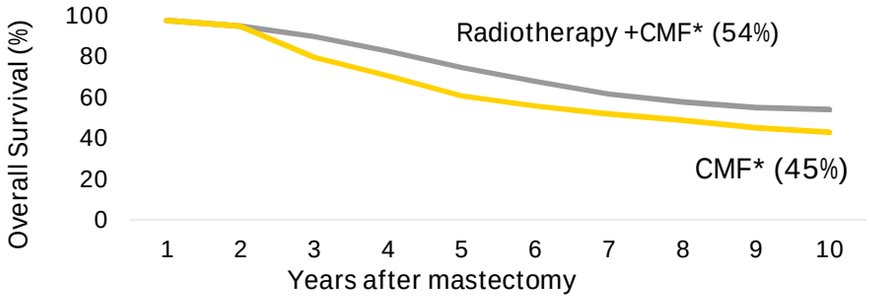
Clinical trials on multimodal treatment

Radiotherapy with surgery[76]



- After lumpectomy radiotherapy to the conserved breast halves the rate at which the disease recurs and reduces breast cancer related death by 1/6th

Radiotherapy with chemotherapy[77]



- Irradiation to mastectomy & adjuvant chemotherapy prolongs survival in high-risk premenopausal breast cancer patients

Refer Annexure 11 for study details

*CMF: Regimen of breast cancer chemotherapy

Excerpts from international and Indian treatment guidelines

Breast cancer treatment guidelines[78-80]

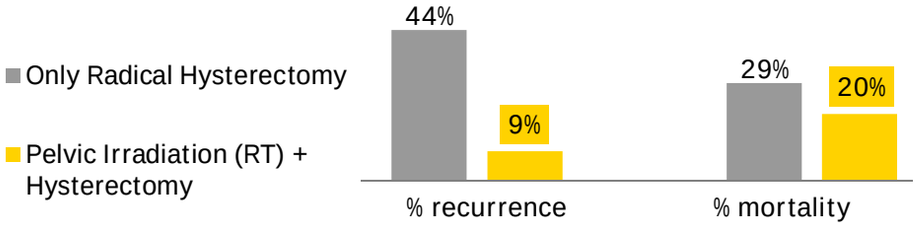
- Post mastectomy radiotherapy (PMRT) to chest wall area reduces breast cancer specific mortality, improves loco-regional control as well as survival. It is recommended for patients with involved axillary nodes and/or with T3–T4 tumours
- All cases of breast conservation therapy need postoperative RT. It is strongly recommended after breast conservation surgery (BCS) as it gives a 50% risk reduction
- 3DCRT or IMRT reduce acute/late toxicity in areas of dose inhomogeneity. LINAC is preferable but Telecobalt can be used if breast is not large
- Whole breast radiation reduces risk of local recurrence and has shown beneficial impact on survival
- Radiation boost treatment in setting of breast conservation can be delivered using enface electrons, photons or brachytherapy

Proven improvements in clinical outcomes has led to inclusion of RT in treatment guidelines (such as NCCN, ESMO and ICMR) across the globe

Multimodal treatment including radiation therapy (RT) significantly improves the patient outcomes, which has led to inclusion of RT in treatment guidelines across the globe (2/2)

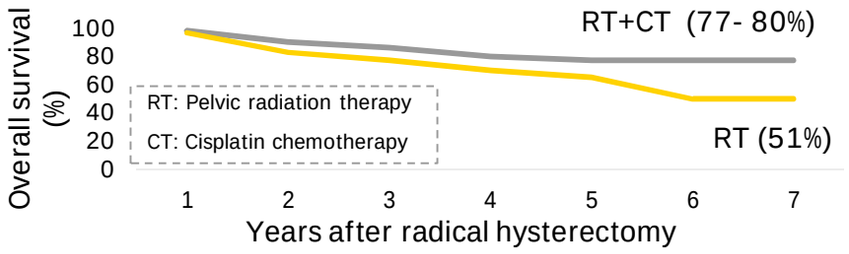
Clinical trials on multimodal treatment

Radiotherapy with surgery[81]



Pelvic radiotherapy after radical surgery significantly reduces the risk of recurrence and prolongs progression-free survival in women with Stage IB cervical cancer

Radiotherapy with chemotherapy[82]



Addition of cisplatin based CT to RT improves progression-free and overall survival for high-risk, early-stage patients who undergo radical hysterectomy for carcinoma of cervix

Refer Annexure 11 for study details

Excerpts from international and Indian treatment guidelines

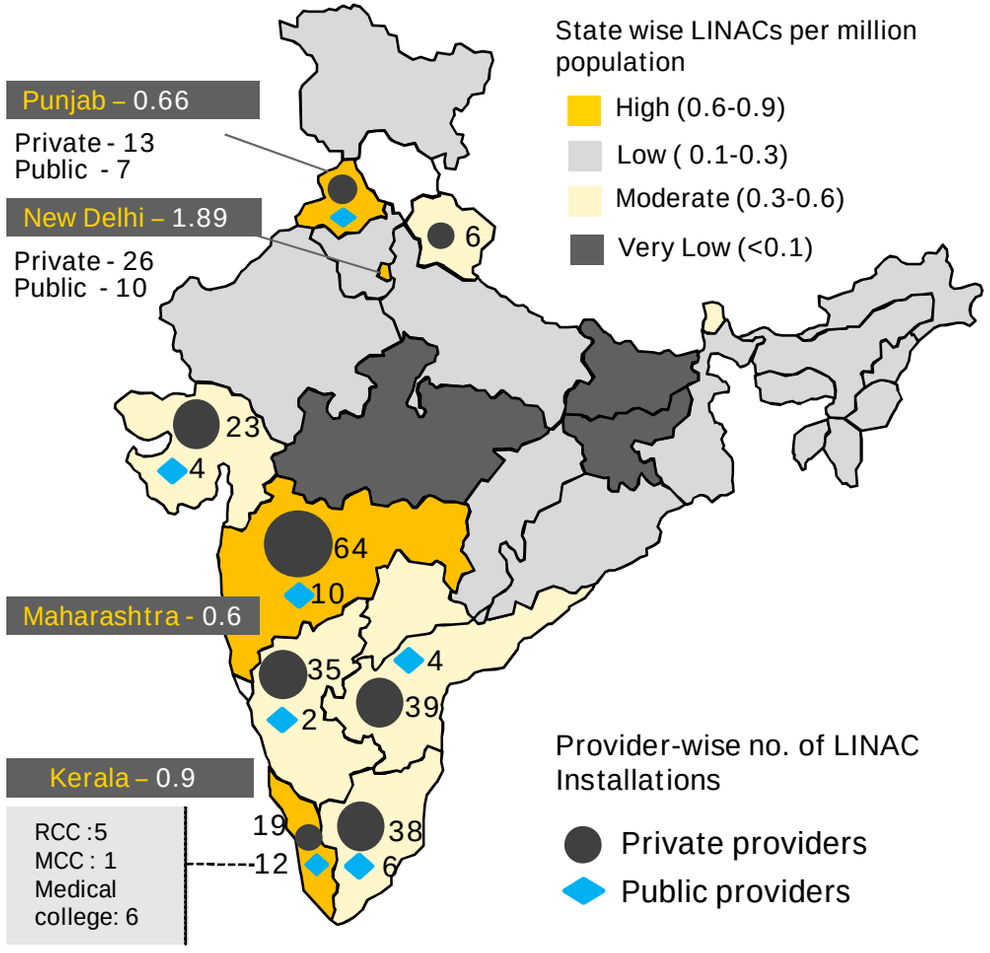
Cervical cancer treatment guidelines[83-85]

- Multimodality therapy with chemotherapy, radiotherapy and surgery seems to improve outcome
- CRT has been the standard of care for patients with bulky IB2–IVA disease for almost two decades, demonstrating an improvement in both disease free survival and overall survival
- Concurrent chemoradiation is the primary treatment of choice for stages IB2 to IVA of cervical cancer. Definitive chemo-radiation is preferred over radical surgery for patients with vast majority of FIGO stage IIA2 or greater cervical cancers
- In all patients treated with radical intent, brachytherapy should be an essential component
- Brachytherapy, an integrated treatment plan is a critical component of definitive therapy in patients with cervical cancer or can be used as adjuvant therapy

Treatment modalities such as brachytherapy and CRT are recommended by treatment standards worldwide for cervical cancer, thus reinforcing the need for increased adoption of advanced radiotherapy

Despite significant positive patient outcomes by inclusion of RT in treatment regimes, penetration of radiation equipment is low, limiting access to superior treatment for Indian patients

Distribution of LINACs by geography 2017



Source: WHO Statistics, "Planning National Radiotherapy Services: A Practical Tool", IAEA, 2010, EY Analysis, discussions with leading global linac manufacturer with presence in India

Global comparison of availability of LINACs v. population, prevalence and incidence

Region/ country	# LINACs	*LINACs/ Population (million)	Prevalence/ LINAC	Incidence/ LINAC
US	3,883	11.93	3,796	427
UK	328	4.97	6,926	1,124
China	1,010	0.73	6,288	4,246
India	409	0.3	18,880	4,401
Africa	205	0.16	33,708	4,449

*LINAC per million population data for India is for 2017, for US,UK, China & Africa is for year 2013

India has ~400 installed LINACs as of 2017 growing at 8-10% in the last 3 years with significant skew in distribution across geographies and between type of providers

- In majority of the states except Kerala, > 80% of LINAC installations are in the private hospital set ups
- Geographical distribution of LINACs is not aligned with the cancer incidence levels with poor LINAC penetration in states such as Tamil Nadu, Karnataka, MP, Gujarat, North East that have moderate to high cancer incidence
- Due to poor access and affordability, only 15%-20% of the patients in India, receive/opt for radiation treatment on an average, vis-à-vis international standards of 50%-60%

While India is adopting advanced radiation technologies, cost per installation is limiting overall penetration in the country

Distribution of external beam radiation equipment by technology

Technology	Nos. installed (2017)	Advancement level
Proton therapy	0%	High
Cyberknife	0.5%	High
SRS/SBRT	9%-10%	High
KV IGRT	14%	High
Gamma	1%	Moderate to high
IMRT	25%-26%	Moderate to high
3D CRT	35%-36%	Moderate to high
Local technology	0.5%	Low to moderate
Cobalt	14%-15%	Low to moderate

High · Moderate to high · Low to moderate

Source: Discussions with leading global LINAC manufacturer with presence in India

Cost of radiation equipment by technology

Type of technology	Equipment Cost (INR crore)
KVIGRT/IMRT/3DCRT/SRS/SRBT	~ 13-15
Cobalt	~ 3-4
Gamma Knife	~ 40-45
Local Technology	~ 4-4.5
Cyber Knife	~ 25-30
Proton therapy	~ 200

Apart from base equipment cost, import duties account for an additional 20% of cost per installation

~8,85,000 new patients require radiation treatment per year

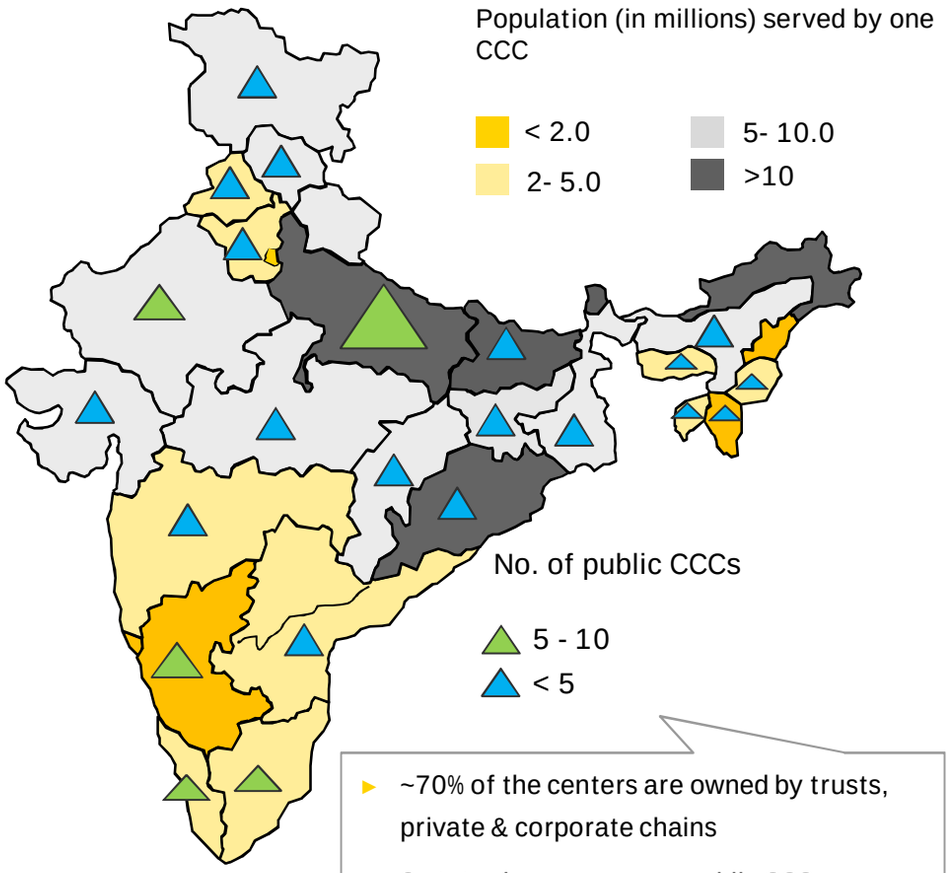
(According to IAEA guidelines, 50%-60% of cancer patients require radiation treatment)

- 1,500-1,600 additional LINACs will be required to treat new patients implying an additional investment of ~INR23,500- 27,000 crore (including 20% import duty of ~INR3,500-5,000 crore)
- While advanced technology adoption in India is improving, cost per installation is a key barrier limiting penetration and access in the Indian context

Refer annexure 12 for LINAC estimation

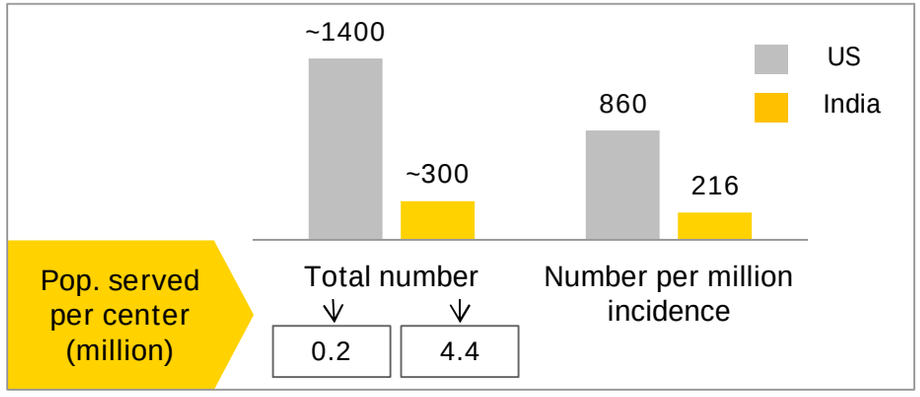
Access to multimodal treatment options provided by comprehensive cancer care centers specially public facilities is limited with high geographical skew in distribution of centers

Distribution of CCCs by geography and ownership



- ~70% of the centers are owned by trusts, private & corporate chains
- 8 states have one or no public CCC

India vs US comparison: density of CCCs



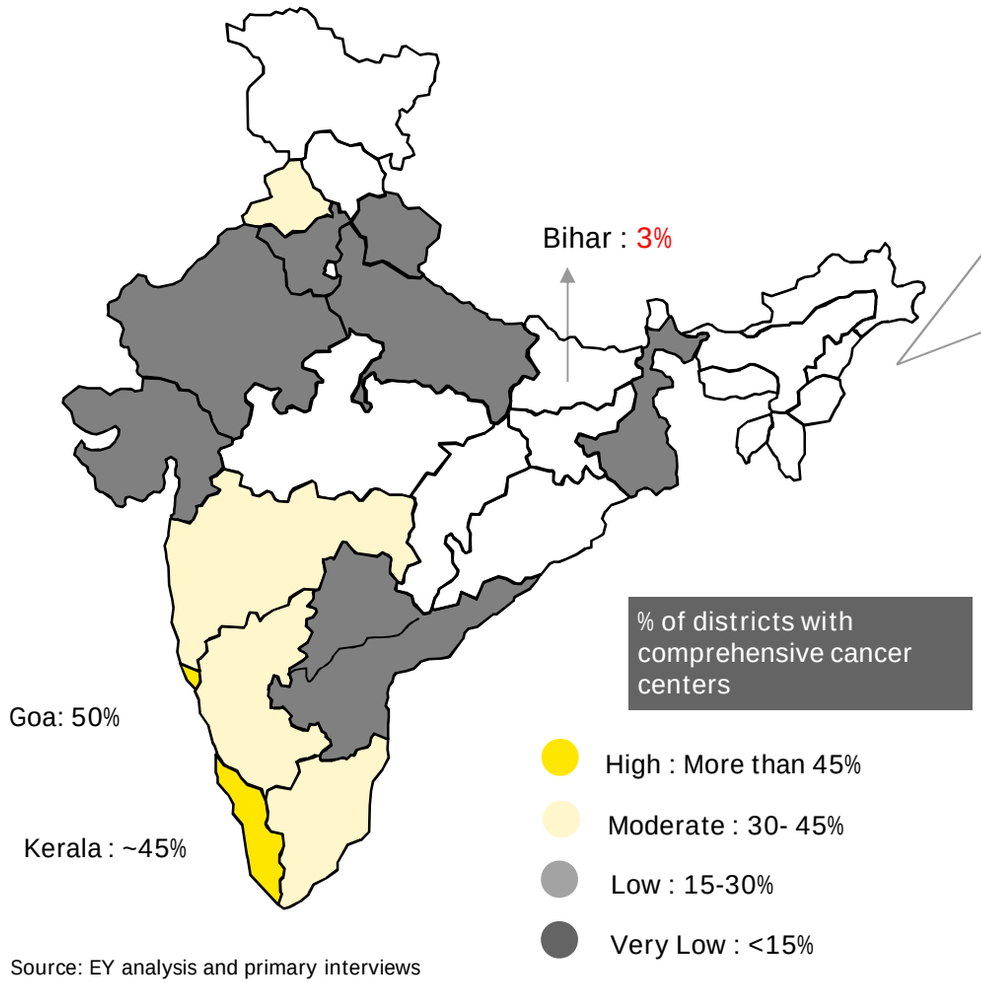
- India, as of 2016, has only 275-325 CCCs. Compared with US, there are significantly low number of centers across the country which are burdened with serving large population
- While ~40% of the CCCs are present in the top six metro cities, even among the metro cities there is considerable skew in the population served per center

Metro	Pop served per center (mn)	Metro	Pop served per center (mn)
Mumbai	1.4	Bangalore	2.3
Kolkata	2.0	Chennai	2.8
NCR	2.1	Hyderabad	3.3

Source: EY analysis and primary interviews

Inconvenience and cost associated with travel for availing comprehensive cancer treatment is a key challenge for majority of Indian population

District wise distribution of CCCs



Source: EY analysis and primary interviews

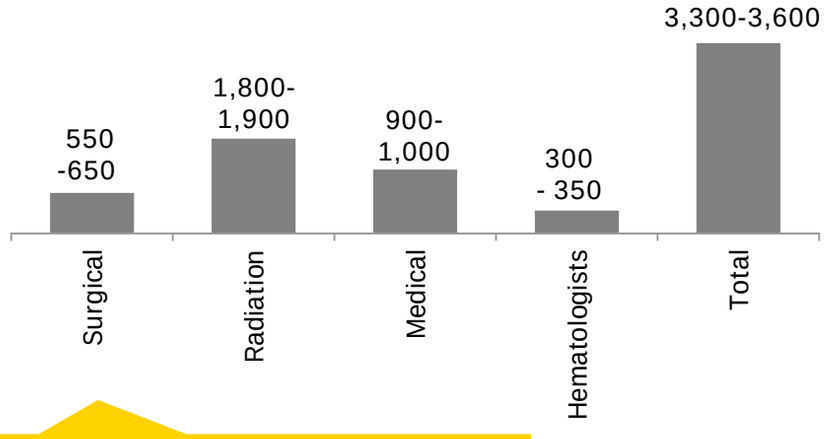
- In 2016, out of ~650 districts in India only ~20% districts had a CCC
  - Bihar with a total of 38 districts had only 1 district with 4 CCCs serving total state population of ~120 million
  - Uttar Pradesh, Madhya Pradesh, Rajasthan, Orissa had few districts with CCCs (<15%). Out of 51 districts in Madhya Pradesh only 5 districts (~10%) had CCCs

Comprehensive cancer treatment is logistically challenging for a very large section of the Indian population with only one-fifth of the total districts being served by CCCs

40%-45% patients in public cancer facilities face difficulties of long distance travel coupled with 20%-25% increase in treatment cost for travel and stay arrangements

In addition, gap also exists in the density and geographic spread of oncologists in India, which further proliferates the challenge of access to specialized multimodal care

Estimated number of oncologists and hematologists in India (2015)

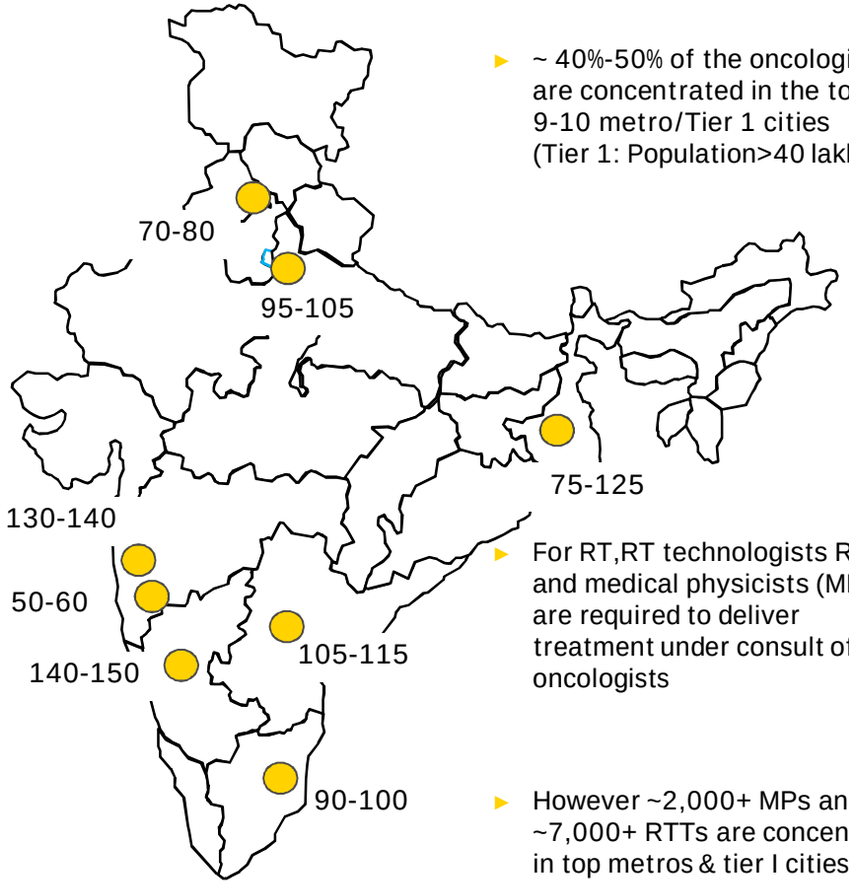


Includes onco surgeons only. Total surgeons with multidisciplinary practice is estimated to be ~1,500 to 1,800

Patients to Oncologist Ratio	
US[89]	95:1
UK[86-88]	250:1
India	585:1

- Annual addition of doctors is ~ 400-450 (includes MCH, DM and DNB courses)
- Despite the increase in the number of seats, the gap in patient to oncologist ratio is likely to remain high compared to developed nations

Distribution of oncologists in key metros



- ~ 40%-50% of the oncologists are concentrated in the top 9-10 metro/Tier 1 cities (Tier 1: Population>40 lakhs)
- For RT,RT technologists RTT) and medical physicists (MPs) are required to deliver treatment under consult of oncologists
- However ~2,000+ MPs and ~7,000+ RTTs are concentrated in top metros & tier I cities

Source: American Cancer Society, Royal college UK websites, Industry reports, Primary interviews, EY analysis

There is yet no regulated set of treatment management guidelines in India coupled with limited focus on benchmarking and peer review to improve quality standards

Comprehensive Cancer Centers

Distribution of CCCs by ownership

- 30% — Public hospitals
  - Government centers[78,90]
  - Tata Memorial Center[90]
- 70% — Corporate enterprises[5]

Guidelines followed

Government centers[78,90]	Tata Memorial Center[90]	Corporate enterprises[5]
▸ National Cancer Grid (NCG) guidelines	▸ Evidence Based Guidelines	▸ Self developed clinical practice guidelines
▸ Regional Cancer center and ICMR Guidelines	▸ National Cancer Grid Guidelines	▸ International Guidelines like ESMO, NCCN
▸ International Guidelines like NCCN	▸ International Guidelines like ESMO	▸ Guidelines co-developed under international affiliation arrangements

Peer review

Government centers[78,90]	Tata Memorial Center[90]	Corporate enterprises[5]
▸ 1 center reviewed by a local NCG peer	▸ Reviewed by an international and local NCG peer	▸ Select providers have been reviewed by international peers

*NCCN- National Comprehensive Cancer Network, ESMO- European Society for Medical Oncology, ICMR: Indian Council of Medical Research

Treatment: Affordability

1 Cost of basic cancer treatment is unaffordable for more than 75% of the population of India at their preferred hospital setting

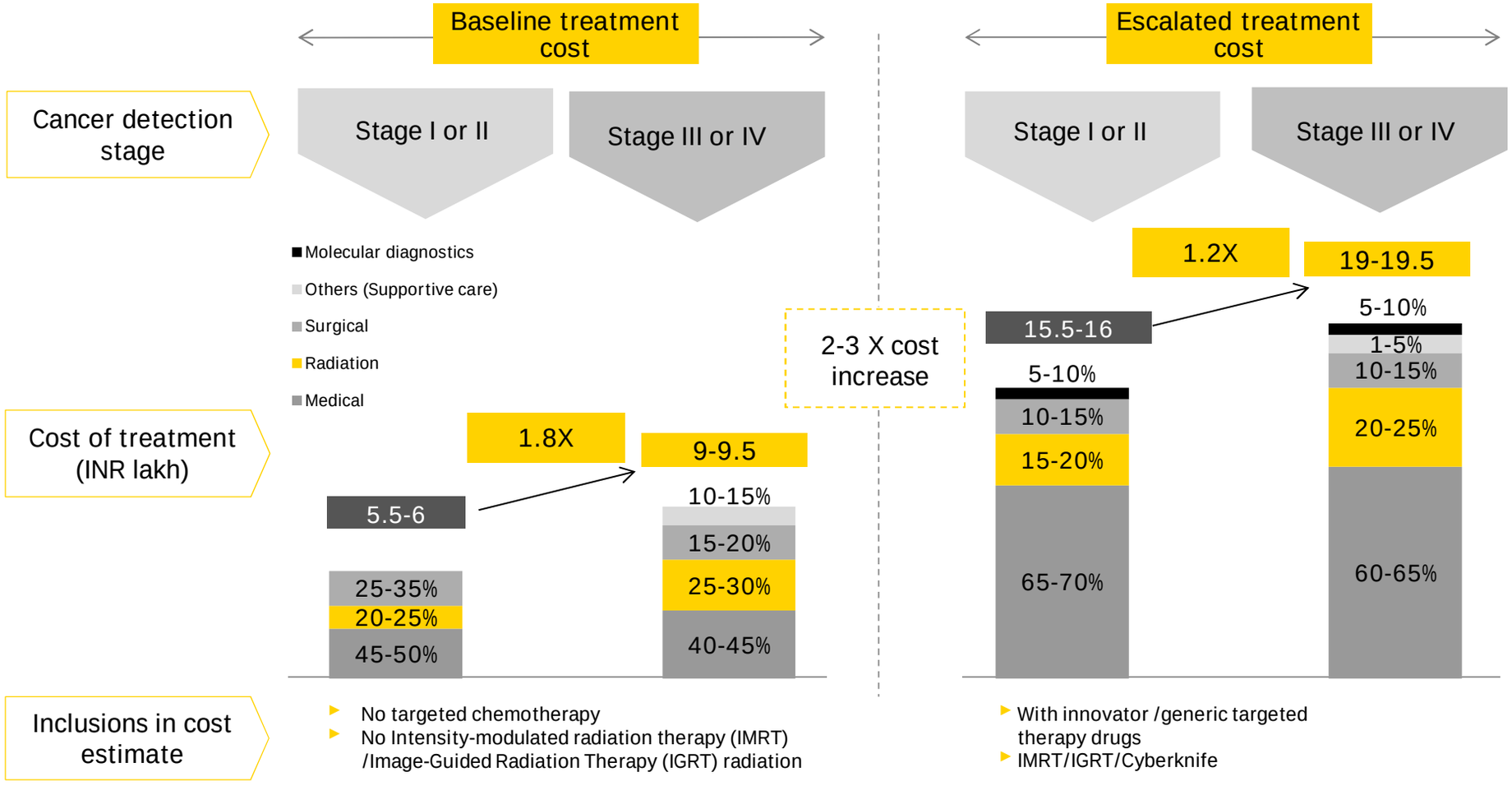
2 Cost of treatment increases 1.5-2 times in late detection cases making treatment unaffordable for more than 90% of the population in India

3 While GOI efforts are ongoing to provide UHC for more than 60% of population of India over the next 3-5 years, w.r.t. coverage for cancer care, there is need to focus on ensuring:

- Coverage for optimal sum assured, which is based on the principles of offering multi-modal treatment options including advanced therapies that are focused on improving outcomes
- Effective utilization of private provider capacity, which represents 70% of the treatment facilities for comprehensive cancer care in India

4 Penetration of targeted therapy drugs which have high efficacy is low in India due to 3-4 times escalation in treatment cost on account of high prices. Drug price controls in India do not drive right pricing for targeted therapy drugs as there is no mechanism for performing comprehensive cost effectiveness studies (including efficacy, safety and cost parameters) before determining drug prices

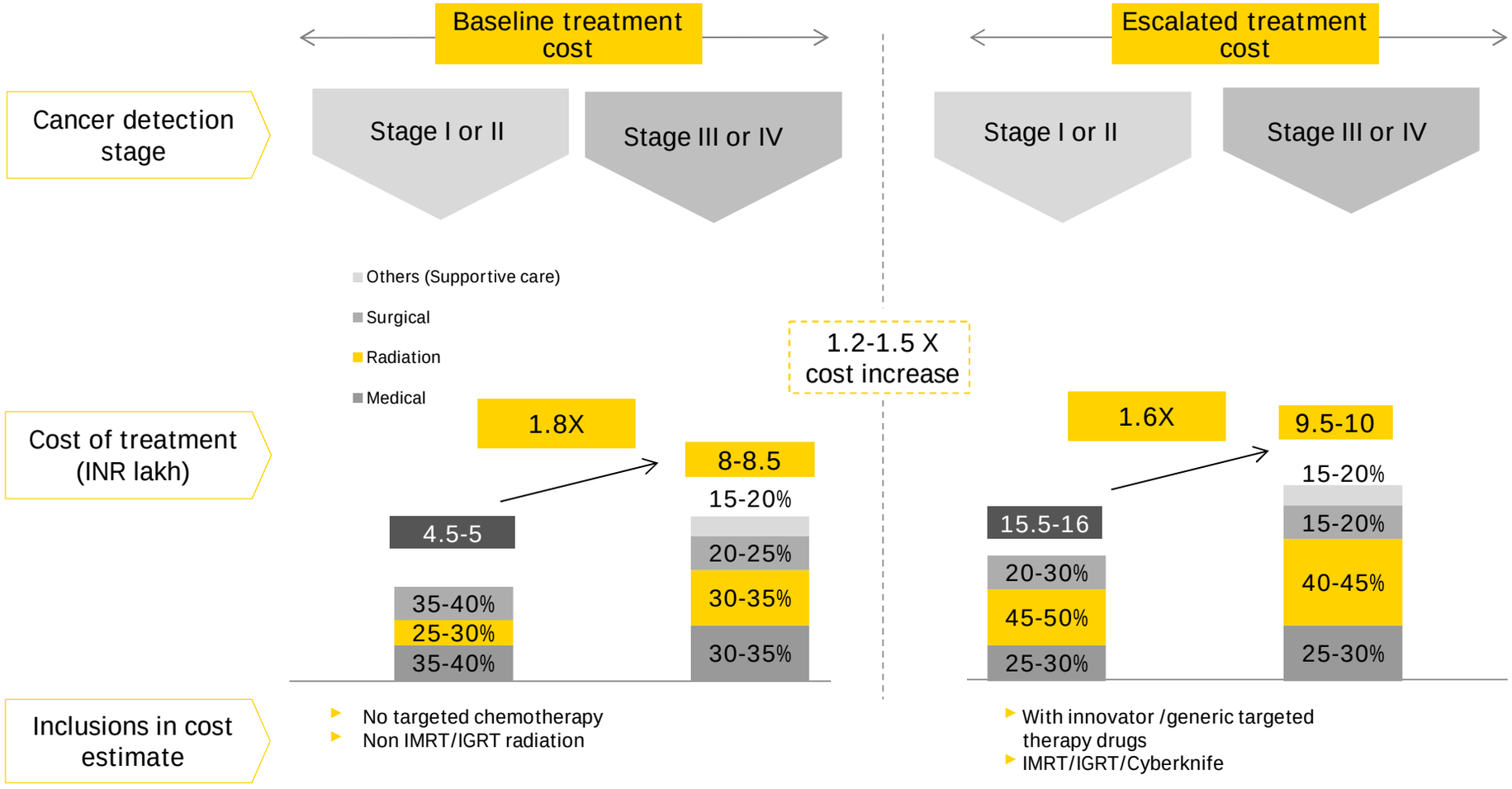
Analysis for breast cancer treatment cost at a leading private hospital highlights 1.5-2 times escalation due to delayed detection and 2-3 times escalation to avail advanced therapies



Patients typically prefer treatment in private hospitals (> 50% of patients surveyed) for cancer care, based on findings from surveys conducted and analysis of service utilization of popular government schemes such as Arogyasri

Source: Primary discussions with a leading private COE for cancer care in India, EY analysis

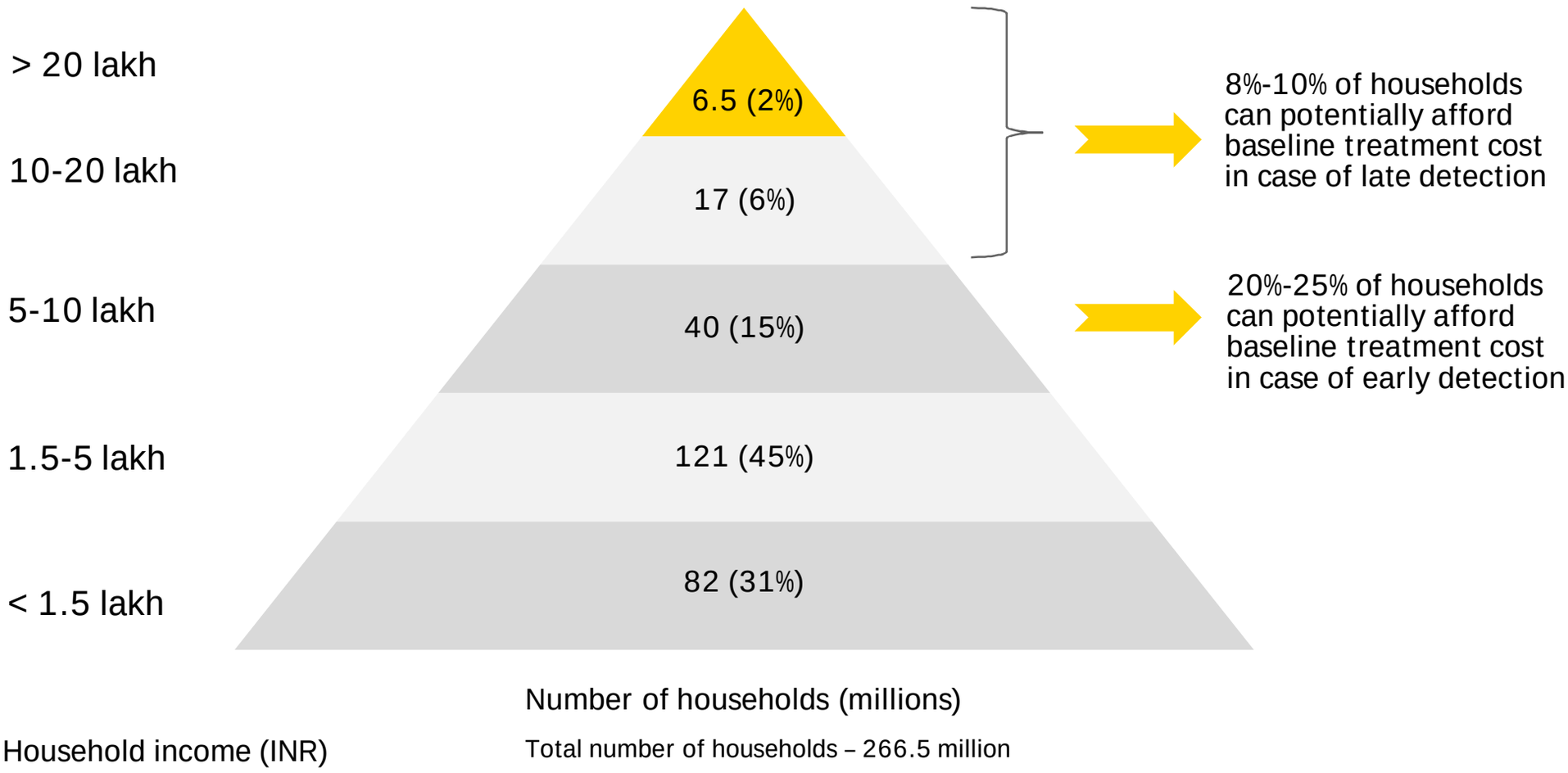
Similar analysis for cervical cancer treatment cost highlights ~2 times escalation due to delayed detection and ~1.5 times escalation to avail advanced therapies



Patients typically prefer treatment in private hospitals (> 50% of patients surveyed) for cancer care based on findings from surveys conducted and analysis of service utilization of popular government schemes such as Aarogyasri

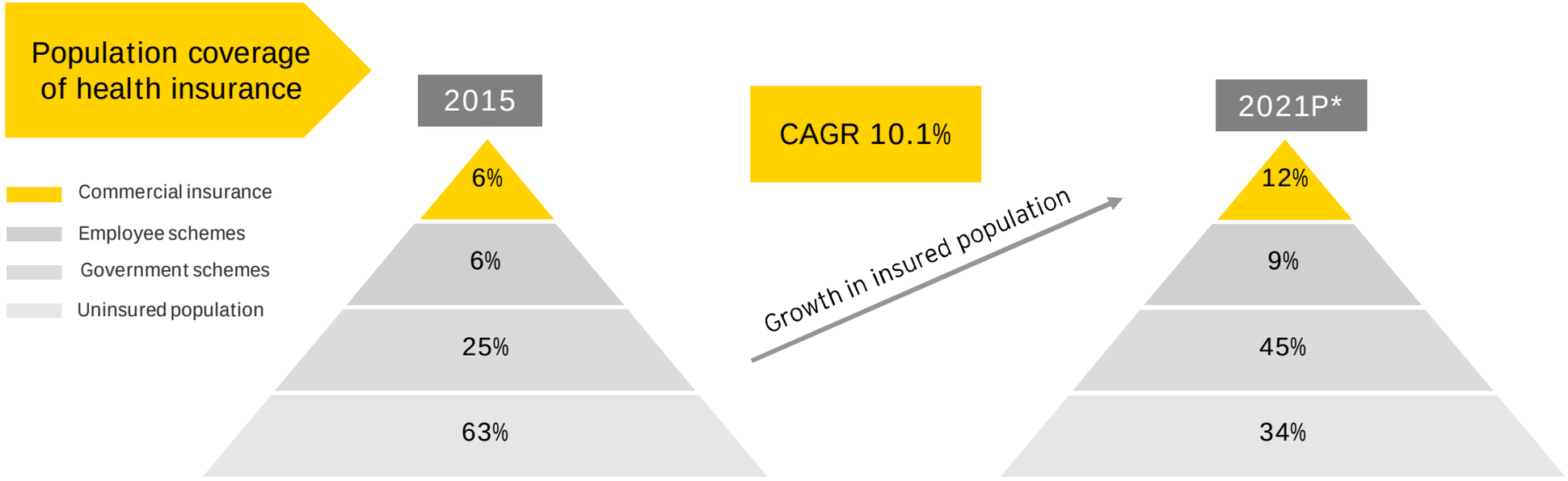
Source: Primary discussions with a leading private COE for cancer care in India, EY analysis

>75% of households in India have income less than baseline treatment cost for early stage cancer and only ~10% households can potentially avail treatment for late stage cancers



Source: IRS, Euromonitor

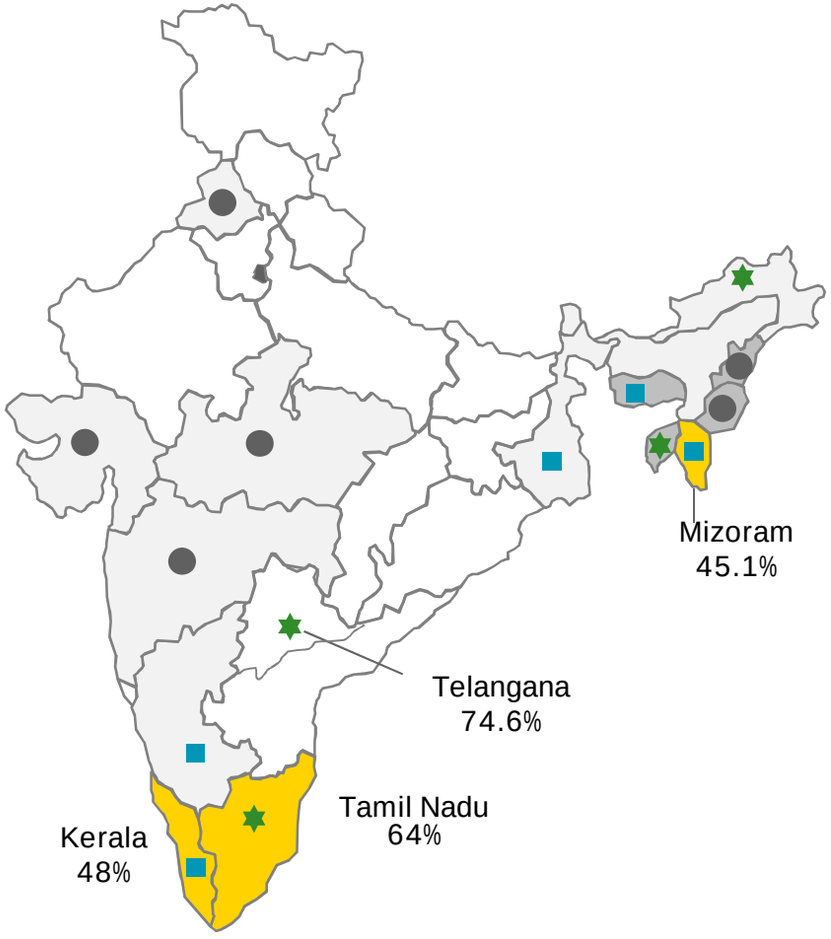
While ~37% of the population is covered by some health scheme or insurance, the Government's Universal Health Coverage is likely to result in coverage for >60% of the population in the next 5 years



6%	Commercial insurance includes cancer coverage by specific policies like ICICI Cancer Plus, Cancer Patients Aid Association (CPAA).Only critical illness coverage in case of general medical insurance policies allow for cancer reimbursement[5,95]
6%	Employee schemes offer reimbursements at CGHS/AIIMS rates[91]
25%	"Government schemes" include central government health insurance scheme[92] such as RSBY (Rashtriya Swastha Bima Yojana) and state sponsored health schemes in Andhra Pradesh, Telangana, Gujarat, Tamil Nadu, Kerala, Chhattisgarh, Jharkhand, Goa, Maharashtra, West Bengal, Rajasthan and Uttarakhand

CAGR: Compound annual growth rate measures growth over multiple periods by compounding, *Projected population coverage of health insurance
Source: IRDA Annual Report 2015-16, EY Analysis, NHP 2015

There is a sizeable geographical skew in the penetration of insurance with states having moderate cancer incidence, viz., Maharashtra, Gujarat, Punjab and MP having low penetration



Note : Figures on the map indicate %age of health insurance penetration
Source: NFHS 4 2015-16, NCRP PBCR reports, EY analysis M.P.- Madhya Pradesh

Overall crude incidence level for females	Health insurance/scheme penetration
High	High (>50%)
Moderate	Medium (25%-50%)
Low	Low (<25%)
No data	

Penetration of health insurance in India is significantly low as out of 29 states only 13 have >25% insurance/scheme penetration and only 5 states have more than 50% penetration

While Mizoram, Tamil Nadu and Kerala have high cancer incidence level for females, these states also have >45% penetration of health insurance schemes, making cancer treatment affordable for larger population groups compared to other states

Tamil Nadu has achieved 64% insurance penetration with state level schemes such as Chief Minister Comprehensive Health Insurance Scheme (CMCHIS)

A study of key central and state government health schemes highlight variations in service coverage for cancer treatment with most schemes reimbursing <50% of private hospital cash tariffs (1/2)

	Scheme specifications	Synopsis of cancer coverage	Package rates as % of cash tariffs*
Aarogyasri (Telangana)[47]	▸ Cover: INR2 lakh per family ▸ Empanelled hospitals: Public: 343, Private: 552 ▸ 17 cancer institutes	▸ All modalities are covered. Limited coverage of surgeries for women-specific cancers. Cap of INR30,000 on palliative chemotherapy ▸ Includes advanced radiotherapy treatment (IMRT, SRS, SRT)	▸ Medical oncology: 33% of cash tariffs ▸ Surgical oncology: 21% of cash tariffs ▸ Radiation oncology: 45% of cash tariffs
MA Yojna (Gujarat)[48]	▸ Cover: INR2 lakh per family ▸ Empanelled hospitals: Public: 21, Private: 96 ▸ 10 cancer institutes	▸ All modalities are covered ▸ Includes advanced radiotherapy treatment (Cyber Knife, Gamma Knife, IMRT, IGRT, SRS, SRT) ▸ Includes targeted therapy	▸ Medical oncology: 29% of cash tariffs ▸ Surgical oncology: 17% of cash tariffs ▸ Radiation oncology: 44% of cash tariffs
CMCHIS (T.N.)[49]	▸ Cover: INR1 lakh per family (INR2 lakh for cancer) ▸ Empanelled hospitals: Public: 209, Private: 537 ▸ 15 cancer institutes	▸ All modalities are covered ▸ Includes advanced radiotherapy treatment (IMRT, IGRT, SRS, SRT) ▸ Limited coverage of targeted therapy	▸ Medical oncology: 33% of cash tariffs ▸ Surgical oncology: 17% of cash tariffs ▸ Radiation oncology: 58% of private tariffs
Sukrutham (Kerala)[50]	▸ Cover: INR3 lakh ▸ Empanelled hospitals: RCC, MCC and medical colleges in Kerala	▸ All modalities are covered. ▸ Includes advanced radiotherapy treatment (IMRT, VMAT, IGRT, SRS, SRT) ▸ Includes targeted therapy	▸ Details not available
Yeshasvini (Karnataka)[51]	▸ Cover: INR1.25 lakh – INR2.50 lakh ▸ Empanelled hospitals: 725 ▸ 5 cancer institutes	▸ Surgical and radiation oncology are covered. Chemotherapy is excluded ▸ Excludes targeted therapy drugs ▸ Includes advanced radiotherapy (IMRT)	▸ Medical oncology: Not covered ▸ Surgical oncology: 19% of cash tariffs ▸ Radiation oncology: 29% of private tariffs

* Cash tariff of private hospitals

A study of key central and state government health schemes highlight variations in service coverage for cancer treatment with most schemes reimbursing <50% of private hospital cash tariffs (2/2)

	Scheme specifications	Synopsis of cancer coverage	Package rates as % of cash Tariffs*
Central Government Health Scheme[91] (CGHS, 1954)	▸ Re-imbursement / cashless treatment at empanelled hospitals	▸ All modalities are covered ▸ Includes advanced radiotherapy treatment (IMRT, IGRT, SRS, SRT) ▸ Includes targeted therapy	▸ Medical oncology: 100% for drug charges, 20%-25% reimbursement for facilities (room, bed ,nursing charges, etc.) ▸ Surgical oncology: 23% of private tariffs ▸ Radiation oncology: 65% of cash tariffs
Rashtriya Swasthya Bima Yojana[92] (RSBY, 2008)	▸ Cover of INR30,000 p.a. per family ▸ Empanelled hospitals: Public: 3,771, Private: 4,926	▸ All modalities are covered. Limited coverage of surgeries for women-specific cancers ▸ Excludes advanced radiotherapy treatment and targeted therapy	▸ Medical oncology: 11% of private tariffs ▸ Surgical oncology: 21% of private tariffs ▸ Radiation oncology: 21% of private tariffs

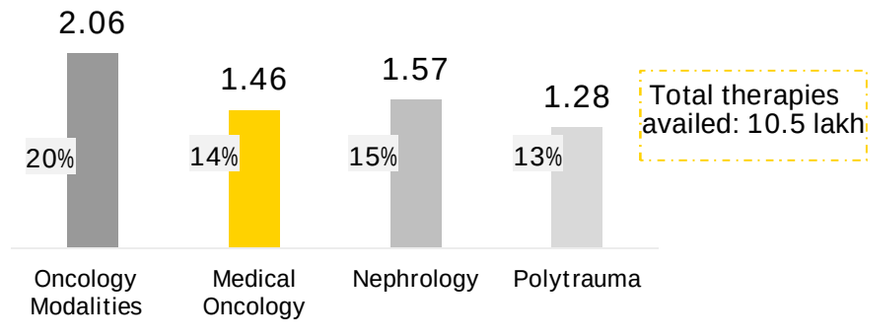
Key comments

- Government schemes such as Aarogyasri (Telangana, AP) or RSBY (pan India) have penetrated deeply in their respective coverage areas in terms of enrollments and empanelled hospitals but state schemes of Gujarat and Tamil Nadu appear to serve as better 'model schemes' in terms of comprehensiveness in coverage of cancer treatment modalities and reimbursing use of advanced technology
- Kerala is the only state that has a cancer specific scheme with special focus on type of treatment providers. Launched in 2014, Sukrutham includes comprehensive modalities and advanced technology usage but its coverage and utilization is yet to be analyzed in the coming years. In addition, there are other support schemes such as the Comprehensive Health Insurance Scheme (CHIS) with wider coverage in Kerala

Case study: Impact of Rajiv Gandhi Aarogyasri Health Insurance Scheme on cancer care affordability in Andhra Pradesh and Telengana

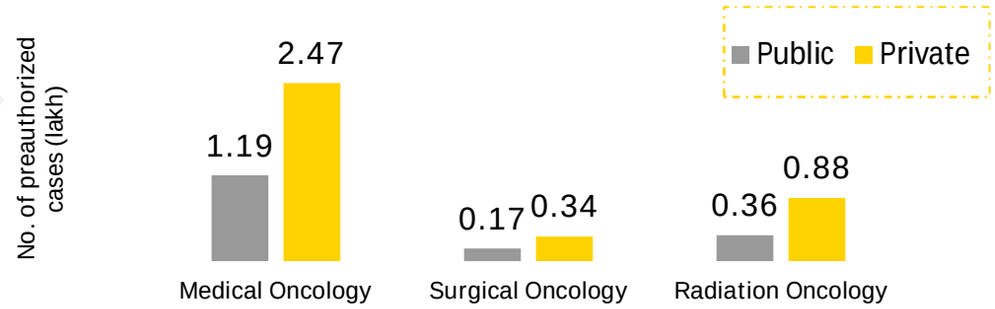
- Based on analysis of cases pre-authorized under Aarogyasri since the launch of the scheme in 2007 till date, it has been observed that oncology is the highest availed treatment under the scheme across the state till date[47]
- Medical oncology is the highest availed modality for treatment under the scheme[47]

Top therapies availed under Aarogyasri



- Private hospitals have higher availment under the scheme for cancer treatment compared to public hospitals[47]
- Services at public hospitals are less availed due to limited resources and management, poor maintenance of equipment, non-compliance with protocol guidelines (example: basic provision of food for inpatient is not adhered to in some public hospitals)[91,94]

Cancer therapies in public v/s private hospitals



- Government health schemes have the potential to improve access to cancer treatment as has been demonstrated by the Aarogyasri scheme
- However, the scheme lacks focus on ensuring utilization of multi-modal treatment options for improving patient outcomes (demonstrated by >65% patients availing medical oncology and <25% patients availing radiation therapy)

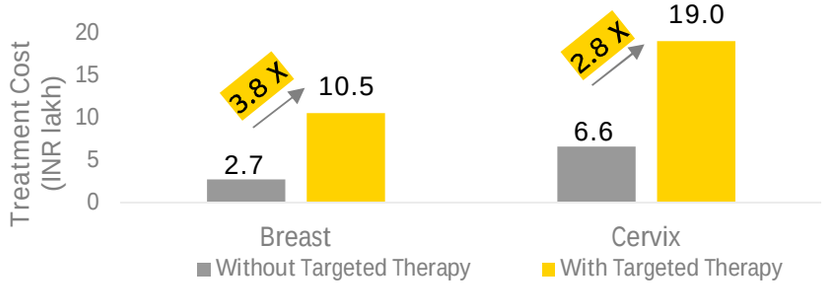
Source: Telangana Aarogyasri Website

While measures have been taken to introduce price control for targeted therapy drugs in India, however cost of treatment using targeted therapy is still not affordable for Indian patients

Cost of targeted therapy drugs[5]

Drug	Trastuzumab	Bevacizumab	Cetuximab
Target Site	Breast	Cervix and Ovary	Head & neck
MRP per vial (INR)	~57,000 (440mg)	~29,000 (100mg)	1,01,000 (500mg)
# cycles	~18	~7	~8
# vials per cycle	~1	~9	~1
Treatment cost (INR)	9 to 10 lakh	19 to 20 lakh	6 to 7 lakh

Cancer treatment cost with targeted therapy[5]



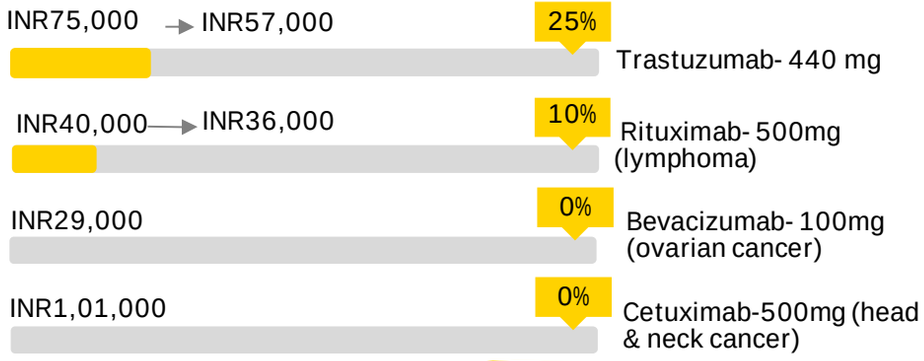
- While targeted therapy drugs increase cost of treatment by 3-4 times, the relative efficacy is significantly better with targeted drugs. A study of targeted drug Trastuzumab vs. other anti-cancer treatment drugs proved that progression free survival improved by 88% by using Trastuzumab[96]

Penetration of targeted therapy in India

- In India ~5,000 patients i.e only 1 out of the potential 7 HER +ve breast cancer cases avail targeted therapy

- Currently, only 7% of the potential #cycles (~6,00,000) of Trastuzumab are performed[5]. Refer annexure 13 on methodology for determining penetration.
- On account of high drug cost, patients either do not avail or do not complete the entire treatment regime for the drug (6-8 cycles per patient out of 18 cycles required)[5]

Price reduction (%) made by NPPA for targeted therapy drugs[5,97]



Although Trastuzumab and Rituximab have been included in NLEM list since 2016; however, price reduction of these targeted therapy drugs has been restricted to 10%- 25%

Treatment: Monitoring and surveillance

1 Registries help in monitoring and evaluating the effectiveness of cancer control programs for primary prevention, early detection, treatment and care and the surveillance information gathered by the registry forms a key part of planning the cancer control strategy

2 Reporting by Indian cancer registry networks needs to be strengthened and made comprehensive to include key outcome and quality parameters to improve surveillance and monitoring of cancer interventions in India

Registries and surveillance information form a key part of cancer prevention and control efforts

Cancer surveillance is the ongoing, timely, and systematic collection and analysis of information on new cancer cases, extent of disease, screening tests, treatment, survival, and cancer deaths

Cancer surveillance sources		
	Hospital based cancer registry	Administrative, review clinical performance
	Pathology based cancer registry	Snapshot of cancer profile
	Population-based cancer registry (PBCR)	Actions aimed at reducing the cancer burden

PBCRs have a unique role in planning and evaluating cancer control programs:

- Monitor cancer trends over time
- Look for cancer patterns in different groups of people
- Guide planning and evaluation of cancer control programs (Measure effectiveness of prevention, screening, and treatment efforts)
- Help set priorities for allocating health resources
- Conduct advanced clinical, epidemiologic, and health services research

Population-based cancer registries are helpful in evaluating the effectiveness of cancer control programs along the cancer pathway

Primary prevention[99]

- Comparison of observed versus the expected incidence rates (based on the predictive model considering the intervention)
  - Success of tobacco intervention program
  - Impact of implementation of immunization program

Early detection and screening[99]

- Screening programs should result in higher incidence rates (as prevalent, asymptomatic cases are detected), and eventually start falling with time
- No reduction in the incidence in programs detecting early invasive cancers

Cancer treatment and care[99]

- Population level survival trends provide an indication of the possible role of the process of diagnosis and care

While Indian registries have focused on reporting of incidence and mortality, there is need to also report and monitor key outcome measures such as 5-year survival rates

Parameter[100-105]	Significance	India					USA					UK					Sri Lanka				
		G	A	S	R	St	G	A	S	R	St	G	A	S	R	St	G	A	S	R	St
Cancer Incidence	Helps in formulating plans for most critical areas of cancer control.	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü
Mortality	Programs can be designed specific to gender/ age/ site/ region	ü	ü	ü	ü	X	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	X	X
Projection of Incidence	Provides guidance for the rational allocation of health resources	ü	X	ü	ü	-	ü	ü	ü	ü	-	ü	ü	ü	ü	-	X				
5-year Survival Rates	Helps in assessment of effectiveness and quality of treatment provided to patients	X					ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	ü	X	X
							5 years					1, 5, 10 years					1 year				
Quality Parameters	These parameters help in establishing the validity of the reported data	MV % - ü					MV % - ü					MV % - ü					X				
		M:I % - ü					M:I % - ü					M:I % - ü					X				
		DCO %- X					DCO % - ü					DCO % - ü					X				
		-					-					SRR - ü					X				

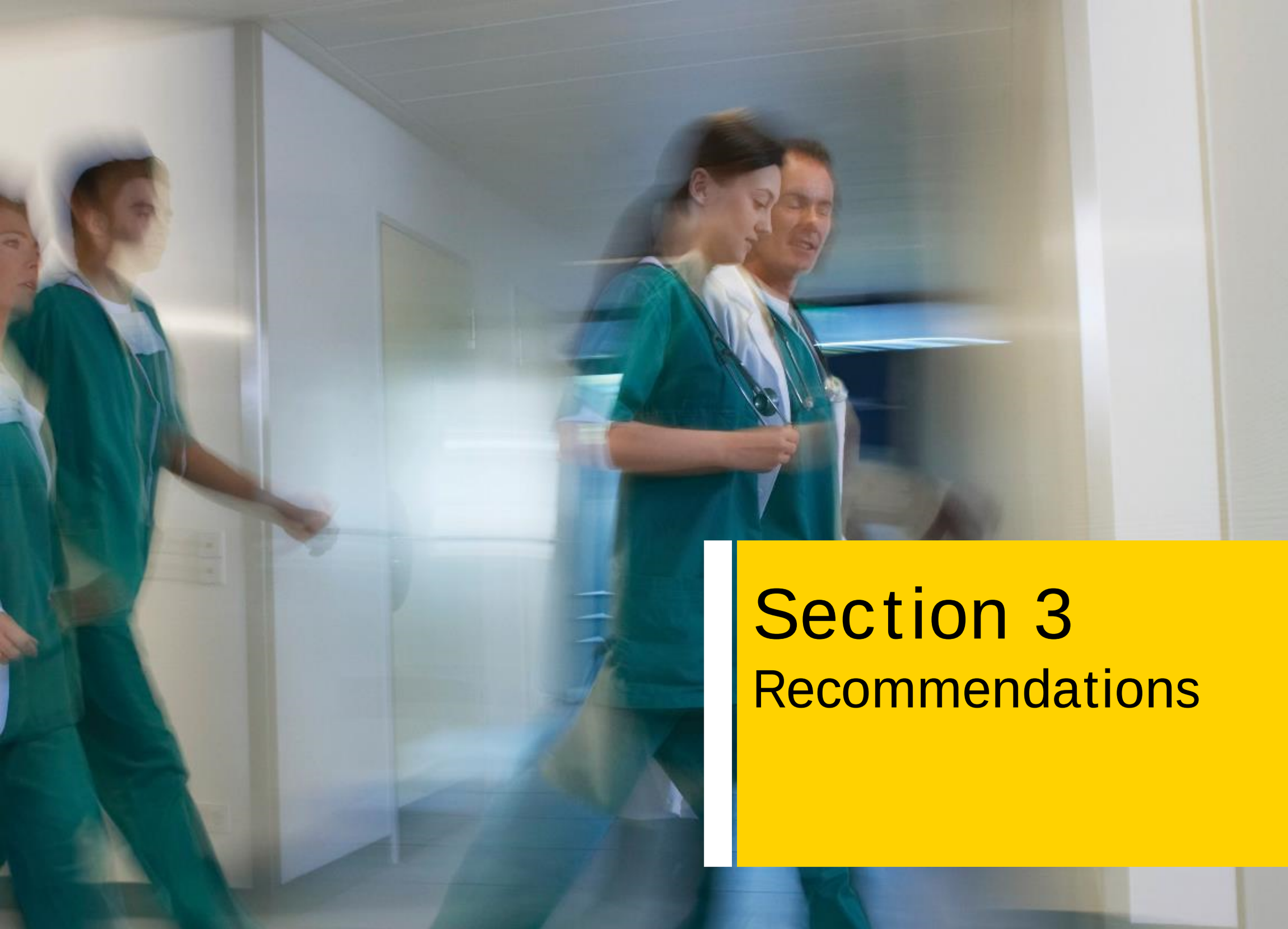
G - Gender
A - Age
S – Site
R - Region

St - Stage
MV% - % of cases with morphologically verified diagnosis
M:I % - mortality-to-incidence ratio

DCO % - Death Certificate Only
SRR - Standardized Registration Ratio
ü Reported
X Not reported

At the same time there is also need for hospital based registries to report and monitor key quality parameters that measure the quality of care offered to patients

Parameter[100-105]	Significance	India	USA	UK	Sri Lanka
Treatment offered	Access to various treatments for patients across various population group	ü	ü	ü	ü
30-day mortality post-surgery/ radiation/ chemotherapy	Provides effectiveness of surgery/ treatment conducted on patient	X	X	ü	X
Post-surgery morbidity	Provides effectiveness of surgery/ treatment conducted on patient	X	X	ü	X
Response rate to chemotherapy	Helps in understanding effectiveness of chemotherapy for treatment	X	X	ü	X
Acute & chronic toxicity post radiotherapy & chemotherapy	Helps in monitoring and treating side-effects across population group	X	X	ü	X



Section 3
Recommendations

Awareness: Focus on primary prevention measures

1 Key imperatives	Proposed actions	Action by
Promote awareness on healthy behaviour, symptoms, screening practices and financing options ▸ WHO estimates that 40% of total cancer cases are preventable by addressing risk factors such as tobacco consumption, dietary habits and infectious agents. ▸ Various studies have demonstrated that Indian population exhibits low awareness on knowledge of risk factors (20%-45% for breast and 7%-19% for cervical across studies), symptoms (7%-22% for breast across studies), screening and financing options. ▸ Even among medical professionals (nursing staff), awareness and acceptability of screening methods is found to be low in India	▸ A Nodal Agency within the Ministry of Health should be instituted to identify, plan and coordinate prevention actions ▸▸ The agency should perform a systematic assessment of cancer risk factors at the country level. This will help in creating good quality and comparable country-level data. This will be key to set priorities for evidence-based allocation of scarce resources.	Central Government
	▸ Mass media campaigns in India should focus on management of risk factors such as obesity, reproductive factors, infectious agents and pollution in addition to tobacco and smoking prevention	Central Government
	▸ Emphasis should be on training of healthcare workers at PHCs, CHCs and local NGOs to provide continuous education to women regarding breast self examination, safe sex practices and genital hygiene	Central and State Government
	▸ Formal creation of patient groups (online cancer blogs, social media groups) to share experiences, testimonials and encourage community participation.	Private Health Care providers NGOs

Vaccination: Evaluate adoption of HPV vaccines in adolescent girls by technical experts to decrease cervical cancer incidence over time (1/3)

2 Key imperatives	Proposed actions	Action by
Evaluation by technical experts of HPV vaccination in Indian context <u>A) Medical skepticism</u> ▸ Concerns regarding safety and efficacy of the vaccine especially in the Indian context along with relatively lower cost effectiveness has led to some experts favoring only VIA screening (CER: INR1,320 per YLS) over vaccination plus screening (CER: INR7,786 per YLS)	▸ While a large scale study in Finland is expected to establish efficacy of HPV vaccine against cervical cancer by 2020, early adopters of the vaccine such as Australia are already observing positive impact in reduction of cervical cancer-related factors. Accordingly efforts should be undertaken for: ▸ Sanctioning of India specific studies to be done by ICMR to reinforce the efficacy of HPV vaccines for Indian context ▸ Establishment of a nation wide surveillance programme, on the lines of the National Polio Surveillance Project (NPSP), for measuring the progress of the campaign along with identifying areas with high incidence and helping devise area-specific strategies to reduce the incidence	Central Government

CER: Cost effective ratio, YLS: Years of life saved

Vaccination: Evaluate adoption of HPV vaccines in adolescent girls by technical experts decrease cervical cancer incidence over time (2/3)

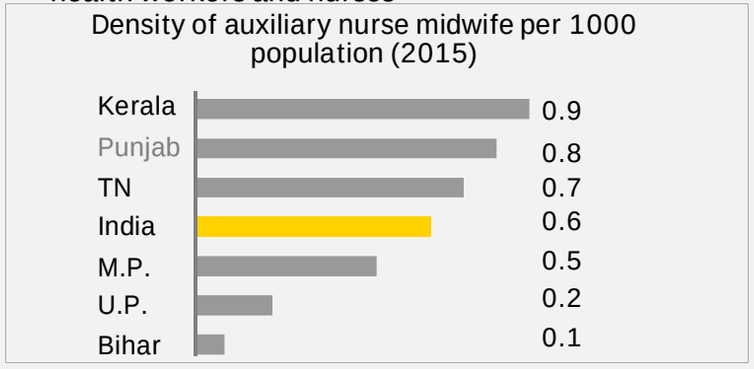
2

Key imperatives

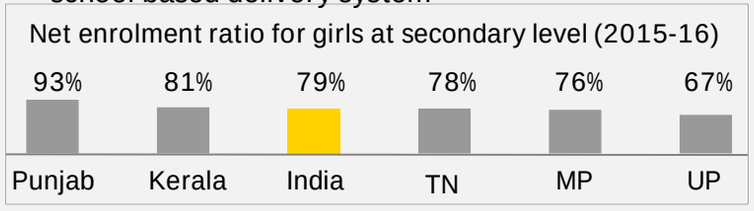
Evaluation by technical experts of HPV vaccination in Indian context

B) Financial and operational constraints

- Cost of the program is estimated to be INR800-850 crore per annum (8%-9% of projected 2017 immunization budget)
- High geographic variation in availability of trained health workers and nurses



- Low net-enrolment ratio* posing a challenge to school based delivery system



Proposed actions

- Phase wise implementation of program
  - First phase should focus on high incidence states with strong infrastructure to deliver vaccination and screening viz. Delhi, Karnataka, Maharashtra, Tamil Nadu, and Punjab with an estimated annual cost of Rs 150-200 crore. Learnings from implementation in phase 1 states can be replicated in the subsequent phases
- Funding support from non-governmental international organizations such as Rotary international (Pulse polio campaign, India), Australian Cervical Cancer Foundation (Bhutan HPV program), Bill and Melinda Gates Foundation
- Private-public-partnerships with private healthcare providers should be incentivized through benefits such as subsidies, tax rebates, etc. for expanding coverage and participation
- Focus should be on a combination of school and community based delivery system to ensure higher coverage vis-à-vis only community based systems
- Strategies such as vaccination days, house-to-house vaccination, identification of missed children and integration into NRHM should be adopted

Action by

Central Government

State Governments

NGOs

Health Care providers

*Net enrolment ratio: Ratio of number of pupils of official secondary school age range enrolled in secondary education and total children of the age group

Vaccination: Evaluate adoption of HPV vaccines in adolescent girls by technical experts decrease cervical cancer incidence over time (3/3)

2 Key imperatives	Proposed actions	Action by

Evaluation by technical experts of HPV vaccination in Indian context
 	
<u>C) Socio-cultural barriers</u>
► Low awareness about the HPV infection and cervical cancer
► Socio-cultural barriers and stigma associated with vaccination and cervical cancer
► Lack of political will for tackling the challenge of cervical cancer
	► National level social mobilization should be launched to spread awareness and advocacy involving the right stakeholders at right levels:
	  ► Collaboration between health ministry and education ministry for ensuring active participation of school authorities
	  ► Engagement of key opinion leaders at grass root levels (such as village sarpanch) for advocacy
	  ► Collaboration with international agencies such as WHO, UNFPA and with non-governmental agencies such as Rotary International and Bill and Melinda Gates Foundation for communication strategies and advocacy plans
	  ► Leveraging of key opinion leaders from the medical fraternity for national and regional campaigns on mass media
	► Inclusion of benefits of sexual hygiene, awareness on risk factors and lifestyle modifications should be encouraged in health education curriculum at school level
		Central Government

Screening: Ensure implementation of the national population based screening policy by bridging capacity and capability gaps in public health systems

3

Key imperatives

Enable implementation of population based screening and referral program for breast, cervical and oral cancers in line with defined policy by bridging gaps in public infrastructure and human resource capacity

- Top 7 states in terms of crude incidence for breast and cervical cancers have low coverage for breast and cervical examination with poor human resource capacity at public facilities

*per 1 lakh women

States	Crude incidence rate* (% pop. undergone examination)		Human resource	
			SC/PHC	CHC
	Breast	Cervical	ANM	Obs/ Gynaec
Norm	-	-	0.40	0.60
AS	14.7 (6%)	8.8 (6%)	0.31	0.19
KL	40.5 (33%)	9.1 (61%)	0.45	0.11
KA	29.3 (12%)	13.1 (14%)	0.22	0.42
MP	28.2 (10%)	11.3 (24%)	0.21	0.14
MH	19.1 (22%)	14.4 (43%)	0.18	0.18
PU	34.2 (21%)	11.8 (38%)	0.26	0.37
TN	40.6 (15%)	16.7 (23%)	0.20	0.13

Below 50% of norm Between 0-50% below norm As per norm

Proposed actions

- Center should incentivize state government's share of allocation to increased budget outlay (25%) for screening under NPCDCS (Budget outlay increased from Rs 3 Cr/district to Rs 10.5 Cr/district) based on objective parameters-
  - Early completion of population coverage goals under screening guidelines
  - Improvement in rate of early detection for cervical, breast and oral cancers
  - Effective surveillance and monitoring of screened patients through care continuum (Screening à Referral à Treatment à Supportive care)
- Public private partnerships with private health care providers/ medical devices companies/ pharma companies/ non-governmental agencies to adopt villages for -
  - Providing screening facilities in line with government policy/ leverage technology and digital platforms to improve screening/diagnosis accuracy
  - Creating a robust referral model for specialist consultation/access to multi-modal tertiary care treatment
  - Maintaining health records of screened population to enable tracking and monitoring of referrals and treatment compliance

Action by

Central and State Governments

State Government, Private Health Care Providers, Medical technology companies, Pharmaceutical companies

Biocon Foundation's PPP in Karnataka and Rajasthan, demonstrates impact on screening coverage by addressing gaps in public health delivery and utilization of technology

Transformation of primary health centers (PHCs) to conform with the IPHS[5]	eLAJ clinics transforms the PHCs into a comprehensive single point treatment center through upgradation of infrastructure, installation of diagnostic centers and recruitment and training of health workers and other support staff to ensure the PHC is running as per Indian Public Health Standards (IPHS)

2015 — First eLaj clinic established in Karnataka

14 — eLaj clinics currently operational in Karnataka and Rajasthan

15 — PHCs to be further transformed in Karnataka (2017 MoU)

1.1 lakh — Annual footfall

Utilization of EMRs[5]	Each eLaj clinic has its own electronic medical records (EMRs) mapped to a unique ID to ensure continuum of care and planning for need based healthcare programs by healthcare administrators
Screening and awareness creation for cancer detection and treatment[5]	▸ Coverage for screening of common cancers, i.e., cervical - >3,000 women, breast - >1,700 women and oral - >10,000 persons. Door-to-door awareness campaigns on risk factors, symptoms and treatment are conducted by community health workers utilizing specially designed awareness aids such as flipcharts, pamphlets and standees ▸ Patients with cancer or those who require further examination or treatment (cryotherapy, LEEP, etc.) are then referred to tertiary care centers
Utilization of novel technology for expanding screening coverage[5]	▸ The breast cancer screening program is run in association with UE Life Sciences using a handheld device (iBreastExam), which is used to identify high risk women who are then referred for ultrasounds/mammograms at tertiary care centers ▸ Oral cancer screening is done through mobile phone based health (mHealth) program wherein remote specialists view pictures and information using mobile app to identify patients with pre-cancerous lesions. High risk patients are then referred to nodal centers for further examination
Financing treatment through micro insurance schemes[5]	Arogya Raksha Yojana (ARY), launched in 2004, is a comprehensive health insurance plan, that offers people in rural areas support for surgeries (up to INR1 lakh) at a network of hospitals at a premium of INR200-300 per annum. Till date about 4,000 claims have been settled

Apollo Hospitals' integrated health and wellness program in rural AP highlights the role private providers can play in bridging capacity gaps in public health systems

Total Health Program covering 70,000 people across 195 villages[5]	"Total Health Program" focusing on total wellbeing of an individual inclusive of physical health, with special emphasis on non communicable diseases (NCDs) – namely, breast, cervical and oral cancer – along with mental, social, spiritual, ecological and economic wellbeing of the community through their journey from "womb to tomb"

Physical health	Social and mental health	Economic health
Preventive & curative health care ►Screening (bi-weekly camps) ►Diagnosis and treatment (referral) Infrastructure: Reach hospital, 2 mobile clinics, 2 satellite clinics	Education: "Apollo Isha Vidya Rural School" for 500 students providing quality education for the community Encouraging sports & yoga: 4 acre sports facility with yoga hall, community center	Skill development and vocational training : Over 600 women trained in stitching / apparel making / jute Products / beauty parlour ► 50% self-employed, 10% wage employed

Primary prevention through awareness and social infrastructure[5]	• Awareness camps and workshops on cancer prevention and screening in the villages through Apollo's outreach staff , SHG groups, retired ASHA workers, women employed in Nutrition Centers etc. • Infrastructure support for WASH (Water, Sanitation & Hygiene): 6 water treatment plants supporting 18,000 people; 700 toilets provided along with gram panchayats
Screening camps[5]	• More than 30,000 people screened for NCDs • Cervical cancer screening conducted by skilled nursing staff trained by specialized team of doctors from Chennai . Through the village outreach approach method, the aim is to screen all married women in the villages
Referral system: hub & spoke model for healthcare[5]	• Cases suspected positive after screening at community level - through camps, satellite clinics & mobile clinics are referred for further evaluation and treatment to Government General Hospital, Chittoor, which is under Apollo Institute of Medical Sciences & Research.

Treatment: Improve access to radiation therapy through measures for reduction in capital cost of equipment

4

Key imperatives	Proposed actions	Action by
Improve access to radiation therapy as a key measure to improve clinical outcomes through multi-modal treatment ▸ Only 15%-20% of patients in India have access to radiation therapy compared to international guidelines of 50%-60% ▸ <20% of LINAC installations are in public hospitals ▸ Geographical distribution of LINACs is not aligned with the cancer incidence levels with poor penetration in states such as Tamil Nadu, Karnataka, MP, Gujarat, North East that have moderate to high cancer incidence To offer radiotherapy treatment to 50% of new cancer patients, India needs 1,500-1,600 additional Linac installations at an estimated cost of INR23,500-27,000 crore	▸ Optimization of available technology: Cost effective variants (e.g. 6 MV photon energy) that deliver >90% care and are usually available at 50%-70% of the cost of high end variants should be evaluated and deployed ▸ Focused "Make In India" campaign through a large PPP program: ▸ Commissioning of LINACs in district hospitals and medical colleges - Key enabler could be a large PPP program launched by the Central Government for large scale purchase of Linacs. Learnings can be derived from Ministry of Health Programs in China and Brazil where the governments released tenders for purchase of ~500 and ~80 Linac machines respectively. This drove equipment manufacturers towards indigenous manufacturing in those countries. ▸ Business model innovation: Given the capital intensive nature of cancer care, risk sharing models should be evaluated. Pay for use/subscription models instead of outright purchase can unleash a tremendous fillip to the industry	Private Health Care Providers Central Government Medical technology companies

Treatment: Improve access to chemotherapy drugs through price control and mandatory reimbursement under UHC schemes

5

Key imperatives	Proposed actions	Action by
Drug price policy and generic adoption to sustain and drive strong focus on "cost of care" ▸ Although many cancer drugs have been included in NLEM list, however price reduction of targeted therapy drugs has been restricted to 10%-25% rendering these drugs still unaffordable for a significant part of the population ▸ Some key cancer drugs still not part of NLEM list, e.g., Epirubicin (breast, ovary), Vinorelbine (breast), Liposomal doxorubicine (breast, ovary), Eribulin (breast) and Irinotecan (cervical)	▸ Measures should be taken to control the prices of essential drugs and mandating the adoption of generic generics (considering that drugs represent >50%-60% of treatment cost for chemotherapy). To increase the adoption of generics, an effective quality monitoring regime should be institutionalized to assure product integrity given the current sub-optimal state of regulatory compliance ▸ As part of the UHC agenda, central / state government should aim to reimburse oncology drugs especially targeted therapies as part of their healthcare schemes	Central Government Insurance companies State Governments

Treatment: Encourage evidence based pricing for inclusion of new drug technologies in the National List of Essential Medicines

6

Key imperatives	Proposed actions	Action by
Increase access to beneficial new drug technologies ▸ India got only 7 of the 50 global cancer drugs in the last five years ▸ The disparity in availability of these therapies becomes even more stark over a 10-year period (2006-16), with not even one-third of the 270-odd oncology molecules being available in India	▸ Right regulatory and financing environment including patient assistance programs (by pharma companies) should be facilitated to broaden access to new technologies. ▸ Skilling, scaling up and engaging the Medical Technology Assessment Board (MTAB) should be done along the lines of National Institute of Health and Clinical Excellence (NICE) in the UK or Health Intervention and Technology Assessment Program (HITAP) in Thailand so that each new drug, medical device or technology could be subjected to a detailed and scientific assessment of clinical effectiveness, safety and cost effectiveness and ensure an evidence-based policy process. ▸ Pricing policy for patented drugs should also recognize country context and use reference pricing with appropriate rationalization for purchasing power parity and per capita income	Central Government Pharmaceutical companies Insurance companies

Treatment: Ensure access to "multimodal" cancer care treatment through ramping up of healthcare capacity for delivering comprehensive cancer care

7

Key imperatives

Improve clinical outcomes in terms of disease free survival period and overall mortality by improving access of cancer patients to multimodal treatment options

- Top 9 states in terms of crude incidence for cancers in women on an average have less than 20-35% districts with CCCs that offer multimodal treatment

*per lakh women

States	Crude incidence rate* (All cancers in women)	% districts with comprehensive cancer care centers
KL	143.4	40%-45%
TN	132.3	30%-35%
DL	121.7	25%-30%
KA	106.5	30%-35%
MP	90.4	8-%10%
AS	88.2	8-%10%
MH	77.5	35%-40%
GJ	73	20%-25%
MA	56	10%-15%

- Also populous states such as UP, Rajasthan, Bihar and Orissa have less than 15% of districts with comprehensive cancer care centers

Proposed actions

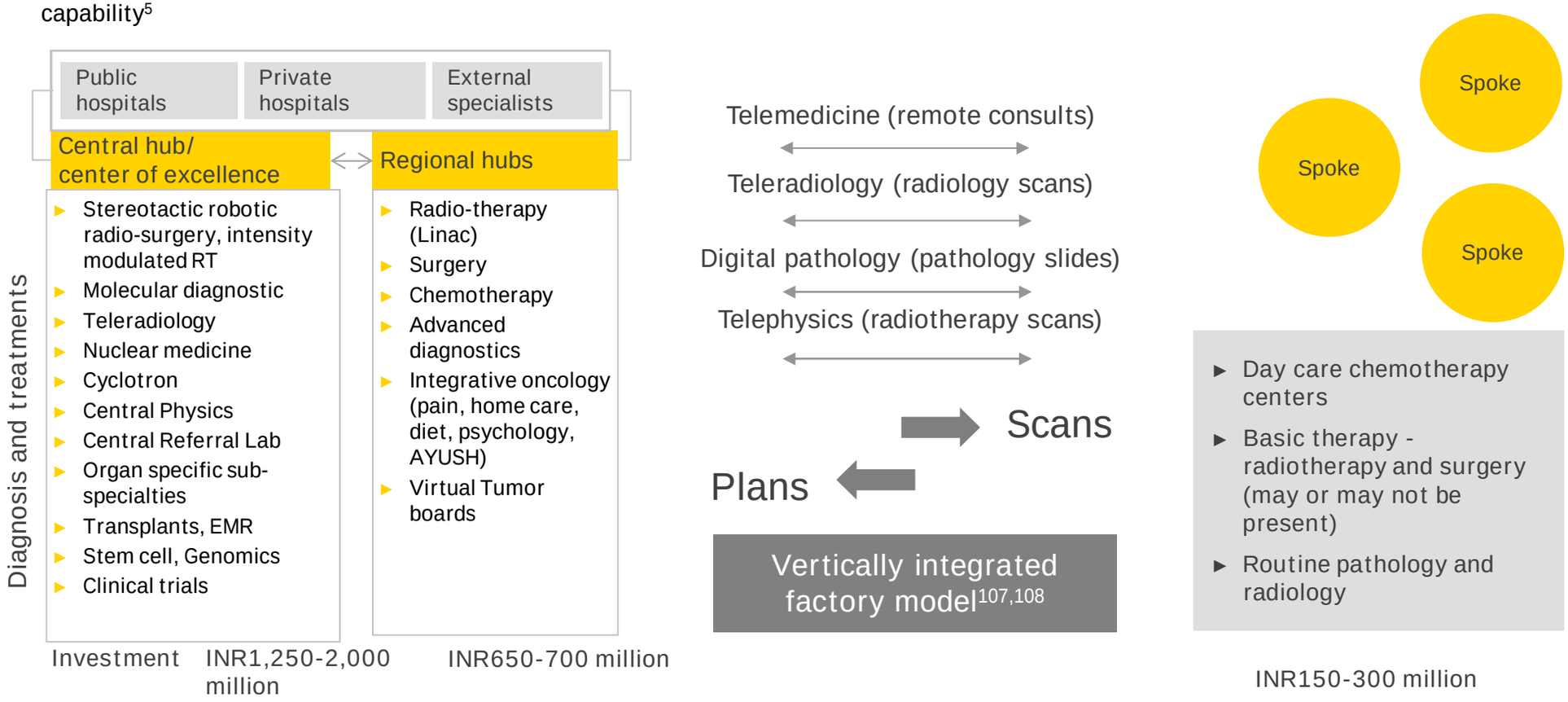
- Investment in comprehensive cancer centers should be promoted. Given the low density per million population of comprehensive cancer care centers (216 in India vs. 860 in the US), there is need for initial focus on states with high cancer incidence and low penetration of comprehensive cancer centers
  - Medical colleges (#470) and select district hospitals (# 760) should be ramped up through investments for delivering comprehensive cancer care
  - Public private partnerships with private health care providers should be forged in these high priority regions as well as in regions with low penetration of public comprehensive cancer care centers such as UP, Bihar, Rajasthan and Orissa for capacity tie ups/operate and manage public assets for treatment and palliative services
- Vertically integrated healthcare delivery models should be evaluated to bridge access gaps where a "central hub" performs high end imaging, therapy and complex procedures and "low cost" spokes provide basic therapy and follow ups in patient's local communities

Action by

Central Government, State Governments, Private Health Care Providers

Health Care Global's (HCG's) hub and spoke model-Innovative integrated delivery care models to take comprehensive care to where the patient is located

- Vertically integrated delivery to bridge acuity of supply is envisaged by a "central hub" called 'center for Excellence' which is equipped with advanced diagnostics and cancer treatment platforms while "low cost" spokes are comprehensive cancer centers that offer onco-surgery, radiation and medical oncology services in Tier I & II cities. HCG currently has 1 central hub and 27 spokes. 60% of patients are treated at spokes which are located in Tier II & III cities at 50% of the cost of treatment at hubs i.e ~ INR2.5-3 lakhs[5]
- Value proposition: Allows patients to remain in local community for majority time of the treatment while ensuring improved patient outcomes. The hub can also service other public and private hospitals, external specialists who can be encouraged to utilize its technology and clinical capability[5]



Treatment: Institute robust referral mechanisms as key lever to reduce wait times from first doctor visit to availment of treatment

8

Key imperatives

Bridge the significant gap in human infrastructure for specialized care by upskilling doctors from complementary specialties/ general physicians

- India has 1 oncologist for 600 patients, which is 3 to 6 times worse than the patient to oncologist ratio in developed countries. The addition in number of oncology seats is not likely to bridge the gap in patient to oncologist ratio in the medium term
- There exists scope to leverage doctor capacity in complementary specialities/ general physicians through upskilling for preliminary consults and diagnosis coupled with a robust referral mechanism for referring cases for specialist consultation

Cancer sties	Focus doctor specialities for skill upgradation
Breast and cervical	Gynecologist
Oral cavity	Dentist ENT specialist
Lung	General physician
Gastro-intestine	Gastro physician and surgeon

Proposed actions

- Robust referral models focused on minimizing waiting time should be created across the care continuum from first doctor visit à diagnosis à staging à treatment à follow up visits. Key features of the model can include-
  - Clearly defined referral pathways from first visit/screening to treatment and supportive care stage customised to adapt with available health care infrastructure leveraging both public and private health care capacity (infrastructure and human resource). Relevant specialists and general physicians should be included as part of the referral network
  - Defined waiting times at each stage of the care continuum and mechanisms to minimize wait times through robust monitoring/reporting and wherever required incentivization /penalty
  - Digitization of health records for effective monitoring and follow up care
  - Simple and easy to use digital/ voice based services for patients and doctors to book appointments/ refer health records
  - Smart incentive model for all stakeholders involved in the referral network which encourages improvement of outcomes in a timely manner

Action by

Central Government, State Governments, Health Care Providers, Medical Practitioners, Insurance companies, Digital/IT companies

Treatment: Develop and deploy AI based systems to aid cancer care delivery as part of "Digital India" campaign

9 Key imperatives	Proposed actions	Action by
Develop and deploy AI based systems (as part of Digital India Campaign) for enhancing effectiveness in primary care, cancer diagnosis and treatment	▸ Developing economies like India should consider investing in an AI based clinical decision support system which could aid physicians with its own analysis of potential diagnosis and alternate courses of action. Powerful, well-curated AI systems can process millions of research papers which when combined with patient-specific health and genetic information can provide valuable insight into disease processes as well as provide up-to-date treatment recommendations. These systems should be available to physicians in both the public and private setting and should be periodically evaluated for clinical effectiveness vis-à-vis oncology experts. At an appropriate time, the Government should consider involving referring physicians (e.g. Gynecology, ENT, Dental) and trained health workers (e.g. three year RMPs), aided by the AI system, in delivery of primary care as well. ▸ One AI system currently in use by oncologists is IBM's Watson for Oncology. The system is part of the rapidly expanding armamentarium of tools available to assist physicians with treatment decision making. At a leading comprehensive cancer center in India, the AI tool achieved 96% concordance in lung cancer and 93% concordance in colon cancer cases as compared to hospital tumor board recommendations.	Central Government

Treatment: Standardize guidelines and protocols for effective treatment and improved outcomes

10

Key imperatives	Proposed actions	Action by
Establish national standard guidelines and protocols and quality measures for effective treatment ▸ While the Indian Council of Medical Research has undertaken measures to release organ specific consensus treatment guidelines, however there is limited acceptance and adoption of the guidelines by healthcare providers in India	▸ A Nodal Agency should be formalised that drives standardization of treatment protocols at national level ▸ Drive periodical reviews of treatment protocols by high level multidisciplinary KOL panels to ensure modern treatment technologies offering improved outcomes are incorporated ▸ Evaluate the option of collaborating with international bodies such as NCCN, ESMO for customizing international best practice guidelines based on local epidemiological needs ▸ Consider developing differentiated treatment protocols for early stage cancers vis-à-vis advanced stage cancers to ensure improved treatment effectiveness ▸ Enable alignment of healthcare infrastructure (such as comprehensive cancer care centers) to deliver care as per standard guidelines through accreditation/audit process and gradation ▸ For e.g., Organ specific multidisciplinary teams for key cancers, tumour boards etc. ▸ Establish mechanisms to monitor quality of treatment and outcomes through reporting and monitoring processes	Central Government, Private Health Care Providers, Public Health Care Providers

Treatment: Determine optimal health insurance coverage for cancer based on a robust framework for determining healthcare services pricing for cancer care

11

Key imperatives	Proposed actions	Action by
Under the aegis of UHC, government insurance schemes to provide coverage for optimal sum assured, which is based on the following principles: ▸ Offering multi-modal treatment options including advanced therapies to improve outcomes ▸ Right pricing for public purchase of private health care services that represents 70% of the treatment facilities for comprehensive cancer care in India	▸ High Level Expert Group should be instituted with due participation from both public and private sector players, to develop a robust framework for determining healthcare services pricing for cancer care based on ▸ Clinical pathways for treatment, palliative and supportive care based on multidisciplinary approach and to the extent possible differentiated for early stage and late stage cancers ▸ Estimation of true cost of delivering care by private and public providers ▸ Clinical outcomes expected to be delivered by following the laid down clinical pathways ▸ Healthcare services pricing for cancer care once determined based on above framework to form basis for determining coverage under government schemes (both central and state government schemes) as well for public purchase of private healthcare services	Central Government, Private Health Care Providers, Public Health Care Providers, Insurance Companies

Treatment: Improve monitoring and surveillance for effective cancer control

12

Key imperatives

Improvement in the network of the cancer registry

- 12 states which account for 50% of Indian population do not have a cancer registry

Increase penetration of the registry to ensure effective surveillance

- 11 out of 17 states which have cancer registry have a poor population coverage (<50%)

Cancer Registry Network : Geographic skew		
Coverage of population	No. of States	% Indian Population
No Registry (0%)	12	50%
Less than 10%	6	30%
10%-50%	5	20%

Reporting of key outcome measures such as survival rates to monitor cancer treatment and quality of care offered

- Currently registries record incidence and mortality data across various parameters but not data which can be used to analyse the efficacy of cancer treatment initiatives

Proposed actions

- Population-based registries should be established in the 12 states to monitor cancer incidence and mortality
  - Expand the network of PBCR to minimize the geographical skew in reporting of cancer data
- Coverage of population should be improved in the existing registries
  - Better coordination of cancer registries with local bodies and healthcare network
  - Investment in technology to enable real-time transfer of information from the network of hospitals
- Collection and reporting of data should be comprehensive by including outcome measures which will help analyse the treatment initiatives
  - 5-year survival rates to be reported which will provide an assessment of the quality of treatment provided to the cancer patients across the country
  - Hospital based quality parameters to be recorded (such as post-surgery morbidity, response to chemotherapy) which will help in clinical assessment of the treatment methods and the quality of services offered by the hospitals

Action by

Central Government, State Governments, Indian Council of Medical Research-

- State Cancer Registries,
- Hospital Based Cancer Registries,
- Hospitals/ Cancer care centers

Prevention and Treatment: Leveraging traditional medicine systems for effective cancer prevention and palliative care (1/2)

13

Key imperatives	Proposed actions	Action by
Promote use of Ayurveda as integrated care for stemming cancer growth and enhancing palliative treatment Increase adoption through international peer learning ▸ Traditional Chinese medicine which has proved its efficacy in chemotherapy toxicity reduction in numerous trials is widely used as an adjuvant in China and its benefit is recognized by western countries like US as well ▸ In the three-year action plan for cancer prevention and treatment (2015-2017), Chinese government has included the development of traditional Chinese medicine management departments and skill enhancement for advance use of traditional Chinese medicine as its goals	▸ Wealth of home remedies to suppress early cancer growth should be encouraged ▸ 'Panchkarma' i.e. balanced body and strong immune system to inhibit cancer growth ▸ Substances like turmeric & black pepper have proved to be effective in cutting off blood supply to tumor mass ▸ Palliative care by additional use of Ayurvedic compounds should be promoted such as Maharishi Amrit Kalash (MAK-4, MAK-5) and Rasayana as pre-adjuvant & post treatment of chemotherapy as evidenced in multiple studies ▸ Example - In a clinical trial covering ~200 breast carcinoma patients receiving CMF (chemotherapy regimen) were treated with MAK-4 & 5 wherein 46% found relief in nausea & 42% found relief in mucositis. MAK demonstrated significant reduction in chemotherapy toxicity & side effects ▸ Domestic research on Ayurveda should be encouraged ▸ Tata Memorial Cancer Hospital and Integrated Cancer Research Center have undertaken a research to explore the efficacy of Ayurveda to treat cancer	Central Government (Ministry of AYUSH)

Prevention and Treatment: Leveraging traditional medicine systems for effective cancer prevention and palliative care (2/2)

14

Key imperatives	Proposed actions	Action by
Organize emotional intelligence (EI) trainings for oncologists, doctors and hospital staff who treat cancer patients	▸ Doctors should be encouraged to signal positive sentiments to cancer patients as anxiety and depression boost cancer growth ▸ Results from 8-year follow-up study among 10,000 patients demonstrated that coexistence of cancer & depression is associated with an increased risk of death	Central Government, Comprehensive Cancer Centers

*AYUSH: Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy, *CMF: Cyclophosphamide Methotrexate Fluorouracil

Annexure

Annexure 1: Comparison between incidence data of cancer registries and that of large randomized screening trials

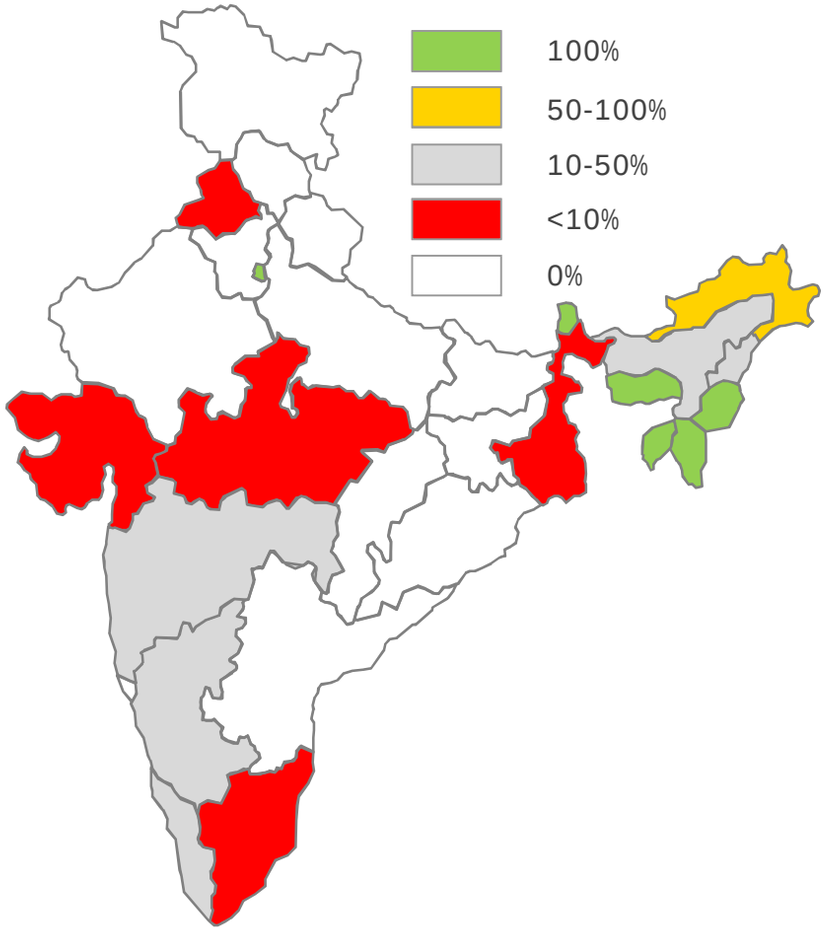
Study details[3]	Location of study	Site	Reference year	Study incidence (per 1,000 pop)	Registry incidence (per 1,000 pop)	Gap between study v. registry incidence (No. of times)
Tata Memorial Hospital[6] Female Age group: 35-64 years N = 75,360	Mumbai	Breast	1998-2005	0.48	0.58*	0.84
	Mumbai	Cervix	1998-2005	0.38	0.30*	1.30
Tata Memorial Hospital[71] Female Age group: 30-49 years N = 75,360	Osmanabad	Cervix	1999-2003	1.05	0.33#	3.15
Male and female[72] Age group: 35+ years N = 96,517	Trivandrum	Oral	1996-2004	0.44	0.22¶	2.02

*Pooled crude incidence based on population based cancer registry data 1999-2005 for Mumbai
Pooled crude incidence based on population based cancer registry data 1999-2003 for Barshi
¶For oral cancer, incidence for lip, tongue and mouth have been considered from population based cancer registry, Thiruvananthapuram for 2006-2008

Source: NCRP reports, Mittra et al. 2010

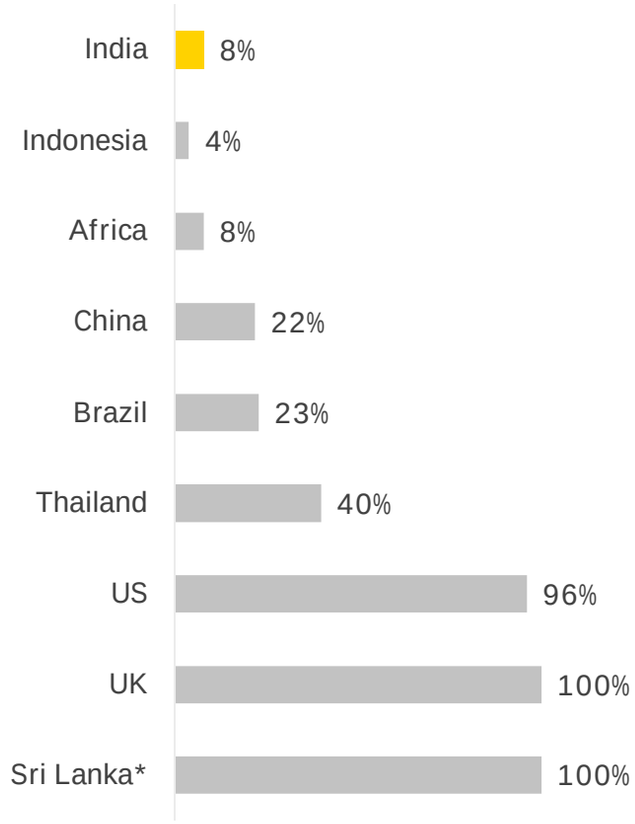
Annexure 2: Population coverage of population-based cancer registries in India is among the lowest in the world

Coverage of PBCRs



Source: NCRP PBCR reports, EY analysis

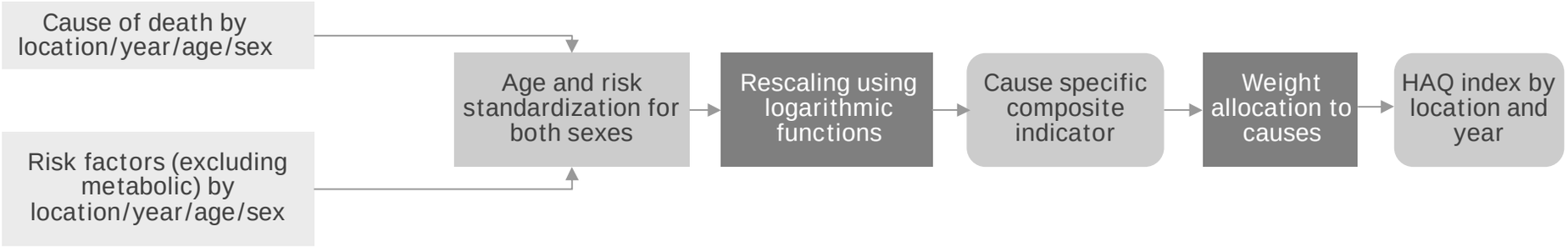
Population coverage of PBCRs for various countries



*Only hospital based registries available

Annexure 3: Healthcare quality and access index demonstrates a strong correlation with other indices

Health access and quality (HAQ) modelling

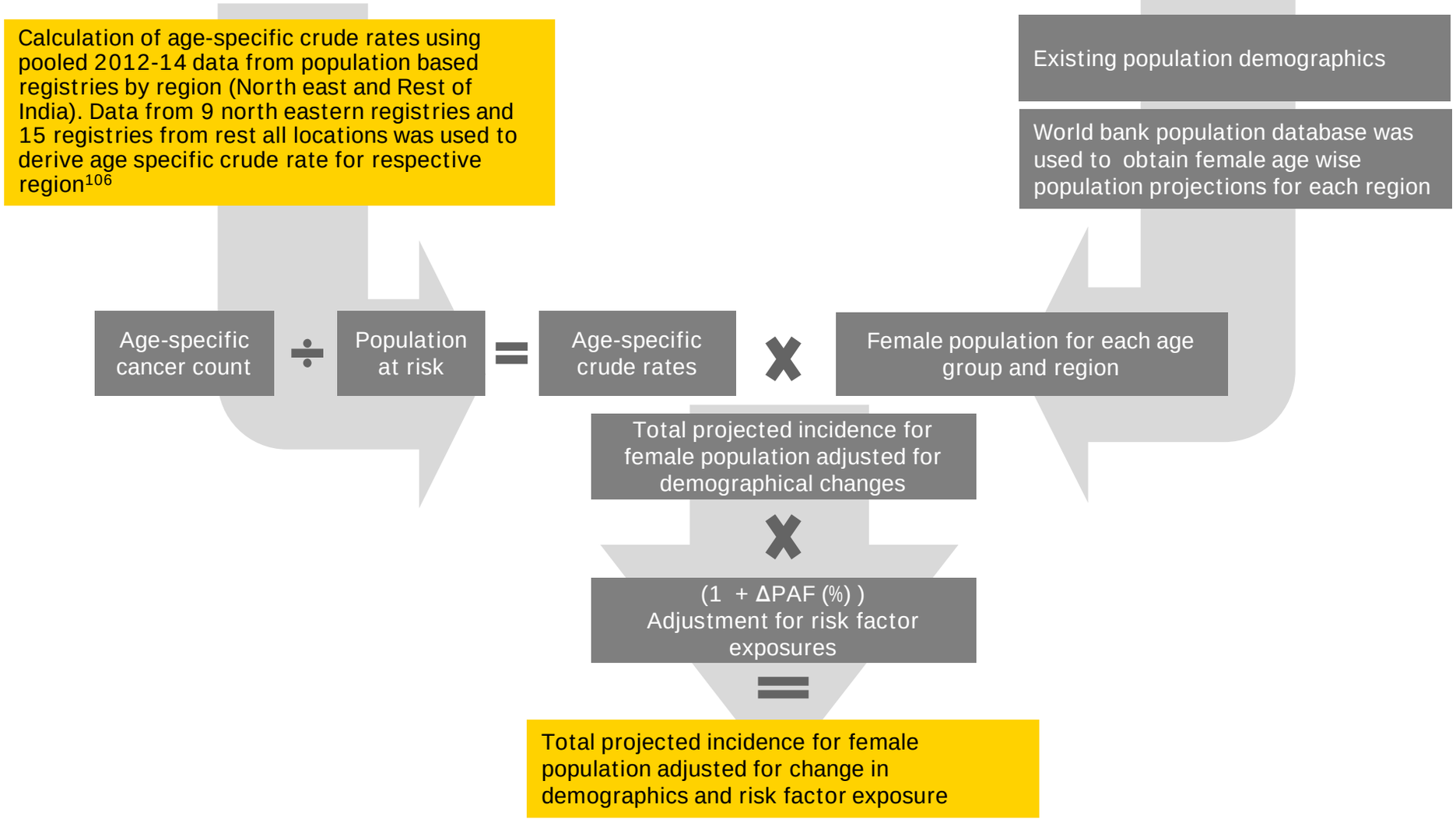


Health access and quality (HAQ) index has a strong correlation with other indicators of healthcare access and quality1

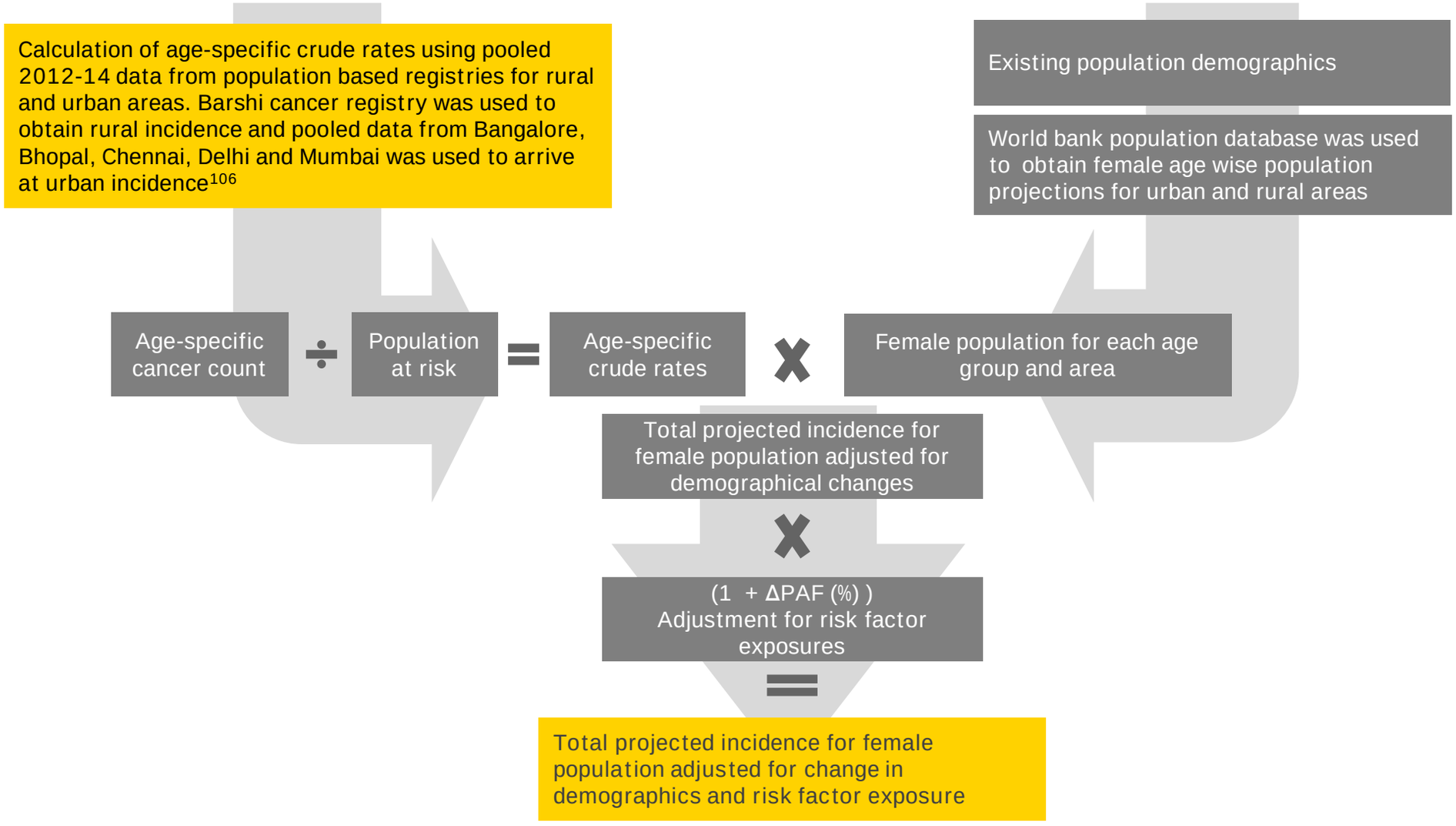
Index	Source and Year	Geographies represented	Mean correlation with HAQ
Health expenditure per capita	GBD 2015	195	0.864
Hospital beds per 1,000	GBD 2015	195	0.650
UHC tracer index of 11 interventions	GBD 2015	188	0.818
Physicians, nurses, and midwives per 1,000	WHO 2010	73	0.732
Proportion of population with formal health coverage	ILO 2010-11	93	0.781
Coverage index of three primary health-care interventions	World bank 2015	123	0.570

GBD: Global burden of disease; ILO: International labor organization; UHC: Universal health coverage

Annexure 4: Framework for projection of age specific crude incidence for all cancer types except breast and cervical for female population



Annexure 4 (contd.): Framework for projection of age specific crude incidence for breast and cervical cancers for female population



Annexure 4 (contd.): Framework for adjusting incidence rates based on risk factor exposure

Population attributable fraction (PAF) is the proportion of incident cases that can be attributed to one or more risk factor exposures

Risk factor profile for women¶	India	UK	Population Attributable Fraction (PAF)		Difference
			India	UK	UK v. India
Tobacco prevalence (%, 2015)	6.8	18.4	5.7	15.4	9.7
Alcohol per capita consumption (Lts, 2015)	0.5	6.9	0.2	3.3	3.1
BMI >25 kg/m^2 (%, 2014)	21.7	58.5	5.5	2.6	4.3
Physical inactivity prevalence (%, 2010)	15.1	44.3	0.6	1.7	1.1
Cumulative difference in exposure (**Δ**PAF%)					18.2

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

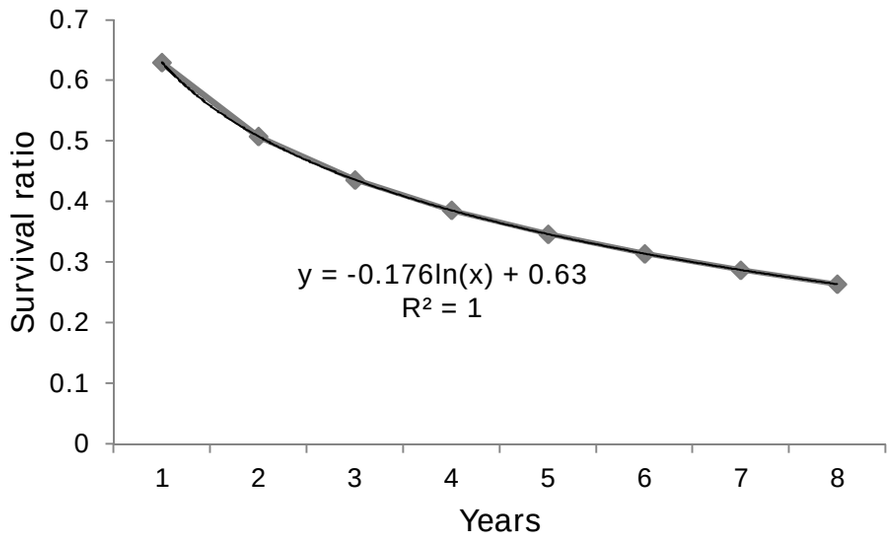
*Overall and organ specific PAF (for breast, cervix and ovary) is taken from Parkin et al (2011) and adjusted for India based on the UK figures in absence of credible India specific studies

¶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 status report on non-communicable diseases (2015); Parkin et al, (2011)

Annexure 4 (contd.): Framework for projection of prevalence: Estimation of survival ratio

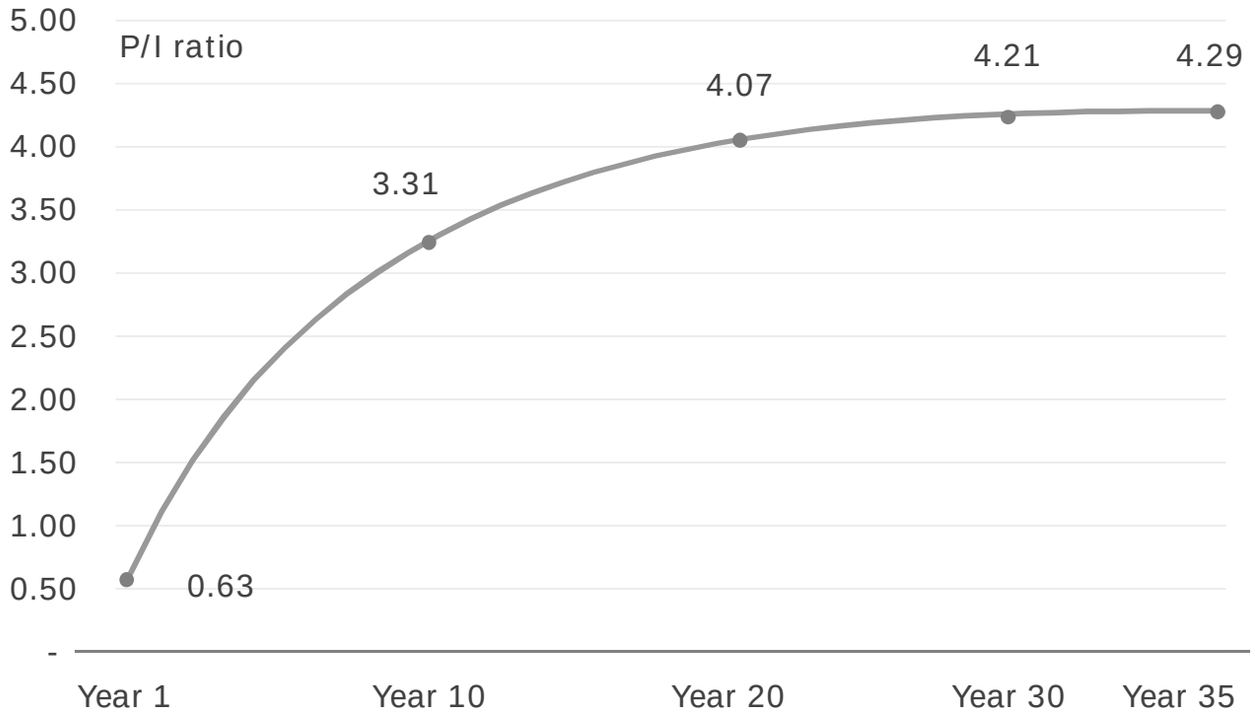
Parameter	Method of estimation
Survival ratio, 2005-09	► Pooled five-year survival of solid tumors was calculated from data ► Pooled survival in CONCORD-2 study, for India, was 34.7% which is 7% higher as compared to figure used by Takier et al for 1999 ► Assuming a similar improvement in the one year 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
0.630	1
0.508	2
0.437	3
0.386	4
0.347	5
0.315	6
0.288	7
0.264	8
0.244	9
0.225	10



Annexure 4 (contd.): 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



Steady state P/I ratio was observed to be 4.29

Prevalence (all sites) $_{year}$ = (Steady state P/I ratio) x (Reported incidence $_{year}$)

Source: Takiar et al. 2013

Annexure 4 (contd.): Illustrative: Calculation of prevalence to incidence ratio

Incidence ('000)		695	724	754	786	818	Prevalence ('000)	Incidence ('000)	P/I (Prevalence /Incidence)
Survival ratio (-0.176*LN(year) +0.63)		Year 1	2	3	4	5			
0.630	Year 1	438					438	695	0.63
0.508	2	353	456				809	724	1.12
0.437	3	303	368	475			1147	754	1.52
0.386	4	268	316	383	495		1463	786	1.86
0.347	5	241	279	329	399	515	1765	818	2.16

(Incidence for the year) x (Corresponding survival ratio)

Summation of prevalence for the year

Estimated incidence

Annexure 5: Studies on cancer awareness (1/2)
Breast Cancer

Study	Period of Study	Region / Location	Population Characteristics	Sample Size
General Female Population				
Somdatta et al.	2008	New Delhi	Resettlement colony	358
Puri et al.	2009	Chandigarh	Peri-urban and slum	981
Khokhar	2009	New Delhi	Urban	441
Ahuja et al.	2010	Mumbai	Rural	80
Garg	2010	Chandigarh	Urban	970
Bala et al.	2011	Ahmedabad	Urban	250
Yadav et al.	2013	Haryana	Urban and Rural	300
Health Professionals (Nurses/ nursing students)				
Oza et al.	2011	Ahmedabad	Urban	250
Khokhar	2012	New Delhi	Urban	259
Fotedar et al.	2013	Shimla	Urban	434

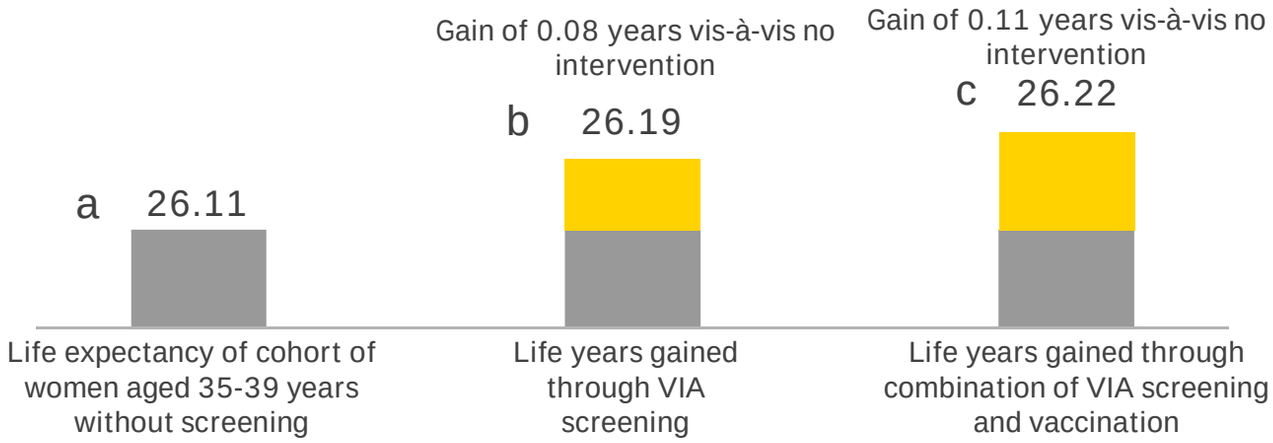
Annexure 5: Studies on cancer awareness (2/2)
Cervical Cancer

Study	Period of Study	Region / Location	Population Characteristics	Sample Size
General Female Population				
Harsha Kumar et al.	2005	Mangalore	Urban	83
Smita et al.	2009	Uttar Pradesh	Rural	511
Saha et al.	2010	Kolkata	Urban	630
Arunadevi et al.	2015	Kanchipuram	Rural	200
Health Professionals (Nurses/ nursing students)				
V Shah et al.	2012	Ahmedabad	Urban	100
Shekhar et al.	2013		Rural	262

Annexure 6: Estimation of cost effectiveness ratio

Life expectancy per women with and without intervention

Source: Goldie (2005), Diaz (2008)



Discounted lifetime cost of intervention (INR) per women

Source: Goldie (2005)

p 580

q 689

r 1492

Cost of intervention is the sum of total discounted cost for all applicable interventions such as screening, vaccination, cryotherapy, LEEP, treatment by stage, etc. for the cohort

Cost effectiveness ratio

Cost effectiveness ratio (in INR): Cost of intervention per year of life saved (YLS)

$$\frac{q - p}{b - a}$$

₹ 1,320 per YLS

$$\frac{r - p}{c - a}$$

₹ 7,786 per YLS

Annexure 7: Key inputs for the cost effectiveness analysis

Parameter	Value	Rationale
Cost per dose of vaccine	$4.5	GAVI rate for HPV vaccine
Screening and other direct and indirect costs	-	Estimated for 2017 based on calculation done by Diaz et al (2008) and Goldie et al (2005)
Vaccine coverage	70%	Assumption
5-year screening coverage	70%	Assumption
Net enrollment ratio for girls at secondary level	79%	Source: DISE flash survey
Preadolescent (aged 12 years) female population (2017)	12 million	Source: World bank

Annexure 8: Implementation of national HPV vaccination program – learnings from Bhutan (1/2)

2000 (1)

Pap smear recommended every 3 years to women aged 20-60 years with average lifetime participation being 45%

National cervical cancer screening program is launched

2009 (2)

Ministry of Health (MoH) decides to add HPV vaccine in the national immunization program

Plan to immunize girls aged 12 years along with a one time catch-up campaign for girls in the 13-18 year age group with 3 doses of HPV vaccine at 0, 2 and 6 months

School based program considering high enrolment (>90%) and available health care infrastructure

2009 (3)

MSD commits to provide the vaccine free of cost in 2010 with ACCF to fund the vaccine cost for 2011-2015.

Government of Bhutan was responsible for logistics and vaccine administration

MoH enters into a PPP with ACCF and MSD for execution of the program

2009 (4)

Pilots and training sessions conducted to assess feasibility and ensuring robust execution

Government collaborated with PATH India, MSD, UNFPA and IARC for education, training, monitoring and surveillance

Pilots were conducted to assess feasibility and acceptability of school based program

ACCF: Australian cervical cancer foundation. UNFPA: United Nations Population Fund

Annexure 8: Implementation of national HPV vaccination program – learnings from Bhutan (2/2)

2010 – 5

District health officers were responsible for coordinating advocacy meetings with all the stakeholders at a local level. Press, radio and TV were used to create nationwide awareness

MoH, with assistance from WHO, reviewed the existing safety data to address safety concerns

Government launches a nationwide social mobilization and advocacy campaign

2010 – 6

HPV vaccination campaign is launched and achieves high coverage (~90%) in the first year itself

Overall 3-dose coverage for the first campaign was ~90% (99% for 12 years old and 89% for 13-18 years old) with over 43,000 girls receiving full dose

Cost per fully vaccinated girl was estimated to be $7.2*

2011-13 – 7

Target population coverage reduced to 59-68%

Immunization strategy shifted from school based to health center based

2014 – 8

HPV vaccination campaign is reverted to school based delivery model

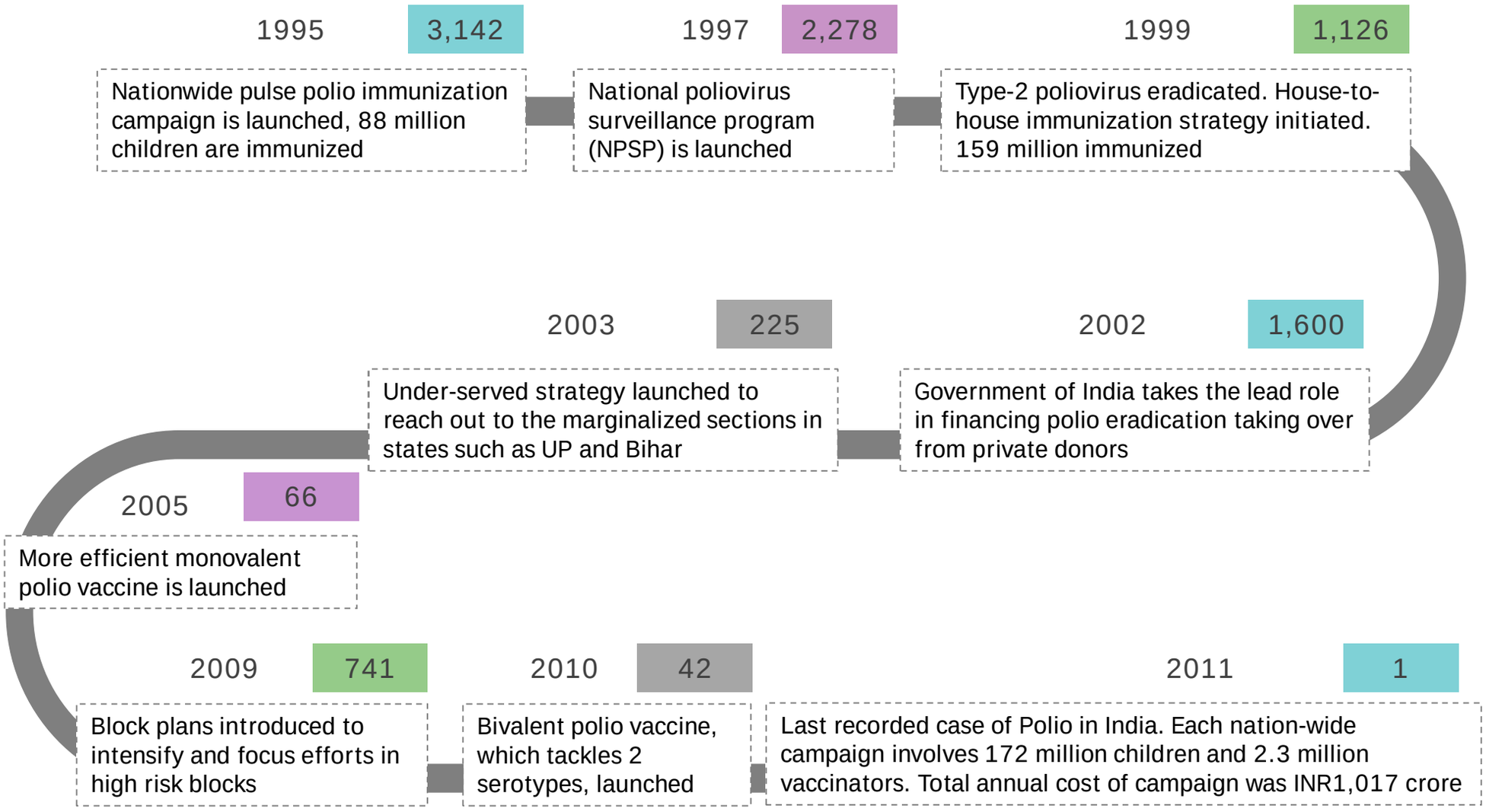
Target population coverage increases to 94%

Over 70,000 girls received full immunization till 2014

*Excluding cost of vaccine

Annexure 9: Addressing implementation challenges – learnings from Polio eradication program in India

Number of polio cases (India)[66,73]



Annexure 10: Government of India's operational guidelines and framework for screening, prevention and management of common cancers

Awareness creation[73]

- ASHAs to create awareness at ground level – social mobilization to proceed screening days for creating awareness and ensuring high participation rate
- Utilization of IEC for health promotion and education on risk factors and benefits of screening and treatment as an enabler for driving change in health seeking behaviour

Training

- Cadres of trainers from leading medical colleges, tertiary care centers and research institutes to lead efforts at national, state and district levels
- District hospitals (DHs) to serve as training hub for staff of SC and PHCs. Dentists, Surgeons, and Gynecologists to be trained at medical colleges
- Training plan:
  - ANMs: 3 day module on breast and oral cancer screening
  - ANMs, staff nurses and lady health visitors: 2 weeks at DH/tertiary care institute for VIA
  - ASHAs: 5 day module on risk factors, documentation, effective communication and referral pathways to ensure compliance to treatment

Surveillance

- Large scale surveys such as NFHS, NSSO, DLHS, etc. will be used to assess effectiveness of program through measurement of parameters such as % of women who were screened, underwent biopsy, initiated treatment, etc.

ASHA: Accredited social health activist, IEC: Information, Education and Communication, CHC: Community Health Center, MoHFW: Ministry of Health and Family Welfare, NPCDCS: National program for prevention & control of cancer, diabetes, cardiovascular diseases & stroke

Annexure 11: Breast cancer clinical trials and treatment guidelines (1/2)

Source No.	Description	Journal	Site of Cancer	Year	Methodology
1	Effect of Radiotherapy After Breast-Conserving Surgery on 10-year Recurrence and 15-year Breast Cancer Death	The Lancet	Breast	2011	Sample Size: 10801 patients who had mastectomy for stage II, III breast cancer Method: Out of 17 trails, 6 were of radiotherapy after lumpectomy (4398 women) 2 trials were RT after sector resection (2399 women), 7 were radiotherapy after lumpectomy for low risk patients (4004 women)
2	Postoperative Radiotherapy in High-Risk Premenopausal Women With Breast Cancer Who Receive Adjuvant Chemotherapy	The New England Journal of Medicine	Breast	1997	Sample Size: 1708 patients who had mastectomy for stage II, III breast cancer Method: 852 received CMF + irradiation and 856 received only CMF Period of Trial: 9.5 years
3	Consensus Document for Management of Breast Cancer	Indian Council of Medical Research	Breast	2016	-
4	ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up of Primary Breast Cancer	Annals of Oncology Supplement, ESMO	Breast	2015	-
5	NCCN Clinical Practice Guidelines in Oncology	National Comprehensive Cancer Network	Breast	2017	-

Annexure 11: Cervical cancer clinical trials and treatment guidelines (2/2)

Source No.	Study Title	Journal	Site of Cancer	Year	Methodology
1	A Phase III Randomized Trial of Postoperative Pelvic Irradiation in Stage IB Cervical Carcinoma With Poor Prognostic Features	International Journal of Radiation Oncology	Cervix	2006	Sample Size: 277 patients who had radical hysterectomy or pelvic lymphadenectomy Method: Out of 277 women, 137 were randomized to pelvic radiation (RT), 140 were randomized to observation
2	Concurrent Chemotherapy and Pelvic Radiation Therapy Compared With Pelvic Radiation Therapy Alone as Adjuvant Therapy After Radical Surgery in High-Risk Early-Stage Cancer of the Cervix	Journal of Clinical Oncology	Cervix	2000	Sample Size: 268 patients with radical hysterectomy or pelvic lymphadenectomy Method:127 received RT + chemotherapy and 116 received only RT. Period of Trial- 5 years (1991-96)
3	Consensus Document for Management of Cervical Cancer	Indian Council of Medical Research	Cervix	2016	-
4	ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up of Cervical Cancer,	Annals of Oncology Supplement, ESMO	Cervix	2015	-
5	NCCN Clinical Practice Guidelines in Oncology	National Comprehensive Cancer Network	Cervix	2017	-

Annexure 12: Model for estimation of the current required number of Linac installations in India

Parameters[5]	2017
Real Incidence	16,06,784
% new cases receiving radiotherapy (based on patient flow analysis of few private and public cancer players and IAEA guidelines which highlight that 50-60% of patients require radiation treatment)	50-60%
Number of patients who require radiation treatment (A)	8,83,730
Existing number of radiation oncologists	1,800
Number of patients a radiation oncologist can treat per annum	540
Total number of patients who can be treated per annum (B)	9,72,000
Average number of patients treated with a Linac per annum	450
Number of Linacs required (Theoretical)	1,800
Current number of Linacs in India	409
Number of LINACs needed to treat the patients given the LINAC is working to its full potential	2,160
Addressable number of patients (Lower of A and B)	8,83,730
Total number of Linacs required to treat the addressable patient load	1,964
LINAC Gap to treat the existing patients	1,555
LINAC Gap to utilise the doctor pool completely	1,751

Annexure 13: Model for estimation of the current utilization of targeted therapy drug (Trastuzumab) in India

Parameters[5]	2017
Real Incidence	16,06,784
Incidence of Breast Cancer in India	1,34,200
% new cases who are HER positive and need targeted therapy treatment (based on primary interviews)	25%
Number of breast cancer patients who need targeted therapy treatment	33,550
Number of Cases who have availed targeted therapy using Trastuzumab	5,000
% of HER positive patients who have availed Trastuzumab	15%
Number of cycles required for complete targeted therapy treatment using Trastuzumab	18
Typical number of cycles availed by HER positive patients by using Trastuzumab	8
Required number of treatment cycles of Trastuzumab for the existing HER positive patients	6,03,900
% of Trastuzumab cycles availed by HER positive patients till date	7%

Sources

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List of Abbreviations

ACCF	Australian Cervical Cancer Foundation
ANM	Auxiliary nurse midwife
APC	Alcohol consumption per capita
ARY	Arogya Raksha Yojana
ASHA	Accredited social health activist
BCS	Breast conservation surgery
BMI	Body mass index
CAGR	Compound annual growth rate
CBE	Clinical breast examination
CC	Cancer center
CCC	Comprehensive cancer center
CGHS	Central government health scheme
CHC	Community health center
CHIS	Comprehensive health insurance scheme
CIN	Cervical intraepithelial neoplasia
CMCHIS	Chief minister's comprehensive health insurance scheme
CMF	Cyclophosphamide, methotrexate, and 5-fluorouracil
COE	Center of excellence
CPAA	Cancer Patients Aid Association
CRT	Conformal radiotherapy
CSR	Corporate social responsibility
CT	Computed tomography
DALY	Disability-Adjusted Life Year
DCO	Death certificate only
DH	District hospital
DLHS	District Level Household Survey
EMR	Electronic medical record
ESMO	European Society for Medical Oncology
FIGO	International Federation of Gynecologists And Obstetricians
GBD	Global burden of disease

List of Abbreviations

GDP	Gross domestic product
GHE	Global health economics
GOI	Government of India
HAQ	Healthcare access and quality
HER	Human epidermal growth factor receptor
HIV	Human immunodeficiency virus
HPV	Human papilloma virus
IAEA	International Atomic Energy Agency
IAP	Indian Academy of Paediatrics
IARC	International Agency for Research on Cancer
ICMR	Indian Council of Medical Research
IEC	Information education communication
IGRT	Image guided radiotherapy
ILO	International Labour Organization
IMRT	Intensity-modulated radiotherapy
INR	Indian rupees
IPHS	Indian Public Health Standards
IRDA	Insurance Regulatory and Development Authority
KOL	Key opinion leader
LEEP	Loop electrosurgical excision
LINAC	Linear accelerator
M:I %	Mortality-to-incidence ratio
MA	Mukhyamantri Amrutum
MMR	Maternal mortality rate
mn	million
MoH	Ministry of Health, Bhutan
MoHFW	Ministry of Health and Family Welfare
MoU	Memorandum of Understanding
MP	Medical physicists
MPCE	Monthly per capita expenditure

List of Abbreviations

MV	Morphologically verified
NCCN	National Comprehensive Cancer Network
NCD	Non-communicable disease
NCG	National Cancer Grid
NCRP	National Cancer Registry Programme
NFHS	National Family Health Survey
NLEM	National List of Essential Medicines
NPCDCS	National program for prevention and control of cancer, diabetes, cardiovascular diseases and stroke
NPPA	National Pharmaceutical Pricing Authority
NPSP	National Polio Surveillance Project
NSSO	National Sample Survey Office
NTAGI	National Technical Advisory Group on Immunization
NTCP	National Tobacco Control Program
OCP	Oral contraceptive pills
OG	Operational guideline
OVE	Oral visual examination
PAP	Papanicolaou
PATH	Program for Appropriate Technology in Health
PBCR	Population Based Cancer Registry
PCOS	Polycystic ovarian syndrome
PHC	Primary health center
PMRT	Post mastectomy radiotherapy
PPP	Public private partnership
PR	Public relation
RCC	Regional cancer center
RSBY	Rashtriya Swasthya Bima Yojana
RT	Radiation therapy
RTT	Radiation therapy technologist

List of Abbreviations

SAARC	South Asian Association for Regional Cooperation
SBE	Self breast examination
SBRT	Stereotactic body radiation therapy
SC	Sub center
SEAR	South-East Asia Region
SMNet	Social mobilization network
SRR	Standardized registration ratio
SRS	Stereotactic radio surgery
SRT	Stereotactic radio therapy
TCC	Tertiary care center
UHC	Universal Health Coverage
UNFPA	United Nations Population Fund
USG	Ultrasound sonography test
VIA	Visual inspection via acetic acid
VMAT	Volumetric modulated arc radiotherapy

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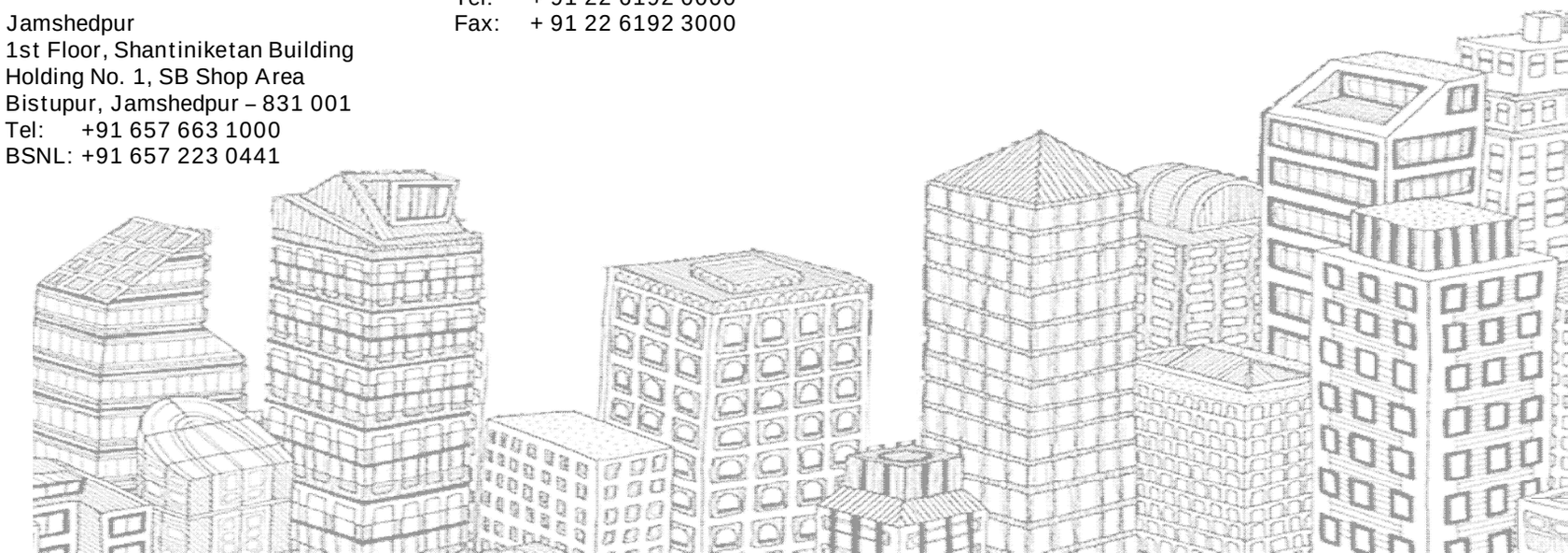

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