System Dynamics Approach to Healthcare Affordability in India

By

Anjali Chaudhary

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Signature of Author..... Signature redacted .....

Anjali Chaudhary
Engineering and Management Program
MIT School of Engineering and MIT Sloan School of Management

Certified and Accepted by..... Signature redacted .....

Patrick Hale
Director, System Design and Management Fellows Program
Senior Lecturer in Engineering Systems Division
Massachusetts Institute of Technology – Engineering Systems Division
Thesis Supervisor

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Abstract

Affordability of healthcare is a growing concern across the world. For India, with a population of over 1.2 billion people and one third of world's poorest, to provide affordable and sustainable healthcare to all its citizens becomes even more challenging. The country faces the triple burden of controlling communicable diseases, managing non communicable diseases, and limiting the deaths from injury and mental health. The public healthcare system is underfunded and underutilized while the private facilities are unregulated and unaccountable for quality and cost of care. The high reliance of the population on the private facilities, low insurance coverage, and high emphasis on curative care than the preventive care is further making the cost prohibitive for the general population. There is a lot to be desired in the areas of Pharmaceuticals, Medical Devices, and Research and Development for a holistic development of healthcare system in India.

This thesis attempts to model the current healthcare system and how different entities of the system interact to influence the affordability. The simulation of the model projects the affordability in the next 50 years. The study also checks the impact of three different policies on the affordability of care.

Thesis Supervisor: Patrick Hale

Title: Executive Director, SDM and IDM, MIT

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1. Introduction: Healthcare in India

Ebola dominated global health in 2014. The health communities around the world were focused on the long standing issues of HIV, maternal health, and vaccine preventable diseases, and missed the onset of the Ebola epidemic. Ebola left a valuable lesson in its wake- when a deadly virus hits the destitute and spirals out of control, the whole world is at risk. A neglected fundamental health system can bring a fragile country to its knees from a shock of an extreme weather event or a disease. Any attempts to build a system during crisis inevitably fail. A weak health system brings down the resilience of population to the unfortunate events like a changing climate, armed violence and civil unrest, or a deadly and dreaded virus, occurring with ever greater frequency and force.[1]

Where does India stand with respect to its healthcare system? The World Health Organization's 2000 World Health Report cites four key functions of a healthcare system- providing services; generating the human and physical resources that make service delivery possible; raising and pooling the resources used to pay for healthcare; and, most critically, the function of stewardship – setting and enforcing the rules of the game and providing strategic direction for all the different actors involved.[2] Based on the performance in these functions, the Health Report ranks India's healthcare system at 112 out of 190 countries.

With a population of 1.2 Billion and three quarters living in the rural areas, India faces a substantial task of providing healthcare services to its citizens besides meeting the healthcare performance parameters set by the world agencies. The wide rural-urban gap in healthcare services; high out of pocket expenses; lack of clarity in the government's insurance and healthcare regulatory policies; growing demand for primary healthcare and infrastructure; increasing disease burden resulting from changing demographics (aging population), epidemiological (change from communicable to non-communicable diseases) and nutritional (high caloric

consumption and low physical activity levels) transitions; and, underdeveloped medical devices sector are a few challenges facing the Indian Healthcare System.[3]

Affordability of healthcare continues to be a cause of concern world over. Any improvement in the six building blocks of a quality healthcare system- services, workforce, Information System, Technology and Medications, financing, and leadership and governance impacts the cost of care. At its current state, the healthcare system in India is substantially cheaper to operate. The increasing demand for medical care services with consistent limited supply, increasing health insurance coverage (with government leaning towards opening of market to the global players), improving medical technology and diagnostic capabilities, and increasing dependence on private providers have started to escalate the overall cost of care in India. Thus, affordability remains a pertinent issue for India as the healthcare system develops in terms of quality, accessibility, accountability, and responsiveness to the needs of the stakeholders.

The focus of the study in this thesis is the affordability of care in the healthcare system in India. The system is a network of public providers, private providers, and Public-Private-Partnerships (PPPs). For the study, the cost of care in a public provider-District Hospital is considered to represent cost of care in the overall healthcare system. The District Hospital provides services at a cost lower than the private hospitals, and thus will continue to have relevance in the underserved population especially when one-third of the world's 1.2 Billion poorest (United Nations Data) live in the country. The District Hospital also has the provision for continuum of care at the primary, secondary, and tertiary levels. The premise is if the cost of care is not affordable in a District Hospital then it is unlikely to be affordable in the private facilities dominating India's healthcare system.

This study attempts to frame the healthcare system; understand the complexity of the system in terms of affordability of care; and, predict the impact of various policies on the affordability. The thesis is largely based on secondary sources of data. It does not provide definitive answers or accurate forecasts about affordability or policy related to healthcare. Nevertheless, it showcases the complexity of the

healthcare system and emerging behavior patterns with application of the principles of System Dynamics.

The outline of the thesis is as follows. The next section describes the healthcare system-demand (burden of disease) and supply (expenditure and infrastructure); followed by section 3 that covers the development of System Dynamics Model. Section 4 has the projections of healthcare affordability, and Section 5 presents three policies for improvement in affordability. Section 6 and Section 7 cover the conclusion and appendices respectively.

2. Healthcare System

To analyze the affordability of care in India, the study reviews the demand and supply side of the healthcare system; and, identifies the gap therein. The demand is elucidated by the burden of disease requiring care; and, the supply entails the spending on healthcare and the existing healthcare infrastructure that enables delivery of care. The thesis does not cover the challenges facing healthcare system in India- shortfall in infrastructure, inadequate and underutilized health workforce, lack of holistic regulatory framework, low insurance coverage, so on and so forth. These are mentioned briefly to illustrate the current status of the healthcare. Any improvement in the status will eventually impact the affordability of care.

A few socio-economic indicators for India are in Table 1.

Measurement Name	Measurement	Trend
Population(2013)	1252.14 Million	▲
Population Density(2013)	421/sq.km	▲
Decadal Population Growth Rate(2011)	17.64 percent	▼
Adult Literacy rate (2011)	74.04 percent	▲
Male/Female Literacy rate(2011)	82.14 65.46 percent	▲
GDP(2012)	$1.87 Trillion	▲
Per Capita Expenditure in Health(2012)	$62	▲
Proportion of population below poverty line (Rural/Urban)	38.8 / 20.9 percent	▼
Birth Rate / 1000 Population (2013)	20	▼
Death Rate / 1000 Population (2013)	8	●
Life Expectancy at Birth (2012)	66.21	▲
Infant Mortality Rate / 1000 Live Births (2013)	41	▼
Maternal Mortality Rate / 1000 Live Births (2013)	1.9	▼
Total Fertility Rate (2012) No. Of Children Per Couple	2.5	▼

Table 1: Socioeconomic Indicators, India[4]

Over the last few decades the healthcare services in India have undergone a tremendous change. Life expectancy at birth has increased from 57 years for males/ 58 years for females in 1990 to 63 years for males/ 66 years for females in 2013. Infant mortality rate per 1000 live births has fallen from 74 in 1994 to 41 in 2013. Maternal mortality rate per 1000 live births also decreased from 3.2 in 1990 to 1.9 in 2013. The coverage of the healthcare service has broadened in the country with increase in the number of care facilities and trained medical professionals. A wide disparity in distribution of healthcare resources between rural and urban India continues to exist.[5] 70 percent of India's population lives in rural and semi-urban areas with only 20 percent of the healthcare infrastructure built in these areas. There are 369,351 beds in government hospitals in urban areas while only 143,069 beds in rural and semi-urban areas. Some other key numbers about the rural-urban divide are-

- Doctors to population ratio is lower by six times in rural areas
- Beds to population ratio is lower by fifteen times in rural areas
- Seven out of ten medicines in rural areas are substandard or counterfeit
- 66 percent of rural population lack access to critical medicines
- 30 percent of rural population travels over 30 km for medical treatment

This rural-urban divide is reflected in the difference in the health outcomes of population living in these areas (Table 2).

Indicator (2007)	Rural	Urban
Crude death rate	8.0	6.0
Infant mortality rate	61.0	37.0
Neo-natal mortality rate	40.0	22.0
Post-natal mortality rate	20.0	16.0
Peri-natal mortality rate	41.0	24.0
Still birth rate	9.0	8.0

Table 2: National Health Profile (2009)

The rural areas lack basic amenities such as electricity, appropriate drainage and sewage, etc. that increase susceptibility to diseases. Another fraction of the population- almost 100 million urban poor is just as vulnerable to diseases. They live in slums characterized by overcrowding and poor sanitation and hygiene.

This disparity in the distribution of healthcare services is also seen among the states. India is a diverse country with 28 states and 7 union territories. Each state is different from the others in the socio-economic status of people, literacy levels, living conditions and political situations, and hence in the resources and healthcare status. There is inter-state diversity in the distribution of healthcare facilities with people in one state having greater access to healthcare than another state.

There is still a lot to be desired when India is benchmarked with other countries in healthcare indicators (Table 3).[6]

			Developed Economies			Emerging Economies		
Indicator	Year	India	US	UK	Japan	Brazil	Russia	China
Life expectancy at birth (years)	2008	64	78	80	83	73	68	74
Infant mortality rate (probability of dying by age 1 per 1000 live births)	2008	52	7	5	3	18	9	18
Maternal mortality rate (per 100000 births)	2000-09	254	13	7	3	77	24	34
Hospital bed density (per 10000 population)	2000-09	9	31	39	139	24	97	30
Doctor density (per 10000 population)	2000-09	6	27	21	21	17	43	14
Births attended by skilled health personnel (percent)	2000-08	47	99	NA	100	97	100	98

Table 3: Health Indicator Benchmarks (World Health Statistics, 2010)

The global events and efforts also influence the development of a better healthcare system. The United Nations Millennium Declaration signed in September 2000 by 191 member states has eight quantifiable goals to be met by 2015. These millennium development goals (MDGs) commit the signatories' to combat poverty, hunger, disease, illiteracy, environmental degradation, and discrimination against women. Health is the central theme in formulating the interdependent MDGs- all

MDGs influence health, and health influences all the MDGs. [7] Post-2015, Sustainable Development Goals (SDGs) will take shape under the shared vision of the member states. [8] SDGs are considered even more ambitious than MDGs and span a broad range of interconnected issues, from economic growth to social issues to global public goods.

December 12 is celebrated as the Universal Health Coverage Day since 2012. On December 12, 2012, a resolution was passed unanimously in the United Nations acknowledging universal health coverage as the pillar of sustainable development and global security. Even though progress has been made in combating vaccine-preventable diseases and killer diseases like HIV, the gap between those who can access healthcare without concerns for financial burden and those who cannot is ever increasing. Around one billion people are unable to access healthcare they need resulting in disease outbreaks becoming epidemics. The result of this resolution is a coalition of 500 global health and development organizations to support governments accelerate reforms that ensure equitable and affordable quality health services for everyone. [9]

Also, in 2014, a Global Infrastructure Facility (GIF) was created to leverage resources to build public-private partnerships for addressing the massive infrastructure deficit in developing economies and emerging markets. The members of GIF include heads of some of the world's largest asset management and private equity firms, pension and insurance funds, commercial banks, multilateral development institutions and donor nations. The infrastructure deficit is considered one of the fundamental bottlenecks to reducing poverty and boosting shared prosperity around the world. The GIF is expected to fulfill two key financial needs. First, the developing countries spend about US$1 trillion a year on infrastructure. However to maintain the current growth rates and meet future demands, an estimated additional US$1 trillion a year are required through to 2020. And, second, the private infrastructure investment in emerging markets and developing economies has dropped from US$186 billion in 2012 to $150 billion in 2013.[10]

Every epidemic- SARS, avian flu, and recently Ebola, is a reminder to build a robust and resilient healthcare system that can deliver quality, essential healthcare and preventative services to everyone, and is equipped with preparedness and responsiveness. Effective disease surveillance and diagnostic capabilities are also needed to rapidly identify, treat, and contain outbreaks. The Ebola crisis also demonstrates the economic downsides of failure to invest adequately in the health sector. Guinea, Liberia, and Sierra Leone lost at least $1.6 billion in income. The health crisis converted into a development crisis leading to these countries seeking support for their farmers during planting season.[11]

Deadly pathogens exploit weak health systems.[12] They create emergency within emergency. Ebola emerged 40 years ago, but being limited to the poor African countries, there have been no incentives for research and development. The epidemic proved that the world is ill-prepared to respond to any severe, sustained and threatening public health emergency, and a need to put the basic healthcare system in place.

The Investment Commission of India estimates that the healthcare sector in India has grown at 12 per cent per annum in the last few years with the rising incomes and growing elderly population driving this growth. The changing demographics, disease profiles and the shift from chronic to lifestyle diseases in the country has necessitated need for tertiary hospitals that are projected to grow faster than the overall healthcare system. To reach world standards, India will require investments of up to $20 billion over the next five years.

A snapshot of the actions required to address the current state of healthcare in India is-[13]

- ~$6 trillion economic loss impact from NCDs
- ~3 million urban diabetes patients who receive adequate treatment, out of ~38 million
- 315 million population affected by tropical diseases
- ~75 percent population without health insurance
- <1 percent care delivery providers accredited

- ~3 trillion cumulative healthcare spending required by 2025

2.1 Demand

Currently, India shares 21 percent of the world's burden of disease.[14] The following shows India's share in global health problems.[15]

- 17.5 percent of world's population
- 17 percent of total deaths
- 23 percent of child deaths
- 26 percent of child deaths preventable by vaccination
- 20 percent of maternal deaths
- 68 percent of leprosy cases; first in the world in new cases of leprosy (2014)[16].
- 30 percent of tuberculosis cases; with highest burden of tuberculosis of 2.2 million cases out of 8.7 million worldwide (WHO 2011); almost 40percent of the population has a latent form of the disease.
- 10 percent of HIV infected persons; the third largest HIV epidemic in the world with 2.4 million living with the virus

The morbidity and mortality profile of the country is getting affected by the changing demographics (ageing population), epidemiological (change from communicable to non-communicable diseases) and nutritional (high caloric consumption and low physical activity levels) transitions. A WHO report provides the following estimates (Year 1990) and projections (Year 2020) for India's burden of disease (Figure 1).

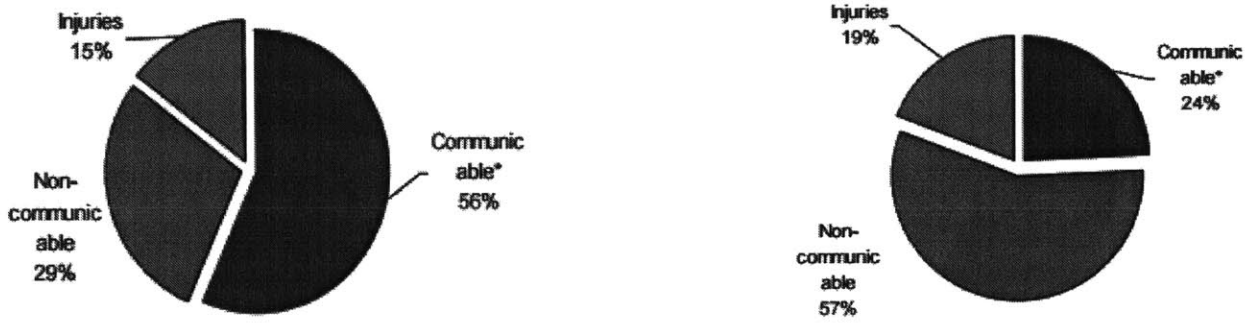


Figure 1: India's Burden of Disease- Year 1990 Estimates and Year 2020 Projections

The pace of epidemiological transition has not been as fast as predicted by WHO because of persisting maternal and child health issues and advent of HIV. However, the morbidity and mortality due to non-communicable diseases, accidents, and trauma has been on the rise in the past two decades.

As the life expectancy has increased, so has the vulnerability to chronic non-communicable diseases (NCDs) that are generally slow in progression and need long term and expensive care. People's awareness to treatment options is also driving the demand for medical care. Also, there is a higher emphasis on the curative care than the preventive care and wellness.

2.1.1 Burden of Disease

Today, India faces the triple burden of disease- managing the rising cost of non communicable diseases, continuing to deal with controlling the communicable diseases, and taking care of the trauma and injuries. Currently, the burden of communicable disease is estimated at 33 percent, non-communicable disease at 50 percent, and injuries account for 17 percent of burden of disease.[17]

Mortality due to mental illness accounts for about 15 percent of total deaths. The highest number of suicide cases is in China and India (WHO 2009).[18] On an average 100,000 suicides happen every year in India. A WHO publication also says that the studies in South Africa, Brazil, India, Puerto Rico and Ethiopia have found that 6 percent to 18 percent of children and adolescents have mental disorders. With evidence of a strong association between mental disorders, poverty and lack of education and the high prevalence of mental illness, the chances of negative effects on social and economic development are high if the mental disorders in children go untreated.

Figure 2 gives an idea about the distribution of diseases in different age groups by survivor and decedent sub groups based on inpatient data (NSSO, 2004-2005). The morbidity and mortality for the children aged less than 15 years is due to the

communicable diseases and for those aged 60 years and above is due to the non communicable diseases.

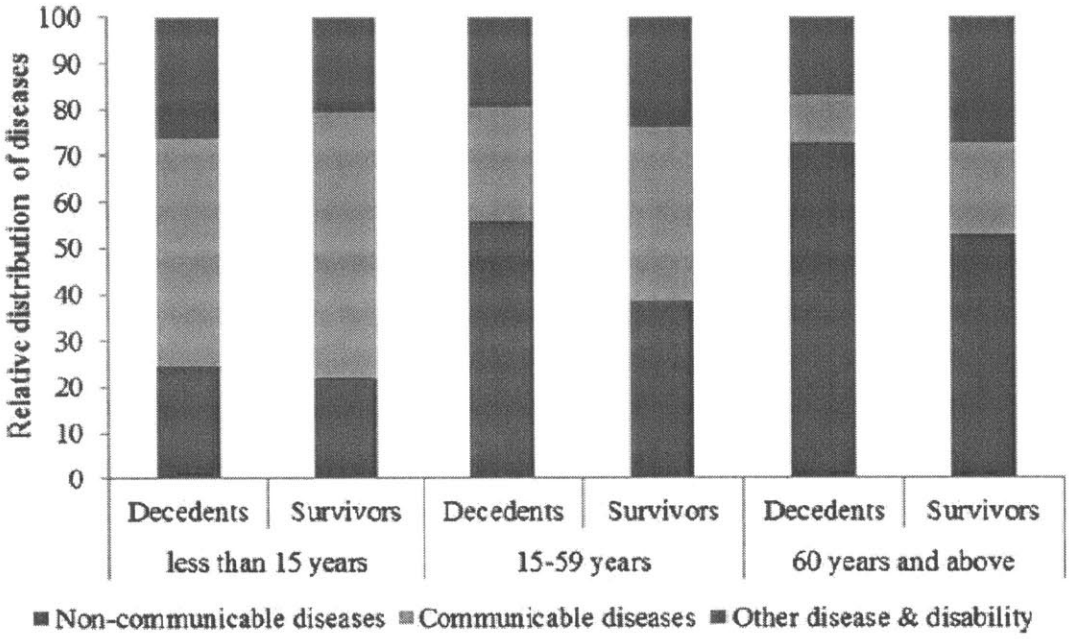


Figure 2: Distribution of Inpatients by Survivor Status (2004-2005)[19]

The Global Burden of Disease Study 2010 (GBD 2010) shows that-

- The number of years of life lost (YLLs) due to premature death in India, preterm birth complications, lower respiratory infections, and diarrheal diseases were the highest ranking causes in 2010
- Measles showed the largest decrease in Disability-Adjusted Life Year (DALYS)[1], falling by 63 percent from 1990 to 2010
- The leading risk factor is dietary risks
- Mortality rate declined at every age range.

1 To quantify burden of disease from mortality, morbidity, and disability, the metric used is Disability-Adjusted Life Year (DALY). One DALY is one lost year of healthy life. The sum of DALYs across the population indicates the gap between the current health status and the ideal health situation when the population lives to an advanced age, free from disease and disability. DALY can be used to compare a disease that causes early death but no disability and disease that does not cause death but causes disability. DALY is not an economic measure but can be used as guide to allocate resources in terms of DALYs/Dollar spent.

- The greatest reductions in all-cause mortality rate were experienced by females aged 1-4 years (63 percent). Males aged 35-39 years saw the smallest decrease in mortality rate (1 percent).

Road injury and self-harm first appeared in the list of causes in 2010. The top 25 causes of loss in DALYs and their percentage change from 1990 to 2010 are presented in Figure 3.

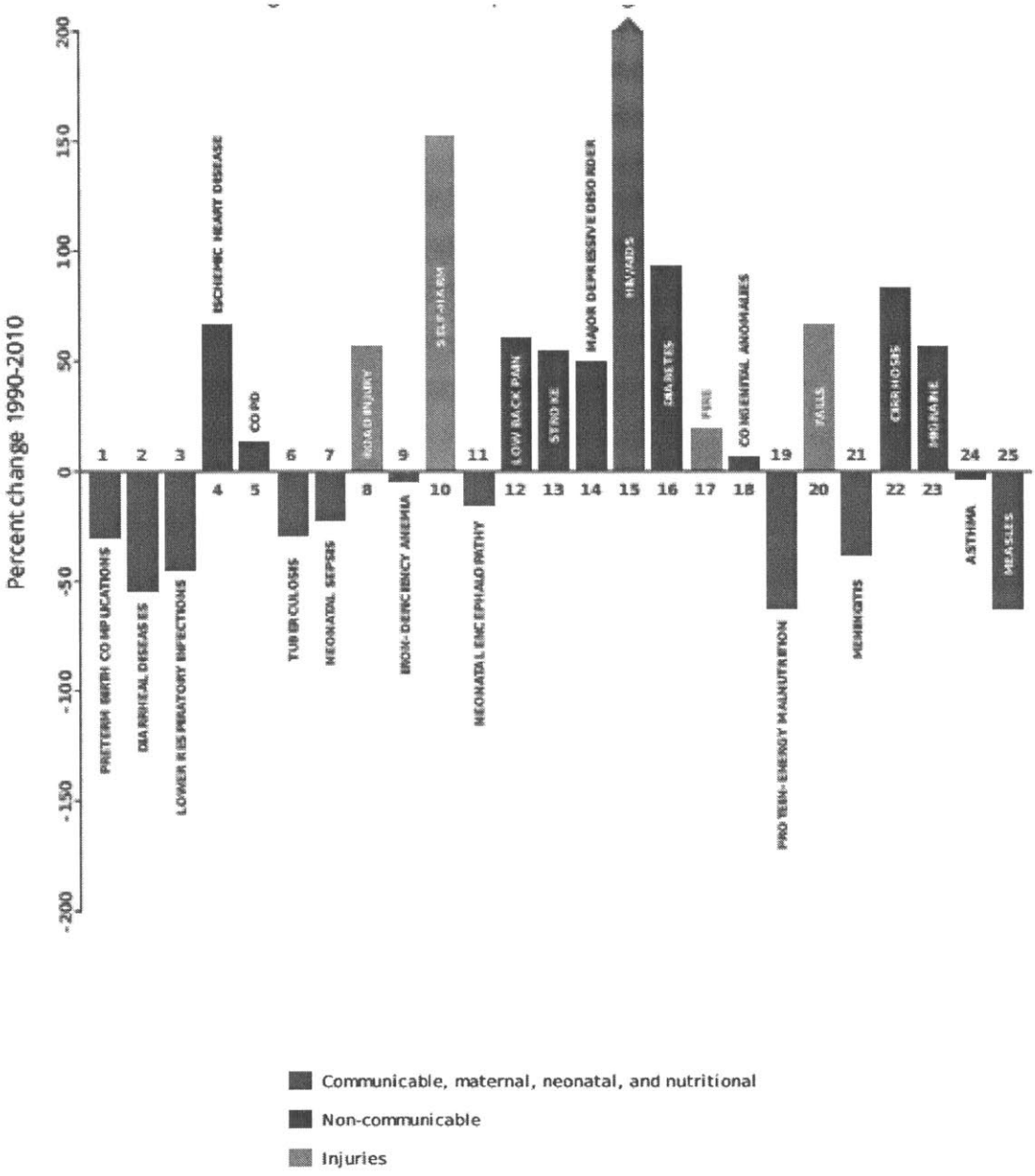


Figure 3: Leading Causes of DALY and Percent Change from 1990 to 2010

Concerning the mortality profile of India, a few of the projections in 2004-2030 time period are shown in Figure 4. The number of deaths due to communicable and to maternal, perinatal, and nutritional reasons is projected to decrease between 2004 and 2030. The total number of deaths due to chronic diseases will rise in the coming years, accounting for slightly less than two thirds of all deaths. Cardio-vascular disease will cause2·7 million in 2004 to 4·0 million deaths in 2030. Injury-related deaths (road traffic injuries and suicides) are estimated to increase by 30 percent.

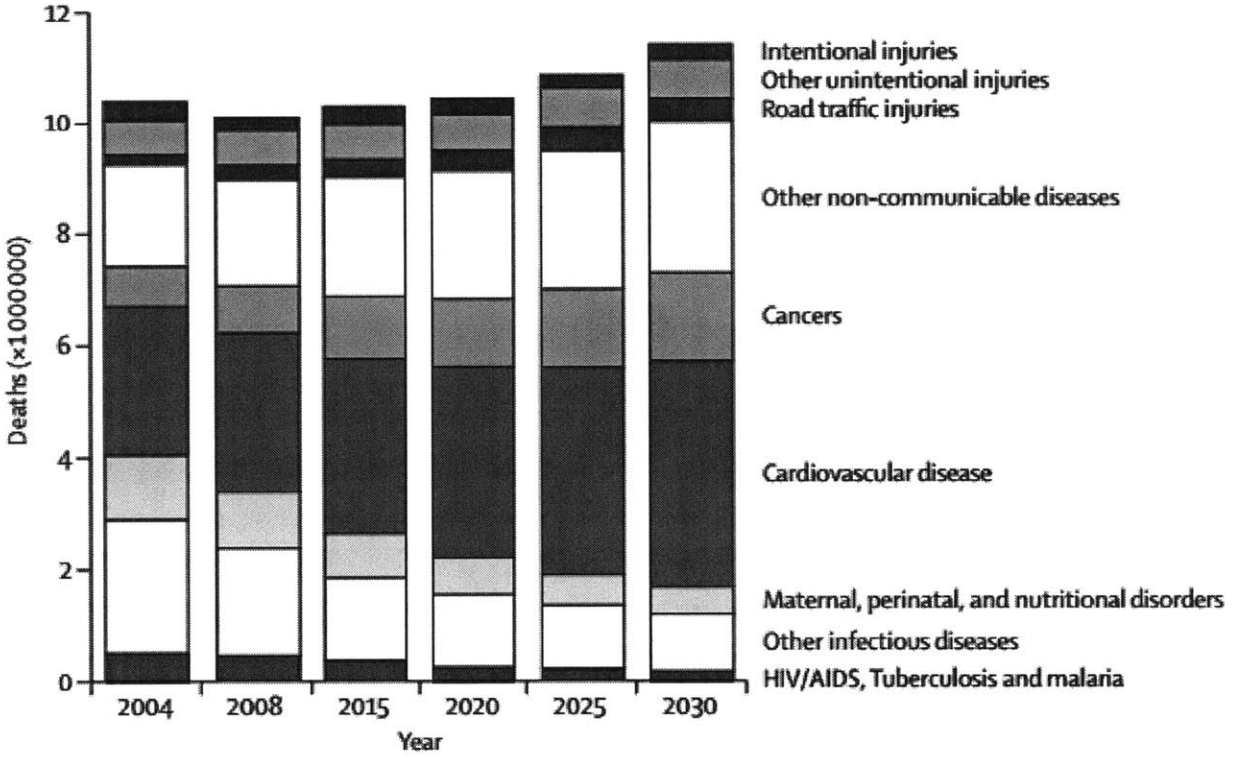


Figure 4: Projected Death by Cause[20]

The total number of DALYs lost in India is expected to decrease by almost 16 percent from 305 million in 2004 to 256 million in 2030. With India's population projected to increase by 30 percent over the same period, this reduction in the number of DALYs lost will substantially reduce global disease burden per person.

The population growth, population ageing and changing disease risks will reduce DALYs for most communicable diseases and diseases due to maternal and perinatal causes. Generally, the increase in DALYs lost due to chronic diseases is tempered by a reduction in incidence rates due to improved socioeconomic conditions resulting in greater access to healthcare and reduced disease risk. However, this may not be the case in the Indian population aged 45 years and older as the number of DALYs lost because of chronic diseases per 1000 people will increase from 278 in 2004 to 307 in 2030 as this age group ages. In 2030, unipolar depressive disorders, ischemic heart disease, COPD, and road traffic injuries are expected to be the leading causes of loss of DALYs in India as projected in Figure 5.

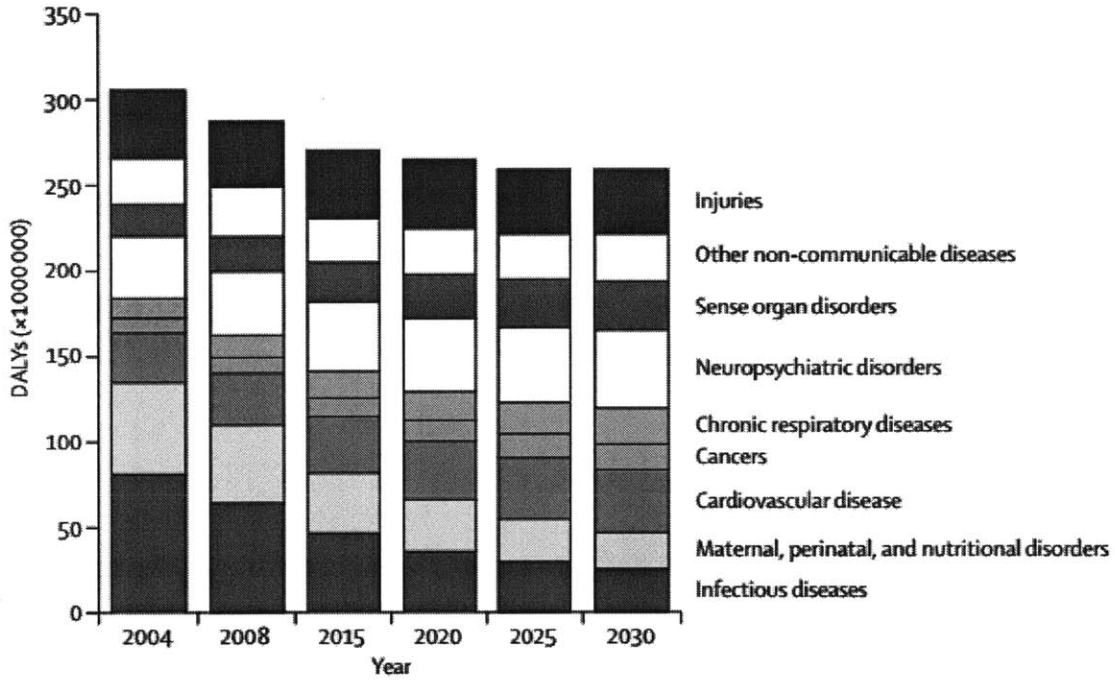


Figure 5: Projected Burden of Disease by Cause[21]

The following sections describe the contributors to the burden of disease in India.

2.1.1.1 Maternal and Child Health[22]

India adopted WHO's Millennial Development Goals (MDGs) with target to reduce maternal mortality rate (MMR) to 109 and infant mortality rate (IMR) to 28 per 1000 live births by 2015. It succeeded in reducing both the rates, but is unlikely to meet the targets, and also has the highest (MMR) and (IMR) among the BRICS (Brazil, the Russian Federation, India, China and South Africa) nations.

India has 20 percent of worlds adolescent (ages 10 to 19 years) population (UNICEF 2011)[23]. With the prevalence of early marriage and childbirth among adolescents, the health indicators for maternal and child health worsen. Each year, over 55,000 women die during pregnancy or childbirth related complications. 42 percent of women who start pregnancy are under weight.[24] 70 percent of maternal deaths during child birth are preventable.

At an annual crude rate of 20 births per 1000 population, the number of births per year is the highest in the world for India, so is the number of deaths of children aged below five years. The major diseases affecting the infants and children aged below 5 are 3.1 percent congenital, 8 percent other infections and parasitic diseases, 10 percent diarrheal, 23 percent respiratory infections, and 46 percent perinatal conditions.[25] 28 percent of infants are born under weight. The nation has the highest number of children below age 5 who are under weight, with 48 percent of the population of children below 5 being under weight. 20 percent of the children below 5 suffer from moderate to severe wasting and 8percent show stunted growth. Only 13 percent of pneumonia cases receive antibiotics for treatment. About 20 percent of children below age of one receive vaccination for Hepatitis B-3. There are around 880,000 women above age 15 suffering from HIV increasing the risk of mother to child transmission of the disease.

India experiences over 2 million deaths from preventable infections or vaccine preventable diseases. Birth at home by unskilled or untrained health professional, lack of essential care for the new born for asphyxia and hypothermia, lack of early detection of sick new born, and lack of specialized care for a sick new born contribute to these 2 million deaths every year.

2.1.1.2 Non-communicable Diseases

Affluence, progressive aging of the population, freedom from many dreaded infectious diseases and upward social and economic mobility have led to prevalence of diseases such as cardio vascular diseases, diabetes mellitus, blindness, accidents, obesity, trauma and injuries and psycho-emotional problems. The socio-economic development is generally associated with more health conscious behavior. However in India improving socio-economic conditions is linked with low physical activity and high incidences of obesity and diabetes.

Chronic disease including diabetes, cardiovascular, respiratory, cancer, and mental diseases often occur as co-morbidities, that is simultaneous occurrence of two or more chronic diseases in a person. More than 20 percent of the population has at least one chronic disease and more than 10 percent has two or more chronic diseases. These diseases are high in the age groups of less than 45 years and in the poorer populations.

The rising incidences of lifestyles diseases (Table 4) can be seen in the increased percentage of hospitalization cases in years 2001 and 2012.

Disease	2001 (percent)	2012 (percent)
Lifestyle Diseases		
Asthma	5.1	7.4
Other circulatory	4.0	6.0
Heart diseases	3.9	5.0
CNS disorders	2.8	1.7
Diabetes	2.0	2.2

Cancer	0.7	1.7
Accidents and emergency	3.0	2.0
Others	9.8	11.2
Acute Diseases		
Acute infections	54.7	42.0
Orthopedics and rheumatology	9.0	13.0
ENT, eye, and skin	5.0	7.8
Total	100	100

Table 4: Percent of Hospitalization Cases (CBHI, India)

These NCDs constitute almost 40 percent of all hospital stays and almost 35 percent of all recorded outpatient visits. NCDs are replacing communicable diseases, maternal and child health as well as malnutrition as the leading cause of death. According to a World Health Organization (WHO) report (2002), cardio-vascular diseases will be the largest cause of death and disability in India by 2020.[26]

Besides economic stress on the healthcare system, the NCDs affect the productivity and economic growth (contribution to GDP).[27]The DALY losses due to infectious diseases are expected to decline from 56 percent in 1996 to 25 percent by 2020. However, the DALY losses due to non-communicable diseases are projected to increase from 29 percent in 1990 to over 57 percent in 2020 (Rajagopalan 2000).

The probability of dying from one of the NCDs and mental health conditions in the age group of 30-60 years, the most productive years of life, is 26 percent. Without intervention, the world stands to lose $47 trillion (India's share $4.58 trillion) in economic output between 2010 and 2030.

Risk factors for the chronic diseases are highly prevalent in the Indian population. A World Health Survey was conducted as a household survey in 2003 related to these risk factors. As a result of the survey, the number of deaths attributable to the main risk factors is shown in Figure 6.[28]

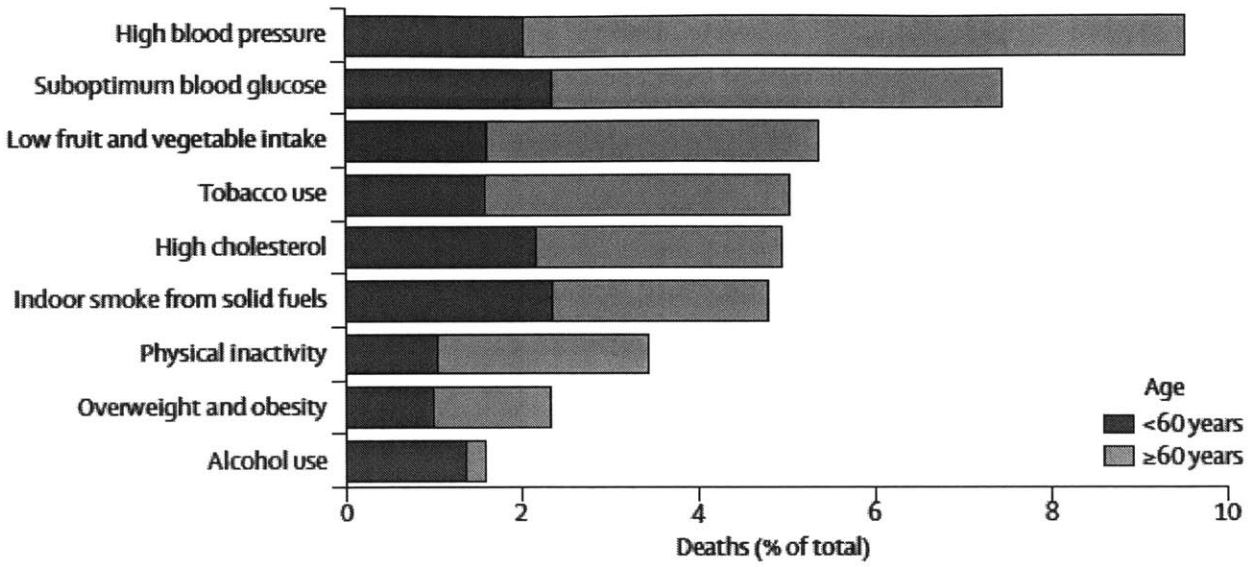


Figure 6: Estimates of Deaths Attributable to Chronic Disease Risk Factors (2004 Data)

Smoking is responsible for 1 in 5 deaths in men and 1 in 20 deaths in women. Smoking prevalence is high in youth as well with 17 percent for boys and 9 percent for girls. 2.5 percent of the men are heavy drinkers with five or more drinks at least two days in the previous week. 12.4 percent of the population does not do sufficient physical activities. 7.3 percent of the population is over-weight and 1.2percent is obese. 80 percent of the population uses solid fuel for cooking.

As per GBD 2010, the three risk factors that cause the most disease burden in India are dietary risks, household air pollution from solid fuels, and tobacco smoking. The leading risk factor for children under 5 was childhood underweight and for adults aged 15-49 years the occupational risks in 2010.

By 2020, with a median age of 29 years, India will be the youngest country in the world. Between 2006
and 2050, the overall population will grow by 40 percent, while the 60 age and above population is likely to grow by 270 percent, constituting 20 percent of the overall population in 2050.[29] This is illustrated in Figure 7. The elderly are divided among three categories: 60-70, 70-80, and 80 plus. Although all three categories

are more likely than the younger age groups to have NCDs, the oldest in these categories, which happens to be growing at 500 percent, is the most vulnerable to disabilities, terminal illnesses, dementia, and other diseases. In addition, almost 50 percent fall below the poverty line. The burden of disease is expected to rise in parallel to ageing of the population.

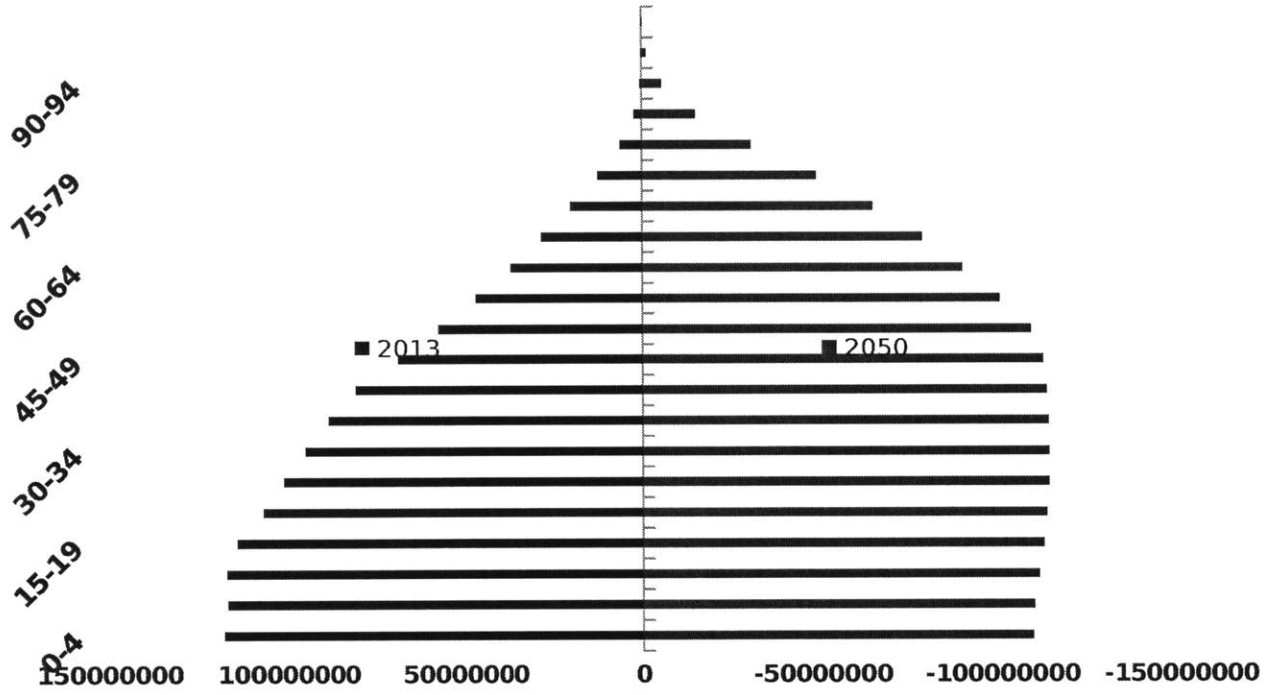


Figure 7: Population Pyramid 2013(LHS) VS 2050 (RHS), (World Bank 2013)

NCD burden will significantly increase in the future. To take one example, obesity which is a major risk factor for diabetes, cardiovascular diseases, hypertension, and some cancers will affect 52.1 million by 2030. The people with diabetes will increase to 69.9 million in 2025. The policies to address the healthcare burden will need focus on prevention as well as curative care strategies for the NCDs.

2.1.1.3 Communicable Diseases

Communicable diseases continue to be a health burden for India. Many communicable diseases like tuberculosis, leprosy, vector borne diseases (malaria, kala-azar, dengue fever, chikungunya, filaria, Japanese encephalitis), water-borne

diseases (cholera, diarrheal diseases, viral hepatitis A & E, typhoid fever), zoonotic diseases (rabies, plague, leptospirosis, anthrax, brucellosis, salmonellosis), and vaccine preventable diseases (measles, diphtheria, tetanus, pertussis, poliomyelitis, viral hepatitis B) are endemic in the country. Community surveys show that about one-quarter of all deaths in the country are due to diarrheal diseases, respiratory infections, tuberculosis and malaria. [30]

Many infections are as a result of poor sanitation, contaminated food, inadequate personal hygiene, or access to safe water and lack of basic health services. These conditions are common to large parts of India.

Deutsche Lepra-und-Tuberkulosehilfe estimates that every fifth new tuberculosis case in the world lives in the Indian subcontinent. The annual risk of TB infection has decreased from 1.5 percent (2002-2003) to 1.1 percent (2007-2010). Still, 23 persons per 100,000 population die every year out of 266 cases reported. India also has the highest number of multidrug resistant TB cases in the South East Asian region.

Malaria accounts for 1.5 million cases annually with an incidence rate of 1.3 cases per 1000 population. Dengue is endemic in 31 states and union territories of the country. 129 million people are at risk of kala-azar. Japanese Encephalitis has caused epidemics in the recent years. Despite early predictions of a disaster, almost three million people are living with HIV virus. Bacterial resistance is a growing threat because of the widespread misuse of broad-spectrum antibiotics.

India's HIV epidemic is slowing down, with a 57 percent decline in new HIV infections between 2000 and 2011, and a 29 percent decline in AIDS-related deaths between 2007 and 2011.[31] It is estimated that about 2.40 million (1.93 -3.04 million) people are living with HIV with an adult prevalence of 0.31percent (2009). Children (<15 yrs) account for 3.5 percent of all infections, while 83 percent are the in age group 15-49 years. 39 percent (930,000) of all cases are among women.[32]

2.1.1.4 Emerging Infectious Diseases

Adding to the burden of disease are the Emerging Infectious Diseases (EIDs). These are the diseases whose incidence has increased in the recent past or is expected to increase in the near future. EIDs include previously undefined diseases as well as old diseases with new features. These new features may include the introduction of a disease to a new location or a new population (*e.g.* it may present in youth where previously it was only seen in the elderly); new clinical features, including resistance to available treatments; or a rapid increase in the incidence and spread of the disease. [33]

Some of the incidents of EIDs are that re-emerged in the recent past are -a large scale cholera breakout in 1992; occurrence of plague in 1994; incidence of diphtheria- a vaccine preventable disease with more than 8000 cases reported in 2004; isolation of new virus belonging to family rhabdoviridae with fatality rate of 55percent and cases identified in 2004 and 2007; and, the morbidity and disability caused due to chikungunya with a loss of 45.26 DALYs per million population in 2006 epidemic. Also, till August 2010, a total of 15,4259 persons were tested for H1N1 influenza and 23.4 per cent were found to be positive and 1833 of these cases resulted in death.

2.2 Supply

The supply side of the healthcare system constitutes the resources spent in the delivery of care. It includes the expenditure, infrastructure, and trained healthcare professionals.

The overall funding allocated to healthcare is 4.1 percent of GDP, which is high in comparison to other emerging countries. However, the government spending is very low at less than or equal to 1.5% of GDP and the remaining share of healthcare spending is from the private sector. This trend with private sector spending more than double the government spending is seen only in India.

The healthcare infrastructure in India is a network of public and private facilities. To alleviate the financing burden for the growth and development of healthcare system, the private and public sectors are now collaborating at a varied pace and are working across a few states in India forming public-private-partnerships (PPPs). Some of the successful PPPs involve laboratory services (pathology, radiology, CT scan, MRI etc.), mobile medical units, PHC management, telemedicine services and hospital maintenance. A few other models that have been experimented with by the states are: contracting out, contracting in, lease, service agreements (outsourcing), buying of a product/ service, joint venture company, social marketing and franchising. Other opportunities for PPP are- sector service delivery through telemedicine, high end tertiary care, innovative models for delivery in rural areas, and community insurance schemes.

The healthcare delivery system is dominated by the private facilities in India with overall 70 percent of the total source of care. These facilities account for 93 percent of all hospitals (up from 8percent in 1947), 64 percent of all beds, and 80 percent to 85 percent of all doctors. Most of this organized private infrastructure is confined to the state capitals or Tier I cities.

India lags most countries in terms of healthcare infrastructure. The U.S. has three beds for every 1000 patients while Japan has 14. In contrast, India has one bed for

every 1,050 patients (Figure 8). The global average 2.9 beds per thousand population, and WHO recommends a bed density of 3.5 beds per thousand. The country also faces shortage of qualified medical professionals. It has 0.7 doctors and 1.5 nurses per 1,000 people that are significantly lower than the WHO average of 2.5 doctors and nurses per 1,000 people (Figure 9). Combined with this, there is an acute shortage of paramedical and administrative professionals. India's healthcare information technology (HIT) is still in early stages of development.

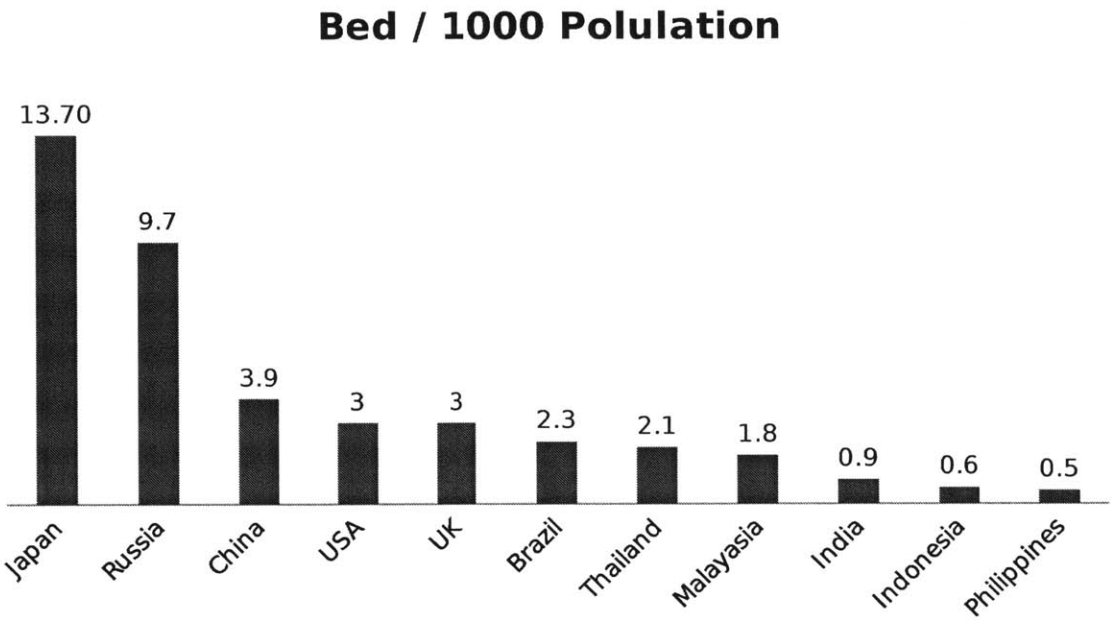


Figure 8: Bed per Thousand Population in India (World Health Statistics 2013)

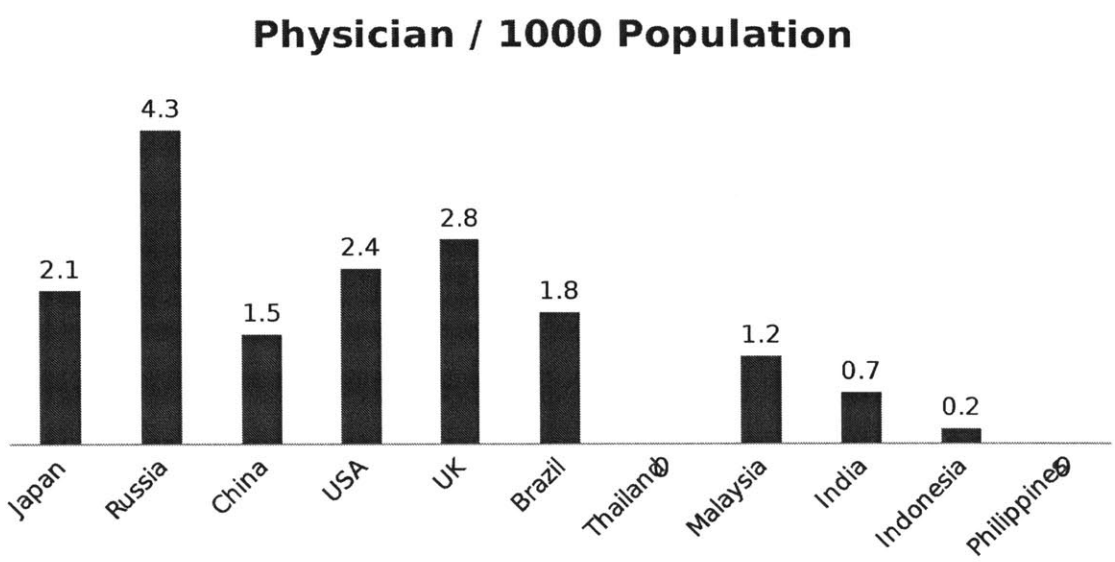


Figure 9: Physician per Thousand Population in India (World Health Statistics 2013)

The public healthcare system is of particular significance in providing free or low cost services to the poor population. It includes sub centers, primary health centers, and community health centers. The Ministry of Health and Family Welfare (MoHFW) in India has indicated a shortfall of public healthcare facilities (2011 Data) as shown in Table 5.

	Required	Functioning	Shortfall
Sub Centers	183886	148124	35762
Primary Health Centers	30935	23887	7048
Community Health Centers	7575	4809	2766

Table 5: Public Health Infrastructure- Shortfall in Facilities (MoHFW, 2011)

The sub centers are for essential health needs and basic drugs and minor ailments. The primary health centers are 4-6 bed facilities and serve as supervisory for the sub centers. The ratio of sub center to primary health center is 6. The community health centers are the facilities with at least 30 inpatient beds, operating theatre, x-ray, labor room, and laboratory facilities. For better healthcare coverage, MoHFW

noted the gap in required and available services at the primary and community health centers (Table 6).

	Required	Available	Gap
At Primary Health Centers			
Operation Theatre	23887	9131	14756 (61.8 percent)
At Community Health Centers			
Laboratory	4809	4545	264 (5.5 percent)
Operation Theatre	4809	4190	619 (12.9 percent)
Labor Room	4809	4557	252 (5.2 percent)

Table 6: Public Health Infrastructure- Shortfall in Services (MoHFW, 2011)

2.2.1 Healthcare Expenditure

The Declaration of Alma-Ata in September 1978 expressed the need for all governments and world community to work towards "Health for All". Following the declaration, India invested in the public healthcare system, especially in the rural sector, reaching the levels of 1.5 percent GDP in the eighties. These efforts brought down the Infant Mortality Rate and improved Life Expectancy. The economic reforms of the nineties cut down the healthcare expenditure.

In the past years India's spending on healthcare has been increasing (Figure 10). It still continues to be among the lowest in the world. As a percentage of GDP, India's healthcare expenditure has been around 4 percent for the past few years (WHO data). In nominal terms, the healthcare expenditure has not been growing at the same pace as the GDP. WHO recommends that countries spend 5% of their GDP on healthcare. [34]

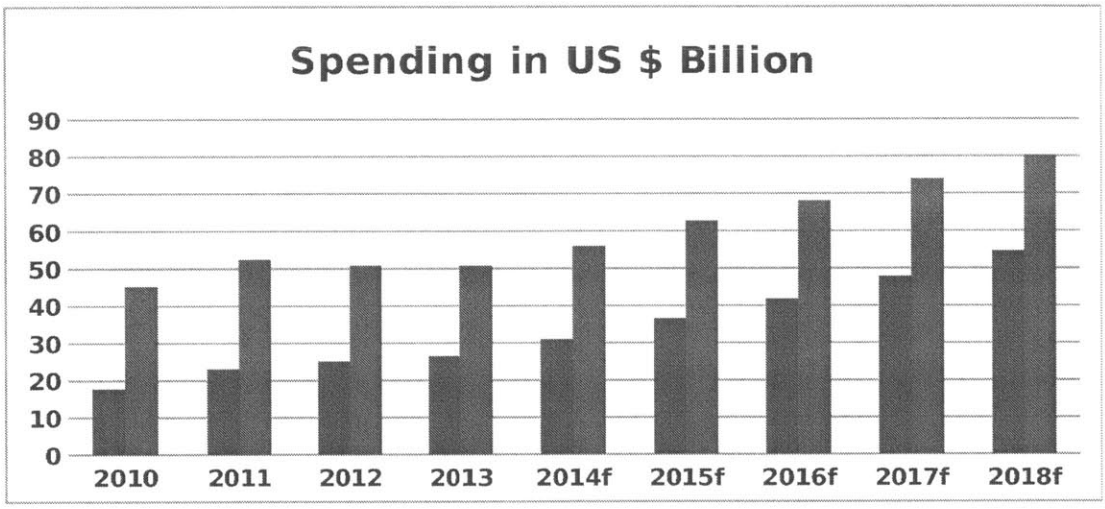
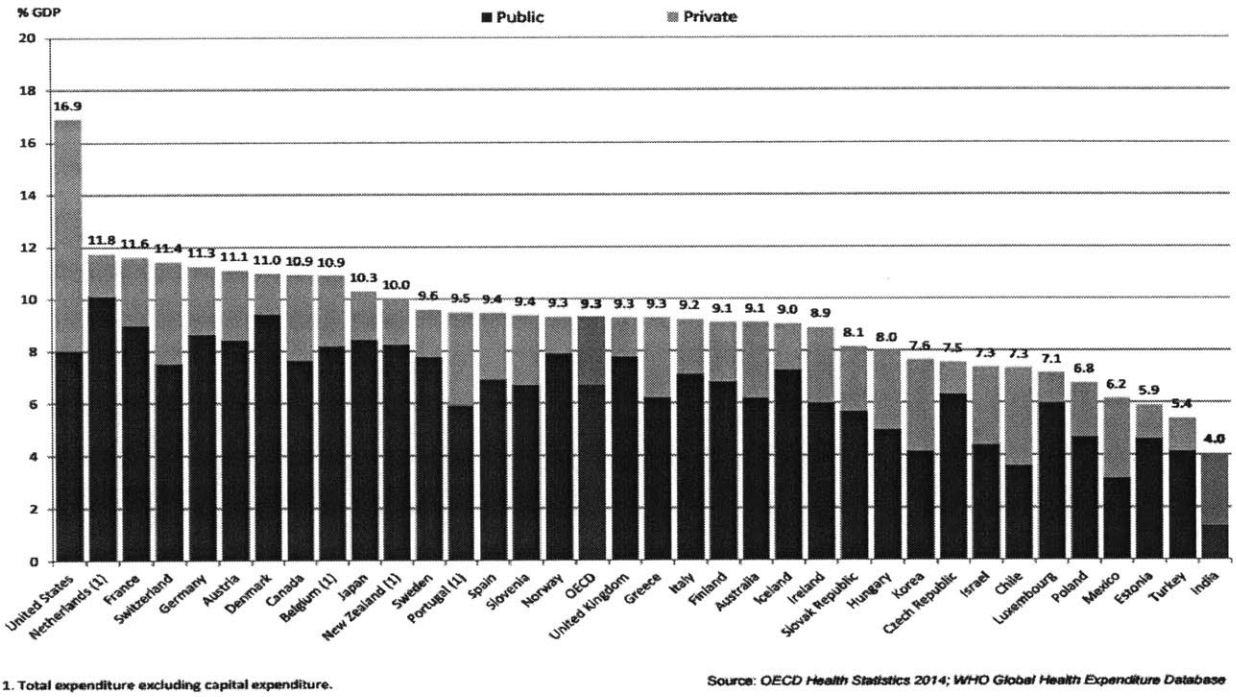


Figure 10: Government and Private sector healthcare spending in India

As compared with health expenditure in other countries (Figure 11), a few points to note-

1. At 4 percent of GDP, India spends almost half of average 9.3 percent spending in OECD (Organization for Economic Co-operation and Development) countries.[35]

2. India spends about 1 percent of its gross domestic product (GDP) on public health, compared to 3 percent in China and 8.3 percent in the United States.
3. In 2012, with spending of USD 157 health expenditure per capita (calculated based on purchasing power parity), India ranks low as compared with an OECD average of USD 3484. (The higher the income, greater is the health expenditure per capita).



1. Total expenditure excluding capital expenditure.

Source: *OECD Health Statistics 2014; WHO Global Health Expenditure Database*

Figure 11: Health expenditure as a share of GDP, India and OECD countries, 2012 or latest year

4. The private expenditure is 3 percent of GDP, with 85.9 percent of this being out of pocket payments (World Bank 2013). China's out of pocket expenses as percentage of private expenditure on health was estimated at 76.7 percent, and USA's was 22.3 percent.

The healthcare expenditure is forecasted to grow as shown in Figure 10. The forecast for 2015 will be lower than projected. Due to fiscal constraints and

underutilization of funds allotted in the previous budget, the government slashed the 2014/15 healthcare budget by almost 20 percent (~USD 948 Million).[36]

The Constitution of India makes the states responsible for the provision and delivery of health services with the cost shared by the states and the central government (the central government contributes 36 percent). Spending in healthcare is not a priority for either of the level of government except in few cases of national and global concern.

According to a World Bank study (2012) the per capita spending on health in India is around Rs. 320 per year with a significant input of 75 percent from private households. The State Governments contribute 15.2 percent, the Central Government 5.2 percent, third party employers 3.3percent and the municipal government and foreign donors provide about 1.3 percent to the total spending, of which 58.7percent goes to primary healthcare (curative, preventive and promotional) and 38.8 percent is spent on the secondary and tertiary care.[37]

A High Level Expert Group (HLEG) on Universal Health Coverage (UHC) was constituted by the Planning Commission of India in October 2010 to develop a framework for providing easily accessible and affordable healthcare to all citizens. Consistent with the government estimates, HLEG projected the healthcare spending and the public-private share till 2021-2022 for UHC. The public expenditures on health will need to be stepped up from around 1.2 percent of GDP today to at least 2.5 percent by 2017 and to 3 percent of GDP by 2022, with the combined public and private spending on health remains at the current level of around 4.5 percent of GDP (Figure 12). Increased public expenditure is likely to result in a sharp decline in the private out-of-pocket spending on health - from around 67 percent today to around 33 percent by 2022 (Figure 13).

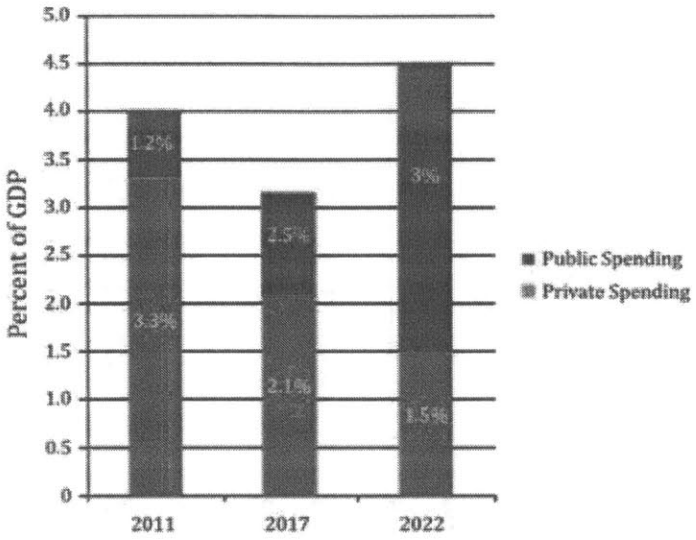


Figure 12: Projected Share of Public Private Spending in Healthcare

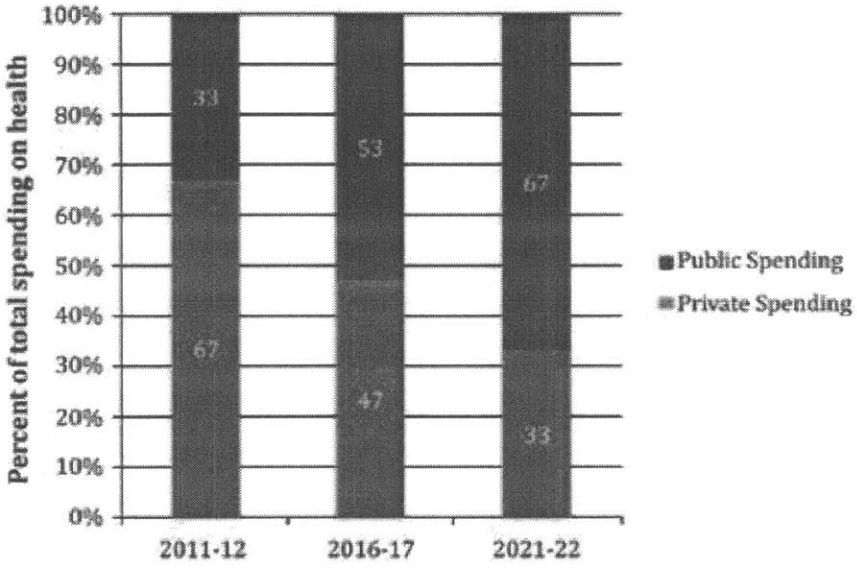


Figure 13: Projected Proportions of Public Private Out of Pocket Spending

2.2.2 Healthcare Infrastructure

The healthcare infrastructure is primarily a network of private and public providers as represented in Figure 14. The public healthcare facilities are managed by the central and state government and provide services for free or subsidized fee. The public system is designed to provide universal health services. Its three tier structure of primary, secondary, and tertiary care is meant to ensure that all households, rural and urban, are close to (within 2 kilometers of) a free public health facility that is fully staffed by a medical professional. When not free, the services in a public facility are still the cheapest option for medical care. As per the planning commission of India, the cost of outpatient services in a private facility is 20-54 percent more expensive than service in a public facility and the inpatient care is 100-740 percent more expensive than in a public facility.

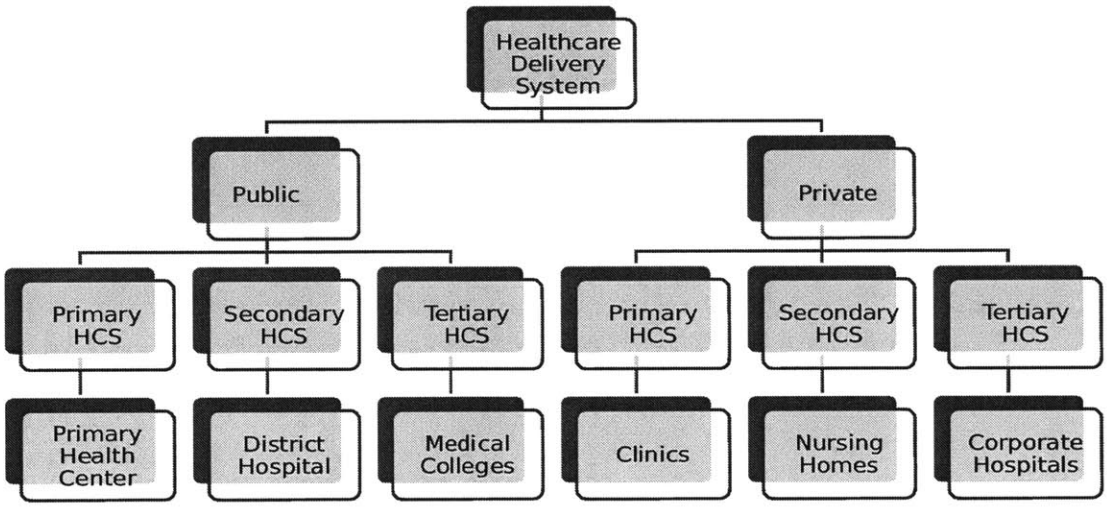


Figure 14: Healthcare Infrastructure in India

A High Level Expert Group (HLEG) on Universal Health Coverage (UHC) envisioned the UHC for India that-

- UHC is an entitlement for the people
- UHC guarantees access to an essential health package (including cashless inpatient and free of cost out-patient care)

- Freedom to choose between public sector facilities and contracted-in private facilities

To realize this vision, one of the recommendations of HLEG and other stakeholder consultations for the period of 2012 to 2017 is - substantial expansion and strengthening of public sector healthcare system, freeing the vulnerable population from dependence on high cost and often unreachable private sector healthcare system.[38]

The existing structure of the public healthcare system provides public health as well as clinical services through its sub centers, primary health centers, community health centers, and district hospitals.

Primary Healthcare System

Primary care in the public system is provided through sub centers and primary health centers (PHC) in rural areas, and family welfare centers in urban. The sub center serves a population of 5000 in plains and 3000 persons in hilly and tribal areas. The PHC serves every 30000 population in the plains and 20,000 persons in hilly, tribal and backward areas. Each PHC supervises 6 sub centers.

Secondary Healthcare System

Secondary Healthcare refers to a second tier of health system. The health centers for secondary healthcare include District hospitals (at least 150 beds) and Community Health Centers (at least 30 beds).

Tertiary Healthcare System

In India, under public health system, tertiary care service is provided by medical colleges and advanced medical research institutes with provisions for specialized Intensive Care Units, advanced diagnostic support services and specialized medical personnel.

There has been an increase in the public health facilities over the period of 2007-2011- Primary Health Centers (PHC) by 5 percent (shortfall remaining of 24 percent) and District Hospitals by 45 percent.[39]

The number of private facilities has been increasing at an annual rate of around 6.0 percent and the total is estimated to exceed 21,000 (in 2014). Several Public-Private Partnership initiatives run by NGOs have been successfully running and are especially catering to the underprivileged in the rural and the urban areas.

An estimated 95 percent of all new hospital beds created in recent years have been in the private sector. According to the Ministry of Health, the private facilities provide around 80 percent of outpatient care and around 60 percent of inpatient care; and, account for more than 75 percent of human resources and advanced medical technology, 60 percent of hospitals and 37 percent of beds in the healthcare delivery system. The majority of these are in the urban areas. India has less than one bed per 1,000 people. Figure 15 shows this data for OECD countries.

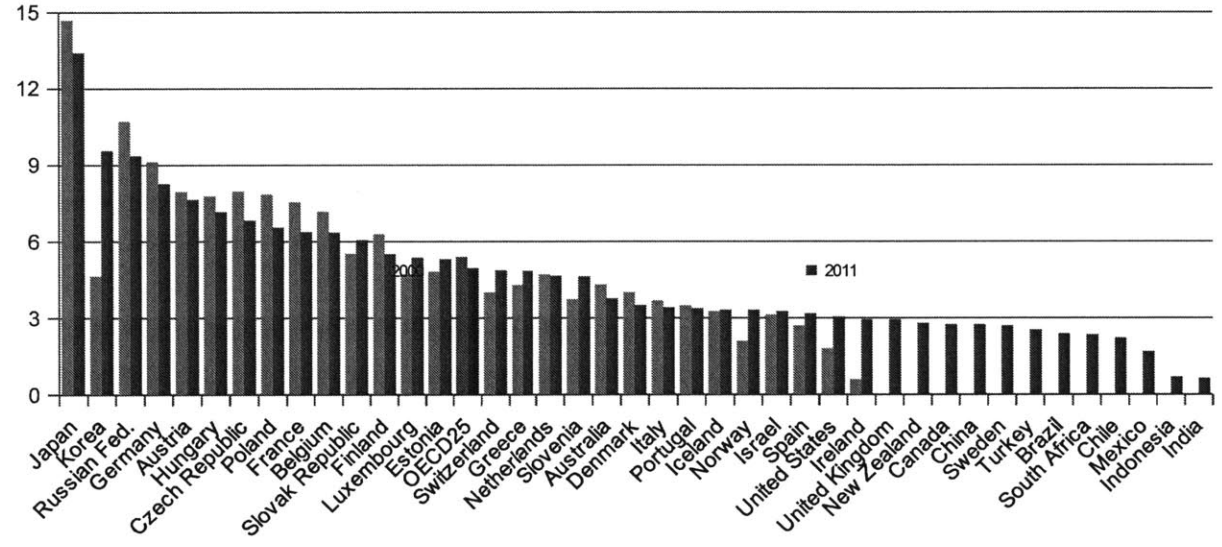


Figure 15: Hospital Beds Per 1,000 Population, 2000 and 2011 (or nearest year) (OECD Data)

A considerable percent of hospital beds are not functional. Also, there is a disproportionate distribution of beds in favor of the top cities (Figure 16).

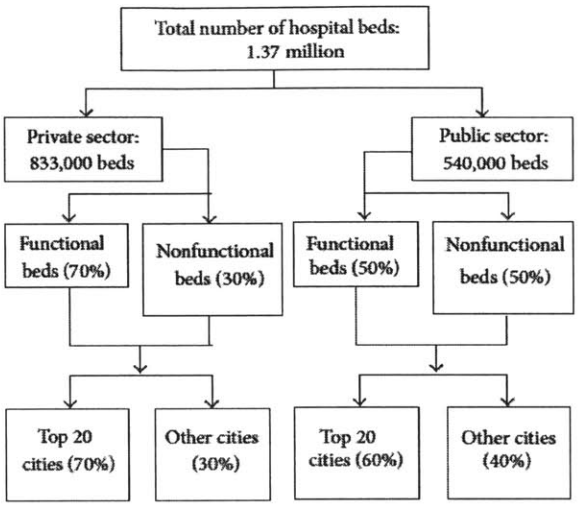


Figure 16: Distribution of Available Beds[40]

India has witnessed an increase in its healthcare workforce (Table 7).

Healthcare Personnel	2008	2009	2010	2011	2012	2013
Physician	761,429	793,305	816,629	850,221	883,812	918,677
Per 1000 population	0.6	0.7	0.7	0.7	0.7	0.7
Nurses	1,652,161	1,702,555	1,894,968	2,124,667	2,241,833	2,241,833
Per 1000 population	1.4	1.4	1.6	1.7	1.8	1.8
Dentist	93,332	104,603	114,047	118,370	120,897	132,608

Per 1000 population	0.1	0.1	0.1	0.1	0.1	0.1
Pharmacist	616,630	635,856	655,081	656,101	630,766	639,984
Per 1000 population	0.5	0.5	0.5	0.5	0.5	0.5

Table 7: Healthcare Personnel in India over the Years (WHO data & BMI forecast)

India's 12th Five Year Plan (2012-2017) draft quotes the improvement as- Auxiliary Nurses and Midwifes (ANM) 27 percent, nurses 119 percent (shortfall remaining for ANM and nurses 52 percent), doctors 17 percent (shortfall remaining 76 percent), specialists 36 percent (shortfall remaining 88percent), and pharmacists 38percent (shortfall remaining 58 percent).

India's healthcare workforce, as compared with that of other BRICS countries and globally, is illustrated in Figure 17.

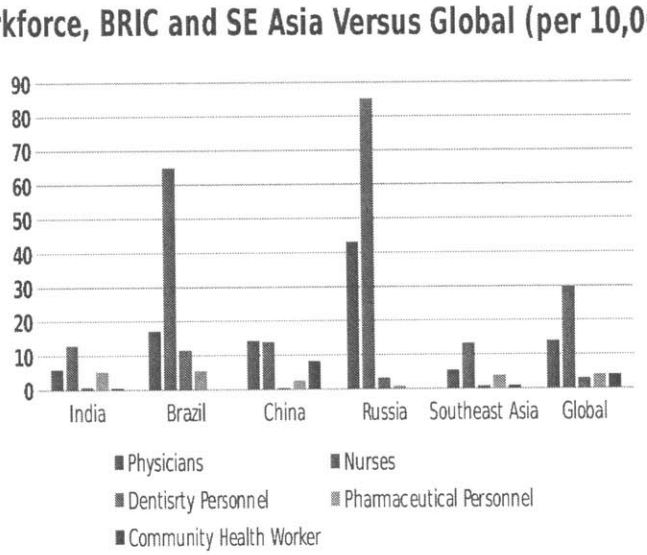


Figure 17: Healthcare Workforce comparison (Frost & Sullivan Analysis)

Table 8 shows the current infrastructure including the health personnel.

Current Infrastructure	
Hospitals	**15393**
Public	**4049**
Private	**11344**
Hospital Beds	**1370000**
Doctors	**592215**
Nurses	**937000**
Dentists	**80000**
Medical Colleges	**170**
Retails Chemist Outlets	**350000**
New Doctors per year	**18000**

Table 8: Current Healthcare Infrastructure in India

Accreditation of hospitals offers higher efficiency, accountability, better governance for the care

providers, and greater benefit and safety to the patients. It also ensures continuous improvement of the healthcare resources- infrastructure as well as professionals. In India, accreditation is voluntary, still many hospitals are seeking it from national and global agencies. Table 9 gives the number of hospitals that are accredited or in the process of doing so.[41]

No. of Indian Hospitals - Accredited and Applicants	
National Accreditation Board for Hospital and Healthcare Providers	
NABH Accredited	51
NABH Applicants	358
Joint Commission International	
Accredited	16

Table 9: Accreditation Status of Hospitals

3. Development of System Dynamics Model

In this study, a system dynamics simulation model is developed to elucidate complexities in the healthcare system with regards to affordability. The model is also used to evaluate various policy decisions over time. The main objective of the thesis is to illustrate how a health system behaves and to understand what can be done to improve the system.

The paper referred to for the system dynamics model is "System Dynamics Model of Singapore Healthcare Affordability" by Adam Tsan Sheng Ng, Charlie Sy, and Jie Li, National University of Singapore.[42]

3.1 Visualization of Healthcare System

Figure 18 depicts the Causal Loop Diagram (CLD)[43] of the healthcare system in India with key elements (represented by nodes) and their inter relationships (represented by links). A link marked positive means that the two nodes change in the same direction, either increase or a decrease. A negative link means that the two nodes change in opposite directions.

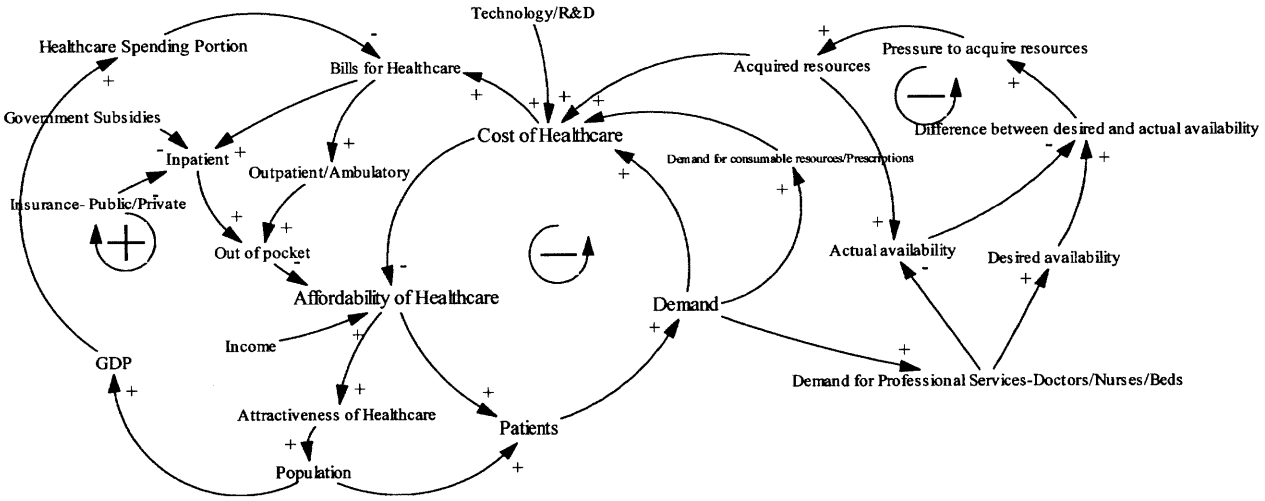


Figure 18: Causal Loop Diagram of Healthcare Affordability

A negative or balancing loop in CLD is a cycle in which the effect of a change in any variable propagates through the loop and returns to the variable a deviation opposite to the initial one. If a variable increases in a balancing loop the effect through the cycle will return a decrease to the same variable and vice versa. In a positive or reinforcing loop, the effect of the change reinforces the initial variation. The effect of the variation then creates another reinforcing effect. Without breaking the loop the system will be caught in a vicious cycles of circular chain reactions.

For affordability of care, the central loop is negative or balancing. When the affordability of care increases, more people will seek care services. As the number

of patients increase, the greater is the demand that drives up the cost of healthcare. As the cost of healthcare goes higher, the affordability of care services go down. This leads to a decrease in the number of patients in the system resulting in lowering of demand for the care services leading to lowering of cost of care, and improving the affordability of care eventually.

Affordability-Healthcare Spending loop is a reinforcing loop. A growth in population is expected to increase the GDP that ideally will also increase the healthcare spending. This increase in healthcare spending will contribute to Bills for Healthcare and thus decrease the out of pocket payments for patients. The lower out of pocket payments will increase the affordability and hence the attractiveness of the healthcare. As healthcare gets attractive, more population is expected to migrate to an area and thus add to the GDP.

Actual availability of Resources-Acquired Resources loop is a balancing loop. When the actual availability of resources decreases, then the difference between desired availability and actual availability of resources increases. And, the pressure to acquire more resources goes higher. As more resources are acquired, the actual availability goes higher, thus lowering the difference between desired availability and actual availability of resources.

3.2 Dynamic Hypothesis

The hypothesis relates to the affordability of care.

With the increasing burden of disease as seen in Section xx, more people will seek healthcare; and, as more people seek healthcare, the more will be the demand for medical services and resources- doctors, nurses, diagnostics, medicines, hospital beds, etcetera. With utilization, the actual availability of these services and resources goes down, which in turn drives up their desired availability. The

difference in the desired and actual availability necessitates acquisition of more resources, thus adding to the cost of care. Research and development and technology advancement are other cost drivers in the bills for healthcare. The healthcare spending from GDP contributes to the operating budget of the hospitals, is thus likely to lower the bills of hospital for the patients.

In India, only 17 percent of the population (5 percent of the households) is covered by a public or private health insurance scheme.[44] In majority of cases these schemes cover inpatient care only, thus reducing out of pocket payment for the beneficiaries. However, the cost of outpatient/ambulatory care is 100 percent out of pocket for the patient. As the out of pocket payments get lower, the affordability of healthcare goes higher. Higher incomes also add to the affordability of care. With healthcare becoming affordable, the more attractive it gets for the population to seek the medical services and driving up the demand.

3.3 Stock Flow Model

The dynamic behavior of the healthcare system is captured in the stock flow model. The software package used to create the model is Vensim. The stock flow model is based on the principle of accumulation i.e. all dynamic behavior is a result of flow accumulating in the stocks. [45] All types of informational and non-informational entities can pass through flows and accumulate in stocks.

Two sub-systems- Demand (persons seeking healthcare) and Supply (resources-doctors/nurses and hospital beds/healthcare expenditure) form the model. The base year for the study is 2010, unless specified. There is lack of available comprehensive data related to healthcare in India. Many of the processes in the healthcare system are still manual and paper based creating a challenge for collection of data. The data from more advanced private hospitals, which are better equipped with informational systems, is mostly not accessible to public domain.

The schema for the stock flow model (in Vensim) is as following (Table 10).

	Notation	Representation
1.		Stock/Accumulation/State Variable/Level
2.		Flow/Rate
3.		Auxiliary/Intermediate concepts or calculations
4.		Connectors

Table 10: Stock Flow Model Schema

3.3.1 Demand Subsystem

The population is divided into three age categories, 0-14 years, 15-59 years, and 60-60+ years, that are widely used in population demographics of India (several of these demographics are also part of the stock flow model, Figure 19).

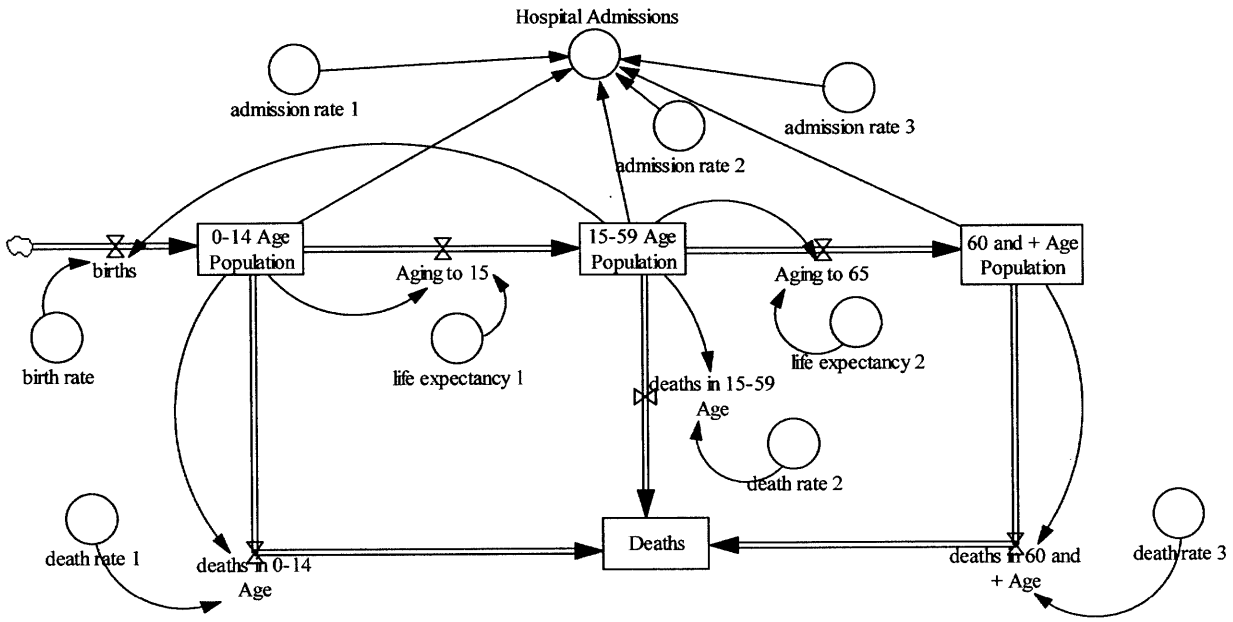


Figure 19: Demand Subsystem

The initial data on distribution of population, birth rate, and mortality rates by age groups in India is taken from Census of India: SRS Statistical Report 2011.[46] Life expectancy is assumed based on the mortality rate (Table 11).

Age Group (years)	Population (in thousands)	Mortality Rate (per 1000)	Life Expectancy (per 1000)
0-14	355,770	6	994
15-59	753,750	5	995
60 and above	96,480	60	940

Table 11: Population Distribution, Mortality Rate, and Life Expectancy by Age Group in India (2011)

The crude birth rate is 21 per 1000 (with minimum as 15 per 1000 for the state of Kerela and 28 for the state of Bihar in 2013).[47]

A survey conducted by National Sample Survey Organization, Government of India, in 2006[48] indicated the following morbidity and health status of the population (Proportion of ailing population, PAP, per 1000 persons) (Table 12). For convenience, rural-urban differential has not been considered.

Age Group (years)	PAP per 1000 persons	Level of Hospitalization (Number per 1000 persons
0-14	151	32
15-59	524	181
60 and above	651	147

Table 12: Health Status of a Population in Broad Age Groups (NSSO India, 2006)

(The reasons for not seeking treatment for an ailment, from the most cited to least, were- ailment not considered serious, financial problem, no medical facility available, lack of faith, and long waiting.)

Age 60 and above of the population show highest instances of ailments. In the next 25 years the burden of diseases is likely to go higher with rapidly ageing population. As accessibility and affordability of healthcare improves, it is likely that healthcare seeking behavior will improve as well, thus increasing the number of hospitalizations.

3.3.2 Supply Subsystem

The supply subsystem is made of two subsystems- Resources and Healthcare Expenditure. The subsystem of resources constitutes the non monetary resources- hospital beds and professionals (doctors, nurses, administrative). The subsystem of expenditure comprises of the spending on healthcare and the cost of healthcare, and the difference between the two thus presenting the affordability of the system.

3.3.2.1 Supply Subsystem - Resources

The availability of hospital beds in India is 0.7 per 1000 persons (WHO Data). The inflow of patients (hospital admissions) and the average length of hospital stay (set at 8 days in the model)[49] determine the bed occupancy. This bed occupancy is an indicator of the capacity utilization and performance of a healthcare system. The availability of the doctors and nurses is 2.1 per 1000 persons and only 1.9 per 1000 persons is in active practice (considered in the model).[50] The stock flow model for the resources is in Figure 20.

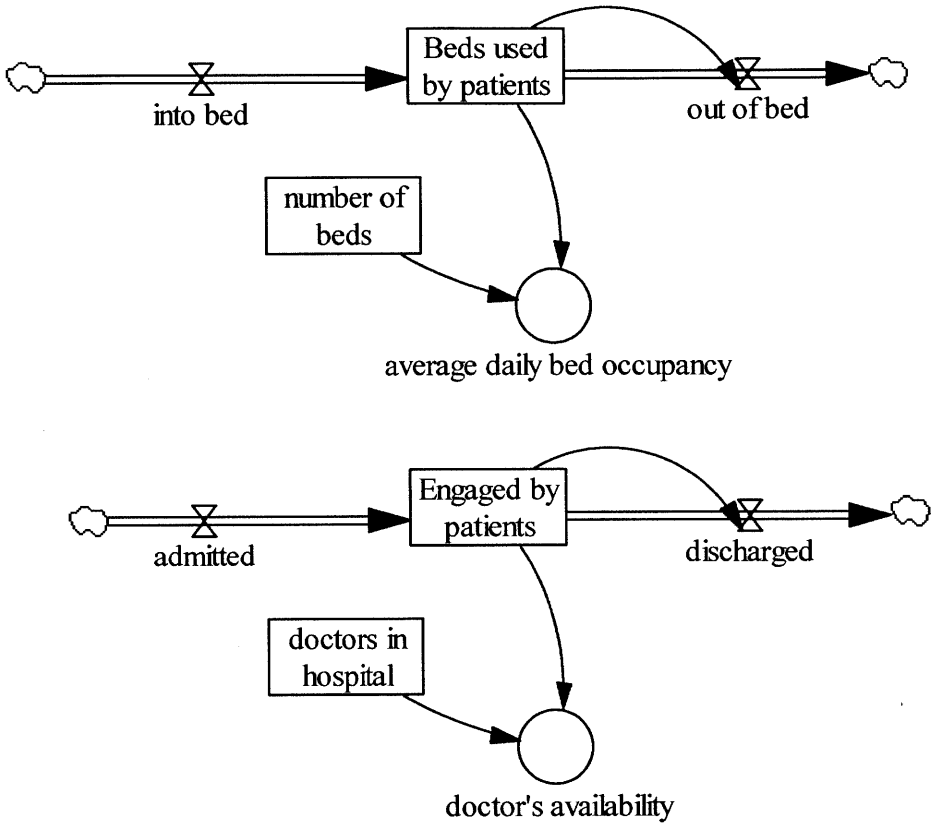


Figure 20: Supply Subsystem-Resources

3.3.2.2 Supply Subsystem - Healthcare Budget and Cost

The healthcare budget allocation has been discussed in the previous sections. The cost of healthcare in a District Hospital is estimated from two sources- 1) Unit Cost of Medical Services at Different Hospitals in India; Susmita Chatterjee, Carol Levin, and Ramanan Laxminarayan, and 2) The Cost of Universal Healthcare in India: Model Based Estimate; Shankar Prinja, Pankaj Bahuguna, Andrew D. Pinto, Atul Sharma, Gursimer Bharaj, Vishal Kumar, Jaya Prasad Tripathy, Manmeet Kaur, and Rajesh Kumar.

The cost of human resources-doctors, nurses, and administrative, the cost of materials- medicines (generic), medical devices, utilities, and maintenance, and the cost of capital- land, building, equipment, instruments, and furniture are assumed in

the ratio of 4:3:2 respectively for an average cost of curative care as $216 per case of hospital services annually. The public spending bears a part of this cost, and the rest as paid out of pocket by the households. For India, a household comprises a family of 4.8.[51] Figure 21 represent the supply subsystem.

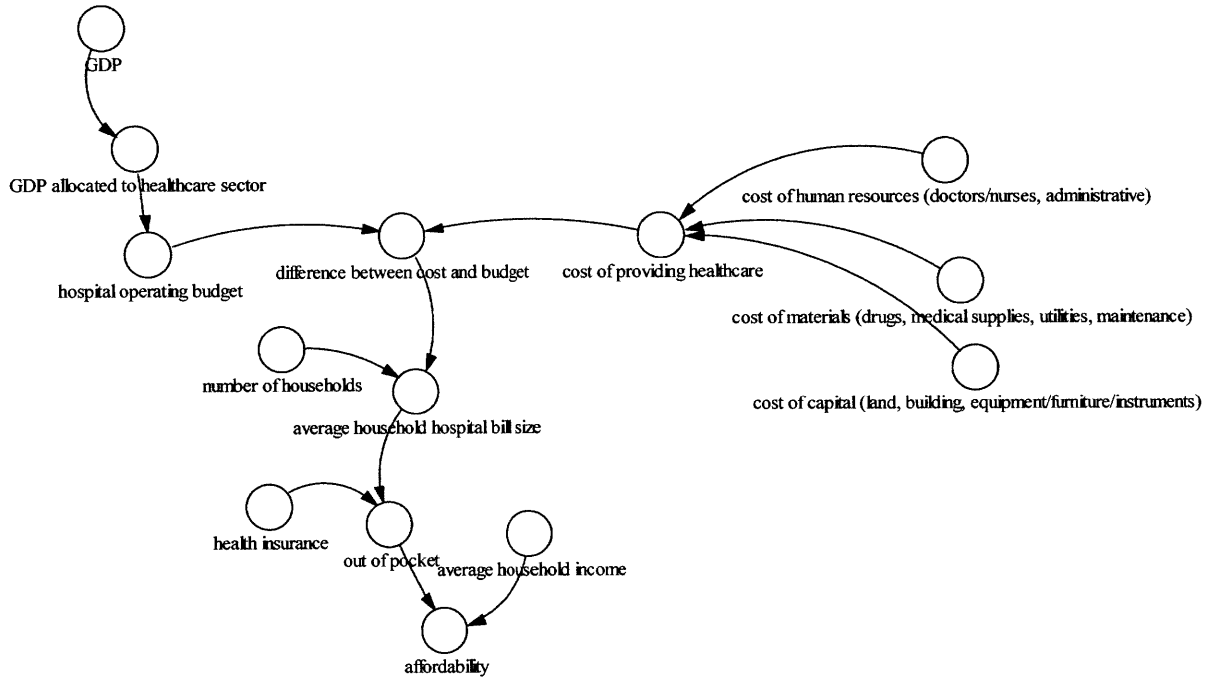


Figure 21: Supply Subsystem-Healthcare Expenditure

3.3.2.3 **Affordability**

There are two approaches to estimate affordability-[52]

1) Ratio of expenditures to total household resources: Under this approach, a product or a service is considered unaffordable if its payment exceeds a certain proportion of a household's income. If a large fraction of the income is spent on an item, there will be less remaining to spend on consumption of other goods and services. The threshold for affordability is subjective, and relative to other obligations of the households. This approach has been used

in determining affordability of transportation, education, healthcare, and utilities such as energy and water.

2) Method that focuses on the residual income after expenditure: This is called the "impoverishment" method and specifically focuses on the poor in the society. It takes into account the absolute quantity of resources available before and after payment for a product or a service. The poverty line forms the threshold of impoverishment. If a household that is above a poverty line drops below the poverty line when it pays for a product or a service, it can be thought to be impoverished because of the payment. This approach has been generally applied to affordability in housing and healthcare.

This study has followed the first approach for affordability of healthcare with focus on the general population and not just the poor (Figure 21). The annual household income (nominal) is assumed as $4,800 in the model.

4. Model Projections

The current healthcare system is tested for various scenarios including how the changes in demand and supply of hospital services and resources impact the affordability of care over the next 50 years. These projections are not definitive. The study needs a more comprehensive analysis and consultations with subject matter experts to be able to prescribe recommendations. The scope of the study is limited to indicative impact of the existing healthcare system in India.

1. Demand for hospital services: With the increasing burden of disease, the hospital admissions will rise in the coming years (Figure 22).

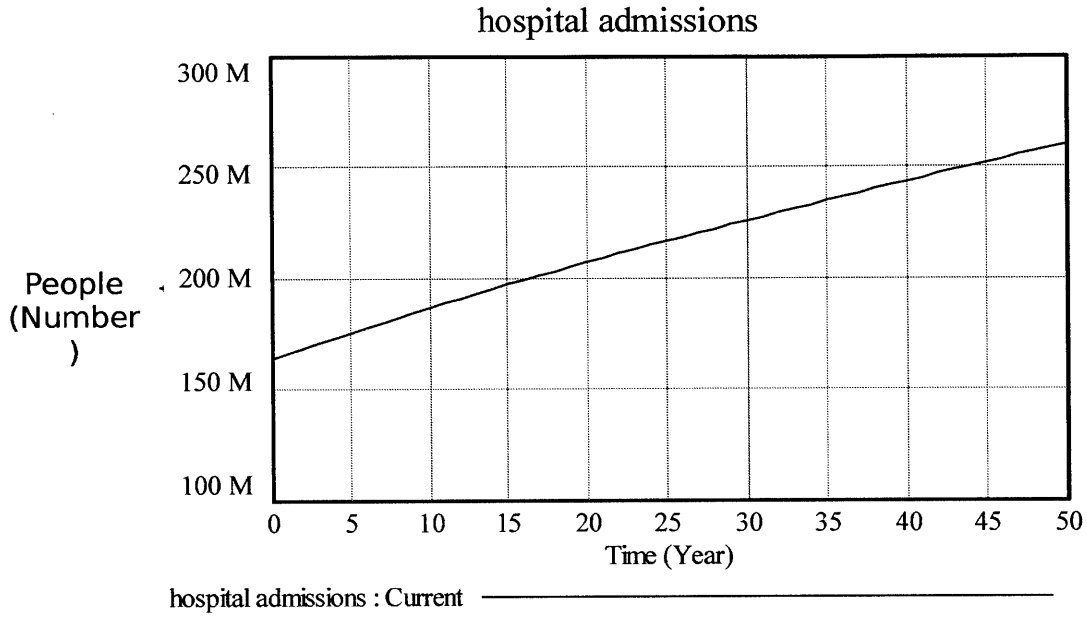


Figure 22: Demand for Hospital Services (Projections for Hospital Admissions)

2. Cost of providing healthcare: The supply is represented by the physicians and medical professionals, and hospital beds in both public and private facilities. The cost of providing curative care in USD is projected in Figure 23.

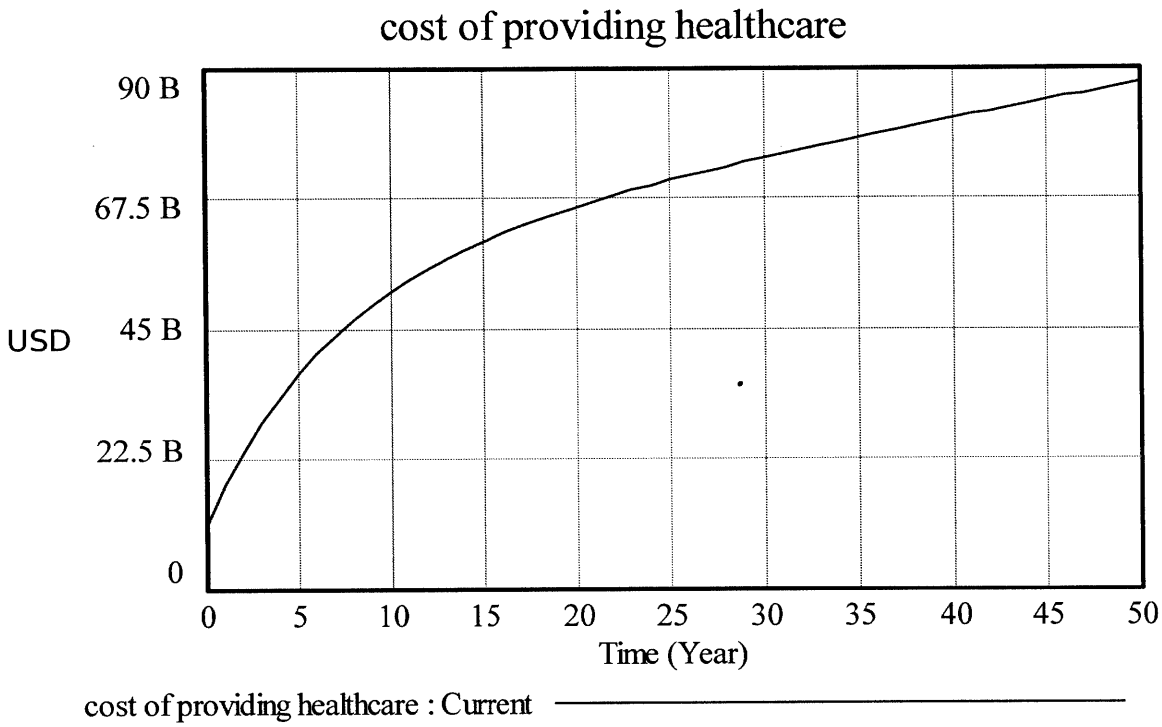


Figure 23: Cost of Providing Healthcare Projections

3. Difference between public healthcare expenditure and cost of healthcare: At current levels of public expenditure as percentage share of GDP set at 1 percent, the difference between the cost and expenditure is expected to continue rising (Figure 24).

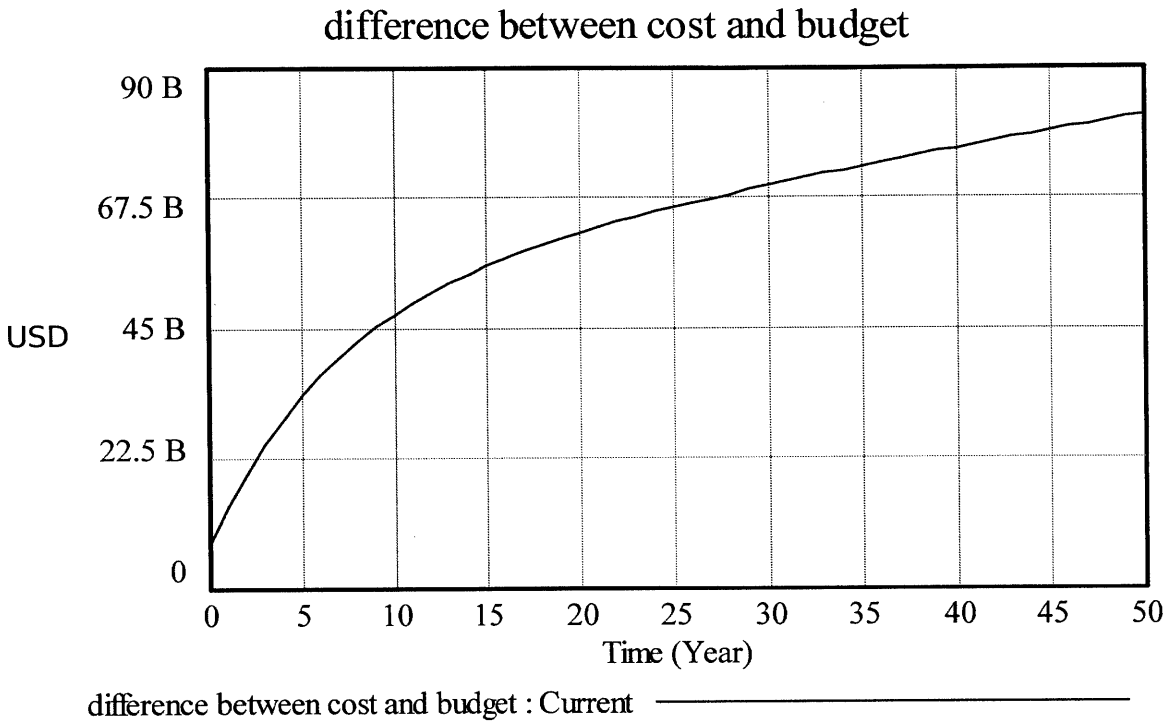


Figure 24: Difference between Cost of Healthcare and Public Expenditure Projections

A senior health ministry official advised that the universal health coverage (UHC) in India with a package of essential care for all including free drugs and diagnostic treatment, as well as insurance cover to treat serious ailments will cost $ 26 billion over the next four years. Once UHC is implemented, it would take $11.4 billion annually to maintain the level of service. Currently, the annual budget allocation is of $5 billion.[53] The model projections for difference between cost of healthcare and public expenditure are also indicating a similar government spending initially.

4. Household hospital bill size: The average hospital bill per household in USD is projected in Figure 25. The cost of services at the hospitals is likely to increase in the coming years as the demand goes up at a pace faster than development of the supply side resources.

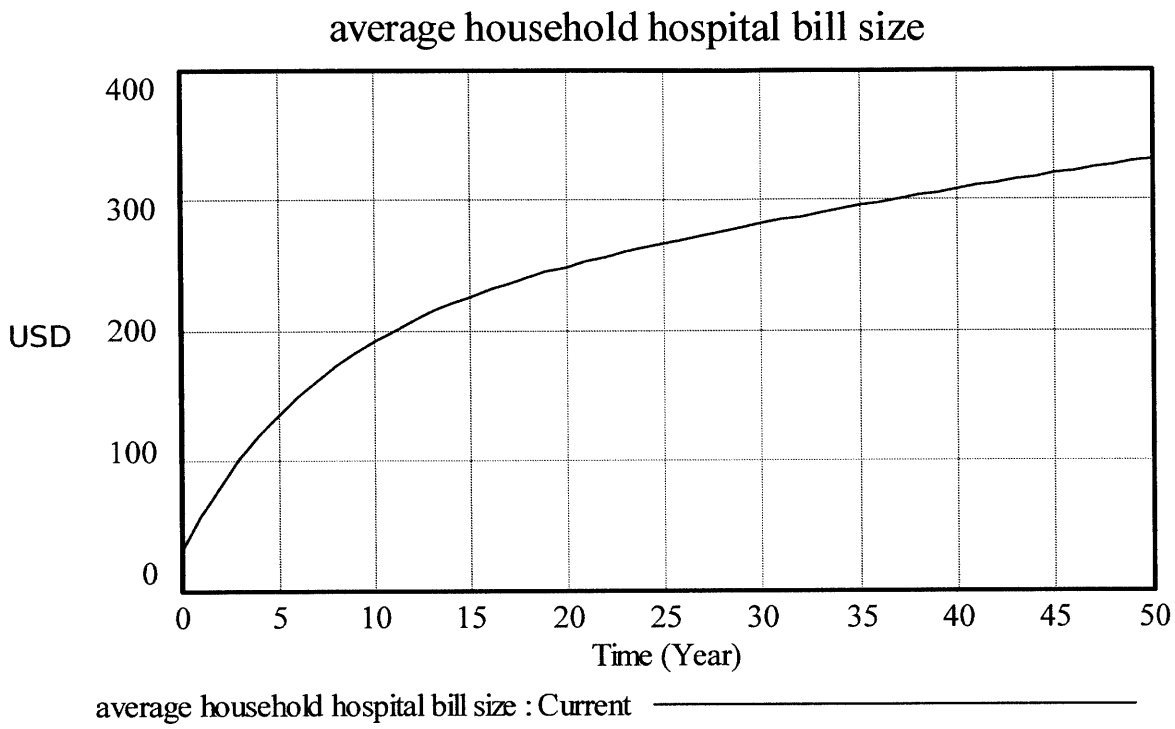


Figure 25: Average Hospital Bill per Household

5. Policies for Improvement

For the study, three policies are considered for improvement in the affordability of healthcare- allocating a higher percentage of GDP to the public healthcare budget, decreasing the average length of hospital stay, and increasing the health insurance coverage for the population.

The affordability of services in the current healthcare system is expected to decrease over the years. Implementation of any one of these policies decreases the cost of care, and the affordability shows a similar trend. With the steadily increasing burden of disease and the underfunding and underutilization of medical resources in the healthcare system, the affordability is expected to continue to fall over the years.

Figure 26 forecasts the out of pocket payments for population seeking medical care. How the different policies influence the overall affordability of the healthcare is illustrated in Figure 27.

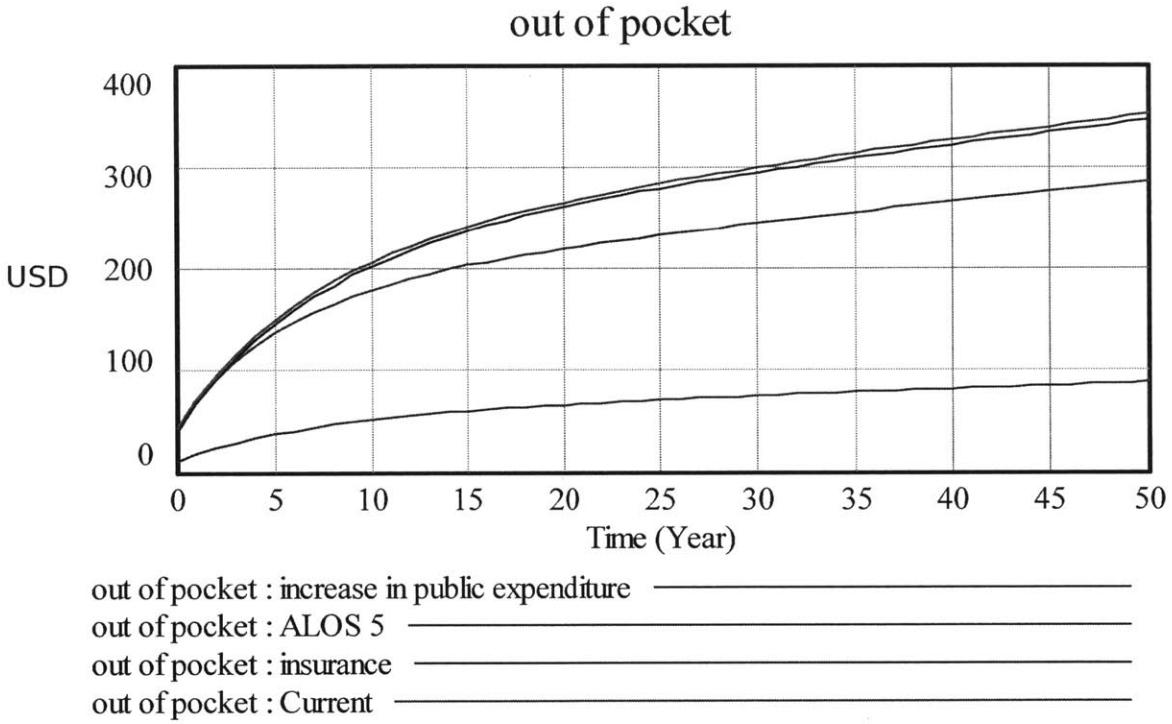


Figure 26: Out of Pocket Payment with Policy Implementation

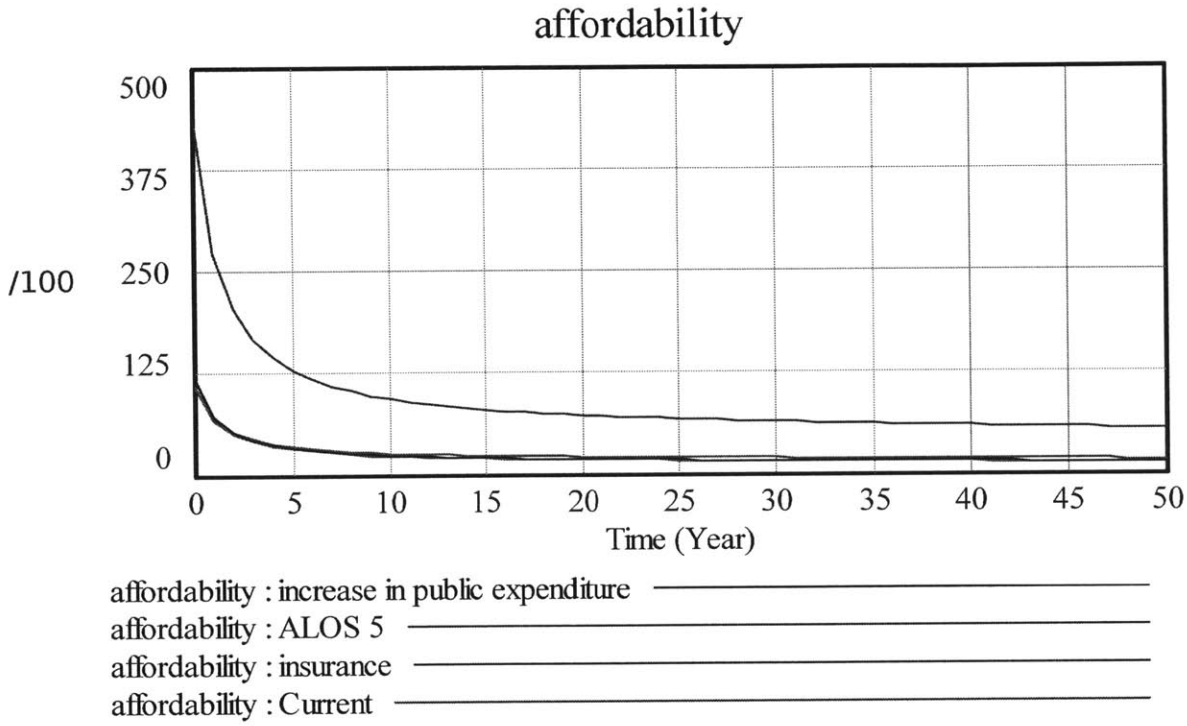


Figure 27: Affordability of Healthcare with Policy Implementation

5.1 Allocating a Higher Percentage of GDP to Healthcare Budget

The economic reforms cut down the health expenditure in the nineties and led to the neglect of public healthcare system with less population seeking medical care in public facilities. This seriously impacted the poor population that depended on the public health system. With declining investment and expenditures, the public system either could not meet the needs or had to deny the services. This set in motion the trend of population seeking care in costlier private facilities and thus paying more for the cost of care. An increase in healthcare budget is likely to improve the affordability of health services in particular for the poor through subsidized/cross-subsidized or free services.

A study by Indian business lobby, Federation of Indian Chambers of Commerce and Industry (FICCI) and consultants Ernest and Young in 2012 estimated that UHC in

India was feasible in a decade and would require government health spending to rise to 3.7-4.5 percent of GDP.

With reference to Figure 26 and Figure 27, increasing the GDP allocation to healthcare by the government has a very little impact on the out of pocket payments and affordability respectively. If this allocation is limited only to the economically neediest population, the improvement may be more. Nevertheless, the impact of the policy will diminish as the increase in cost of healthcare services will outstrip growth in GDP. Also, it may not be feasible to sustain affordability at a national level only by continuously increasing GDP allocation to counter the increasing cost of care.

5.2 Decreasing Average Length of Hospital Stay

Average length of stay (ALOS) in a hospital is defined as the average number of days a patient spends in a hospital. It is generally calculated by the total number of days spent by all the inpatients in a year (excluding the day patients) by the total number of admissions or discharges. All other things remaining equal, decreasing average length of stay will increase the availability of resources- hospital beds and doctors/nurses. The cost per day and intensity of service is likely to be higher for a shorter length of stay.[54] If ALOS is too short, it may result in reversal in health outcomes, higher readmission rates, and/or higher costs. However, an optimum shorter ALOS is expected to improve productivity, decrease waiting times and improve patient experience.

A study conducted in a hospital in Kolkata, India[55] quotes that the hospital benefitted nearly USD 0.9 million during the study period of nine months by reducing ALOS to 4.5 days.

ALOS has been decreasing in the OECD countries from 8.2 days in 2000 to 7.2 on average in 2009. It is as low as 5 days for Norway and USA, and 4 or less for Mexico and Turkey.

In the model, reducing the ALOS from 7 days to 5 days decreased the out of pocket payments (Figure 26). This is feasible when the cost benefits of the maximum capacity utilization are transferred to the patients. In terms of affordability, the policy shows an improvement similar to increasing the GDP allocation. However, as the demand continues to outstrip the supply of medical services, the impact of ALOS will also decrease over the years.

5.3 Increasing Health Insurance Coverage

Ideally, differentiating subsidies based on income groups is likely to decrease burden on state as compared with a uniform subsidy for all income groups in UHC. This is likely to improve the affordability for the lower income households, and may decrease the affordability of the higher income groups, as is expected in any cross subsidization service model. However, for the simulation, a uniform insurance coverage is considered that decreases the out of pocket payments and improves the affordability overall.

6. Conclusion

The majority of the population is seeking care in the private hospitals, thus bearing the major share of cost of care through out of pocket payments. The performance of the doctors at these private hospitals is increasingly being evaluated on the number and cost of the services provided. To take advantage of the growing healthcare market, the private hospitals are also investing in technological and process improvements for operational efficiencies. In such a scenario, without any intervention or regulation, the consumers-patients find it tough to negotiate the cost of care.

50 percent of the healthcare is thought to be driven by the hospital and doctor supply and not the value of services provided to the patients.[56] One of the ways to disrupt the existing healthcare and making it more affordable is by making the low

cost healthcare facilities more capable and not expecting the large and private hospitals to cost less. Supported by health insurance coverage or government subsidies, more efficient operational practices at the hospitals, the cost of care may not be as prohibitive as what is projected in the coming years.

India is undergoing significant social and economic transformation. It may take a while to achieve universal health coverage involving complexity of the healthcare system and emerging behavior. Still, understanding the system is half the solution.

7. References

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