HEALTH HORIZONS 2021: EMERGING OPPORTUNITIES FOR SOCIAL ENTREPRENEURS IN INDIA

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SOCIAL ENTERPRISE FUTURES IN HEALTH REPORT

Critical Factors

Urbanisation: Where and how fast will population density increase?
Economic Growth: how fast will incomes, particularly those of the poorest, increase?

Demographics: How will the future of health care in India change with a dual market of a relatively young population and large absolute number of elderly people?

Healthcare Finance: Who will determine how and where the anticipated increase in public funding for health is spent?

Health Literacy: How can people's knowledge of preventative and public health and wellness be strengthened to help improve India's health outcomes and quality of care?

Policies, standards, and regulations: How can policies and transparent data standards across health systems enable better governance and health outcomes?

Health Information Capture: How accurately and effectively can patient data be captured and digitized from a growing volume of health monitoring tools across hospitals and homes?

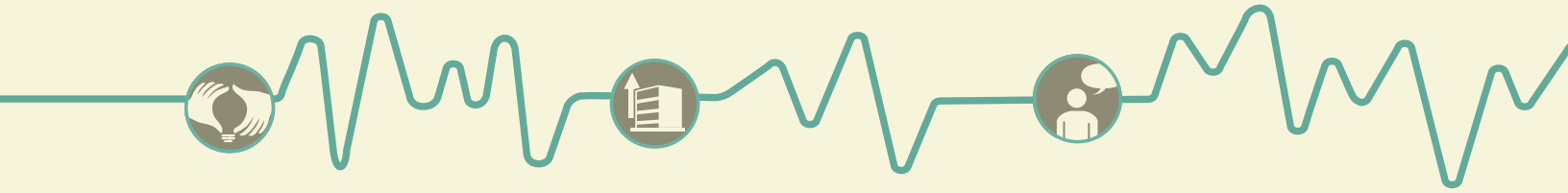
IT Infrastructure: How quickly can access to broadband data connections expand?

Scenario 1

The Rising Tides

A burgeoning homegrown medical device industry faces cutbacks in 2021. An assault on generics has pharma pivoting towards orphan drugs and neglected tropical diseases. Formal healthcare infrastructure remains weak. Zoonotic diseases and multi-drug resistance add to the disease burden. Health consumers and providers forced to try new partnerships to cope with scarcity.

Some Opportunities



Innovation

- Lab-on-a-chip diagnostics to test different diseases
- Precision medicine, novel molecular therapeutics, orphan drugs, treatments for Neglected Tropical Diseases
- Simulation & visualization tools and instructional platforms for medical graduates, hospitals

Enabling Infrastructure

- Public health awareness campaigns on zoonotic diseases, antibiotic resistance
- Information portals with compendia of medical protocols & guidelines
- Easy-to-apply quality metrics, ratings, certification of providers
- Low cost extension of communications and energy solutions

Customer Needs

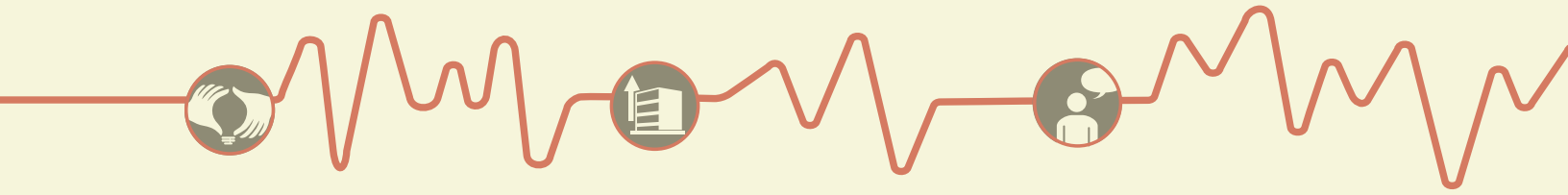
- **Individual:** Identification of counterfeit medications, Low-cost scans for self-diagnosis, creation of genomic and personal profile
- **Enterprise:** Links to existing sales & distribution channels for health product outreach, scheduling and management solutions for leveraging scarce talent through telemedicine

Scenario 2

The Social Surge

India creates a national health literacy policy by 2021. The lead-up to the policy kindles a surge of interest in participatory and preventive health, with patients increasingly active in maintaining their own health. New innovations, financing programs, and partnerships are galvanized across private, public sectors as personal health gains and their value become more measurable.

Some Opportunities



Innovation

- New curricula & platforms for preventative and public health literacy
- Multi-media channels & digital content for medical training & recertification courses
- Foolproof diagnostic, health and environment monitoring tools for non-professionals

Enabling Infrastructure

- Expanded education for mental health, prevention & wellness, including community workers
- Incubators for health care innovation in Tier 2, 3 cities & at universities
- Curriculum development for primary and secondary school on up

Customer Needs

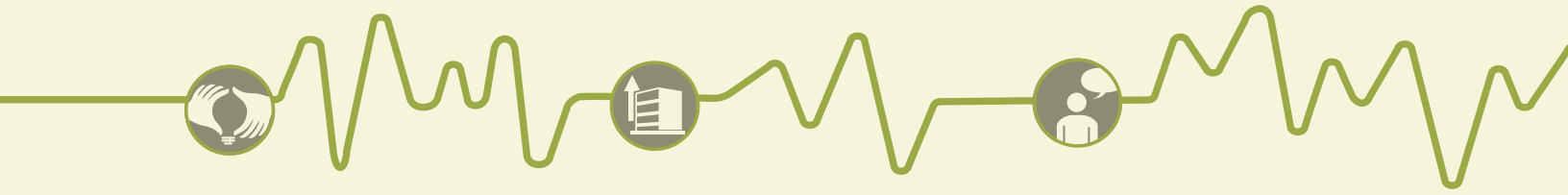
- **Individual:** Services and applications for prevention, wellness, mental health disorders, food certification and branded packaging
- **Enterprise:** Information aggregation and analytical services to assess health financing and risks

Scenario 3

All Wired Up

By 2020, eHealth transforms Indian health care. Digitization and real-time environmental and patient data blend into networked health systems. The scale and access to massive data flows improve health outcomes and spur new businesses based on process innovation, specialization, and task-shifting enabled by information flows.

Some Opportunities



Innovation

- Health ATMs for diagnostics and over-the-counter medications
- 3D prototyping labs for startups to test and design device ideas
- Predictive analytics services for pharmaceuticals, health care suppliers, & providers

Enabling Infrastructure

- Interoperability standards, functionality between electronic health systems
- Human resource & regional talent scouting for health care start-ups
- Real-time health dashboards to aggregate district & state level information
- Sensor networks for environmental & health monitoring

Customer Needs

- **Individual:** Health record management and mentoring on uses and protection
- **Enterprise:** Integration of IT into hospitals, clinics, health provider processes including solutions for data entry; staff training on leveraging data

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About This Study

The Villgro Innovations Foundation and Okapi Research have undertaken this report as the first of a series of sector-focused "Future Social Enterprise Opportunities" studies that provoke would-be social entrepreneurs, impact investors, incubators, and others involved in the ecosystem of private finance for public purpose to look ahead as well as around themselves.

The IIT Madras Healthcare Technology Innovation Centre (HTIC), CIRM Design and Research Labs (CDR), and Dr. Brinda Dalal, President of Dhoopa Ventures, have joined the group as expert contributors on healthcare, medical technology, and the futures methodology.

Villgro Innovations Foundation

Villgro believes in the power of invention and market-based models in transforming the lives of the world's most under-served communities. As one of India's oldest and foremost social enterprise incubators, Villgro has supported med-tech and other innovators and social entrepreneurs during their early stages of growth. Since 2001, Villgro has incubated 94 such enterprises and helped them secure Rs 873 million in follow-on funding. These enterprises have generated around 4000 jobs and touched over 5 million lives. This research is part of Villgro's efforts to deepen its understanding of the future of medical technologies and healthcare for the next billion as it builds a dedicated platform to fund and support impact-focused med-tech innovators and to help the development of the ecosystem to support innovators and entrepreneurs.
www.villgro.org

Okapi Research & Advisory

Okapi is an institutional design consultancy focused on creating social, policy, and organizational infrastructure for collective action toward sustainable development goals. It works closely with policy makers, civil society groups, non-profit leaders, and impact investors in India and internationally to help them create policy environments, ecosystems, and organizations that motivate and aggregate individual contributions to broader public purposes. It specializes in complex design problems involving the institutional underpinnings for organizations or partnerships at the interface of public purpose and private gain: social and enterprise, public and private, innovative and inclusive. Okapi's practice draws extensively on academic social science research for insights and innovative approaches to the challenges that our clients face - from regulatory design and public investment prioritization, to developing and refining strategies for catalyzing small enterprise innovation, to establishing organizational practices that encourage alignment with social missions.
www.okapia.co

IIT Madras Healthcare Technology Innovation Centre

Healthcare Technology Innovation Centre (HTIC) of IIT Madras is a Research & development centre established through a joint initiative of IIT Madras and Department of Biotechnology (DBT), Government of India to develop affordable healthcare technologies. Since its inception in 2011, HTIC has evolved into a

unique and leading med-tech innovation ecosystem in the country bringing together more than 20 medical institutions, industry, government agencies, collaborating with HTIC in developing affordable healthcare technologies for unmet clinical needs. HTIC is delivering innovations and technologies that are reaching the field, enabling business and bringing benefits to lives, businesses and society. Several technologies in areas of cardiovascular, ultrasound, neonatal, oncology, intensive care, ophthalmology and diagnostics are under development in collaboration with leading organizations. HTIC also works to develop human resources in healthcare technology innovation in the country through various channels including Innovation fellowships, IITM students and interns. Going forward, we envision HTIC becoming a national asset of global standards in affordable healthcare technology innovation, creating impact in healthcare.
http://htic.iitm.ac.in/

CIRM Design and Research Labs

CDR's product design and research activities focus on innovative solutions for managing health, agriculture, livestock, and catastrophe risk. CDR's policy advocacy effort involved data-backed market analysis to support equitable and efficient delivery of safety-net solutions, building greater resilience in emerging markets.
http://www.cirm.in/

Dhoopa Ventures

Dhoopa Ventures LLC is a strategic consulting company in California focused on innovation discovery and futures research. Dhoopa Ventures advises organizations about emerging technology innovation, upcoming changes in the marketplace and potential risks in the next 2-5 years. Brinda Dalal, the founder and president, previously served as a research director in the technology and health horizons programs at the Institute for the Future in Palo Alto, and prior to that worked as a research scientist at Xerox and Xerox PARC.

The study is supported by the International Development Research Centre (IDRC) as a part of a larger grant to Villgro for "Learning from Pro-Poor Market-Driven Innovation."

Chapter 1: Introduction

Health – physical and mental wellness - has become increasingly synonymous with development. Six of the eight broad targets for the Millennium Development Goals include targets for health status or health-related environmental targets. Development economist Angus Deaton's (2013) The *Great Escape* focused on health, at least as much as wealth, as the mark of progress and a dimension of on-going inequalities.[1] In narrow economic terms, health enables productivity. In human terms, health is an important determinant of happiness (and vice versa). The World Happiness Report (2013) found that even crude indicators of a country's health level such as life expectancy at birth explained significant cross-country differences in subjective wellbeing. Globally, mental health is the single most important determinant of happiness.[2]

And India is no exception. India's achievements are often reported in terms of economic growth, poverty reduction, changes in inequality, or even the global reach of its major corporations. But in the end, the conversation about progress often comes back to health and the health context: the air quality in Delhi, the chagrin that preventable and curable diarrheal diseases continue to kill large numbers of children, the figures on childhood malnutrition, and the maternal deaths have made headlines in the last few months alone. Health is starting to emerge on political agendas and in popular debates. A High Level Expert Group on Universal Health Care Coverage for India was convened in 2010, producing a widely cited report a year later. The Congress and Aam Aadmi Party framed healthcare as a "right" in their manifestos. The Bharatiya Janata Party made more specific reform promises including a "National Health Assurance Mission;" reorganisation of the Ministry of Health and Family Welfare to converge departments that deal with healthcare, food and nutrition, and pharmaceuticals; a push for Indian systems of medicine such as Ayurveda; and establishment of top class medical colleges in every state (Chatterjee, 2014).[3]

The healthcare system ("institutions, facilities, and actors involved in delivering healthcare services")[4] has taken significant strides in the past decade, with the advent of the National Rural Health Mission, the investments in training hundreds of thousands of front-line workers, and the foundation and scaling up of important national and state insurance schemes. Social entrepreneurs are increasingly active in the healthcare space - setting up ventures ranging from low-cost hospitals and clinics to innovative diagnostic and treatment devices. The health system ("a much wider range of institutions and actors beyond the traditional so-called health sector, including actors who directly or indirectly influence and affect health in a society") has also accelerated its activities, with new emphasis on food security, increasing attention to air and water quality monitoring and management, and high-tech, high-profile experimentation with community-based preventive measures.

However, there is much to do. The opportunities to achieve wide-ranging social impact by improving India's health systems and extending access to them are enormous.

These are not easy challenges to resolve, but the solution space is also changing in ways that open enormous possibilities for social enterprises – innovative for-profit businesses with a commitment to social impact – to change the health system for the better. New technologies are emerging daily and disseminating more rapidly than ever. Information and communication technologies that allow easy, frequent communication and data sharing across distances and enable new, distributed work teams are becoming more common and cell phones are nearly ubiquitous. The costs of diagnosis for many of India's critical diseases are dropping, as is the speed of insight. Treatment protocols and technology are developing to enable lower-skilled people in more remote environments with weaker infrastructure to respond to health crises more effectively. India's population is slowly urbanizing and population densities in rural areas are also increasing, tipping more geographies into viable catchment areas for market-based models alongside traditional public and philanthropic approaches.

This report is designed to help social entrepreneurs make sense of emerging possibilities and identify signs that new pathways for the evolution of the health system (both positive and negative) are forming.

We focus primarily on opportunities that have the potential to be financially viable as businesses as well as feasible for new and smaller businesses to tackle. We have drawn the boundaries loosely, however, in order to recognize the importance of innovative hybrid and non-profit models in delivering healthcare as well as flag important areas for financial viability to be tested.

Social enterprise and technology incubators Villgro Innovations Foundation and the IIT Madras Healthcare Technology Innovation Centre came together with the action research groups Okapi Research and CIRM Design and Research Labs along with Dr Brinda Dalal of Dhoopa Ventures out of a common interest in understanding where opportunities for social entrepreneurs in India were heading.

We also sought to provide a provocative piece of research to challenge all stakeholders in the healthcare sector to think critically about how India's health system might be evolving.

India has a long tradition of using futures research to generate important debates about societal issues, and to shape national strategy.[5][6] This report, in part, aims to integrate futures thinking and pluralistic perspectives[7] into discussions about health[8] and the health and social entrepreneurship in India.

Anticipating the future involves understanding and planning for multiple, even divergent possibilities rather than a single, dominant one. Given that the future is inherently uncertain, and that India has a unique set of socio-economic, geo-political and historical characteristics, this report will not make normative predictions. Instead, our goal is to highlight a variety of options and encourage social entrepreneurs who are working in India or wish to enter the Indian market to explore an array of prospects and choices as they design products and services for individuals and communities living in low-resource settings.

The intent of our collaborative research was to discover potential opportunities and identify upcoming uncertainties and challenges in health care, as well as to help stimulate ideas and innovations for the social enterprise in India. To think systematically and creatively about healthcare innovation in the next five to ten years, the research team drew on methods from futures studies. These include horizon scanning and developing future scenarios and alternative futures (each of which will be briefly described below).

The key findings and provocations in the report are based on primary and secondary research. Primary research included seeking expert opinions (a list of those consulted is in Appendix A), conducting site visits, and interviews, and observing interactions in the field in different cities and villages across the country. We visited primary health care clinics, accompanied mobile health vans into different areas, and spoke with dozens of practitioners, managers, forerunners and experts who form national policy, lead and assess organizations, and spearhead local programs.

Interviews solicited people's views on the current and future state of healthcare. We explored perceptions about new technologies, care delivery and standards, and probed debates about financing and other topics. At workshops, experts shared their views on barriers to effective health care and opinions about macro and micro trends. They also developed scenarios and discussed how socio-economic, technological, environmental or political factors might affect the future of the health care industry. We would like to thank everyone who has participated in the research thus far without implicating them in our findings.

Secondary research involved surveying market reports, academic literature and conducting horizon scanning. Here, we searched for directional shifts in health care, as well as factors outside the health care industry such as demographic trends, that could influence it. We gathered examples of new innovations, incipient practices, and trends from within India and around the world.

Horizon scanning[9] or environment scanning[10] is a strategic forecasting method that involves perusing a wide range of online and offline sources to look for emerging patterns and changes occurring in society. Typically (and also in our case) this means scanning for weak[11] and strong signals, as well as wild cards. Signals help to identify indicators of the future that exist today. They appear in many forms, as technology prototypes, a breakthrough business idea, new values or practices being adopted or an outlier concept. Signals can demonstrate emerging trends and offer a tangible glimpse into what future(s) can be. They can also be a one-off innovation, a discrepancy or exception that may or may not pan out a few years from now. "Weak signals" are precursors or early examples of changes that occur in society or in an industry today. Critical to spot, they help us anticipate and prepare for surprises. They are also highly uncertain, providing only partial, fragmentary insights. A convergence of weak signals can sometimes flag an emerging trend, but not always. Thus, signals should be observed over time to see the directions in which they develop. The reason to use weak signals is not to predict the probability of future events, but to open one's thinking to a range of new possibilities. Our horizon scanning exercise was conducted by individuals and in pairs and reviewed by a third person.

Similarly, "strong signals" are helpful to track. These provide evidence of changes taking place across—not just within—different domains in society. They often denote trends, counter-trends and even influential shifts in cultural values. Finally, wild cards, a concept similar to Nassim N. Taleb's notion of black swans, are low probability events that can have a substantial impact on society if they occur (such as a tsunami or meteor hitting the earth).

Our research team analysed signals, expert insights, data from primary and secondary sources and identified clusters of key research themes through half-day workshops. Themes were written up in the form of idea briefs, which formed the foundation for this report. In addition, we created three scenarios to immerse readers in different possibilities for the future. They offer insights into a variety of situations in a plausible manner, and describe emerging trends, threats and—for this report—areas for health innovation. They invite us to anticipate different risks and prospects, provoke our imaginations, and plan for multiple futures.

Scenarios[12] are like narratives: they describe a postulated set of events and actions in the future. Each of our scenarios explores different variables, assumptions and actions that may occur in the future. Reflecting on the volatile and complex nature of our economy and society, they attempt to shine a light on divergent possibilities in the next five years.

"While one can create any number of potential futures, Professor Jim Dator (University of Hawaii, Manoa) argues that all of them can be reduced to four archetypes that illustrate different points of view in a comprehensive way. Mapping possibilities to these four categories is useful for encouraging consideration of a broad range of possibilities.

The first archetype, a "Growth" focuses on the possibilities for expansion of business as usual. A growth scenario might offer assumptions about financial progress, where for example, due to actions and a convergence of circumstances, GDP rises year after year, businesses and incomes expand in certain sectors and help to raise the national standard of living, and governments remain fairly stable. Dator warns, however, that not all assumptions about continued growth are positive. As wealth disparities widen, income inequalities can deepen, and social instability move to the fore. The point here is not to predict factors that guarantee perpetual growth, but to explore various and even contradictory factors within the scenario, as well as the different directions for the future.

"Discipline" or "Constraint" futures, the second archetype, assume that some form of boundary or limit will be reached that in turn shapes the way the system evolves. This may also be fiscal: for example, organizations or states may be looking to cut costs and increase efficiencies across the system. In so doing, new possibilities for innovation arise. Jugaad innovations are examples of constraint scenarios.

"Collapse" scenarios, the third archetype, anticipate potential failures and breakdowns and their impacts on society. Understanding how unusual weather events affect public health is one example. Similarly, community resilience to unexpected events is a topic often addressed in futures of collapse.

In "Transformation," the final archetype, societies are irrevocably changed as a result of disruptions. The invention of penicillin and the advent of personal computing are examples of transformation – developments that led to fundamentally new practices, expectation, and possibilities. Each of these futures captures distinct characteristics. By keeping the diversity of these archetypes in mind, simultaneously, strategic plans can be enriched and innovations made more compelling.

Given the relatively short timeline of our horizon - 5-7 years – our report offers three scenarios that blend elements of the archetypes: "The Rising Tide" bridges collapse and constraint scenarios to look at the implications of a crumbling health system faced with increasing disease burdens. "The Social Surge" combines growth and constraint scenarios to highlight the possibilities that come with expanded health literacy, patient agency, and awareness of the economic importance of wellness. "All Wired Up and Somewhere to Go," combines growth and transformation to explore developments in a world with much greater data liquidity and many stakeholders seeking to leverage the information for varying purposes.

The report attempts to capture the most prominent, promising and provocative ideas for the future, to stimulate social innovations in the health care sector in low resource settings.

The report proceeds as follows: Chapter 2 provides a brief overview of India's health system, describing both the burden of illness (the "demand" side) and the state of the system (the "supply" side). It is meant to establish a baseline of the status quo for those who aren't familiar with the terrain. Chapter 3 discusses emerging platforms for innovation, particularly focusing on social enterprise activity. Chapter 4 focuses on critical factors, or dynamic aspects of the context that are important determinants of the shape of the future. Chapter 5 presents three scenarios of how the health system might look in 2021. These are meant to be provocative and to stretch the imagination while remaining grounded in today's reality and plausible paths of evolution. Chapter 6 concludes with a discussion of emerging opportunities for social entrepreneurs.

Endnotes

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Chapter 2: India's Health System

An Overview

This chapter provides a broad overview of India's health system. The first part starts with a summary of India's major health challenges – the "demand" side for health services – and then describes the supply side, India's healthcare infrastructure as it stands today. The second half of the chapter turns to the broader economic context for the health system.

Many of the challenges we describe are well-known, long-standing, and difficult to change overnight even if financial resources were no constraint. Skilled health workers take time to train in addition to resources to retain in today's global labor market. Hospitals are more than just buildings, but also collections of processes, and protocols, all of which settle into place over time. They are also nodes on supply chains that need to be built for drugs, instruments, diagnostic tools, and other supplies. Health literacy- the background of knowledge and access to information that allows one to be an informed, discerning consumer of health services - increases gradually over time, even when literacy is widespread.

We hope that the following chapters, however, will highlight some emerging points of leverage for social entrepreneurs to shape the future of India's health system.

India's Health Challenges: Demand Side

India's health needs have shifted over the past decades from a predominance of communicable to non-communicable diseases. The 1999 World Health Organization (WHO) Report found that about half of the more than 260 million disease adjusted life years (DALY) lost in India were due to communicable diseases, followed by non-communicable diseases (33%) and injuries.[1] A decade later, according to figures compiled in the World Bank's World Development Indicators, the communicable diseases, maternal, prenatal and nutrition conditions accounted for just 36% of total deaths while the cause of death by non-communicable diseases and injury rose to 53% and 10% respectively.[2] By combining maternal deaths with communicable diseases these figures underestimate the shift in the disease burden. India's Maternal Mortality Ratio (MMR) remains high, at 212 per 100,000 live births.[3]

This shift in the burden of disease from communicable to non-communicable is not unusual among developing countries, but we highlight it because it has important implications for the nature of healthcare required. The health system must not only be capable of identifying and limiting outbreaks of infectious disease and provide curative care for diseases that may build up drug resistance over time (such as tuberculosis TB); but it must also be capable of pre-empting chronic (and costly) illness. It must be done through promoting healthier lifestyles, early diagnosis, and, generally more frequent interactions with people even when they are ostensibly healthy[4]. Even as the health system gears up to manage widespread diabetes and its effects, deadly vector borne diseases are on the rise: dengue cases have more than doubled between 2010 and 2013 with a 38% increase in the number of deaths, while cases of Japanese encephalitis have risen by 73% with a 68% increase in the number of deaths[5].

The Global Burden of Disease Study 2010 and 1990 (GBD 2010)[6] illustrates the continued importance of communicable diseases in terms of the causes and risk factors for Years of Life Lost (YLL). It also highlights three other important factors for today's health system to consider.

Figure 1

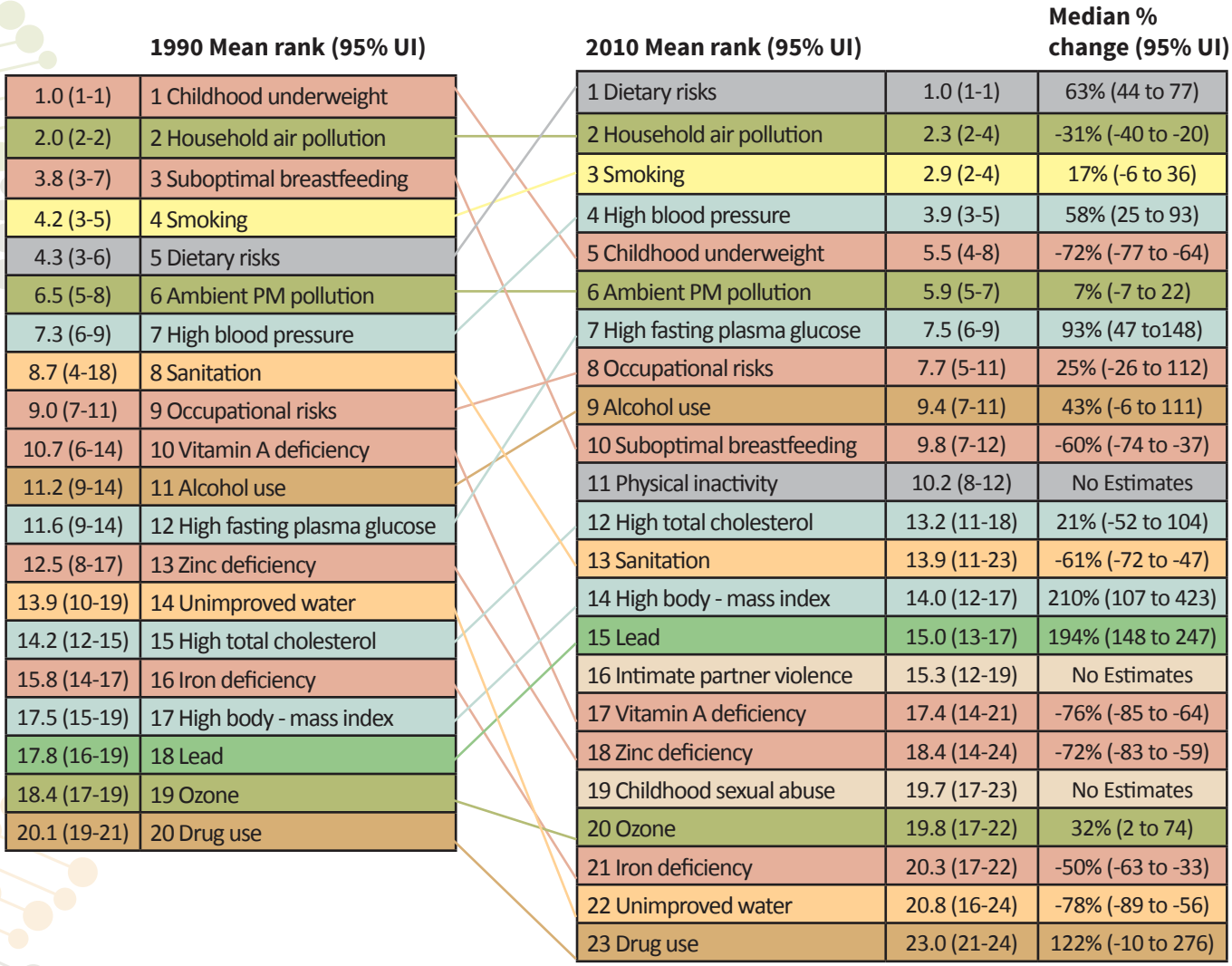
Causes

1990 Mean rank (95% UI)		2010 Mean rank (95% UI)		Median % change (95% UI)
1.1 (1-2)	1 Diarrheal diseases	1 Preterm birth complications	2.0 (1-5)	-31% (-49 to -8)
2.0 (1-3)	2 Lower respiratory infections	2 Lower respiratory infections	2.5 (1-4)	-45% (-54 to -33)
3.0 (2-4)	3 Preterm birth complications	3 Diarrheal diseases	2.8 (1-5)	-56% (-66 to -43)
5.2 (4-7)	4 Tuberculosis	4 Ischemic heart disease	3.0 (1-4)	66% (38 to 87)
5.6 (4-10)	5 Neonatal sepsis	5 COPD	5.5 (5-7)	2% (-11 to 15)
6.2 (4-9)	6 Protein-energy malnutrition	6 Neonatal sepsis	5.9 (5-7)	-23% (-51 to 29)
6.9 (5-9)	7 COPD	7 Tuberculosis	6.5 (2-12)	-32% (-54 to -10)
8.5 (7-10)	8 Ischemic heart disease	8 Self-harm	7.8 (5-11)	154% (15 to 253)
9.4 (612)	9 Neonatal encephalopathy	9 Road injury	8.5 (5-14)	63% (20 to 171)
10.3 (3-27)	10 Measles	10 Stroke	9.5 (7-12)	54% (16 to 77)
11.7 (10-15)	11 Meningitis	11 Neonatal encephalopathy	10.2 (6-14)	-17% (-49 to 45)
13.4 (8-21)	12 Tetanus	12 HIV/AIDS	12.5 (1015)	6147% (605 to 17785)
13.9 (11-17)	13 Stroke	13 Fire	13.9 (921)	19% (-31 to 88)
14.1 (10-19)	14 Maternal disorders	14 Congenital anomalies	14.7 (11-19)	4% (-38 to 46)
15.2 (12-20)	15 Road injury	15 Protein-energy malnutrition	15.9 (11-21)	-66% (-76 to -52)
16.7 (10-23)	16 Malaria	16 Cirrhosis	16.5 (14-22)	84% (21to 131)
16.8 (11-20)	17 Congenital anomalies	17 Meningitis	17.2 (14-21)	-38% (-52 to -17)
17.3 (13-22)	18 Fire	18 Diabetes	19.3 (16-23)	92% (48 to121)
17.9 (14-21)	19 Encephalitis	19 Measles	19.7 (8-38)	-63% (-78 to -31)
19.6 (13-23)	20 Self-harm	20 Drowning	20.5 (15-24)	1% (-20 to 38)
22.6 (20-27)	21 Drowning	21 Encephalitis	22.0 (19-25)	-35% (-48 to -14)
26.6 (24-30)	27 Cirrhosis	23 Maternal disorders	24.0 (19-29)	-54% (-68 to -38)
31.0 (2834)	31 Diabetes	36 Malaria	36.5 (23-56)	-71% (-90 to -42)
77.2 (39-101)	78 HIV/AIDS	44 Tetanus	43.7 (26-59)	-84% (-92 to -67)

(Source: Global Burden of Disease, Visualization from http://www.healthmetricsandevaluation.org/)

Figure 2

Risks



(Source: Data from Global Burden of Disease, visualization from http://www.healthmetricsandevaluation.org/)

First, the "health system" is intertwined with the environment, infrastructure, and other contextual factors that may be outside of the control of a narrowly defined healthcare agenda. Environmental factors, for example, are an important concern. The high incidence of respiratory infections also highlights the importance of attention to air quality. Outdoor and indoor air pollutions in India are recognized significant contributors to illness. Indoor air pollution is the second highest risk factor for life years lost, and ambient air quality is the sixth highest risk factor. The GBD 2010 estimates over 2.1 million premature deaths and 52 million years of healthy life lost in 2010 due to ambient fine particle air pollution in Asian countries, 712,000 of which were in South Asia. Chronic exposure to air pollution not only leads to respiratory infections and cardio-vascular diseases including cancer, but can also disrupt the reproductive system.

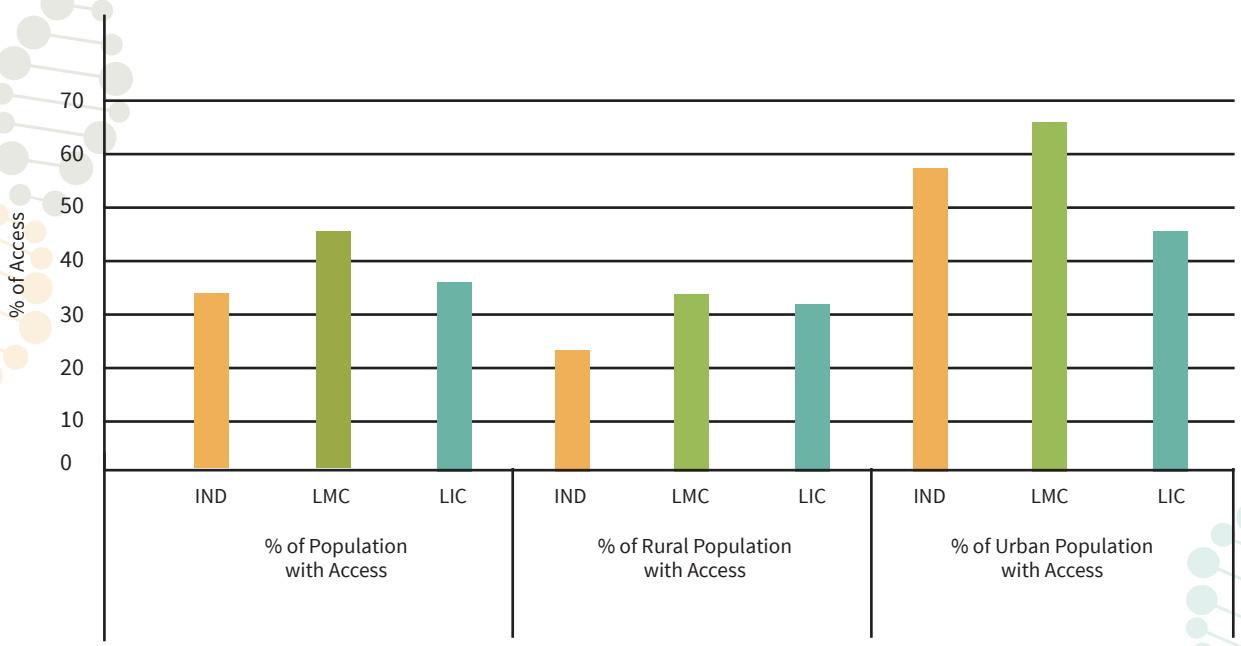
Infrastructure also matters. Diarrheal diseases have consistently been among the first three ranks in the GBD report over a period of 20 years. In 2006, World Bank's Water and Sanitation Program report, "The Economic Impacts of Inadequate Sanitation in India," estimated that 6.4% of the GDP would be the

total economic impact of inadequate sanitation. The study, which focused on the safe management of human excreta and associated hygiene behaviour put the health related impacts (premature death, cost of treatment, productive time lost, etc) of inadequate hygiene at Rs. 1.75 trillion. The report also found that the poorest 20% living in urban areas bear the highest per capita economic impacts of inadequate sanitation. In addition to this, diarrhoea in children under the age of five contributed to 47% of the total health related economic impacts.[7] Spears (2013) finds that lack of access to sanitation explains a substantial portion of the variation between malnutrition in India relative to other countries.[8]

These diseases do not necessarily require a medical approach – measures such as hand washing (especially after defecation), control of flies, and encouragement of safer practices in food preparation and water storage[9] are also effective. Infrastructure also plays an obvious role. India continues to lag behind its peers in Lower Middle Income Countries (LMC) in access to sanitation, and in some cases even behind access in Low Income countries (LIC).[10]

Figure 3

Improved Sanitation Facilities



The increasing prevalence of traffic injuries and fires as causes of life-years lost also reiterate the importance of taking a broad look at infrastructure as part of the health system.

Second, the health system cannot be disentangled from food policies and markets. Dietary risks are the leading risk factor for life years lost in India. Though the life years lost due to protein energy malnutrition has decreased in rank from 3 to 15 in the span of twenty years (1990-2010), malnutrition and particularly childhood malnutrition continue to be prevalent. The percentage of children under three with a low weight-to-height ratio ("wasted" – one indicator of malnutrition) in India rose from 16% to 19% between 1999 and 2006. Nearly half (46%) of children under three were undernourished and a third of adult women have a body mass index (BMI) lower than 18.5, a level commonly associated with chronic energy deficiency.[11]

The poorest seem to live on less than 1,500 calories a day compared to a norm of over 2,000.[12] The National Family Health Survey (NFHS)'s last two rounds found important gaps in nutrition: In the 1998-99 survey, only 55 per cent of adult women in India consumed milk or curd at least once a week, 33 per cent ate fruits at least once a week, and 28 per cent had an egg. The 2005-6 NFHS found similar results: Milk or curd was consumed daily by 40 percent of women and weekly by 16 percent of women, but 11 percent never consume milk or curd and 33 percent consume milk or curd only occasionally. The fourth round of the survey (2014-15) is currently underway.

Third, mental health must be seen as an integral part of the challenge for India's health system. "Self harm" has risen sharply from a rank of 20 to 8 as a cause of life years lost in India. More generally, 6-7% of the population is thought to have some form of mental disorder, with no clear distinctions between rural and urban India.[13] Over 90% of mental disorders are also estimated to go untreated.[14] Many constraints contribute to these treatment gaps. On the demand side, cost considerations, socio-cultural beliefs, stigma, and overall lack of health literacy are all barriers to formal mental health seeking. On the supply side, resources are limited. The 1982 National Mental Health Program called for integrating mental health into healthcare structures, but it has so far not been incorporated into the National Rural Health Mission. Primary care systems almost uniformly omit mental health services. Almost none make psychiatric drugs, including anti-depressant or anti-anxiety medications, available. The 1992 District Mental Health Program (DMHP) called for decentralizing mental health services across the healthcare spectrum, but so far only covers about a fifth of all districts. Human resource constraints prevail across the board. Private services are available in India, but expensive, hard to access, particularly for rural populations, and are largely unregulated. Mental health also is not covered by any Indian insurance plans. Mental health expenditure by the government was just 0.06% of the total health budget in 2011. This is clearly an area for development – later chapters of the report will return to discuss some innovative approaches that are emerging from the social sector.

India's Health Challenges: Supply Side

India's health system has improved its performance relative to middle-income country peers in some areas, such as immunizations (Figures 4 and 5) but infrastructure for sustained attention to the emerging health demand is still lacking. We focus here on the traditional indicators of healthcare to establish a sense of the magnitude of the gaps in physical infrastructure as well as human resources that remain to be addressed through policy and entrepreneurial effort. A full accounting of the health system, including investments in air quality management, sanitation, nutrition, and other factors raised above is beyond the scope of the report although we urge social entrepreneurs to address the demand for these aspects of the health system.

Figure 4

Immunization 2005

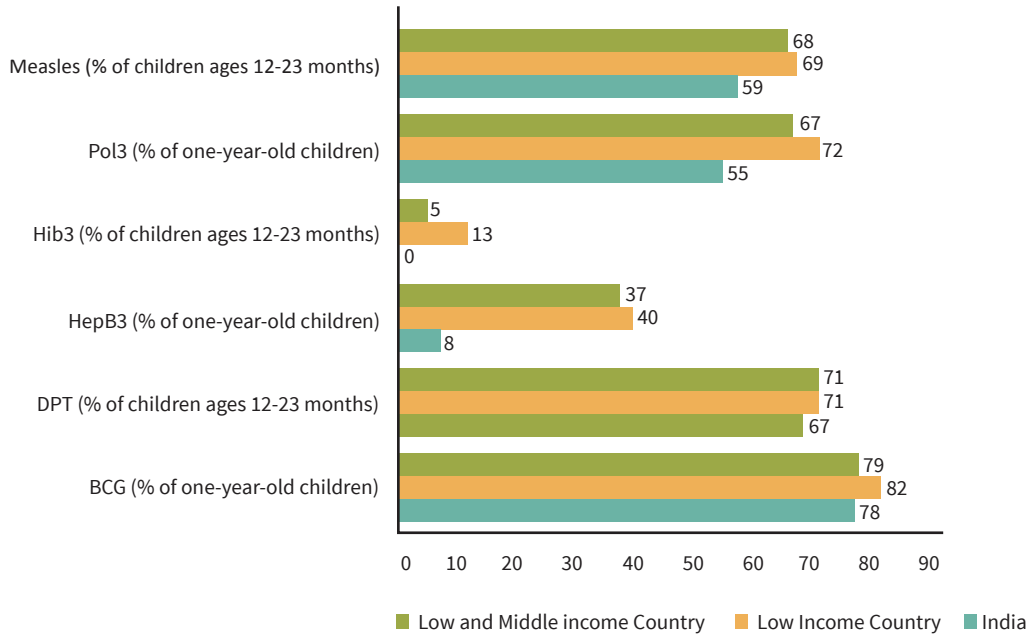
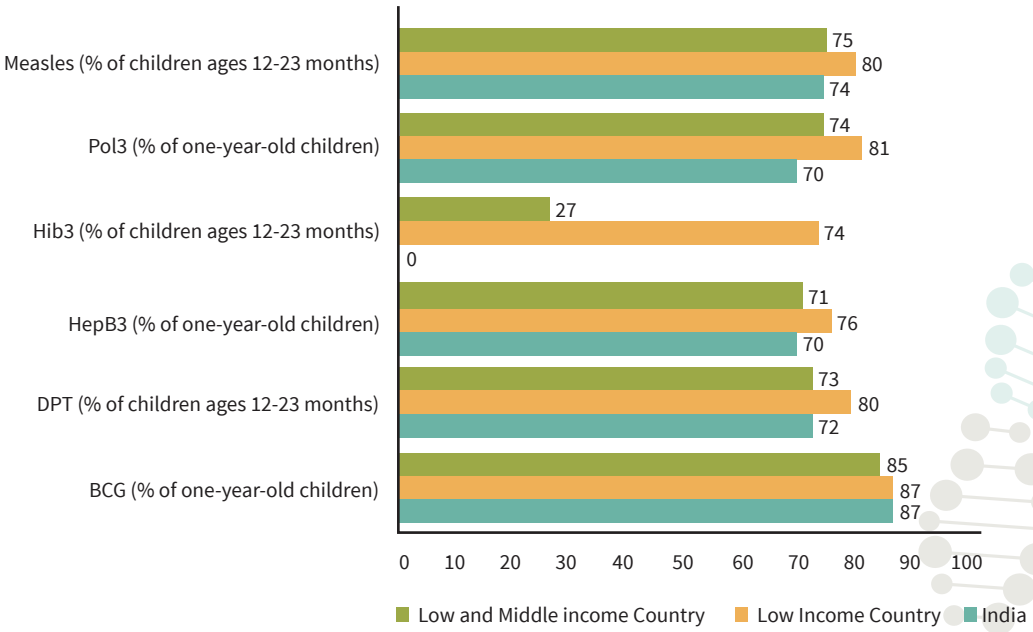


Figure 5

Immunization 2012

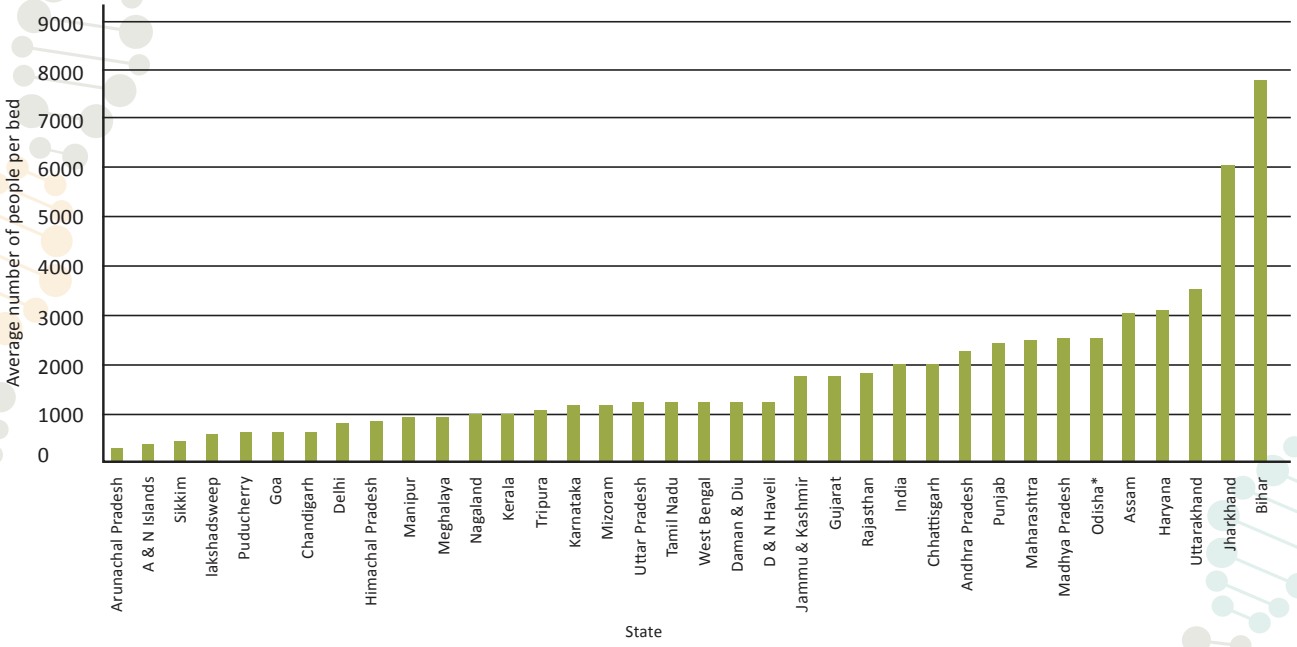


The percentage of one year old children who have received BCG immunization in India (78%) was lower than the average of LIC (82%) and LMC (79%) for 2005. In 2012, however, the state of immunization improved as evidenced in the table. It was higher than the LIC and LMC average. In case of DPT, Polio, Hepatitis B and measles, the percentage of immunization has been lower than the average LIC and LMC for the 2005 and 2012 period. The percentage of one year old children who received hepatitis B immunization was as low as 8% which was much lesser than the 37% average of LMC.

The tallies of India's formal health infrastructure vary across sources,[15] but both domestic and international figures concur that India has less than one bed per thousand people, compared to an average of 1.4 beds per thousand in other lower middle income countries. Public hospitals are stretched thin across the board, though beds per number of people ranges from 1 bed per 300-550 people in smaller states/territories such as Puducherry and Lakshadweep to 1 per 7000 people in Bihar. Despite mandates of having a public health facility within 2 kilometers of an average household, the average distance is 9 kilometres.[16] Data on access to private providers are not available.

Figure 6

Average population served per Govt. hospital bed



Similarly, there was less than one nurse or mid-wife per 1000 population in India as of 2010, compared to an average of nearly 1.8 nurses/midwives per person in lower middle income countries. India had 0.65 physicians per 1000 population, compared to the lower middle-income country average of 0.79 in the same year.

The gaps are especially acute at the primary care level. Of the approximately 30,000 new doctors and 10,000 medical specialists who graduate from India's approximately 400 medical institutions each year, most of them end up working in towns and cities or go overseas. New graduates prefer to pay stiff fines

than complete mandatory service in rural areas. There is a growing demand for English-speaking trained professionals in higher-wage countries. Barring a committed minority (who often experience burnout),[17] new medical graduates face a scarcity of medical equipment, laboratories and medical infrastructure in low-resource settings. Absenteeism is also a perennial problem – a 2003 study based on random spot checks found absenteeism of 40%, higher than Bangladesh (35%), Uganda (37%) and Peru (23%). Medical Outreach Work (37.6%) and Authorized Leave (24.4%) were the most commonly stated reasons for absence (Chaudhury et al, August 2004). Banerjee and Duflo (2006) find that the absentee rates in the rural sub-centers (46%) are higher than the larger centers (35%), a serious challenge since the rural sub-centres are often run by just one person. Doctor absenteeism is a primary reason for patients in underserved areas to seek private health services. This nearly doubles their costs for care when compared to public sector hospitals.

The gaps in India's mental health infrastructure are even more striking. The country had 25,000 beds in mental hospitals (both public and private) in the entire country as of 2002 (CBHI, 2012). While more than a decade has passed since these data were collected,[18] even a 50% increase in these facilities would provide an average of 2 beds per 100,000 compared to a global average of closer to 8 per 100,000.[19] (Morris et al, 2012)

National and state efforts to address these gaps are gaining some traction. The National Rural Health Mission (NRHM, now the National Health Mission), for example, has succeeded in training 825,534 female community health activists (as of 30 June, 2013), who have been placed in primary health care centers. Many belong to and have a stake in these communities. In addition, a growing number of nurse practitioners are invited to work in rural areas. The NRHM/NHM has also been instrumental in upgrading and operationalizing public health care centers as 24/7 facilities, establishing specialty newborn care and stabilization units, engaging and providing skill based training to nearly 1.4 lakh human resources working as Auxiliary Nurse-Midwifes (ANMs), Staff Nurses, Paramedics, AYUSH Doctors, Doctors, Specialists and AYUSH Paramedics.[20]

Looking forward, the Union and State governments, which set national and regional budgets, regulatory standards, provision targets, and subsidies and incentives for the large public health infrastructure must continue to play a role in meeting these gaps, but there are abundant opportunities for social entrepreneurs to contribute to meeting healthcare needs. We return to some of these in later sections.

The Scope For Market-Based Models In Improving Health Systems For Low Income India

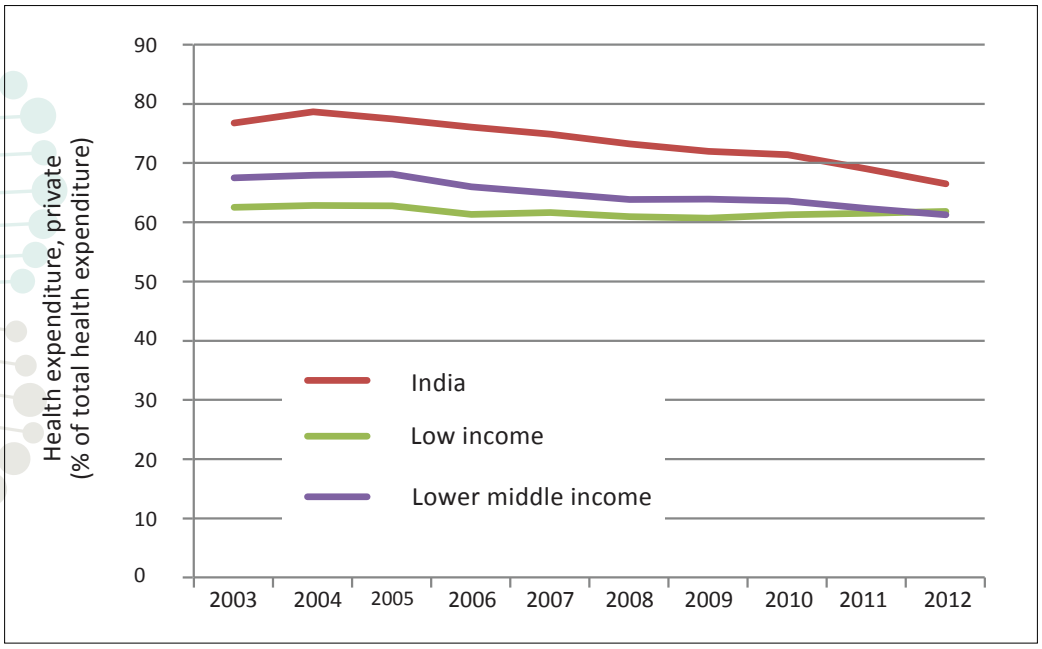
Overall, India's healthcare industry is currently estimated at USD 60 Bn with USD 32 Bn attributed to healthcare delivery, USD 20 Bn in pharma and biotech, USD 4.4 Bn in medical technology, and USD 3.7 Bn in medical insurance. As Asia's fourth largest medical device market and a global top 20 market for medical devices, the Indian market for medical technology is expected to grow to USD 7.8 Bn by 2016, a compound growth rate of over 15%.[21]

That said, the main customers in the health market continue to be households: public health expenditure in India is about 1.3% of the Gross Domestic Product (GDP), compared to private health expenditure of 2.7% of GDP of private health expenditure.[22] And many of these households are poor. India is a lower middle income country with an average per capita income of approximately USD 1500 per

year.[23] A fifth of the country, and as much as 40% of the population of some states, lives below the official poverty line. About a third of the country (32.7%) lives below the World Bank-defined poverty line of $1.25 (Purchasing Power Parity) a day.[24] Over half of the country, 56%, lives on less than Rs 1336/month, or "the level of consumption required for an individual to fulfill his/her basic need for food, energy, housing, drinking water, sanitation, health care, education and social security at a level sufficient to achieve a modest standard of living."[25]

Figure 7

Private Health Expenditure as a percentage of Total Health Expenditure



To put this in perspective, at the Narayana Health multi-specialty hospital, made famous by Dr. Devi Shetty for significantly bringing down the cost of cardiac care, a caesarean section starts at Rs. 20,000 and an angioplasty costs Rs. 50,000 in the general ward. Open-heart surgeries can range from Rs. 100,000-200,000. While this is much less than what the same procedure would cost in the US, it is easy to see that in India, where these costs are likely to be paid out of pocket, just one emergency procedure can quickly launch a family into poverty.[26]

Costs are also rising. Health care cost inflation, commonly estimated at 15%, is double the overall inflation of 6-7%, and these rising costs have been a factor in political debates. It not clear how this inflation is distributed across income groups, but it appears to be fairly consistent across different types of procedures including essential ones (see Table 1). Innovations can reduce the costs of treatment, but also increase the range of possible treatments and, in doing so, may increase the total cost of "doing everything humanly possible."

Table 1

Healthcare Inflation[27] (General Insurance Public Sector Association Rates)

Procedures	2007-08	2008-09	2009-10	2010-11	2011-12
Kidney Transplant	147,231	144,741	194.352	157,825	200,180
Total Knee Replacement	175,986	163,385	166,862	173,674	167,706
Liver Transplant	-	250,000	142,599	140,650	192,881
Mitral Valve Replacement	144,111	126,327	160,921	179,053	152,351
PTCA	150,535	139,817	148,728	145,736	150,258
CABG	139,846	138,005	144,301	151,077	144,043
Total Hip Replacement	129,414	112,889	116,500	129,697	115,376
Pacemaker Impalntation	115,275	117,460	116,925	115,125	120,107
Pacemaker Impalntation	42,375	44,109	43,578	50,662	51,842
Turp	37,361	41,790	47,995	52,886	56,054
Hysterectomy	35,137	34,649	38,922	39,837	37,528
Chemotherapy	32,189	29,516	31,243	32,046	32,627
Dialysis	23,788	23,628	24,470	23,321	19,128

All figures in Rs; Source: TTK Healthcare

Health expenditures have been pushing nearly 39 million people into poverty every year. A recent Lancet study found that 30% of rural households and 20% of urban households were untreated or didn't go for any treatment due to financial constraints in 2004.[28] Financial hardship is one of the major reasons for poor uptake of maternal healthcare services in India. For example, in Bihar, one of India's poorest states where over 80 per cent of births are home births, approximately 50 per cent of women reported financial concerns as the reason for not opting for institutional delivery care. Maternal healthcare services are in principle provided free-of-charge in public health facilities in India,but payments for antenatal, delivery, and postnatal services are widespread in the Indian public health sector.[29]

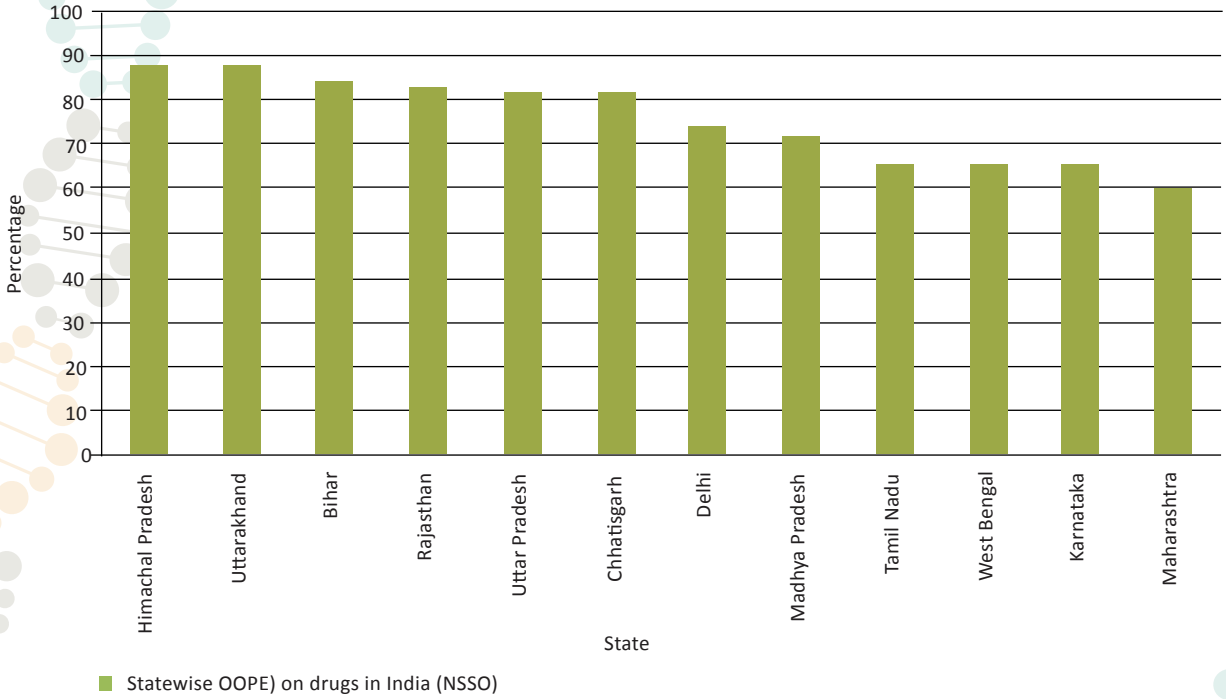
In 2010, 66% of the total spending on health was in the form of out of pocket expenditure (WHO Atlas 2012).[30] This figure rose to 86% in 2012 according to the World Development Indicators (World Bank 2014).[31] Though all Indians are eligible for public health services, their direct out-of-pocket expenses have been among the highest in the world (WHO Report 2013).[32]

According to the High Level Expert Group Report of the Planning Commission almost 74% of private out-of-pocket expenditures today are on drugs (Planning Commission, 2011).[33] Though medicines are meant to be supplied for free when there is availability, private supply of medicines in public centers appears to be common (Kanavos 2012).[34] The private sector mark-ups applied to the cost of the production of medicines as they move through the supply and distribution chains ranges between 29-694% (United Nations, 2008).[35] In an effort to minimise this portion of out of pocket expenditure, the Indian Government has proposed the expansion of Jan Aushadi stores and provision of generic drugs without brand names. (Planning Commission 2012).[36]

The Government outlets only sell unbranded quality generics at no more than 50% of the prevailing maximum retail price (WHO 2011).[37] However, according to the World Health Statistics, 2011 and 2012 the median availability of selected generic medicines between the period 2001 and 2009 was only 20.5% in the public health clinics while it was 75.4% in the private health clinics (WHS 2011 and 2012).[38,39] This figure increased to 22.1% in the public clinics and 76.8% in the private clinics when the median years were 2001-2012 (WHS 2013).[40] The table below indicates the National Sample Survey Organization (NSSO) records on the highest out-of-pocket expenditure on drugs. The highest is in Himachal Pradesh (87.95%), followed by Uttarakhand (87.75%), Bihar (84%), Rajasthan (83%), Uttar Pradesh (81.86%) and Chhattisgarh (81.38%), Delhi (74%), Madhya Pradesh (71%), Tamil Nadu (66%), West Bengal (65.80%) , Karnataka (65%) and Maharshtra (60%) (TOI, 2012).[41]

Figure 8

Statewise Out of Pocket Expenditure (OOPE) on Drugs



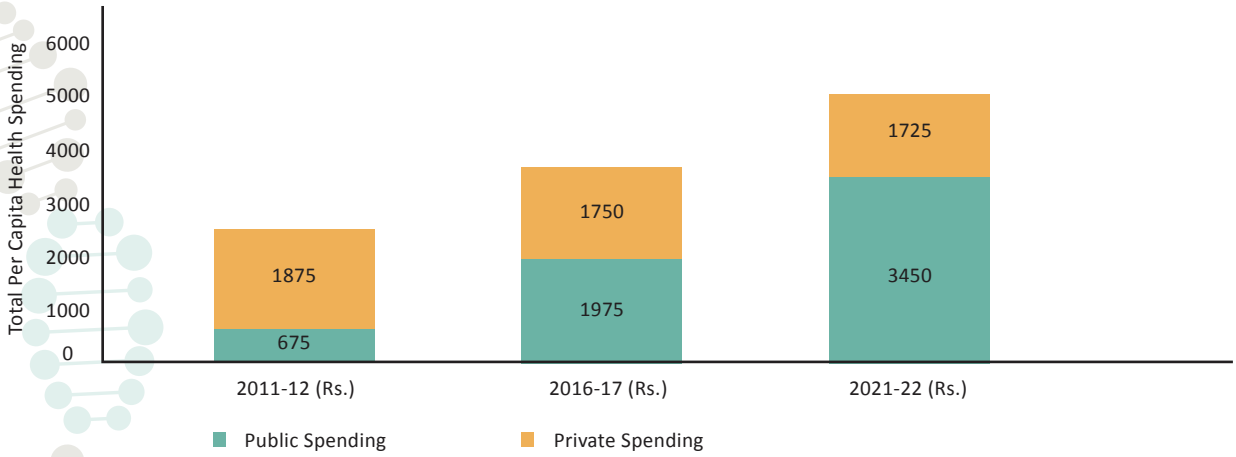
Source: NSSO

The future prospects for market-based models for improving the health system will depend on the implementation of current plans to provide Universal Health Coverage. The High-Level Expert Group on Universal Health Coverage has called for a substantial increase in public funding, to 2.5% of GDP in the current Plan Period (2012-17) and to 3% by 2022. The way in which this additional public expenditure is routed – as support to public hospitals, insurance schemes and health allowances that allow patient choice or other forms of distributing funding - will play a significant role in the evolution of India's health care system. We discuss this further in the coming chapters.

Projected Real Per Capita Health Spending In India At Current Prices (2009-2010)

Figure 9

Projected Projected Total Per Capita Health Spending



Source:Retrieved from http://planningcommission.nic.in/reports/genrep/rep_uhc0812.pdf

Endnotes

[1]World Health Organisation (1999). World Health Report 1999. Geneva

[2]The data are from different sources but are reasonably comparable. In the World Development Indicators, Communicable diseases and maternal, prenatal and nutrition conditions include infectious and parasitic diseases, respiratory infections, and nutritional deficiencies such as underweight and stunting. Non-communicable diseases include cancer, diabetes mellitus, cardiovascular diseases, digestive diseases, skin diseases, musculoskeletal diseases, and congenital anomalies. For WHO, infectious diseases are caused by pathogenic microorganisms, such as bacteria, viruses, parasites or fungi; the diseases can be spread, directly or indirectly, from one person to another. Zoonotic diseases are infectious diseases of animals that can cause disease when transmitted to humans. Non-communicable diseases (NCDs), also known as chronic diseases, are not passed from person to person. They are of long duration and generally slow progression. The four main types of non-communicable diseases are cardiovascular diseases (like heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructed pulmonary disease and asthma) and diabetes. Retrieved from http://www.who.int/topics/en/

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[15]We use figures from the Central Bureau of Health Intelligence (2012) National Health Profile, a report produced by the Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India unless otherwise indicated. International comparisons are based on figures reported in the World Bank World Development Indicators.

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[22]Public health spending in India's peers (lower middle income countries), by way of reference, spent 1.7% of GDP on healthcare; low-income countries spent an average of 2% of GDP on healthcare. Private spending on health care is about double the public expenditure in both cases.

[23]Rs. 60,972 as reported by the Government of India, USD 1503 as reported in the World Bank World Development Indicators, or USD 5,138 adjusted for Purchasing Power Parity.

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Chapter 3: Innovation Ahead

India's health system needs are clearly significant. The country has multiple burdens of disease (chronic, known and common infectious diseases, and emerging novel threats to human health), a sparse and varied public health infrastructure, a larger low-income population, and still-limited public expenditure and support for insurance. It is hard for any health venture not to have some kind of impact in this setting; but is at the same time equally challenging to identify the points of leverage which can have a significant impact while being financially viable. The analysis and scenarios in this report seek to provide some frameworks to help entrepreneurs identify such opportunities to transform the health system. But for now, we complete the discussion of context with a look at the state of the social enterprise ecosystem around health.

There is clearly an entrepreneurial buzz around healthcare in India, at least part of which is focused on healthcare for low-income India. Healthcare is one of the hottest sectors for impact investing, with funds being channeled into a variety of sub-areas – from hospitals and clinics to innovative diagnostic tools and medical devices designed for low-resource settings. This section of the report focuses more on healthcare than the health system in order to keep the chapter readable and finite, but the same kind of buzz appears to be emerging in the broader health system. Areas such as nutrition, water access, and other contributors to health are gaining some traction among investors in addition to continued support from philanthropists. The first part of this chapter describes the landscape for financing social enterprises in health.

Looking ahead, however, building up the social enterprise ecosystem to support new ventures in health in a complex context requires more than just investment. This is a risky space, in which entrepreneurs may have to build their own market infrastructure – supply chains, maintenance support, trained professionals – as well as devote time to discovery of customer preferences and undocumented details of the health systems as is. In 2012, Acumen Fund and Monitor Inclusive Markets released their "Blueprint to Scale" report, which introduced the idea of the pioneer firm in social enterprise.[1] In this study, they introduce the four stages of a pioneer firm as blueprint, validate, prepare, and scale. Healthcare for low income India is largely in this stage: market conditions, such as customer awareness and training, distribution, and appropriately skilled professionals, while growing, remain at a nascent stage. This is a challenging sector and many moving parts need to come together efficiently for successful responses to the kinds of opportunities that this report highlights.

The second part of this chapter discusses some of the emerging innovation platforms. Innovation is the process of developing solution for an unmet need and in doing so making a larger difference to the community of end users. The process of innovation is often very complex and is divided over various distinct phases, including, for example: identification of an unmet need, assessment of the potential impact of a solution, iterative development of a prototype or a process, deployment of the final solution for validation, and eventually scaling-up and commercialisation.

The various platforms discussed here play an important role in bringing together networks of collaborators. Innovation in the area of healthcare is particularly difficult because of its long and complex value chain, which includes care seekers (patients, general population), care providers (doctors, nurses, health workers), hospital administrators, service providers, manufacturers, traders, distributors, retailers, regulatory bodies, policy makers and so on. A deep understanding of this value chain is necessary to drive the

process of innovation. Creating a successful healthcare innovation also requires knowledge and skills from diverse disciplines such as medicine, science, engineering and technology, business, law, and social sciences - a multi-disciplinary approach as well as grounding in deep understanding of the real-life context.

The Entrepreneurial Buzz

Entrepreneurs have stepped into this market. With investors from all walks putting increasing amounts of capital into the sector – including mainstream venture capital and private equity, corporate investors, angels, and impact investors – there is growing interest in the private sector's potential to provide progressive delivery models combined with innovative technologies that can bring down the cost of care while improving accessibility and quality.

Current Funding Landscape

From Jan 2008 to April 2014, there were 164 rounds of venture funding[2] into 118 Indian companies, for a total of over USD 1 Bn in funding[3] (this figure is for 147 of 164 deals for which information available). This figure is for 147 of 164 deals for which in for water available. USD 136 Mn of the total funding was in social enterprises (13.6%) – 42 deals and 26 companies (22%). Forty two M&A exits in healthcare were made, 11 of which were strategic sales to the industry. Forty-nine companies were incubated, with ICICI Knowledge Park incubating the most (10)[4]

Figure 1

Funding across sectors

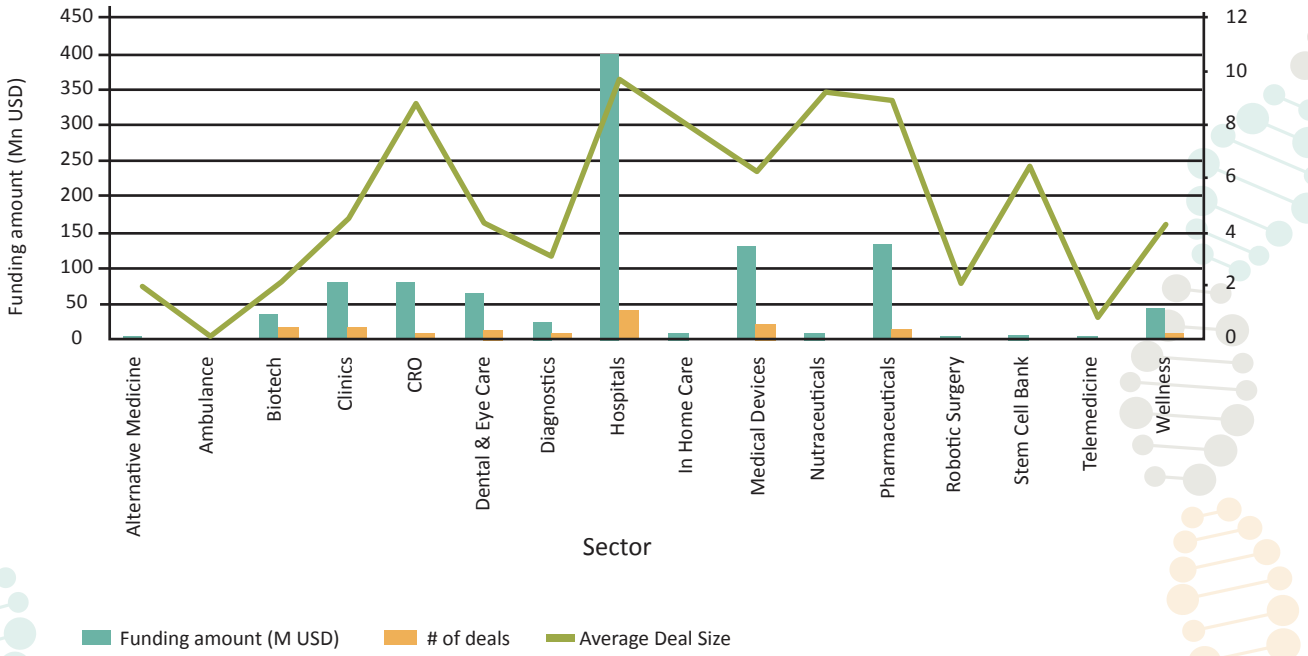
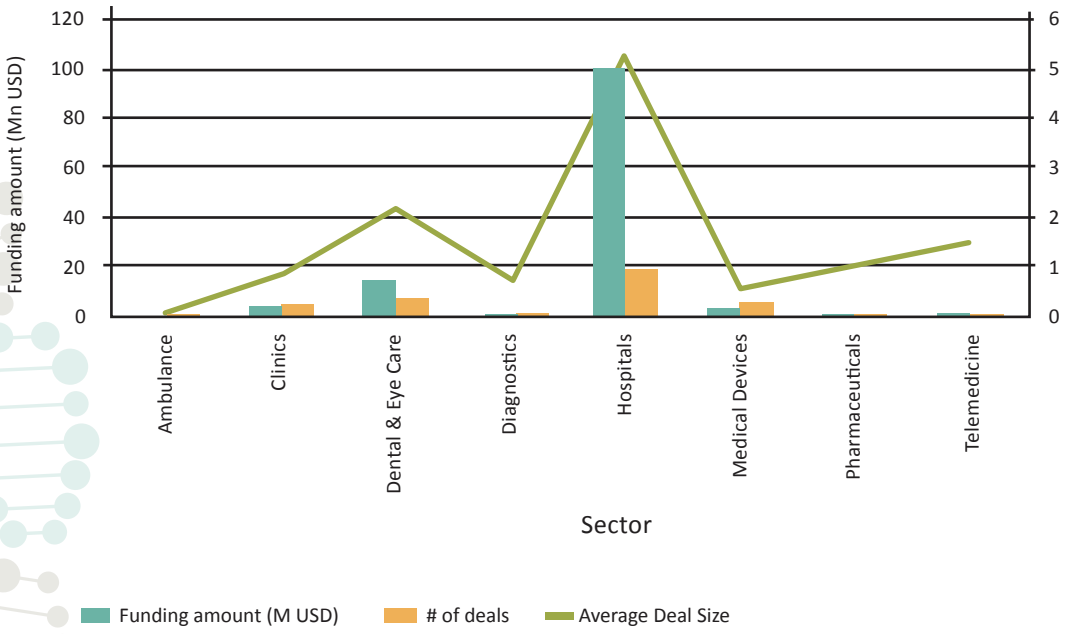


Figure 2 provides a breakdown of the USD 136 Mn injected by impact funds:

Figure 2

Social funding by sector



While social funding in most sectors accounted for a fairly insignificant proportion of total funding in that sector, social funding into hospitals accounted for 24% of total healthcare funding, and social funding into dental and eye care accounted for 25% of total healthcare funding. Of the 15 hospitals in this category which were socially funded, two promote traditional and ayurvedic health and three were single-specialty hospitals –viz. maternal care, nephrology, and oncology. Social investment so far has been dominated by innovations in delivery models. If the funding of specialized clinics in maternal care, dental care, eye care, and nephrology are an indication, we may continue to see specialized clinics emerge across other forms of lifestyle care. The hospitals, clinics, and even devices that are attracting social investment, however, are catering to lifestyle and chronic diseases, which tend to rise with incomes. However, little social investment is going towards communicable diseases that are more common among those living below the poverty line. This may be an indicator that such financially sustainable innovations in delivery models can only price low enough to cater to lower middle class populations.

After hospitals, pharmaceuticals accounted for the second largest percentage of total funding (13%), which is not surprising given the global success of Indian pharmaceuticals in developing low cost generics. Medical devices accounted for the third largest (again 13% of total investment). This was almost wholly dominated by mainstream funding. Villgro funded three of the four companies which received social funding (Biosense, OneBreath, and Windmill Health), and Khosla Impact funded Embrace. Two have raised follow-on rounds (Biosense was invested in by Insitor, and OneBreath received funding from Ventureast)– an early indicator that greater social funding is likely. Mainstream investors that are funding medical device companies include Accel and IDG Ventures (Forus Health, Perfint Healthcare), Ventureast (OneBreath, Mardil Medical Devices, Total Proshetics & Orthotics), and India Venture Partners (Consure Medical).

Companies that received seed or series A funding from an impact investor and went on to raise follow-on rounds include:

Table 1

Name of the company	What it does	Funder / Investor	Investment details	Investment made in
Eye Q	A speciality eye-care chain in Delhi and neighbouring states that is committed to high quality, affordable eye care	Song Investment Advisors (managed by Soros Economic Development Fund, Omidyar Network, and Google)	Series A USD 2Mn	May 2010
		Helion and Nexus Venture Partners	Series B USD 10M	October 2011
		Helion and Nexus	USD 4.5Mn	January 2014
Nova Medical Centers	Day-care, Multi speciality surgical centers at affordable prices	GTI Capital Group	Capital injection of USD 3.5Mn	2009
		Goldman Sachs and New Enterprise Associates	USD 54Mn	August 2012
Vaatsalya	Low-cost primary and secondary multi-speciality hospital chain in South India	Aavishkaar	USD 1.4Mn	March 2008
		Seedfund and Oasis fund,	USD 4Mn	2009
		Aquarius India and Seedfund	USD 10Mn	2011
Nephrolife Care	Single-specialty chain of clinics providing dialysis treatments.	US based ROI capital	USD 3Mn	2009
		New Enterprise Associates and multi-national kidney care company DaVita, Inc.	USD 25 Mn	2012
One Breath	Low-cost, portable, mechanical ventilator.	Incubated by Villgro in 2013	with initial seed capital	2013
		Ventureast	USD 3Mn	2014

Table 2

Matrix highlighting the sectors in which both seed capital and venture capital are flowing

Funder	Single Speciality Hospitals / Clinics	Multi Speciality Hospitals / Clinics	Biotech	Pharma	Medical Devices
Seed					
Villgro			X		X
Lok Capital	X				
Indian Angel Network		X			
Venture Capital					
Acumen	X	X			
Aavishkar		X			
Omidyar	X				
Sequoia		X			
Accel					
Venture East					X

Corporate Venture Funding

Corporate venture funding is the investment of corporate funds into external start-ups. There are two primary reasons companies engage in this: 1) to identify and exploit synergies between the two companies, such as access to new markets, technologies, resources, or distribution channels, and 2) for financial returns. Strategic rationales tend to dominate the purpose of corporate venture funds.

In healthcare, the largest corporate venture capital funds are led by firms in the pharmaceutical and biotech industries.[5] A survey by Global Corporate Venturing indicated that the top 75 corporate VCs in healthcare are more influential and larger than many independent VCs. In this report, of the 75 most influential healthcare corporate VCs, only 3 were based in India (although others may be investing in Indian companies) – Ajay Piramal Group (India Venture Advisors, INR 4 Bn), Dr. Reddy's Labs (I-Ven Pharma, USD 56Mn), and Zydus Cadilla.[6]

As mentioned above, many of the health startups that are being incubated or funded today are stuck in the "pioneer gap" - they are paving the way for the market to take off, but at its current state, market conditions may not be ideal for these companies to take off quickly.

Organizations such as Stanford India Biodesign and Grand Challenges Canada (both discussed in more detail below) are taking on the challenge of introducing companies at the blueprint stage. They are helping to define precisely where the needs are and giving entrepreneurs both the tools and the funding necessary to design for these challenges. There is room for more such organizations to enter the landscape, possibly through more academic and philanthropic partnerships, as grant funding is likely to be required at this stage.

Startups often make the mistake of trying to skip the validation stage altogether and go directly from blueprint to mass commercialization. In doing so, they may find that their design or model is not quite what the market demands and have to go back to the drawing board after significant failures. Acclerators and incubators are addresssing this gap.By strengthening resources at the validation stage, startups are enabled to "fail quickly" and enter the commercialization stage with a more appropriate product. In the medical technology sector, validation is particularly crucial as product failures can have detrimental outcomes. Unfortunately, the lack of regulation in India means that there are few formal, established processes in place to offer proper product validation. Buyers look to their competitors, peers, global organizations such as the WHO, or global product standards such as FDA approval (which is expensive and may not be necessary for Indian products at this stage) for product validation. This limits the scope for startups to displace existing products. While startups are discovering their own creative ways to validate their product, there are opportunities for players to emerge to address this concern and help speed up product validation, particularly in the device sector.

At the market preparation stage, challenges include distribution, customer awareness, and changing customer behaviors and attitudes on the demand side, and improving capabilities of suppliers, designers, and manufacturers and promoting indigenous manufacturing on the supply side. Distribution of medical devices, for example, is highly fragmented. Established distributors are often unwilling to work with single product companies, and many new devices are being developed for low resource settings, where distributors are not reaching. In addition, many innovators are bringing down costs by developing low margin, high volume products, which distributors do not want to take up until it has been proven that minimum volumes are attainable.

Overview of Emerging Platforms

The landscape of early stage funders in the form of incubators and accelerators is rapidly expanding in India and creative platforms are beginning to emerge to promote and uncover entrepreneurial activity.

Incubators

A business incubator works hands-on with an entrepreneur or startup to provide a range of support services to help a company grow. They typically are semi-long term engagements (1-3 years) and may or may not provide funding support in the form of debt or equity. They often seek to work with companies that are developing novel products or have unique, untested business models. The stage of company they work with often ranges from prototype development to the early stages of commercialization. The types of support incubators offer includes (but not limited to) financial, fundraising, networks, lab facilities, media, and recruiting. As incubators expand their networks and gain exposure to greater numbers of startups, the shared knowledge creates a pool of information that can be leveraged to help new incubatees navigate the challenges common to startups in a more efficient manner.

Villgro

Villgro Innovations Foundation[7] is one of India's oldest and foremost social enterprise incubators, supporting innovators and social entrepreneurs during their early stages of growth. Since 2001, Villgro has incubated 94 such enterprises, generated around 4000 jobs, secured INR 873 million in follow-on funding, and touched over 5 million rural lives.

Healthstart

Launched in 2013, HealthStart[8] is India's first accelerator program dedicated to supporting start ups in healthcare industry through funding, mentorship and other requisite support.

RTBI

Rural Technology and Business Incubator (RTBI)[9] of IIT Madras incubates start-ups, which focus on creating an impact in rural and underserved societal segments. It has focased on leveraging ITC for various aspects of health services. It was established in 2006.

SeedSurge

eHealth Technology Business Incubator (TBI) programme SeedSurge[10] provides a platform to budding entrepreneurs through wide ranging services such as mentoring, seed funding, marketing and branding, IPR plug-in, product design and prototype conceptualization. SeedSurge is focused on applications of ICT in healthcare.

IKP Knowledge Park

IKP Knowledge Park,[11] India's premier science park, is facilitating business driven R&D for over a decade. It provides ready-to-use infrastructure such as modular wet laboratory blocks along with shared facilities and support services.

Accelerators / Hackathons

Accelerators are shorter term engagements than incubators, often offering services ranging from a weekend to one year. These tend to be structured programs with a series of courses or assignments to help budding entrepreneurs design, develop, and prototype more quickly. Many incubators host accelerator programs to help build a strong pipeline for their incubator, where they get a chance to see how the entrepreneur thinks and gain more insights into whether they would be a good fit as an incubatee.

Hackathons are "super accelerators" which are meant to bring together people from a variety of backgrounds, including design, engineering, medicine, and business, to leverage their experiences and begin designing solutions over the course of a weekend, with the advice of mentor investors and experienced entrepreneurs. Glocal Healthcare, in collaboration with the Boston based Consortium for Affordable Medical Technologies (CAMTech), MIT, and Harvard Medical School launched a "Jugaadathon" in January 2014 in Calcutta. Three overarching themes were provided to participants: emergency and critical care, maternal and child health, and mobile health, with nine contextual examples and problem statements from which participants were to choose one to develop solutions for.

Public Private Partnerships (PPP)

The Biotechnology Industry Research Assistance Council (BIRAC) was founded in 2010 out of the Department of Biotechnology as a Section 25 non-profit company with the stated mission to "facilitate and mentor the generation and translation of innovative ideas into biotech products and services by the industry, promote academia – industry collaboration, forge international linkages, encourage techno entrepreneurship and enable creation and sustainability of viable bio enterprises".[12] Today, biotech in India is nascent, with a market size of USD 5-7 Bn, compared with Pfizer India's budget of USD 7 Bn. To-date, BIRAC has funded more than 200 companies including 40 startups. They have piloted several programs to attract innovators, and see themselves as facilitators and ecosystem builders to bridge the gap across industry, government, and non-profits, while forging partnerships with incubators for mentoring and guidance.

Projects have included the University Innovation Center in partnership with Sam Pitroda, where they strategically decided not to work with India's top universities, but rather regional institutes to provide fellowship opportunities, conferences, and interactions with industry professionals to give exposure to the students. Another upcoming initiative is SPARSH through which they plan to marry social innovation with biotechnology. The program focussed on product development and delivery, as well as building a pipeline of 'enterpreneurially minded innovators'. The concept is that participants will be accepted into an 18-24 month intensive program, with support from incubation and mentor partners across India. Successful participants will receive INR 500,000 and incubation support following the program. As opposed to accelerators and hackathons which aim to achieve lofty goals in a short period of time, the SPARSH program takes the view that up to two years of intense support is required for entrepreneurs to even fully understand problems in the biotech industry and begin the design process.

Academia

Creating a successful healthcare innovation requires knowledge and skills from very diverse disciplines such as medicine, science, engineering and technology, business, law, and social sciences. In India, traditionally training in these disciplines is provided by academia through degree programmes at undergraduate and graduate levels. Premier academic institutions in India in these disciplines are world-renowned. IITs, IIMs, AIIMS and PGIMER, TIFR, NLS, TISS, and so on (acronyms intentionally not expanded). Graduates of all these institutes are highly sought after in industry and academia all over the world. Apart from education and training, many of these premier institutes have also contributed significantly to R&D in the country, albeit in their own specialisation areas.

However, as we discussed earlier, innovation in healthcare requires a multi-disciplinary approach. In the Liberal Arts University model, where many different departments, research centres, institutes, and even start-up companies are housed in the same campus, such multi-disciplinary "ecosystems" naturally enables innovation through dialogue and close collaboration between students, researchers, and academics from different disciplines. While geographic proximity can be seen as the reason for this interchange, what is equally important is the cross-fertilisation of ideas that happens right from the most junior level of

undergraduate students. The work culture of multi-disciplinary approach thus is an integral part of education and training.

In the absence of such naturally developed university based innovation ecosystems, India needs an effort where ecosystem can be created by forming collaborations across different institutes. Such collaborations could be individual or multiple collaborations could be aggregated together in the form of a collaborative platform – with resources such as skilled workforce, equipment, workspace, and network of experts shared between different collaborations.

Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), declared as an Institute of National Importance by the Government of India in 1980, has played an important role in the country of bringing medicine and technology together.[13] The most well-known example of its contribution is indigenously developed artificial heart valve. IIT Kharagpur, one of the leading technology institutes in India, started The School of Medical Science & Technology in year 2001 with the objective "to provide a platform of interdisciplinary teaching and research in diverse areas of medical science and technology."[14] The school runs a three year interdisciplinary graduate level programme in medical science and technology, a one of a kind programme in the country, where MBBS doctors are trained in a technology institute. More recently, the Translational Health Science and Technology Institute (THSTI) was started by Government of India to create biomedical innovations through translational research.[15] THSTI houses many research centres, including in the areas of paediatric biology, vaccine and infectious diseases, bio-design and diagnostics, and drug development. These centres undertake translational research in public health areas of national priority.

While the examples in the preceding paragraph show an approach of starting new academic institutes or starting new academic programmes in the existing institute, a new type of academic collaborative platforms have started emerging in the past few years which deviate markedly from the traditional academic models. These new platforms strategically focus on activities related to entrepreneurship and industry partnership right from the inception.

Stanford India Biodesign[16] is a collaboration among the All India Institute of Medical Sciences (AIIMS), IIT-Delhi, and Stanford University with the goal of identifying bright engineers, doctors, and scientists and providing the appropriate experiential training for frugal innovation in healthcare for the Indian context. There are two programs offered: the fellowship is typically given to 3-4 people per year and consists of a 6-month period at Stanford where fellows follow Stanford's biodesign curriculum and learn to identify unmet clinical needs. Fellows work in teams on this needs-finding exercise where they identify as many as 100 unmet needs, filtering this down to 10 or fewer with potential for high impact as well as strong market potential. They then begin to prototype ideas until they decide on a single concept to follow-through with. The second six month phase happens in the SIB Center at AIIMS in Delhi where fellows continue developing and prototyping their technologies while going through an intense immersion process in both urban and rural locales, shadowing doctors, nurses, and staff and deeply observing common practices.

Dr. Balram Bhargava, Director of the program and cardiologist at AIIMS, has identified this as one of the most important components of the program. While the training at Stanford is important in learning design techniques and needs analysis, a program that removes itself from the local context loses its applicability. Anirudh Chaturvedi, 2013 SIB fellow who has created a company called Brun to develop a wearable fetal monitoring device, identified the mentoring relationships as an important program component. While at Stanford, fellows receive access to three core mentors one time per week, in addition to industry experts, and

even “team therapists” who help them to navigate team dynamics. However, while the mentoring network at Stanford was strong, upon return to India he found that there were far fewer entrepreneurs in the medical device space and has largely relied on previous fellows for mentoring.

SIB is considering expanding the India component to give fellows even greater access to local mentoring and more immersion time. The second year of the fellowship is for further development, refining, testing, and fundraising. Unlike other ecosystem players (funders, incubators, etc), who tend to be more risk averse and focus on identifying strong concepts with market potential, the SIB program uniquely starts with identifying the right talent and guides them towards development, even before the concept stage. This approach is expensive, costing roughly USD 200,000 per fellow, and requires the right partners that can provide extensive amounts of knowledge and capacity building, but the success rates seem promising. For example, Mecmann Healthcare, a Delhi based manufacturer of medical devices, has licensed three products that have come out of the 2012 and 2013 intern and fellow batches. Incubators and funders are starting to forge tight relationships with SIB as it is becoming recognized as a very strong pipeline.

Healthcare Technology Innovation Centre (HTIC)[17] of IIT Madras is an R&D centre established through a joint initiative of IIT Madras and Department of Biotechnology (DBT), Government of India. HTIC was started in 2011 with the vision “to develop technologies that create impact and drive innovation in healthcare, and be a leader known for technical excellence and collaborative spirit”. Over the past few years HTIC has evolved into a unique and leading med-tech innovation ecosystem in the country bringing together more than 20 medical institutions, industry, and government agencies. Through highly dynamic collaborations with some of the leading organisations in the country, HTIC is developing affordable healthcare technologies for unmet clinical needs in areas of cardiovascular care, ultrasound, neonatology, oncology, intensive care, ophthalmology, and diagnostics. Strong industry participation is one of the defining characteristics of HTIC. A wide range of industries, from large companies to early stage start-ups, are partnering with HTIC to develop affordable healthcare technologies. HTIC also undertakes capacity building activities to develop skilled human resources in healthcare technology in the country through various channels including innovation fellowships, IIT Madras student placements and internship.

Centre for Cellular and Molecular Platform (C-CAMP)[18] is a Government of India initiative started with the goal “to act as an enabler of successful bioscience research and entrepreneurship”. C-CAMP provides support to academic and industrial scientific research in the country through services offered in the form of access to high-end platform technology facilities and expertise. As a partner in the national level scheme started by the government, named Biotechnology Ignition Grant (BIG), C-CAMP provides support to young innovators and entrepreneurs in taking their ideas to the next stage.

Located near IIT and AIIMS, Delhi’s Medtech Row is a strip of 5-10 startups that have conveniently set up shop nearby to take advantage of the relationships forged with and expertise that can be gained from IIT and AIIMS, as well as the nearby Bill and Melinda Gates Foundation and the Program for Appropriate Technology in Health. More medtech startups are beginning to flock there. In addition to the expertise from the neighboring institutes, companies located here gain access to small batch manufacturing nearby. This model was largely influenced from the top-down – research institutes that have encouraged a local ecosystem and brought together like-minded individuals who are beginning to create a community and culture around India’s medtech innovation.

Biosense Technologies, a medical diagnostics startup in Mumbai, won the second prize for their non-invasive anemia testing device at the 2008 IIT-Bombay Tech Fest. Since then, the company has stayed in close proximity to IIT-Bombay and has proactively continued tapping into the human and lab resources offered. The relationship has largely been influenced from the bottom-up, with the startup relying heavily on the institute for its hiring needs. Rather than relying on the university to promote entrepreneurship, Biosense saw an opportunity for them to proactively handpick and test out students through internships and projects before giving formal offers. The company has become highly reliant on IIT-Bombay grads for their hiring needs.

Through these new models, Indian academia has started responding to the evolving needs of innovation in health care.

What Lies Ahead?

India has become known as a global leader in "frugal innovation,"[19] with multi-nationals such as Unilever and GE adapting these techniques to produce low margin, high volume products that are adapted for the Indian context. The approach is being hailed across the world as a new wave of design thinking. MIT, Stanford, and Santa Clara University in the US all have programs, courses, and labs in frugal engineering, and are largely looking at India for inspiration. This is clearly an important moment for social entrepreneurs in India to work on the cutting edge of global innovation trends. And we must also seize this moment to innovate for a rapidly evolving healthcare system.

Endnotes

[1]Acumen Fund and Monitor Inclusive Markets. (2012). From Blueprint to Scale.

[2]Venture funding is being defined here as funding into early and growth stage companies, as defined by Venture Intelligence

[3]Venture Intelligence

[4]Wikipedia Corporate Venture Capital Retrieved from http://en.wikipedia.org/wiki/Corporate_venture_capital

[5]Global Corporate Venturing, June 2010, "Most Influential Healthcare Corporate Venturing Divisions"

[6]Retrieved from http://www.villgro.org

[7]Retrieved from http://healthstart.co.in/

[8]Retrieved from http://www.rtbi.in/

[9]Retrieved from http://www.quantumtunneler.com/index.jsp

[10]Retrieved from http://www.ikpknowledgepark.com/index.php

[11]Retrieved from http://www.sctimst.ac.in/

[12]Retrieved from http://http://www.birac.nic.in/

[13]Retrieved from http://www.iitkgp.ac.in/departments/home.php?deptcode=MD

[14]Retrieved from http://thsti.res.in/index.php

[15]Retrieved from http://biodesign.stanford.edu/bdn/india/

[16]Retrieved from http://htic.iitm.ac.in/

[17]Retrieved from http://www.ccamp.res.in/mission

[18]Frugal innovation, broadly speaking, refers to the strategy of developing for constrained, low-resource settings and removing unnecessary product components in order to produce a basic, low-cost, no-frills, durable, easy to use product that simply solves a common problem.

Chapter 4: Critical Factors

Looking ahead, there are several developments that will be particularly important determinants of the shape of India's health system. This is not a comprehensive analysis of everything that matters for the health system, but it is an effort to pick out some of the most important factors that will influence the opportunities for social entrepreneurs to improve the health system for low-income India.

As discussed in the introduction, these driving factors have been distilled from a series of consultations with experts from government, academia, social sector and the private sector on what is "important," interspersed with secondary research and the team's analysis of primary data. We further narrowed the set of "important" factors to "critical" factors by focusing on developments where we could see significant change by 2021. The human resource constraint, for example, is an "important" consideration and we discuss it in Chapter 2 as overview of the context, but it is not a "critical" factor since it is unlikely to change substantially in the 5-7 year time horizon. The potential set of responses to the human resource constraint will certainly change as some of the critical factors discussed below open up new possibilities and challenges, but the fact of limited numbers of formally trained medical professionals will remain. Similarly the challenges of implementing good ideas and scaling up promising innovations are important factors, but also perennial challenges (not just for India, but around the world). The challenges of building and scaling institutions, in the broadest sense of norms, processes, and rules as well as organizations and policy, are likely to continue to be thorny issues well beyond the futures horizon for this report. Several of the critical factors may change the nature of implementation challenges and offer new possibilities for rapid scale, but these will not be silver bullets.

Box 1 summarizes the critical factors, which can be loosely grouped into three categories:

- Broad context: urbanization, demographics, and economic growth;
- Data liquidity: information generation, digitization, and the physical and institutional infrastructure for data interchange;
- Patient Agency: health literacy and health finance.

"Some context" factors depend on broader economic, social, and policy developments; others can be shaped more substantially by social enterprise activity. The trajectories for India's demographics and urbanization are relatively predictable, for example. While social entrepreneurs may shape the consequences of these developments for the health system, they are unlikely to affect the trends themselves. Similarly, the country's economic growth path is an important aspect of the context for market-based models, but also largely exogenous to social enterprise activity.

Data liquidity often refers to the use of common terminology or standards – ontologies – to allow information to pass seamlessly across individuals, organizations, and contexts. We use a broader definition here that encompasses the whole process of data creation, conversion to digital forms that can be shared across electronic networks, and the state of networks as well as data governance that allow digital information to flow and integrate. We believe that this most accurately reflects the state of health information in India – where basic vital signs are not always measured, paper-and-pen ledgers co-exist with fully digital health management information systems (HMIS), access to broadband remains limited, and the discussions about data standards are nascent.

Patient Agency refers to patients' ability to identify, seek out, and obtain the kinds of attention and care that they need. It is influenced by a variety of factors, ranging from the level of ability that the average citizen has to monitor their own health and diagnose illness, to their ability to access care and attention from experts, on to their ability to evaluate the quality of care that they receive and be a forceful voice in demanding better.

Box 1: Critical Factors

Context

- *Demographics:* India has a combination of relatively young population along with large absolute numbers of the elderly that opens up a number of potential avenues for the social entrepreneur. On the one hand, there is substantial scope for working with schools and community programs focused on youth to infuse new attitudes, knowledge, and capacities for engaging with the evolving health system. On the other, there is a large and growing need for ongoing care of chronic conditions and vulnerabilities associated with aging.
- *Urbanisation:* India's cities are growing, and urban-like population density is increasingly common even in rural areas, with implications for both health risks as well as entrepreneurial opportunities that leverage economies of scale.
- *Economic Growth:* How fast will India's economy grow and how geographically and socially concentrated will the growth in incomes be?

Data Liquidity

- *Data creation:* Individuals' vital signs, health status, risk exposure, interactions with the health system, social networks, and other information relevant for understanding wellness are increasingly measurable at lower and lower cost.
- *Digitization:* In what circumstances and at what scale can the information being generated about individuals and their interactions with the health system be converted into formats that can be shared over electronic networks?
- *IT Infrastructure:* What will be the pace of expansion and improvement of India's information pipelines?
- *Data Interchange:* Data points are anecdotes. Analytics rely on scale. How will commercial incentives, state and national policy, and technology standards evolve to allow for integration of health information for analytics? And who will be eager customers for the insights?

Agency

- *Healthcare Finance:* Economic growth may determine the broad health budget, but healthcare finance institutions will affect who calls the shots. Will patients, insurers, lenders, the state, or some other voice drive the demand side?
- *Health Literacy:* Health literacy, or patients' ability to manage and improve their own health and navigate the health system to secure the care that they need, affects both the scale and nature of demand for healthcare. Will patients advance from being recipients of health care to becoming informed and engaged participants?

Social entrepreneurs can, however play an important role in shaping several of the more complex, less predictable critical factors, particularly data liquidity and patient agency. It is clear that information matters for the health system at all levels, patient to doctor, financier to policymaker, and public health prioritization to private clinic tactics. How organizations collect, share and use information is critical to patient agency and the improvement of health outcomes in the long run. The IT revolution is reshaping health systems around the world by enabling telemedicine, digital health, and more widespread health literacy. Some observers have argued that these changes are nothing short of revolutionary – a process of "creative destruction," according to Dr. Eric Topol, for example.[1] And while this is shaped by policy, it is also a new playing field for entrepreneurs.

Box 2: Information & Medicine

According to WHO, telemedicine is "the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities."[2]

Digital medicine is healthcare built around a much more granular and personalized sense of the patient enabled by digital representation and the analytics that such representation allows.

These two aspects of IT are intertwined with health literacy discussed above. Telemedicine will provide a "platform" to overcome challenges of accessibility and availability of workforce; Digital medicine will provide "evidence" of patient treatments, outcomes and care. Health literacy will bring "awareness" – participation and cooperation by general population, without which it is not possible to improve care delivery. Each of these can contribute to more personalized, targeted medicine.

The evolution of patient agency also rests on a mix of policy and entrepreneurial influences. Public policy around health care finance as well as general economic growth will affect who is paying for healthcare. But social entrepreneurs can affect customers' capacity, by building demand for improved quality of service and better value for money. Patients themselves are also potentially important contributors to the health system, through their own lifestyle choices as well as pro-active search for preventive care and contribution of information about present health status. Who will be the first to build and leverage this resource?

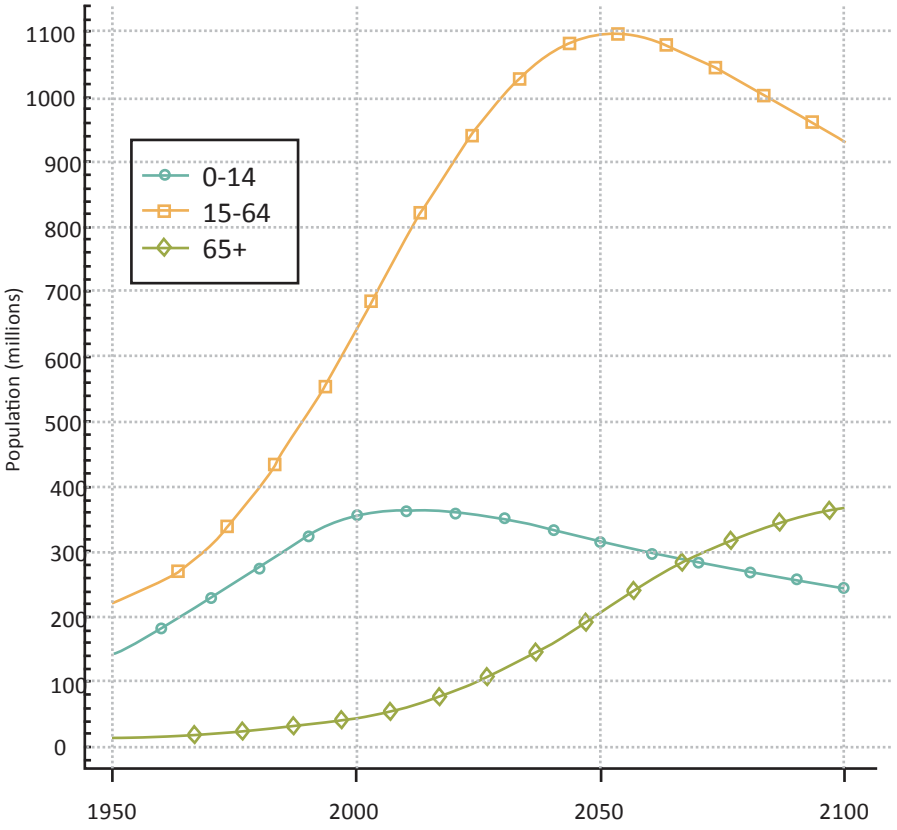
Broad Context

Demographics

India is the second most populated country in the world. Over 1.21 billion people—or about a sixth of the global population—live here, according to the 2011 census. With an approximate 1.1% annual rate of change over the next five years, India's population is projected to surpass that of China's by 2030, to become the world's largest.[3] India's proportion of younger people is also among the most sizeable worldwide, with 35.3% of the population in the 0-14 years age group, and over 50% under age 25. In 2020, the average age of an Indian will be 29 years.[4] At the same time, over 5.5% of people are above 65 years of age (2011 census), and this number is rising steadily. Life expectancy in 2012 was 68 years for women and 64.5 years for men.[5]

Figure 1

Total Population by major age groups (INDIA)



Source: United Nations World Population Prospects: The 2012 Revision

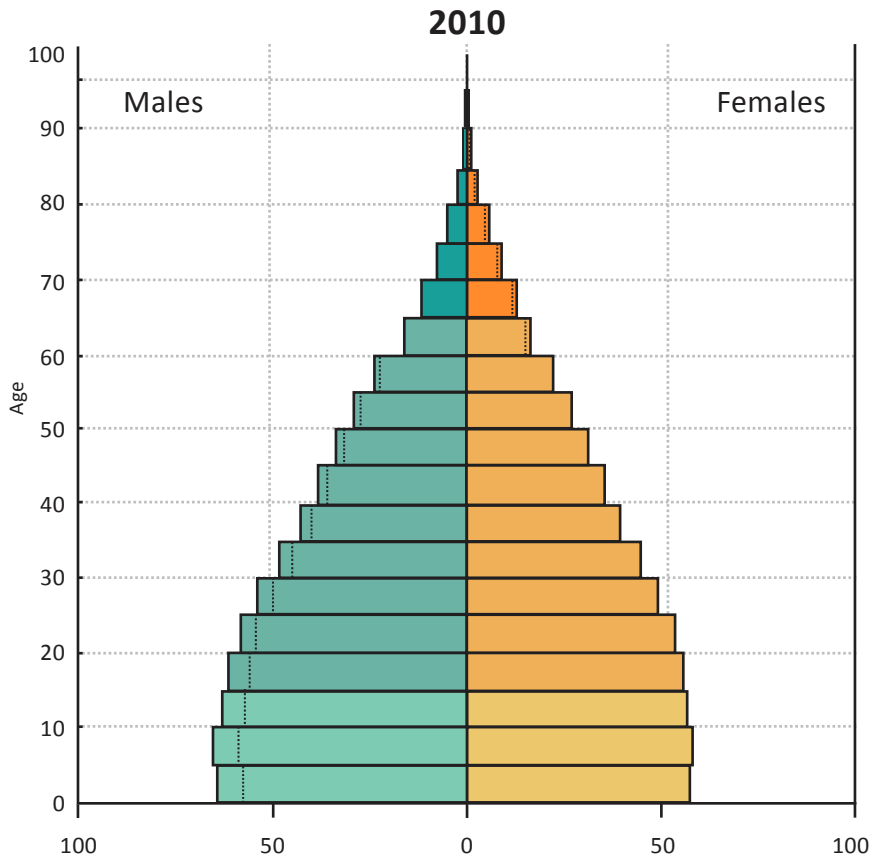
India's demographics have significant implications for health system requirements. India's young population is often taken as a sign of an impending "demographic dividend" for economic growth, but the productivity of this workforce depends on good health among other factors. That will mean addressing broad problems including a rising incidence of non-communicable diseases and illness due to exposure to environmental risks. Ill health shows up most obviously in national statistics, but it also affects individual employers, particular those who rely on employees with particular skills, training, or tacit knowledge.

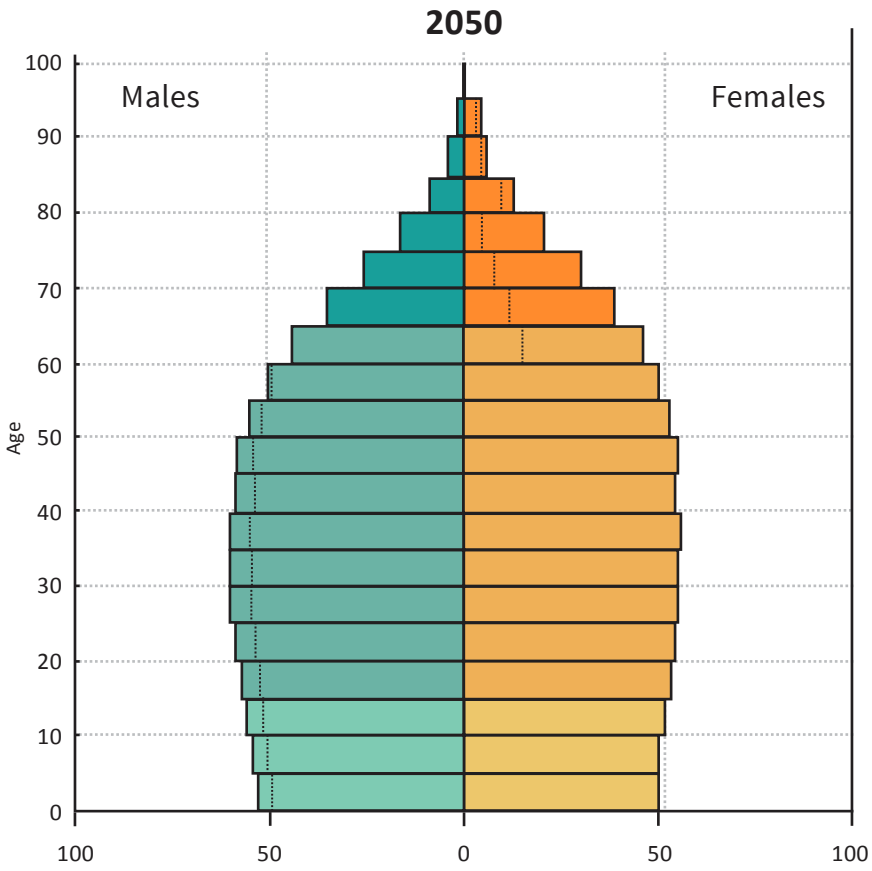
The demographics also create opportunities for social impact. For example, as mentioned above, school-aged children are particularly ripe for health literacy interventions. Approximately 114 million children will pass through primary school, and another 114 million through secondary school every year between now and 2025.[6] The social gains from ensuring that these students graduate with the skills to maintain their own health and be informed consumers of health services are potentially enormous. It is not clear how these translate into opportunities for market-based models since the social value of health literacy may be hard for educators to capture, but it is plausible that insurers, state health systems, and others with substantial exposure to the costs of healthcare may be willing customers for interventions that would emphasize preventative care and build a more savvy group of health customers.

Older people in the 50-70 year range will account for over 240 million people in 2025: a giant cadre of Indians facing increasing health concerns and pressing need to stay healthier longer. Finally, 65 million Indians will be above 70 years old in 2025, most of them requiring ongoing health care.[7] Social entrepreneurs can play an important role by addressing the specific needs of these different groups. We outline a few innovation opportunities that speak to these demographic shifts in a later chapter.

Figure 2

Age Composition





Source: United Nations, Department of Economic and Social Affairs, Population Division, Population Estimates and Projections Section

Urbanisation

Urbanisation has two sets of implications for the health system. First, it affects the areas where health providers are able to achieve economies of scale in treating broad health concerns as well as particular conditions. Second, it affects the geography of illness in several ways. Cities are hotspots for air pollution and some forms of water pollution (pesticide and agricultural runoffs as well as natural hazards such as arsenic are also in rural areas). They are also potential flash points for outbreaks of contagious diseases including zoonotic varieties.

India is urbanizing, and two aspects of its pattern of urban growth are particularly relevant for looking ahead at opportunities for social entrepreneurs. First, much of the projected growth in India's urban population is expected to take place in the smaller cities. Figures 3 and 4 show projections for urban and rural populations from the United Nations World Urbanization Projections.[8]

Figure 3

Population Growth

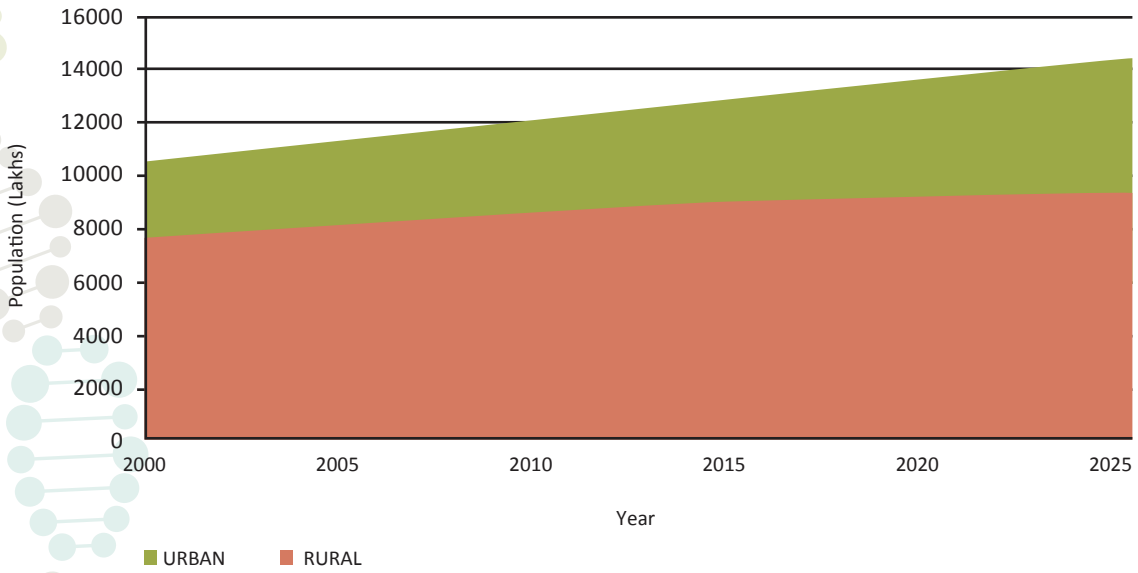
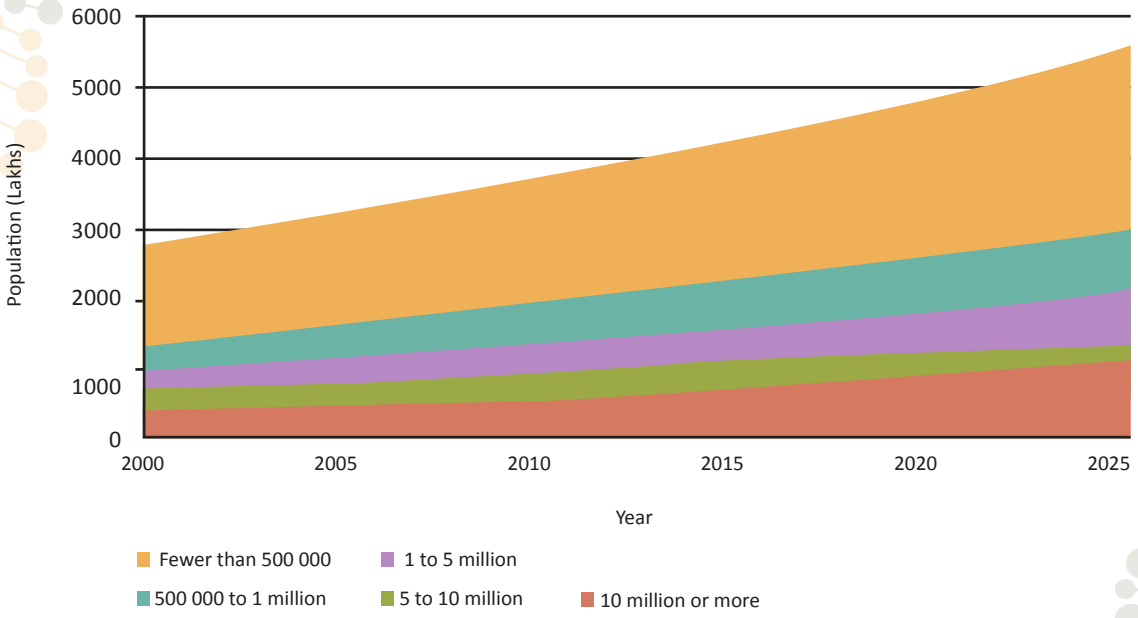


Figure 4

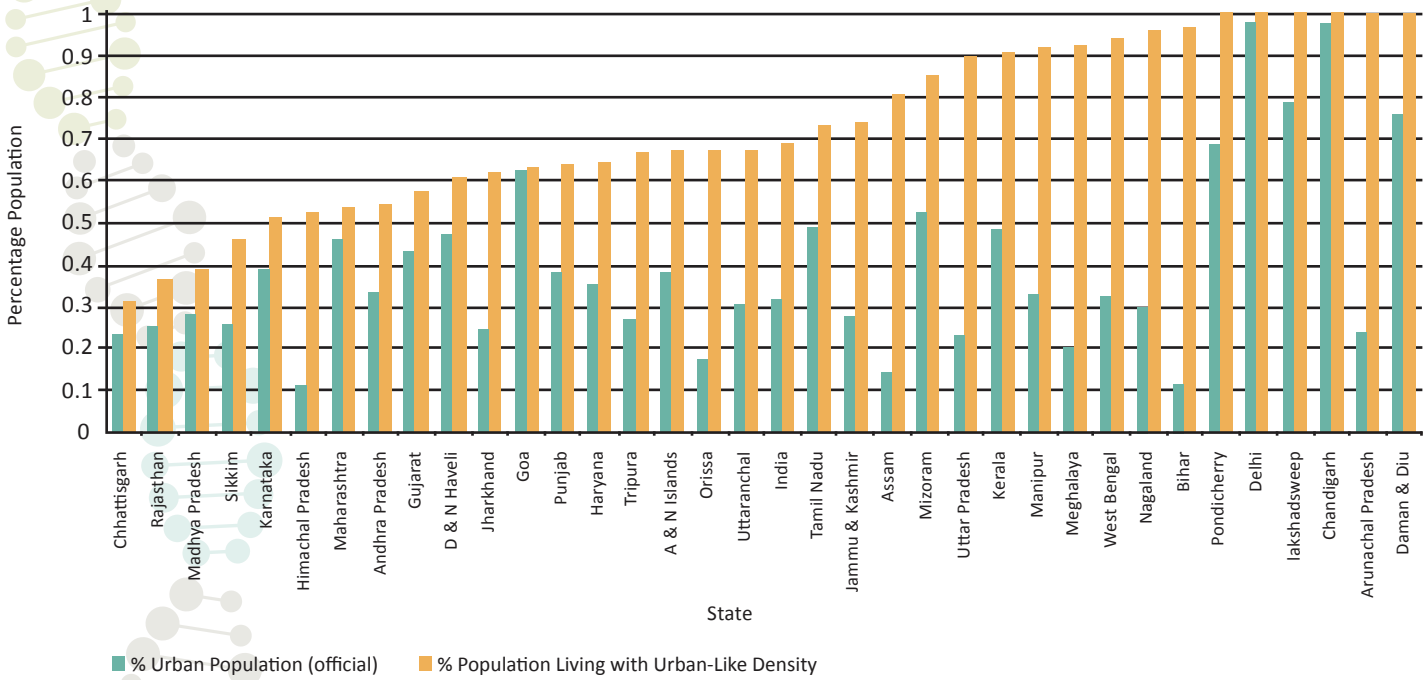
Urban Growth by City Size



Second, there appear to be substantial portions of the population that live in areas that are not officially designated as urban but are urban-like in terms of health system needs. By the official 2011 Census count, just over a third of India lives in cities, but as much as half of the population lives in officially rural areas with urban-like population density[9] that may be sufficient to support market-based models that require economies of scale. Figure 5 compares the official figures for urbanization with data on the extent of population living in urban-like conditions as of the 2001 census (the most recent data for which it is possible to perform the density analysis).

Figure 5

Urban Population, State-Wise



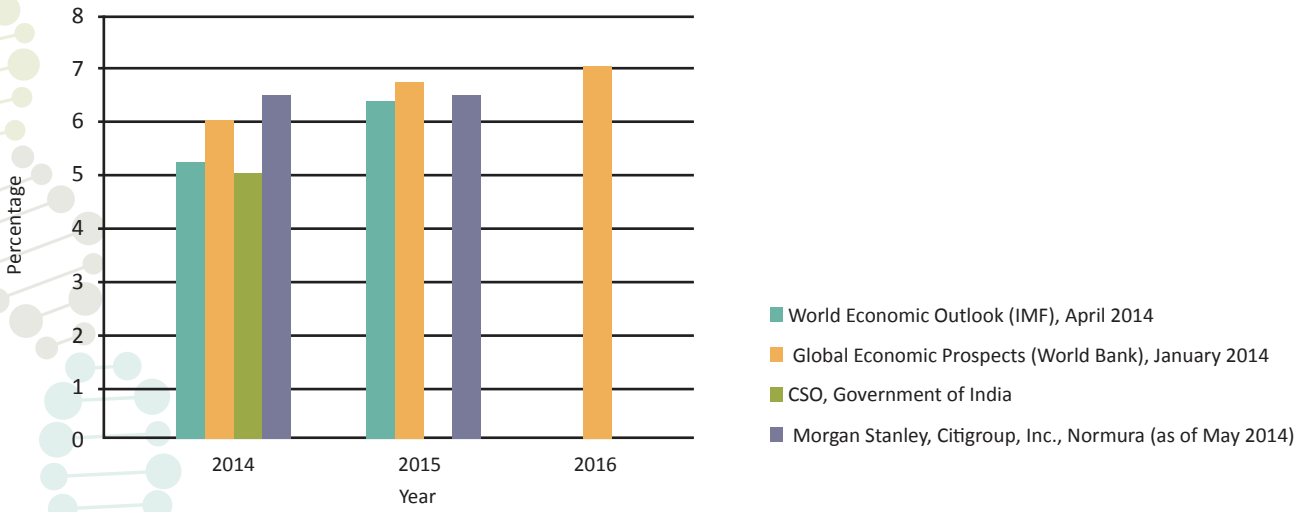
Economic Growth

India's macroeconomic trajectory will obviously shape the health system and prospects for market-based models. Most of the projections and implicit commitments for public health expenditure are in terms of percentage of GDP – so the actual amounts are quite different between growth scenarios of 5 and 9 percent. The second important question for social entrepreneurs is "where:" where within India are incomes and the potential for health expenditure likely to rise?

Figure 6 summarizes some of the public projections for India's growth rate over the coming years.[10] There are few available projections for the longer time period between now and the end of the decade. Industry estimates, such as the Dunn and Bradstreet (2011) India 2020, tend to cite optimistic estimates (9% in that report's case) with many caveats.[11]

Figure 6

Projected Economic Growth



Credible sub-national growth projections are not currently available.

Data Liquidity

The various aspects of data liquidity for India's health system are intertwined: devices and protocols for diagnosing illness and measuring health status can produce information useful for immediate decision-making, but the impact of this information on system learning depends on whether it can be aggregated and analyzed. And that takes, at a minimum, digitization. This, in turn comprises a variety of activities including digitization of patient health records and digital capture of patient interactions with healthcare providers, diagnoses reached through devices that increasingly have a digital component designed for display, analytics, and/or record-keeping, sensor networks that track ambient conditions, and social networking platforms that capture records of broader interactions beyond the health system.

But these pieces of digital information may or may not ever come together in a single dataset. And if incorporated into a dataset, they may never become widely accessible. The potential to aggregate and share information depends on the IT infrastructure as well as the industry, legal, policy, and other support for data interchange. The data pipelines are usually taken for granted in much of the literature on the future of medicine, but this cannot be assumed in India in the near future. The distribution of access to broadband or reasonably fast data streams could play an important role in the relative health literacy of the formal healthcare system and patients and communities – will reliable high-speed data be available in remote rural areas at all in the next five years? And if so, will it be confined to particular "centres" or will people be able to access it from their homes at their convenience? Emerging technologies offer the potential for rapid expansion of access to broadband, but seizing this potential will also require regulatory and policy change.

The current decentralization of health and health-relevant information is in part simply the product of the current "each-to-his-own" regime of data collection for specific purposes, with formats and fields set in for the convenience of the particular application, and in part for strategic reason. How will standards evolve? Will they be sufficient to start to enable entrepreneurs to be able to interlink the accumulating isolated datasets to start drawing out broader insights? At what scale – within a state? Nationally? Within a subsector of the health system? What perspective will start to create pressure to erode the boundaries: Population-level analytics? Or patient-centric efforts to understand genetic, environment, or other health risks and different outcomes for individuals? These questions are important for understanding the speed of India's transition to the kind of individualized medicine that seems to be emerging on the global frontier.

Data Generation

Health information comprises a broad set of data ranging from person-level information such as health status, symptoms, body functions or genetic profiles; transactional records of patient interactions with the health system and quantification of the context in which people exist – ambient air quality or water quality, for example. Each of these pieces of information is a potential contribution to the kinds of maps of system-level and individual health needs and health dynamics that most analyses of the "future of medicine" rely on.

Diagnostics, a broad term we use to describe information about particular individuals' vital functions and health status are important information for a range of decisions in the health system: collaboration in treatment between local workers and specialists who can now understand more about the patient faster; sorting of patients to leverage expert resources efficiently; and faster and more precise responses to vague symptoms, including early responses to potentially life-threatening conditions. Many of these diseases can be prevented or controlled effectively if detected in time and additional economic burden on the health system could be averted. It is no surprise that many prominent impact investors and social entrepreneurs are focusing on being able to detect medical conditions faster, more accurately, at lower cost. Diagnostics are also a necessary (but not sufficient) contributor to larger-scale population-level datasets that can shed greater insight into disease burden, treatment effectiveness, and other information for health planning.

The individual-specific information flow coming in through diagnostics is undergoing two shifts likely to influence the nature and scope of information becoming available for health system entrepreneurs to work with for these and other business models.

First, there appears to be a broad shift toward more competition and new entrants into diagnostics industry. In the recent times, India has seen emergence of large laboratory chains, especially in metropolitan cities and urban areas. With markedly changing life-style, availability of information related to health care especially on the internet, increasing awareness about disease conditions and wellness, and with increasing purchasing capacity, the concepts of prevention and wellness have also started taking root, for example, especially in urban areas. Many laboratory chains and hospitals have started offering annual health check-up packages, with growing numbers of subscribers.

Screening and prevention in rural areas has traditionally been carried out through camps, with referral to separate treatment. Low cost diagnostics are being used to increase the volumes and accuracy of screening by sorting cases that require specialist attention. (Box 3)

Box 3: Diagnostics For Leveraging Expertise

Forus Health, a Bangalore based company, has developed an affordable and portable eye fundus camera which could be operated by non-experts.[12] This eye fundus camera could be used to detect five major causes of preventable blindness. Eye images taken using this camera could be sent from remote locations to secondary or tertiary care centres to perform screening for eye diseases remotely and only those who require immediate attention could be referred to the eye-specialist.

Similarly, the Tamil Nadu Health Systems Project (TNHSP) runs cervical cancer screening programme, where trained female doctors and paramedics perform screening test known as visual inspection with acetic acid (VIA) at primary health centres.[13] No specific device is used for this – the only equipment required is an adequate light source and some degree of magnification can increase accuracy. Only women with a positive test are triaged for the more resource-intensive colposcopy examination, which is done by gynaecology specialist.

Second, there is a concerted effort to develop new "point of care" diagnostic devices that integrate with health care delivery to provide rapid, actionable, point-of-care information. (Box 4)

Box 4: Point of Care Diagnostics

Point-of-care (POC) testing involves conducting screening or diagnostic test outside the conventional laboratory setting. In certain type of POC testing, called rapid testing, outcome of the test could even be known in short duration, say half an hour, instead of waiting for hours or days. Well-known examples of POC testing include kits for glucose monitoring and pregnancy indication. In countries like India, where burden of infectious diseases is still significant, kits for infectious diseases such as HIV, malaria, and dengue are being used. There is active research going on all over the world to detect markers through POC tests for chronic diseases such as cancer and cardio-vascular diseases. Another important area of interest is to detect markers through POC tests in urine and faeces samples, as these samples are relatively easy to obtain than blood samples and self-collection is possible. As screening and early detection becomes important in resource constrained settings of India, we will need to undertake R&D in designing our own POC tests that meet constraints and challenges posed in Indian settings such as affordability and non-expert operability without sacrificing quality.

While screening, early detection, and prevention is important in the context of India, as discussed earlier, it is not very easy to convince the general population to participate in screening programmes when they do not see any symptoms of disease in them. This problem is compounded by the fact that laboratory facilities may not be available in the areas where the population being screened lives. There is a very "small window of opportunity" between the subject showing willingness to undergo screening tests, conducting the test, and convincing the screening test-positive subjects to follow-up for further confirmatory diagnostic tests or treatment. Missing this window of opportunity means the subject is lost to the follow-up, thereby rendering the whole effort of screening and early detection futile. It is in this context, point-of-care testing is an increasingly important element for both market-based models as well as public health goals. It is also a major business opportunity for entrepreneurs and more established businesses alike.

There are two aspects of designing indigenous POC tests. The first one is to design processes related to molecular biology and biochemistry to perform the test with acceptable sensitivity and specificity. Secondly, to design devices and instruments that will provide a platform to carry out the test in POC setting. The first aspect requires high-end facilities to carry out basic and translational research in human disease biology. While some private companies have established such facilities, much of this research in India is being carried out in research centres and institutes due to the nature of research and resources required. Some notable institutes involved in such research include Rajiv Gandhi Centre for Biotechnology (RGCB) located in Thiruvananthapuram, International Centre for Genetic Engineering and Biotechnology (ICGEB) – India section located in New Delhi, and Centre for Cellular and Molecular Platform (C-CAMP) located in Bangalore.

The second aspect – designing of new devices and instrumentation for POC testing – is where more and more entrepreneurial efforts are noticeable in India. For example, Bigtec Labs located in Bangalore leverage expertise in the areas of micro electro-mechanical systems (MEMS) and handheld electronics, genomics and proteomics, biology, and chemistry to develop microfluidic devices and lab-on-chip technology.[14] These technologies can be used to develop platforms capable of performing sample preparation, complex biochemical reactions, and sample screening and detection on a single chip. Molbio Diagnostics recently launched a real time micro-PCR (polymerase chain reaction) system named TrueLab™ capable of conducting rapid, microchip based real time, quantitative tests.[15] These tests can be conducted starting from sample preparation to the final reporting in less than one hour. The system is portable, light-weight, and can be operated on rechargeable battery. Achira Labs, a Bangalore based company started in 2009, is developing technology platforms to perform rapid, quantitative, and multiplexed immunoassays at a low cost.[16] The first technology platform of Achira Labs comprises of microfluidic chip and a reader, and is targeted for the diagnosis of disorders associated with thyroid or female fertility. Achira Labs recently won Grand Challenges Canada award for their idea of developing fabric diagnostic chip ("Fab Chips"). This highly innovative way of making diagnostic chips using silk fabric allows the production to be easy and very scalable. Fab Chips are targeted at large-scale applications such as public health initiatives.

Recent advances in technology have also resulted in the availability of low-cost portable instruments and smart sensors for accurate, reliable measurement of essential vital signs such as pulse, body temperature, heart rate, and breathing rate. Coupled with advancements in mobile computing and widespread connectivity, this opens up new possibilities for remote health monitoring and value-added clinical services in many application areas. Traditional health monitors with numerous sensors and connection wires, for example, may be manageable in an ICU where reliable and accurate measurements take priority over patient comfort, but are less tenable in observation wards and routine hospital wards where the patient may have to spend an extended time, as they limit patient mobility and affect quality of life. Recent technology developments have focused towards developing wireless solutions that offer seamless connectivity and reduce clutter around the patient.

Technology and devices for health monitoring in non-clinical settings are also a potentially important new source of information. These were primarily driven by the needs in sports and fitness space. Focus was on creating wearable devices that can be used during exercise, fitness training and in routine life. While technology components for connectivity, display and computing were often borrowed from the rapidly

developing consumer electronics market, limitations in core sensing technology and practical constraints limited the capability of devices to a limited set of clinically relevant parameters such as heart rate, body temperature, and breathing rate. These technologies further evolved into devices for use in home monitoring and wellness that offer value added services by leveraging connectivity options provided by a smart phone / tablet device, along with support for data storage and analytics via an online server system. The limitations of the core sensing technology in capturing clinically relevant parameters were alleviated by supplementing devices with motion sensing technologies using accelerometers to offer additional parameters such as activity monitoring, and sleep cycle detection. While most of these devices are not yet available for purchase in India, there is increased awareness and interest towards these technologies, albeit mostly among people in the socio-economic upper strata of the population. The ability of performing continuous monitoring and logging of vitals offers the promise of long term health records, while the minimally obtrusive nature of measurement offers possibility of using such technology for screening, triaging and primary diagnosis.

Screening for communicable diseases is a second area for entrepreneurs to watch (or participate in) over the coming years. Significant grant funding is going into research and development for diagnostics for diseases such as typhoid, tuberculosis, malaria, dengue fever, and hepatitis B & C. Grand Challenges Canada, for example, identifies critical barriers to healthcare in the developing world, and provides grant funding to innovators tackling these. Of the 49 Indian innovators they have supported, three were in POC monitoring (two maternal health, one glucose monitoring), and 18 were in POC diagnostics. Of the POC diagnostics, 13 were for communicable diseases (TB, leishmaniasis, rotavirus, HIV, pneumonia, and elephantiasis). While certainly not exhaustive, this provides some sense as to areas that have been identified as opportunities for POC diagnostics that, in turn, generate new actionable information.

Just as the technologies for quantifying individual health status are becoming more common,cheaper, and easier to use in clinical and non-clinical setting, measurement of the health-affecting context is also becoming easier, cheaper, and more common. On the one hand, the public sector committed to invest in more detailed, higher-resolution air and water quality monitoring as both have become more salient political issues as well as obvious contributors to health damages. Even though air quality data is notoriously poor in most of India's cities, the System of Air Quality Forecasting and Research (SAFAR) initiative under the Ministry of Earth Sciences, for example, has established high-resolution air quality monitoring systems in Delhi and Pune and similar networks are underway in Mumbai, Chennai, Kolkata, and Ahmedabad.[17] The Water Quality Assessment Authority was established in 2001 under the Ministry of Water Resources, and protocols for measurement established in 2005. The Ministry of Urban Development also established service level benchmarks for water quality.

On the other hand, the costs of measuring both air and water quality have fallen over time and private initiatives have started to complement and challenge public data around the world. The costs and accuracy of personal monitors for ozone precursors as well as fine particulate matter have dropped to the point of being affordable for individuals in higher-income countries and civil society organizations elsewhere. In water, the WaterCanary[18], a relatively low-cost water testing device (about $100) also allows people to transmit their findings. Similarly, mWater is a mobile application that enables communities to survey and monitor local water quality. Information can be updated and shared with others online.[19] It seems reasonable to expect the level of information about health risk factors to improve over the coming years, opening new opportunities for enterprises that assess, manage, and warn against risks as part of their services.

Digitization

"Digitization" comprises both mechanical and human processes. On the one hand an increasing number of diagnostic or health measurement devices may generate, store and, transmit information in digital form as part of the measurement process. On the other hand, digitization of existing paper records – doctors' notes, hospital archives, logs of screening camps – is an organizational process aided by technology. These activities may take place in distinct settings, enabled by particular technology advances, and motivated by particular models of profit, but they are all avenues for converting information into a form that can integrate easily with new forms of medical practice.

We combine the discussion of distinct forms of digitization to emphasize a common underlying dilemma around the act of capturing information about the health system. Is the information collected for a specific use case, for example a specific interaction between a patient and a healthcare provider, or with an eye to further and potentially unknown use of information in combination with other data streams?

These two types of information capture (Figure 7 and 8) have different implications for the health system. In the case of the closed loop, digital capture may be designed to be ephemeral –a flash on a screen or a colored light, designed to be seen by the patient and the healthcare worker at that point in time. In the second, the technology would be designed to store and share information in some format. The physical channels that enable information capture would exist.

Figure 7

Closed Loop

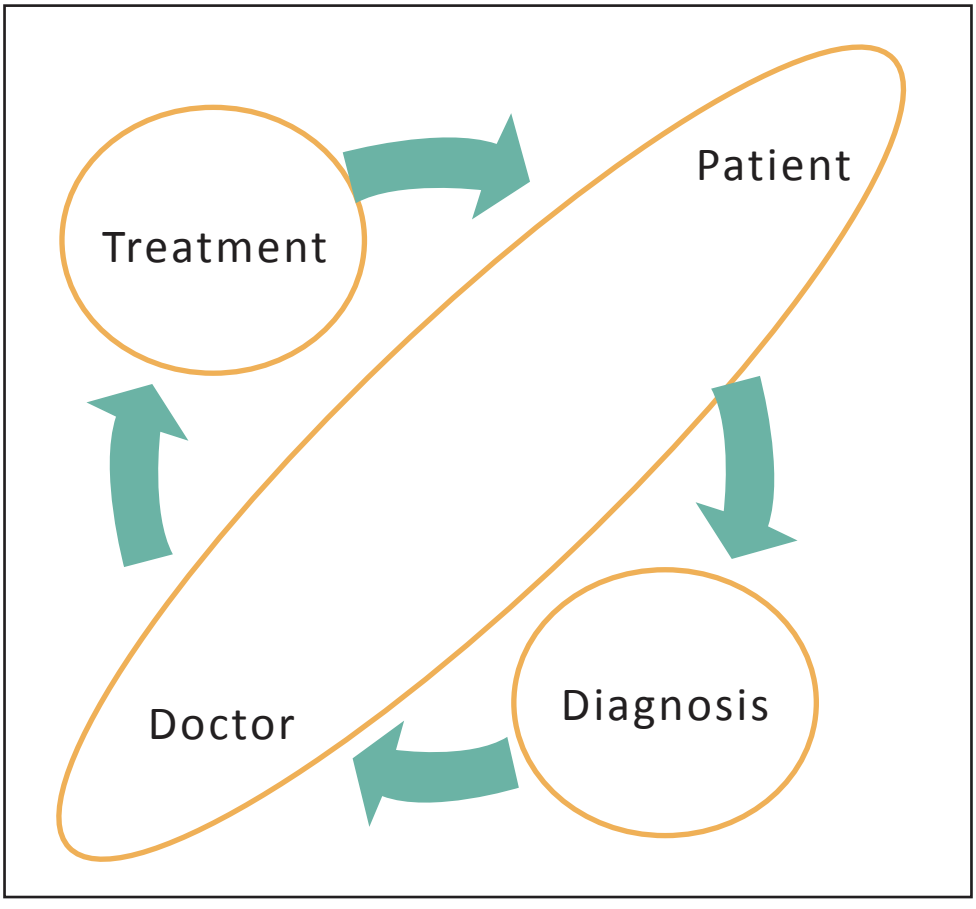
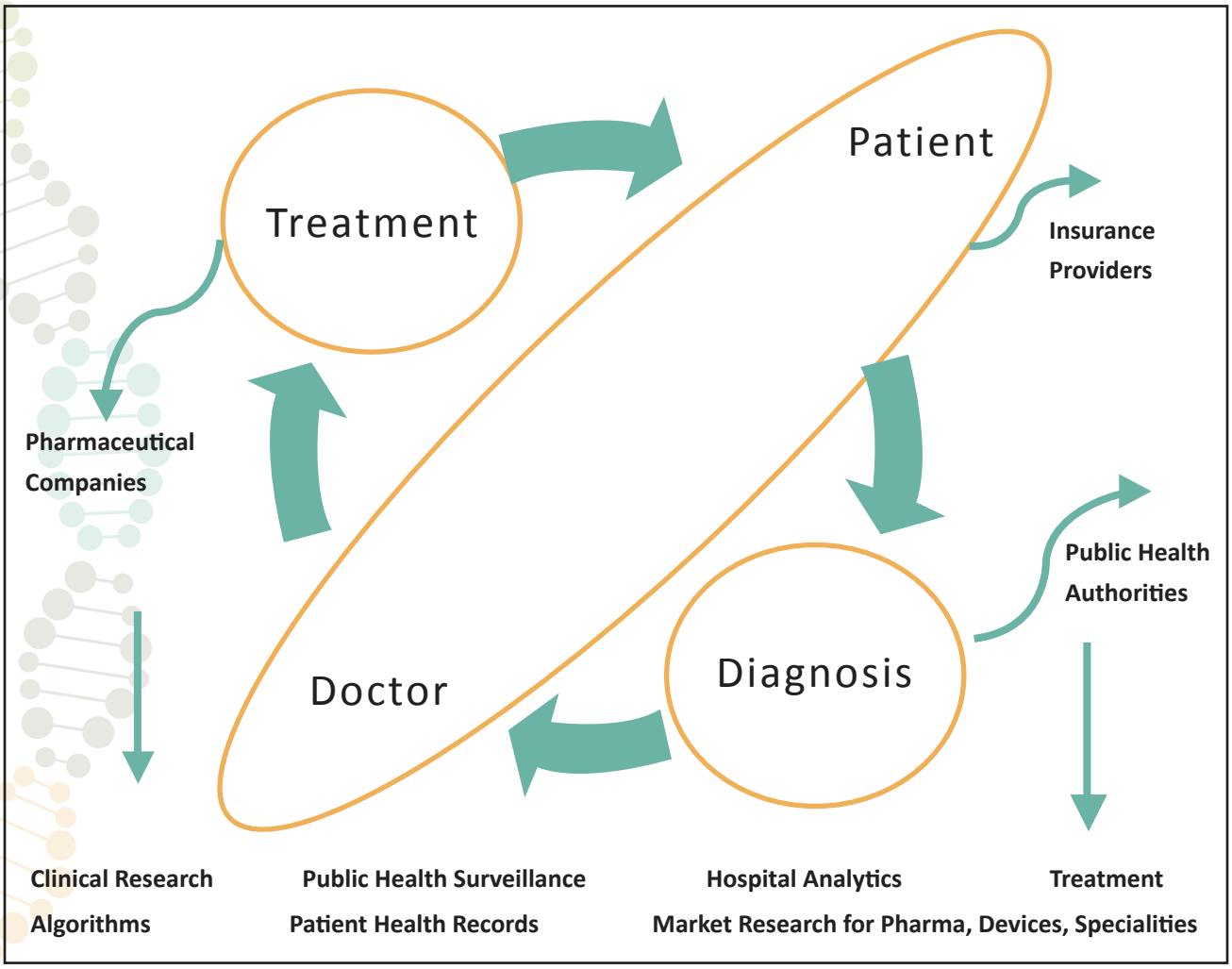


Figure 8

Information Harvesting



The influence of this new information on health system outcomes over the coming years also depends on the evolution of the market for health data. Much of this information is currently generated in the "closed loop" regime of episodic communication between patients and healthcare providers, and neither gets linked to longer-term patient records nor multi-patient datasets that could inform clinical practice, business models, or public understanding of health dynamics.

On the other hand, an increasing number of diagnostic devices explicitly involve digitization and transmission of information, generally with an eye to specific use cases that require coordination over longer distances based on shared information. These developments are significantly aided by the increasing range of data services along with the dropping costs of smartphones in the Indian market. Global majors LG, Samsung, Motorola as well as startups such as Obi and local companies such as Lava are all launching models in the Rs 5000 – 8000 range this year and competition will likely drive costs even lower.

Box 5 and 6 discuss several examples of diagnostics designed for digitization and transmission of information.

Box 5: Diagnostics For Remote Response

Swasthya Slate[20] developed by Public Health Foundation of India (PHFI) can perform 33 diagnostics tests. The Slate is a portable device that allows Android based tablets and cell phones to carry out wide ranging tests such as blood pressure, sugar, ECG, body temperature, water quality, foetal Doppler, routine blood grouping and typing, rapid pregnancy test, and malaria check. The test results can be digitally captured and transferred to the data cloud via an Internet connection. Doctors and public health officials can access both individual tests and aggregated tests results, remotely. The Slate can enable frontline health workers and doctors to provide screening and remote diagnosis in PHCs and CHCs. It also has the potential to simplify referrals, follow-ups, and reporting.

Box 6: Digitization For Program Management

Health Management and Research Institute (HMRI) based in Hyderabad, India leverages cutting edge information and communication technologies to cut costs to deliver affordable and accessible healthcare to all segments of the population, especially those most vulnerable[21]. HMRI designed Dox-in-Box technology specifically for remote areas to digitally capture, store, and transmit eight vital signs. HMRI uses this technology for a diabetes management program in Assam.

These kind of data are also potentially helpful for broader understanding of the health system – and as discussed below, health financiers may be eager customers for such information.

Digitization of transactional data, the interactions of individuals with the healthcare system, is currently happening in a piecemeal fashion. On the one hand, some of India's private hospitals catering to higher-income and international clientele have award-winning health management information systems and processes for managing patient histories. On the other hand, field screening camps, some public health clinics and private primary care providers still rely on paper log books with perhaps much-delayed recording of these data into some form of dataset that may or may not include patient identifiers that allow for the construction of patient histories or return of profiles to patients themselves. In the middle, hospitals drowning under the weight of paper records kept for compliance, are literally scanning files to save space. The resulting databases of images of handwritten notes record patient histories for posterity, but are not able to be used for large-scale analysis without extensive further processing.

We were unable to quantify the relative prevalence of these three settings in the healthcare system that is accessible to low-income India. However, there is clearly a move toward greater digitization of transactional data that is linked to the move to increase public spending on health and public support for insurance programs. The National Rural Health Mission is currently the largest single implementation of an open-source health information system in India and involving hundreds of thousands of health workers serving hundreds of millions of patients.[22] Several state insurance schemes have also moved to digital patient records, a move that could drive similar change among private providers if empanelled as service providers. (Boxes 7,8,9)

Box 7: Tamil Nadu[23]

Funded by the State Government of Tamil Nadu and the World Bank, the Health Management Information Systems began in 2005, with the initial period of 2005-10 later extended to 2013. It aims to improve data collection, availability and standardization in order to save time and validate improvements in health outcomes for the poor. The services that are computerized are online registration of outpatients and inpatients, doctors services for out-patient services including diagnosis, prescriptions, and lab requests entered online (real time), reporting of the lab test results online, online indents and issues (for drugs), online ward transfers, linen, diet and biomedical waste management related transactions, and online day end/ periodic reports generation, saving significant time for end users in collation and consolidation of data. Discharge summaries and the final disease diagnoses are mapped to International Classification of Diseases (ICD). Online access is provided to all end users/primary data entry owners to input data directly into the online system with no data entry support.

In 2012, Chief Minister's Comprehensive Health Insurance Scheme was launched to provide free medical and surgical treatment in Government and Private hospitals to the members of any family whose annual family income is less than Rs.72,000/- (as certified by the Village Administrative Officers). Carrying of smart cards became a mandate under this scheme in 2013. New Health Insurance identity card biometrics are being issued to all those members who have been holding the smart cards in the earlier scheme. This provision has been made to reduce time delays in treatment and to streamline the process of disbursing claims.

Box 8: Orissa[24]

All India Institute of Medical Sciences decided to launch an electronic health card in February 2014. The call for tenders includes the provisions similar to that of the Tamil Nadu HMIS. The proposed card will store individual patient records right from registration, primary consultation, diagnosis, pathological and other diagnostic tests and medicines prescribed during every visit to the hospital. Since the first phase is starting off with students and faculty members of AIIMs suffering from chronic illness, the tender has also included a separate provision for AIIMs student and staff. The next phase is to make available these smart cards to the general public. The smartcard is also planned to be made part of the integrated hospital information management system (HMIS) network being implemented across the six new AIIMS in the country. This would enable seamless consultation and treatment of patients between the institutions.

Box 9: Karnataka[25]

The Karnataka State Health System Resource Center project was created under the National Health Rural Mission to develop the HMIS in Karnataka. As of 2013 the HMIS was still in the development phase. The main objective of the program was to integrate all the other national health programs. Besides this the Karnataka Government implements the Rashtriya Swasthya Bima Yojana (RSBY), which provides health insurance cover for below poverty line population. The plan is to provide cashless insurance cover up to Rs. 30,000 for a year for hospitalization by paying Rs. 30 per month (Medicines and tests which are not related or do not lead to hospitalization need to be paid by the beneficiary). Smart cards were issued to enable the beneficiaries to get cashless health insurance benefits across the country, and also to maintain a record of the beneficiary's health information. As of July 2012, 17.5 lakh state residents have been provided with smart cards.

Fiscal constraints and the popular wave for "good governance" could both accelerate digitization efforts given the prevalence of public funding for the healthcare system. Full conversion of health provider information into open or even analyzable data formats is a powerful weapon against fraudulent claims.

In any case, these data are one step closer toward being a basis for "big data" analysis that could find a market among healthcare providers and insurers as well as the programs that currently mandate digitization. Whether the data become widely available for integration, analysis, and real-time decision-support in clinical practice depend on the physical and institutional infrastructures that we discuss in the following sections.

IT Infrastructure: How Far, How Fast, and How Cheaply?

Health system change can move faster than general infrastructure. Telemedicine practice, for example, started gaining roots in India relatively late, in late 1990's and early 2000's, even before a general-purpose physical infrastructure for data transmission was available. The Indian Space Research Organisation (ISRO) started building satellite-based telemedicine network through Indian Satellite System (INSAT) in 2001 under the GRAMSAT (rural satellite) program.[26] What started as a pilot project continues to expand and now includes 382 Hospitals with the telemedicine facility, 306 district hospitals and rural health centres, and 16 mobile telemedicine units connected to 60 super-specialty hospitals located in the major cities.[27]

However, the main growth in telemedicine rests on expansion of telecommunication facilities available for the general population. These have grown rapidly over the last decade, due to arrival of the mobile phone technology, participation of private sector in creating and delivering telecommunication services to larger population, and conducive government policies. Telecommunication subscribers in India increased from 76.53 million in March 2004 to 915.19 million in December 2013.[28] The staggering growth in the number of telecommunication subscribers is mainly due to wireless (mobile phone) connections, which increased from 33.69 million to 886.3 million in the same period. Wireline telecommunication connections actually decreased from 42.84 million to 28.89 million in that period. There were 238.71 million internet connections in December 2013, of which 220.38 million were wireless connections. However, of the total internet connections, only 55.2 million were broadband connections. Overall teledensity of connections was

74.02 in December 2013 (meaning 74 connections for every 100 people living in an area), but its distribution was markedly different in urban and rural areas. Teledensity was 144.95 in urban areas, but only 42.67 in rural areas.

While the number of connections have grown at high rate, one should be careful in understanding that this itself may not allow transaction of high amount of information – for example, while there were 220.38 million internet connections in December 2013, only 55.2 million were broadband connections which could transfer higher amount of data over the connection. Also, the definition of broadband connection was considered as minimum download speed of 512 Kbps, which itself could be insufficient for certain applications.

Continuing with this growth and with the objective of making it equitable, the Government of India formulated National Telecom Policy (NTP) 2012 with the vision "to provide secure, reliable, affordable and high quality converged telecommunication services anytime, anywhere for an accelerated inclusive socio-economic development."[29] This commitment has been reiterated in nearly every development manifesto from national Budgets to party platforms in the 2014 elections.

Policy commitments aside, technological change is also opening up new opportunities to lessen and bypass the challenges of extending and leveraging India's existing network. Data compression for moving more information over limited spectrum and physical networks is an active commercial area. "Google blimps" are offering a glimpse of a new way to provide broadband service using airwaves typically reserved for television broadcast in areas with limited infrastructure.

Data Interchange: Who will share what with whom?

Information creation and digitization are necessary foundations for generating the kinds of information basis for building knowledge to improve the health system, while the physical infrastructure for moving data around affects the inclusiveness of the knowledge in terms of both underlying data points as well as breadth of access to insights and decision support. But the softer infrastructure of protocols and standards for the way that health records are coded, stored, and retrievable is the linchpin for a transition to full data liquidity from the current status quo of institutional islands.

Full national data liquidity is a complex policy challenge, potentially requiring new institutions to be established. "Ultimately, to achieve semantic interoperability, it is anticipated that multiple layers – network transportation protocols, data and services descriptions, information models, and vocabularies and code sets – will need to be standardized and/or harmonized to produce an inclusive, consistent representation of the interoperability requirements," according to the 2013 report of the Expert Committee on Electronic Health Records established by the Ministry of Health and Family Welfare.[30] Furthermore,

"It is also recognized that a sustainable and incremental approach to the adoption of standards will require processes for harmonizing both current and future standards. This will allow the incremental updating of the initial set of standards, implementation specifications, and certification criteria and provide a framework to maintain them. The decision to adopt such updates will be informed and guided by recommendations from an appropriate authority akin to a National Health Information Authority."

Policy is currently moving cautiously. The Committee's September 2013 recommendations were "an incremental approach to adopting standards, implementation specifications, and criteria to enhance the interoperability, functionality, utility, and security of health information technology and to support its widespread adoption. It is to be kept in mind that these standards should be flexible and modifiable to adapt to the demographic and resource variance observed in a large and developing country like India."

In the meantime, there are various market and political forces that could affect the de facto basis for data liquidity.

First, within the industry, health finance and health literacy (both discussed further below), are both sources of demand for standardization as well as digitization of data. To the extent that insurers require particular formats for patient transaction records, private providers will be pushed to comply with these and thus, to some extent, standardize records across each other. This could lead to some degree of segmentation between institutions focusing on higher-income clientele and those relying on public financing, particularly since both patient pools are large enough to justify development of distinct health records software products or customized solutions. It is also not clear whether this pull for standardization would manifest as a demand among healthcare providers for information systems with particular features or as a growth area for third-party aggregators (TPAs).

Health literacy and consequent interest in one's own medical history creates a separate pull for interoperability since patients would need to aggregate information from the multiple institutions that they have visited. The move for standards need not come from the government. The United States "Blue Button" initiative, a coordinated set of data management guidelines for healthcare providers and insurance companies to make their data queriable by patients, for example, originated in series of consultations between the nonprofit Markle Foundation and the healthcare and technology industries. The data guidelines are now managed by the national government Department of Health and Human Services, as is certification of compliance. Apollo vice-chairman Sangita Reddy's stated ambition to link health records to the Aadhar number represents a similar impulse, though it is not clear how this would work given restrictions on linking the Aadhar number to other information sets.[31]

Social entrepreneurs may find opportunities to participate in building this infrastructure as well as opportunities based on leveraging it. In some ways, the current state of health information systems is like the early days of egovernance, when various particular, customized implementations co-existed, each heralded as "cutting edge" and "to be replicated." These are yet to have one common format or link to be comparable or interchangable.[32] The underlying information structure and requirements of each client varied and so did the solution provided. Information standards, in this case National Municipal Accounting Standards, created an opening and a basis for productization of egovernance around finance. The companies that worked on

customized solutions found a reasonable market; those who saw the opportunities to productize found an even larger one.

Agency

The last two critical factors discussed in this chapter examine two dimensions of agency:

- The evolution of health finance: in particular, how much does the budget expand and who decides where it goes? What is the potential direction and speed of India's evolution from private out of pocket expenditure as a dominant source of finance to pooled finance and/or some form of public finance. Will the expected increase in public finance be routed through public sector institutions or through patients who would be free to choose among public and private providers with some conditions? What role will insurance companies, public and private, play as patient advocates?

- Health literacy: How will the prevailing level of citizen awareness of their own health, treatment options, healthcare rights change? How might the level of health literacy change from access to information to a active integration of information amounting to decision making changes? How will access to data flow enabled by improved telecom infrastructure encompassing a push concept move to a paradigm of data that is pulled in and absorbed due to genuine demand.

Finance: Who ultimately writes the check?

Who will be the customers for healthcare? If the budget for healthcare for low-income Indians increases largely through expanded public commitment as expected, given the size of the gap between health costs and household income, then the way that the public funding is spent will substantially affect the market.

Will the public sector work through demand-side finance, or financial support to patients and prospective patients? In principle, this is supposed to increase competition, efficiency, and may also pull in new private healthcare providers and provoke innovation. Or will the approach be supply-side finance, with public funding for healthcare flowing directly to public providers? These funds could be managed to motivate innovation within the public sector, as well as accountability and competition, but it means that the funding increase will generate a different set of opportunities for social entrepreneurs. Rather than setting up institutions that compete with the existing three-tier system, they might see the increasing well-funded and ideally well-run public institutions as customers for services, diagnostics, treatment devices.

Table 1.

Transition in health financing and insurance to Universal Health Coverage

	2011	2017	2020
Tax financing	Relatively low	Increasing	Relatively high
Private financing	Relatively high	Decreasing	Relatively low
Employer-employee contribution	Relatively low	Increasing	Relatively high
Coverage	Mostly rich and targeted poor	Expanded coverage to include poor and other targeted communities	Universal
User fees	Prevalent	Eliminated	Eliminated
Central Government insurance schemes	Large numbers catering to different groups	Reduced in numbers; merged with the UHC system	None - and integrated fully with the UHC system (including CGHS, ESIS and schemes for the railways and other public sector institutions)
State government insurance schemes	Option open subject to state government financing	Option open to top up Central Government's UHC-National Health Package (NHP) funding subject to state government financing	Option open tyo top up Central Government's UHC-NHP funding subject to state government financing
Private (including community-based) insurance schemes	Large variety with option to individuals to top up government coverage	Large variety with option to individuals to top up government coverage	Large variety with option to individuals to top up government coverage

Source: Report of the High-Level Expert Group on Universal Health Coverage (2010)

There is currently a mix of supply and demand side public health finance. National programs such as the National Health Mission are supply-side. Existing Ministry of Health strategy documents suggest a continued commitment to the approach (Table 1). Some national Ministries' programs such as the Ministry of Labour's RSBY are more focused on demand-side finance. States tend toward demand-side financing. The terms of the demand side finance vary across states so that social entrepreneurs seeking to establish medical institutions may have to develop distinct approaches for sub-markets of the country in order to benefit from any surge in public funding. The differences between two of the larger state-funded programmes Aarogyasri and Kalaignar, are, suggest that the product design is customized to respond to regional requirements. Aarogyasri in Andhra Pradesh initially provided a hospitalization cover, but over the years its package expanded to include critical illness. Kalaignar, on the other hand, operates in Tamil Nadu, which has a more robust and functional public health infrastructure, and consequently it only needed to cover critical illness. Yeshavini invests less in identification technology than others, but all schemes rely heavily on electronic data collection and transmission and have fairly robust management information systems (MIS). RSBY and Kalaignar use biometric cards to control fraud; RSBY issues real-time health cards (at the enrolment camp) to improve customer service and control any rent seeking behaviour by the card-issuing agency.

The recent change in government may mark a substantial shift from previous strategies, but it is too

Table 2.

Chronological evolution of pro-poor mass health insurance schemes in India

Scheme	Yeshasvini Cooperative Farmers Health Care Scheme	Weaver's Insurance	Rajiv AarogyaSri Community Health Insurance Scheme	RSBY	Chief Minister Kalaignar Insurance Scheme for Life Saving Treatments
- Location - Year started - Outreach	- Karnataka - 2003 - 3 million lives	- Multi-state - 2005 - 6.4 million lives (1.6 million families)	- Andhra Pradesh - 2007 - 70 million lives (20.4 million families)	- National - 2008 - 63 million lives (23 million families)	- Tamil Nadu - 2009 - 35 million lives

Source: Ruchismita, R.; Churchill, C. 2012. "State and Market Synergies, Insights from India's Microinsurance Success", in: Protecting the Poor: A Microinsurance Compendium Volume II. (Geneva, ILO) pp. 424-463.

soon to assess likely directions. Here we discuss some of the key developments to watch for in health finance:

Universal health coverage vs universal social protection?

The national level Ministry of Health focus on Universal Health Coverage is running parallel to the goal of a comprehensive social insurance including health, life accident, pension as a combined package. The latter approach, along lines of what the erstwhile Andhra Pradesh has been delivering under Indira Kranti Patham[33], appears to have stronger backing in the Ministry of Finance.

Accountability and oversight:

Both demand and supply side finance create perverse incentives. Supply-side finance is seen as creating complacency since the main customer – the patient – has only indirect control through political accountability rather than "voting with their feet." Insurance reimbursements, on the other hand, can encourage creative accounting and over-billing. Also, in settings with low reimbursement rates, hospitals may selectively reject patients for which procedures are less well reimbursed. What will be safeguards to prevent and respond to such cases? These are not only normatively important for public health but also set the playing field for competition for well-meaning social entrepreneurs.

Fiscal incentives:

The financial incentive to manage risk can come in by a shift of responsibilities to the private sector from public, from a shift in public sector incentives – introduction of so-called "hard budget constraints" – or by changes in legislation or competition that reduce opportunities for profit among existing private providers of health finance.

The demand for risk management as well as information to feed into underlying analysis could come from several quarters, including:

- Standalone health insurance companies, through focused models around pools either as employee benefits with corporates or larger government employee schemes.
- Large state and centre level insurance funded programs.
- Quota-driven innovations: Insurance companies are required by the Indian Insurance Regulatory and Development Authority (IRDA) to originate a percentage of their portfolio in the "rural and social sectors." Servicing these markets requires new approaches, potentially leading to significant innovations in risk management.

Health Literacy

Insurance and public support for health, however, is only as good as peoples' ability to access the benefits and leverage the support for health needs. The overall international evidence of the impact of health on out of pocket expenditure is mixed.[34] In some cases, particularly for third-party payment programs (when the government pays on behalf of the household) beneficiaries are often not even aware they are insured. In other cases, while insurance's reimbursement for particular conditions may lead to additional care being given to households, it can also lead to warped provision – focus on the type of care the hospital can provide rather than what the household really needs.

The role of the patient—as a key constituent in potentially improving health care outcomes—has also

fallen through the cracks in other ways. Our research proposes that strategic investments to grow health care capacity in India must reach beyond professionals, paraprofessionals and institutional services and include the empowerment of patients and community groups on a national scale. The next few pages outline reasons for this and suggest that the domain of health literacy be explored as a vital area for innovation and impact.

The health care sector faces an ongoing paradox. India has an experienced and well-trained cadre of health professionals, a growing marketplace for health insurance services and any number of private and public health care providers. Yet there is a dearth of professionals to treat and advise the majority of the country's population. This is not for lack of funding. Though 2013 allocations for human resources in health was INR1.1 billion, the budget was underspent. Quality-of-care and health outcomes remain disparate, with deep variations across states and districts. Furthermore, public health and chronic care issues are exacerbated across slums and less accessible rural and peri-urban areas, where most of India's population reside.

India has made impressive headway in addressing the health needs of her diverse population through affordable generics, improved access through different tiers of care, and investments in infrastructure, biotechnology and public health. However, it is also clear that human resource and infrastructure capacity will continue to lag behind the needs of India's population. The National Rural Health Mission's ability to train close to 900,000 frontline health workers and volunteers at primary health centers demonstrates the strength and impact of political will. The successes and insights from such programs have inspired similar attempts in slums and informal settlements in metropolitan areas, through the National Urban Health Mission. With analogous levels of effort and political expediency, raising the standard of health literacy can become a powerful vector in transforming health care in India.[35]

In pockets of India where food security, poverty and malnutrition predominate, the notion of basic health literacy and participatory medicine, which seeks to actively engage patients in medical decisions and care, may seem like a tall order. Without these, vulnerable communities with inadequate access to basic services continue to carry the greater burden of disease. There are good reasons to build a sense of urgency around participatory health. Societies are seeing a surge of communicable and zoonotic diseases cross international borders. Natural climate events may occur more frequently and with more ferocity.

Beyond medication, behavioral changes and adjustments in lifestyle have a significant role in managing non-communicable diseases in India. Each of these underscores the importance of public health interventions, improved health awareness and personal agency.

Today, the majority of patients around the world lack the skills to understand basic information about their own health and manage or prevent disease. According to the US National Patient Safety Foundation, "1 of 5 American adults reads at the 5th grade level or below …yet health materials are written at the 10th grade level". According to a 2013 report by the WHO, almost 50 per cent of "all Europeans have inadequate and problematic health literacy skills", with the Netherlands experiencing a 29% gap and Bulgaria as high as 62%.[36]

The situation in Asian countries is no different. Even though 96% of Singapore's population aged 15 years and over is literate, their Health Promotion Board is designing nation-wide policies and infrastructure around health literacy. China, like India, is concerned about the rapid escalation of non-communicable diseases among its population. According to surveys conducted prior to 2008, only 6% of their population

was health literate. As a result, they designed Health Literacy 66, a book enumerating 66 goals for conducting health surveillance and evaluation across at least 60% of all their counties, many of which are rural.

Decades of studies show that health care outcomes can be significantly improved through patient education, awareness, personal agency and self-efficacy.[37] In other words, it is entirely possible for lay people to become more informed about their health, be motivated about managing it, and build up confidence to make better health decisions. Research also points out the effects of peers and social contagion, where the health of your peers and family members may reflect your own state of health or have an influence on it.[38] The consequences of low health literacy are significant. Patients have a higher risk of hospitalization, readmissions and a lower rate of medical compliance. There may be a higher error with medication, and unhealthier decisions and behaviors.

In the future, the promotion of participatory medicine across policy and practice may create profound improvements in the quality of care, where patients play a far stronger role in understanding, advocating for and participating in their own health. Elias Zerhouni, a former director of the National Institute of Health, discusses the promise and challenges of participatory medicine,

> "As opposed to the doctor-centric, curative model of the past, the future is going to be patient-centric and proactive. It must be based on education and communication. This is what I am pushing for at NIH. I like to change things and believe we need to be ahead of the curve. The challenge is to channel the energy of this outstanding organization to help the public better care for itself. No one knows exactly how to do this. It requires voluntary, intelligent participation, not passive acceptance. We can provide the information, but you have to do something for yourself."

Health literacy is a forerunner for participatory medicine. It can be defined in various ways but in this report, we emphasize two aspects that can potentially improve health outcomes in resource-poor settings. The first is the knowledge and information that patients can develop to improve their own health decision making and behaviors over time. A more recent corollary is the knowledge and skills required to leverage e-health capabilities in low-resource areas. According to Ratzan and Parker (2000), health literacy is "the degree to which individuals have the capacity to obtain, process and understand basic health information needed to make appropriate health decisions and services needed to prevent or treat illness."[39]

Health literacy also applies to the training of medical professionals, to communicate more appropriately with their patients, and the setting of standards such that products, services, user interfaces and interactions are clearly understood by people who use them. Within tertiary and secondary care institutions, few medical professionals have the time or skills to ensure that patients fully understand the implications of their diagnosis and medications, and how to improve their health day-to-day let alone plan towards healthier futures. On both counts, large-scale networked initiatives on public health awareness and health literacy can address the gaps.

A growing number of organizations in India are addressing functional health literacy through visual media. For example, messages about public health or how to prepare and deal with natural disasters are communicated through graphical illustrations, comic books, the radio, television and even videos via mobile

phones. These efforts are especially amenable to cross-sector innovation, where educators, designers and communities can work with health professionals to improve literacy.

At the same time, for social entrepreneurs who wish to have an impact in this broad and at times amorphous domain, it's important to know that the definitions and scope of health literacy vary widely. The implication is that one's starting assumptions about health literacy can potentially shape the directions in which the field can grow.[40]

As in education, some organizations emphasize reading and numeracy as their health literacy baseline. Can patients for example, read and pronounce the names of medications; are they able to describe their diagnosis accurately; and how knowledgeable are they about medical compliance? If social enterprises were to assume functional literacy among customer segments, this would naturally raise the barrier to entry for many communities.

Other definitions maintain that oral literacy, comprehension, and clearer patient interactions with medical professionals are key. In these cases, products and services can be designed to probe whether patients grasp the information that doctors, nurses and health workers share with them. In addition, can patients easily and appropriately apply medical, nutritional or mental health advice after they leave the clinic or hospital? Yet another set of definitions emphasize patients' cognitive ability to understand disease risk factors and apply those and other vectors to behavior.

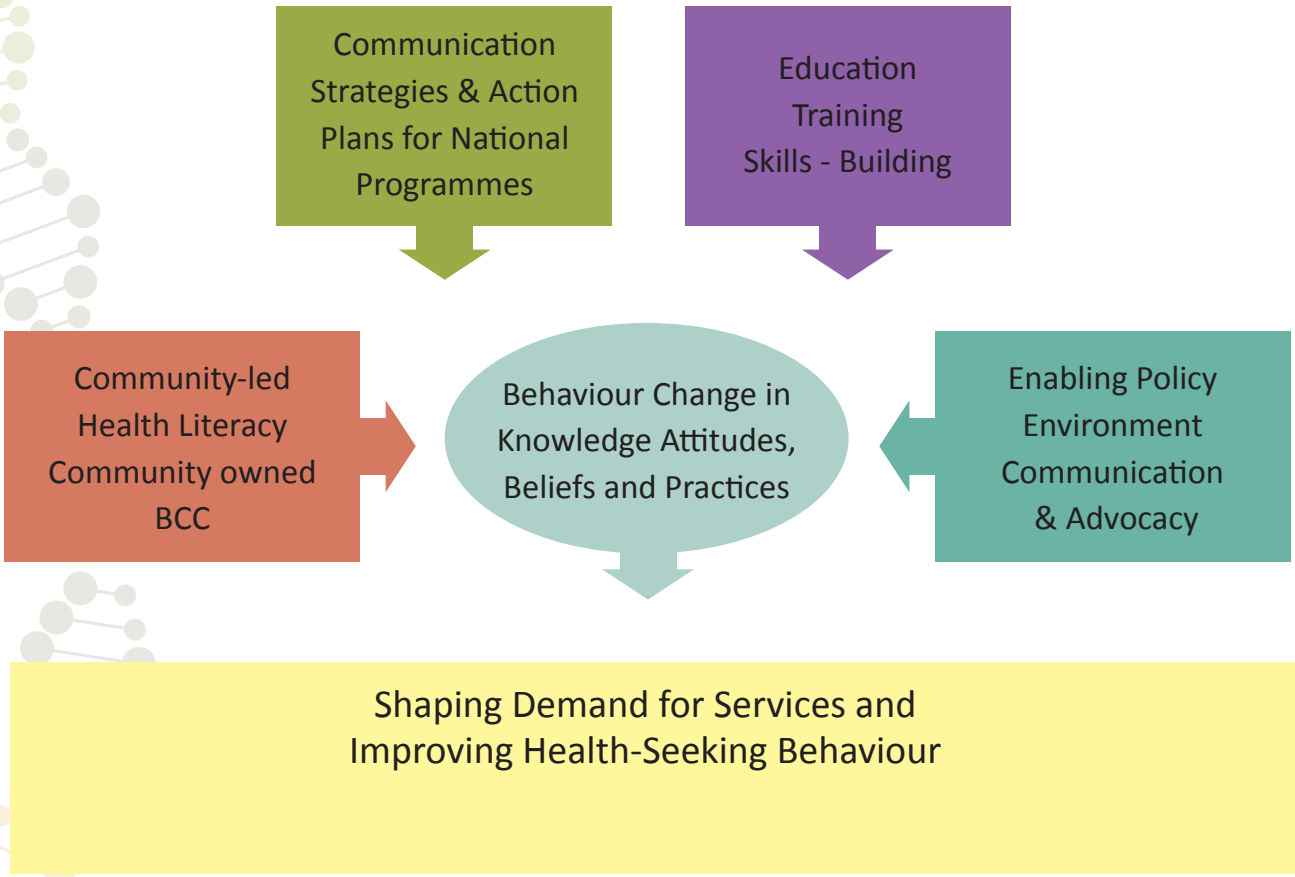
Different levels of health literacy can influence decisions at different scales, for example, decisions made for and by individuals or for groups, such as personal (digital) health assistants for people suffering from hypertension, in contrast to decision support systems for public health. Regardless of the preferred definition, the consensus is that new medical professionals be trained to use appropriate communication with patients, in language that patients understand; in ways that are contextually relevant and take into account social and cultural variability. All of these dimensions and myriads of others, would greatly improve the quality of life of individuals and their families.

Clearly, these ideas are not new. They have been promoted in India for years by National Policy programs, institutions like the Public Health Foundation of India (PHFI), public sector organizations with interventions for targeted groups, and academic and private libraries such as the Health Education Library for People. Many programs address issues in the domains of public health, reproductive, maternal, child and environmental health. The foundations of research, policy and practice exist today. But the game changer is to shift health literacy from the periphery to the forefront when deliberating health policy, designing innovations and developing investments. A further question is how the social enterprise can play a stronger role in accelerating and scaling up these goals.[41] Two models about health ecosystems may be useful to keep in mind.

As demonstrated in Figure 1, PHFI envisions a number of critical components for driving health behavior change, ranging from data sharing to advocacy. Among them are creating persuasive and pragmatic policies, building community ownership and agency, creating appropriate skills training, and finally, agreeing on systematic ways to communicate, implement and measure outcomes.

Figure 9

Framework for improving health-seeking behavior, by the Public Health Foundation of India



Source: http://www.phfi.org/our-activities/health-communication

The Sorenson et al. Health Literacy Model, (see Fig. 10), which is being promoted by a large regional arm of the WHO, offers a slightly different framework. Here health literacy is integrated into the system-wide ecosystem of care. The scale of intervention extends from the individual--incorporating social and environmental determinants of health—to entire populations, examining disease prevention and health promotion measures. The framework starts from a realistic premise that "building personal health literacy skills and abilities is a lifelong process. No one is ever fully health literate. Everyone at some point needs help in understanding or acting on important health information or navigating a complex system …especially when a health condition makes them more vulnerable."

Figure 10

Sorenson Health Literacy Model

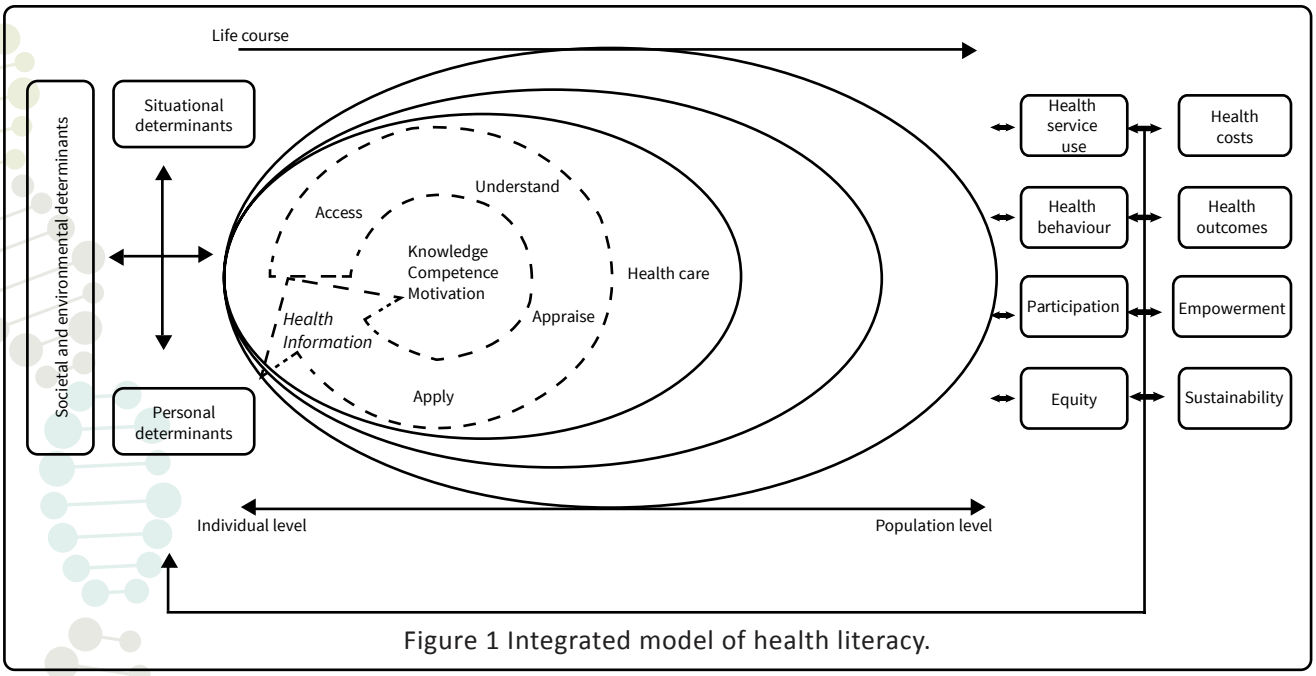


Figure 1 Integrated model of health literacy.

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Chapter 5: Scenarios

Scenario 1: The Rising Tides

This scenario describes elements of collapse and constraint futures

With the Rupee in freefall against the dollar, hospitals, clinics, and other medical professionals are seeing the prices of medical equipment and consumables skyrocket. In 2020, a recent update of the Drugs and Cosmetics Act created a new category for all medical devices and diagnostics, demanding a stricter approval process for equipment designed and manufactured in India. By 2021, private foreign and domestic capital begins to drain out of the burgeoning medical equipment industry as people anticipate facing countless regulations, administrative obstacles, and informal payments for post-clearance certifications.

As equipment and consumables become more expensive to buy and maintain, hospitals continue to pass rising costs to their patients. For larger hospitals or those catering to medical tourism, costs are added to treatments. For smaller, rural hospitals and clinics for lower income populations, the situation is punitive. They are unable to afford imported medical equipment, or to purchase domestic ones. As a result, services for basic diagnostics dwindle away and it becomes harder for doctors to conduct appropriate diagnostic tests before prescribing medications.

Earlier, hospitals and clinics operating in Tier 2 and 3 cities tried to reduce costs by bringing low-cost diagnostics and treatments closer to the patient's doorstep. But a small glitch in equipment set back the entire industry. A much-touted pilot program in Bihar gave pregnant women smartphone-enabled fetal monitoring devices. By wearing these,doctors no longer needed to manually check pregnant women's vital signs as often as before. One batch of devices failed to sound a warning after several mothers' blood pressures had dropped during labor, and resulted in a spate of maternal deaths. This unfortunate incident instigated a widespread media campaign cautioning doctors and patients against using medical technologies that decreased reliance on doctors. Now, around the country, patients are as hesitant to purchase and use such devices and clinics are wary of stocking them. At the same time, there is little improvement in the scarcity of human resources. People living in low resource settings continue to face the shortage of trained doctors, and nurse practitioners are highly restricted in what they can diagnose without oversight. Telemedicine consultations attempt to fill some of the gap but it is hard for patients to trust the opinions of a random specialist seen on the other side of a camera.

As a brief reprieve, public-private partnerships are forged to systematically expand training programs for health care workers. There's a greater push in Tier 2 cities to recruit nurses and medical technicians. The number of licensed nurses increases significantly. With greater awareness about the government's new "best practice" certifications,(which are heavily influenced by international standards), these workers are highly qualified in a competitive market hungry for new resources.Many of the new nurses speak and communicate in English, and are offered attractive salaries to work for overseas medical subsidiaries in Dubai, Vietnam and other Asia-Pacific countries. In India, with the growing concerns of rising healthcare costs, salaries of health care workers simply cannot keep pace with inflation.

Public health issues also escalate. New zoonotic diseases appear in unexpected places, and long-dormant communicable diseases re-emerge, triggered by changes in the environment and adverse climate events. Pharmaceutical companies try to develop vaccines for new subtypes of flu, but cannot produce them fast enough.

In addition, surveillance studies show dramatic spikes in food-borne pathogens that are resistant to multiple drugs. The pharmaceutical industry redoubles its efforts to understand local strains of pathogens found in outbreaks in South Asia. But the rate at which these adapt to human immune systems is faster than labs can develop responses.

Eight years after the Chennai Declaration of a roadmap for antimicrobial resistance, statistical reports show an alarming upturn of antibiotic resistance across public and private hospitals. Prescriptions for antibiotics are on the rise and larger numbers of patients are not being cured of disease or are dropping their course of treatment. Antibiotics are being overprescribed for non-bacterial infections, and there is a growing threat of multi-drug resistance.

With scores of migrant workers seeking opportunities in cities, the slums of India's metros continue growing. Public officials are unable to clean up the water supply or take appropriate sanitation measures. Seasonal outbreaks of water-borne diseases are rampant among slum-dwellers, with new strains that are increasingly resistant to existing treatments.

While the government continues to fund public health initiatives and subsidize the cost of medications and vaccines increasingly, they do so at a great loss. Patients with co-morbid conditions bear a greater cost. Medicines are growing more expensive and patients in low resource settings continue buying cheap, substandard or counterfeit drugs. This fuels an increasing supply of fake medicines that is nearly impossible to track, and further diminishes trust in the healthcare system.

Regulatory agencies attempt to enforce standards and monitor quality control but competing private interests and the nature of challenges and mismanagement across the health ecosystem turn regulatory efforts into a Sisyphean task. Agencies are unable to review institutional licenses due to large private lobbies and a lack of funds for systematically pursuing fraudulent claims. The perception that private and specialty hospitals might be dropping their standards of care has a direct impact on medical tourism.

The pharmaceutical industry too, is struggling. Previously, India supplied 20 per cent of the world's generics. Since then, competing interests between companies with long, expensive drug development cycles and those focused on affordable generics have crippled the industry. The last decade was marked by an assault of intense lobbying, litigation around intellectual property and bilateral trade agreements that focused on regulatory changes articulated as required for a business friendly environment. These undercut production for all but the largest domestic pharmaceutical firms. With hundreds of millions of dollars spent on fines and essential upgrades of physical plants and equipment, small and mid-sized pharmaceutical suppliers are going bankrupt or being acquired. Larger players are under extreme pressure to sell controlling stakes to foreign companies. Firms that survive have fewer assets and capital for longer term R&D. The ability to make long-term bets for new drug development and investments in vaccines has shriveled. India loses its international competitive edge in low cost, controlled production.

For the surviving pharmaceutical firms, there is faint silver lining. International regulations encourage the local manufacture of pharmaceuticals. As a result, companies like Cipla have gone global. They expand across Southeast Asia and Africa through acquisitions and develop state-of-the-art manufacturing plants. Their profit margins grow by continuing to supply generic versions of drugs like Viagra and Zoloft to western countries, while producing affordable generics at competitive rates for rural populations at home. Global expansion also allows these companies to hire leading R&D experts with more ease, and develop R&D for new orphan drugs and Neglected Tropical Diseases (NTDs).

The number of Indians suffering from rare diseases are estimated to be around 70 million (more than the US and EU rare disease populations combined)[1] and about a billion patients worldwide suffer from NTDs[2]. Earlier, drugs to treat rare diseases were not accessible to most Indians as they were too expensive. They involved substantial development costs and target populations are perceived to be smaller than those who suffer from diseases considered more common in the West. But the Indian government has watched its traditional pharmaceutical sector drying up. And it sees foreign countries cutting back on their manufacturing of orphan drugs, which, due to regulatory restrictions are highly expensive to develop. The government makes a big bet on India becoming a central player in the production of orphan drugs worldwide. In part, India's ability to develop know-how for highly personalized medical conditions offers a foretaste of precision medicine, a growing trend across the world. People anticipate an era in the near future when individualized treatments for different populations and drug regimes for rare and co-morbid conditions actually become the norm. With the approval of an Orphan Drug Act, tax benefits accrue and there's greater regulatory leniency to develop orphan drugs in India, for domestic and international markets.

Scenario 2: The Social Surge

This scenario highlights factors related to discipline and continued growth futures

Non-communicable diseases explode across India, with increasing numbers of children also affected. Desperate families scramble for healthcare solutions, but most are overwhelmed by the costs and burden of extended treatment periods, and begin to spiral into poverty. Governments step in to run vertical programs for lifestyle diseases such as diabetes and hypertension, and private hospitals offer health care financing and preventive care for well-to-do customers. But these solutions are incremental at best, and leave few options for resource-strapped families. Public interest groups lobby for governments to expand state-financed insurance plans beyond acute care to cover out-patient and chronic illness management, with patchy success.

Finally, patients realize their best and only option is to help themselves. Despite low levels of health knowledge and overcoming great odds, patients take steps to become more informed, discerning healthcare customers. Leveraging community health resources, education programs, and newly available e-health tools, they begin to take control of their health by becoming aware of public health issues, and making personal changes in nutrition and lifestyle. A widespread use of consumer health devices prompts a shift towards participatory health, where health care workers and remote medical specialists play a larger role in helping patients' self-care and tracking health outcomes.

Young people help drive this shift. Demographically, India has changed. While a large proportion of the population is elderly and requires chronic care management, a majority is young and has different expectations of the healthcare system. 60 per cent are at risk for NCDs. They are, on average, more literate

than the previous generations, with aspirations to live longer and have a better quality of life than their parents. Most are versatile in adopting mobile and tele-health platforms to access healthcare and health information. They also begin to recognize links between health, productivity, and future employment, and learn about risk factors for chronic disease. In time, they grow more diligent about abiding by medical directives and prescriptions. This generation is key to changes in health literacy.

Doctors and health officials view demographic changes in attitude with interest and some skepticism. While better informed Indians address the growing NCD burden (with mortality rates estimated at 53% of all deaths in 2011)[3], medical professionals also notice worrisome results. Since patients are informed but not experts, they continue to self-diagnose and self-prescribe medications, buying substandard generics over the counter with increasing frequency—often with dangerous consequences for their own health and that of the public. Health literacy is also not always enough to overcome false advertising.

To stem negative outcomes, and to support a growing recognition that population health indicators are directly linked to the economy, the government creates its first national health literacy policy in 2020. Architects of the strategy have learned from the successes and failures of India's general literacy program over the past half-century. They have also gleaned lessons from China's commitment to health literacy in rural areas, and ASEAN's Regional Action Plans on Health Lifestyles.

Massive campaigns are planned to improve people's knowledge and awareness of public and preventive health over the next 15 years. The health care sector realizes that it must be part of the solution to accelerate health care compliance and improve health outcomes, as challenging and disparate as these are in India. Central and state governments, along with private industry partners, finance initiatives targeting urban slums, rural areas and schools. Public health information is distributed through Common Service Centers. Enriched training programs are set up for ASHA, AYUSH and anganwadi workers.

CSRs that formerly focused on maternal and child health programs branch out into preventative care and public health literacy. With the help of social entrepreneurs, they work closely with health professionals to develop health education curricula for schools, design multimedia materials in local languages and conduct health information camps. Social entrepreneurs collaborate with NGOs like Ananya to test and develop public outreach programs. Others create metrics to measure and improve impact. Even television and radio producers begin to embrace health care themes in their programs.

New cadres of college and university volunteers, school teachers, and groups of municipal and public sector employees are coached as trainers to implement and assess health literacy programs within communities where resources are scarce.

Schools are important vectors for policy implementation, and become pivotal to shifts in national nutrition and food production. As part of the new health literacy policy, basic health education is introduced in secondary schools. Growing numbers of children across the country learn about health, wellness, and nutrition. They take these messages home to their families, feeding into a cycle of demand for health care and of increasingly health literate citizens.

The new policy also revises the national noon-day lunch program, so that children are given more nutritious meals. New research shows that "unhealthy diets are worse for health than tobacco".[4] This is important for children's health and health literacy, more so because it demonstrates a commitment to significant changes in India's agricultural food production. Over the next two decades, an agricultural transformation takes place, moving away from cash crops and mono cropping and returning to crop diversification. Multi-grain, gluten-free crops and pulses eventually lead towards sustainable agriculture with higher yields. A percentage of these crops are set aside at whole sale prices for school lunch programs. These seemingly incremental shifts set India well on its way to tackling an ever-increasing onslaught of NCDs and many other burdens.

Families in turn become more active and aware of preventative health. Homebound patients invite community health workers in to learn about medical compliance and monitor health conditions. Primary care centres are energized around new patient demands and build better links to preventative health services. Where doctors are absent, access is provided via tele-health. Traditional medicine and stress-management treatments are incorporated, including Ayurveda and yoga.

Through these, and facilitated by ASHA workers and AYUSH doctors, patients access mental health camps and disease screening sessions. Those at the very last mile use mobile clinic extensions to diagnose and manage illnesses ranging from diabetes and heart disease to glaucoma. Common mental disorders such as depression and anxiety—long neglected and stigmatized—are increasingly recognized as integrally linked to non-communicable and other diseases, and mental health services become small but important components of many PHC systems. Increasingly, psychosocial and behavioural interventions are integrated with health prevention programs, helping people to manage chronic hypertension within families, and cope with stressful life events, crushing debt burdens, and natural disasters. With preventive health programs on the rise, secondary and tertiary care institutions hire psychologists and mental health professionals to help support patients to enhance their overall quality of life.

Revisions to the National Health Mission also require that clinics teach patients when to seek out health care, what options and treatments are available to them, how to decipher symptoms. These include how to separate out somatic and psychic complaints and how to communicate these accurately to health workers and physicians. These classes help patients become more engaged with providers, holding ongoing conversations and collaborations with each other for diagnosis, treatment, and preventive care.

As citizens learn to collaborate on and monitor their own health, they also begin to take proactive health decisions and make health-related demands. Higher income families keen on healthier meals insist that shops supply appropriate grains and non-processed pulses in bulk and other ingredients. Growing demands lead to new businesses around food certification and branded packaging aimed at the middle class.

In slums, smaller towns and villages, people begin to organize themselves around health and public health issues. Knowledge about the importance of vaccines leads to increasing immunizations. Community-based committees are formed, some that demand training and part-time work, to track and monitor health targets for the region, including environmental toxicity and pollutants. Other efforts focus on women, adolescents and targeted health groups.

With more active involvement, people's knowledge about public health improves over time, and may gradually lead to improvements in health indicators. However, community groups do not always consider all citizens' needs or concerns. Women's Panchayati leaders are often from the more powerful families in the area; their concerns do not always match with those of the general population. Accordingly, less well-to-do citizens begin to lobby for wider inclusion and form their own groups.

Innovations in low-cost diagnostic tests and breakthroughs in biomedicine have galvanized the design and manufacture of mobile medical devices for the Indian market. Affordable monitoring devices extend health care delivery services beyond the walls of hospitals and clinics. Patients are empowered to use a proliferation of e-health tools and are directly or indirectly contributing to patient data aggregation. Across the country, Indians use mobile phone technologies to access health advice and directives, and to confirm the validity of medicines. Others, including those who can't read, monitor blood sugar levels and other conditions on self-operated home devices. But technologies are not always administered correctly, leading to inaccruate readings and risk of poor health outcomes.

Some of these technologies are networked and linked to local health systems and tertiary hospitals. They are important channels for data gathering and dissemination. For example, blood sugar monitoring devices can feed results back to a databank. Patients who use their mobile phones to check the validity of their medications are contributing data on usage, namely, which medications are being used and where, and who has prescribed or sold them. This data is aggregated, processed, and channelled back to patients through health workers—further strengthening their knowledge and agency—or into predictive analytic systems. However, some patients with a high prevalence NCDs are getting paid small sums to contribute health data towards clinical trials, raising alarm bells about potential exploitation.

Massive banks of patient data are used to develop new insurance and payment plans. Insurance companies can now determine treatment costing information to design their plans. Social entrepreneurs develop tools to assess health risks. Mental health patients, long uninsured because rate sheets, points-of-care and costing information about treatments were unavailable, now have access to payment plans for common mental disorders. Primary care services use data findings to fine tune health subscription plans and user-fee models.

Scenario 3 – All Wired Up And Somewhere To Go

This scenario addresses possibilities for growth and transformation futures

It's 2021 and the health system is going the way of governance: the pockets of digitization of records, e-governance interfaces and e-enabled processes.Health identity cards are back on the table, and linked to electronic health dossiers for families. Workflows that started as isolated experiments driven by idiosyncratic goals have started to grow and, in some cases, converge into state and national physical, regulatory, and policy infrastructures for moving information around. These information flows, in turn, open up new possibilities for contributing to the health system through market-based models. We trace these through a ficitionalized anecdote.

His reputation preceded him. Or rather the electronic profile arrived before the patient. It is the year 2021. Atul, a consulting radiation oncologist at Nalanda hospital is looking over his caseload and afternoon roster. One of his patients is losing ground and seems to have developed a second tumor in spite of a full regimen of radiation therapy. Atul makes a mental note to contact the diagnostics lab at the Shatrughan Sinha Hospital in Patna. He'll ask them to run computer simulations to gauge how well his patient will respond to different treatments, based on genomic data and past medical history. Accuracy isn't guaranteed but at least it gives him more evidence for treatment plans.

At the same time, hundreds of kilometers away in the national capital, the Secretary of Health and Family Welfare is reviewing the rates of outbreaks of infectious diseases across Bihar and Orrisa. She notes that some kind of flu with joint swelling and brain hemorrhaging is showing up in the east. She informs the region's Disaster Management Cell, orders a team of specialists to head out immediately, and alerts the railways and civil aviation authorities in surrounding states to screen passengers. If specialists think it's leading to an epidemic, they must contact local social franchising networks to distribute and stock up on vaccines, and alert mobile call centers with appropriate public health information.

Next, the Secretary turns her attention to insurance payouts in Bihar. Purnea district stands out. Nearly 60% of insurance reimbursements for kidney dialysis are going to two centers. Either they are the masters of all kidney issues or something fishy is going on. Are the claims realistic or overblown? Are they caused by glitches between electronic records and insurance payment systems? Drolly, she remembers another case and its aftermath; "Thank god at least the strange insurance claims for men getting hysterectomies in Haryana have disappeared." Serious investment in data entry and cleaning took care of that issue!

Looking through the health dashboard is somewhat actually comforting after a morning spent with the nurses' union in New Delhi. Nurses are demanding the retraction of a new performance bonus scheme based on targets for community fitness. The union was clever in their campaign for change. They didn't argue that the government should reward performance that is based on community wellness metrics. They simply pointed out that performance metrics went beyond the control of medical service providers. How could their bonuses be tied to health outcomes if they have no control over air and water pollution, workplace hazards, road safety, alcohol and tobacco use, not to mention patients' pre-existing conditions? Really, they were as bad as the teachers – arguing that test results were not their fault if they had some not-so-bright ones in the class.

The Secretary is briefly tempted to replace them with digital PHCs. The Ministry's pilot project to test several health ATMs in Assam was going well. Any adult or child who feels ill can walk into a health centre kiosk, get their vital signs scanned, tell their history to the automated assistant, and wait a few minutes to get a diagnosis or referral delivered. Automated dispensing machines stock over-the-counter medications and supplements (though they needed to be manned by live guards to prevent theft). Especially popular with pregnant women concerned about anemia, Health ATMs allow women to measure their hemoglobin levels without having to draw blood.

Based on successful pilots,various states governments want to experiment with using Health ATMs and digital PHCs for preventative rather than curative health. People are encouraged, even being paid,to go for routine checkups when they aren't ill. Family members develop personal health baselines by measuring their vitals on a regular basis. Younger kids take to health monitoring like ducks to water. In this way, the Health Ministry hopes to draw on these data to anticipate health risks based on people's stage of life, occupation and other parameters.

Keen to build cohort studies and longitudinal health histories for families, the government also hopes to tie health information to genetic and environmental data. Epigenetics is far off, but data from Health ATMs can be collected, made anonymous and cleaned up by hordes of medical researchers working on open data platforms for large clinical trials. These options are exciting but probably still far off and fraught with risks that challenge current health policy. The Secretary knows that integrated health systems are a good 20 years away, and may not happen before she retires.

Some of the risks of having all of this information available are becoming apparent. Private insurers working through Third Party Administrators (TPAs) who network with hospitals and maintain client history, are now armed with much of the same data as the ATMs and use it to great effect to update their risk calculations and optimize their portfolios. The riskier individuals are increasingly denied coverage for one reason or another and those who cannot afford to pay the higher premia fall back into the state-supported pool. All around, the health system is slowly and surely becoming a numbers game. And thisis changing the playing field.

Several factors converged to allow this to happen.

•The India Respiratory Syndrome (IRS) debacle, which was not caught until it made its way to New Jersey and Australia, became a national embarrassment for public health surveillance. This resulted in a demand for data on patient profiles, disease progression and presentation/symptoms and effectiveness of treatment.

•India signed a MoU with the Swedish Ministry of Health and Social Affairs, to build health information systems that can collect Family Health Records. Designed to support cohort studies, researchers can begin to track changes in health outcomes across multiple generations of immediate and extended family.

•Rising costs of treatment, coupled with healthcare inflation and crumbling public facilities drove the need for big data and analytics to the top of the health care agenda. Public and private sectors were hungry for information and analytics. As growth in India slowed, the public sector was facing tight fiscal constraints. Entitlement spending increased, and domestic and international investors became wary of India's debt. More transparent data, it is believed, can help to ensure system efficiencies across the board.

On the one hand, the private sector, eager for new markets in healthcare among the emerging middle class, tried to lock in standards for data-sharing as access to health data is considered a competitive advantage. In the race for large-scale data aggregation systems, venture capital went to the smartest.

Islands of information curated by state insurance companies—the major buyers of healthcare - started to form. These datasets also open up a lucrative sideline in attracting pharmaceuticals and other partners for research and development.

On the other hand, the central government, under considerable fiscal pressure, tries to pry open corporate data silos through incentives for data sharing. Directives mandate that companies release data related to public health events and emergencies.

Initially, these developments occur in an ad-hoc, decentralized way, with limited guidance about data standards. Like the early days of e-governance, there is a proliferation of experiments around the country. Every state has their databank, as does every hospital chain and many NGOs. Savvy techies, sensing future markets for data aggregation, try to stitch systems together. Entrepreneurs, having seen the success of EMC's rapid digitalization project in Karnataka, dive into digitizing and integrating paper, voice and other forms of records. Social franchising networks build alliances across different organizations, coordinating efforts and offering a richer and more diverse set of health related services to customers. They help patients understand different options for insurance, treatment, or preventative care.

The scope of data collection and digitalization extends into tracking factors that affect health on a larger scale. The government invites bids to install network-monitoring systems on air and water quality and their impact on NCDs. Tamil Nadu,an overall pioneer in health systems standardization, using its CM's insurance scheme is able to pull such data into its electronic health records, where it discovers detailed information on disease burdens and aligns initiatives to address key concerns.

Among the larger private players, companies and health systems that were once reluctant to share data, have developed strategic alliances to exchange critical and preventative care information. Private hospitals align around state systems because of the cumulative purchasing power of health allowances. Reimbursement claims at scale require cross-institutional alignments.

The hype about big data has its detractors. And they have some tough questions: How to ensure data accuracy and system interoperability? How easy is it to clean inaccurate data across systems? Can health information systems represent actual state and variables of disease, or are they biased towards metrics that are easily implemented? How do they account for variations in disease progression, presentation and individual responses to treatments, as epigenetics come into play? Will automated and evidence-based treatment protocols cause the demise of personalized engagement and attention? Will people's health issues creep into credit ratings and financial identities? How do we maintain anonymity in an environment where the client doesn't value privacy? How will the data be representative in a reliable way for seasonal migrant workers?

Endnotes

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Chapter 6: Social Enterprise Opportunities

In this chapter we focus on avenues through which social entrepreneurs – small, new, ideally growing, for-profit businesses with social impact – can make a difference. The previous chapters have taken a broad view of the health system and its evolution, including some challenges that will require concerted effort from public, private, for-profit and non-profit contributors. Large-scale public investment in health training, for example, is one approach to solving India's shortage of trained health care professionals. Start-up, for profit businesses are unlikely to fill the gap by themselves – though start-up universities such as the Public Health Foundation of India (PHFI) are certainly making a dent. This chapter seeks to bring the discussion back to the more specific view of the emerging scope for social entrepreneurs. To continue with the same example, social entrepreneurs do have much to contribute to making healthcare education more accessible and effective, from new teaching tools to content for massively open online courses (MOOCs) to skills refresher video material or games for health workers in the field. As information on individual and community health outcomes over time improves, the impact of such training on employee effectiveness and cost-savings will become easier to track and the financial value of such products and services will also become clearer.

As discussed throughout the report, there are several driving forces in the background of these "new avenues." First, the rising household budgets for health. Part of this is due to rising per capita incomes: the lowest income Indians are still very poor, but less poor than they were a decade ago and ideally this trend will continue. The kind of policy support for expanded, more effective insurance cover that is emerging at the time of writing this report also effectively expands household budgets for healthcare.[1] Second, science is progressing. We know more in general about diseases, disease progression research, treatment options, and underlying human physical systems every year. As the cost of genomics profiling drops, we are likely to learn more about individuals and populations' particular physiology and be better able to understand risks and predict their responses to treatment. These developments not only expand the potential scope of healthcare, but also raise new questions about the appropriate use and ownership of information. Third, the commitment to technology innovation as well as the ecosystem for financing and otherwise supporting entrepreneurship is developing. Conditions for entrepreneurs working in healthcare in India appear to be improving. Finally, the information revolution is transforming medical systems around the world by enabling specialists, healthcare workers, financiers, communities, and individuals to know more, faster, and in more remote areas. While India's information infrastructure—the pipelines for data flow to its farthest corners—is evolving slowly, there are multiple non-linearities possible. Slowly, but surely, key attributes of people, their networks, and their environments are moving into the digital realm and this, in turn, opens up opportunities for substantial innovation in business models.

Throughout this report, our underlying questions have been: How to improve and broaden access to care? And what are some of the opportunities where there is potential for market-based models to contribute?

The answers that have emerged lie in several broad opportunity areas. First, expanding the scope of care. Advances in diagnostics, for example, open up new treatment options by enabling earlier detection of anomalies and, correspondingly, options for avoiding rather than curing serious illness. Preventive health services may also find new markets as public and private providers of health finance become more cost-conscious and individuals become more aware of the relationship between these investments and their own wellbeing as well as economic productivity. Mental health services, a domain of growing interest, focused funding, and more quantified benefits around the world, is another potential growth area.

A second avenue of opportunity is to expand people's participation in care, as motivated sources of information about their health and risk factors, informed advocates for quality, and even in self-treatment. Engaging patients in the supply of medical care could not only mitigate some of the shortages in health care providers, but also contributes to a robust bulwark against fraud, abuse, and misuse of medical information. The technology tools for people to learn from their social networks and broader online communities exist, the challenge is to empower people to draw on these and effectively filter information. The potential transformation of healthcare discussed in the scenarios could also involve an expanded role for primary health clinic workers through greater face-to-face engagement with community groups, the forging of new partnerships between different levels of health care systems and governments, and extending health care outreach and communications via eHealth platforms. Some of these models will be based on state and philanthropic support, but the changes in practice also create opportunities for support services to government and non-profit providers. Health information services as well as initiatives to improve metrics around quality of care, for example, are likely to find customers among groups focused on ensuring value for money in healthcare.

Third, there are opportunities to improve access to care. One route is through medical technology innovation – developing lighter, smaller, cheaper devices for diagnostics and treatment that can extend the kinds of services now available in urban areas and larger secondary/tertiary hospitals to smaller, more far-flung clinics or even homes. A second route is through supporting access to health finance, as stand-alone ventures or in collaboration with or emerging state and national government initiatives. As in other opportunity areas, the transformation of health care finance also opens up opportunities for support services ranging from data aggregation to patient support to risk analytics that leverage the growing information base on everything from environmental risks to patient profiles. A third route is through tackling the skills gap to help build the group of trained professionals contributing to service provision.

Fourth, the ecosystem for innovation for low-cost medical care is still developing. There is more consensus on the gaps than on the means to remedy them, and many of the ecosystem investments may have to be philanthropic at first while different approaches are being tested. But, just as the broader social enterprise ecosystem has transitioned from a donor-supported model to one that also includes financial investments and portfolio-level strategies for generating financial values, so too may the healthcare ecosystem. The scale of demand for healthcare suggests that it will.

The remainder of this chapter fleshes out each of these opportunity spaces.

From Health To Wellness, Care To Ecosystem

Many opportunities exist for social enterprises to help extend delivery models to include preventive health and early diagnostics. Changing demographics and growing incidence of diseases mean more Indians are seeking out health care, but the current system can't possibly cater to them all, nor can Indians afford the related costs. This creates an urgent need to reduce the demand for health care by preventing problems before they begin. Effective programs in countries such as Cuba, Thailand, and Brazil have achieved this at the primary care level by offering universal access to health promotion and prevention programs. Health screenings, health education and programs are delivered through a network of expanded primary care clinics, each with a strong community engagement component. The results are improved country health indicators, mitigated disease burdens, and reduced overall costs for patients. Groups throughout the U.S. and U.K. are experimenting with similar strategies with embedded community clinics, and by offering comprehensive health services in low-resource settings. Across India, steps have been taken in similar directions, from National Health Mission's focus on expanding the primary care network to private initiatives such as Sughavazvhu Healthcare.

Preventive Health & Early Intervention

Preventive health and early interventions have traditionally been seen as an activity for public or philanthropic activity due to the difficulty of assessing the individual impact of averted illness. This calculus changes as patients themselves become more aware of the value of avoided illness. Competition among private healthcare financiers also generates harder budget constraints, as does tighter or more tightly enforced regulation that prevents "easy" ways of limiting costs through discrimination or denial of coverage on technicalities. Services that support value for money also become more valuable as funding for public health insurers or care providers shifts to emphasize performance. In short, preventive health care is one of the most cost-effective ways to lower aggregate healthcare costs. This broad need turns into a market opportunity as soon as these savings can be measured and claimed.

Several potential growth areas in preventive health include:

- More accurate early-use diagnostics for chronic conditions (e.g. diabetes) as well as diseases for which treatment complexity escalates substantially with disease progression (e.g. cervical cancer).
- Molecular diagnostics for precision medicine and more focused, targeted treatment, should be looked at as slightly longer-term opportunity for social entrepreneurs, but certainly on the horizon. Market forecasts for molecular diagnostics are substantial, and costs are dropping rapidly. One of the challenges will be to integrate this new information into existing systems for delivering care.
- Tools for managing information and aggregating inputs from various sources to spot risk factors, patterns of disease progression, or otherwise inform effective preventive health.

As discussed earlier in the report, social entrepreneurs can affect both the demand and supply for early diagnostics. Should they be adopted widely, remote health monitoring will enable precise readings of patient conditions and offset the pressure for in-clinic visits, cutting costs of providing health services for lower-income patients.

Social entrepreneurs may also find opportunities in integration of diagnostic tools with information

systems and healthcare providers' operations. Medical devices for monitoring or diagnostics are generally standalone today, but once they become networked and are able to communicate patient information to providers, new healthcare models can be built that integrate these data with back-end intelligence and higher capabilities for analytics. Smartphones are an ideal platform for diagnostics and monitoring, not just because of the advanced functionality they offer, but due to the fact they have become so widespread that the cost of the device is minimal in comparison to specialized, medical technologies. Attachments to the phone or applications on it can turn smartphones into medical sensing devices.

Widespread use of low-cost medical devices may also generate new health care delivery models. The San Francisco based start-up called Cellscope is one early signal. The company is designing an array of innovative optical attachments for smart-phones, which could be used as 'digital first-aid kit' to capture quality data for remote diagnosis by a doctor.[2] Their first commercial product, called CellScopeOto, allows visualising and capturing images of insides of the ear by converting cell phone into a connected digital otoscope. This example belongs to a growing list of initiatives where data in the form of text, numbers, audio, and images are being used to provide healthcare services remotely.

Mental Health

As mentioned in other sections of this report, addressing mental health issues is an important need most mental health cases go untreated in India. Yet across the world it is emerging as a critical area of focus, particularly as links between non-communicable diseases and mental health concerns such as anxiety, stress and depression become increasingly clear. Within India, important innovations reveal new avenues where social enterprises can make significant contributions. For example, several well-received studies and programs including the Raipur Rani and Sakalwara projects in the 1980s and 1990s, and, more recently, the MANAS intervention and COPSI trial, demonstrated that mental health can successfully be delivered at the primary care level through a "stepped care" approach, which relies heavily on lay health workers. Also, organizations such as Banyan in Southern India are increasingly developmental in their mental health approach, working more closely with communities and community systems. Other organizations such as Sangath have developed easily scalable treatment packages and lay health worker training materials.

In addition, attitudes towards mental health appear to be changing in ways that evoke the recent shift in attitudes around elder care. Care for older people has traditionally been regarded as a family obligation, with limited acceptance of commercial models except for specific treatment. This has shifted in the last decade (in part out of necessity as more families live separately for economic reasons), and elder care is one of the growing areas of for health services. Similarly, stigma and lack of awareness may contribute far less to treatment gaps than traditionally thought. No hard data exist here, but several experts we spoke with say that they see great willingness and reduced resistance on the part of insurance and other companies, health care providers, communities, and individuals to change their outlook on and approach to mental health issues. Given these shifts and the emergence of potential customers for mental healthcare, there is increasing recognition among some of these experts of the need to test the feasibility of social enterprise models in the mental health sector.

Expanding Peoples' Participation In Care

Earlier, we discussed extending primary care systems to include preventive care. Importantly, these can also be extended to help enhance patient agency by improving health literacy and stimulating health care seeking behavior through strengthened community engagement programs. Such initiatives can be compared to businesses' use of "village level entrepreneurs" who stimulate demand, create product awareness, and fill value chain gaps at the last mile. There is always the potential for these initiatives to go awry by promoting some treatments or drugs over others, particularly when they are part of a commercial endeavor[3], but this risk can be mitigated by public, private, and philanthropic investment in health literacy as well as (for social entrepreneurs) adequate due diligence from incubators, impact investors, and other funders.

Some significant examples of community outreach in social enterprise settings lie in the Sugha Vazhvu and Aravind Eye Hospital programs, where a significant proportion of resources go to community engagement. A main Aravind Eye Hospital goal, moving forward, is to strengthen community engagement and increase numbers of rural care centers or "vision centers." The goal here is to create health care demand, stimulate a need for curative care, and create awareness -- all of which directly improve patient agency that is likely to extend into other interactions with the health system. Activities include counselling, community screenings, and house-to-house geo-mapping of catchment areas. This information is also potentially valuable as market insight for health entrepreneurs, as it can feed into databases that allow for health care system optimization and patient satisfaction, and reveals insights such as how distance to facilities affects healthcare seeking behaviour. Along the same lines, there is room to strengthen community health worker roles using ICT interventions such as mobile phones loaded with data to track health and monitor problems and medical compliance.

Quality of Care

As people (and financiers) begin to become more involved in evaluating care, another related opportunity for social entrepreneurs is to improve quality of care by developing consistent methods and standards for measuring it. In a world of demand-side health finance and increasing competition for patients as well as accountability for funding healthcare providers are under increasing pressure to demonstrate their audit trails, efficiencies and efficacy – all of which may be processes outside of standard management metrics. Social entrepreneurs can build capabilities and services to address these needs by convening standards committees, establishing systematic metrics and protocols that can be used across secondary and community based care clinics, and creating certifications for quality assurance.

Social entrepreneurs may also find markets for protocols, or forms of expertise that help supplement personnel training or enable less-trained people (even the patients) to diagnose and treat some health concerns. There is a public system for creating standards, and many may come from university and government supported entities, but the translation of these guidelines into actionable organization modules that support healthcare providers' compliance with regulations or conditions for funding is potentially an entrepreneurial activity. Protocols are currently developed internally by social entrepreneurs, but these also may be 'franchisable.' Innovative programs such as those being implemented at Sugha Vazhvu have developed strict protocols for health workers to follow. Backend teams or statisticians constantly review health worker decisions and diagnoses for accuracy, and feed these back into protocol updates. Protocols are particularly

helpful for expanding and guiding the role of ASHA or AYUSH workers. Glocal Hospitals, for example, describe themselves as protocol rather than physician driven.

Inform and Empower: the Patient Perspective

Another angle for social entrepreneurs to explore are personal health tools that empower patients to track their own health issues over time and data portals that aggregate reliable medical information so that patients can be more informed about healthier behaviors. Start-ups like WellnessFX™, Cake Health and VitaPortal are prime examples of these. Ideally, some of these applications would use mobile phones platforms to ensure greater reach. At scale, anonymized data streams from these can also feed predictive analytic platforms to gauge efficacy and quality of care by provider and location – a knowledge product with a market among healthcare consumers and financiers.

Over the last few years, unique innovation models have emerged that attempt to create sustainable business models that blend consumer health care needs and leverage a variety of data streams. PharmaSecure is one such example. A US-based company with offices in India, this mature start-up works with pharmaceutical companies to print unique, randomly generated codes on medicine packages along with a phone number. The patient or customer can send the unique code by an SMS or text message to a given phone number, to verify whether or not the medicine they have is genuine. PharmaSecure has sold over 800 million codes so far to help identify genuine or counterfeit drugs. The same technology platform also enables low cost, two-way communication between the consumer and the drug manufacturers. Drug manufacturers can get consumer-lever intelligence about medications, as well as drug utilization patterns, persistence and adherence to medication, and so on. PharmaSecure is working with Bill and Melinda Gates Foundation on a Grand Challenge to try to improve patient adherence to tuberculosis (TB) treatment. What is so compelling about PharmaSecure is that it offers value propositions to multiple stakeholders (from direct consumers, to pharmaceutical companies) throughout the value chain of healthcare delivery.

Expanding Access To Care

Social entrepreneurs in health often seek impact through expanding access to care: by establishing care centres in areas others have avoided, cutting costs through business model or technology innovation, relieving human capital and financial constraints among other activities. These opportunities are still very much needed; but the possibilities of expanding access have evolved.

Human Capital

The perennial challenge of filling the gap between healthcare workers required and those that exist creates three kinds of social enterprise opportunities: capacity arbitrage, teaching, and reducing the skill required for any particular diagnostic or treatment.

Capacity arbitrage becomes possible when there are areas with large numbers of skilled workers in one place but not another and there are some means to transfer the capacity, if not the people, from one to the other. Telemedicine provides such a means. Doctors and nurses may prefer to stay in urban or higher income areas as discussed earlier in the report, and access to medical care in rural areas suffers. However, their insights and expertise can be shared through telemedicine.

To many, "telemedicine" means a video-conference between patients and doctors, or doctors and specialists, the kind of activity that will grow as broadband becomes more common. Currently, tele-health activities include awareness, counselling on health related matters, checking compliance to seek care, screening and early detection, and then finally diagnosis and consultation itself. Some providers are public: DISHA-1056, a 74-doctor, 24 x 7, helpline on physical and mental wellness, for example, is a joint venture undertaken by National Health Mission (NHM) and the Kerala Government Department of Health and Family Welfare. Others are foundations: the Apollo Telemedicine Foundation, for example.

But there are signals of potential markets for social entrepreneurs. The Apollo Telemedicine Foundation, for example, has collaborated with a telemedicine provider to provide video based telemedicine designed by CIRM Design & Research Labs (CDR) to the members of the urban microfinance institution Equitas – service to a private limited company.

Fig. 1 Apollo Hospitals conducting a telehealth information session for communities in Tamil Nadu.[4]

Initial overhead costs and infrastructure can be substantial and must then be maintained: does the network have sufficient bandwidth to support high-resolution, multi-point video conferencing? Still, the capital costs of the initial infrastructure for telemedicine are also decreasing over time, lowering entry barriers. On-going improvements need to be made in video compression, storage, indexing and access capabilities, including options for wired and wireless video transmissions for higher definition streaming will all contribute to this trend. Today, doctors who conduct remote diagnostic consultations are accustomed to working around lags in the network and low-resolution images by using lower-fidelity techniques or requesting that imaging and lab results be sent to them over the Internet.

In the spirit of frugal innovation, it is getting easier to patch together free and commercial tools to accomplish their tasks. Narayana Hrudayalaya, for example, switched from the use of satellite communications to using Skype for tele-consults, with the result that each physician can potentially reach patients across India, Pakistan, Afghanistan and the Middle East with greater ease, without having to do extensive hardware installations or maintain the software.

Finally, successful telemedicine depends on a lot more than data transfer – the challenges of optimizing human resources, for example, presents opportunities for social entrepreneurs to find a competitive edge. Tele-consultations are especially useful in providing tertiary care support for patients at the secondary health care level. When it comes to primary and preventive care or catering to larger population, however, access to specialists and doctors may be more intermittent. Resources need to be organized and scheduled well in advance: which doctors are available at what times? What are backup plans in case one part of a fragile network drops out?

Similarly, organizing various streams of data flows can also affect competitiveness. Tertiary care teams can also use tele-health infrastructure to regularly review patient cases with ASHA workers, offer advice about post-operative care, answer questions and share information about medications, test results, and coordinate medical clinics in regional areas, and so on. But all of these streams of information must be coordinated.

Can social entrepreneurs develop portals that connect tertiary with primary health care centers? The overarching opportunity for innovation in this space is to improve data liquidity between systems. This might range from developing interoperability between systems to discovering ways to aggregate current data and medical histories about patients from their test results, data feeds off monitoring devices, self reports and other sources. The more quickly and seamlessly physicians and medical professionals can access and review layers of relevant information (or data that is often buried in the patient record), the easier it may be to develop accurate diagnoses during tele- consultations. Ideally, frontline workers with greater proximity to and responsibility towards patients in low-resource setting, will be included in conversations regarding continued care.

While a widespread adoption of telemedicine depends on ease of use, access to tools and adequate infrastructure, we should not assume that online interactions simply replicate face-to-face consultations. Visual diagnostics and multi-sensory clues that experienced doctors usually rely on to understand a patient's state, such as gait, body posture, tone of voice, respiration and eye contact among others, will be harder to gauge online.

Over the next five years, formal training programs and modules can be developed to instruct and guide users about the use of tools, methods and how to improve online patient-doctor interactions, regardless of whether the tools are being accessed from clinics, hospitals or at home, where doctors may in the future conduct evening consultation sessions. Equally importantly, training modules must address curative as well as preventative care, focusing on lifestyle changes, chronic disease management as well as medications.

De-skilling health delivery is another big challenge, and a perennial opportunity - trying to optimize efficiencies by dividing activities up into smaller, distinct tasks and using different resources to complete those tasks. In the next five years, the opportunities for task-shifting may arise between appropriate personnel, software algorithms and automation. Already, medical laboratories are automating diagnostic tests so they can increase the processing speed and volume of tests and quality control and to reduce the chances of contamination and human error. In India, immediate opportunities for innovation include workstation automation in clinical labs (rather than automating entire diagnostics labs which are far more expensive) and miniaturization. Molecular diagnostics has strong growth potential as well. According to a 2013 report on MedicalBuyer.com, the current market for molecular diagnostics is around USD 5 billion, estimated to grow

at 11% CAGR from 2012 to 2017.[5]

Swasthya India (http://www.swasthindia.in), an urban health care clinic model, leverages a different kind of capacity rationing. Presently, their clinics are based in informal settlements Mumbai and other locations. Their model provides clean, integrated health clinics located in highly visible areas, (in close proximity to shops that people use frequently, for example), but limits availability of medical professionals to particular times of the day and evening, which helps to reduce costs of doctors. They also rely on branded generics to reduce overall cost of medication for patients.

A third opportunity area for social entrepreneurs to address is the growing deficit in human capital across the health care sector. Here, we highlight a few compelling areas for *innovation in medical education and practice* that can be accomplished in the near term. Ideas to explore include educational tools to enhance medical skills and knowledge; new partnerships to boost vocational training; diverse portfolios for point-of-care diagnostics; and applications to improve patient health behaviors.

Social entrepreneurs with an interest in educational tools have ample prospects to design medical education for the future. In the last five years open education has transformed pedagogy and the ways in which we teach and learn. High volumes of digital content, instructional materials, tools and videos are now accessible to anyone around the world with an Internet connection.

Among the more promising tele-health use cases for the future is continuing health education for specialists and frontline health workers. The Apollo Hospitals in Chennai, for example, through the efforts of Professor Ganapathy and his team, founded the PAN African e-Network. Since 2012, they have organized hundreds of talks for medical practitioners, including nurse practitioners, in more than 13 countries in Africa.[6] According to Bhowmik et al, these efforts have culminated in a plan to develop 25 health care telecenters across Africa. Prof Ganapathy envisions this medium as a powerful way to train rural health care workers as well: “Constant virtual access to experienced urban specialists will also benefit the rural healthcare provider—be it the PHC doctor, the nurse, or the AYSHA—and may increase their level of competence,” he notes.[7]

India has the second highest users of Massive Open Online Courses (MOOCs) worldwide. With changing business models, universities and companies no longer need to offer material for free. Online educational courseware aggregators like Coursera or Udacity offer short certification courses for a fee, and are exploring new models of payment for professionals who teach online. The future of digital education, however, is not simply virtual, but uses blended learning frameworks, integrating digital content for self-directed and peer-based work in the classroom.

Social entrepreneurs can leverage open educational resources to build peer-based learning platforms for medical colleges. Perhaps these platforms can enhance traditional clinical skills instruction by encouraging new competencies in translational research, data analytics and simulations. New digital training laboratories with computer simulation tools could vastly improve what medical students retain and help them to put to practice what they learn in traditional lecture halls. Today, medical simulation tools are used to train students in various surgical procedures, including dissections using high-resolution anatomical images, and even to simulate the response of pathogens to antibiotics at a molecular level, instead of using live animals.
Tutoring programs for medical college entrance exams can also be built, at scale. At the secondary school

level, students may find new digital content about medicine, dentistry and nursing, increasingly compelling, and develop an early interest in the biomedical sciences, which eventually draws more students into medical professions. Digital content can help to streamline courses for certification and re-certification over the career of a medical practitioner. Skills training can be extended to vocational schools as well, building a future pipeline for jobs. In sum, MOOCs and open education platforms, peer-based tools and digital media have unlocked radically new avenues for life-long learning. There are any numbers of opportunities to apply these to the health care sector in India.

Two *new needs for education* stand out in particular. As the volume of electronic medical records increases, there is a corresponding need for trained data entry jobs, where systematic and longitudinal data can be captured about patients when they visit primary and secondary care centers. The second is Health IT training to maintain the physical and communications infrastructure at primary health care centers and health sub centers. There is a strong role for PPPs and further government investment in vocational training that targets job creation in health care.

Any number of the significant challenges in medical education and training today might inspire innovation to strengthen and expand human capital for the future. As business models shift, we may well see a corresponding shift from educational training to re-training, re-skilling and on-going learning throughout people's lives.

Insurance & Financing

The anticipated spread of private and state-supported health insurance and demand-side finance would not only expand the market for health services, but also generate new avenues for business-to-business ventures. In terms of the provision and administration of health systems, there is a clear role for Third Party Administrators (TPAs) to play in rural areas. For instance, in Karnataka, a rural TPA, Sudhanand Health Care services, provides insurance services to Grameen Koota, a microfinance institution's member base. It networks and empanels hospitals and pre-authorizes hospitalization cases and costs. This is a natural path for BPO start-ups that already have a data-handling back-end and could add health expertise while maintaining BPO-like cost structures.

TPAs' services (client identification, hospital facility quality assessment based empanelment or de-empanelment, setting pre-authorisation process for claims with insurers, cash management of payments to hospitals and archiving of claim papers) are also important for the functionality of health finance for low income India. They will be critical to insurers as they bring not only historical data, and on ground operational team, but also loyalty and technology alignment of health service providers. Indian has only 31 TPAs.[8]

Similarly any move toward more comprehensive medical records including histories would create opportunities for social entrepreneurs, much as digitization of government records created a new cadre of local technologies and tiny enterprises. Digitisation as a business started with E-Bhoomi in Karnataka and expanded with voter lists, followed by the National Rural Employment Guarantee Scheme (NREGS), and financial inclusion initiatives in rural areas. FINO, a banking correspondent, for example, earns a substantial share of its revenue from government transfers, NREGS, and No Frills Account creation efforts. There are potential similar businesses for health finance - RSBY card issuance is an important source of revenue for

FINO. New entrepreneurs may find opportunities to enter this space to offer additional client benefits (e.g. enrollment with health checkups, health status reports) even as existing digitization agencies move into the new business line.

Building The Ecosystem

In the absence of naturally developed university-based innovation ecosystems, India needs to fund efforts to form ecosystems through collaborations across different institutes within universities as well as outside of them. These can be individual or multiple collaborations. They can also be aggregated together in the form of a collaborative platform – with resources such as skilled workforce, equipment, workspace, and network of experts shared between different collaborations. Premier academic institutions in India (IITs, IIMs, AIIMS and PGIMER, TIFR, NLS, TISS, and others), have contributed significantly to R&D in the country, across dozens of areas of specialization.

The challenge is to bring these disciplines and practice areas (academic and other) together. At many universities overseas, different departments, research centres, institutes, and even start-up companies are housed on the same campus. They form multi-disciplinary "ecosystems" that foster innovation through dialogue and close collaboration between students, researchers, and academics from different disciplines. Geographic proximity enables these interactions where a cross-fertilisation of ideas can occur right from the start of an undergraduate programme.

This cross-fertilization is essential. Take medical devices, for example. Most of these technologies will require some combination of technology, design, and business inputs. Technologies have to be robust in the most challenging of settings, including lack of consistent electricity (popular models include solar powered products or manually operated machines) or portability (which is largely driven by the mobile health movement). They also have to be user-friendly: less invasive, easier to use, and require less training or certification to enable lower skilled healthcare workers to perform a test or administer a treatment. Building and sourcing in ways that bring down the cost of the device is also important. Some designers are utilizing 3-D printing for "lean experimentation" and "quick failures" – rather than conceptualizing a design, putting it to paper, sending it off to a manufacturer, and waiting 1-2 weeks for a prototype, by having a 3-D printer onsite, multiple design iterations can be realized in a day using cheaper materials. Innovators are also finding creative ways to identify lower-cost suppliers or manufacture critical pieces on their own, within India, to bring down the bill of materials.

In addition, across the set of entrepreneurs that we interviewed through this research, certain patterns emerged which could also be seen as opportunities for business to business services or, at the very least, contributions to the ecosystem. Most social entrepreneurs faced the following challenges in growing and scaling their businesses:

• Talent – Some startups are successfully hiring technical talent, but still reported spending considerable time and expense trying to recruit students. It takes a great deal of effort to convince students of the benefits and flexibility of joining a startup rather than pursuing a corporate career. Hiring business experts is even more difficult, as few graduates are willing or able to forgo a corporate salary, even when these companies offer equity to employees. Founding CEOs, who typically come from a medical or engineering background, find that at a certain point, their administrative duties become so overwhelming that the innovation so core to the business begins to suffer. Similarly, many innovations developed through universities or research institutes often have a lack of business resources to bring a product to market, and thus only a handful of innovations ever make it out of the research hub. One such success story exemplifies multi-disciplinary and multi-cultural collaboration: San Francisco based OneBreath, is a portable ventilator developed by Matthew Callaghan, an MD from Stanford's Biodesign program, who brought on board Bangalore-based Vijay Simha, to serve as CEO of the company.

• Distribution – with a nascent private system for healthcare and an opaque public procurement process, entrepreneurs reported challenges in finding distribution challenges. These challenges may subside, however, if increased public funding channeled through patients expands the reach of private chains. Similarly, the on-going changes in the public system may also streamline procurement and open the public health infrastructure as a viable distribution channel.

• Mentoring – There was a universal sense of a shortage of mentors. Impact investors or incubators who are able to crack this, to find champions in the ecosystem, links to highly respected doctors in regions, may find themselves attracting and building more successful social impact start-ups.

• Product Design and Testing – there may be opportunities for business models to emerge around access to product design and testing facilities. Often these require a certain scale to be profitable, the challenge is how to offer small portions of the infrastructure to entrepreneurs as a service model.

In the end, there is no substitute for being "in context" to spur innovation to meet the needs of low income Indians. Take the example of Biosense, a Mumbai-based early-stage company developing low-cost diagnostics. The company was faced with a price constraint – the cost of their kit, and thus the payback period to their customers, depended on the cost of the expensive and imported urine strips that test the albumin to creatinine ratio (an important marker in detecting kidney and cardiovascular diseases). The standard strips used by most labs cost INR 85 per strip. In order to bring the cost of their tests down, the team at Biosense developed their own strip at half of the cost, bringing the cost down to INR 40 per strip. In addition to the cost challenge, during an initial deployment with Wockhardt Foundation for use in their mobile vans, Biosense found that they were receiving multiple complaints about the smell of urine in the van. The kit offered by Biosense contained a cup to receive samples, which would sit open in the van while the test was being conducted. Doctors would avoid conducting tests in order to avoid working all day in a hot van that smells of urine. The team is now working on a solution to the problem, but these types of design challenges would likely not be discovered, or discovered later in development, if the product had been developed overseas where such an issue may not exist.

In fall 2013, Medtronic, a US based leader in medical technologies such as cardiac and diabetes products, announced a partnership with Apollo Hospitals to develop a lower-cost dialysis system that is contextualized to the challenges in India. Medtronic recognized that India is a very large potential market, and they strategically chose a local partner to aid in the development. This is the first time Medtronic has developed a product in India, and is relying on Apollo for clinical insights, as well as establishing their own local R&D team. Typically, dialysis in India occurs at a hospital or a center that specializes in dialysis, but with the emergence of home health care trends that are successfully bringing down the cost of care while improving accessibility, Medtronic saw an opportunity to create a portable device specifically designed for the unique delivery models emerging in India.[9] Other enterprises, large and small, are following suit.

The challenge before us is to accelerate these developments.

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