

A STUDY ON DIGITAL HEALTH INSPIRED BY THOUGHT LEADERS



Report on Joint Marketing Opportunities in DIGITALIZATION OF HEALTHCARE

STUDY COMMISSIONED BY INNOVATIOCURIS AND TARTU BIOTECHNOLOGY PARK

16/09/2020

CONTENTS

Introduction	6
Scope of the Report	7
Why did we choose the three regions for this report?	7
Focus	11
Part I	13
Introduction of Healthcare Ecosystem - Estonia	13
X-road - Estonian e-solution environment	13
Market Size	16
Attracted Investments	17
Research/Academia	19
Part II	20
Competitive Intelligence	20
Part III	27
Expert Profile & Opinion	27
Part IV	29
Summary	29

CHAPTER II

Healthcare Sector in India

Part I	31
Introduction to Healthcare Ecosystem - India	31
Market Size	32
Attracted Investments	33
Government Initiatives	33
National Digital Health Mission (NDHM)	34
Digital Information Security in Healthcare Act (DISHA)	38
e-Sanjeevani	38
Aarogya Setu	38
Regulation of telemedicine in India	38
National Health Stack (NHS) and National eHealth Authority (NeHA)	39
NABH to set Digital Health Standards (NDHS)	39
How Covid-19 may change Indian healthcare for good?	40
Road Ahead	40
Part II	42
Competitive Intelligence	42
Part III	52
Expert Profile & Opinion	52
Part IV	53
Summary	53

CHAPTER III

Healthcare Sector in Australia

Part I	55
Introduction to healthcare ecosystem - Australia	55
Market Size	57
Attracted Investments	57
Government Initiatives	58
Australian Digital Health Agency (ADHA)	58
The (Australian) National Digital Health Strategy	59
Medicare	60
Healthier medicare initiative	60
Researcher Exchange and Development within Industry (REDI) initiative	60
Research Data Infrastructure initiative	60
BioMedTech Horizons initiative	61
My Health Record	61
Prioritising Mental Health	61
National Real Time Prescription Monitoring (RTPM)	61
Electronic Prescribing	61
Australia to Expand Use of and Reimbursement for Telehealth	63
The Melbourne Ecosystem – the first Australian digital health ecosystem	63
Road Ahead	64
Part II	
Competitive Intelligence	65
Part III	71
Expert Profile & Opinion	71
Part IV	72
Summary	72

ANNEX LIST

ANNEX I	74
East-Tallinn Central Hospital	74
Tallinn University of Technology (TalTech)	74
Ministry of Social Affairs	75
Estonian Health Insurance Fund	76
ELIKO Tehnoloogia Arenduskeskus OÜ	78
Clinical Research Centre, Institute of Clinical Medicine, University of Tartu	79
National Centre of Transnational and Clinical Research	80
Tervisetehnoloogiate Arenduskeskus AS (The Competence Centre on Health Technologies, CCHT)	81
ANNEX II	82
Interoperable Electronic Health Records	82
Integrated Disease Surveillance Program (IDSP)	83
Electronic Vaccine Intelligence Network (eVIN)	83
National Health Portal (NHP)	84
Online Registration System (ORS)	84
Mera Aspatal/My Hospital (Patient Feedback System)	84
The National Health Mission (NHM)	84
Ayushman Bharat Yojana	84
ANNEX III	86
Consortium of Accredited Healthcare Organizations (CAHO)	86
Max Healthcare	87
Wadhvani Initiative of Sustainable Healthcare (WISH) Foundation	88
The International Innovation Corps (IIC)	90
National Accreditation Board for Hospitals & Healthcare Providers (NABH)	90
Qure.ai	92
National Health Authority (NHA)	93
ANNEX IV	95
University of Melbourne	95
Curve Tomorrow	97
University of Tasmania	97
Monash University	98
Australia's National Digital Health Initiative (ANDHealth)	100

Introduction

A combination of demographic, market and technology trends is making digital transformation increasingly critical to the future of healthcare.

Great progress is being made in improving health and well-being around the world. Global healthcare trends (Economic cost burden, Ageing population, Increased incidence of chronic disease, unsustainable cost of care, Government policy, regulation and mandates, Empowered consumers and Emerging technology/Scientific triumphs) suggest that digitalization is playing a vital role in delivering future improvements to the world's health at a sustainable cost.

Despite these impressive breakthroughs, it is acknowledged in the healthcare industry that more effort needs to be made to develop new technology and introduce more digital innovation. There are a number of reasons why healthcare has not benefited from digitalization as fully as many other industries like automotive, consumer, electricity, logistics and media. Although data is being captured at an accelerating pace, it has been challenging to standardize that data and promote interoperability. There have also been barriers to sharing data because of privacy regulations, and the sensitivity of the data makes access and sharing even more of a challenge.

The delivery of care is also still critically dependent on the expert labor of highly skilled healthcare professionals. Therefore, the industry's culture and tradition have made automation more difficult.

Although digitalization in healthcare has so far only been incremental, we believe digital transformation has a central role to play in the industry over the next decade. Drawing on the demographic, industry and technology trends outlined in this report, we have tried to identify some of the digital healthcare themes that will underpin the digitization of healthcare.

From the European perspective there are two big drivers for digital health. One is that of preventive healthcare as it seems to be the only way of containing healthcare budgets under control and yet improving the quality of life¹. Preventive healthcare approach requires a variety of digital health tools that can monitor and bring insights to the population which can help them stay fit.

The second aspect is of common data, this need was greatly emphasized during the COVID-19 crisis within Europe as researchers wanted quick and easy access for tackling the pandemic. In the recently concluded Scanbalt Forum Summit a joint declaration for EU common data spaces was initiated and is resonating well with the current German presidency of the EU. As the forum was an official German presidency event². So, as regulators make it easy for cross border collaboration on health data to happen within the EU, it will open up the digital health market within Europe and also enable developers to build more sophisticated artificial intelligence driven tools and make societies more resilient to handle pandemics such as COVID-19.

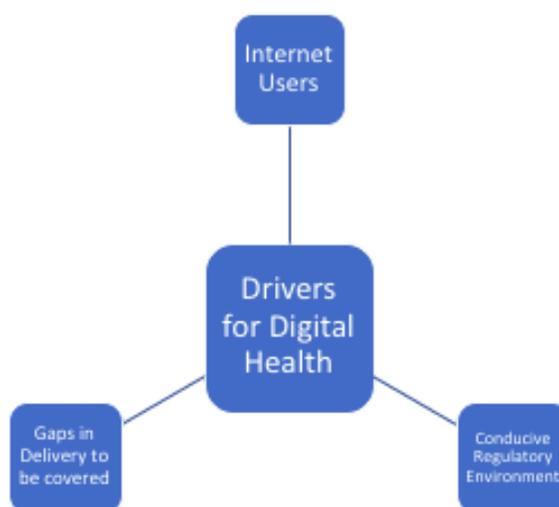
Note: Please note that this report uses the European number formatting

¹ <https://www.nordicinnovation.org/2019/nordic-health-2030-magazine>, accessed 14.09.2020

² <https://scanbalt.org/scanbaltforum2020/>, accessed 14.09.2020

Scope of the Report

Why did we choose the three regions for this report?



We looked at the various regions and chose the three regions Estonia in Europe, Australia and India. Based on the aspects of which market offers a huge upside in form of India, mid size market of Australia which is a good proxy to many other english speaking markets and lastly, Estonia, which is a strong innovator and could be a good market for pilots and co-creation of new services within the EU market.

India represents a very large opportunity in terms of 733,74 M users of the Internet but still with a modest coverage of only 53,66% population but it is growing fast. India is also a low cost market and proxy to many other low cost markets such as African and smaller Asian countries. Hence success in India also opens new markets similar to it. India does not have any strong regulations that are in mature markets like in European Union and USA. Hence would allow more flexibility for new entrants yet organisations from the EU would have a long term advantage as the proposed data protection act of India is aligned with GDPR.

In an effort to facilitate the digitisation of the country's healthcare systems, India released a National Digital Health Blueprint in January 2020, which provides a detailed framework for a "Federated National Health Information System." This has made a case for expanding the scope of the blueprint to include digital therapeutics, digital diagnostics, and telemedicine. The ongoing Covid-19 pandemic has underlined and presented a strong need for action on this.³

Indeed, India has become a force to reckon with in the field of technology. India's healthcare scenario remains less than ideal. It is short by almost half of what the World Health Organization (WHO)

³ <https://www.orfonline.org/research/towards-a-holistic-digital-health-ecosystem-in-india-63993/>, accessed 11.09.2020

recommends as the optimal number of doctors, nurses, medical technicians and healthcare facilities required to serve the population.⁴

Australia is chosen because it can be considered a midsize mature market that offers a good entry point to many other English speaking markets (USA, UK, Canada etc), it has the right gaps in delivery of healthcare where digital can create value and the support structure to attract foreign entities.

Australia's digital health industry has a long history of using innovative communications technology to improve healthcare delivery. Back in 1929, the invention of an affordable pedal-powered radio gave people in isolated areas access to advice and emergency medical services from the newly founded Royal Flying Doctor Service. Continuing to use the latest in medical and communications technology, the Royal Flying Doctor Service is now one of the largest and most comprehensive aeromedical organisations in the world.

Australia has one of the world's best and most efficient healthcare systems, delivering high life expectancy at a low cost. Australia's universal health system is a global benchmark, with Medicare (government health coverage) working together with private health insurance to provide comprehensive healthcare for all Australians.⁵

The Australian Government and private sector organisations are working collaboratively to develop a broad range of innovations across the entire healthcare system. Hospital spending on digital health initiatives also drives industry growth, and Australian companies are leading innovators in electronic information sharing, connecting general practice and specialised physicians, community, mental health and aged care providers⁶

Estonia on the other hand is very small but very advanced in e-governance and considered a strong innovator in Europe. Many of the building blocks of Estonian IT architecture are now being adopted EU wide from digital signature to X-Road infrastructure with Finland. Hence, Estonia might be a good pilot country for a digital health startup as it is very small but influential in the e-health space.

According to the "Estonian Research and Development Activity and Innovation Strategy for 2014-2020" and the "Estonian Entrepreneurship Growth Strategy 2014-2020" the first priority of preparing local workforce, are the areas with the highest growth potential in the Estonian economy – which are the horizontal application of Information and Communications Technology through other sectors, health care technologies and services, also the more effective use of resources⁷.

According to research in 2016-2018, about ¼ of Estonian enterprises were innovative - working out on the period a good or service that was different by at least one characteristic from the ones that are already on the market. But it was found that most of the enterprises involved in innovation were amending

⁴ https://www.orfonline.org/research/towards-a-holistic-digital-health-ecosystem-in-india-63993/#_edn1, accessed 11.09.2020

⁵ Department of Health and Ageing. Strategic Review of Health and Medical Research in Australia – Better Health Through Research. ISBN: 978- 0-9872039-5-3. Commonwealth of Australia 2013, accessed 11.09.2020

⁶ [Digital Health industry overview Austrade](#), accessed 10.09.2020

⁷ https://www.hm.ee/sites/default/files/estonian_lifelong_strategy.pdf, accessed 21.08.2020

products that were already on the market. So on most cases the activity of enterprises was more like imitation of innovation⁸.

Some of the key aspects of three markets are given in the table below:

Parameters	India	Australia	Estonia
Internet Users / Population Coverage ⁹	733,74 M / 53,66%	24,45 M / 86,54%	1,15 M / 88,1%
Access to Healthcare	Rural Urban Divide is high, Country is large	Rural Urban Divide is high, Country is large	Country is relatively large but access is good
Population Density ¹⁰	420/km2	3/km2	29/km2
Conducive Regulatory Environment	COVID-19 created new opportunities	Yes	Very high
Other important factor	One of the largest market for digital health intervention which will grow further	Part of commonwealth nations, Free Trade Agreements give access to many other regions	Very advanced users. Good for innovation testing

⁸ <https://blog.stat.ee/2020/05/25/eesti-ettevotetest-ligi-kolmveerand-on-innovaatilised/>, accessed 21.08.2020

⁹ https://en.wikipedia.org/wiki/List_of_countries_by_number_of_Internet_users, accessed 11.09.2020

¹⁰ <https://worldpopulationreview.com/country-rankings/countries-by-density>, accessed 11.09.2020

Country Context: Estonia



Population (000s)	1.287	Life expectancy at birth (years)	77
GNI per capita (PPP US \$)	24.230	Total health expenditure (%GDP)	5,7
Physician density (per 1000 population)	3,24	ICT development Index rank (2017) ¹¹	17
Nurse and midwife density per 1000 population	6,38	Mobile-cellular subscription (per 100 people) ¹²	147
Hospital bed density (per 10 000 population)	54	Internet users (% population)	88,10

Country Context: India



Population (000s) ¹³	1.380.004	Life expectancy at birth (years) ¹⁴ (2018)	69,4
GNI per capita (PPP US \$) ¹⁵	6960	Total health expenditure (%GDP) ¹⁶	1,28
Physician density (per 10 000 population) ¹⁷	3,8	ICT development Index rank (2017) ¹⁸	134
Nurse and midwife density per 10 000 population ¹⁹	20,6	Mobile-cellular subscription (per 100 people) ²⁰	86,94
Hospital bed density (per 10 000 population)		Internet users (% population) ²¹	53,66

¹¹ <https://www.itu.int/net4/ITU-D/idi/2017/index.html> accessed 12.09.2020

¹² <https://data.worldbank.org/indicator/IT.CEL.SETS.P2?end=2019&locations=EE&start=1991&view=chart> accessed 12.09.2020

¹³

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwilmpbMp-PrAhWNbisKHUJMAAsQFjACegQIDBAE&url=https%3A%2F%2Fwww.worldometers.info%2Fworld-population%2FIndia-population%2F&usq=AOvVaw2ziWeCvQWsvMlz_YjEeE6U accessed 12.09.2020

¹⁴ <https://data.worldbank.org/indicator/SP.DYN.LE00.IN?locations=IN> accessed 12.09.2020

¹⁵ <https://tradingeconomics.com/india/gni-per-capita-ppp-us-dollar-wb-data.html>, accessed 12.09.2020

¹⁶ <https://www.statista.com/statistics/684924/india-public-health-expenditure/>, accessed 12.09.2020

¹⁷

<https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwj9x9-6n-PrAhWYX SsKHV6iC-oQFjACegQICxAE&url=http%3A%2F%2Fdocuments.worldbank.org%2Fcurated%2Fen%2F928481468284348996%2Fpdf%2F702410BRI0P1020k0Final000Vol010no03.pdf&usq=AOvVaw3ty2ziKqFBiBseKecuRvux>, accessed 12.09.2020

¹⁸ <https://www.itu.int/net4/ITU-D/idi/2017/index.html> accessed 12.09.2020

¹⁹

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjobe_oOPrAhXZbX0KHfmrBC8QFjACegQICxAF&url=https%3A%2F%2Fwww.ncbi.nlm.nih.gov%2Fpmc%2Farticles%2FPMC6549895%2F&usq=AOvVaw10JfnhN7wifsyY6GDqgtha accessed 12.09.2020

²⁰ <https://data.worldbank.org/indicator/IT.CEL.SETS.P2> accessed 12.09.2020

²¹ https://en.wikipedia.org/wiki/List_of_countries_by_number_of_Internet_users accesses 12.09.2020

Country Context: Australia



Population (000s)	23.343	Life expectancy at birth (years)	83
GNI per capita (PPP US \$)	42.540	Total health expenditure (%GDP)	9,4
Physician density per 1000 population	3,27	ICT development Index rank (2017) ²²	14
Nurse and midwife density per 1000 population	10,65	Mobile-cellular subscription (per 100 people) ²³	111
Hospital bed density per 10 000 population	38	Internet users (% population)	86,54

Focus

This report provides an overview of the economic activities and related market opportunities in digitalization in healthcare in Estonia, India and Australia.

The report has taken a horizontal view point especially from the delivery of healthcare perspective instead of focusing on one particular aspect of the health sector such as Pharma, Biotech, Medtech or Hospital IT for example. As digital technology in itself is a horizontal intervention and the adoption of it is more about the attitude of users and beneficiaries than the business rationale alone. As COVID-19 has accelerated the change and provided a conducive environment where digital is no more an alternative but the only option in most professions for organising business activities.

The report covers the market size, attracted investments, government/ policy initiatives, important business landscape (road ahead) information based on the desk research, expert opinions through in person interviews of cluster and research organizations throwing light on important aspects of policy and business landscape.

The report also lists in tabular form a list of interesting organisations and startups relevant for the digital health topic.

Economic activities, companies, research organizations and universities are taken into account for the analysis of the ecosystem.

²² <https://www.itu.int/net4/ITU-D/idi/2017/index.html> accessed 12.09.2020

²³

<https://data.worldbank.org/indicator/IT.CEL.SETS.P2?end=2019&locations=EE-AU&start=1991&view=chart> accessed 12.09.2020

Chapter I

Healthcare Sector in Estonia

Part I

Introduction of Healthcare Ecosystem - Estonia

Estonia has a collaborative healthcare cluster spanning government, academia, competence centres, production and IT companies.

A pioneer in e-health for 25 years, today over 95% of data generated by hospitals and doctors is digitised. A person's unified health record and x-rays are available on-demand throughout Estonia, allowing health professionals to make informed decisions. Blockchain technology assures system integrity while patients access their data and prescriptions using Estonia's secure e-ID solutions²⁴.

Estonia consistently ranks as a world leader in human capital, digital capability, and ease of doing business. From 2019 Estonia is considered a strong innovator in Europe²⁵. This creates a competitive environment which allows solutions and services to be researched, developed and delivered globally. As a result of its two-decade commitment to IT, Estonia is the world's most advanced digital society and recognised leader in digital skills, infrastructure and legislation.

Estonia has unique capabilities in the research, development and application of software, high-tech systems, digital identity technologies and telecommunications. Estonian companies lead the world in blockchain, connected networks, and cleantech, and are at the cutting edge of IOT, big data, automation and real-time computing.

Estonia boasts a full digital ecosystem, world class cyber-security, and soon-to-be 5G infrastructure.

Through the application of medtech and e-health solutions²⁶ Estonia aims to lead the world in societal wellbeing and the efficient use of resources²⁷.

Patient records in Estonia are digitised and secured by the Blockchain, providing a single immutable data source for healthcare professionals. With a unique digital platform and collaborative ecosystem, Estonia is positioned to lead on preventative medicine, patient self-treatment and industry efficiency²⁸.

X-road - Estonian e-solution environment

X-Road® software based solution X-tee is the backbone of e-Estonia. It allows the nation's various public and private sector e-service information systems to link up and function in harmony.

²⁴ <https://investinestonia.com/business-opportunities/cyber-security/>, accessed 24.08.2020

²⁵ <https://ec.europa.eu/growth/sites/growth/files/ris2019.pdf>, accessed 24.08.2020

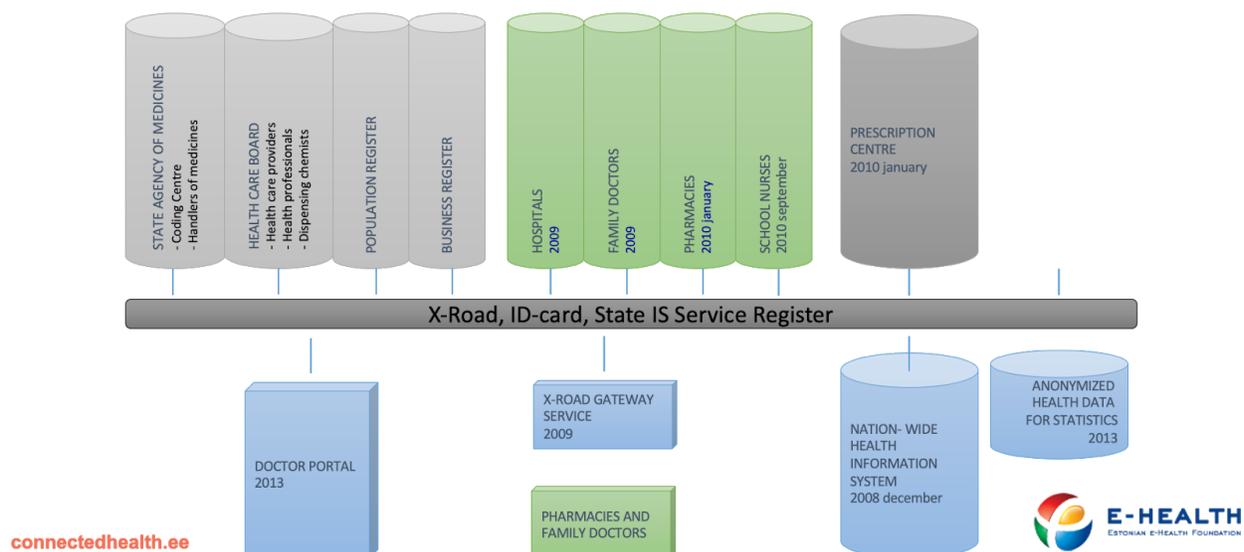
²⁶ <https://e-estonia.com/>, accessed 24.08.2020

²⁷ <https://investinestonia.com/business-opportunities/e-health/#healthcare>, accessed 24.08.2020

²⁸ <https://investinestonia.com/business-opportunities/e-health/>, accessed 24.08.2020

Estonia's e-solution environment includes a full range of services for the general public, and since each service has its own information system they all use X-tee. To ensure secure transfers, all outgoing data is digitally signed and encrypted, and all incoming data is authenticated and logged.

eHealth architecture



It connects different information systems that may include a variety of services. It has developed into a tool that can also write to multiple information systems, transmit large data sets and perform searches across several information systems simultaneously. X-Road® software based Estonian environment X-tee was designed so it can be scaled up as new e-services and new platforms come online.

Today, it is implemented in Finland, Kyrgyzstan, Faroe Islands, Iceland, Japan and other countries. Similar technology that is based on the Estonian interoperability experiences has also been implemented in Ukraine and Namibia.

Two X-Road® ecosystems can be also joined together, federated as a one to one relationship between two ecosystems. Members of the federated ecosystems can publish and consume services with each other as if they were members of the same ecosystem. Federation enables easy and secure cross-border data exchange between these ecosystems.²⁹

Estonia and Finland are the first two nations in Europe to develop a joint data exchange platform based on Estonia's X-Road in 2018, which allows databases in both countries to interface, assist with cross-border services, and make e-services accessible to Estonian and Finnish citizens.³⁰

²⁹ <https://e-estonia.com/solutions/interoperability-services/x-road/>, accessed 14.09.2020

³⁰ <https://e-estonia.com/x-road-between-finland-and-estonia/>, accessed 24.08.2020

According to Estonian Ministry of Social affairs there are changes planned to involve more private enterprises to development of healthcare (read more from expert opinion Annex I).

Major players supporting the field or working on the field of digitalisation in healthcare:

Connected Health Cluster, founded by the [Science Park Tehnopol](#), is a country-wide partnership between health-related stakeholders in Estonia, who are committed to accelerating the adoption of connected health solutions, on an international scale and on commercial terms³¹.

Science Park Tehnopol is a research and business campus helping to develop startups and SMEs more quickly. Tehnopol Startup Incubator helps technology-based startups to develop their business and get investments.³²

Tartu Health Cluster, founded by Tartu Biotechnology Park, is for life science and biotechnology companies and other stakeholders on Tartu City, Southern-Estonian and Estonian level, alleviating the Estonian biotechnology sector bottlenecks by connecting local industry with potential partners abroad through our network, helping local companies thrive through providing access to conferences, trade fairs and exhibitions and providing joint marketing for Estonian companies in events and webinars³³.

Tartu Biotechnology Park provides physical infrastructure as well as business development and consultancy services to companies and R&D institutions in the fields of biotechnology, medicine and veterinary medicine³⁴.

Medicine Estonia Cluster joins medical institutions interested in export of medicine by attracting patients from abroad³⁵.

Health Founders is a vertical health technology accelerator in the Baltics. Helping exceptional founders develop breakthrough ideas into sustainable business models.³⁶

Roles of governmental institutions in digitalisation of Estonian healthcare:

The Ministry of Social Affairs plans the health care policy and organises its implementation. The objective of the Ministry of Social Affairs, together with relevant institutions, is to ensure the following through health policy:

- the availability, quality, and safety of health care;
- the awareness of and satisfaction with health services among residents.³⁷

TEHIK (Centre for Health and Welfare Information Systems) is a competence centre of information and communication technologies in healthcare, social protection and social work fields³⁸.

³¹ <https://www.connectedhealth.ee/>, accessed 24.08.2020

³² <https://www.tehnopol.ee/en/startup-incubator/>, accessed 24.08.2020

³³ <https://biopark.ee/tartu-biotechnology-cluster?lang=en>, accessed 24.08.2020

³⁴ <https://biopark.ee/?lang=en>, accessed 24.08.2020

³⁵ <https://biopark.ee/?lang=en>, accessed 24.08.2020

³⁶ <https://healthfounders.ee/>, accessed 14.09.2020

³⁷ <https://www.sm.ee/en/e-health>, accessed 26.08.2020

³⁸ <https://www.tehik.ee/>, accessed 26.08.2020

Information System Authority enables and secures all the e-solutions³⁹.

The Health Insurance Fund's main task is to organize national health insurance to provide insured people with access to necessary healthcare services, medicines, medical equipment and cash benefits⁴⁰.

The National Institute for Health Development is a government established research and development body collecting, connecting and providing reliable national information from a multitude of sources, related to the health of the Estonian population⁴¹.

Market Size

Estonia is a low spender on health and the level of health expenditure as a share of gross domestic product (GDP) in Estonia has been consistently among the lowest in the region. The Estonian health care system is mainly publicly funded through solidarity-based mandatory health insurance contributions in the form of an earmarked social payroll tax, which accounts for about two thirds of total health care expenditure. Private expenditure constitutes approximately one quarter of all health expenditure, mostly in the form of co-payments for medicines and dental care.

Estonia's healthcare expenses were in 2018 to total €1,74 billion or 6,7% of GDP, growing 14,5 percent in year to year. The growth was the result of the Estonian government's 2017 historic step of expanding the revenue base of the health system, which has been a longstanding challenge⁴².

Public sector expenses, including the Estonian Health Insurance Fund, central government and local governments, grew by 13% in 2018 from the previous year to €1,1 billion, while people's personal spending on healthcare increased 19 percent. Household expenditures grew more quickly than public sector spending, although the public sector's contribution to the absolute growth of healthcare expenses was greater. The public sector's share in healthcare spending increased to €147 million this year; household spending, meanwhile, grew to €68 million⁴³.

³⁹ https://www.ria.ee/sites/default/files/content-editors/ria_aastaraamat_2020_48lk_eng.pdf, accessed 24.08.2020

⁴⁰ <https://www.haigekassa.ee/en>, accessed 26.08.2020

⁴¹ <https://www.tai.ee/en/>, accessed 26.08.2020

⁴² https://www.sm.ee/sites/default/files/content-editors/Tervishoid/hit_-_estonia_-_web_version_01.06.2018.pdf, accessed 14.09.2020

⁴³ <https://www.tai.ee/et/terviseandmed/tervisestatistika-ja-uuringute-andmebaas/uuendused/4610-tervishoiusektori-majandustulemused-paranesid>, accessed 07.09.2020

Attracted Investments

Latest investments to Estonian IT companies that support the digital healthcare sector development:

Viveo Health, telemedicine start-up for fast healthcare service (2.000.000€ capital raised in 2020)⁴⁴.

Transformative AI, the predictive patient monitoring software allows healthcare providers to respond to life-threatening medical events before they occur (1.445.000€ capital raised in 2020)⁴⁵.

TBD-Biodiscovery, biotechnology company, which already produces 90% of the active pharmaceutical ingredients, used in medicines that mitigate travel discomfort of pet animals (4.500.000€ capital raised in 2019)⁴⁶.

Veriff Identity, fast identity verification. Veriff collects more data points than any other identity verification provider. While users submit their verification data, machine learning technology is used to collect additional technical inputs without adding any extra steps⁴⁷. (14.000.000€ capital raised in 2020)⁴⁸.

Elisa UP - over 100 ongoing partnerships with startups in different fields including well-being and health tracking devices⁴⁹.

Public funding has been awarded to:

DocuMental, 2016, a mental health digital decision support system, EIT Health, Connected Health Cluster, EU PEARL/ IMI. Total 375.000€.

Government has invested in several healthcare digitalisation applications in recent years.

- 1) Digital reception - Estonian patients can use e-booking for the appointment with medical doctors
- 2) e-consultations between a patient and medical doctor. This service enables family physicians to quickly and conveniently consult with a specialist to clarify their patient's diagnosis and prescribe treatment. In the beginning years, EHIF funded the e-consultation service only in the specialties of Urology and Endocrinology, but over the years the use of the service has increased among family physicians and several dozen new specialties have been added to the service⁵⁰.
- 3) "HOIA" corona app for quickly finding out about possible close contact with a COVID-19 infected person, allowing you to take steps to protect the health of your own and other people⁵¹.

⁴⁴ <https://www.aripaev.ee/uudised/2020/03/12/hanschmidt-ja-anderson-panid-panuse-kaugmeditsiinile>, accessed 07.09.2020

⁴⁵ <https://www.tera.vc/news/tera-ventures-invests-in-transformative-ai/>, accessed 07.09.2020

⁴⁶ <https://biodiscovery.eu/tartu-biotechnology-company-receives-a-4-5-million-euro-investment/>, accessed 07.09.2020

⁴⁷ <https://www.veriff.com/>, accessed 07.09.2020

⁴⁸ <https://www.veriff.com/news/veriff-closes-15.5-million-usd-financing-round>, accessed 07.09.2020

⁴⁹ <https://up.elisa.com/>, accessed 07.09.2020

⁵⁰ <https://www.haigekassa.ee/en/uudised/increasing-number-family-physicians-use-e-consultation>,

⁵¹ <https://hoia.me/en/>

- 4) Larger hospitals have invested in their health information system telemedicine options.⁵²
- 5) The Estonian state supports the continuation of the Genome project in 2019 with EUR 2.3 million. In addition, EUR 5 million from the European Regional Development Fund will be invested in 2019-2022 in order to link genetic data to the health information system so that the doctor will also be able to take the personal genetic information of the individual into account when assessing the patient's health risks.⁵³
- 6) Applied research in smart specialisation growth areas: NUTIKAS (from 2015 to 2020)

The support aims to contribute to growth in the research-intensity of the Estonian economy, supporting collaboration between R&D institutions and companies. Furthermore, the support will help to raise the capabilities of R&D institutions to carry out applied research needed for business in smart specialisation growth areas.

Smart specialisation growth areas are fields of activity where the companies should have above-average development opportunities and where the allocation of resources to R&D would enable them to achieve a competitive advantage. The current R&D&I strategy 'Knowledge-based Estonia' sets out three growth areas:

- information and communication technologies (ICT) related to other areas of economy (e. g. cybersecurity, software development or the use of ICT for automating industrial processes);
- health technologies and services (e. g. the use of biotechnology or IT for the development of medical services or products);
- more effective use of resources (valuation of resources) (e. g. materials science and/or industry, innovative construction options, more effective utilisation of oil shale in the chemical industry).⁵⁴

EU investments

Enterprise Estonia is supporting the innovation of enterprises with different measures. They offer various grants for enterprises, consultation services and practical training courses and workshops by the top people of their field are provided, incl export advisers who also help to reach foreign markets⁵⁵. One of the measures is supporting Research and Innovation Centers that are research partners to enterprises.

OÜ Eliko Tehnoloogia Arenduskeskus launched an Internet of Things (IoT) driven industrial R&D program, to ensure that companies invest in future-proof technologies in the IoT. Projects under the first area, sensing and signal processing in the IoT, develop algorithms suitable for compact and energy efficient electronic devices. Better energy efficiency is essential for future connected applications.

In the second focus area, Eliko designs software and communication solutions that simplify data transmission in the IoT environment. IoT infrastructures, applications and services combine complex sets of technologies to deliver end-user applications for smart cities, smart factories and the smart home.

⁵² <https://www.itk.ee/patsiendile/vastuvotu-info>

⁵³

<https://www.sm.ee/en/news/genome-project-100000-samples-collected-2019-least-50000-more-people-can-join>, accessed 16.09.2020

⁵⁴ <https://www.etag.ee/en/funding/applied-research-funding/23917-2/>, accessed 16.09.2020

⁵⁵ <https://www.eas.ee/teenused/?lang=en>, accessed 28.08.2020

The program includes 22 industry-led R&D projects in a range of fields. The Competence Centre Project is financed by the European Regional Development Fund with 6.996.700 euros⁵⁶. The funding is 50-60% of the project cost, depending on the size of the enterprise .

The Competence Centre for Health Technologies (Tervisetehnoloogiate arenduskeskus AS) is a biotechnology company focused on research and product development in personal medicine, drug development and both human and veterinary reproductive medicine. They collaborate closely with leading Estonian scientists, universities and biotechnology companies as well as scientific, medical and R&D institutions from Europe, Asia and America⁵⁷. The funding comes from different EU projects and partly through Enterprise Estonia.

Research/Academia

Estonia has altogether 26 educational institutions offering higher education.

The leading university with a highest reputation offering master and degree programmes focused on healthcare is the **University of Tartu**. Several masters programmes are provided by **Tartu Health Care College** and **Tallinn Health Care College**. Various courses related to digitalisation of healthcare are provided by some other universities like **Tallinn University** and **Tallinn University of Technology**.

Next to the universities several research institutions are established. **University of Tartu Institute of Genomics** gathers - Estonian Biocentre, Estonian Genome Centre and Core Facility. The University of Tartu, Institute of Genomics Core Facility is dedicated to providing genotyping and sequencing services to researchers, clinicians and others with the state-of-the-art technology of Illumina.

Estonian Biobank is a population-based biobank of the Estonian Genome Center at the University of Tartu. The cohort size is currently 200.000 gene donors (≥ 18 years of age), which closely reflects the age, sex and geographical distribution of the Estonian population.⁵⁸

Also, the **Institute of Clinical Medicine** is created at the University of Tartu.

The main task of the institute is to conduct teaching, research and development activities in its disciplines and related disciplines. Most of the clinical subjects of the Medicine programme are taught at the Institute of Clinical Medicine. The institute is the main coordinator of the residency (postgraduate specialist medical) training, the clinical medicine doctoral (PhD) studies and the doctors' continuing education at the University of Tartu and in Estonia. Most of the academic staff are clinicians, who hold different positions at the Tartu University Hospital.⁵⁹

Research and development units are found in all biggest hospitals in Estonia.

The North Estonia Medical Centre is one of the top healthcare providers in the country. Research and Development department gives opportunity to organise science, training and development activities⁶⁰.

⁵⁶ <https://www.eliko.ee/competence-centre-program/>, accessed 27.08.2020

⁵⁷ <https://ccht.ee/home/>, accessed 27.08.2020

⁵⁸ <https://genomics.ut.ee/en/about-us/estonian-genome-centre>, accessed 27.08.2020

⁵⁹ <https://kliinilinemeditiin.ut.ee/en>, accessed 12.09.2020

⁶⁰ <https://www.regionaalhaigla.ee/et/teadus-ja-arendustegevus>, accessed 27.08.2020

Part II

Competitive Intelligence

In this chapter all companies that develop products or services for the digitalization of healthcare market are considered. To enable further analysis and because the list of companies is quite long additional sub-categories have been defined.

List of companies by sub-categories.

For this overview we only consider those companies that have a significant part of their turnover in healthcare or at least consider this as an important growth segment.

Category - Digital Healthcare Devices

S.No.	Name	Location	Founding Year	Website	Contribution
1	TempID	Tallinn	2016	https://tempid.ee/	TempID is a disposable or reusable smart-patch and mobile app solution that measures and records body temperature.
2	Dermtest	Tallinn	2013	https://www.dermtest.ee/	Telemedicine to check the birthmarks by taking a photo of the birthmark with a special camera and forwarding the information to the dermatologist.
3	Clinic4U oü	Tallinn	2016	https://www.astrakliinik.ee	Digital surveillance device for Sklerosis multiplex patients, telemedicine
4	Optofluid Technologies	Tallinn	2012	https://optofluidtech.com/	Real-time and on-line dialysis quality monitoring. Technology is based on years of intensive research & development in the field of biofluid optics
5	Hygify	Tallinn	2018	https://www.f6s.com/hygify	Automated hand washing training stations for improving awareness and skills to proper hand hygiene.
6	SignLang		2018	http://signlang.io/	SignLang is an automated sign language retranslator using the schemes 'gesture-text-voice' and 'voice-text-gesture' based on DeepSign technology. The weight of the product is due to total lack of services for automated direct communication between and feedback from deaf mute users.

Category - e-Pharmacy

S.No.	Name	Location	Founding year	Website	Contribution
1	MinuDoc OÜ	Tallinn	2018	https://www.minudoc.ee/	Telemedicine and solution for prolonging prescriptions.
2	MediKeep	Tallinn	2015	http://www.medikeep.ee/	MediKeep is aiming to become DNA based health & wellness empowerment tool in the era of artificial intelligence.

Category – Diagnostics

S.No.	Name	Location	Founding year	Website	Contribution
1	DocuMental	Tallinn	2016	https://documental.ee/	A clinical decision support system (CDSS) DocuMental (www.documental.ee) provides the highest international standards for assessment and management of mental disorders and integrates indicators for quality and outcomes tracking in mental health services. In particular, it has 1) diagnostic module: consists of digitized, structured and 'tick mark' choice ICD-10 diagnostic criteria for all mental disorders; 2) treatment module: consists of the whole list of registered in the EU psychotropic medications with their doses and regime; 3) history and routine assessment modules contributing to standardized and digitizing clinical workflows.
2	Transformative AI OÜ	Tallinn	2016	http://transformative.ai/	PREDICTIVE AI for PATIENT MONITORING. Their predictive patient monitoring software allows healthcare providers to respond to life-threatening medical events before they occur.
3	Vementis Group	Tallinn	2013	http://vementis.com/	1) PVmonitoring.net is an All-In-One solution for pharmaceutical companies who operate within the sphere of pharmacovigilance – searching for adverse drug reactions (ADR) reported in specialized medical and pharmaceutical printed media. 2) Screener for Drug Safety Perfect solution for identifying, tracking, evaluating and reporting of found adverse events for Drug Safety

4	Haut.AI	Tallinn	2018	https://haut.ai/	AI-powered SaaS platform for skincare and pharma companies. Platform allows to collect, store, manage and analyse skincare and skin health-related data using computer vision and machine learning algorithms.
5	Labtowellness OÜ	Tallinn	2011	https://www.labtowellness.com/	We transform your existing laboratory reports, health checkup reports into patient friendly format or design completely new patient reports for your services. After setup reports will be delivered just in seconds via our secure platform or integration with your existing IT-system
6	IPDx Diagnostics	Tallinn	2017	http://www.ipdx.eu/	Using biomarkers to detect disease earlier and guide treatment decisions. Our core technology Mimotope Variation analysis (MVA) combines random peptide phage display library screening, next-generation sequencing, and big data analytics to decode antibody signatures.
7	Sensoramo OÜ	Tallinn	2018	http://www.sensoramo.com/	A health telemetry with advanced transducers and biometric sensors capable of doing automated monitoring of vital signs and basic diagnostics based on Artificial Intelligence (AI). 2) A health telemetry with optical, acoustic and radio transmitters and receivers integrated into environment as Internet of Things (IoT) devices in the Smart City system. 3) A preventive maintenance system to predict failure of industrial equipment and consumer products based on Wireless Network of advanced low-power Sensors (WNS) and Artificial Intelligence (AI).
8	Diagnostic Match OÜ	Tallinn	2017	http://www.diagnosticmatch.com/	Decision support platform to help general practitioners to detect hidden HIV+ patients with indicator diseases to achieve targeted HIV testing.
9	Talkie	Tallinn	2018	https://evaai.io/	AI powered digital therapy platform
10	LEIA	Tallinn	2018	https://healthcodeai.com/	To help physicians we have developed Leia - AI physician Leia is the most efficient "co-pilot" that any physician could have. Through pre-evaluation, preparation of disease overview and hypothesis of diagnoses, Leia frees time for physicians

11	Rapid Bio-Labs	Tallinn	2019	https://rapidbiolabs.com/	<p>The Machine Learning technologies delivered by Rapid Biolabs provide a quick, cost-effective and accessible software solution to researchers and medical institutions for cell counting. Applying image processing practices, microscopy cell images are processed, classified and calculated, with transparent results that reveal the level of accuracy per sample.</p> <p>The data used to train our models are acquired through conventions with educational institutions which ensures a high level of accuracy and guarantees fast results at accessible prices.</p>
----	----------------	---------	------	---	---

Category- Healthcare Information System (HIS)/Electronic Medical Records (EMR)/Electronic Health Record (EHR)

S.No.	Name	Location	Founding year	Website	Contribution
1	SA Geenikeskus	Tartu	1999	www.genomics.ee	Research of using DNA in different fields
2	Ridango AS	Tallinn	2009	https://masc-global.com/	Medical supply data MASC is gathering demand data, connecting demand with trustworthy supply, and distributing scarce resources equitably. MASC Gov solution went live in Estonia in April 2020, and is today used by the Health Board, the Ministry of Social Affairs, the Ministry of Finance, and around 300 public sector institutions in Estonia (including all hospitals).
3	STACC OÜ	Tartu	2009	https://www.stacc.ee/solutions/personalized-medicine/	STACC is developing a variety of solutions based on data science and machine learning, which contribute towards preventive, predictive and participatory health system. Contact us and let's discuss opportunities in the field of personalized medicine.
4	Cognuse	Tallinn	2010	http://cognuse.com/	Cognuse offers software solutions for critical disease management and rehabilitation. The solutions are targeted both for the clinical staff and patients. Core values reinforcing their innovative products include integrity, demonstration of constant care, and

					<p>productivity. Striveing to design highly integrative digital tools to help guide clients through the recovery process from start to finish.</p> <p>Applications - Patient Intensive Care Unit dashboard, incl patient and caregiver educational center,therapy exercises etc</p>
5	Guardtime	Tallinn	2006	https://guardtime.com/health	Solving healthcare challenges with blockchain. Guardtime HSX APIs provide easy to use APIs for building distributed, secure and compliant health-care applications.
6	Helmes AS	Tallinn	1998	https://www.helmes.com/	International custom software development company, with clients across the world. Eg e-prescription, custom healthcare software and self-service solutions in Estonia's foremost hospital.
7	Nortal AS	Tallinn	1998	https://nortal.com/	Nortal combines a strategic approach and data-driven technology in order to simplify and optimize processes for governments, business and healthcare. We are an end-to-end service provider in selected segments where we promise and deliver meaningful impact.has been implementing large-scale projects in the medical field for more than 15 years, leveraging innovation in areas such as secure data exchange, electronic ID, analytics and privacy. Have successfully exported their experience to many countries.
8	Kodality	Tallinn	2017	https://www.kodality.com/	Currently are developing HEDA (Health Enterprise Data and Applications), which is a modern web-based hospital information system (HIS) designed to make healthcare services smooth and quick.Their open-source FHIR Server has proven itself as a stable and reliable interoperability platform. Team has developed FHIR-based HIS, NHS (National Health Services) and e-Prescription solutions for different regions and countries.
9	EGeen AS	Tartu	2001	http://www.egeeninc.com/	EGeen's business focus is to conduct drug development via expeditious and cost-effective clinical trials by taking advantage of several unique assets built. Part of EGeen Inc (US).

10	Healthcard	Tallinn	2013	https://www.projecthealthcard.com/	Healthcard automates health wellness processes through simplifying and understanding health data. We make processes more effective by involving users via taking care of their health wellness. Data collected from end-users through multiple sources (including smartwatches, immunisation records etc) Healthcard analyses complex individual data sets. Information is combined, analysed and interpreted Easy-to-read, visual and live reporting. Clear/ helpful tips and trends based on the user's lifestyle and health Information based decision making for organisations. Automated, reliable, GDPR-compliant data collection and analytics
----	------------	---------	------	---	---

Category- Telemedicine

S.No.	Name	Location	Founding year	Website	Contribution
1	MinuDoc OÜ	Tallinn	2018	https://www.minudoc.ee/	Application for telemedicine
2	Viveo Health Insurance Agency OÜ	Tallinn	2017	https://viveohealth.ee/	Full telemedicine solution from e-consultation of doctor and specialised doctor to visiting specialists in real life fast.
3	Tervise teejuht OÜ (HeBA Kliinik)	Tallinn	2019	https://heba.ee/hebadigital/	Data and AI driven employee health risk management
4	Perearsti Nõuandeliin OÜ (1220 kiirliin)	Tallinn	2004	https://www.haigekassa.ee/1220	Medical advice on the situations when family physicians are not reachable
5	Abtram29 OÜ	Tallinn			Develop and implement citizen centred health and healthcare applications based on innovative secure data exchange methods, intuitive user interface design and open enterprise architecture.
6	MiaMed OÜ (CallMidWife)	Tallinn	2014	https://callmidwife.com/et/	Midwife advice through calls and telemedicine

7	Triumpf Research OÜ		2018	http://triumf.health/	Combining a scientific approach with machine learning & an engaging game design for personalized care
8	Antegenes OÜ	Tartu	2018	www.antegenes.com	Antegenes offers advanced genetic tests for assessing the risk of breast, prostate, colorectal cancer and melanoma. Online genetic video consultation.
9	Velmio OÜ	Tallinn	2019	https://www.velmio.com/	mHealth system that builds a complete digital health profile of the individual to reduce the risk of adverse health outcomes We have built a series of advanced mathematical and AI-driven technologies to create a seamless bridge connecting digital health records, wearable data and telemedicine
10	Migrevention OÜ	Tallinn	2020	https://migrevention.com/	Multidisciplinary digital treatment platform for headache patients and specialists Multimodal treatment by practitioners from different disciplines - neurologist, nurse, clinical psychologist, physiotherapist Treatment is available at all times (between visits; video consultations; distance treatment and monitoring) Digital tools for specialists to reduce work time and assess patients' condition

Part III

Expert Profile & Opinion

The chapter is summary from the interviewed experts' opinions. According to specialists interviewed the market will continuously grow in different areas.

It was brought out that Estonian e-health is among leading countries globally with a number of advanced e-health applications like e-prescription, e-consultation, e-health records in hospitals and digital health history of patients. Estonia has 4 major health databases on which are based different services - Estonian nation-wide Health Information System, Estonian Health Insurance Fund's database, Estonian Bank of Healthcare Images and Estonian Genome Bank. Estonian Genome Bank has restricted access through individual request by the participants, but the other three are accessible by health professionals. The government is in the process to develop a platform for managing informed consent by data subjects that can digitally give consent on their health to secondary data users incl. private companies.

Nevertheless there are some challenges in Estonian healthcare digitalisation that experts pointed out.

Data Usage and Management

Data is kept in different databases and the interactions between those databases is not always sufficient and reliable. There is a lot of information gathered in the healthcare sector, but this information needs further analysis in the next periods to make the most use of them.

Digitalisation needs investments and optimizing the costs is a common driver of using innovative technology. Although there are financial measures that enable innovation, the high technological solutions remain often too expensive.

Innovational technological possibilities are not known widely, so the decision makers don't know what are the most recent technological possibilities.

Small Market

Estonia is rather small, so we always need to see how we can go abroad with different solutions that we create. However, due to the dynamic environment Estonia is suitable for piloting and co-creation.

Public and Private Sector Cooperation in Digitisation of Healthcare

The government is working on development of an infrastructure for cooperation projects- like sandboxes e.g. so that enterprises could come and test their products on data from various datasets (genomic, health, clinical) in Estonia.

Recent Developments:

COVID – 19 has speed up innovation and different solutions that enable social distancing. In the beginning of the Corona crisis the Estonian Health Insurance Fund reacted in days and started promptly

to remunerate teleconsultations.⁶¹ This measure prevented that regular treatment would have been paused and kept away the infection in risk groups and medical personnel. It was possible as the plan to use virtual consultation, but due to the crisis, the application was used earlier and more actively than planned. Teleconsultations were very well received by patients and medical professionals and 2/3 of all doctor's appointments were done remotely.

Another example is the "HOIA" app for anonymous detecting contacts between mobile phones and informing people who have been in close contact with coronavirus carriers. There are also an increasing number of applications to optimise health and social care costs.

Some examples. An app for Sclerosis Multiplex patients for home surveillance of movement and other parameters enabling to analyse the condition of the patient and react on time to the changes,⁶² or an indoor GPS patient monitoring system for an Estonian rehabilitation center to evaluate the effectiveness and impact of rehabilitation.

Telemedicine improves the healthcare of patients living in the remote areas. With the applications it is possible to reduce the impact of lack of medical personnel in remote areas - possible to use doctors to get a second opinion from another doctor and for a patient to visit a specialist of some specific field.

Road Ahead

The market growth will probably follow the overall development in the world. Expectedly, the growth will be bigger when the state is able to set up a cooperation framework for development of new products and services.

In the next 5 years, using the health and genomic data will be available to create new services and products for the private sector. Estonia has a valuable asset as a long term digital health data, but we are not making much out of it now. There is the potential that we can create new services and products based on health data that is available and other digital data that Estonia is rather good at.

Genomic data will be used in practice for prevention and health promotion incl. cancer risks, in clinical practice and in personal prescription of medications.

Wider use of patient home surveillance devices for providing healthcare from distance and less hospitalisation - using sensors and measurement devices combined with the apps that collect and monitor the information, enabling the personalised medicine from distance. Monitoring of cancer risks are more visible for people so they could take actions to prevent it.

Expert opinions were shared by the following experts:

1. Katrin Kaarna - Institute of Clinical Medicine, University of Tartu, Tartu University Hospital, Project of National Centre for Translational and Clinical Research
2. Andres Salumets - The Competence Centre on Health Technologies, CCHT
3. Carmen Siitsman - ELIKO Tehnoloogia Arenduskeskus OÜ
4. Kalle Killar - Estonian Ministry of Social Affairs
5. Kitty Kubo - Estonian Health Insurance Fund

(read more from expert opinion Annex I)

⁶¹ <https://www.haigekassa.ee/partnerile/raviasutusele/kaugvastuvotud>, accepted 16.09.2020

⁶²

<https://www.astrakliinik.ee/sclerosis-multiplex/kodumonitoring-muutub-sclerosis-multiplexiga-inimeste-jal-gimisel-uha-tahtsamaks/>, accessed 27.08.2020

Part IV

Summary

Estonia has been a pioneer in e-health for 25 years, today close to 100% of data generated by hospitals and doctors is digitised. A person's unified health record and data on imaging diagnostics are available on-demand throughout Estonia, allowing health professionals to make informed decisions. Blockchain technology assures system integrity while patients access their data and prescriptions using Estonia's secure e-ID solutions.

Estonia has unique capabilities in the research, development and application of software, high-tech systems, digital identity technologies and telecommunications. A number of Estonian companies are among the global leaders in blockchain, connected networks, and cleantech, and are at the cutting edge of IOT, big data, automation and real-time computing.

Estonia has a strong central e-health system that serves as an excellent basis for big data use in co-creation, product testing and piloting. The government is actively developing a platform (DIGINEST) to offer a single entry to the health and genomic data in central databases.

The quick developments in IT industry and a number of start-ups with unicorn aspirations, have caused a shortage of qualified IT savvy work force and companies have to recruit a notable share of the staff globally.

Chapter II

Healthcare sector in India

Part I

Introduction to Healthcare Ecosystem - India

Healthcare has become one of India's largest sectors, both in terms of revenue as well as employment. Healthcare consists of hospitals, medical devices, clinical trials, outsourcing, telemedicine, medical tourism, health insurance and medical equipment. The Indian healthcare sector is growing at a fast pace due to its strengthening coverage, services and increasing expenditure by public as well as by private players.

Indian healthcare delivery system is categorised majorly into two components - public and private. The Government, i.e. public healthcare system, comprises limited secondary and tertiary care institutions in key/primary cities and focuses on providing basic healthcare facilities through Primary Healthcare Centres (PHCs) in rural areas. The private sector: however, provides the majority of secondary, tertiary, and quaternary care institutions with major concentration in metro cities and tier I and tier II cities.

Traditional medicine is now being overlapped by modern day artificial intelligence enabled healthcare. The healthcare industry as a whole is undergoing a massive transformation because of the invasion of information technology into healthcare. The year 2020 has proved to be the year of major transformation for digital healthcare and its acceptance across various nations including India. The reason is obvious, the pandemic! But it's not only Covid-19, there are many other factors too that have led to automation and digitisation of healthcare. Increasing population, changing lifestyles, environmental imbalance, etc. to name a few. These factors in the form of challenges have given opportunities and have enabled humans to use technology and overcome the disease burden from time to time.

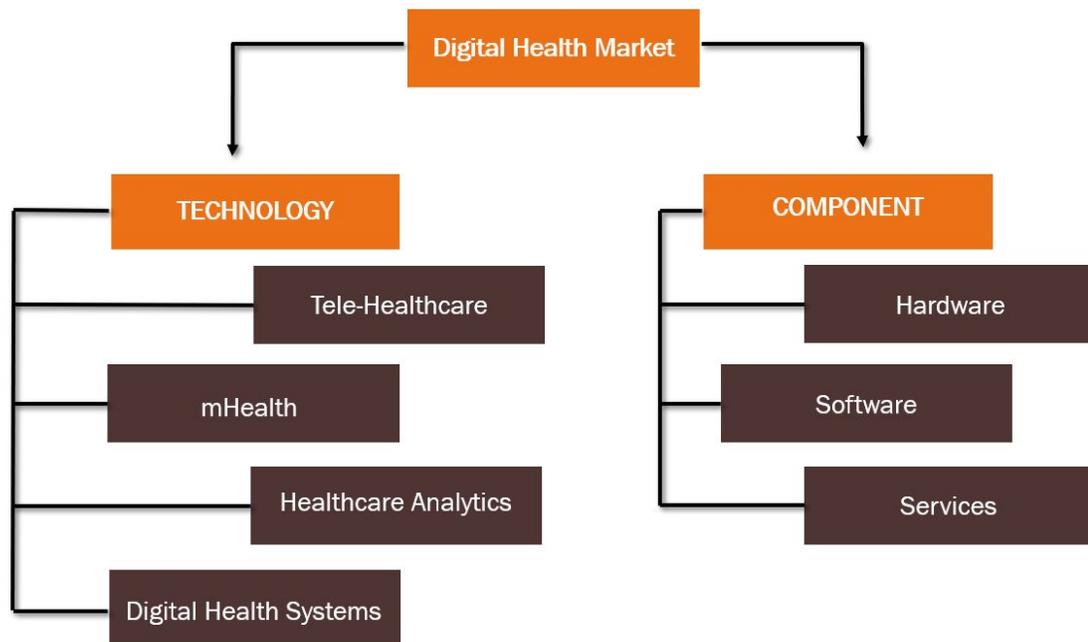


Image Credits: www.gminsights.com

Factors like huge population size, inferior technology infrastructure, data security, lack of structured regulations and rural-urban disparity pose challenges to the digital healthcare market. Furthermore, a complex and multi-layered ecosystem leads to difficulties in access, approvals and adoptions.

“The biggest challenge, going on fast track in terms of digital health implementation per se is the concerns of privacy security, access and data protection.”
- Debanshu Roy, Engagement Manager, IIC

According to data gathered from Google Trends, a tool which analyzes the relative interest in a particular search term, India ranks among the top five countries for search terms like ‘mobile health’, ‘health apps’, ‘medical apps’ and ‘mHealth’. This confirms that the Indian population is interested in digital health. Also, India ranks 145 among 195 countries in terms of quality and accessibility of healthcare, hence possess a great scope of improvement and opportunity.⁶³

The digitization initiatives undertaken by the Indian government, including the digital biometric identification program (Aadhaar), have created a favorable ecosystem for the digital healthcare market and benefit various e-Gov initiatives like the National Health Portal, e-Hospital, and Integrated Health Information Program (IHIP), which further fueled market growth. Moreover, the steady inflow of foreign direct investment has stabilized the digital healthcare market by addressing the concerns of stakeholders.

Digital health has its own limitations because the whole healthcare cannot be delivered just by the digital way. It is also the maturing of the community to start accepting things in a digital way, because traditionally, we're so used to seeing your doctor one to one and talking to him.
-Dr Vijay Agarwal, President CAHO

A large segment of the population (65%) resides in rural areas, where the low-income group lacks access to quality healthcare. Hence, the greatest opportunities lie in providing digital healthcare to patients in remote areas or where healthcare access is limited. With various emerging technologies and mHealth technology, it is now possible to connect patients to healthcare professionals regardless of distance.

“Access to health services in India is very skewed. 80% of the health facilities are in urban areas catering to 30% of the population and 20% of the facilities are in rural areas cater to 70% of the population”
- Sachin Gaur, Director Operations, InnovatioCuris

Pieces of health which are more consumer facing would lead with digital health adoption.
- Rohit Ghosh, Founding Member, Qure.ai

Market Size

As per studies, the healthcare market can increase three-fold to INR 8,6 trillion (US \$ 133,44 billion) by 2022.

According to The "Digital Healthcare Market in India 2019" report of Research And Markets, India has emerged as one of the fastest-growing digital economies over the past few years, characterized by a 90% growth in terms of digital adoption index, from 2014 to 2017. The healthcare sector in India has embraced digital transformation to improve quality and accessibility.

In terms of revenue, the digital healthcare market in India was valued at INR 116,61 billion in 2018, and is estimated to reach INR 485,43 billion by 2024, expanding at a compound annual growth rate (CAGR) of ~27,41% during the 2019-2024 period.⁶⁴

⁶³ <https://www.ibef.org/industry/healthcare-india.aspx> ,accessed 10.08.2020

⁶⁴

<https://www.businesswire.com/news/home/20200221005363/en/Insights-Digital-Healthcare-Market-India-2019-2024>, accessed 10.08.2020

Attracted Investments

With 100% FDI allowed under the automatic route for greenfield projects and up to 100% FDI permitted under the government route for the brownfield projects, there is an increase in ease of doing business in India.

Hospitals and diagnostic centers have attracted Foreign Direct Investment (FDI) worth US \$ 6,72 billion between April 2000 and March 2020, according to the data released by the Department for Promotion of Industry and Internal Trade (DPIIT).

Some of the recent investments and collaboration in the Indian digital healthcare industry are as follows:

- In April 2020, the first COVID-19 sample collection mobile lab of the country, namely 'Mobile BSL-3 VRDL Lab', was launched, which can process more than 1,000 samples in a day and enhance the country's capabilities in fighting COVID-19.⁶⁵
- In July 2020, Google announced a US \$10 billion India Digitization Fund. Technology giant Google will invest US \$10 billion (INR 75,000 crore) in India over the next five-seven years with a focus on digitising the economy and building India-first products and services.⁶⁶
- In August 2019, As part of Microsoft's AI Network for Healthcare initiative, Microsoft India and Apollo Hospitals Group entered into an agreement to set up a National Clinical Coordination Committee for AI-powered Cardiovascular Disease Risk Score API.
- Apollo TeleHealth signed a Memorandum of Understanding (MoU) with TeleHealthcare Malaysia under which it will upgrade 100 primary healthcare delivery centres of the government. The scope broadly involves providing technical know-how and remote specialist consultations. The organisation aims to add new products and services with a focus to offer comprehensive healthcare solutions through telehealth in states where healthcare suffers from a major dearth of resources.
- Japan based venture capital firm and a subsidiary of the SBI Group, SBI Investment has invested US \$17.2 million in Bengaluru based healthtech AI startup mfine. mfine will use the funds to expand its hospital network across the country and build its AI technology.⁶⁷

Government Initiatives

The broad programmes/activities covered under eHealth/digital health are as below:



⁶⁵ <https://pib.gov.in/PressReleasePage.aspx?PRID=1617544>, accessed 10.08.2020

⁶⁶

<https://www.thehindu.com/news/national/pm-modi-googles-pichai-discuss-how-tech-can-transform-lives/article32065016.ec>, accessed 10.08.2020

⁶⁷ <https://www.investindia.gov.in/sector/healthcare>, accessed 10.08.2020

National Digital Health Mission (NDHM)

Building on the digitising Healthcare in India, the ambitious NDHM was unveiled by Prime Minister of India on Aug 15, 2020, under which every Indian will get a health ID, which will store an individual's medical records, that will ease access to medical services has been rolled out on a pilot mode in six union territories.

The National Health Authority (NHA), the apex agency responsible for the implementation of Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB-PMJAY), has been given the mandate by the government to design, build, roll-out and implement the NDHM in the country.

“The implementation of NDHM is expected to significantly improve the efficiency, effectiveness, and transparency of health service delivery overall and will tremendously improve equity in access to quality healthcare.”

-Varun Jhaveri, Officer on Special Duty, National Health Authority (NHA)

The six union territories where the mission was rolled out through a pilot launch are Chandigarh, Ladakh, Dadra and Nagar Haveli and Daman and Diu, Puducherry, Andaman and Nicobar Islands and Lakshadweep.

The health ID will contain information about medical data, prescriptions and diagnostic reports and summaries of previous discharge from hospitals for ailments. The mission is expected to bring efficiency and transparency in healthcare services in the country. NDHM also aims to empower all Indians with the correct information and sources enabling them to make an informed decision to avail the best possible healthcare.⁶⁸

“It requires preparedness of the medical professionals, it requires preparedness of the community and it requires infrastructure preparedness & trust.”

-Dr Vijay Agarwal, President, CAHO

The NDHM is a holistic, voluntary healthcare programme that will reduce the existing gap between various stakeholders such as doctors, hospitals and other healthcare providers, pharmacies, insurance companies, and citizens by bringing them together and connecting them in an integrated digital health infrastructure.

“NDHM will significantly improve the efficiency, effectiveness, and transparency of health service delivery and will be a major stride towards achievement of the United Nations Sustainable Development Goal 3.8 of Universal Health Coverage, including financial risk protection.”

-Dr. Rishi Bhatnagar, Member, NABH

The NDHM comprises six key building blocks or digital systems:

1. HealthID
2. DigiDoctor
3. Health Facility Registry
4. Personal Health Records
5. e-Pharmacy
6. Telemedicine

This is believed to enable access to timely, safe and affordable healthcare through a 'citizen-centric' approach.

“Very ambitious and very positive approach towards health. And very challenging as well, and I'm happy to see that something actually started at least that has been rolled out, that means that there is a vision to actually combine the health data of a particular person; major challenges I could foresee is the lack of standardization, as there is no standard for the basic data transfer”

-Dr Vibha Jain, Deputy General Manager - IT, Max Healthcare

⁶⁸ <https://ndhm.gov.in/>, accessed 24.08.2020

Expected challenges: NDHM is expected to face hurdles in rural India with low internet penetration and little digital health resources. However, India has majorly pushed telemedicine services during Covid-19 pandemic, the country has been facing major problems in running the services in rural India for long. Telemedicine involves the use of telecom and information technology to provide healthcare from a distance which is impeded in rural India due to absence of infrastructure, Internet connectivity and lack of sufficient medical personnel, data security point, lack of data.

NATIONAL DIGITAL HEALTH MISSION

Partnering with citizens, doctors and healthcare providers in creating a digital health ecosystem



Image Credits: www.nha.gov.in

Though private stakeholders will have an equal opportunity to integrate with the building blocks of NDHM and create their own products for the market, the core building blocks of NDHM like Health ID, Digi-Doctor and Health Facility Registry shall be owned, operated and maintained by the government of India. Also, the core activities and verifications, for example, generation of Health ID or approval of a doctor/facility shall remain with the government.

Opportunity that NDHM possesses: Additional components, like Personal Health Record (PHR) and Electronic Medical Record (EMR) solutions can be developed by private players as well, in line with guidelines taking care of security, privacy and standards of the NDHM ecosystem, that will be issued by the government.

“NDHM is probably the biggest policy change in public health in the last 50 years. Some of the guidelines like EHR guidelines, telemedicine guidelines are out. Apart from it, as the products are built, the guidelines will come up along with that.”
-Debanshu Roy, Engagement Manager, IIC

NATIONAL DIGITAL HEALTH MISSION VISION

To create a seamless, comprehensive digital health ecosystem in partnership with doctors, healthcare providers and citizens



Image Credits: www.nha.gov.in

THE NDHM ECOSYSTEM

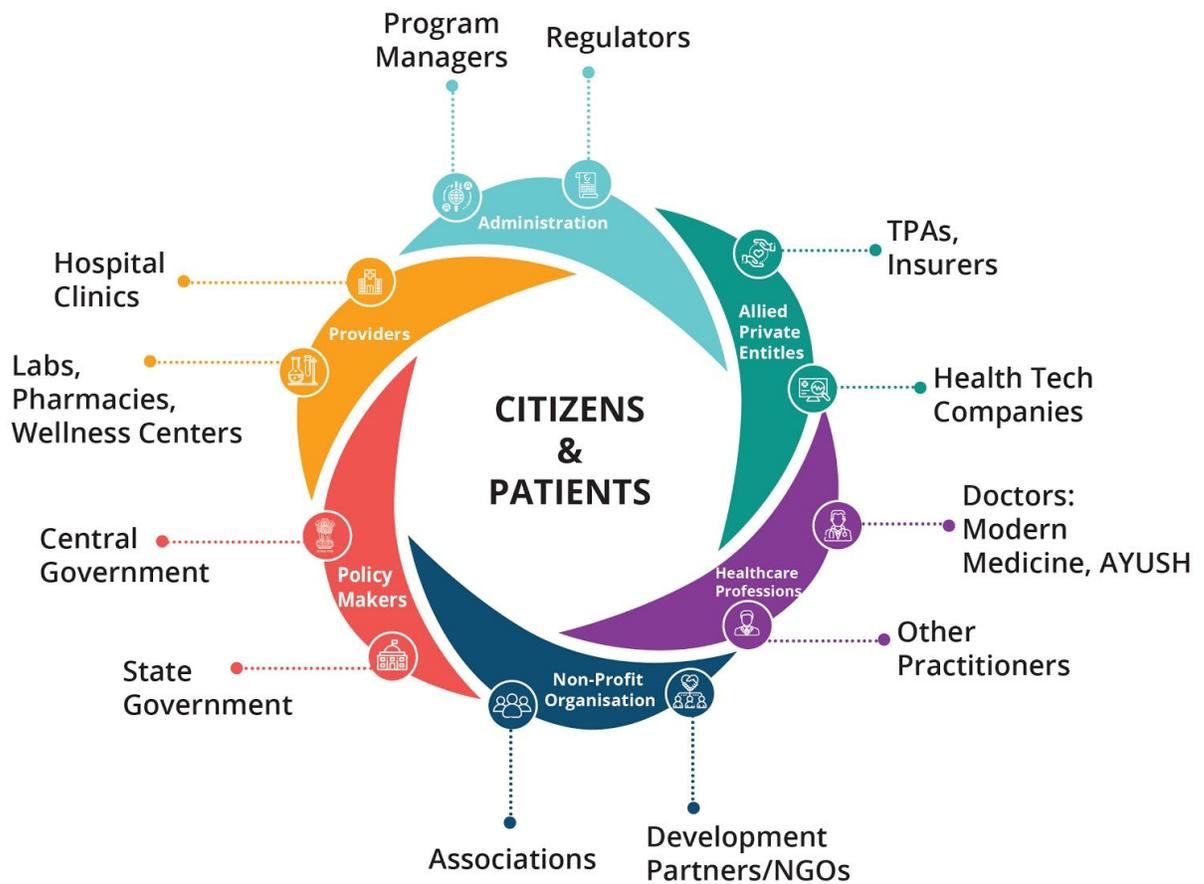


Image Credits: www.nha.gov.in

Background of NDHM

The **National Health Policy 2017** had envisaged creation of a digital health technology eco-system aiming at developing an integrated health information system that serves the needs of all stakeholders and improves efficiency, transparency and citizens' experience with linkage across public and private healthcare.

A **Digital Health ID** was proposed to “greatly reduce the risk of preventable medical errors and significantly increase quality of care”.

In the context of this, the central government's think-tank NITI Aayog, in June 2018, floated a consultation of a digital backbone for India's health system — **National Health Stack (NHS)**.

NHS was intended to be a digital infrastructure built with the aim of making the health insurance system more transparent and robust, while factoring in the uniqueness of India's health sector, and the political realities of federalism.

In essence, the NHS covers multiple mechanisms, including,

- An electronic national health registry that would function as a single foundation of health data for the nation.
- A coverage and claims platform to function as the building blocks for robust health protection schemes, thereby allowing for the horizontal and vertical expansion of schemes such as Ayushman Bharat by the states, and further allowing a robust system of fraud detection.
- Providing a Federated Personal Health Records (PHR) system to provide the citizens with access to their health data, and further facilitating the accessibility of the health data for medical research, which is crucial for evolving the understanding of human health.
- The introduction of National Health Analytics (NHA). The NHA provides an inclusive data-sharing platform covering various health schemes, and sustaining this platform for smart policymaking and regulation by way of improved techniques, such as, for example, by enhanced projecting analytics.

To ensure that various aspects of the NHS are fully connected and prevent the accumulation of detached silos, the NHS further includes the introduction of supplementary horizontal systems with a unique digital health ID, health data language, and supply chain control via health programmes.

A committee headed by former Unique Identification Authority of India (UIDAI) chairman released the **National Digital Health Blueprint (NDHB)** in July 2019.

NDHB recognised the need to establish a specialised organisation, called the National Digital Health Mission (NDHM), to facilitate the evolution of the National Digital Health Ecosystem.

On 7th August 2020, **National Digital Health Mission (NDHM)** released its latest strategic document, outlining the envisioned digital registries of doctors, hospitals, pharmacies, and insurance companies, digital personal health records, and digital clinical decision systems.

And finally the Prime Minister of India announced the launch of National Digital Health Mission (NDHM) on 74th Independence Day, 15th Aug 2020.

Also, in recent past, India rolled out several initiatives to work on overall development of digital health ecosystem to support growth and adoption of digital health in the country, under which following trends are being promoted:

- Metadata & Data Standards,
- Electronic Health Record Standards,
- Interoperability & Data Exchange Platform,
- Application Certification Programmes,
- Regulation of Data Security/Privacy/Confidentiality etc.

Given the integral role of technology in healthcare delivery, National Health Policy, 2017 envisaged extensive deployment of digital tools for improving the efficiency and outcome of the healthcare system. In addition, the policy intends to strengthen the health surveillance system and to establish a country-wide health information exchange network by 2025.

MoHFW has taken various initiatives in 2018-19 towards its aim of implementing digital health in an integrated manner across central and state levels.⁶⁹ For details refer to annex II

Recent Developments towards Digitalisation of Healthcare

Here we briefly discuss some of the recent developments like the new regulation on telemedicine and other emerging investment opportunities in India's healthcare sector.

Digital Information Security in Healthcare Act (DISHA)

Previously, the government drafted a bill for the [Digital Information Security in Healthcare Act](#) (DISHA) in 2018. In July 2019, the Ministry of Electronics and Information Technology [sought to include it](#) in the forthcoming 'Data Protection Framework on Digital Information Privacy, Security & Confidentiality' Act. However, more information and clarity on these regulations are still awaited.

e-Sanjeevani

An online OPD (doctor-to-patient), integrated telemedicine solutions developed by C-DAC (Centre for Development of Advanced Computing) Mohali, last year in 2019. It has been rolled out across many states in India, including Punjab, Maharashtra, Tamil Nadu, and Kerala.

Aarogya Setu

Mobile app developed by the Ministry of Electronics and IT (MeitY) to help citizens identify their risk of contracting COVID-19.

Regulation of telemedicine in India

In March 2020, the Indian government issued the [Telemedicine Practice Guidelines](#) to enable registered medical practitioners to provide healthcare services using telecommunication and digital technologies.

⁶⁹ <https://main.mohfw.gov.in/sites/default/files/20%20ChapterAN2018-19.pdf>, accessed 11.08.2020

Given the urgent need to overcome major gaps in India's healthcare system during the pandemic, the new guidelines were essential towards establishing legal transparency and accountability while also providing immediate consultations and preventing exposure to infection.

“COVID actually has brought to the forefront very beautifully, an opportunity to the hospital, rather to the patient.” Telemedicine and teleconsultation will help reduce the unnecessary burden on the tertiary care hospitals that sometimes arises due to lack of awareness among patients.

-Dr Vibha Jain, Deputy General Manager - IT, Max Healthcare

- The Telemedicine Practice Guidelines recognize the following models of patient consultation – video, audio, and text, which includes telephones, video devices, chat platforms (like WhatsApp, Facebook messenger), email, fax, or special apps developed for remote consultation.
- The registered medical practitioner will use their best judgment with respect to whether a teleconsultation is acceptable, or the patient requires an in-person consultation.
- The consultant must maintain a record of the telemedicine interaction – phone logs, email records, chat or text records, and video interaction logs as well as patient records, reports, documents, images, diagnostic data, etc.

“Telemedicine will improve health care services and reduce out of pocket expenses for the beneficiaries in rural areas”

- Rajesh R Singh, CEO, WISH Foundation

The general requirements under the Indian Medical Council Act, 1956 relating to professional misconduct and ethics will be applicable to telemedicine consultations as well. The Telemedicine Practice Guidelines also outline the process for prescribing medicines, first consult and follow-up consult, identity and consent, action to be taken during emergency situations, among other concerns.⁷⁰ The Guidelines, however, do not allow the use of digital technologies to conduct surgical or invasive procedures remotely. The Guidelines do not cover data management systems or consultations outside India's jurisdiction.

National Health Stack (NHS) and National eHealth Authority (NeHA)

Digital framework to support healthcare across India. Goal is to compile digital health records for all citizens by 2022 to leverage benefits of telemedicine and e-health for Indians.

NABH to set Digital Health Standards (NDHS)

NDHS which was initiated in March 2020 in line with Digital India under the National Health Policy 2017. As COVID has fast tracked the adoption of digital health and also as the telemedicine practice guidelines are out in April this year, it has become logical and important to have a well defined framework to ensure the quality of services/care delivered through the use of digital tools, hence the need for standards has arisen. Digital health standards are a must have for a country to ensure patient privacy, safety and quality of care.⁷¹

The standards are building upon the existing work done by the National Digital Health blueprint, EHR standards 2016 and other relevant initiatives by various ministries and departments.

70

<https://www.india-briefing.com/news/india-healthtech-telehealth-regulation-investment-outlook-20578.html/>, accessed 12.08.2020

71

<https://ehealth.eletsonline.com/2020/07/india-will-be-the-first-country-to-have-comprehensive-digital-health-accréditation-standards-before-2020-ends/>, accessed 12.08.2020

“NABH, in the first initiative of its kind in the world, started work on the Health Standards, including accreditation of digital health providers which will act as a catalyst in the faster adoption of technology.”

-Dr. Rishi Bhatnagar, Member, NABH

How Covid-19 may change Indian healthcare for good?

The world is racing towards finding the right vaccine candidate. India as a country has great expertise in large scale manufacturing of vaccines. It is commonly known as the vaccine factory of the world. Organisations like Serum Institute of India, Pune are already partners to key vaccine candidates. Another strong domain of Indian expertise is the IT services and India is home to multiple billion dollar IT services companies.

Once the world will have a winner or multiple winners in finding the covid-19 cure. Most countries of the world will start implementing nationwide vaccination programs. If such a program needs to take place in India for 1,3 billion people it may need a logistics of a scale that has not been done in the past. If that population has to move around the world or country and the person needs to share the evidence of being vaccinated, it is not possible to do it without digital record keeping. Hence, both of the strengths of India have to work in tandem. We can only imagine as of now when the vaccine will come and how the vaccination program will be implemented.

“Digital technologies have been instrumental in efficient tracking and prediction of pandemic across the world, helping policy makers across the board in planning the response more effectively. During the post COVID times as well, these technologies are expected to contribute big time to building resilient healthcare systems which are more affordable, accessible and well prepared for handling future similar situations as well.”

- Rajesh R Singh, CEO, WISH Foundation

We are not surprised that the government of India has taken a step to launch the National Digital Health Mission in August 2020 as we believe that it is a stepping stone in the roll out of nationwide covid-19 vaccination program⁷².

But, if India succeeds in one year from now in implementing the vaccine program it may play an important role in rolling out a similar intervention in other countries in her neighborhood. As it has the necessary vaccination and IT industry in place and may emerge as a COVID-19 saviour of the world.

Road Ahead

India is a land full of opportunities for players in the medical devices industry. The country has also become one of the leading destinations for high-end diagnostic services with tremendous capital investment for advanced diagnostic facilities, thus catering to a greater proportion of population. Besides, Indian medical service consumers have become more conscious towards their healthcare upkeep.

Key segments where new opportunities will emerge include:

- Development of tools to facilitate emergency care
- Improvements to medical infrastructure through technology-based optimization.

72

<https://economictimes.indiatimes.com/tech/ites/aadhaar-model-can-help-in-vaccinating-population-quickly-infos-ys-chairman-nandan-nilekani/articleshow/77754154.cms?from=mdr>, accessed 14.08.2020

This includes expanding the scope of wearable devices that can track health conditions, developing patient-facing mobile health applications, and the greater integration of artificial intelligence (AI), robots, and blockchain technologies – for example, electronic health records, surgical robots, automated/ robotic carriers, and monitoring systems, sensors, remote diagnostics, etc.

Contactless healthcare tools and systems, immunity-boosting nutrition, and safety and hygiene are some of the most viable segments for investors going forward as COVID-19 has brought about a paradigmatic shift in India's healthcare ecosystem's consumption priorities and people's social behavior.



Image Credits: <https://www.ideatheorem.com/>

With the rolling out of NDHM, HMIS systems will have to be redesigned, because now those systems will have to read codes and report to the government on one side and report to the hospital on the other. So that is definitely an area where most of the innovation will happen.
- Debanshu Roy, Engagement Manager, IIC

In one of the interviews with ETHealthworld, Executive Director and Group COO of Narayana Health, Viren Shetty said, “NH believes that adopting a digital strategy is one of the few ways hospitals can cut costs, increase efficiency, and improve the quality of healthcare.”

Indian healthcare sector is much diversified and is full of opportunities in every segment, which includes providers, payers and medical technology. With the increase in the competition, businesses are looking to explore for the latest dynamics and trends which will have a positive impact on their business. The hospital industry in India is forecast to increase to INR 8,6 trillion (US \$ 132,84 billion) by FY22 from INR 4 trillion (US \$ 61,79 billion) in FY17 at a CAGR of 16-17 per cent. The Government of India is planning to increase public health spending to 2,5 percent of the country's GDP by 2025.⁷³ (**Note:** Conversion rate used in April 2020, INR 1 = US \$ 0,013123)

“The role of digital technology in healthcare continues to evolve. The COVID situation has seen a tremendous increase in demand and adoption of digital health solutions, thus mainstreaming the role of technology in healthcare service delivery.”
-Rajesh R Singh, CEO, WISH Foundation

⁷³ <https://www.ibef.org/industry/healthcare-india.aspx>, accessed 14.08.2020

Part II

Competitive Intelligence

Digital health industry is witnessing momentous growth amid the COVID-19 pandemic owing to increasing trends of social distancing and rising adoption of digital healthcare. Various market players are launching novel services and product portfolios to cater to the growing demands of the people.

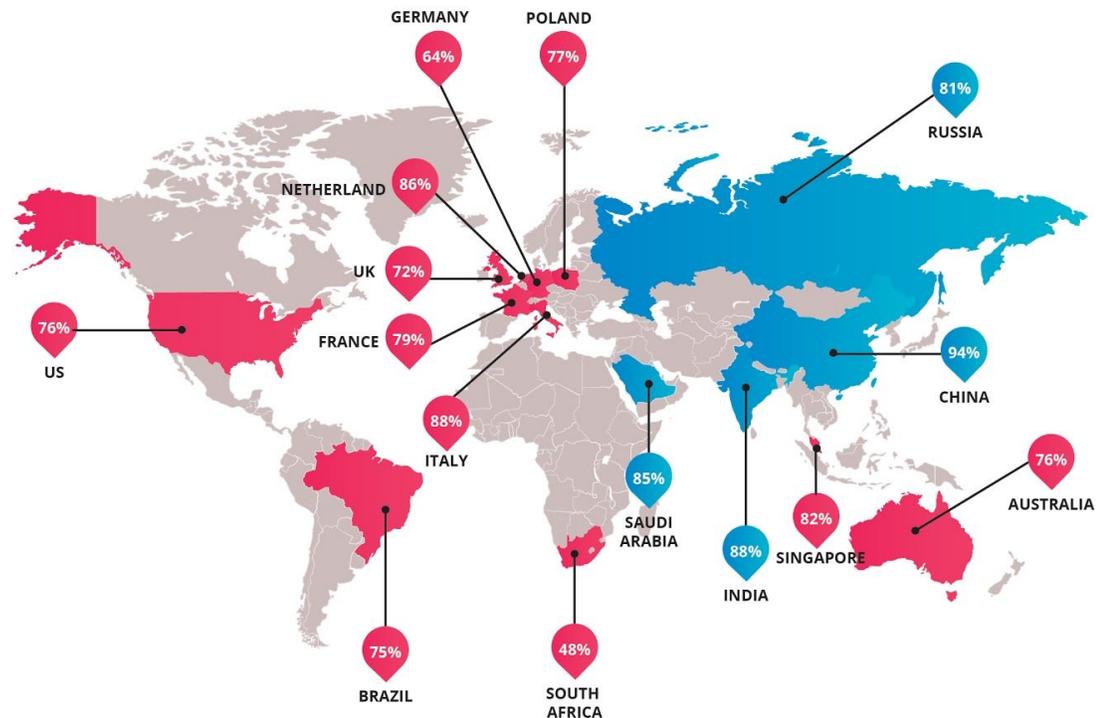


Image Credits: Philips Future Health Index 2019

According to Royal Philips' findings of the 15-country Future Health Index (FHI) 2019, India is a forerunner in the adoption of digital health technology with 88% of healthcare professionals in the country.⁷⁴

In this part all companies that have made news and have developed products or services for the digitalization of healthcare market are considered. To enable further analysis and because the list of companies is quite long additional sub-categories have been defined. For this overview we have considered those companies that have made a significant contribution in healthcare or at least consider this as an important factor.

Note: The last column in below tables gives the link of the article that points out the organization's latest/recent developments.

74

<https://www.philips.co.in/a-w/about/news/archive/standard/about/news/press/2019/20190821-digital-health-technology-can-revolutionize-healthcare-in-india-identifies-philips-of-2019-future-health-index-report.html>, accessed 25.08.2020

Major Players in Indian Digital Healthcare Market

Category- Digital healthcare devices

S.No.	Name	Headquarter	Founding year	Website	Contribution	Article Link
1	Transasia Bio-Medicals	Mumbai	1979	https://transasia.co.in/	Transasia Bio-Medicals manufactures state-of-the-art, MADE IN INDIA, diagnostic instruments and reagents that equip laboratories. The devices range in various subjects such as Biochemistry, Hematology, Coagulation, ESR, Immunology, Urinalysis, Critical Care, Diabetes Management, Microbiology and Molecular Diagnostics.	https://transasia.co.in/
2	Polymed Medical Devices	New Delhi	1997	https://www.poly medicure.com/	Polymed produces around 125 different medical products. It produces over 3 million disposable medical devices per day and is the largest exporter of disposable medical devices in India, with sales in more than 100 countries.	https://health.economictimes.indiatimes.com
3	Trivitron Healthcare	Chennai	1997	https://www.trivitron.com/	Trivitron manufactures and distributes exceptional medical technology products to 180 countries marketing its products to hospitals, individual healthcare providers, independent clinics and laboratories, extended care facilities and all other roofs providing healthcare solutions. Today, Trivitron spearheads innovation in the fields of Newborn Screening, In-Vitro Diagnostics, Imaging & Radiology, Radiation Protection, Critical Care and Operating Room Solutions, thus, engraving its name as a holistic healthcare provider.	https://health.economictimes.indiatimes.com
4	Sahajanand Medical Technologies (SMT)	Gujarat	1997	https://smtpl.com/	India's largest cardiac stent maker. Leading developer and manufacturer of minimally invasive coronary stent systems, with one of the broadest product portfolios in the industry. Supraflex Cruz is an amalgamation of the best-in-class features like lowest strut thickness (60 µm), biodegradable polymer and offers an extensive size matrix.	https://www.thehindubusinessline.com

5	Meril Life Sciences	Gujarat	2006	https://www.merillife.com/	Meril's core objective is to design, manufacture and distribute clinically relevant, state-of-the-art and best-in-class medical devices to alleviate human suffering and health and improve the Quality of Life. Manufactures medical solutions in the form of vascular intervention devices, orthopaedic supplements, in-vitro diagnostics, endo-surgery and ENT products.	https://www.merillife.com/blog/
6	Romsons Group of Industries	New Delhi	1962	https://www.romsons.com/	leading manufacturer of disposable medical devices. They cater to products for every need that promote healing, well-being and safety of patients. The manufacturing technology is largely automated and computerized with a well documented sterilization cycle for better quality assurance with precision within close tolerance.	https://www.romsons.com/products/
7	Qure.ai	Mumbai	2016	https://qure.ai/	AI based products for healthcare - qXR detects abnormal chest X-rays, qER tool detects critical abnormalities such as bleeds, fractures, qQuant tool is used to monitor the progression of patients with traumatic brain injury.	https://qure.ai/news/2020/06/30/
8	Forushealth	Bangalore	2010	https://www.forushealth.com/	Digital imaging devices for ophthalmic care - 3nethra classic, 3nethra neo, 3nethra flora.	https://www.linkedin.com/posts/
9	Predible Health	Bengaluru	2016	http://prediblehealth.com/	LUNGIQ - tool for Lung CT scans to discover accurate and quantitative insights from a variety of diseases.	https://theprint.in/science/
10	Helyxon	Tamil Nadu	2015	https://helyxon.com/	Low cost remote monitoring devices - Oxy2, Feverwatch	https://www.hospitalmanagement.net
11	Aerobiosys innovations	Hyderabad	2019	https://www.aerobiosys.com/	AI-enabled Smart Ventilation System. Smart, Hybrid Duo-vent for patients in the Critical Care unit with Acute and Chronic Respiratory illness.	https://www.biospectrumindia.com
12	BeatO	New Delhi	2015	https://www.beat-oapp.com/	BeatOSmart, BeatOCurve devices - offers diabetics a smartphone glucometer and app, which connects them with in-house specialists, helps share and analyse readings, track fitness levels, and manage diet.	https://www.expresscomputer.in
13	Ai Highway Inc.	Bangalore	2018	https://aihighway.org/	AiSteth, an acoustics device that can screen, detect & predict heart disorders using state-of-the-art signal processing and AI capabilities, focused on making screening of chronic diseases cost-effective at the primary care clinic.	https://www.international-sound-awards.com/shabd-1st-sound-a-baby-hears-in-womb/

Category- Diagnostics

S.No.	Name	Headquarter	Founding year	Website	Contribution	Article Link
1	Practo	Bangalore	2008	https://www.practo.com/	Practo Ray app (practice management software), provides door-to-door diagnostic services.	https://www.exchange4media.com/
2	1mg	New Delhi	2015	https://www.1mg.com/	Integrated Healthcare Platform "Wiki" for healthcare information & India's largest eDiagnostics services.	https://analyticsindiamag.com/
3	Dr Lal Pathlabs	Gurgaon	1949	https://www.lalpathlabs.com/	An established brand associated with Quality Services. One of India's Top Diagnostic Chains. Pathology Laboratory, Advance Diagnostics, Health Checkups, Clinical Trials, Online Health Package Booking, and Home Collection Facility.	https://www.hindustantimes.com/
4	Mahajan Imaging	New Delhi	1999	http://www.mahajanimaging.com/	Bringing new technologies into the private sector in the country, for example, functional MRI, MR tractography, MR mammography, CT coronary angiography, etc.	https://indianexpress.com/article/
5	Predible Health	Bengaluru	2016	http://prediblehealth.com/	Provides a platform for radiologists to visualize and quantify medical images to diagnose diseases.	https://theprint.in/science/
6	Medall Healthcare Pvt Ltd	Chennai	2009	https://www.medall.in/	India's leading integrated Healthcare Diagnostics and the fourth largest Diagnostics player in India. Medall is pioneering clinical and technological innovations in Diagnostics.	https://yourstory.com/smbstory/
7	Suburban Diagnostics	Mumbai	1994	https://www.suburbandiagnostics.com/	Suburban Diagnostics offers various services like Diagnostics, Pathology, Corporate Wellness Programs, etc. Suburban Diagnostics offerings include a comprehensive range of pathology, radiology, cardiology, health check-ups and a host of other value-added services.	https://telanganatoday.com/

8	Srl Diagnostics	Gurgaon	1995	https://www.srlworld.com/	largest Diagnostics Company in India having an impressive 'Reach', providing superior quality diagnostics services to its customers through a very efficient network of labs and collection points. Involved in in-house R&D, management of Fortis hospitals' and other hospitals laboratories, home collection services, co-marketing activities, preventive health check-ups, corporate & wellness solutions, mass onsite health checks, clinical trials, revolutionizing diagnostic services in India by ushering in the most specialized technologies, and innovative services.	http://www.uniindia.com/
9	Oncquest Laboratories Limited	New Delhi	2003	https://www.oncquest.net/	known for its excellence in Clinical Diagnostics & its core competence in Cancer Diagnosis. They have developed & validated biomarkers based on a wide range of technologies possessed by Oncquest and have launched many molecular tests in Indian market.	https://www.linkedin.com/posts/
10	Vijaya Diagnostic Centre	Hyderabad	1981	https://www.vijayadiagnostic.com/	Vijaya Diagnostic Centre (VDC) is India's largest comprehensive diagnostic network with over 75 state-of-the-art centres spread across 12 cities. They offer a wide range of services like Diagnostics, Radiology, Pathology, Imaging, Nuclear Medicine, MRI, CT Scan, Corporate Wellness Program, Annual Health Checks, Pre-Employment Health Checks, On Site Checkups, Lab Management, Cardiology, Diagnostic Centre, Diagnostic Network, Preventive Health Checkups, Mammography, Neurology, Gastroenterology, Health Checkups, and Health Packages.	https://vijayadiagnostic.com/news https://www.livemint.com/Companies/miCRnq51blMd3buYj2WgGO/Kedaara-Capital-invests-Rs430-crore-in-Hyderabad-Vijaya-Di.html
11	Thyrocare Technologies Ltd.	Mumbai	1996	https://www.thyrocare.com/	Thyrocare is India's first fully automated diagnostic laboratory with a focus on providing quality at affordable costs to laboratories and hospitals in India and other countries. Specialities include Preventive Health care, Diagnostic Laboratory, Medical Health Care Services, and PET CT Scan	https://health.economictimes.indiatimes.com/
12	Metropolis Lab	Mumbai	1981	https://www.metropolisindia.com/	Chain of diagnostic centres across India, South Asia, Africa and the Middle East, offers a comprehensive range of clinical laboratory tests and profiles.	https://www.livemint.com/market/

Category- e pharmacy

S.N o.	Name	Headquarter	Founding year	Website	Contribution	Article Link
1	Pharmeasy	Mumbai	2014	https://pharmeasy.in/	Online pharmacy platform providing medicines and other products. To be merged with its rival 'Medlife.'	https://www.live-mint.com/
2	Practo	Bangalore	2008	https://www.practo.com/	Practo Ray app provides online pharmacy service.	https://www.exchange4media.com/
3	1mg	New Delhi	2015	https://www.1mg.com/	Integrated Healthcare Platform "Wiki" for healthcare information & India's largest ePharmacy marketplace.	https://analyticsindiamag.com/
4	Netmeds.com	Chennai	2015	https://www.netmeds.com/	Provider of an online store for medicines and healthcare products.	https://leaderpost.com/pmn
5	Medlife	Bengaluru	2014	https://www.medlife.com/	One stop online pharmacy service for all health needs. Wellness and various health products. To be merged with PharmEasy.	https://tech.economic-times.indiatimes.com/

Category- HIS/EMR/EHR

S.N o.	Name	Headquarter	Founding year	Website	Contribution	Article Link
1	Medgenome Labs	Bangalore	2012	https://diagnostics.medgenome.com/	Bioinformatics database called OncoMD. Offers end-to-end clinical genomics services for Indian pharma, hospitals and clinics and genomics bioinformatics to global pharma, research and diagnostics organizations.	https://www.business-standard.com/
2	Akhil Systems Pvt. Ltd.	New Delhi	1989	https://akhilsystems.com/	One of the pioneer Hospital Information System (HIS) companies with over 22+ years of experience in the single domain of healthcare and specialized in delivering management information systems for Hospitals, Medical colleges, Nursing Homes, Clinics, Diagnostic Centers and Pharmacy Chains. Launched MIRACLE EMR and HIS solution which is completely web-based and can be hosted on cloud computing. They are also developing add-on modules such as Web-based Electronic Medical Records, Patient Portal, SMS/Email Connectivity, Online Lab results, and recently launched Mobile Application for MIRACLE EMR and M-Lab App.	https://www.linkedin.com/posts

3	Binary Spectrum	Bangalore	2004	http://www.binaryspectrum.com/	Leading provider of Technology Solutions for the Global Healthcare sector. Binary Spectrum combines a thorough understanding of the healthcare marketplace with a superior approach to developing incremental, cost-justified solutions and aligns them with time-to-market requirements. Binary Spectrum provides technology as well as healthcare industry subject matter expertise within all areas of the Healthcare industry. They specialize in custom software development framework of more than 20 healthcare applications like Electronic Medical Records (EMR) / Electronic Health Record (EHR) systems, Practice Management Software, Hospital Management Information System HMIS, Medical Billing and Coding, Digital Secure Copy, Call Scheduling, Credentialing, etc	http://www.binaryspectrum.com/
4	Birlamedisoft Pvt Ltd.	Pune	2001	https://www.birlamedisoft.com/	Birlamedisoft caters with innovative and advanced integrated software to reduce the usage of time, and paperwork involved in the healthcare industry. Offerings include hospital management, blood bank management software, PACS software, Laboratory management software. All software are developed through cutting-edge-technology and user friendly for doctors and catering to small to large scale enterprises.	https://www.birlamedisoft.com/news-healthcare.html
5	Healthplix	Bangalore	2014	https://healthplix.com/	Healthplix app (EMR on app). Electronic Medical Records (EMR) software for hospitals and clinics integrated with AI-driven Clinical Decision Support (CDS) system to assist doctors while performing treatment on various diseases.	https://www.vccircle.com/
6	Daytoday Health	Bangalore	2018	https://www.daytoday.health/	Offers personalised care journeys through its AI platform to guide patients throughout surgical preparation and recovery. Digital healthcare platform for Smiles Institute of Coloproctology, Bengaluru.	https://www.daytoday.health/

Category- Telemedicine

S.No.	Name	Headquarter	Founding year	Website	Contribution	Article Link
1	Pharmeasy	Mumbai	2014	https://pharmeasy.in/	Telehealth services, online consultations. It offers a smartphone app for ordering medicines from a local pharmacy and home sample collection for diagnostic testing from nearby labs. To be merged with its rival 'Medlife.'	https://www.livemint.com/
2	Practo	Bangalore	2008	https://www.practo.com/	Practo Ray app, online consultations, telemedicine, digital healthcare management system	https://www.exchange4media.com/
3	1mg	New Delhi	2015	https://www.1mg.com/	Online teleconsultation services	https://analyticsindiamag.com/
4	Docsapp	Bangalore	2015	https://www.docsapp.in/	Online medical consultation platform. Docsapp to be merged with Medibuddy to create India's largest digital healthcare platform.	https://www.cnbcv18.com/
5	Lybrate	New Delhi	2013	https://www.lybrate.com/	Lybrate app for all health solutions. Provide doctors with a clinical management system (CMS.)	https://www.expresshealthcare.in/
6	Reliance Industries	Mumbai	2018	https://www.jio.com/en-in/apps/jio-healthhub	Jio healthhub app - enable people to book online consultations, securely store and share health records and book lab tests, among other services.	https://leaderpost.com/
7	Onco.com	Bangalore	2014	https://onco.com/	A virtual cancer platform for the world, provides accurate, unbiased consults to cancer patients at every stage of their disease.	https://www.expresscomputer.in/
8	Portea	Bangalore	2013	https://www.portea.com/	Portea Medical is a provider of in-home healthcare services in India. It works with hospitals and individuals to improve health outcomes by providing home visits from clinicians. It has over 50 hospitals as partners and a network of 200+ referring physicians all over India. Its services focus on geriatric, post-operative, chronic diseases and primary care treatments.	http://bwdisrupt.businessworld.in/
9	Credihealth	Gurgaon	2013	https://www.credihealth.com/	Credihealth is an online solution to all the healthcare needs. They are also involved in educating and empowering families to ensure that right healthcare decisions are made.	https://www.expresshealthcare.in

Category- Hospitals / Institutions

S.No.	Name	Headquarter	Founding year	Website	Contribution	Article Link
1	AIIMS Delhi	New Delhi	1956	https://www.aiims.edu/en.html	AIIMS-Delhi is running the “COVID-19 National Teleconsultation Centre” (CoNTeC) on behalf of the MoHFW, Gol. It is catering to doctors, from anywhere in the country, who want to consult our faculty for the management of COVID-19 patients, as well as to the public in general.	https://covid.aiims.edu/
2	Max Healthcare	New Delhi	2000	https://www.maxhealthcare.in/	The Bio Medical Engineering team at Max Saket has come up with an innovative solution to cope with the high demand for ventilators during the expected surge in Covid 19 patients. They designed a simple yet ingenious device, which can be safely attached to the ventilators, splitting the airflow into four distinct streams for 4 patients. They also made parts using 3D printing available at Max Hospital Saket to fabricate the device.	https://www.linkedin.com/
3	Apollo Hospitals	Chennai	1983	https://www.apollohospitals.com/	Apollo has floated Apollo 24 7, an end-to-end omni-channel healthcare platform, to enable users from any part of the country to avail Apollo services over phone. At present, 15 percent OPD consultations are so. Their plan is to make it 50 percent.	https://www.moneycontrol.com/
4	Fortis Healthcare (Parkway)	Gurgaon	2001	https://www.fortishealthcare.com/	The post-COVID-19 OPD is based on three key pillars, clinical assessment, psychological intervention and rehabilitative care. Detailed clinical assessment will help in tackling the residual impact of the infection. At the post-COVID-19 OPD, patients will also be assessed for Lung fitness and Pulmonary Fibrosis, especially amongst those who have had complicated recoveries in the ICU. Those with pre-existing conditions such as Diabetes, Hypertension, Obesity, etc. will be evaluated to gauge the seriousness of the disease before, and after contracting COVID-19.	https://ehealth.eletsonline.com/

5	Manipal Hospitals	Bangalore	1953	https://www.manipalhospitals.com/	With an overhead design, da Vinci's robotic system developed by Intuitive was adopted by Manipal Hospital, as it comes with flexible configuration but also with upgradable architecture according to hospitals requirement. The robots are designed with a wide range of motion, maximum insertion depth and multi-quadrant access that allows for a variety of surgical approaches, including the complex ones like cancer.	https://analyticsindiamag.com/
6	Narayana Health	Bangalore	2000	https://www.narayanahhealth.org/	India's leading & one of the largest hospital groups in the country with a network of 22 hospitals, 6 heart centres and 19 primary care facilities.	https://health.economictimes.indiatimes.com/
7	Columbia Asia India	Bangalore	2005	https://www.columbiaindiahospitals.com/	In order to enhance teleconsultation services in the country care.fit, cure.fit's primary healthcare vertical and Columbia Asia India enter into partnership. Doctors from more than 20 specialties from Columbia Asia will be available on the care.fit platform for a tele-consult.	https://www.columbiaindiahospitals.com/
8	AIIMS Nagpur	Nagpur	2018	https://aiimsnagpur.edu.in/	AIIMS Nagpur and the Indian Institute of Information Technology (IIIT) Nagpur have joined hands to bring out an indigenously designed gadget for effective tracking and monitoring of Covid-19 patients. The device is designed to overcome limitations of any existing online mobile apps for tracking and monitoring.	https://health.economictimes.indiatimes.com/
9	Medanta	Gurgaon	2009	https://www.medanta.org/	As part of its outreach program for OPD, Medanta clinical teams leveraged our digital platforms to provide high-end clinical diagnosis and consultation by specialist doctors in different areas of the country.	https://www.expresscomputer.in/
10	Caretel	Kochi		http://www.caretel.net/	A web-based and mobile-based virtual hospital, which offers consultation services of doctors from over 20 specialities. A group of specialist doctors have come together to launch Kerala's first virtual specialty hospital.	https://health.economictimes.indiatimes.com/

Part III

Expert Profile & Opinion

The report “Future Health Index (FHI) 2019” confirms that digital health technology is a pivotal pillar in delivering value-based care across the Indian healthcare continuum.⁷⁵

Talking about India’s adoption of digital health in an article for the Observer Research Foundation (ORF), Prof Rajendra Pratap Gupta from Digital Health India, said: “Given that India is setting up 150,000 health and wellness centres by converting its rural health centres, and these have an element of tele-medicine as its offering, it is the right time to frame legal and regulatory frameworks/standards for digital health, data privacy and protection act.”

Meanwhile, in a recent interview for QUARZ India, Dr Shetty was quoted saying: “The disruption caused by Airbnb and Uber is nothing compared to how technology will disrupt the healthcare industry. People talk about the use of data analytics and artificial intelligence (AI). But all these technologies need data. Now, how do you get the data when 95% of the hospitals in India don’t have EMRs. If you don’t have EMR, you are looking at manually typing in the data, which will not be 100% accurate. So the big game of data analytics making a big difference in healthcare will only happen if every hospital is using EMR, and every patient has his own personal health record in a digital format.”

According to Dr Devi Shetty, who is the Chairman, of Narayana Hospitals: “In future, the world’s largest healthcare provider will not be a hospital. It will be a software.”⁷⁶

The report also covers some of the thought leaders’ opinion and insights from industry players on digitalisation of healthcare and cross border collaboration opportunities and challenges. Expert opinions (in person view point) are shared by the following experts:

1. Dr Vijay Agarwal, President, Consortium of Accredited Healthcare Organizations (CAHO)
2. Dr Vibha Jain, Deputy General Manager - IT, Max Healthcare
3. Rajesh Singh, CEO, Wadhvani Initiative of Sustainable Healthcare (WISH) Foundation
4. Debanshu Roy, Engagement Manager, The International Innovation Corps (IIC)
5. Dr. Rishi Bhatnagar, Member, National Accreditation Board for Hospitals & Healthcare Providers (NABH)
6. Rohit Ghosh, Chief of Staff, Founding member, Qure.ai
7. Varun Jhaveri, Officer on Special Duty, National Health Authority (NHA)
(Read more on expert opinion from Annex III)

⁷⁵

<https://www.livemint.com/news/india/digital-health-technology-can-revolutionise-healthcare-in-india-report-1566457450376.html>, accessed on 21.08.2020

⁷⁶ <https://qz.com/india/1709040/devi-shetty-of-narayana-health-on-robots-replacing-doctors/>, accessed on 21.08.2020

Part IV

Summary

Based on type, the digital healthcare market is segmented into telehealth, mHealth, electronic health records/electronic medical records (EHR/EMR), and others like remote diagnostics and healthcare analytics. The mHealth segment is estimated to dominate and lead the market in 2024, followed by the telehealth segment. Enhanced accessibility and convenience encourages patients to embrace mHealth services and solutions, including wearable devices and healthcare apps.

COVID-19 has emerged as the key change agent in healthcare delivery in India. With the release of telemedicine guidelines and the launch of the NDHM, Indian population is learning fast to navigate the new user interfaces and screens of digital health. A large population with huge latent needs opens up enormous opportunities for all kinds of interventions.

A keen focus on patient-centric healthcare services (even more due to NDHM rolled out) bolstered the demand for various telehealth services, including telemedicine, telecare, and teleconsulting.

Emerging technologies such as artificial intelligence (AI), machine learning, Blockchain, Internet of Things (IoT), Internet of Medical Things (IoMT), and Big Data analytics have helped shape the digital healthcare market. The advanced algorithm based on AI and machine learning has the potential to analyze complex medical data and thus predict treatment and care plans for the patients. IoT and IoMT have also contributed to the growth of the digital healthcare market through the introduction of smart bands, smartwatches, smart glasses, connected medical devices for remote monitoring, and location-based trackers.⁷⁷

The presence of numerous players leads to a fragmented market. This in turn makes the market relatively untapped, offers high potential and thus attracts significant investment opportunities. Although Indian healthcare market has witnessed the execution of successful pilot projects, there are challenges in scaling up the pilots to meet industry requirements.

To sum up, there are vast opportunities for investment in healthcare infrastructure in both urban and rural India. And also a huge scope for development.

⁷⁷

<https://www.businesswire.com/news/home/20200221005363/en/Insights-Digital-Healthcare-Market-India-2019-2024> , accessed on 28.08.2020

CHAPTER III

Healthcare sector in Australia

Part I

Introduction to healthcare ecosystem - Australia

Digital health is not just restricted to health IT, but extends far beyond it, and includes mobile health, connected devices and wearables, telehealth and telemedicine, and personalised and precision medicine. “Digital medicine” and “digital therapeutics” are also concepts increasingly gaining traction on the global stage.

The Australian digital health sector is vibrant and diverse, and growing in size, but to date has lacked the types of targeted funding and support historically provided to the biopharmaceutical and medical devices sectors. Despite this, there is a vibrant emerging digital health sector within Australia, with increasing numbers of success stories illustrating the varying paths to international markets available to earlier stage enterprises.

Technology has already revolutionised many industries. In the travel, banking and retail industries, digitisation has changed the ways we hail transport, conduct banking transactions and shop. Similarly, in healthcare, digital intervention is changing the landscape. Over the last 20 years, Australia has seen the evolution in the manner in which healthcare is provided and viewed in its new health systems and technology. Those improvements have been based on public quality, increased reliability, transparency, and accountability. Its productivity and therapeutic results have been significant. The positive effect of innovations on healthcare is digital transformation.

Digital health in Australia is definitely getting a lot of traction. The government sees the potential of what digital health can do and what it can create. Especially with COVID, there's been an increase of big hospitals, big government organizations, even the big health insurers. They are a lot more ready to use digital health as part of their solutions and as part of their services.
-Sanji Kanagalingam, Executive Director, Curve Tomorrow

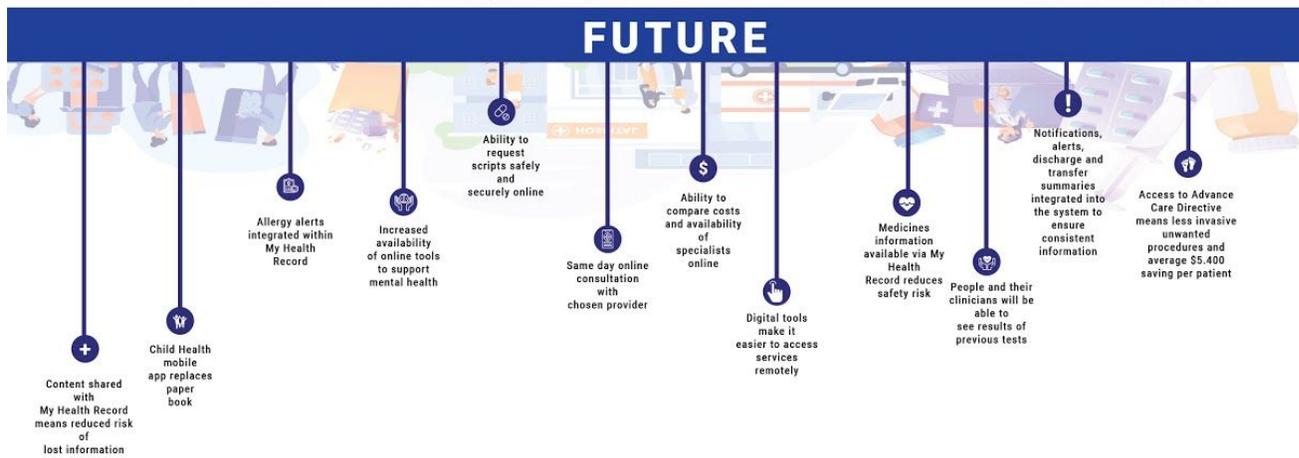
Telemedicine, artificial intelligence (AI) enabled medical devices and blockchain electronic health records are only a few realistic indicators of digital health transition.

The majority in Australia has made clear what they want from today's and future health systems. Australians expect a first-class healthcare program – offering patients more choice, flexibility and accountability. They want greater exposure for the entire population to modern electronic health systems – not just the experienced consumers of new technologies. They want to know that their health information is secure and protected, protected from cyber-criminals and unwanted access. Providers of treatment are similarly transparent. They want safe digital infrastructure, delivering medical information immediately—notably in crises, encouraging early identification and improved clinical control, and the creation of new drugs and therapies.

They want to reduce their administrative burden so that you can spend more time with patients. As healthcare systems around the world grapple with the coronavirus, ‘**virtual-first healthcare**’ is fast becoming the global response of private and public healthcare systems alike. Covid 19 has been a potent catalyst for a change in the way we view our healthcare system and has challenged us to reimagine our healthcare system and adopt strategies for Healthcare providers who need a new strategic framework to outmanoeuvre uncertainty, while demonstrating measurable benefits—a reflection of the shift towards better patient value and health outcomes.



Prebirth Baby Childhood Youth Young Adult Adult Older Adult Seniors Aged Care End of Life



REFERENCE LIST:

Prebirth – Today

http://www.materonline.org.au/getattachment/Services/Maternity/Health-Professional-Information/Guidelines-and-Policies/MMH_AntenatalAppointmentSchedule.pdf

Baby

<http://www.abs.gov.au/ausstats%5Cabs@.nsf/0/8668A9A0D4B0156CCA25792F0016186A?OpenDocument>

<https://www.medicalsearch.com.au/nsw-health-seeks-opinions-for-its-latest-blue-book-review/19016y>

Childhood

[http://www.jacionline.org/article/S0091-6749\(15\)00702-2/fulltext](http://www.jacionline.org/article/S0091-6749(15)00702-2/fulltext)

Youth

<http://www.mindframe-media.info/for-media/reporting-mental-illness/facts-and-stats>

Young Adult

<http://onlinelibrary.wiley.com/doi/10.1016/j.jmwh.2005.01.011/Adult>

<http://www.ruralhealth.org.au/infographics>

Senior

Early cost and safety benefits of an inpatient electronic health record Zlabek et al J Am Med Inform Assoc (2011) 18 (2): 169-172

Aged Care

Does facilitated Advance Care Planning reduce the costs of care near the end of life?

Systematic review and ethical considerations Corinna Klingler1, Jürgen in der Schmitzen2 and Georg Marckmann1

End of Life / Palliative

<https://grattan.edu.au/wp-content/uploads/2014/09/815-dying-well.pdf>

Image Credits: <https://conversation.digitalhealth.gov.au/australias-national-digital-health-strategy>

Market Size

According to a report of Frost and Sullivan, Global Digital health Outlook 2018, Australia's digital health market, valued at US \$1,488 billion in 2017, is expected to grow to US \$1,851 billion in 2020.⁷⁸ The 2015 healthcare IT market size is estimated at \$1,20 billion. According to studies, the global digital health market will grow at over 25,9% compound annual growth rate to reach US \$379 billion by 2024⁷⁹

Attracted Investments

Australia provides a unique opportunity for investors to pilot solutions here or grow existing businesses, then leverage international regulatory compatibility to enter global markets. In addition, Australia's numerous Free Trade Agreements ensure enhanced access to key markets.

Examples of global digital health research collaboration in Australia include:

- US conglomerate Johnson & Johnson has opened an Innovation Partnering Office at Monash University in Victoria. JIPO@MONASH is the Victorian headquarters for Johnson & Johnson's scientific, investment and commercialisation arms and identifies medtech projects for potential collaboration and commercialisation.
- Fujifilm Medical Systems partnered with Alcidion to develop an intelligent cardiovascular information system that delivers advanced decision support to cardiovascular clinicians.
- IP Group plc, a UK-based intellectual property (IP) commercialisation company, has committed to invest at least AU \$200 million over a 10-year period to fund investments in spin-out companies based on the IP developed by academics at eight Australian universities, generated from research in areas such as digital medicine, new medical therapies and quantum computing.⁸⁰

Tap into government funding and tax rebates through following:

The Australian Government supports productive foreign investment partners through the Medical Research Future Fund (AUD 20 billion endowment by 2020) to collaborate with Australian organisations.

Foreign investment partners can also access the Biomedical Translation Fund (AUD 500 million) to co-invest in emerging Australian biomedical companies with licensed Australian venture capital firms.

Research and development (R&D) tax rebates as well as Australia's enviable lifestyle helps attract and retain world class talent, which in turn can help a business achieve its goals in this region.⁸¹

Australian government has invested millions of dollars in Digital Health CRC, in order to allow research institutes to collaborate with industry. Also, there's a big initiative in the government called MTPConnect for the med tech, biotech and pharmaceuticals sector to increase commercialisation and collaboration.

⁷⁸ <https://www.austrade.gov.au/digitalhealth/why-australia/why-australia>, accessed on 21.08.2020

⁷⁹ https://www.health.qld.gov.au/_data/assets/pdf_file/0030/652674/qcs-pp-1703-kelsey.pdf accessed on 17.09.2020

⁸⁰ IP Group plc - [Commits AU\\$200m in landmark deal with 9 leading universities in Australia and New Zealand](#), accessed on 28.08.2020

⁸¹ <https://www.austrade.gov.au/DigitalHealth/why-australia>, accessed on 25.08.2020

- **The George Institute for Global Health, is one of eight partners to be working with MTPConnect received AU \$32 million** from the Australian Government's Researcher Exchange and Development within Industry (REDI) initiative, through the Medical Research Future Fund.⁸²
- **AU \$1,1 billion to support more mental health, Medicare and domestic violence services. Medicare support at home – whole of population telehealth:** To provide continued access to essential primary health services during the coronavirus pandemic, AU \$669 million will be provided to expand Medicare-subsidised telehealth services for all Australians, with extra incentives to GPs and other health practitioners also delivered.

Australians will be able to access support in their own home using their telephone, or video conferencing features like FaceTime to connect with GP services, mental health treatment, chronic disease management, Aboriginal and Torres Strait Islander health assessments, services to people with eating disorders, pregnancy support counselling, services to patients in aged care facilities, children with autism, after-hours consultations and nurse practitioners.⁸³

- **AU \$18,8 million to supercharge digital health technologies:** The Morrison Government is investing AU \$18,8 million to supercharge the discovery of better treatments for cancer, epilepsy, stroke, paralysis, Irritable Bowel Syndrome, brain injuries, back pain and chronic middle ear disease.

Under round three of Government's AU \$45 million BioMedTech Horizons (BMTH) program, 21 very promising projects will receive funding to help unlock some of the key health challenges of our times. Successful applicants will use the funding to develop medical devices—including wearable devices—telehealth and telemedicine, and digitally-enabled personalised medicine.⁸⁴

Government Initiatives

Australian Digital Health Agency (ADHA)

The Australian Digital Health Agency, established in 2016 by the governments of Australia is the system operator for the My Health Record, and a number of other clinical information systems and standards and has also led the development of the National Digital Health Strategy (the Strategy) and its implementation.⁸⁵

Major areas where ADHA is currently working on are:

- a) myHealth Record
- b) National digital health strategy
- c) Interoperability and quality of data
- d) Secure messaging
- e) New innovations

⁸²<https://www.miragenews.com/new-funding-to-ensure-australia-s-health-innovators-are-redi-for-business/>, accessed on 28.08.2020

⁸³

<https://www.pm.gov.au/media/11-billion-support-more-mental-health-medicare-and-domestic-violence-services-0>, accessed on 29.08.2020

⁸⁴

<https://www.health.gov.au/ministers/the-hon-greg-hunt-mp/media/188-million-to-supercharge-digital-health-technologies>, accessed on 21.08.2020

⁸⁵ <https://www.digitalhealth.gov.au/>, accessed on 21.08.2020

“Australia has a national digital health agency which is the overarching agency for digital health. Previously it was a transitional agency but now it's a full agency which handles these national digital health initiatives.”

-Dr Tafheem Ahmad Wani, Tutor, University of Melbourne

The (Australian) National Digital Health Strategy

The Australian Digital Health Agency established by the government of Australia to lead the development of the National Digital Health Strategy (the Strategy) and its implementation. NDHS was designed in August 4,2017 through extensive consultation with the Australian community and comprehensive analysis of the evidence.⁸⁶

The Strategy was launched on July 3,2020 and proposes seven strategic priority outcomes to be achieved by 2022:

1. My Health Record
2. Secure Messaging
3. Interoperability and Data Quality
4. Medicines Safety
5. Digitally Enhanced Models of Care
6. Workforce and Education
7. Driving Innovation

This proposes a number of pioneering initiatives co-produced between consumers, governments, researchers, providers and industry. Opportunities for international expertise include:

1. Investing in the integrated management of chronic illness
2. Developing new digital services to support the health of babies and young children
3. Improving digital services for advanced care planning
4. Improving information sharing in urgent and emergency care
5. Widening access to telehealth services, particularly in rural and regional Australia.

The National Digital Health Strategy will benefit Australians by helping to:

- prevent adverse drug events, reduce medical errors, improve vaccination rates, better coordinate care and better inform treatment decisions;
- sustain a more efficient health system, through less time searching for patient data, reduction of avoidable hospitalisations, and reduced duplication of pathology tests and x-rays which inconveniences patients and increases the cost of healthcare;
- improve healthcare availability and patient experience by putting the patient at the centre of their healthcare, and keeping people out of hospital;
- provide greater access to healthcare for people living in rural and remote areas of Australia;
- protect the national digital health infrastructure and secure the personal health information of Australians.

⁸⁶ <https://conversation.digitalhealth.gov.au/>, accessed on 21.08.2020

Medicare

Medicare is Australia's universal health insurance scheme which aims to ensure that all Australians have access to free or low-cost medical, optometry, midwifery and hospital care and in special circumstances, allied health.⁸⁷ The [Medical Benefits Schedule \(MBS\)](#) lists the medical services covered by Medicare. A Medicare card also gives you access to the [Pharmaceutical Benefits Scheme \(PBS\)](#), i.e. patients only pay part of the cost of many prescription medicines listed on the PBS. The PBS covers the rest of the costs.

Healthier Medicare initiative

The Australian Government wishes to work hand-in-hand with health professionals and patients to deliver a healthier Medicare to ensure Australians continue receiving the high-quality and appropriate care they need as efficiently as possible. To that end, the Australian Government has developed the 'Healthier Medicare' initiative to review three priority areas:⁸⁸

- Medicare Benefits Schedule (MBS) Review Taskforce
- Reform of the Primary Health Care System
- Medicare compliance rules and benchmarks

Researcher Exchange and Development within Industry (REDI) initiative

Is a AU \$32 million investment over 4 years that brings universities and industry together. It will provide researchers with provide researchers with:

- industry placements
- mentoring
- exchange programs
- exposure to entrepreneurialism
- skills in research translation and commercialisation
- a diverse range of experiences beyond the research lab

The Australian Government will fund a service provider to run this program.⁸⁹

Research Data Infrastructure initiative

The Research Data Infrastructure initiative will fund the creation or extension of national research data infrastructure with a focus on data registries, biobanks and data linkage platforms to support Australian medical research. It will provide AU \$80 million over 8 years, starting in 2020–21.⁹⁰

⁸⁷ <https://www.health.gov.au/health-topics/medicar>, accessed on 20.08.2020

⁸⁸ <https://www1.health.gov.au/internet/main/publishing.nsf/Content/healthiermedicare>, accessed on 21.08.2020

⁸⁹

<https://www.health.gov.au/initiatives-and-programs/researcher-exchange-and-development-within-industry-redi-initiative>, accessed on 21.08.2020

⁹⁰ <https://www.health.gov.au/initiatives-and-programs/research-data-infrastructure-initiative>, accessed on 21.08.2020

It is focused on being able to have transparent shared open source data, and making sure we've got the infrastructure that then facilitates data sharing. And it's all about reducing the need to unnecessarily click data being able to pull data together and be able to draw other conclusions that might have been missed if we didn't actually pull that data. It's a very similar philosophy to what we do in health already around data linkage and big data.

-Dr Kerryন Butler-Henderson, Associate Professor of Digital Innovation in Health, University of Tasmania

BioMedTech Horizons initiative

This initiative funds innovative, collaborative health technologies. It drives discoveries that address key health challenges towards proof-of-concept and commercialisation, maximising entrepreneurship and idea potential. It now forms part of the [Medical Research Commercialisation initiative](#).⁹¹

My Health Record

The My Health Record system is the Australian Government's digital health record system that holds My Health Records. It was previously known as a Personally Controlled Electronic Health Record (PCEHR) or eHealth record. A [My Health Record](#) is an online summary of an individual's [health information](#). It allows doctors, hospitals and other healthcare providers involved in the individual's care to view their health information. Individuals can also access their My Health Record online.⁹²

Earlier, My health record had an opt-in system but due to poor response it was shifted by legislation to opt out system. So, technically every Australian has a unique identifier and every Australian has a My Health Record. You just need to actually make time with your general practitioner, to set up the My Health Record.

-Dr Kerryন Butler-Henderson, Associate Professor of Digital Innovation in Health, University of Tasmania

Prioritising Mental Health

Improving telehealth for psychological services in Rural, Regional and Remote Australia-

The Government is providing AU \$9,1 million over four years from 2017-18 to remove barriers to telehealth through enabling better access to psychological services in rural and regional Australia via a range of telehealth delivery channels.⁹³

National Real Time Prescription Monitoring (RTPM)

RTPM provides information to prescribers and pharmacists about a patient's use of controlled medicines when they are considering prescribing or supplying these medicines.⁹⁴

Electronic Prescribing

Allows prescribers and their patients to use an electronic Pharmaceutical Benefits Scheme (PBS) prescription. It forms part of an [Australian Government budget measure](#) to improve PBS efficiency.⁹⁵

⁹¹ <https://www.health.gov.au/initiatives-and-programs/biomedtech-horizons-initiative> accessed on 23.08.2020

⁹² <https://www.oaic.gov.au/privacy/health-information/my-health-record/about-my-health-record/> accessed on 23.08.2020

⁹³ https://www.infrastructure.gov.au/department/statements/2019_2020/ministerial-statement/health.aspx accessed on 23.08.2020

⁹⁴ <https://www.health.gov.au/initiatives-and-programs/national-real-time-prescription-monitoring-rtpm> accessed on 23.08.2020

⁹⁵ <https://www.health.gov.au/resources/publications/health-portfolio-budget-statements-2018-19> accessed on 23.08.2020

Digital health milestones

2005

National E-Health Transition Authority (NEHTA) established to develop the specifications, standards and infrastructure for an interconnected health sector, and create unique health care identifiers for all individuals, providers and organisations (still in use)

2012

Personally Controlled Electronic Health Record (PCEHR) launched

2015

My eHealth Record in the Northern Territory – evaluation report showed exponential increase in usage and benefits, once critical mass was reached

2017

Evaluation of My Health Record opt-out trials in North Queensland and the Nepean Blue Mountains of New South Wales supported recommendation to move to an opt-out model

2019

All Australians have a My Health Record, unless they choose not to

2008

National E-Health Strategy endorsed, leveraging learnings from HealthConnect and building on the NEHTA specifications

2014

Review of PCEHR identifies obstacles to its uptake and recommends a new governance structure, a name change to My Health Record, richer clinical content and a move to an opt-out model of uptake

2016

Australian Digital Health Agency established;
PCEHR renamed My Health Record

2017

Australian Digital Health Agency delivers National Digital Health Strategy aimed at laying a common digital health foundation, in which patients, carers and health care providers are engaged, and on which government industry and researchers can innovate

2005
2019

Recent Developments towards Digitalisation of Healthcare

Australia to Expand Use of and Reimbursement for Telehealth

Prior to the COVID-19 pandemic, telehealth services in Australia (outside select specialty areas, such as psychology) was largely nonexistent due to significant policy, clinical, and reimbursement barriers. As has happened in so many jurisdictions throughout the developed world, the unique challenges posed by COVID-19 precipitated widespread adoption of these clinical systems throughout Australia—at least temporarily. For example, whereas the Federal Medicare system and private insurance sector did not provide reimbursement for most telehealth services prior to the pandemic, various legal and regulatory reforms have resulted in temporarily expanded coverage under both payor systems until September 2020. In March 2020, at the height of Australia's first wave of the COVID-19 pandemic, the Federal Government introduced universal coverage for telehealth services. These sweeping reforms resulted in pushback from the medical community, who cited concerns about the rise in low-value pop-up services. In response, the Federal Government announced that the expanded telehealth coverage would be confined to telehealth sessions conducted by a patient's regular general practitioner, effective from July 20, 2020. As the expiration date for these temporary changes looms closer, technology companies, advocacy organizations for vulnerable people, and other stakeholders are lobbying for the Federal Government to permanently retain reimbursement expansion for telehealth services. In the coming months, Australia may find itself adopting permanent legal and regulatory structures to support telehealth services despite the existence of nearly insurmountable barriers less than a year prior. The COVID-19 pandemic is, yet again, proving to be a potent catalyst for the long-overdue adoption of telehealth systems to provide care for patients throughout the world.⁹⁷

The Melbourne Ecosystem – the first Australian digital health ecosystem

RMIT has partnered with the European Connected Health Alliance (ECHAlliance) for the launch of a digital health ecosystem in Australia that will strengthen the connections between patients, clinicians, researchers, policy makers, technology providers and the community.

The Melbourne Ecosystem – the first Australian digital health ecosystem – brings together people in the health and social care sectors with the aim to break down silos and open up opportunities for collaboration through regular meetings, events and online platforms and tools.

These cross border collaborations would cater to a very important setting which is information in silos and lack of interoperability or transfer of information.
-Dr Tafheem Ahmad Wani, Tutor, University of Melbourne

The Melbourne Ecosystem joins an international network of digital health ecosystems across three continents. "The Melbourne Ecosystem will engage with ecosystems across the world, further providing knowledge exchange opportunities for Australian researchers, health providers and community groups."⁹⁸

⁹⁶ <https://www.mja.com.au/journal/2019/210/6/australias-digital-health-journey> accessed on 21.08.2020

⁹⁷ <https://www.jdsupra.com/legalnews/vital-signs-digital-health-law-update-24098/> accessed on 23.08.2020

⁹⁸ <https://www.rmit.edu.au/news/all-news/2019/nov/australian-launch-of-digital-health-ecosystem> accessed on 21.08.2020

Road Ahead

Respondents to a survey undertaken in May 2020 believe that telehealth-related digital health technologies will be the biggest beneficiaries of the pandemic (85,3%), followed by remote monitoring (67,6%). However, they are hopeful that data analytics will also benefit (35,3%), along with mental health-related technologies (29,4%) and self-testing (26,5%)⁹⁹. No respondents believed that no aspect of digital health will not benefit from the pandemic.

Finally, more than half (53%) of our May 2020 respondents are convinced that COVID-19 will leave a permanent imprint on the digital health industry. Another 26,5% believe that it will only make its mark for one or two years.

As a market to develop new digital health solutions, or a launchpad into Southeast Asia, Australia is an ideal place to do business. There are more than 30 incubators and accelerators across the country, with ANDHealth providing a dedicated ecosystem for the development and commercialisation of evidence-based digital health products. Supported by a highly skilled and technology-driven workforce and backed by leading research institutions, Australian expertise across medtech and health is world class.¹⁰⁰

Australia has been ranked first in the developed world for health care outcomes and administrative efficiency and second overall for our healthcare system by the Commonwealth Fund. Australian healthcare system delivers a long life expectancy at a low cost - just US \$4.207 per capita, compared with US \$9.364 for the US.

The leadership of the Global Digital Health Partnership, a collaboration of 23 countries and the World Health Organisation, reflects their commitment to and excellence in digital health.

Australia needs to invest in the cyberspace and they have created a cybersecurity center but lacks people with the skills and infrastructure to tackle these issues. The government has funded more than a billion dollar for cybersecurity especially in healthcare. The value of healthcare information is a lot and it has been a target of cyber attackers so there's a high need to have strong mechanisms in place to prevent those issues.

-Dr Tafheem Ahmad Wani, Tutor, University of Melbourne

⁹⁹ https://andhealth.com.au/wp-content/uploads/2020/07/Digital-Health_-_Australias-Sleeping-Giant_FINAL.pdf accessed on 25.08.2020

¹⁰⁰ <https://www.austrade.gov.au/DigitalHealth/why-australia> accessed on 23.08.2020

Part II

Competitive Intelligence

Approximately 80% of the medical devices used in Australia are imported and the domestic manufacturing industry is controlled by subsidiaries of large, global corporations namely:

Category-Digital healthcare Devices

S.No.	Name	Headquarters	Founding year	Website	Contribution	Article Link
1	Johnson & Johnson	New Brunswick, New Jersey, United States	1931	https://www.jnj.com.au/	-Works for verticals-Consumer Healthcare, Medical Devices & Diagnostics and pharmaceuticals.	https://fortune.com/2020/08/14/johnson-johnson-thirty-madison/
2	Philips HealthCare	Amsterdam, Netherlands	1891	https://www.philips.com.au/healthcare	-Philips helps Sydney Adventist Hospital to streamline their procedures in the hybrid OR.	https://www.philips.com.au/
3	Medtronic Inc.	Dublin, Ireland	1973	https://www.medtronic.com/au-en/about/contact-us.htm	Medtronic and ChristianaCare are working to standardize an enhanced respiratory monitoring initiative to help address OIVI (opioid-induced ventilatory impairment); the project is designed to identify patients receiving opioids for pain management who are at high risk for OIVI and apply continuous monitoring technology to track breathing, and help alert the care team to abnormal trends.	https://www.healthcareitnews.com/
4	GE HealthCare	Chicago, Illinois	1994	https://www.gehealthcare.com.au/	have launched the Thoracic Care Suite, which uses AI to scan for eight chest X-ray abnormalities, including pneumonia indicative of COVID-19, which is a key cause of mortality in patients who contract the virus.	https://www.gehealthcare.com/article/
5	Siemens AG	Munich, Germany		https://new.siemens.com/au/en/company/about/contact.html	are working to develop a digital twin of the heart not only for diagnosis, but also for testing the safety of treatments.	https://www.siemens-healthineers.com/

Category - Diagnostics

S.No.	Name	Headquarters	Founding year	Website	Contribution	Article Link
1	I-MED Radiology Network	Sydney, NSW.	2000	https://i-med.com.au/home	-Providing e-referrals for practitioners -Ehealth for practitioners	https://i-med.com.au/media/alfred-medical-imaging
2	Sonic Healthcare	Sydney NSW	1987	https://www.sonichealthcare.com/#/	-laboratory medicine/pathology, radiology/diagnostic imaging and primary care medical services.	https://www.sonichealthcare.com/#/
3	Healius	St Leonards, Australia	1985	https://www.healius.com.au/	-Acting on the Evidence education series with their education partners. These are a series of 3 short videos followed by a webinar with 3 specialists to answer all your questions related to the topic in their specialties of endocrinology, cardiology and nephrology.	
4	Integral Diagnostics	Australia	2008	https://www.integraldiagnostics.com.au/	The Company adopts a fully integrated digital imaging (filmless) solution.	https://www.integraldiagnostics.com.au/page/what-we-do/

Category- e pharmacy

S.No.	Name	Headquarters	Founding year	Website	Contribution	Article Link
1	My Chemist Retail Group	Melbourne	2000	https://www.mychemist.com.au/	The company's line of business includes the retail sale of prescription drugs, proprietary drugs, and non-prescription medicines.	https://www.bloomberq.com/profile/company/1248759D:AU
2	Sigma Healthcare	Victoria, Australia	1912	https://sigmahealthcare.com.au/	Full line wholesale and distribution business to community and hospital pharmacy.	https://sigmahealthcare.com.au/
3	EBOS Group	New Zealand	1989	https://www.ebosgroup.com/	Australasian marketer, wholesaler and distributor of healthcare, medical and pharmaceutical products.	https://www.ebosgroup.com/about-us/our-company/
4	API	Washington, D.C., United States	1910	http://www.api.net.au/	Involved in pharmaceutical distribution, retailing and manufacturing	http://www.api.net.au/

Apart from above, as per consumers rating based on their service & advice, range of products, prescription availability & speed of dispensing, availability of pharmacist, value for money and overall satisfaction:

S.No.	Name	Headquarters	Founding year	Website	Contribution	Article Link
1	Good Price Pharmacy Warehouse	Queensland, Australia	2003	https://www.goodpricepharmacy.com.au/	Is actively working on the e-sale of medicines (prescription ordering also) personal care, baby care and equipments	https://www.canstarblue.com.au/stores-services/pharmacies/
2	Discount Drug Stores	Queensland, Australia	2001	https://www.discountdrugstores.com.au/	Drugs can be ordered online and Discount Drug Stores app will send you reminders when it is time to take your medication and order a new supply	https://www.discountdrugstores.com.au/health-services
3	Terry White Chemmart	Queensland, Australia	1959	https://www.terrywhitechemmart.com.au/	Have TerryWhite Chemmart Health App to order your prescription medications, add health essential items and either pick up in store or have delivered. It accepts eScripts (electronic prescription) to dispense medicines.	https://www.terrywhitechemmart.com.au/escripts/
4	Amcal	Melbourne, VIC,	1937	https://www.amcal.com.au/	Launched amcal app to allow customers to select an Amcal pharmacy to fulfil their prescriptions digitally. -AMCAL in collaboration with QMS and Nunn Media have set up digital billboards that broadcast live pollen count warnings for different areas using data from Breezometer.	https://rpassistants.com.au/news/amcal-launches-new-app/ https://mumbrella.com.au/amcal-pharmacy-launches-live-pollen-count-billboards-to-help-hay-fever-sufferers-601958
5	Pharmacy4Less	Strathfield, NSW	2007	https://www.pharmacy4less.com.au/	Has a network of over 100 stores Australia-wide, making it Australia's fastest growing discount pharmacy chain. Is actively working on the e-sale of medicines (prescription ordering also) personal care, baby care and equipments	https://ajp.com.au/news/pharmacy-businesses-enter-administration/

Category- HIS/EMR/EHR

S.No.	Name	Headquarters	Founding year	Website	Contribution	Article Link
1	Siemens	Munich, Germany	1847	https://new.siemens.com/au/en.html	Developed digital care application, teamplay myCare Companion 'Pandemic' used for suspected COVID-19 patients.	https://www.siemens-healthineers.com/en-au/news/bendigo-teamplay-mycare.html

2	Cerner	Missouri, United States	1979	https://www.cerner.com/ap/en	Enable safe, digitised patient care across the healthcare facilities with Millennium® Electronic Health Record (EHR),.Also have HealthIntent® platform i.e. integrating whole health systems to enable next generation population health management.	https://www.cerner.com/se/en/about
3	Allscripts	Illinois, United States	1986	https://au.allscripts.com/	Has launched many innovative products such as Allscripts' innovative products, including Sunrise PAS and EMR module, as well as EMR-agnostic population health solutions including dbMotion.	https://investor.allscripts.com/news-releases/news-release-details/allscripts-extend-emr-offerings-australia
4	InterSystems	Massachusetts, United States	1978	https://www.intersystems.com/au/	Launched TrakCare clinical system that allows healthcare professionals to use touchscreen devices to create patient notes with swipes and taps, capture images and barcodes via camera, and add information by voice.	https://www.healthcareit.com.au/article
5	NEC	Tokyo, Japan	1899	https://www.nec.com.au/	Sign Foundation Partnership with the NSW Government for the State's Digital and Technology Revolution	https://www.nec.com.au/insights/media
6	Fujitsu	Tokyo, Japan	1972	https://www.fujitsu.com/au/	Developed Fujitsu Healthcare Solution Healthcare Personal service Platform, a platform-as-a-service (PaaS) for the integrated management of consumer-facing offerings based on health and medical information	https://www.bisinfotech.com/
7	MediTech	Massachusetts, United States	1969	https://ehr.meditech.com/global/meditech-asia-pacific	MEDITECH's Diabetes Prevention Toolkit — an extension of our Diabetes Management Toolkit — helps organizations to take a proactive approach by identifying and monitoring patients who are either at risk for prediabetes or are already prediabetic.	https://ehr.meditech.com/news/

Category- Telemedicine

S.No.	Name	Headquarters	Founding year	Website	Contribution	Article Link
1	DoctorOnDemand	California, United States	2015	https://www.doctorsondemand.com.au/	Is bridging the gap between General Practice and Community Pharmacy by providing 24/7 on-demand access to qualified Australian doctors and prescription medications when and where it is needed most.	https://www.mobihalthnews.com/news/doctor-demand-collects-75m-series-d
2	HealthTap	Mountain View (HQ), CA United States	2010	https://www.healthtap.com/	Use artificial intelligence to "interview" members, and triage (classify and prioritize) their symptoms. The results from HealthTap AI can be used by themselves, or inform one of HealthTap's doctors in a virtual consultation.	https://en.wikipedia.org/wiki/HealthTap
3	doctoroo	Sydney, Australia	2016	https://www.doctoroo.com.au/	Offers telemedicine services	https://ajp.com.au/news/gp-app-eases-codeine-trouble/
4	LiveHealth Online	Miramar, Florida	2013	https://livehealthonline.com/	Work with healthcare providers as a cloud based POS(point of sale) and EMR (electronic medical records) platform.	https://www.healthline.com/health/best-telemedicine-companies https://www.proactiveinvestors.com.au/companies/news/923434/cardio-x-strengthens-partnership-and-collaboration-deal-with-us-based-inhealth-medical-923434.html

Category- Hospital / Institutes

S.No.	Name	Headquarters	Founding year	Website	Contribution	Article Link
1	Royal Children's Hospital	50 Flemington Road Parkville, Victoria 3052	1870	https://www.baker.edu.au/	Launched a new drive-through immunisation service at the RCH. This service will operate on Tuesdays and Wednesdays and aims to help make it easier for families to access these important vaccinations.	https://www.rch.org.au/immunisation/

2	Department Health & Human Services of Tasmania Royal Hobart Hospital	St. Hobart TAS 7000, Australia	1804	https://www.health.tas.gov.au/		
3	Baker Heart Research Institute	Melbourne, Victoria	1926	https://www.rch.org.au/home/	Discovered two new cell types that may be the key drivers of heart failure.	https://baker.edu.au/news/institute-news/new-heart-cells
4	Children's Hospital at Westmead	Westmead 2145	1880	https://www.schn.health.nsw.gov.au/hospitals/c/hw	Is arming its clinicians and workforce managers with a real-time dashboard which shows at a glance how many COVID-19-positive children are inpatients at its two hospitals, and in which wards, and where any affected outpatients reside.	https://www.schn.health.nsw.gov.au/news/articles/2020/05/using-emr-data-in-the-fight-against-covid-19
5	Royal Adelaide Hospital	Adelaide SA	1840	https://www.rah.sa.gov.au/	Successfully carried out australia's first kidney and pancreas transplant for type 2 diabetes.	https://www.rah.sa.gov.au/news/australian-first-kidney-pancreas-transplant-for-type-2-diabetes-patient

S.No.	Name	Headquarters	Founding Year	Website link	Contribution	Article link
1	University of Sydney	Sydney	1850	https://www.sydney.edu.au/	Pioneered a 3D-printed ceramic implant that could transform the lives of millions of people with bone defects.	https://www.sydney.edu.au/research/
2	University of Melbourne	Melbourne	1853	https://www.unimelb.edu.au/	A device to detect and eventually predict epileptic seizures is undergoing a Phase I clinical trial. It was developed by Epi-Minder, which has raised AU \$10 million in initial investment.	https://research.unimelb.edu.au/
3	The University of Queensland	Queensland	1909	https://about.uq.edu.au/	Developed a simple tool called Geriatric Anxiety Inventory (GAI) to detect anxiety in older adults, and it's being used around the world.	https://stories.uq.edu.au/research/

Part III

Expert Profile & Opinion

Australia's decades-long policy of supporting innovation, significant investment into digital health capabilities and infrastructure, and now it's successful management of the COVID-19 pandemic has given Australia an unprecedented opportunity to build a world-leading digital health industry.

Though the industry is hampered by key commercialisation challenges: access to capital, access to customers, and access to expertise necessary to commercialise (regulation, reimbursement and overseas markets) in this nascent and evolving space.

The COVID-19 pandemic has been a catalyst for swift, wholesale change to the way we view healthcare in the modern world.

In the first half of 2020 Australia has seen significant reform to reimbursement for telehealth and virtual care services, increased acceptance of digital health technologies by the medical community and patients, and a widespread recognition of the need to embrace digital health, in all its forms, to create a resilient, pandemic-proof healthcare system.¹⁰¹

This report covers some of the thought leaders' opinion and insights from industry players on digitalisation of healthcare and cross border collaboration opportunities and challenges. Expert opinions (in person view point) are shared by the following experts. (Read more on expert opinion from annex IV)

1. Dr Tafheem Ahmad Wani, Tutor, University of Melbourne
2. Sanji Kanagalingam, Executive Director, Curve Tomorrow
3. Dr Kerryyn Butler-Henderson, Associate Professor of Digital Innovation in Health, University of Tasmania
4. Dr. Sunita Chauhan, Director, Robotics & Mechatronics Engineering and Professor, Mechanical & Aerospace Engineering, Monash University
5. Bronwyn Le Grice bio, Founder, CEO & Managing Director, ANDHealth

¹⁰¹ https://andhealth.com.au/wp-content/uploads/2020/07/Digital-Health_-Australias-Sleeping-Giant_FINAL.pdf accessed on 15.09.2020

Part IV

Summary

Australia is a compelling destination to develop, commercialise, scale and source the next generation of digital health technologies. They have a strong track record in health. As the inventors of the Cochlear implant, spray-on skin, the cervical cancer vaccine and a cure for peptic ulcers, Australian health and medical research is changing lives for the better. Australia has embraced digital health to provide new ways of delivering services and to radically transform current processes, improve outcomes and increase efficiencies, creating opportunities for collaboration and investment.

The Australian Government is continuing to invest in digital health infrastructure, and notable projects include:

- A National Digital Health Strategy, with pioneering initiatives co-produced between consumers, governments, researchers, providers and industry. This includes a framework for secondary data use
- My Health Record, a personally controlled electronic health record covering over 90% of Australian residents
- The \$20 billion Medical Research Future fund, the largest endowment fund of its kind in the world.

62% of Australians are using technology to better manage their health. 91% believe technology can help them better manage their health.¹⁰²

Opportunities for collaboration

The leadership of the Global Digital Health Partnership¹⁰³, a collaboration of 23 countries and the World Health Organisation, reflects Australia's commitment to and excellence in digital health. Australia's digital health market, valued at US\$1,488 billion in 2017, is expected to grow to US\$1,851 billion in 2020.

The Australian Digital Health Agency's National Digital Health Strategy 2018–2022¹⁰⁴ proposes a number of pioneering initiatives co-produced between consumers, governments, researchers, providers and industry. Opportunities for international expertise include:

- Investing in the integrated management of chronic illness
- Developing new digital services to support the health of babies and young children
- Improving digital services for advanced care planning
- Improving information sharing in urgent and emergency care
- Widening access to telehealth services, particularly in rural and regional Australia.

As a market to develop new digital health solutions, or a launchpad into Southeast Asia, Australia is an ideal place to do business. There are more than 30 incubators and accelerators across the country, with ANDHealth¹⁰⁵ providing a dedicated ecosystem for the development and commercialisation of evidence-based digital health products. Supported by a highly skilled and technology-driven workforce and backed by leading research institutions, Australian expertise across medtech and health is world class. Australia has been ranked first in the developed world for health care outcomes and administrative efficiency and second overall for our healthcare system by the Commonwealth Fund. Australian healthcare system delivers a long life expectancy at a low cost - just US\$4.207 per capita, compared with US\$9.364 for the US.

¹⁰² <https://www.austrade.gov.au/DigitalHealth/why-australia>

¹⁰³ <https://www.gdhp.org/>

¹⁰⁴ <https://conversation.digitalhealth.gov.au/australias-national-digital-health-strategy>

¹⁰⁵ <https://andhealth.com.au/>

Contacts

Eleri Seer

Project Manager
Tartu Biotechnology Park
eleri@biopark.ee

Parthvee Jain

Head-Market Access & Partnerships
InnovatioCuris Pvt Ltd
parthvee@innovatiocuris.com

Sachin Gaur

Director Operations
InnovatioCuris Pvt Ltd
sachin@innovatiocuris.com



ANNEX I



IDA-TALLINNA KESKHAIGLA

East-Tallinn Central Hospital

East-Tallinn central hospital is one of the two major hospitals in the capital of Estonia, Tallinn. There are 7 individual clinics at the heart of East Tallinn Central Hospital – Diagnostic Clinic, Clinic of Internal Medicine, Eye Clinic, Women's Clinic, Surgery Clinic, Clinic of Medical Rehabilitation and Long-Term Nursing Clinic. Clinics in turn include centers and departments which are focused on a specialty in a more strict meaning. Medical operation is supported by administration and several services.¹⁰⁶



Tallinn University of Technology (TalTech)

TalTech is the only technological university in Estonia, is the flagship of Estonian engineering and technology education. Here the synergy between different fields (technological, natural, exact, economic and health sciences) is created and new ideas are born. TalTech is to become one of the leading technological universities in the Baltic Sea region. TalTech is a university, which by relying on academic competencies and professional management, responds actively to the needs of the rapidly developing society and is involved in tackling the challenges of the digital era.¹⁰⁷

Expert: Dr Peeter Ross, professor of e-health and senior research scientist in eMedicine Lab, Tallinn University of Technology.

Peeter also holds a radiologists position in East Tallinn Central Hospital, Estonia. He is a founder and member of the board of e-health and radiology consulting company SMIS International OÜ and OÜ Safe To Act.

Dr. Ross has previously worked as a Director of R&D and a Head of Diagnostic Clinic in East Tallinn Central Hospital and as an e-health expert at Estonian E-Health Foundation. He has been a member of the supervisory board of the Estonian E-Health Foundation and Estonian Health Insurance Fund.

Peeter Ross studied medicine in Tartu University, Estonia, and in Helsinki University, Finland 1985-91. Dr. Ross completed residency in radiology in Tartu University in 1996. He studied radiology in Oulu University, Finland, and in the Armed Forces Institute of Pathology, Washington DC, USA, as well as health care

¹⁰⁶ <https://www.itk.ee/en/hospital>, accessed 02.09.2020

¹⁰⁷ <https://old.taltech.ee/university/ttu-in-brief/about-university/>, accessed 02.09.2020

management in INSEAD, France. He received a PhD degree in Medical Engineering in Tallinn University of Technology in 2011. The title of his thesis work was Data sharing and shared workflows in medical imaging. His current research topics are medical terminology, integration of home monitoring data with large scale health databases and citizen on-line access to personal health related data.

Peeter Ross has participated in EU funded eHealth projects InterregPacs, Baltic eHealth, R-Bay, Dreaming, Regional Telemedicine Forum, epSOS, eMedic and Chromed. Peeter Ross is a past president (2005-2011) of Estonian Society of Radiology.

In expert's personal opinion:

The Estonian digital healthcare system is one of the best in the world. They have 4 major health databases on which are based different services - healthcare system, Estonian Health Insurance Fund, Estonian Bank of Healthcare Images and Estonian Biocentre. Estonian Biocentre has restricted access, but other three are accessible for those who have the right to watch these and to patients. We have all digital - e-prescription, e-consultation and digital health history, etc.

The biggest investments to digital health in Estonia are made by the government and major hospitals, the private sector investments are rather small.

The next steps of e-health are the standardisation of health and medicine data and making it readable for computers. Now there is still a lot of free text and computers are used like typing machines, as now there is no standardised terminology and standards and methodologies of data, the possibilities using a computer cannot be used. When the aforementioned shortages are eliminated, there would be possibility for using digital decision support and for using AI. Bigger involvement in people to their healthcare - people could insert their complaints to the healthcare system before visiting a doctor. Also the health data gathered by patients could be used for medicine (eg activity monitors, health applications, etc).



REPUBLIC OF ESTONIA
MINISTRY OF SOCIAL AFFAIRS

Ministry of Social Affairs

The role of the Ministry of Social Affairs is to plan the health care policy and organise its implementation.

One of the responsibilities of ministry is E-Health as a cooperative network of health services based on digital solutions, which supports the promotion of consistency of the treatment, timeliness of the services, and patient satisfaction.

The Digital Health Information System contains health data that hospitals, family physicians and other providers of health services enter there. Health data concerning each person is collected in the system and everyone has an opportunity to see their health data from the patient's portal www.digilugu.ee

Expert: Kalle Killar, Deputy Secretary General on E-services Development and Innovation in Estonian Ministry of Social Affairs

In expert's personal opinion:

Digital health in Estonia is a centralized system that serves all healthcare sector providers. We aim to keep the centralised approach and our objective is to enhance the centralized services for different healthcare sector providers and also for the patients using the existing infrastructure that we have been putting in place for e-health. Our idea is that we see the strengths in having centralized data exchange in the healthcare sector and see the advantage of building these new services both for service providers and citizens.

We just launched one year ago the countrywide digital registration for specialised healthcare – as a citizen, you can enter the patient portal and book a time for specialized healthcare no matter where the healthcare provider in Estonia is and we are trying to improve the service to make it more user friendly and to amend different aspects into this service.

The main initiative is that we have now started – what is quite long-term 5 years or more - that we want to upgrade the healthcare system as such. There is one side of technical depth that we need to address. Supporting infrastructure that is keeping our e-health system alive is rather old, we need to upgrade this to new principles.

The second aspect is that currently the E-health information system is gathering all the information but unfortunately this information is rather unstructured and it is not easy for doctors and patients to get good information out of it. Figurative speech is currently a pile of electronic papers, from where it is hard to see latest developments in the patient situation, an overview of the patient situation and it is difficult for doctors to see what has happened to the patient in other healthcare providers. It is possible but is very time consuming and we see that this is the main obstacle we need to address to provide quality care and also to provide to patients and citizens an understandable overview of the treatments and health situation.

We need to have better interaction with the patients that means of course joint cure plans with patients.

This is very much expected from different counterparts because the current system has not changed for 15 years. There have been changes here and there new services but it's getting harder to create the services and that's why we need to upgrade the healthcare system.

We haven't been invested a lot recently, but our plans are together with the Health Insurance Fund and EU Funds to address the shortcomings in our e-health system in coming 5 years.



The main task of the Health Insurance Fund is to organize national health insurance to provide insured people with access to necessary healthcare services, medicines, medical equipment and cash benefits.

The Health Insurance Fund is guided by two principles when organizing health insurance:

Solidarity - Currently employed insured persons cover the costs of health insurance for those currently unemployed. It means solidarity between generations - the cost of healthcare for children, students and pensioners is fully covered by those currently employed. It also means solidarity between employed persons whose financial contribution to the health insurance depends on their income, not on their personal health risks, and who receive health insurance benefits on an equal basis, regardless of the size of their financial contribution.

Equal treatment - We guarantee equal rights and equal treatment for all insured persons and partners in accordance with applicable legislation.

The Estonian health insurance system complies with internationally approved principles:

- As much of the population as possible must be covered with health insurance.
- The scope of health insurance must be as wide as possible, i.e. based on the principle of solidarity, health insurance must offer a package of health services that is as comprehensive, coherent and modern as possible.
- Health insurance must be as far-reaching as possible, i.e. the out-of-pocket expenses of a person in the total cost of treatment must be optimal and should not lead to poverty risk.

Strategic goals of the Estonian Health Insurance Fund until 2022

- People are able to take better care of their health.
- Health insurance benefits are available, and their choice extends expediently.
- High-quality healthcare services ensure comprehensive patient care.
- The Health Insurance Fund is a health insurance organization valued by insured persons and partners.

Expert: Kitty Kubo, Innovation Lead, Estonian Health Insurance Fund

In expert's personal opinion:

Usage of digital health applications (outside digital healthcare system) is underdeveloped in Estonia, because in Estonian healthcare system digital health applications are not used or funded.

Digital healthcare industry is lacking in Estonia as the Estonian Health Insurance Fund is the main healthcare insurance provider and it has slowed down the process. Hopefully Estonian Health Insurance Fund will turn from hinderer to accelerator. There are other obstacles when the financing part is solved through the financing these services:

- 1) Lack of skills, willingness and will take into use these applications.
- 2) Framework for digital health is lacking - supporting early stage innovation is not sufficient - digital health ecosystem and funding should give better results. Estonian Health Insurance Fund is funding only mature enterprises, but if you look at investments in the risk capital in digitalisation of healthcare there are only few larger investments. Which is not in proportion compared to the size of the other economic fields. There should be more mature enterprises.
- 3) Readiness of patients to accept digital solutions. Although internet with good connection speed is available in peripheral areas, the persons who would need the remote assistance the most are elderly, sicker people with lower levels of education, who may not have the equipment or skills needed. The problem will solve in 10-15 years, but now we can't ignore it. We would like that elderly people with

chronic diseases would be monitored through remote surveillance methods, information about the patient's condition would move to the doctor and the doctors would have a better decision base for medication etc.

In 5 years time the remote services will be available and routinely used in healthcare. It would be common practice that in addition to procedures and medications to get a possibility to use an app that would help patients to cope better with the sickness, help to remember to take the medications etc. Digital health would have become a natural part of common healthcare.

Cross-border cooperation is important also in assessing and regulating the applications from European Healthcare insurance companies. Now all the states of European Union are independent in their healthcare digitalisation. So the enterprises working in this field need to learn the difficult regulation of healthcare in each country, also prove to every local healthcare insurance the efficiency of your operation and costefficiency and these enterprises are funded on different bases in every country. It is really hard to offer the same service. Solution would be more coordinated activities of healthcare insurance companies.

ELIKO Tehnoloogia Arenduskeskus OÜ

Eliko was created over 10 years ago by the Estonian software and electronics industry and the Tallinn University of Technology. They have since published numerous pieces of original research, acquired patents and developed innovative products for their clients.

Eliko's core competence is in the Internet of Things (IoT) related technologies. Eliko launched an Internet of Things (IoT) driven industrial R&D program in 2015. The aim is to help companies develop competitive products through active collaboration with universities. This is to ensure that companies invest in future-proof technologies in the IoT.

The program has two focus areas. Projects under the first area, sensing and signal processing in the IoT, develop algorithms suitable for compact and energy efficient electronic devices. Better energy efficiency is essential for future connected applications.

In the second focus area, Eliko designs software and communication solutions that simplify data transmission in the IoT environment. IoT infrastructures, applications and services combine complex sets of technologies to deliver end-user applications for smart cities, smart factories and the smart home.

The program includes 22 industry-led R&D projects in a range of fields. The Competence Centre Project is financed by the European Regional Development Fund with 6 996 700 euros.

Expert: Carmen Siitsman, R&D Program Manager

Carmen Siitsman PhD (chemical and materials technology) works as R&D Program Manager in ELIKO Competence Centre in Electronics-, Info- and Communication Technologies. Her main responsibilities are initiating and organizing new research projects (impedance in medical technology; projects about real-time positioning systems and IoT) and coordinating and writing EU funding applications about related technologies.

In expert's personal opinion:

Currently there is a project in progress to integrate real-time location and activity data to rehabilitation processes - to evaluate the effectiveness of rehabilitation treatment.

The upcoming innovation in digital health will be a broader use of patient home monitoring in recovery time to reduce the hospital days and increase effectiveness of treatment (eg correct exercises, moving etc) and generally wider usage of different sensors.

When the readiness level of technologies increases (e.g. complexity of infrastructure of indoor location systems decreases), then prices of those technologies will hopefully drop and it will be more affordable.

We encourage business leaders and technicians to think innovatively, to take the time to learn about (new and future) technologies and to seek advice from experts in their field. Innovation refers to an increase in competitive advantage.



Clinical Research Centre, Institute of Clinical Medicine, University of Tartu

The goal of the National Centre of Translational and Clinical Research (CTM) for the period 2017-2020 is to develop a clinical research unit. In connection with that, the partners of the project (University of Tartu, Estonian University of Life Sciences and Tartu University Hospital) are developing the Clinical Research Centre. As a result of that, the total CTM's structure will ensure the technologies and strong support system needed for the preclinical and clinical field. This is going to enable to organize high standard health surveys in Estonia, which will improve our international impact.

The Clinical Research Centre:

- organizes clinical project management and courses to ensure high-quality clinical trials;
- advises with the applications for an ethics committee and State Agency of Medicines approvals;
- provides support with questions regarding both clinical and translational research;
- assists with organizing biobanks and biological materials;
- consults on writing grant proposals;
- helps to find funding for existing project ideas.



NATIONAL CENTRE OF
TRANSLATIONAL AND CLINICAL
RESEARCH

National Centre of Transnational and Clinical Research

The general aim of CTM is to improve the quality and innovation in the health research in Estonia. The Centre brings together researchers working in different areas in health research, and combines competencies from diverse areas of medical research. CTM is a partner for the state, businesses and society to provide expertise in the field of health research. The National Centre of Translational and Clinical Research (CTM) is a national research infrastructure formed by the University of Tartu, Estonian University of Life Sciences and Tartu University Hospital in 2010. From the same moment, the Centre was added to the list of Estonian Research Infrastructures Roadmap. As a result of the first period, the Laboratory Animal Centre has been established. During the second period (2017-2020) we are developing services of the Clinical Research Centre.

The vision of CTM is to implement Estonian research, development and innovation (R&D&I) strategy for health.

The mission of CTM is to ensure a high level medical research and efficient medical innovation in Estonia. In order to accomplish its mission, the Centre develops and maintains high-level internationally recognized infrastructure for medical research. CTM aims to be a professional partner to various stakeholders (companies, government agencies, health care institutions, other organisations) and advise them in the field of health research.

Expert: Katrin Kaarna MD, Head of Clinical Research Centre, Institute of Clinical Medicine, University of Tartu

Clinical Research Coordinator of Tartu University Hospital.

CEO, Project of National Centre for Translational and Clinical Research

Long - term demonstrated history of working in pharma (5 years) and in the clinical research industry (18,5 years). Skilled in Management of people and teams at local, sub-regional, Central European and Global level. Experienced Neurologist. Strong healthcare services professional graduated from University of Tartu.

In expert's personal opinion:

Current scenario of Estonian healthcare:

In medical field:

- All Estonian patients/ citizens have digital health records
- Hospitals are using electronic health records
- Medicines are prescribed for the patients only in a digital way
- Estonian patients can use e- booking for the appointment with medical doctors

The biggest problem in Estonian healthcare is that data is kept in different databases and the interactions between those databases are not always sufficient and reliable.

I see that 5 years from now genomic data will be used in prophylactic suggestions for the life-style, in clinical practice and in the prescription process of medications.

Tervisetehnoloogiate Arenduskeskus AS (The Competence Centre on Health Technologies, CCHT)

CCHT is a biotechnology company focused on research and product development in personal medicine, drug development and both human and veterinary reproductive medicine. We collaborate closely with leading Estonian scientists, universities and biotechnology companies as well as scientific, medical and R&D institutions from Europe, Asia and America.

Personalised Medicine Development Area (DA) is focused on eliminating several bottlenecks that globally hinder the application of the achievements of molecular medicine and info- and communication technology (ICT) in the interests of human health. Therefore, we have set the general aims of personalised medicine DA as combining the recent key advances in medical and population genetics, bioinformatics, E-Health and ICT in general, to develop preventive, diagnostic and treatment algorithms and decision-support systems for personalised medicine for common complex diseases and cancer.

Expert: Andres Salumets, PhD

Andres Salumets is a biologist and biochemist, currently Professor of Reproductive Medicine at the University of Tartu, where he completed his Undergraduate and Graduate studies. In October 2003 he received his PhD at the University of Helsinki with the academic dissertation "Effects of embryological parameters on the success of fresh and frozen embryo transfers". Salumets is currently President of the Baltic Fertility Society; he's been a member of the Executive Committee (2013–2015) of the European Society of Human Reproduction and Embryology and has a significant number of publications in several scientific journals. He is also a Board Member at the Competence Center for Reproductive Medicine and Biology, as well as Project Manager for the scientific synergy "Novel approaches for human infertility diagnostics" for the sub-project: "Endometrial receptivity: systems biology approach".

In expert's personal opinion:

Market is small, we need to grow to stay alive. If we grow outside of Estonia, there is a question if you are Estonian company anymore or not, if you look at the commercial side.

In the public sector one of the shortcomings is the lack of personnel who would understand or be able to thrive some kind of innovation or push this process further.

We are living in the situation where the Money is not problem – if there is enough interest or skills from ordering side – several things from science sector you can find finances from different programs, funds , but if you are not able to order anything the innovation cannot be supported if it is not somebodies dear aim or somebodies problem. It should be issued from public level, ministry level each year gathering milestones to push it further.

We are Developing solutions to create solutions and data structure for big data for animal health. This data should be gathered since the first-second day and it should be gathered 24/7. It is an initiative itself, It doesn't say how the state can win out of using this kind of data if there are no good examples of other countries to follow and you are a leader, it might be difficult. There is a passive or hesitating position – people are not sure if they should be such a needy country.

ANNEX II

Interoperable Electronic Health Records

MoHFW has envisaged establishing a system for interoperable Electronic Health Records (EHRs) of citizens to be created, made available and accessible online to facilitate continuity of care, better affordability and better health outcome and better decision support system. Following initiatives have been undertaken:

- **EHR Standards:** (revised version of 2013 Standards) has been notified in December, 2016. The EHR Standards include standards for Disease Classification, Medicine and Clinical terminology, Laboratory Data exchange, Digital Imaging and Communication etc. for semantic interoperability.
- **Metadata & Data Standards (MDDS):** To enable semantic interoperability among healthcare applications MDDS standards were developed following the guidelines of Ministry of Electronics and Information Technology (MeitY) and open standards policies of GOI. The MDDS standards have more than 1000 data elements to be used in healthcare applications and are aligned with the global health IT standards. The approved MDDS standards have been notified by MeitY in August, 2018.
- **National Identification Number (NIN) to Health Facilities in India:** A unique identification number, which a key requirement for achieving interoperability and creation of EHRs, is being assigned to all health facilities (both public & private) to facilitate interoperability among health IT systems deployed. So far approximately 99% of public health facilities have been allocated NIN.
- **Hospital Information System (HIS):** HIS is being implemented for computerized registration and capturing EHR/ EMR of patients in Public Health facilities upto PHC level. This will also facilitate workflow management leading to better delivery of services to patients and improvement in efficiency of processes in these facilities. So far, financial assistance provided to 21 States/ UTs for implementation of HIS application. Current status of HIS implementation is as below:
 - **eHospital (NIC):** implemented in more than 320 hospitals. Screenshot of the dashboard is as under

Month wise Patient Registration All States, All Hospitals



Image Credits: <https://dashboard.ehospital.gov.in/dashboard-testing2/>

- **e-Sushrut (C-DAC Noida):** more than 80 Hospitals in the State of Maharashtra (1), Telangana (3), Rajasthan (72) and Delhi 389 CHAPTER-20 (1); State wise roll out plan received from Telangana.
- **My Health Record:** provides a single online personal medical record storage platform to citizens of India to enable them to manage their own medical records in a centralized way, which greatly facilitates the storage, accessibility and sharing of personal health data.

My Health Record can be accessed from anywhere, anytime by the patients and also by physicians, thus increasing flexibility for a patient to visit any doctor without carrying the burden of physical files, and thus benefit both the citizens and the physicians. It helps the physician to understand patient's past medical history which is important to the treatment to be given and will have following benefits:

- It helps in recovering medical records which might be lost in physical form.
- The data stored in a standardized format can be used for data analytics to understand disease trends, etc.
- Reduces medical error and improves patient compliance.
- Helps patients in taking a second opinion and provides emergency medical records for unconscious/unattended patients.

A few other initiatives in Digital Health being implemented by MoHFW include:

- **Integrated Disease Surveillance Program (IDSP)**

Is a disease surveillance scheme under the Ministry of Health and Family Welfare in India (MoHFW), assisted by the World Bank. It aims to strengthen disease surveillance for infectious diseases to detect and respond to outbreaks quickly.

It seeks to set up a Central Disease Surveillance Unit and a State Surveillance Unit in each State where data is collected and analyzed. A large amount of data on disease reports are collected in order to be able to identify the outbreak of a disease, identify its causes and take corresponding preventive and responsive measures. An early warning system has been put into place in order to take timely preventive steps. IDSP segment of Integrated Health Information Platform (IHIP) was soft launched in a number of states on 26 November 2019. Website: <https://idsp.nic.in/>

- **Electronic Vaccine Intelligence Network (eVIN)**

An innovative technological solution aimed at strengthening immunization supply chain systems across the country. This is being implemented under the National Health Mission (NHM) by the Ministry of Health and Family Welfare. eVIN aims to provide real-time information on vaccine stocks and flows, and storage temperatures across all cold chain points in the country. This robust system has been used with the requisite customization during the COVID pandemic for ensuring continuation of the essential immunization services and protecting our children and pregnant mothers against vaccine preventable diseases.¹⁰⁸

¹⁰⁸ <https://pib.gov.in/PressReleasePage.aspx?PRID=1643172>, accessed 10.08.2020

- **National Health Portal (NHP)**

The National Health Portal aims to establish a single point access for authenticated health information for citizens, students, healthcare professionals and researchers. Users can get detailed information pertaining to health related issues. It gives information related to diseases, health services, tips for healthy living, health programmes, insurance schemes, health apps and widgets. Users can also get helpline numbers, blood banks details, etc. Website: <https://www.nhp.gov.in/>

- **Online Registration System (ORS)**

Is a framework to link various hospitals across the country for Aadhaar based online registration and appointment system, where counter based OPD registration and appointment system through Hospital Management Information System (HMIS) has been digitalized. Website: <https://ors.gov.in/index.html>

- **Mera Aspatal/My Hospital (Patient Feedback System)**

Is a Ministry of Health, Government of India initiative to capture patient feedback for the services received at the hospital through user-friendly multiple channels such as Short Message Service (SMS), Outbound Dialling (OBD) mobile application and web portal.

My Hospital helps the government to make appropriate decisions for enhancing the quality of healthcare delivery across public facilities which will improve the patient's experience. The patient will be able to receive effective and appropriate care. My Hospital ultimately helps establish a patient driven, responsive and accountable healthcare system. Website: <https://meraaspataal.nhp.gov.in/>

These initiatives are operational at a substantially mature level and are already generating enormous amounts of data in the health sector.

The National Health Mission (NHM)

NHM was launched by the government of India in 2013. Since health is a State subject in India, States are supported under the NHM [Website: <https://nhm.gov.in/>] for services like Telemedicine, Tele-Radiology, Tele-Oncology, TeleOphthalmology and Hospital Information System (HIS).

In 2017, the Government of India approved the **National Health Policy 2017 (NHP 2017)** with the vision of providing Universal Health Care to all citizens of India based on digital technologies for achieving higher efficiency and effectiveness.

Ayushman Bharat Yojana

As a sequel to the NHP 2017, in September 2018, India also launched its National Health Protection Mission called "**Ayushman Bharat Yojana**" a program designed to address health holistically through a two-pronged approach:

1. To set up 150,000 Health and Wellness Centres for comprehensive primary healthcare, offering preventive and promotive healthcare accessible to all, and
2. A flagship scheme **Pradhan Mantri-Jan Arogya Yojna (PMJAY)** to provide healthcare cover to over 100 million poor and vulnerable families up to INR 5,00,000 (US \$ 6561,5) per family per year for secondary and tertiary care requiring hospitalization.

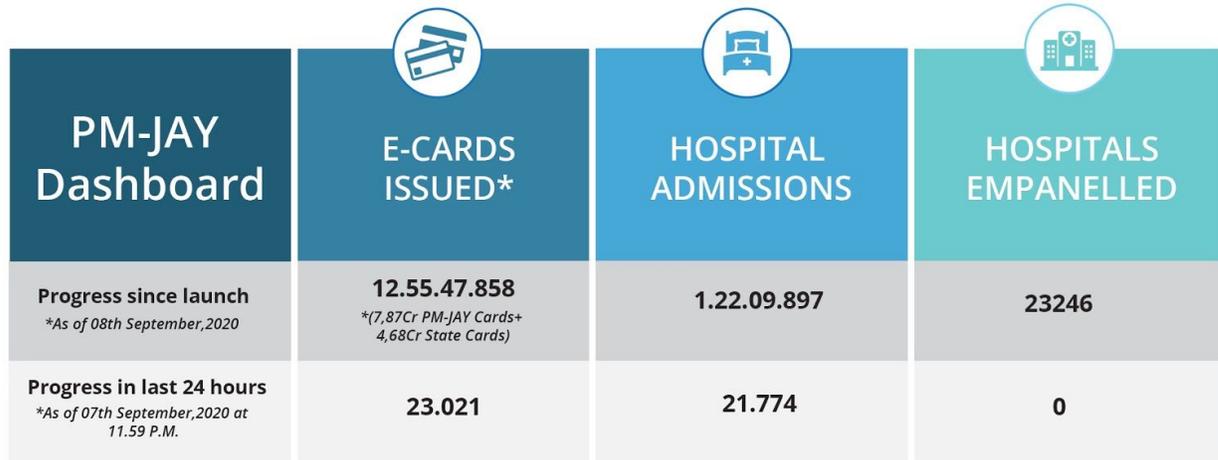


Image Credits: <https://pmjay.gov.in/>

Through Ayushman Bharat, the Government of India has taken steps to lay the foundation of a 21st Century Health System. It is expected that the provision of services through the public and private sector under Ayushman Bharat will generate enormous amounts of health data, mostly in the digital space. To ensure that India can leverage the cutting-edge digital technologies, it is crucial to focus on creating an appropriate architecture and data structures which are both pan-India.

The aforesaid challenge also presents an opportunity to build a state-of-the art **National Digital Health Ecosystem (NDHE)** that can enable India to leapfrog many of the traps that bedevil health information systems even in developed economies.

ANNEX III



Consortium of Accredited Healthcare Organizations (CAHO)

With a growing number of healthcare organizations achieving NABH, NABL and JCI accreditation, there has been a need for a common platform that will facilitate communication amongst the accredited HCOs, share best practices, and provide benchmarking, while promoting and continuously improving the quality and safety of healthcare services provided by the HCOs across India, in collaboration with all stakeholders.

CAHO is a not-for-profit society that was formed to fulfil this need.

This year, CAHO along with CHIME and HIMSS India partnered with DHIndia to establish a [Telemedicine Registry for India](#). The objective is to guide healthcare providers in India on technology solutions for telemedicine as proposed in the National Digital Health Blueprint (NDHB) and Telemedicine Practice Guidelines (TPG). Purpose of the study is to put together a repository of telemedicine solution providers and evaluate their suitability for healthcare providers in India aligned with TPG and NDHB.

CAHO also organises an annual conference called CAHOTECH. It is a platform for healthcare organizations and technology industry to share and utilize combined experience, to guide themselves continuously towards more efficient practices utilizing technological development. The theme of year 2020 is “Future of Healthcare – Making it Happen”.

It is a 6-day virtual event starting with the Pitch Fest on 20th September and the main conference from 25th Sep onwards to 29th Sep, 2020. The event will be highly focused to understand future healthcare technologies for clinicians, hospital managers and administrators, biomedical engineers, scientists, researchers and other stakeholders of the healthcare industry interested in promoting change through innovation and advancement in healthcare. Event website: <https://www.cahotech.com/>

Expert Profile: Dr Vijay Agarwal, President CAHO



Dr. Vijay Agarwal is currently the President of Consortium of Accredited Healthcare Organization (CAHO) and Advisor to Max Healthcare focused on Quality & Business Excellence. He is an Advisor to the Global Association of Physicians of Indian Origin.

Over the last four decades he has played a key role in making an impact in improving the state of Healthcare in India. He played an anchor role in driving national programs such as Pulse Polio Program and introducing Centralized Waste Management Scheme in Delhi. These programs have had a far-reaching impact. He has been the chairman of the Nursing Home Forum of Delhi for ten years from 1992

to 2002.

Dr. Agarwal is a graduate and post graduate in pediatrics from the prestigious Maulana Azad Medical College and continues to leverage his expertise as an excellent organizer, strategist & administrator. He is playing an important role in promoting quality through accreditation in Healthcare. He is the co-chairman of the Accreditation Committee of NABH.

He has conceived the idea of training quality implementers in the country. Already, more than 280 professionals have been trained in the basic program approved by NBQP. The advanced program has been approved by HSSC(Health Sector Skill Council) and has 80 plus professionals who have been trained.

Dr. Agarwal is the founder President of Society for Child Development. The society works towards vocational training of mentally challenged children and their work has footprints all over the country.

He is a recipient of Distinguished Alumnus Award of Maulana Azad Medical College and Lifetime Achievement Award of Indian Medical Association.

In expert's personal opinion:

There are some low hanging fruits for the digitalisation of healthcare like follow up consultations, initial consultations, second opinions etc but the most important disrupter will be mobile health and more and more, applications connecting to the mobile platform.

There are a huge number of healthcare professionals who are now retired (with a lot of expertise and experience) or they want to work from home or they are not wanting to be in major cities, they are wanting to relocate to some different places. And so, the idea may also be to get connected to this huge pool of people of doctors, and then to see how do you kind of connect to the people, who may then require the additional services which are going to be totally physical and how to kind of make it seamless.

There is also a huge opportunity in the field of training and education. So creating an ecosystem where my nurses can get trained using simulation, which is based on a 3d experience in digital health, etc. So, training medical education, nursing or other medical professionals is going to be a very important part where cross border collaboration can be very, very, very helpful.

Keeping this in mind, CAHO is about to launch a program, which may be the first program to train healthcare workers for being risk managers in the hospitals.



Max Healthcare Institute is a hospital chain based in New Delhi, India. It is a joint venture between Max India and Life Healthcare, South Africa.

With over 1900 beds and 14 top hospitals in India, 2300+ world-class doctors and 9300 support staff, Max Healthcare is one of the leading chains of hospitals in India. It has the most advanced technology, state-of-the-art infrastructure is rated the best in North India, thereby making Max Healthcare one of the best hospitals in India. It offers treatment across all 29 specialties. Max hospitals are NABH and ISO accredited hospitals.

Expert Profile: Dr Vibha Jain, Deputy General Manager - IT, Max Healthcare



Dr Vibha is a process oriented, outcome focused healthcare analyst with over 21 years of work experience in healthcare. A clinician by qualification, she has been working in healthcare IT for close to 9 years. She is a medical graduate from LLRM Medical College Meerut and is an alumnus of Symbiosis International University from where she pursued her MBA. She has a highly successful record of accomplishment of clinical and business tech platforms like RIS PACS, EHR, Online E prescription etc. in collaboration with cross-functional teams across the organisation. She has a keen interest in working on solutions for cost effective healthcare deliveries and process transformation enabling operational efficiencies.

With zeal to add new skills and growing with the organisation, set up the IT EPMO for effective monitoring and execution of business critical projects. Currently she is working with Max Healthcare IT. She is working on setting up AI based platforms and clinical data analytics for clinical research & operations alongside upgrade of EHR which according to her is the backbone of clinical automation.

Electronic journey of Max Healthcare started way ago when they adopted the hospital information system with the adoption of electronic medical records, since the inception of the hospital in 2011.

In expert's personal opinion:

The art of leadership is also to realize the importance of getting digital and technologically sound, and it got focused on during the COVID pandemic. And now, all are talking about moving things to automating processes, talking about robotic process automation, and talking about artificial intelligence, talking about providing services to the patient digitally, in the home using variables or the sensor.

Cross border collaboration is a very good idea and very promising as well. But still an idea, it's a very good concept but will take a lot of time to develop.

India is very much price conscious. We are still working to develop standards on data security but we are cautious and are aware of the security system. So a cross border digitalization is a very good solution coming from outside, but its success will depend on two major aspects, one being the cost and the second the legalities and security people want.



Wadhvani Initiative of Sustainable Healthcare (WISH) Foundation

Wadhvani Initiative for Sustainable Healthcare (WISH), under the aegis of Lords Education Health Society (LEHS), a not-for-profit organization in India, works to scale innovations for an equitable healthcare system and make quality primary healthcare available and accessible to underserved populations. WISH plays a facilitative role within the healthcare ecosystem to ensure need based, high potential innovations are identified, supported and scaled up within the healthcare service delivery system. We work toward transforming the primary healthcare system with an inclusive and interoperable technology strategy providing comprehensive healthcare service to the underserved population at the last mile.

WISH Foundation was launched in 2014 with great optimism, supplemented by a strong vision and strategy for addressing primary healthcare through innovation and technology. We at WISH, firmly believe that a fully operational and high quality-compliant primary healthcare delivery system significantly expands service-coverage, contributes to improved health outcomes, and reduces out-of-pocket-expenditure for beneficiaries. Through our initiatives, we intend to leverage healthcare innovations, which we identify and support in terms of their quality, efficacy and affordability and help with incorporating them in the public healthcare service system. WISH supports the Govts. in MP, Rajasthan, Assam, Delhi and UP by providing technical support and quality health services to the underprivileged and hard to reach populations.



Expert Profile: Rajesh Singh, CEO, WISH Foundation

Mr. Rajesh R. Singh is a social entrepreneur, public health, civic participation and Non-Profit sector specialist, with close to three decades of management and programmatic experience. He currently is the Chief Executive Officer of WISH. Prior to joining LEHS/WISH, Rajesh was working as a Chief Operating Officer for a

Non-profit institution active in South and South East Asia and South East Africa. His professional experience is founded in multi-sectoral responses to community development, public health, education and livelihood issues in Asia and Africa. Before returning to India, Rajesh worked in southern and western Africa and has led various institutions in leadership positions including that of Deputy/Country Director. He excels at developing new partnerships and building stakeholder relations and has proven success in mobilizing resources and managing grants. He is committed to critical self-reflective practice, love facilitation and learning, and has a wealth of experience in monitoring and evaluating international development programs. He has been part of various national core committees developing strategic guidelines and framework on public health issues.

In expert's personal opinion:

Healthcare systems often struggle with a range of issues including limitations and constraints on data collection, access and sharing, resistant mindsets and an excessive focus on risks to the detriment of potential benefits. Although digital health has made significant strides, one of the most crucial challenges in digital healthcare implementation is the absence of interlinkages and inter-connections between multiple disparate solutions available today. Healthcare information tends to reside in fragmented, individual platforms that often exist in silos and do not share data with one another. Digital solutions can greatly facilitate the seamless exchange of patient and other information and data between providers/systems. One of the main focus areas of the newly-launched National Digital Health Mission (NDHM) is interoperability and availability of open platforms, including the usage of open APIs and open-source frameworks, and following these guidelines will go a long way towards alleviating these interoperability issues in the Digital Health ecosystem.

Telemedicine, digitized supply chain management systems and electronic health records are just a few of the digital solutions that have been widely implemented. However, the digital health ecosystem sometimes overemphasizes domains such as EHR and AI/ML. Digital Health companies need to be very clear and purposive in terms of their objectives by defining impact metrics and focusing on context-appropriate technology. Healthcare has also lagged behind when it comes to embedding digital strategies in the core planning process. Digital health is currently allowing us to capture vast amounts of data, resulting from the implementation of various technological solutions. However, we are yet to reach the stage where tools like predictive analytics and machine learning models are actively contributing to decision making. Data-enriched algorithms that work on big data can provide several important benefits, including facilitating preventive care through predictive models, a lower rate of medication errors, accurate staffing and supply chain resource allocation.

Cross-border collaborations in digital health, when applied in specific key contexts, can be a vital development in online healthcare service-delivery to produce positive outcomes in both populations. Certain digital health solutions, such as Telemedicine, have the potential to transform the nature of healthcare provision across borders in a meaningful way, either by linking a health professional to a patient in a different country, or health professionals across different countries. However, implementing cross-border digital healthcare initiatives requires overcoming significant hurdles, such as the lack of interoperability between different IT systems and differing regulatory, legislative and financial systems between the countries in question with respect to healthcare services. These challenges will need to be addressed on an individual basis for any such international initiative to succeed.

India represents a huge potential market for the growth of Digital Health solutions. There are several unique factors that contribute to this, including the sheer size of the country's population (poised to become the largest in the world over the next decade), the large proportion of that population below the age of 35 (65% as of 2020), India being one of the biggest and fastest-growing markets for mobile and smartphone applications in the world still with significant untapped potential, and a proactive governmental and regulatory climate in this arena. With the ongoing COVID situation in the country, the importance of Digital Health technologies has never been more apparent. In the backdrop of the COVID pandemic and the post-pandemic recovery, and

India's highly self-sufficient supply of medical and technology professionals, the stage is set for the country to witness significant growth in the area of Digital Health.



The International Innovation Corps (IIC)

IIC is a Fellowship program that runs as a part of the University of Chicago's Harris School of Public Policy. It bridges the gap between innovation and impact.

The IIC recruits and places high-performing young professionals with up to five years of experience and top-tier academic backgrounds from top ranking global universities, on teams that work on-site with governments and foundations to implement large-scale projects to address India's most critical development challenges.

Expert Profile: Debanshu Roy, Engagement Manager, IIC



Debanshu is a clinician and a health economist by education. He graduated from Grant Medical College (MBBS), Mumbai and later from The University of Texas Health Sciences Center at Houston (MPH health economics and Policy). He was one of 11 Fulbright Masters Scholars representing India in the USA in 2015. His work in the healthcare space has spanned clinical consultation, medical technology development, and healthcare policy and operations consulting. He has worked across India, Bangladesh and the USA in healthcare policy. His focus areas are Healthcare Finance, Universal health coverage and digital health.

In expert's personal opinion:

The government kickstarts an ecosystem and it further evolves with the help of private stakeholders. Digital health by definition only is so wide. It ranges from medical devices to AI to software. It can be from Digital stethoscope to X-ray or MRI. Each one of them will have different ear buds and there wouldn't be much change in a year. So, it'll probably start picking up maybe after three years. The first obstacle most people will face is the changed hospital billing systems and they will have to adapt to that and compliance based software. It's a checklist one has to maintain to comply in India today.

If any digital health product is certified by a foreign authority (CE or FDA), the chances are that it already has more than 85- 90% of the clearances and compliances for India.



National Accreditation Board for Hospitals & Healthcare Providers (NABH)

NABH is a constituent board of Quality Council of India (QCI), set up to establish and operate accreditation programmes for healthcare organizations. Formed in 2005, it is the principal accreditation for hospitals in India. NABH and QCI have designed an exhaustive healthcare standard for hospitals and healthcare providers. This

standard consists of stringent 600 plus objective elements for the hospital to achieve in order to get the NABH accreditation. These standards are divided between patient centered standards and organization centred standards

To comply with these standard elements, the hospital will need to have a process-driven approach in all aspects of hospital activities – from registration, admission, pre-surgery, peri-surgery and post-surgery protocols, discharge from the hospital to follow up with the hospital after discharge. Not only the clinical aspects but the governance aspects are to process driven based on clear and transparent policies and protocols. In a nutshell, NABH aims at streamlining the entire operations of a hospital.

NABH is equivalent to JCI and other International standards including HAS: Haute Autorite de Sante, Australian Council on Healthcare Standards, the Japan Council for Quality in Health Care and the National Committee for Quality Assurance in the United States. Its standards have been accredited by ISQUA the apex body accrediting the accreditators hence making NABH accreditation at par with the world's most leading hospital accreditation.

Expert Profile: Dr. Rishi Bhatnagar, Member, NABH, President for Aeris Communications, India, Chairman IET Future Tech Panel, Chairman Broadband India Forum for AI/IoT Committee.



Dr. Rishi Mohan Bhatnagar is an International speaker and thought leader in the Internet of Things and Digital Space. He has co-authored the book “Enterprise IoT” along with a team from Bosch. Currently, as President of Aeris Communications India Private Ltd. (100 % subsidiary of the privately held, Silicon Valley headquartered Aeris Communications Inc., pioneers in the m2m/IoT business since 1992); Dr. Bhatnagar is leading the Aeris business in the Indian subcontinent, MEA and the APAC region.

Prior to joining Aeris, Dr. Bhatnagar worked with Tech Mahindra in various portfolios and served as the Global Head for Digital Enterprise Services in his last role. Dr. Bhatnagar did Global Program for Management Development from Michigan Ross

School of Business, USA and holds Doctorate in Philosophy in Computer Science and Engineering and Masters in Computer Applications.

In addition, Dr. Bhatnagar is chairing and is a member to many national and international committees, like Technical Committee at NABH Digital Health Technology and Telemedicine Standards, NASSCOM Smart Cities Task Force and the Startup Core Committee, CII National Committee on Technology and the IoT Core Panel, FICCI Smart Cities Committee, Telecommunication Engineering Center (TEC), Govt. of India for framing Standards and Guidelines for Machine to Machine in India. He is also a member of the Advisory Committee, Deen Dayal Upadhyay Kaushal Kendra, a UGC initiative for skill development from industry in India.

In expert's personal opinion:

The National Accreditation Board for Hospitals and Healthcare Providers (NABH) has taken a leap towards ensuring the quality of healthcare and patient safety by establishing a committee on setting standards for digital health whose mandate is to consider all relevant aspects of the application of patient interfacing technologies across the continuum of care applicable for outpatient, inpatient, and remote patient monitoring.

In a country like India, with most of its population still being deprived of basic healthcare facilities, technology enabled services such as telemedicine and mHealth are emerging as a life saviour. In the current scenario, telemedicine and mHealth may turn out to be the cheapest, as well as the fastest, way to not only bridge the rural–urban health divide but also manage the Covid-19 crisis in a more structured manner.

A lot of work has already been initiated for ensuring safety and security in digital healthcare in the National Health Policy 2017 itself. The key principles of NHP 2017 include universality, citizen-centricity, quality of care

and accountability for performance. The policy lays significant emphasis on leveraging digital technologies for enhancing the efficiency and effectiveness of delivery of all the healthcare services.

The launch of National Digital Health Blueprint in January 2020 is a step in the right direction to provide a detailed framework for a Federated National Health Information System. The proposed “National Digital Health Blueprint 2.0” has diverse elements of a futuristic digital health ecosystem, representing the interplay of new science, new actors, and technological innovations laced with a list of policy and value principles to create a suitable policy framework for India.

With 1 billion plus mobile phone connections, mBanking, mEntertainment, mCommerce and mGovernance are becoming a reality. This indicates huge potential of digitization in the healthcare sector too as setting up telecom infrastructure in rural and remote areas to increase reach of healthcare services is easier than making the health specialists physically available 24x7. Another driver of increased digitization is the Indian government’s commitment to providing equal access to quality care to all. Digital health is a critical enabler for the overall transformation of the health system. India’s digital health policy advocates use of digital tools for improving the efficiency and outcome of the healthcare system and lays significant focus on the use of telemedicine services, especially in the health and wellness centers at the grassroots level.

By 2025, the Indian telehealth and telemedicine market is expected to reach US \$5,4 billion with a 31% CAGR. Investments for the implementation of IoT solutions alone in the healthcare sector will drive a 19,9% annual market growth between now and 2025, eventually reaching an estimated US \$534,3 billion.

Cross border collaborations for digitisation of healthcare can be a boon for in cases of emergencies and also for specific highly specialized medical care and care for rare diseases where the most suitable expertise may be available abroad.



Qure.ai was founded in 2016. Our mission is to use artificial intelligence to make healthcare more accessible and affordable. Our core team combines deep learning expertise with clinical, scientific and regulatory knowledge. Our advisory panel consists of radiologists, other doctors and public health experts. We work with these specialists to define clinically relevant problems and design real-world solutions.

Expert Profile: Rohit Ghosh, Chief of Staff, Founding member, Qure.ai



Rohit is an IIT-Bombay grad & Founding Member of Qure.ai. Rohit is currently responsible for business development and strategy within Qure for particular geographies. He has previously worked as an AI Scientist and was deeply involved in building R&D products in the computer vision area.

In expert's personal opinion:

The digitalization journey would be fast-tracked in places where systems are broken. NDHM is a classic evidence of the same. Apart from the UAE, Nordic countries and some states within the USA, there’s no example of a National Health Exchange being implemented. To be implementing such an ambitious project in a country with a population like India is already bold enough. On top of it, the detailed plans of implementing catalysts like AI can genuinely propel public health and quality of care within public health by leaps and bounds. It remains to be seen how much of it’s successful since at such a scale is always a challenge like how Aadhar was. Having

said that, it's prudent to get started somewhere and then from there on, it's an ongoing iteration towards perfections. Starting is important and that's what's encouraging.

Once healthcare access crosses the chasm from urban to rural in the country, digital health would see a sharp rise in adoption since I mentioned earlier as well – the adoption of digitalization is more quicker where systems are broken. So the next few years would usher in a huge influx of patients under the cusp of digital healthcare.

Data protection from a provider perspective is extremely important and critical. The regulations might not be equally stringent everywhere but patients across geographies are the same and no patient would definitely want their data be breached just because the regulation in said region is lax. So it makes any company dealing in the space to consider data privacy and cyber security critically. In fact, I think there's another reason why providers would anyways take this more seriously - that is from a protection of self-interest perspective as well. Providers would definitely want to guard the information of their users from other providers and foul agents. It's in their self-interest to do so as well.

Cross-border collaborations overall seem like a great idea to co-fund and co-develop innovations. But in order to ensure cross border collaborations succeed in reality, the innovation should flow should be bidirectional and involve common challenge areas like eradication of a disease rather than thematic areas like AI, Drug Development etc. so that the solutions are at least aligned. Thereafter, there should be enough leeway for countries to adopt a more nationalized design based on the common IP.



National Health Authority (NHA)

The National Health Authority or the NHA is the apex body responsible for implementing India's flagship public health insurance/assurance scheme, Ayushman Bharat Pradhan Mantri Jan Arogya Yojana (AB-PMJAY). NHA has been set-up to implement the PM-JAY at the national level. In the States, SHAs or State Health Agencies in the form of a society/trust have been set up to implement the scheme.

Further, NHA is now leading the implementation for the National Digital Health Mission (NDHM) in coordination with different ministries/departments of the Government of India, State Governments, and private sector/civil society organizations.

NHA is governed by a Governing Board chaired by the Union Minister for Health and Family Welfare, Government of India and is headed by a full-time Chief Executive Officer (CEO). The Governing Board comprises Chairperson and 11 members.

Expert Profile: Varun Jhaveri, Officer on Special Duty, National Health Authority (NHA)



Varun is currently deputed as an Officer on Special Duty at the National Health Authority (NHA), Government of India. He leads the innovation strategy and focuses on supply side strengthening at the NHA.

Earlier, he has worked as an Engagement Manager and Project Lead for the IIC (University of Chicago) wherein he led the team for designing India's first Universal Health Coverage Scheme, Arogya Karnataka for the Government of Karnataka. Prior to that, he was deputed at NITI Aayog (Formerly Planning Commission of India) wherein he worked as a Project Associate for the International Innovation Corps. He was responsible for project management of the Digital Transformation Index and National

Data and Analytics Platform developed by NITI Aayog.

He has extensive experience in policy strategizing, designing large scale implementation processes, multi-sectoral coalition creation, advocacy strategies, public affairs, multilateral diplomacy and negotiation.

In expert's personal opinion:

The COVID-19 pandemic has brought out a critical need to integrate all three parts of the health system (primary, secondary and the tertiary) to remove existing siloes and advance towards designing a more holistic healthcare system.

In the last few years, India has tremendously moved towards digitization. This has led to the creation of various avenues for improving service delivery of citizen-centric programmes. Leveraging digitization to improve access to quality healthcare calls upon a dedicated approach – the National Digital Health Mission.

With the digital health infrastructure, the aim is to digitally connect different fragments in the health system. NDHM shall create a seamless online platform “through the provision of a wide-range of data, information and infrastructure services, duly leveraging open, interoperable, standards-based digital systems” while ensuring the security, confidentiality and privacy of health-related personal information.

The implementation of NDHM is expected to significantly improve the efficiency, effectiveness, and transparency of health service delivery overall. Patients will be able to securely store and access their medical records (such as prescriptions, diagnostic reports and discharge summaries), and share them with health care providers to ensure appropriate treatment and follow-up. They will also have access to more accurate information on health facilities and service providers. Further, they will have the option to access health services remotely through tele-consultation and e-pharmacy. NDHM will empower individuals with accurate information to enable informed decision making and increase accountability of healthcare providers.

It will provide choice to individuals to access both public and private health services, facilitate compliance with laid down guidelines and protocols, and ensure transparency in pricing of services and accountability for the health services being rendered. Similarly, health care professionals across disciplines will have better access to a patient's medical history (with the necessary informed consent) for prescribing more appropriate and effective health interventions. The integrated ecosystem will also enable a better continuum of care. NDHM will help digitize the claims process and enable faster reimbursement. This will enhance the overall ease of providing services amongst the health care providers.

At the same time, policy makers and programme managers will have better access to data, enabling more informed decision making by the Government. Better quality of macro and micro-level data will enable advanced analytics, usage of health-biomarkers and better preventive healthcare. It will also enable geography and demography-based monitoring and appropriate decision making to inform design and strengthen implementation of health programmes and policies.

Finally, researchers will greatly benefit from the availability of such aggregated information as they will be able to study and evaluate the effectiveness of various programmes and interventions. NDHM would facilitate a comprehensive feedback loop between researchers, policymakers, and providers.

In the next few months, NDHM will focus on stabilizing and scaling the core technology modules. The NDHM brings across a variety of opportunities to build innovative services on top of the digital infrastructure.

ANNEX IV



University of Melbourne

University of Melbourne is one of the leading universities in Australia, conducts research in Digital Health with a focus on Health Information Systems and Health Informatics. The aim is to support the design and development of healthcare systems which meets the increasing demand to provide service and innovation in the health sector.

Changing relationships between patients and the health system encourages them to explore how health data management practices can facilitate systems for patient-centred care and remote care, while respecting the security and privacy of patient data.

In addition, they also explore how health informatics can inform decision-making by healthcare stakeholders, and thus deliver a better health outcome. Also focusing on how digital technologies can align with both health system strategies and constraints, and support high quality patient care.

Many of their projects in this research theme are conducted in collaboration with colleagues from the School of Medicine, Dentistry and Health Sciences at the University of Melbourne.

Within this theme, their research focuses on the following research pillars:

- Adoption and appropriation of technologies
- Participatory health and consumer health informatics
- Health information systems processes and management
- Health sector change arising from new technologies

Website: <https://www.unimelb.edu.au/>

Expert Profile: Dr Tafheem Ahmad Wani, Tutor, University of Melbourne



Tafheem Ahmad Wani is a PhD student in digital health at the University of Melbourne. His key research interests include IT security management in healthcare, bringing your own device security in hospitals and enterprise mobility management solutions for large healthcare settings.

Previously, he has been a high-achieving Master of IT graduate with an exceptional academic record. Tafheem was featured in University of Melbourne's Dean's Honours List 2016, representing the top 5% among the cohort of Master of IT students based on academic performance and was felicitated for the same by the Dean at the Engineering and IT Awards night.

He has had extensive exposure to IT projects and consistently delivering exceptional results, achieving top grades while also meeting strict deadlines. Some of the research papers authored by Tafheem are on the topics of Hospital Bring-Your-Own-Device Security Challenges and Solutions: Systematic Review of Gray Literature and BYOD in Hospitals-Security Issues and Mitigation Strategies.

In expert's personal opinion:

One of the important challenges is lack of interoperability and there are many disjointed systems in silos there's a lack of integration. So for example, if you have an electronic medical health record then it's not

integrated with other services, it's not integrated with decision support systems or patient management systems so that means that there are a lot of inside those disconnected systems and even within the hospitals that provide healthcare services. There is not much interoperability.

We need broad collaborations across a wide range of stakeholders and cross border collaborations with different countries. Having a mix of countries that essentially would increase the pace of innovation and go to provide a better space for exchange of ideas. So that way , countries can learn from each other and provide better digital health services, and in their own respective countries.



Curve Tomorrow is a digital health technology company co-located within a leading tertiary hospital.

Curve specialises in solving healthcare problems, like how you diagnose and treat a concussion for kids, measure PROMS & PREMS or helping non-english speaking patients talk to their nurses. The technology can be a mobile app or online platform, an AI algorithm that predicts hospital readmissions or a smart watch app that tracks your sleep. Curve tomorrow focuses on the following aspects:

FOR HEALTHCARE PROVIDERS:

- Identify opportunities with innovation workshops and audits.
- Build digital products to improve quality,efficiency and patient care.
- Integrate digital products into secure hospital infrastructure and workflow.
- Commercialise ideas into solutions.

FOR RESEARCHERS:

- validate the user's need for your digital health product idea.
- Build digital products to engage users and increase adherence safety store data and avoid data errors,
- Translate your research into a sustainable product with business modeling.
- Write grants for philanthropic and government programs, including NHMRC

FOR CLINICAL INNOVATORS:

- Understand users, and their health journey.
- Build product feature set with medical grade security and compliance.
- Develop business strategy for a commercial return pitch your prototype to funders and investors.

Website: <https://www.curvetomorrow.com.au/>

Expert Profile: Sanji Kanagalingam, Executive Director, Curve Tomorrow



Sanji is responsible for overall strategy, people and the Curve Ventures arm of the business. He has over 15 years experience in design, engineering and business creation of safety-critical products and health technology. With time spent in the rail, automotive and health sector across Asia, Europe and the US. He is passionate about using technology to make a positive change in our society and working with health professionals to improve healthcare.

In expert's personal opinion:

Few of the aspects to be kept in mind while developing the technology (apps/platforms) is that, introducing things like EMR and My Health Record is critical but the systems don't make it easy for integration and interoperability. User experience of both EMR and myhealth record have to become better in usage for the general public. So, user experience is first. The other is at a minimum, it's an expectation that if it is a medical device that is complying with the TGA and/or FDA regulations. And the third part is security. And the fourth being the clinical evidence like the evidence base that doesn't actually solve the problem.



University of Tasmania

University of Tasmania offers eHealth programs. This program has been developed to meet the varying needs of our health. Various courses are offered, from health professionals seeking a foundation in digital health to support their health role (Graduate Certificate of e-Health) through to those interested in working in health informatics (Master of e-Health). Website: <https://www.utas.edu.au>

Expert Profile: Dr Kerryn Butler-Henderson, Associate Professor of Digital Innovation in Health, University of Tasmania



Dr Kerryn Butler-Henderson is the Associate Professor of Digital Innovation in Health and Health Pedagogy for the College of Health and Medicine. Kerryn has been a leading academic in digital health in Australia for more than the last decade, making a significant contribution to the national health information management and health informatics educational direction. Her research interests include health information education and workforce; health data: planning, management, and analysis; and the application of eHealth improve efficiencies in health.

Kerryn joined the University of Tasmania in February 2015, coordinating the Master of Health Information Management 2015-2018 before moving into her current role as Associate Professor of Digital Innovation in Health and Health Pedagogy. Prior to 2015, Kerryn was the coordinator and lecturer in Health Information Management at Curtin University, Western Australia. Throughout her academic career Kerryn has also worked as a consultant, providing health information advice to hospitals and private healthcare providers throughout Australia and globally. Kerryn has held a number of positions on state and national committees and boards, including the Health Information Management Association of Australia (HIMAA), Australasian College of Health Informatics (ACHI), Australian Health Informatics Education Council (AHIEC) and the Certified Health Informatician Australasia (CHIA).

In expert's personal opinion:

The Medicare scheme is the Australia's funding system for the procedure one undergoes that is within the Medicare benefit scheme, and that amount can be reimbursed up to a particular amount. So by adding more telehealth items to the Medicare benefits means there are more things that that general practitioners could then actually do through telehealth and be able to build that back to Medicare so that the consumers don't have to bear that cost.

Infrastructure and training is needed the most in Australia post COVID for the digital health. The Australian digital health agency have developed this workforce roadmap and they know one of the most important things they need to do is to make sure people are being upskilled and improve their digital capabilities, and that in the university training, we need to include more about digital health, because one day, it won't be digital health one day or just be health, and we are just using technology as part of everyday effort.

Monash University is one of Australia's leading universities and ranks among the world's top 100. A public research university based in Melbourne, Australia. Named for prominent World War I general Sir John Monash, it was founded in 1958 and is the second oldest university in the State of Victoria.

Monash is a member of Australia's Group of Eight research universities, a member of the ASAIHL, and is the only Australian member of the M8 Alliance of Academic Health Centers, Universities and National Academies. Monash is one of two Australian universities to be ranked in the École des Mines de Paris (Mines ParisTech) ranking on the basis of the number of alumni listed among CEOs in the 500 largest worldwide companies. Website: <https://www.monash.edu/>

Expert Profile: Dr. Sunita Chauhan, Director, Robotics & Mechatronics Engineering and Professor, Mechanical & Aerospace Engineering, Monash University



Sunita CHAUHAN (Ph.D., DIC, Medical Robotics, Imperial College of Science Technology and Medicine, London, UK -1999) is a Professor at the Mechanical and Aerospace Dept., Faculty of Engineering; Director of Mechatronics Engineering Program (one of the core Eng. branches at Monash); Chief Investigator of the BmRAS (Biomechanics, Robotics & Automated Systems) research group at Monash University, Australia. Her current research interests include three main areas:

- Medical/Surgical Robotics (including Computer Assisted and Integrated Surgery, Medical Ultrasound – Imaging, Therapeutic and Surgical ultrasound, Tissue characterization, Image, and Sensor-data processing/fusion/interpretation and the like;
- Intelligent Diagnostics, Robotics and Cyberphysical systems, Infrastructural Healthcare (Agri-robots, High-rise Buildings, Railways, Aerospace, Defense/Airforce, Solar farms, etc.);
- Mechatronics & Automation in Sports Engineering

In expert's personal opinion:

It had been more than a decade or rather two, of research initiatives and commercial system developments in this direction, including computer-assisted/integrated radiology and surgery, telemedicine, medical/surgical robotics and AI/AR/VR systems, Big-data and machine learning in biotechnology and bioengineering domain, and so digitalisation in healthcare is not that a recent shift. Yes, the clinical adaptation of these systems and commercial developments have seen a much rapid uptake recently. So, it can be said that it has passed a long incubation phase and entered into a more pervasive & versatile scenario now, with more and more new applications emerging every now and then.

Australia spends more than 9% of its GDP in healthcare costs and majority of healthcare facilities (primary, secondary and tertiary hospital care) have sophisticated, state-of-the-art services. An instant and secure patient information (electronic medical records) is made accessible, especially during emergency, in order to provide fast diagnosis and better decision support strategies for treatment/management of medical conditions. The Australian Digital Health Agency launched a National Digital Health Strategy & Framework for Action in

2018 for a safe, seamless and secure healthcare. Australia has a strong R&D ecosystem and there are two major funding agencies that support the research: ARC - the Australian Research Council and NHMRC - the National Health and Medical Research Council. The government has recently rolled out the Medical Research Commercialisation initiative under the MRFF (Medical Research Future Fund) 10-year plan for fast translation of new R&D technologies in medical devices and healthcare systems.

Australia, like any other developed nation, has also seen its share of rapid development in the digital devices & systems for diagnostics and treatment, mainly in the R&D domain and new opportunities are opening-up. It has, however, not seen a great surge of start-ups or new companies in the area on the scale as you would see in the US and Europe. There are only a few big players in the market of the ground origin and the manufacturing industry is managed and coordinated by subsidiaries of large, global corporations. Having said that, the Australian BioTech and MedTech market is quite mature, with a well-established regulatory system - the Therapeutic Goods Administration (TGA). AusBiotech is one of the major Australian organizations in the healthcare/biotechnology industry. However, Australia imports approximately 80% of the medical devices used nationwide. These include innovative and digital medical devices, which are in growing demand especially for aged care, chronic pain and disability sectors. If you look at the structure of the TGA, you will find that it is very adaptable for devices that have CE Mark and have passed European regulatory requirements.

This pandemic has definitely fast paced the adoption of and innovation in digital technology worldwide. A simple example is the accelerated use of telemedicine, tele-consultation and electronic prescriptions. In Australia as well, appropriate changes have been made to the legislation (temporarily) in order to recognize electronic prescription as an alternative to paper prescriptions. On one hand, this can protect medical professionals from unnecessary infections and on the other it can also provide greater choice to patients at most-risk from COVID-19 while maintaining safe social distancing and reducing community transfers.

Monash University is actively engaged in COVID-19 related research in a wide variety of research projects encompassing better understanding of virus strain and its impacts, modeling anti-virus drugs to block replication, repurposed drugs & clinical trials, COVIDsafe tracing app, data-analytics for health impacts etc. Please visit <https://www.monash.edu/research/latest-covid-19-research> to know further details.

Our research in medical devices and systems over the last approximately two decades encompass novel intelligent diagnostic techniques, smart sensors, minimally-invasive and non-invasive robotic & AI techniques for surgical applications. In particular, we are investigating into: innovative medical devices and dedicated robotic systems in the detection and treatment of several diseases affecting different parts of the human body. These devices include portable/hand-held diagnostic and therapeutic products - as embedded systems comprising imaging, pre-and post-operative planning platforms and customized robotic configurations (hard and soft robotic approaches), biomimetic approaches to assist surgical interventions. We employ machine learning, AI/AR/VR techniques for surgical simulation and automated assessment for medical training and education. Our research group is named as BmRAS - Biomechatronics, Robotics & Automated Systems lab; it belongs to the Department of Mechanical and Aerospace Engineering and is an affiliate of Monash Institute of Medical Engineering. We collaborate with various hospital partners at Monash Health, Alfred Health and Eastern Health. In the past, I had worked with various hospital collaborators in Asia and Europe for our medical robotic systems. Our research is translational in nature with international patents granted/pending for most of the systems.

Biomechatronics is an interdisciplinary area that encompasses bio-medical devices based upon principles of electromechanical systems, physiological mechatronics, robotics, control engineering, bio-mechanics, human factors, man-machine interaction, rehabilitation medicine and others. Also, techniques and modalities used for

detection, acquisition and processing of signals from human patients, mechanics of tissue types, therapeutic and prosthetic devices prevalent in modern biomedical systems are involved.

Advanced manipulation by the use of robotic technology and computational tools can be used in pre-planning, registration, and navigation of surgical devices utilizing the pre-operative and intra-operative imaging data. Thanks to the availability of non-invasive imaging techniques, such as computed tomography (CT), magnetic resonance imaging (MRI) and functional MRI, positron emitted tomography (PET) ultrasonography etc., which can provide digitized images for precise location and function of diseased areas. Computer integration and robotic techniques provide several benefits such as higher accuracy, precision and repeatability in positioning surgical tools and maneuvering controlled trajectories. For further details, please visit the group website: <http://users.monash.edu/~sunitac/>

A rapid and scalable change can be foreseen in the global digital healthcare technology industry, due to disruptive technology drivers such as mobile connectivity and IT-enabled systems, AI, big-data, cloud-computing & analytics as well as business management disruptors of new business models, care-models, strategies and power-shift. Hence, cross border collaboration is really a great idea to go ahead with for speedy developments and standardized protocols as such changes and their impact are global in nature.



Australia's National Digital Health Initiative (ANDHealth)

ANDHealth was incorporated in 2017 to provide specific support to high potential growth companies innovating within the broader digital health sector, with a specific focus on technologies designed to have a positive impact on patients and transform clinical outcomes (digital medicine and digital therapeutics).

ANDHealth's initial objective was to support mid-stage companies to navigate systemic barriers to commercialisation and accelerate their ability to access institutional investment and global markets. The initial two-year pilot was designed to test three hypotheses:

- There existed a significant pipeline of high potential growth companies in digital health that were not fulfilling their potential due to a lack of specific domain expertise and support;
- That a novel, multi-sector, industry-led model would have the greatest impact in supporting these companies to scale; and
- That ANDHealth's program could significantly accelerate these companies to investment and export success.

Expert Profile: Bronwyn Le Grice bio, Founder, CEO & Managing Director, ANDHealth



Bronwyn has more than 18 years' executive experience in the health technology sector spanning venture capital, transaction management, capital raising, corporate development, investor relations and industry advocacy.

Formerly an Investment Director with leading healthcare VC BioScience Managers, Bronwyn has managed over AU \$65M of private and public equity capital raisings and been actively involved in over AU \$30M of portfolio investments. In 2017, Bronwyn founded ANDHealth, Australia's only dedicated digital health accelerator & commercialisation support organisation. Now Australia's leading health technology

scale up accelerator, ANDHealth's unique industry-led model has led to significant growth within Australia's nascent digital health sector.

Bronwyn holds a number of health, technology and innovation advisory roles both in Australia and internationally (NSW Cyber Security Industry Standards Harmonisation Taskforce, Data Governance Committee OUTBREAK,RMIT University Health and BioMedical Sector Expert Research Advisory Group,Swinsburne University Innovation Precinct Advisory Board,Australia New Zealand Leadership Forum Health Technologies Sector Group). She has a Masters of Commercial Law from the University of Melbourne and a Bachelor of Commerce from the University of Western Australia.

In expert's personal opinion:

Australian digital health companies face some unique challenges, not least of which is that as a sector digital health struggles for recognition and appropriately focused funding structures here at home. That in turn means that there is a paucity of investors with enough knowledge of the sector to be able to make smart investments – which means that digital health companies often have to seek capital from investors who lack the knowledge to adequately support them.

With savvy, sustained investment, Australia can create world-leading health technology sectors, as we have done in biopharmaceutical development and medical devices. However, simply assuming these traditional investments will allow us to keep pace with other OECD nations across healthcare, without support for emerging and enabling sectors such as digital health, is naive.

Collaboration between academic institutes, clinical sites, industry players and innovators is the key. We also need to acknowledge that, increasingly, innovators and innovations may not originate in the traditional domains of research and academia, but might come from clinicians, patients, caregivers, allied health professionals, and non-health domain professionals with smart ideas for transforming health.

Accessing international networks, reflecting on best-practice models and technologies and implementing appropriate regulatory and reimbursement frameworks which are globally harmonised and supporting access to dedicated capital, all offer significant benefit for Australia: In order to be truly successful we need to both create an environment for Australian innovation to thrive as well as attracting international companies seeking partners for development and commercialisation here in Australia.