INITIATIVES IN HEALTH CARE INDUSTRY IN KERALA

(Expert Committee Report)

JULY

2020

INDUSTRY & INFRASTRUCTURE DIVISION
KERALA STATE PLANNING BOARD

GOVERNMENT OF KERALA

Foreword

At the request of the Minister for Industries, Government of Kerala, the State Planning Board constituted an Expert Committee to recommend policy interventions to encourage the growth and development of the healthcare industry and medical devices production Kerala.

The Chairperson of the Expert Committee was Dr Jayan Jose Thomas, Member, State Planning Board. The Report is the outcome of the expertise of the members of the committee and of the extensive consultations that they held with leading representatives of the medical devices and healthcare industry in India.

On behalf of the State Planning Board, I thank the members of the Expert Committee and thank all those who contributed their advice and expertise for their efforts.

We are happy to present the report to the Honourable Minister for Industries, Government of Kerala.

V K Ramachandran

Vice Chairperson

PREFACE

The State Government has received suggestions from different sources regarding a range of medical technologies that can be utilised in COVID-19 management and, subsequently, for other medical conditions as well. Kerala State Drugs and Pharmaceuticals Limited (KSDP) has taken the initiative to produce chloroquine and other drugs that can be used for such infections. Some startups in the State have developed prototypes of equipment such as ventilators and Personal Protection Equipment (including N95 masks).

In this context, and in the specific context of COVID – 19 pandemic, the State Planning Board, on the request from Government, has constituted an Expert Committee to examine and suggest policy interventions to coordinate and guide innovative initiatives in healthcare industry in Kerala.

The Expert Committee comprises members drawn from the State Planning Board, Department of Industries and Commerce, research institutions, public sector units, and the private sector. The Committee held extensive consultations with leading members of medical devices and healthcare Industry in India. Mr. E. P. Jayarajan, Minister for Industries, Government of Kerala participated in one of the interactive sessions organized by the Committee. This document is the outcome of above-referred consultations and contributions made by the Expert Committee Members.

The Expert Committee recognizes that Kerala's achievements in health and social sectors could form the springboard for the State's successful entry into a range of innovative industries in the healthcare sector. These include medical equipment and connected devices, as well as research and manufacturing in biotechnology, diagnostics and pharmaceuticals. In particular, the Committee has identified three main areas, which promise potential for future growth. First is in medical equipment and connected devices, and the Committee has suggested strategies to nurture entrepreneurs capable of setting up high technology firms in these sectors. Second, the Committee recommends that, in the post-COVID era, Kerala could emerge as a preferred wellness and healthcare destination. With good planning by local self-governments, towns and villages in Kerala could attract not just tourists but also professionals who remote work from Kerala -- including IT workers, creative professionals, researchers, architects, legal professionals, and management analysts. Third, in the medium to long run, Kerala could become a leading centre of research and high-end manufacturing in the areas of diagnostics, biotechnology and pharmaceuticals, as well as of medical devices. There is high potential for the development of a number of biotechnology and life sciences clusters across Kerala, including Thiruvananthapuram, Kochi and Kozhikode.

We thank one and all who have contributed to the effort in bringing out this report and hope the State Government will initiate action plans based on the recommendations in this report.

Dr.Jayan Jose Thomas
Chairperson
Expert Committee

Contents

EXPERT COMMITTEE ON INITIATIVES IN HEALTHCARE INDUSTRY IN KERALA:

IN THE CONTEXT OF THE COVID-19 PANDEMIC

EXECUTIVE SUMMARY

Kerala's relative success in the handling of the COVID-19 pandemic has focus international attention on the State's effective health services, efficient governance mechanisms, and strong social institutions. As part of its efforts to battle the virus and to manage the post - COVID situation, the State Planning Board, Government of Kerala, constituted an Expert Committee to understand the opportunities for Kerala in the healthcare and medical equipment industries. The Committee comprises members drawn from the State Planning Board, Department of Industries and Commerce, research institutions, public sector units, and the private sector.

The Committee recognizes that Kerala's achievements in health and social sectors could form the springboard for the State's successful entry into a range of innovative industries in the healthcare sector, including medical equipment and connected devices, as well as research and manufacturing in biotechnology, diagnostics and pharmaceuticals. In particular, there are **three main areas,** which promise potential for future growth. They are discussed below.

THREE MAIN AREAS FOR FUTURE GROWTH

First is in medical equipment and connected devices. With respect to research and manufacturing in the area of medical devices, Kerala already possesses some expertise and key advantages, including the presence of a few leading research centres, availability of skilled workers, and favourable natural environment. Combining these advantages with the State's strengths in the IT sector, Kerala can emerge as a significant player in the medical devices sector. Kerala should devise strategies to **nurture entrepreneurs capable of setting up high technology firms in the health sector** across the State. Given the critical importance of the medical devices sector on the one hand, and the large dependence in the country now on imported medical devices, Kerala can contribute significantly to the national efforts to build technological and manufacturing capabilities in this sector.

Second, in the post-COVID era, Kerala could emerge as a **preferred wellness and healthcare destination, attracting tourists as well as professionals who choose to remote work from the State.** Given the effectiveness of local self-governments in the State and with widespread adoption of connected devices among its population, Kerala should be able to battle its future health challenges with greater efficiency. Kerala's well-known strengths in *Ayurveda* and tourism will enhance its advantages as a wellness and healthcare destination.

Third, in the medium to long run, **Kerala could become a leading centre of research and high-end manufacturing in the areas of diagnostics, biotechnology and pharmaceuticals, as well as of medical devices**. In addition to the existence of some leading research institutions and the availability of skilled labour, one of Kerala's key strengths in the above-referred areas is the State's health infrastructure itself. The wide network of hospitals, health professionals and patients (who are educated and health conscious) across Kerala provide an enabling environment, including a rich source of data, for researchers in all fields relating to health.

NURTURING HIGH TECHNOLOGY ENTREPRENEURSHIP IN MEDICAL DEVICES

The market for medical devices in India is currently valued at Rupees 32,000 crores (approximately), which include Rupees 15,000 crores for the medical instrumentation sector. However, close to three-fourth of this demand is met by imports. Boosting manufacturing and technological capabilities in the medical devices is, therefore, a national priority. The Central and State governments can intervene in this sector in two distinct ways.

First is the role of government as a strategic investor: There is a need to strengthen public investment in research and development in medical devices, especially in new areas such as tissue engineering. Secondly, government could be a facilitator and catalyst for private sector investments, especially in technologically advanced areas.

Kerala could focus on the **moderate to high-risk medical device segment**, which include mainly implants and extracorporeal devices. Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST) in Thiruvananthapuram is a leading research centre in the country in the area of medical devices. SCTIMST has a long record in nurturing high technology small and medium enterprises (SMEs) in the health sector. **The aim of the government should be to nurture entrepreneurs who are capable of setting up high technology SMEs in Kerala in the healthcare industry**.

CONNECTED DEVICES (HEALTH CARE): KERALA AS AN EARLY ADOPTER AND AS A DEVELOPER OF TECHNOLOGIES

With respect to connected devices, Kerala's potential for future growth arises from its **role as an early adopter as well as a developer of technologies (in connected devices)**. The adoption of IT-enabled or connected devices for healthcare is likely to be high in Kerala because of its health conscious population and the relatively widespread use of mobile phone and Internet in the State. At the same time, Kerala has well-established strengths in the IT sector. There is potential for the **emergence of a number of startups and high tech firms in Kerala, which benefit from the State's strengths in IT and healthcare**. Kerala Startup Mission (KSUM) has already devised plans to support startups in the IT, healthcare and related areas.

KERALA AS A WELLNESS AND HEALTHCARE DESTINATION:

AND WITH OPPORTUNITIES FOR REMOTE WORK

In the post-COVID era, Kerala could emerge as a **preferred wellness and healthcare destination,** attracting tourists as well as professionals who choose to remote work from the State.

Experiences from different parts of the world indicate that a combination of technology and community engagement is going to be crucial in the management of health crises (including coronavirus) in the coming days. **The effectiveness of local self-governments** and the widespread use of connected devices for healthcare in the State can help Kerala battle its future health challenges with greater efficiency.

It may be noted here that in addition to the immediate threat posed by COVID-19, Kerala's health system has been battling the challenge of non-communicable diseases (NCDs), which include heart diseases and diabetes. In 2016, NCDs accounted for 74.6% of the disease burden (measured by disability-adjusted life years or DALYs) in Kerala, while the corresponding figure for India as whole was 55.6%.

At the same time, Kerala could take advantage of some of the changes in the nature of work, especially in the post-COVID world -- a growing preference for greener and healthier workspaces and greater options for remote work (afforded by teleconferencing and cloud-based sharing). Across Kerala, there are numerous towns and villages, which provide safe public places, clean and hygienic living spaces, and modern amenities, including good IT infrastructure. **With good planning by local self-governments, these towns and villages could attract not just tourists but also professionals who remote work from Kerala** -- including IT workers, creative professionals, researchers, architects, legal professionals, and management analysts.

Kerala State Government has already initiated efforts to set up 'work near home' facilities or co-working spaces in 100 towns across the State.

DISTRIBUTED MANUFACTURING FOR PERSONAL PROTECTION EQUIPMENT (PPE)

The Committee suggests that Kerala may adopt a hub and spoke model of distributed manufacturing for PPEs, including 2ply/3ply face masks, N95/KN95 masks, and sterile /non-sterile aprons. At the core of the hub and spoke model for PPEs will be relatively small production facilities dispersed across the State. Typically, a production facility for the manufacture of facemasks may employ 10 to 20 workers per shift and will have a production capacity of 1200-1500 units (face masks) per shift. Such a facility will require 6000 square feet of built up space and machinery worth approximately INR 30 lakhs. At the same time, raw material procurement, training, quality control, marketing and distribution may be handled by a central facility (hub), which may be housed in a few of the leading public or private sector firms (in the area of healthcare or textiles). The manufacturing hub ecosystem will be connected to all spokes, or the individual manufacturing units, using mobile technology or other IT solutions.

The technology for the manufacture of PPEs is relatively simple and easy to obtain. At the same time, given the large increase in the demand for PPEs in the context of the epidemic, PPE manufacturing has the potential to generate employment opportunities in large numbers. The opportunities in this sector could benefit women workers in particular, who may be trained to work in the highly clean and quality-conscious environments that are needed for PPE manufacturing. A number of Kudumbashree units have already ventured into the production of PPEs.

KERALA AS A LEADING CENTRE FOR RESEARCH IN BIOTECHNOLOGYAND PHARMACEUTICALS

In the medium to long run, Kerala can aim to become a major player in research and development in the areas of medical equipment, biotechnology and pharmaceuticals. The State should particularly encourage startups and high technology SMEs in research and high-end manufacturing in these areas.

Biotechnology offers the potential for the development of a range of value-added products in Kerala, especially given the State's rich natural diversity. Kerala has a number of academic and research institutions in the areas of biotechnology and life sciences, which are considered as among the best in the country. These institutions have created a critical mass of human resources, which is an important asset for Kerala in the biotechnology and life sciences industries.

One of Kerala's distinctive strengths in the above-referred areas is the State's health infrastructure itself. The wide network of hospitals, health professionals and patients (who are educated and health conscious) across Kerala provide an enabling environment, including rich source of data, for researchers in all fields relating to health.

KNOWLEDGE ECONOMY CLUSTERS IN THIRUVANANTHAPURAM, KOCHI AND KOZHIKODE-KANNUR

In fact, Thiruvananthapuram has the potential to emerge as one of the most dynamic centres of knowledge economy within the country, with a distinctive advantage in biotechnology and life sciences. The premier academic and research institutions in Thiruvananthapuram include the Rajiv Gandhi Center for Biotechnology (RGCB), Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST) and Indian Institute of Science Education and Research (IISER).

Kerala State Industrial Development Corporation (KSIDC) has set up a Life Sciences Park in Thiruvananthapuram. Within the Life Sciences Park, the Institute of Advanced Virology has started operations in 2019. A facility for the manufacture of medical equipment is also being set up within the Life Sciences Park.

Kochi and its surrounding areas also offer exciting potential for the growth of biotechnology. Cochin University of Science and Technology (CUSAT) and Mahatma Gandhi University (in Kottayam) carry out research in this field. Kerala State Drugs and Pharmaceuticals (KSDP) Limited has pharmaceutical production facilities in Alappuzha. Kerala is planning to set up a Pharma Park in Kochi, which will be developed along with the Petrochemical Park, both of which are being set up adjacent to BPCL-KRL (Kochi Refinery Limited). Pharma Park in Kochi could provide space for firms that are engaged in research and high-end manufacturing in the areas of pharmaceuticals and biotechnology.

A third cluster of biotechnology and life sciences industries could be developed in the northern part of Kerala, which will take advantage of the academic and research institutions as well as the rich biodiversity in this region, including Kozhikode, Kannur and Wayanad. Both Kozhikode and Kannur have international airports, and they can benefit, in particular, from their relative proximity to Bangalore (firms in high technology areas considering a shift out of an overcrowded Bangalore may consider setting up their bases in these cities).

TESTING FACILITIES AND SHARED SPACES

Biotech or medical equipment products manufactured by startups or other firms have to be tested at facilities accredited to or certified by national and international agencies so that the products obtain regulatory clearances. For nurturing startups and small firms in Kerala in the

areas of medical devices, biotechnology and pharmaceuticals, it is crucial to set up within the State (especially in the emerging technology clusters, such as in Thiruvananthapuram) advanced testing facilities as well as shared facilities such as clean rooms, research laboratories, and pilot production facilities.

LONG-TERM STRATEGIES TO BUILD TECHNOLOGICAL EXCELLENCE

In the medium to long-term, Kerala should take steps to enhance its human resource capabilities in the area of biotechnology, life sciences and related technologies. Academic and research institutions in Kerala should try to build collaborations with leading technology institutions in India and abroad. Such collaborations could lead to the exchange of students and faculty members, joint research projects and publications, and to a faster growth in the formation of technology firms in Kerala.

IN A NUTSHELL: HEALTHCARE PRODUCTS AND TECHNOLOGIES: POSSIBLE STRATEGIES FOR KERALA

Key Sectors	Main features	Key advantages for Kerala	Future Strategies for Kerala
1. Medical equipment	Focus on medium to high-risk medical device segment, and on advanced technologies.	The expertise of SCTIMST and other institutions, and the presence of a few leading players, mainly in Thiruvananthapuram.	Promotion of high technology SMEs; Government may help set up testing facilities and shared common resources to nurture entrepreneurship.
2. Connected devices	Combining Kerala's strengths in the IT and healthcare sectors.	Early and widespread adoption of technologies (IT-enabled devices) in Kerala is, in itself, an important stimulus to innovation.	Promotion of startups. Build on Kerala Startup Mission's initiatives.
3. PPEs (including masks and gowns)	Distributed manufacturing	Large demand for PPEs in Kerala; availability of workers with the skills to work in high quality conditions.	Promotion of a hub and spoke model: relatively small production facilities dispersed across the State, coordinated by a central facility (hub).

4. Opportunities for remote work and tourism	Kerala as a wellness and healthcare location.	Towns and villages with good infrastructure and internet connectivity; Ayurveda; and a growing preference for healthy and green places of work.	Local self-governments could take the initiative to make Kerala a preferred location for knowledge workers -- IT workers, creative professionals, researchers, architects, and legal professionals.
5. Biotechnology And pharmaceuticals	Research and high-end manufacturing in these areas.	Human resources, presence of research centres, and natural diversity.	Collaborations with leading research institutions in India and abroad.

EXPERT COMMITTEE ON HEALTHCARE INDUSTRY IN KERALA – CONSTITUTED BY

STATE PLANNING BOARD, GOVERNMENT OF KERALA, MAY-JULY 2020

Constitution of an Expert Committee (Post COVID-19 to examine and suggest policy intrventions to ccordinate and guide innovative initiatives in Healtcare industry in Kerala.

The Government has received suggestions from different sources regarding a range of medical technologies that can be utilised in Covid-19 management and, subsequently, for other medical conditions as well.

There have been suggestions regarding producing pharmaceuticals like chloroquine by KSDP. KSDP has taken the initiative to produce chloroquine and other drugs that can be used for such infections. Some startups also have developed prototypes of equipment such as ventilators and Personal Protection Equipment such as N95 masks.

Since morbidity in Kerala (from communicable and noncommunicable diseases) is high, we need to mass-produce equipment, instruments, devices, and pharmaceuticals in Kerala. The Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST) has taken the initiative to establish a Devices Park in the Life Sciences Park. The KSDP is attempting to produce drugs that can be used for conditions prevalent in Kerala.

In this context, and in the specific context of the Covid-19 pandemic, the Minister of Industries has requested the State Planning Board to appoint a committee to examine and suggest policy interventions to coordinate such initiatives in Kerala.

The **Terms of Reference** for the Expert Committee are as follows:

1. Explore the areas where Kerala can develop and produce equipment, software, technologies, pharmaceuticals that can be used for Covid-19 control and subsequently to manage emergency medical situations.

2. Examine the quality and immediate applicability of the technologies, software (mostly for data collection) proposed by start-ups, research centres, universities, and other institutions.

3. Examine, evaluate and where appropriate showcase the positive efforts of different agencies in producing and marketing technologies and products for use in Covid-19 control (for example, antigen and antibody kits by SCTIMST, antibody kits by RGCBT, PPE production by Kitex). This will give us optimism and confidence in proceeding further.

4. Identify technologists and institutions in the private and public sectors who have the capabilities to develop and produce new technologies, devices, software, and pharmaceuticals. Such persons and institutions will continue to be of value to the State in the future.

Committee Members

Dr Jayan Jose Thomas, Member, Kerala State Planning Board (Chairperson)

Dr A Jayathilak, IAS, Member Secretary, Kerala State Planning Board

Dr B Ekbal, Member, Kerala State Planning Board

Dr K N Harilal, Member, Kerala State Planning Board

The Department of Industries and Commerce, Government of Kerala (Shri. V.R.Premkumar and Shri. Mohammed Hanish)

Sri Balagopal Chandrasekhar, Former Managing Director, Terumo Penpol

Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST) (Muraleedharan C.V, Scientist and Associate Head, Biomedical Technology Wing)

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Other details and Acknowledgements

The Expert Committee on Healthcare industry in Kerala held extensive consultations on the following dates: 6 May 2020, 12 May 2020, and 29 May 2020. The meeting on 29 May 2020 included an interactive session with the Confederation of Indian Industry (CII). The speakers at the interactive session included Mr. E. P. Jayarajan, Minister for Industries, Government of Kerala; Dr. V.K. Ramachandran, Vice Chairperson of Kerala State Planning Board; Dr. K.Ellangovan, Principal Secretary, Industries; as well as leading members of the medical devices and healthcare industry in India. The section on personal protection equipment (PPE) in this report is based on a written note prepared by Mr. Ajit Mathai and Mr. S. Manikandan in consultation with Mr. C. Balagopal. This report has benefitted from inputs provided by Dr. Linda Koshy, Mr. Robin Alex Panicker and Ms. Priyanka Singh.

EXPERT COMMITTEE ON INITIATIVES IN HEALTHCARE INDUSTRY IN KERALA: IN THE CONTEXT OF THE COVID-19 PANDEMIC

FULL REPORT

1. INTRODUCTION

Kerala's relative success in the handling of the COVID-19 pandemic has attracted international attention. In particular, the State has received praise for its effective health services, efficient governance mechanisms, and for its strong social institutions. As part of its efforts to battle the virus and to mange the post-COVID situation, State Planning Board, Government of Kerala, constituted an Expert Committee to understand the opportunities for Kerala in the healthcare and medical equipment industries.

Kerala recognizes that a robust healthcare industry is important for the State in at least two respects. First, some degree of self-sufficiency within the State with respect to the supplies of personal protection equipment (PPEs) and other critical medical equipment are necessary for effectively containing the epidemic in the long run. Secondly, Kerala realizes that its achievements in the health and social sectors could form the springboard for the State's successful entry into a range of innovative industries in the healthcare sector, including medical equipment and connected devices, as well as research and manufacturing in biotechnology, diagnostics and pharmaceuticals.

Given the above context, the Expert Committee on Healthcare industry in Kerala focused on the following objectives:

First, the Committee tried to identify products or technologies in the healthcare sector in which Kerala has the potential to emerge as a significant player, and particularly so in areas which are likely to see an increase in demand in the context of the COVID-19 pandemic.

Second, the Committee has recommended short-term as well as medium to long-term strategies for Kerala in the above-identified areas.

2. CONTEXT

The World Health Organization (WHO) has declared COVID-19 -- or the disease caused due to coronavirus (SARS-CoV-2) -- a pandemic. After the first cluster of cases being reported in Wuhan City in Hubei Province of China on December 31, COVID-19 has now spread to most regions of the world. As on 19 June 2020, there were 8.4 million (83,85,440) confirmed cases of COVID-19 across the globe,

which included 4.5 lakh deaths (4,50,686). India was the fourth worst affected country with 3.8 lakh (3,80,532) confirmed cases (according to WHO: https://covid19.who.int/).

Table 1: Cumulative number of COVID-19 cases, India and Selected Indian States

State	24 March 2020	14 April 2020	14 May 2020	19 June 2020
Kerala	96	379	534	2794
Maharashtra	91	2557	26292	120504
Tamil Nadu	15	1193	9330	52334
Delhi	30	1542	8107	49979
Gujarat	33	666	9342	25601
India	523	11519	78920	380532

Source: https://www.ndtv.com/ (Infographics)

Kerala reported the first confirmed case of COVID-19 on 30 January 2020, which was, in fact, the first such case reported in the country. Even on 24 March 2020, just a day before India went into a countrywide lockdown, Kerala was the State with the maximum number of COVID-19 cases in the country (96 cases or 18.3% of a total of 523 cases in the country). However, over the following weeks, Kerala has been relatively successful in slowing the spread of the coronavirus. As on 19 June 2020, there were 2794 COVID-19 cases in Kerala, which was, however, less than 1% of the total number of COVID-19 cases in India.

Kerala's success in slowing down the spread of the corona virus disease has attracted international attention (see for example, Spinney, 2020). In particular, the State has received praise for its effective public and private health services, efficient governance mechanisms, particularly of local self-governments, and for its strong social institutions.

However, the challenge posed by the COVID-19 pandemic is not going to fade away anytime soon. As of now, there are no known therapeutic drugs for treatment and no vaccines for the eradication of COVID-19. Experts in India and elsewhere are not able to predict when the coronavirus pandemic will be contained. Meanwhile, an article that appeared in *Lancet* suggested that about 1.7 billion people or approximately one in five individuals worldwide could be at increased risk of severe COVID-19, should they become infected, due to their underlying health conditions. They include individuals with cardiovascular disease, chronic kidney disease, diabetes, chronic respiratory disease, and a range of other chronic conditions (Andrew Clark et al. 2020).

Experiences from different parts of the world indicate that a combination of technology and community engagement is going to be crucial in the management of the disease in the coming days (Cash and Patel, 2020). It is recognized that community participation is essential in making a collective response to the coronavirus disease. Community participation is important, for instance, in syndromic diagnosis (clinical diagnosis based on the constellation of symptoms and signs which are a hallmark of infection) (Cash and Patel, 2020).

Health professionals should try to incorporate the insights and ideas from diverse communities in what may be described as the coproduction of health – to plan, research, deliver, and evaluate the best possible health promotion and health-care services (Marston et al, 2020). However, pandemic responses in many parts of the world have largely involved governments telling communities what to do, seemingly with minimal community input (Marston et al, 2020).

India has a remarkable record in the manufacture of affordable medicines – or generic versions of expensive drugs. In the context of the pandemic, India has been trying to achieve greater self-sufficiency in technological development and manufacturing, especially in areas related to healthcare, pharmaceuticals, and medical equipment. The moves towards self-sufficiency are important given the growing recognition that developing countries should adopt healthcare products and technologies that suit their requirements and social contexts rather than indiscriminately adopting the products (such as expensive kits) developed and used in the wealthy countries (see, in particular, Cash and Patel, 2020).

In recent months, a number of firms and research institutions in India have come up with technological solutions to fight the pandemic. For instance, Indian Institute of Technology (IIT) Delhi has developed a testing kit to diagnose COVID-19 and IIT Kanpur is in the process of commercializing a low-cost ventilator (which according to the developers will cost only about 6 per cent of the international price of ventilators). Sree Chitra Tirunal Institute of Medical Sciences and Technology (SCTIMST), a national institute based in Thiruvananthapuram, has developed a testing kit called Chitra GeneLamp-N (which can confirm COVID-19 in two hours or so at a cost of less than INR 1000 per test) as well as cost effective swabs (for collecting oral and nasal specimens for COVID-19 suspected persons) (Mani 2020).

3. KERALA'S HEALTH CHALLENGES

Kerala's advances in the areas of social and economic development have also had impacts on the disease pattern of the State. Non-communicable diseases (NCDs), which include heart diseases and diabetes, account for a much larger share of the disease burden in Kerala relative to the rest of the country.

In 2016, NCDs accounted for 74.6% of disability-adjusted life years (DALYs) in Kerala, while the corresponding figures were 55.6% for India as whole and 47.9% for Uttar Pradesh. At the same time, communicable, maternal, neonatal and nutritional diseases (CMNNDs) accounted for 13.6% of DALYs in Kerala compared to 32.7% for India. CMNNDs had accounted for 60.9% of DALYs in India in 1990 (Source: *India: Health of the Nation's States — The India State-Level Disease Burden Initiative*).[1]

Epidemiological transition ratio, which is defined as the ratio of DALYs caused by CMNNDs to those caused by NCDs and injuries, ranged from 0.16 only in Kerala to 0.74 in Bihar in 2016. A ratio greater than one indicates a higher burden of CMNNDs than NCDs and injuries, while a ratio less than one indicates the opposite.

CMNNDs include diarrhoeal diseases, tuberculosis, lower respiratory infections, preterm birth complications, iron deficiency anaemia, other neonatao disorders, hepatitis, neonatal encephalopathy, and measles. NCDs include stroke, COPD (chronic obstructive pulmonary disease), Ischaemic heart disease, sense organ diseases (including hearing and vision loss) and diabetes (Source: *India: Health of the Nation's States — The India State-Level Disease Burden Initiative*).

While the decline in mortality due to communicable, maternal, neonatal, and nutritional diseases (CMNNDs) is indeed a positive development, there have been concerns about the rise in the incidence of non-communicable diseases (NCDs) in Kerala.

[1] DALYs express the premature death and disability attributable to a particular cause, and are made up of two components: years of life lost (YLLs) and years of life lived with disability (YLDs). YLLs measure all the time people lose when they die prematurely, before attaining their ideal life expectancy. Ideal life expectancy is based on the highest life expectancy observed in the world for that person's age group. YLDs measure years of life lived with any short- or long-term condition that prevents a person from living in full health. They are calculated by multiplying an amount of time (expressed in years) by a disability weight (a number that quantifies the severity of a disability) (Source: *India: Health of the Nation's States — The India State-Level Disease Burden Initiative*)

Table 2: Contribution of major disease groups to disability-adjusted life years (DALYs)

	India, 1990	India, 2016	Kerala, 2016	Uttar Pradesh, 2016
Communicable, maternal, neonatal and nutritional diseases (CMNNDs)	60.9	32.7	13.6	40.5
Non-communicable diseases (NCDs)	30.5	55.4	74.6	47.9
Injuries	8.6	11.9	11.8	11.6

Source: *India: Health of the Nation's States — The India State-Level Disease Burden Initiative*, 2.017

Table 3: Major factors contributing to disability-adjusted life years (DALYs), for males and females combined, as % of all factors contributing to DALYs

Factors	Uttar Pradesh, 2016	Kerala, 2016	Kerala, 1990	India, 2016
Malnutrition	18.2	4.4	17.4	14.6
Air pollution	11.1	6.2	9.3	9.8
Tobacco use	6.2	6.9	6.5	5.9
WaSH	6.1	1.3	3.3	4.6
Dietary risks	5.7	11.2	8.1	8.9
High blood pressure	5.1	13.4	7.9	8.5
High fasting plasma glucose	4.1	11.1	5.9	6
Alcohol and drug use	3.3			3.6
Occupational risks	2.9	3.7	3	3
High body-mass index	2.5	7.6	1.7	3.6
High total cholestrol	2.4	7	4	4.1
Impaired kidney function		4.8	2.8	2.8

Note: Malnutrition is child and maternal malnutrition.
WaSH is unsafe water, sanitation and handwashing.
Source: *India: Health of the Nation's States — The India State-Level Disease Burden Initiative*, 2017.

4. PRODUCTS AND TECHNOLOGIES FOR HEALTHCARE IN THE CONTEXT OF COVID-19

After the outbreak of the COVID-19 epidemic, there has been a large increase in the demand for healthcare products and technologies all over the world. The rate of growth of this demand has been particularly fast in Kerala, given the high levels of public awareness about health in the State. There has been a large increase in demand for products that will help prevent the spread of the virus and for tools to diagnose persons affected by the virus. These include a wide range of personal protection equipments (PPE), including face masks, aprons, hood caps, shoe leggings, gloves, face shields, and goggles, which are required for protection from infection and contamination.

There has been a growing demand for lab diagnostic products, including regents and equipment. In the aftermath of the pandemic, many patients with serious complications will have to undergo a variety of biochemical testing for kidney, cardiac, hepatic complications. There should be sufficient number of testing centres and sufficient quantity of lab reagents and equipment to meet the increased demand. For work related to isolation, handling and diagnostics of the coronavirus, WHO recommends practices and procedures described for basic laboratory – Biosafety Level 2 and Biosafety Level 3 (BSL-2 and BSL-3), as detailed in the WHO *Laboratory biosafety manual*, 3rd edition. Kerala should make sure that there is sufficient amount of laboratory space meeting the required standards (which include facilities for fluorescent (ELISA) plate readers and Real-time PCR machines).

Similarly there has been a growing demand for a range of medical equipment, which include critical care tools (such as economical ventilators) and patient monitoring systems, (such as ultrasound/IR gadgets, ECR monitors, blood pressure monitors, blood sugar checking machines, and digital infrared non-contact thermometers).

Table 4: Healthcare products and technologies, by nature of use

Nature of use	Products and technologies
A. Preventive care and Diagnosis	
A1. Isolation (barrier) products for healthcare workers and patients	PPEs, masks, swab collection booths, examination booths, patient isolation pods, patient transportation pods, infected secretion disposal systems etc
A2. Disinfection devices	Gateways, UVC chambers, fumigators, UV Cleaner–Recirculator, Autoclaves, incinerators etc for reducing the bioburden in critical locations
A3. Diagnostics testing (to help screen and confirm the viral infection)	Detection devices and kits such as PCR kits, RNA extraction kits, cDNA synthesis kits, COVID-19 specific primer sysnthesis, LAMP kits, and IgG/IgM anti-body based detection kits High throughput Next generation sequencing (NGS) based kits.
B. Curative care	Cost effective respirators, breathings aids (ventilators), bubble helmets
C. Long-term care and prevention	(IT) Connected devices, servers and patient data handling softwares.

IT-ENABLED OR CONNECTED DEVICES

Information technology (IT) can assist in healthcare in several ways: by providing reliable information to the general public, as well in diagnosis and treatment.[2] are playing an important role in medical research and healthcare. With AI-based data analytics and predictive modeling, medical professionals are able to understand better about a number of diseases, including about disease spread, medication, and treatment (Manjunath, 2020).

Thermal Cameras or thermal drones have been used in public spaces (including in coronavirus hotspots such as Dharavi) for monitoring large numbers of people with high body temperatures, and from a distance. In the post-COVID scenario, it is likely that thermal cameras will be installed in offices, schools, warehouses, airports, and railway stations for preventing the spread of the disease. [3] Some healthcare firms have manufactured smart thermometers that have the ability to be paired with a mobile phone app, uploading the recorded temperature of the user to its database. [4]

[2] In the context of the coronavirus disease, there has been spread of much misinformation about fatalities, treatment options, government policies, and so on, often leading to panic and anxiety among the population. Information technology and social media tools have an important role to play in making accurate information and vital health messages available to everybody.

[3] On the use of FLIR E40 thermal cameras by the Indian Railways, see [https://www.financialexpress.com/infrastructure/railways/indian-railways-installs-thermal-imaging-camera-at-electric-loco-shed-bhusawal-to-prevent-covid-19-features/1922470/]. On the use of FLIR A320 cameras are being utilised by various airport authorities, see[https://www.gothermal.co.za/pages/flir-a320-thermal-camera-coronavirus-fever-screening-solution]

[4]Kinsa, San-Fransico based healthcare company, has developed such an application. [https://www.cnbc.com/2020/04/02/this-smart-thermometer-could-help-detect-covid-19-hot-spots.html] Researchers at NHHID Chennai along with Bengaluru based firm Triphase technology have also developed a similar smart thermometer costing about Rs 350 (https://zeenews.india.com/tamil-nadu/amid-coronavirus-covid-19-pandemic-researchers-develop-bluetooth-based-thermometer-for-efficient-fever-monitoring-2283009.html] Baidu, a Chinese multinational technology company, has built AI-based solutions to effectively screen large populations (about 200 people per minute) and detect any change in their body temperature while they are on the move.

In China, following the lifting of the lockdown, a colour coded health system has been used to regulate the movement of people across provinces. The system works through a software installed in popular Chinese payment and messaging platforms like Alibaba and WeChat.[5] In order to travel, people have to fill out a health survey requiring details such as body temperature, health background and local travel.

IT TOOLS FOR CURE

IT tools such as telemedicine technologies have been used in the treatment of diseases. For instance, e-ICU monitoring programmes in hospitals allow nurses and physicians to remotely monitor the status of 60-100 persons in multiple hospitals.[6] There is going to be a greater role for IT connected devises and Total Lab Automation Systems in which where patients from any remote place can share the relevant biochemical and physiological results with and receive medical advice from a clinician practicing at a distant place (telemedicine and teleconsultation). Some companies have developed a remote examination (incldluing for home-quarantined patients) device, which examines heart, lung, throat, body temperature and informs patient about their health status.[7] Such devises are useful for remote medical examination.

The diagnosis and care of cancer, for instance, is undergoing a technological revolution. The use of advanced diagnostic assays, which make use of artificial intelligence, has the potential to downstage cancer at diagnosis. Genomic technology is used to develop new molecules, which can silence cancer-driving genes. Another advance has been in the use of minimally invasive robotic arms guided by real-time navigation.

5. PERSONAL PROTECTION EQUIPMENT (PPE)

HUB AND SPOKE DISTRIBUTED MANUFACTUING MODEL[8]

With the outbreak of the COVID-19 epidemic, there has been a sharp increase in the demand for Personal Protection Equipment (PPE), which are required for protection from infection and contamination. PPEs include face masks, aprons, hood caps, shoe leggings, gloves, face shields, and goggles.

Even before the outbreak of the coronavirus, PPEs have been ordinarily used in large numbers in developed countries. The use of PPEs have been, in general, limited in India, largely due to issues of affordability. Howver, the pandemic is likely to change the situation drastically, with widespread and even mandatory use of PPEs for all healthcare professionals and also by the general public. It appears that the

[5] [https://www.businessinsider.in/slideshows/miscellaneous/as-china-lifts-its-coronavirus-lockdowns-authorities-are-using-a-color-coded-health-system-to-dictate-where-citizens-can-go-heres-how-it-works-/slidelist/75033994.cms#slideid=75033998

[6] e-ICU was launched in 2012 by GE HEALTHCARE in partnership with Fortis Healthcare. Apollo introduced e-ICUs later. Philips Healthcare is also working on e-ICUs.

[7] Israelian company Tyto-Care has developed this technology.
[https://www.youtube.com/watch?v=xsh9O1vnOe8&feature=youtu.be]

[8] This section on personal protection equipment (PPE) is based on a written note prepared by Mr. Ajit Mathai and Mr. S. Manikandan in consultation with Mr. C. Balagopal.

COVID-19 pandemic has fundamentally changed levels of awareness and perhaps even social behaviour with respect to 'social distancing', hygiene, and the use of PPEs in Kerala and in the rest of the country.

Given the sharp rise in the demand for PPEs and the very criticality of PPEs in the future containment of the epidemic, there is a need to boost the production of PPEs in Kerala. The production of PPEs is important in at least two respcts. First, achieving some degree of self-sufficiency in critical PPE supplies is important from a public health perspective. Secondly, the large increase in demand for PPEs presents an opportunity for businesses and for employment generation. The Expert Committee discussed how an enabling environment can be created for this very young yet critical industry.

MANUFACTURING OF PPE PRODUCTS

Typically, the manufacture of PPEs have been carried out in large and highly automated production facilities, which are capable of turning out thousands of pieces of each item per day. While some products are produced in India, mass production of these items are largely from production lines in China, Taiwan and a few other countries, from specialized production units of companies such as 3M.

In the coming days, it will be important for Kerala to have control over the complete process of sourcing and manufacturing of PPEs, the simple but important product for the healthcare sector, in order to deal with urgent and concentrated requirements like pandemics and disasters.

HUB AND SPOKE MODEL OF DISTRIBUTED MANUFACTURING OF PPE PRODUCTS

There are many PPE products that are not made end to end on an automated line but need to be assembled or fabric converted into a product through processes like fusing using ultrasound welding or heat sealing. The most commonly used material is 100% meltblown nonwoven polypropylene fabric. Different weights (gsm) of fabric are used for different products.

Given below is a list of indicative PPE products, their weight specifications, and the feasibility to manufacture in Kerala on the hub and spoke model of distributed manufacturing. However, some other PPEs such as nitrile gloves, face shields and protective goggles are difficult to be manufactured in the hub and spoke model discussed above. These products need to produced on a bigger scale.

PPE products that may be manufactured in Kerala on the hub and spoke model of distributed manufacturing

No	Particulars	Weight in grams per square metre (GSM)
1	2ply/3ply face mask	20-25
2	N95/KN95 mask	800
3	Sterile / non-sterile apron	38-43
4	Hood cap	40
5	Shoe leggings	90

For example, a facility that is making face masks will indicatively have around 10 to 20 operators per shift and will have a production capacity of 1200 to 1500 units (of face masks) per shift. Such a facility will require 6000 square feet of built-up space (including standardized modular clean rooms) and machinery worth approximately INR 30 lakhs.

As these PPE products are required in large numbers, these units will need to be aggregated on a hub and spoke model with centralised raw material procurement, training, quality control, marketing & distribution.

The manufacturing hub ecosystem will need to use an IT solution that connects all spokes, the distributed manufacturing units, using mobile technology. Raw material supply, production, quality control, dispatch, logistics and payment will need to be driven through this solution.

It is interesting to note that the PPE products listed in the Table above are made out of 100% meltblown nonwoven polypropylene fabric of different weights (gsm) using the same base raw material namely, polypropylene resin granules.[9] Kerala State Textile Corporation (KSTC) has initaited a project to manufacture nonwoven fabric.

In order that Kerala derives the maximum advantage from the use of these PPE products, they need to be packed into kits that will contain other items too needed for common procedures in hospitals. This will enable good practices to be adopted fully in hospital OTs and wards, leading to lower infections and lower contamination and improvements in patient outcomes. These kits will be configured to the best practices followed internationally, and will also lead to standardization of hospital practices and processes, again with improvement in patient outcomes.

The manufacture of these PPE kits, however, will require manual processes, since items will need to be placed into inner covers or thermo-formed trays, before these are sealed prior to sterilization. Different combinations of various items of PPE will need to go into each kit intended for a specific surgical or clinical procedure. This means that many different combinations will need to be designed for different procedures, making it difficult to automate.

[9] Polypropylene resin granules, the rawmaterial for meltblown nonwoven polypropylene fabric, is produced in large quantities by large established players in India and is available easily.

6. OPPORTUNITIES FOR KERALA IN MEDICAL EQUIPMENT AND CONNECTED DEVICES

MEDICAL DEVICES: NEED FOR GREATER TECHNOLOGICAL DEVELOPMENT

It is estimated that the market for medical devices in India is currently valued at Rupees 32,000 crores (approximately), which include Rupees 15,000 crores for the medical instrumentation sector. However, close to three-fourth of this demand is met by imports, The domestic firms in the medical devices sector have been playing only a limited role, and they are largely involved in the manufacture of low technology products. Factors limiting the growth of the medical device industry are:

High cost or non-availability of imported technology

Large risks involved in marketing medical devices

Lack of sufficient indigenous technology development

Lack of sufficient trained human resources

Given the rising demand for medical devices following the outbreak of the pandemic, India should formulate an industrial development strategy to boost domestic manufacture of medical devices. Both Central and State Governments will have a vital role to play in this development strategy. has to a holistic one in which the government funded institutions take up the roles of Facilitator, Catalyst and Strategic Investor.

First, government as a strategic investor:

There is a need for strengthening public investment in research and development in medical devices, especially in new areas such as tissue engineering. The aim of the government should be to develop domestic capabilities in technologically advanced areas.

Second, government as a facilitator and catalyst for private investments:

The government should set up testing facilities, which are accredited to international agencies, so that the products tested here could gain global acceptance.

The government could set up modular flexible manufacturing units and other key infrastructure to provide support to entrepreneurs for pilot production and market seeding. The government could also arrange facilities to generate and transmit information in the area.

OPPORTUNITIES FOR KERALA IN THE MEDICAL EQUIPMENT INDUSTRY

There is great potential for Kerala in research and manufacturing in the area of medical equipment and connected devices. Sree Chitra Tirunal Institute for Medical Sciences and Technology in Thiruvananthapuram is a leading research centre in the country in the area of medical devices. Kerala could focus on the moderate to high-risk medical device segment, which include mainly implants and extracorporeal devices. This is a sector in which there is a growing demand but domestic manufacturing and technology capabilities are limited.

In fact, in the medical equipment industry, Thiruvananthapuram had an early start when Peninsula Polymers Limited and HLL Lifecare Limited set up facilities for production of blood bags in this city. Peninsula Polymers Limited started the production of blood bags in 1987 with technology obtained from Sree Chitra Tirunal Institute for Medical Sciences and Technology (known then as the Chitra Medical Centre). Terumo Penpol, which evolved from Peninsula Polymers Limited, is today one of the leading producers of blood bags in the world, with an annual production of 30 million units.

A facility for the manufacture of medical equipment is being set up within the Life Sciences Park in Thiruvananthapuram.

A number of institutions in Kerala have started development of IT tools and medical equipment needed for the diagnosis and care of COVID-19. At the Super Fab Lab under Kerala Startup Mission's (KSUM) Integrated Startup Complex in Kalamassery, a working prototype of the minimum viable ventilator has been developed and is ready for trial production.

OPPORTUNITIES FOR KERALA IN CONNECTED DEVICES

With respect to connected devices, Kerala's potential arises from its role as an early adopter as well as a developer of technologies.

There is high potential for the large-scale adoption of IT-based tools for healthcare in Kerala. This is because of the relatively widespread use of mobile phone and Internet in the State.[10] According to Internet And Mobile Association of India (IAMAI), Kerala's Internet penetration rate (defined as number of individuals aged above twelve per 100 population who accessed the Internet in the last month; survey period January-March 2019) is the second highest in the country (54%). The highest was in Delhi NCR (69% penetration rate).[11]

Kerala's healthcare system could consider making use of a secure analytics platform such as 'OPEN SAFELY' of the United Kingdom (UK). In the UK, 'OPEN SAFELY' analyses data relating to more than 24 million patients (full pseudonymised primary care NHS records) to answer important questions with respect to the coronavirus emergency (questions such as: which patients are most at risk of death in hospital from COVID-19, or which treatments increase or decrease risk).[12] In the case of 'OPEN

[10] CyberMedia Research, a market intelligence firm 65% of the mobile phone users in Kerala are on smartphones. The corresponding proportion for the country as a whole was only 47%. See <https://ultra.news/t-t/40425/kerala-tops-smartphone-penetration-in-india-gujarat-punjab-close-behind>

[11] Available at: https://www.thehindu.com/news/national/where-does-kerala-internet-access-stand-compared-to-other-states/article29910398.ece

[12] OpenSAFELY is a new secure analytics platform for electronic health records in the National Health System (NHS), created to deliver urgent results during the global COVID-19 emergency. OpenSAFELY is a collaboration between the DataLab at the University of Oxford, the EHR group at London School of Hygiene and Tropical Medicine, TPP and other electronic health record software companies. It is now

SAFELY', the basic software is open source, and can be freely downloaded from GitHub for security review, scientific review, re-use and re-writing.[13] A similar IT-led platform in Kerala could help the State's healthcare system to be more patient centric and be better prepared to fight communicable and non-communicable diseases that attack the State.

Telemedicine is being utilized in the Heart Failure Clinic at Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Thiruvananthapuram, mainly to enable follow-up reviews of registered patients. The Wayanad district administration in association with Sree Chitra Tele Health Unit (SeTHU) of SCTIMST and the Health Department has launched a telemedicine project for patients with chronic diseases.

SCTIMST has also been making advances in Total Lab Automation Systems: picture archiving and communication system (PACS) has been setup at SCTIMST that archives patient details maintained on secure servers.

At the same time, IT firms in Kerala have been taking advantage of the demand for IT devices for healthcare. Kerala Startup Mission (KSUM) has devised plans to support startups in the IT, healthcare and related areas through seed grant, market connect, and expert mentoring. In addition, Kerala Startup Mission has set up two specialized incubators to provide support for medical and biotech startups. They are: **KRIBS-BIONEST and Biomedical Research, Innovation and Commercialization in Cancer.**

The Maker Village in Kochi, a major electronic incubator in the country, has several startups working in medical electronics field.[14] In addition to startups operating from Bionest, Maker Village and BRIC, there are over 65 startups in Healthtech area in Kerala. A Kerala-based firm manufacturing robots has supplied 2 robots, which can distribute masks and hand sanitizers and disinfect premises, in a Kochi village.[15] Some of the products developed by startups in Kerala include: biocalculus or an AI-powered platform for remote cardiac monitoring ecosystem (http://waferchips.co.in); technologies that can cheaply detect early

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successfully delivering analyses across more than 24 million patients' full pseudonymised primary care NHS records. OpenSAFELY says its analytic software is open for security review, scientific review, and re-use. This new statistical analysis platform is helping to provide urgent answers on key clinical and public health questions during the Covid-19. The platform also support modellers to understand and predict the spread of the disease, and pressure on NHS services, using hyperlocal real-world data. Source: https://opensafely.org/

[13] https://www.privateinternetaccess.com/blog/opensafely-more-proof-that-tackling-the-coronavirus-pandemic-does-not-require-privacy-to-be-compromised/

[14] The Maker Village in Kochi is supported by KSUM and funded partly by Ministry of Electronics and Information Technology, Government of India.

[15] Asimov Robotics [https://www.indiatoday.in/india/story/coronavirus-in-india-robots-in-this-kochi-village-spray-sanitizer-inform-people-about-covid-19-1657421-2020-03-19

and pre-cancerous squamous cell lesions (http://www.sasacan.in); and mobile telemedicine kiosk (www.mobilexion.com).

Cochin University of Science and Technology (CUSAT) has plans to set up an ICT- based Technology center for Disaster management. It plan to make use of technologies such as AI, IoT, Big data and innovations in robotics and drone technologies in combating disasters.
The use of IT tools for detection of the coronavirus disease can have positive impacts on sectors such as tourism in Kerala. In the post-COVID world, tourists will prefer to travel to places, which provide them some degree of reassurance against infection from the disease.

7. KERALA AS A WELNESS AND HEALTHCARE LOCATION

In the context of the COVID-19 epidemic, tourists and other visitors will prefer to travel to locations that assure them some degree of protection against infection from the disease. Intervention by local self-governments along with widespread use of IT connected devises by the general public can potentially make Kerala a relatively 'safe' location from the point of view of public health.

Given such a scenario, Kerala now has the chance to showcase itself globally as a location that not only assures wellness and healthcare but also provides a greener and healthier environment for work – to locals and visitors alike. Increasingly, Kerala could try to attract not just tourists but also professionals who may prefer to remote work from Kerala.

It is expected that the COVID-19 epidemic may lead to fundamental changes in the relation between economic growth and urban spaces.[16] On the one hand, future growth is likely to prefer spaces that are greener and healthier.[17] At the same time, with better options for teleconferencing and cloud-based

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[16] In the context of the pandemic, some architects are rethinking urban infrastructure to promote a more local lifestyle in what is described as a "15-minute city," in which most people's daily needs are a short walk, cycle ride or public transport commute away (this ideas was being trialled in Melbourne, Australia before the coronavirus outbreak). See: https://www.weforum.org/agenda/2020/05/coronavirus-change-cities-infrastructure/

[17] Increasingly, health needs of the population is becoming a factor in the design of cities and other urban spaces. Since 2016, the National Parks Board of Singapore has been building therapeutic gardens in public parks to boost the mental and emotional well-being of citizens. In Tokyo, citizens are working with urban designers to greenify their neighbourhoods to improve their health. The availability of green space and provisions for cycling is a major advantage for Copenhagen. Access to lots of green space is considered important for the mental and physical health of city residents during a pandemic. See the report: 'How do you build a city for a pandemic?' by Harriet Constable, 27th April 2020, available at: <https://www.bbc.com/future/article/20200424-how-do-you-build-a-city-for-a-pandemic>

sharing, office spaces can be moved to suburban regions with greater ease. Kerala's claim to be a globally preferred 'wellness' location can arise from some of the key advantages that the State possesses.

They include, first, Kerala's well-known achievements in human development, and the effective intervention by local self-governments in the State.

Second is the diffused nature of spatial development in Kerala. Across Kerala, there are numerous towns and villages, which provide safe public places, clean and hygienic living spaces, and modern amenities, including good IT infrastructure.

Third is Kerala's advantage in Connectivity. There are four international airports in Kerala. Most places in Kerala are connected by good roads and with the railway network.

Given the above-referred advantages, Kerala could become a preferred location, not only for tourists but also for a range of professionals who can work remotely – IT workers and those engaged in knowledge-based activities, including creative professionals, researchers, architects, legal professionals, and management analysts.

In fact, Kerala State Government has initiated efforts to set up 'work near home' facilities or co-working spaces in 100 towns across Kerala to take advantage of the demand for such facilities in the context of the pandemic.

Kerala should try to combine its existing strengths in tourism and *Ayurveda* to enhance the State's reputation as a wellness location. With respect to Ayurveda, the State may put in place a strong regulatory framework to ensure that only qualified practitioners and quality certified establishments are allowed to operate.

8. BIOTECHNOLOGY AND PHARMACEUTICAL RESEARCH

Biotechnology utilizes biological systems or living organisms to develop or create value-added products.[18] Biotechnology has applications in four major areas: healthcare (medical); agriculture (crops modified with genetic engineering); industry (non-food uses of crops and other products, such as in biodegradable plastics, vegetable oil and biofuels); and environment (cleaning up environmental wastes).[19]

Modern biotechnology has applications in areas such as pharmaceutical drug discovery and production, pharmacogenomics, and genetic testing (or genetic screening). With biotechnology, our knowledge of disease biology and our ability to develop new medicines to treat previously untreatable diseases have

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[18] Source: https://www.ntnu.edu/ibt/about-us/what-is-biotechnology
[19] Source: https://en.wikipedia.org/wiki/Biotechnology

increased. For instance, pharmacogenomics (a combination of pharmacology and genomics) allows us to analyse how genetic makeup affects an individual's response to drugs, thereby allowing the possibility of "personalized medicine", in which drugs and drug combinations are optimized for each individual's unique genetic makeup.[20]

The biotechnology industry is one of the key sectors in the emerging knowledge economy. A distinguishing feature of the biotechnology industry is its tendency to grow in clusters – in certain select geographical locations. At the global level, some of the well-known biotechnology clusters are: San Francisco Bay Area and Boston in the United States, the 'Golden Triangle' of London, Oxford and Cambridge in the United Kingdom, Bio Valley biotech cluster in Europe (comprising regions from Switzerland, Germany and France) and Shanghai in China. Singapore, Taipei and Hsinchu in Taiwan, Hyderabad and Bangalore in India are some of the leading clusters for biotechnology and life sciences in Asia.

A cluster is defined as a geographical concentration of different actors such as interconnected companies, specialized suppliers, service providers, and other institutions, which compete and cooperate in the same industry (Su and Hung 2009).

Some studies have identified the factors that aid the formation of a successful biotech cluster (Su and Hung 2009). They are, first, a strong scientific and industrial base, including strong networks between industry and academia. Such an environment will facilitate the continuous generation of new science-based companies or the so-called dedicated biotech firms. Second is the availability of funds. Product development in biotech is typically long, risky and costly, and availability of pre-seed capital, seed capital, venture capital and government funds can play a hugely beneficial role (Su and Hung 2009).

The third important factor in the formation and viability of innovative industries and clusters are entrepreneurs (Su and Hung 2009). The fourth important factor is social capital, or the ability to secure resources through trusting alliances and partnerships by virtue of membership in social networks or larger social structures. The fifth factor is networking to create links between industrial participants at the core of a successful biotech cluster (Su and Hung 2009).

There is huge potential for the development of biotechnology and life sciences in Kerala. The potential arises from two factors. Kerala, situated in the equatorial tropics, is blessed with natural diversity. The State produces a rich variety of agricultural products, including rice, coconut, rubber, pepper, cardamom, banana, and pineapple. The State has enormous forest and marine resources. Kerala is home to a wide array of rare species of medicinal plants; in fact, the State has been identified as one of the twenty-five 'hotspots of bio-diversity' in the world. Biotechnology offers potential for the development value-added

[20] Source: https://en.wikipedia.org/wiki/Biotechnology

products from natural resources.

Secondly, Kerala has a number of academic and research institutions in the areas of biotechnology and life sciences, which are considered as among the best in the country. These include the Rajiv Gandhi Center for Biotechnology, Thiruvananthapuram; Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST), Thiruvananthapuram; Department of Biotechnology, Cochin University of Science and Technology (CUSAT), Kochi; Department of Biotechnology, University of Calicut, Kozhikode; and School of Biosciences, Mahatma Gandhi University, Kottayam. In addition, a number of colleges in Kerala run undergraduate and postgraduate courses in biotechnology, biosciences, life sciences, pharmacology, and related fields.

Graduates from the above-referred institutions now form a critical mass of human resources for Kerala in the biotechnology and life sciences industries. A number of alumni from these institutions work in advanced areas in the fields of biotechnology and healthcare in different parts of the world – as researchers, academicians, entrepreneurs, and industry professionals. The government could encourage some of them to return to Kerala and start enterprises in the State. Some of these non-resident Keralites can act as mentors to technology start-ups from the State, providing technology, expertise and financial assistance to young entrepreneurs. At the same time, students, especially those enrolled in technical institutions across the State are also another source of entrepreneurship in the State.

Kerala has a rich and long tradition in the practice of *Ayurveda*, and the State is endowed with a wide variety of medicinal herbs. Kerala can build for itself a niche in the production of herbal cosmetic products and drugs that combine the strengths of *Ayurveda* and biotechnology.

Kerala should consider focusing its energies in developing a selected number of clusters of growth of biotechnology and life sciences. Thiruvananthapuram has the potential to emerge as one of the most dynamic centres of knowledge economy within the country, with a distinctive advantage in biotechnology and life sciences. This is mainly because of the existence in this city of a number of leading research and academic institutions, a rich pool of human resources created by these institutions year after year, and a firm base in information technology built by a network of firms, including firms located in Technopark.

The major research and academic institutions in Thiruvananthapuram, especially those contributing to the building of biotechnology cluster are: Rajiv Gandhi Centre for Biotechnology (RGCB), Sree Chitra Tirunal Institute for Medicals Sciences and Technologies Trivandrum (SCTIMST), Medical College Hospital Thiruvananthapuram.

Regional Cancer Centre, Thiruvananthapuram, Kerala University, Thiruvananthapuram, Indian Space Research Organization (ISRO), and Indian Institute of Science Education and Research (IISER), Thiruvananthapuram (a longer list is given in Appendix). Technopark in Thiruvananthapuram is one of India's largest and earliest IT parks and employs approximately 60,000 workers.

Kerala State Industrial Development Corporation (KSIDC) has set up a Life Sciences Park in Thiruvananthapuram. Within the Life Sciences Park, the Institute of Advanced Virology has started operations in 2019. A facility for the manufacture of medical equipment is also being set up within the Life Sciences Park.

Another region ideal for the growth of the biotechnology and pharmaceutical industries is Kochi and its surrounding areas. Cochin University of Science and Technology (CUSAT) and School of Biosciences at Mahatma Gandhi University in Kottayam are some of the leading academic institutions in this region in the area of biotechnology. The State public sector unit, Kerala State Drugs and Pharmaceuticals (KSDP) Limited, has major pharmaceutical production facilities in Alappuzha (both Kottayam and Alappuzha are within a distance of 50 – 60 km from Kochi).

Kerala is setting up a Pharma Park in Kochi, which will be seeking private sector investments in pharmaceutical production and research. The Pharma Park is being developed along with the Petrochemical Park, both of which are being set up adjacent to BPCL-KRL (Kochi Refinery Limited). We expect that the new projects will benefit from the expansion of BPCL-KRL as well as from their proximity to sea-port and air-port.

The upcoming Pharma Park in Kochi could provide space for firms that are engaged in manufacturing and research in the areas of pharmaceuticals and biotechnology. In setting up the Pharma Park, Kerala may study and draw lessons from the experiences of some of the leading biotech and pharma clusters, including Biopolis in Singapore and Genome Valley in Hyderabad.[21] In the case of bulk drugs or active pharmaceutical ingredients (APIs), the focus could be on industries producing 'high value, low volume' products.[22]

A third cluster of biotechnology and life sciences industries could be developed in the northern part of Kerala, mainly in the districts of Kozhikode, Kannur and Wayanad. This region in general, and Waynad in particular, is rich in biodiversity. There are a number of academic and research institutions in Kozhikode city and neighbouring regions: Calicut University, Indian Institute of Management (IIM) Kozhikode, Indian Institute of Spices Research and M.S. Swaminathan Botanical Garden in Meppadi (78 kilometres from Kozhikode city).

Both Kozhikode and Kannur have international airports. Another advantageous factor for these cities is their relative proximity to Bangalore – through road as well as through air (Road distance from Kannur to

[21] The Genome Valley, which is set up on a 200-acre plot of land, comprises a Science Park (set up in 2000), Life Science Incubator (set up in 2006) and a Bio Nest Incubator.

[22] This is because, in general, the requirements of land needed for the production of bulk drugs are relatively large. The Ramky Pharma City in Visakhapatnam is located on a 2400 acres plot. The generation of waste is another problem (with the production of bulk drugs).

Kochi is 275 km, and from Kannur to Bangalore is 312 km. It takes approximately 7 hours by road to reach either of these cities from Kannur). Kozhikode, Kannur and their neighbouring regions could benefit from firms in the areas of IT, biotechnology and other technologies considering a shift out of an overcrowded Bangalore.

9. NURTURING ENTREPRENEURSHIP IN HEALTH AND BIOTECHNOLOGY

CREATION OF TESTING FACILITIES

Biotech or medical equipment products manufactured by startups or other firms have to be tested at facilities accredited to or certified by national and international agencies so that the products obtain regulatory clearances. The absence of sufficient facilities for testing and validating newly developed PPEs, testing kits and other products has been a major hurdle in the fight against Coronavirus. As of now, firms in Kerala have to depend on the testing facilities at National Institute of Virology, Pune or Defense Research and Development Organization (DRDO)'s testing facilities in Gwalior (which has now been shifted to Delhi).[23]

Diagnostics involving isolation of full-length genomic ribonucleic acid (RNA) and its detection should be carried out at Biosafety level (BSL) 2 laboratories. Protocols that involve isolation and propagation of high concentrations of live virus or large volumes of infectious samples should be performed in no less than a BSL-3 lab.[24]

There should be central laboratories with advanced **testing facilities** for biotech and medical equipment firms in each of the biotech clusters that Kerala is planning to develop – including the Life Sciences Park in Thiruvananthapuram and the upcoming Pharma Park in Kochi.[25] It is important that testing facilities available in Kerala are capable of validating different medical devices and reagents with national and international accreditation.

Laboratory Medicine and Molecular Diagnostics (LMMD), which is the molecular diagnostics arm of Rajiv Gandhi Center for Biotechnology, Thiruvananthapuram, has facilities for performing 46 viral, 3

[23] In May 2020, eight laboratories have been given the approvals for now testing prototype samples of Personal Protective Equipment (PPE) coveralls required for protection from coronavirus. The include laboratories run by South India Textiles Research Association (SITRA), Coimbatore, DRDO-INMAS, New Delhi, and Heavy Vehicle Factory, Avadi, Chennai.

[24] A first of its kind mobile viral research lab (MVRL) to speed up COVID-19 screening and related research and development activities was developed by Research Centre Imarat (RCI), the Hyderabad based laboratory of DRDO, built as per WHO and ICMR Bio-safety standards to meet international guidelines. The facility, which is a Bio-Safety Level 2 and Level 3 laboratory, was built in a record time of 15 days and can process more than 1,000 samples in a day.

[25] Consider, for instance, the facilities available at Andhra Pradesh Medtech Zone (AMTZ) Limited, Vizhakapatanam.

bacterial, 14 cancer markers and cardiac disease parameters. LMMD is possibly the only facility in India with the capability to perform these many parameters. LMMD has a huge repository of positive samples, which can be utilized for testing and certifying products (including those fighting COVID-19 virus) manufactured by startups and other biotechnology firms. The facilities at LMMD can also be used to evaluate the medical diagnostic platforms developed for fighting viral and bacterial infections. National Institute of Virology (NIV), Alappuzha, has been designated as the state nodal laboratory for testing the novel Coronavirus (nCoV). ICMR has given nodal laboratory status to NIV Alappuzha.

There is a need to step up research and testing facilities related to the diagnostics and cure of COVID-19 in Kerala. One of the possibilities is to set up COVID blood banks for collecting antibody-rich plasma from recovered patients, which will help in carrying out investigations on plasma therapy. Accuracy of SARS-CoV-2 Antibody Tests has been reported to vary depending on the threshold of these kits as set by different manufacturers. A normalization method should be set up to enable cross comparison of results, if diagnostics data needs to be reviewed by clinicians or analyzed by epidemiologists. Kerala Government could make attempts to improve coordination between various agencies and research institutes involved in research and testing on COVID-19.

INCUBATION SUPPORT AND OTHER SHARED FACILITIES FOR BIOTECH AND MEDICAL EQUIPMENT FIRMS

The creation of common or shared facilities and capital resources such as clean rooms, research laboratories, and pilot production facilities is important for nurturing startups and small firms in the areas of biotechnology and pharmaceuticals, especially during the early phases of translation (that is, pilot production, obtaining of regulatory clearances, and market seeding). Common or shared facilities will greatly reduce the initial capital requirements of entrepreneurs and will certainly help attract more players to the healthcare and biotechnology segment.

ENHANCING TECHNOLOGICAL CAPABILTIES

In the medium to long-term, Kerala should take steps to enhance its human resource capabilities in the area of biotechnology, life sciences and related technologies. This can be done in a number of ways. One option will be to expand the teaching, research and infrastructure capabilities in the existing academic and research institutions in Kerala (including RGCB, SCTIMST, IISER, CUSAT, and the relevant departments in Kerala's Universities). Second, academic and research institutions in Kerala should try to build collaborations with leading technology institutions in India and abroad. Such collaborations could lead to the exchange of students and faculty members, joint research projects and publications, and to a faster growth in the formation of technology firms in Kerala.

A challenge that Kerala-based biotech firms could face is in the area of finance – especially venture capital funds that new technology firms require. Entrepreneurs and the government should be recognize this challenge and take steps to address it in the coming years. Once firms in Kerala build a reputation in their chosen areas of technology, new options for finance will certainly follow.

Most importantly, steps should be taken to showcase at the national and global level Kerala's human resources and technological and institutional capabilities in the areas of healthcare and biotechnology.

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APPENDIX 1:

Leading academic, research and industrial institutions in Thiruvananthapuram (contributing to the areas of biotechnology and life sciences)

1. Rajiv Gandhi Centre for Biotechnology (RGCB) (https://rgcb.res.in/)

2. Sree Chitra Tirunal Insttute for Medicals Sciences and Technologies Trivandrum (SCTIMST) (https://www.sctimst.ac.in/)

3. Medical College Hospital, Thiruvananthapuram

4. Regional Cancer Centre, Thiruvananthapuram

5. Kerala University, Thiruvananthapuram

6. Indian Institute of Science Education and Research (IISER), Thiruvananthapuram

7. Indian Space Research Organization (ISRO)

8. Indian Institute of Space Science and Technology (IIST)

9. Government College of Engineering, Thiruvananthapuram

10. HLL Lifecare Limited (a public sector unit with facilities for manufacturing in condoms (Peroorkkada unit) and blood bags (Akkulam unit).

11.Terumo Penpol Pvt. Limited

12. Life Sciences Park – being developed by Kerala State Industrial Development Corporation (KSIDC) (Institute of Advanced Virology, set up within the park, has started operations in 2019) https://www.bio360.in/

13. National Institute for Interdisciplinary Science and Technology (NIIST), an Institute of Council of Scientific and Industrial Research (CSIR)

14. Centre for Development of Advanced Computing (CDAC), a premier R&D organization of the Ministry of Electronics and Information Technology, carrying out R&D in IT, electronics and associated areas

15. Electronic Regional Test Laboratories (ERTL), one of the flagship laboratory of the Ministry of Electronics and Information Technology, Government of India engaged in providing accredited Calibration and Testing facilities.

APPENDIX 2: SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY (SCTIMST)

Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST) is an institute of national importance under the Department of Science and Technology, Government of India. It has three divisions: a tertiary referral super specialty hospital; a biomedical technology wing; and Achutha Menon Centre for Health Science Studies (AMCHSS).

The hospital serves as tertiary referral center for cardio-vascular, thoracic and neurologic diseases. AMCHSS is a leading research centre on public health, with a focus on non-communicable diseases, health policy and management. The institute has the status of a university and offers super specialty post graduate, doctoral and post-doctoral training in healthcare, public health and biomedical engineering and technology.

The **Biomedical Technology Wing** (BMT Wing) is committed to research, teaching and commercialization of technologies in the areas of medical devices, biomaterials, and tissue engineering.

BMT Wing has been instrumental in establishing a medical device industry base in India by successfully developing and commercializing technologies of a number of devices. Some of the commercialized technologies produced by the BMT Wing include blood bags, membrane oxygenator, hydrocephalus shunt, artificial heart valve, dental materials, and hydroxyapatite-based materials. During the past four decades, SCTIMST has transferred more than 75 technologies to the industry. In Kerala alone, there are more than fifteen industrial establishments either manufacturing or are in the process of setting up manufacturing units based on the technologies received from the Institute (SCTIMST).

The Biomedical Technology Wing has implemented quality management systems that meet international standards for its medical device testing operations and is accredited by Le Comite Francais d'Acreditation (COFRAC), France, enabling its industrial partners in obtaining regulatory clearance all across the world.

The Department of Science and Technology, Government of India has identified the BMT Wing as **Technical Research Centre for Biomedical Devices (TRC**. The centre has the mandate of developing medical device technologies in five identified segments, viz. Cardiovascular, Neuroprosthetics, Hard Tissue Devices, Biological & Combinational Products and In Vitro Diagnostics.

The Technology Incubator, **SCTIMST-TIMed,** is promoted by SCTIMST for encouraging innovation and entrepreneurship in medical technologies through support to innovators, start-ups and industry. **MedSpark** is a proposed joint initiative of SCTIMST and KSIDC (Kerala State Industrial Development Corporation), which will be set up at the Life Sciences Park in Thiruvananthapuram.

APPENDIX 3: RAJIV GANDHI CENTRE FOR BIOTECHNOLOGY (RGCB)

RGCB currently functions from three campuses. The bulk of its discovery research programs are being carried out the main campus located at Jagathy in Thiruvananthapuram. The second campus located at the KINFRA Park in Thiruvananthapuram functions as the transit facility for the Bio-Innovation Center where RGCB's core Bio-Imaging, Genomics and Laboratory Medicine & Molecular Diagnostic core facilities are located in addition to laboratories for Chemical Biology, and Tropical Disease Biology. The third campus, located in Kalamaserry, Kochi, is called the Bio-Nest, which is a setting for translational biotechnology.

Rajiv Gandhi Centre for Biotechnology does pioneering research in cellular and molecular mechanisms of human, animal and plant disease biology by amalgamating theory, modelling, simulation and experimental science, encompassing disciplines such as cell biology, genetics chemical biology, and immunology. RGCB has a comprehensive PhD programme.

Rajiv Gandhi Centre for Biotechnology (RGCB) has been engaged in various research activities linked to the detection and cure of COVID-19. RGCB has finalized the rapid IgM, IgG kit for COVID 19 screening and submitted to ICMR for approval. They have been working on an IgG quantitation analysis by ELISA, which will augment the efforts of SCTIMST in plasma therapy, and on an antigen-based rapid testing device for the detection of COVID19 virus presence using nasal swabs.

RGCB aims to create a specialized ecosystem called Bio-Innovation Center (BIC). This will be a unique knowledge centre for innovation founded on advanced level technical platforms. This will be located on a plot of 20 acres of land in Thiruvananthapuram city.

APPENDIX4: BIONEST AND BRIC

KRIBS-BIONEST (https://rgcb.res.in/BioNest/index.php)

Bionest Biotech Incubation Centre has been set up jointly by **Rajiv Gandhi Centre for Biotechnology (RGCB)** and **Kerala Start up Mission (KSUM).** Bionest is located at Kochi, in proximity to institutions such as Cochin University of Science and Technology, hospitals and medical colleges in Ernakulam, and Kinfra Hi-Tech Park. Bionest aims to nurture startups and other new firms in the fields of biotechnology and life sciences by providing incubator facilities and state-of-the-art biotechnology instrumentation platforms. Bionest operates from a two-storeyed building with an area of 42,000 square feet, with spaces for laboratories and offices and with facilities for effluent treatment. Bionest will provide a four-year incubation facility for startups. Technological assistance and support will also be provided to startups until they reach the maturation phase. **Currently,** there are 24 startups operating from the Bionest facility in Kochi, and they work on areas including nano bionics, nutraceuticals, drug development and medical device development.

BRIC -Biomedical Research, Innovation and Commercialization in Cancer

BRIC is a joint initiative of Kerala Startup Mission and Cochin Cancer Research Centre (CCRC) primarily focusing on developing technologies for the prevention, detection and treatment of Cancer. The center will have startups working on biomedical research as well as startups involved in data analytics and AI applications for Cancer Care. The physical facility of BRIC is expected to be ready by August 2020.

APPENDIX 5: Kerala State Drugs and Pharmaceuticals Limited

Kerala State Drugs and Pharmaceuticals Limited (KSDP), a State public sector undertaking, was founded in Alappuzha in 1974. KSDP has been manufacturing and supplying essential and life-saving medicines to cater to the needs of the poor patients in particular. It has been supplying medicines for the public health system in Kerala and other States. KSDP manufactures quality drugs of various formulations such as tablets, capsules, liquid orals, external preparations, powders, ORS, and injectable. KSDP has the capacity to manufacture 40 lakh plain and coated (film and sugar) tablets during a three-shift operation. KSDP also has the facility to manufacture Beta Lactam, non Beta Lactam and gelatin capsules.

PROCEEDINGS OF THE MEMBER SECRETARY, STATE PLANNING BOARD
(Present: Dr A Jayathilak, IAS)

Sub: - Constitution of an Expert Committee-(Post Covid 19 scenario) - to examine and suggest policy interventions to coordinate and guide innovate initiatives in Health Care Industry in Kerala – reg.

Ref: - 1. Request from Industries Minister to State Planning Board
2. Note from Vice Chairperson, State Planning Board on 04/05/2020

ORDER NO.SPB/167/2020/I&I/SPB DATED: 05.05.2020

The Government has received suggestions from different sources regarding a range of medical technologies that can be utilised in Covid-19 management and, subsequently, for other medical conditions as well.

There have been suggestions regarding producing pharmaceuticals like chloroquine by KSDP and has taken the initiative to produce chloroquine and other drugs that can be used for such infections. Some Startups also have developed prototypes of equipment such as ventilators and Personal Protection Equipment such as N95 masks.

Since morbidity in Kerala (from communicable and noncommunicable diseases) is high, we need to mass-produce equipment, instruments, devices, and pharmaceuticals in Kerala. The Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST) has taken the initiative to establish a Devices Park in the Life Sciences Park. The KSDP is attempting to produce drugs that can be used for conditions prevalent in Kerala.

In this context, and in the specific context of the Covid-19 pandemic, the State Planning Board has decided to constitute a committee to examine and suggest policy interventions to coordinate and guide innovate initiatives in Health Care Industry in Kerala. The committee is hereby constituted with the following members.

Sl.No	Name & Address	Designation
1	Dr Jayan Jose Thomas Member, Kerala State Planning Board	Chairperson
2	Dr A Jayathilak, IAS Member Secretary, Kerala State Planning Board	Member
3	Dr B Ekbal Member, Kerala State Planning Board	-do-
4	Dr K N Harilal Member, Kerala State Planning Board	-do-
5	Sri Balagopal Chandrasekhar Managing Director, Terumo Penpol	-do-
6	Sri. Rajiv Vasudevan MD & CEO Ayur VAID Hospitals, A 706, Mantri Elegence,	-do-

	Bannerghata Road, NS Palya, Bengaluru 560076	
7	Sri. Thomas John Managing Director, Agappe Diagnostics Ltd Pattimattom P0, Ernakulum -682 311	-do-
8	Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST)	-do -
9	Rajiv Gandhi Centre for Biotechnology(RGCB)	-do-
10	Cochin University of science and Technology (CUSAT)	-do-
11	Kerala State Drugs & Pharmaceuticals Ltd (KSDP)	-do-
12	The Department of Industries and Commerce, Government of Kerala	-do-
13	Representative from Start up Mission	-do-
14	Sri. Joy. N R Chief, Industry and infrastructure division Kerala State Planning Board	(co-ordinator)

Terms of Reference

1. Explore the areas where Kerala can develop and produce equipment, software, technologies, pharmaceuticals that can be used for Covid-19 control and subsequently to manage emergency medical situations.

2. Examine the quality and immediate applicability of the technologies, software (mostly for data collection) proposed by start-ups, research centres, universities, and other institutions.

3. Examine, evaluate and where appropriate showcase the positive efforts of different agencies in producing and marketing technologies and products for use in Covid-19 control (for example, antigen and antibody kits by SCTIMST, antibody kits by RGCBT, PPE production by Kitex). This will give us optimism and confidence in proceeding further.

4. Identify technologists and institutions in the private and public sectors who have the capabilities to develop and produce new technologies, devices, software, and pharmaceuticals. Such persons and institutions will continue to be of value to the State in the future.

5. The Committee can Co-opt other Members as special invitees as deemed fit.

6. The Committee will submit its report within 10 days from the date of proceedings.

All expenditure in connection with the committee will be met from the Head of Account 3451-00-101-93 "Preparation of Plans and conduct of Surveys and Studies" during 2020-21 Budget provision .

5/5/20

Sd/-
Dr.A.Jayathilak IAS
MEMBER SECRETARY

To

The Persons concerned

Copy to:-

1. The Accountant General, Kerala (A&E) with C/L
2. The Sub Treasury Officer, Vellayambalam.
3. The PS to the Hon. Vice Chairman, State Planning Board.
4. PA to Member Secretary
5. CA to Member (JJT)
6. The Sr. Administrative Officer, State Planning Board.

Forwarded /By Order

Senior Administrative Officer

C.V. SUNIL KUMAR (PEN : 382575)
Senior Administrative Officer
Kerala State Planning Board
Pattom P.o., Thiruvanthapuram -695 004
Tel: (0471) 2541270, 2542714 Ext. 100
Mobile: 9847172518

PROCEEDINGS OF THE MEMBER SECRETRY, STATE PLANNING BOARD
(Present: Dr A Jayathilak, IAS)

Sub: Constitution of an Expert Committee (Post Covid-10 Scenario) –to examine and suggest policy interventions to coordinate and guide innovate initiatives in Health Care Industry in Kerala- modified orders- issued-reg.

Read: Order No. SPB/167/2020/I&I/SPB Dated: 05.05.2020

ORDER NO SPB/167/2020/I&I/SPB DATED:25.05.2020

As per order read as above, an Expert Committee in Health Care Industry has been constituted. But as per the decision of the Committee on 12/05/2020 it has been decided to modify the proceedings incorporating names of nominated experts representing institutions & departments. Accordingly the modified list of Committee members are:-

Sl. No	Name & Address	Designation
1	Dr Jayan Jose Thomas Member, Kerala State Planning Board	Chairperson
2	Dr A Jayathilak, IAS Member Secretary, Kerala State Planning Board	Member
3	Dr B Ekbal Member, Kerala State Planning Board	-do-
4	Dr K N Harilal, Member, Kerala State Planning Board	do
5	Sri. Mohammed Haneesh IAS, Principal Secretary, Department of Industries and Commerce Government of Kerala	-do-
6	Sri. Balagopal Chandrasekhar, Managing Director, Terumo Penpol	
7	Sri. Rajiv Vasudevan MD & CEO Ayur Vaid Hospitals, A 706, Mantri Elegence, Bannerghata Road, NS Palya, Bengaluru 560076	-do-
8	Sri. Thomas John Managing Director, Agappe Diagnostics Ltd Pattimattom PO, Ernakulam-682311	-do-
9	Sri. Muraleedharan.C, Associate Head, Bio-Medical Tech: Wing, Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCTIMST)	-do-
10	Dr. Radhakrishnan, Scientist, Rajiv Gandhi Centre for Biotechnology (RGCB)	-do-
11	Dr. P.G Sankaran, Pro Vice Chancellor, Cochin University of Science and Technology (CUSAT)	-do-
12	Smt.S.Syamala, Managing Director, Kerala State Drugs & Pharmaceuticals Ltd (KSDP)	-do-
13	Dr Saji Gopinath, CEO, Kerala Start up Mission	-do-
14	Sri. Joy N.R, Chief, Industry & Infrastructure Division, Kerala state Planning Board	Co-Ordinator

Terms of Reference

1. Explore the areas where Kerala can develop and produce equipment, software, technologies, pharmaceuticals that can be used for Covid-19 control and subsequently to manage emergency medical situations.
2. Examine the quality and immediate applicability of the technologies, software (mostly for data collection) proposed by start-ups, research centres, universities, and other institutions.

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4. Identify technologists and institutions in the private and public sectors who have the capabilities to develop and produce new technologies, devices, software, and pharmaceuticals. Such persons and institutions will continue to be of value to the State in the future.

5. The Committee can Co-opt other Members as special invitees as deemed fit.

6. The Committee will submit its report within 10 days from the date of proceedings.

All expenditure in connection with the Committee will be met from the H/A 3451-00-101-93 "Preparation of Plans and conduct of Surveys and Studies" during 2020-21 budget provision.

The order read as 1st stands modified to the above extend.

Sd/-
Dr A Jayathilak, IAS
MEMBER SECRETARY

Forwarded by Order

Chief (I&I)

To

The Persons concerned

Copy to:-

1. The Accountant General, Kerala (A&E) with C/L
2. The Sub Treasury Officer, Vellayambalam.
3. The PS to the Hon. Vice Chairman, State Planning Board.
4. PA to Member Secretary
5. CA to Member (JJT)
6. The Sr. Administrative Officer, State Planning Board.

INITIATIVES IN HEALTH CARE INDUSTRY IN KERALA

(Expert Committee Report)

JULY 2020

KERALA STATE PLANNING BOARD