



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

## Chapter 15

# Emerging health start-ups for economic feasibility: opportunities during COVID-19

Shweta Nanda

*IILM Graduate School of Management, Noida, India*

### 15.1 Introduction

The Internet of Things (IoT)/artificial intelligence (AI)-based health start-ups are building a complete health ecosystem for people worldwide, connecting patients, caregivers, doctors, and hospitals with a common thread. The smartphone was initially meant to make and receive phone calls and has now become a medium to share a rich stream of personal data on a cloud-based platform (Ferguson et al., 2016).

“Coronaviruses are a class of viruses that may cause illness in animals or humans. In humans, several coronaviruses are known to cause respiratory infections ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome and Severe Acute Respiratory Syndrome. The most recently discovered virus causes coronavirus disease known as COVID-19.” Many Indians returned to work as the economy opened up gingerly; while things are turning uglier for the economy and start-ups, there are some bright sparks. Due to technology, people got abreast of this virus. Further, the following applications of AI proved its capabilities in assessing nature of risk for COVID-19

- **Monitoring hospital visitors and patients using AI:** Facial scanner and thermal scanners help identify the facial attributes and fever conditions of the people.
- **Remote monitoring:** This is a sensor-based technology. If the sensor is placed under the patient’s mattress, we can track the heart rate, respiratory rate, and body movement. It helps to take care of COVID patients.
- **COVID voice detector:** The AI tool will detect the infected one by evaluating their cough and breathing problems.

**Use of IoT:** IoT is playing a vital role in limiting the spread of virus. It also helps in treating COVID-19 infected people with touch-free attendance, sanitization conformity, and supervising body temperature. Now the warehouse, hospitals, and offices are using it.

- Tracking the coronavirus pandemic.
- Connected thermometers.
- Smart wearable.
- IoT buttons

There is a tremendous potential of wearable ECG systems to bring revolution in treatments for various cardiovascular diseases (CVD). Patients with chronic ailments will be benefited most by these types of wearable remote systems. IoT-based remote wearable sensors and the integrated cloud platform enable healthcare providers to capture vitals remotely and perform analysis (Nanda, Khattar, & Nanda, 2019). Continuous ECG graph monitoring of geriatric patients and offering them with preventive care at a preliminary stage would drastically reduce the aberration stances. Four major applications of wearable devices have been observed: portable devices, home adaptations, electronic systems, and connected devices (Doughty & Appleby, 2016). It is also proposed that through smartphones, consumers can obtain the most routine lab test which transfers the ownership of data from health stakeholders to the patients (Kish & Topol, 2015). The IoT-based remote health monitoring system may also be used for falling detection, elderly care, sports training, rehabilitation training, postoperative care, and other fields. Microcontrollers are used to record physiology-based data with the help of these devices. The central controller helps process the data and generates a message of warning to the person taking care and even help predict upcoming disease.

In order to maximize the benefits from IoT, many consortiums of companies and industry bodies have drafted technology and regulatory protocols to promote standardization and uniformity. IoT is benefitting both consumers and industries in distinct and innovative ways through varied applications. IoT helps create value for stakeholders through the availability of information, with the help of technologies such as sensors, networks, standards, augmented intelligence, and augmented reality (AR). It is also helping to enhance process efficiencies significantly across industries, particularly manufacturing and healthcare, thus taking industrial applications to the next level.

According to a report by Federation of Indian Chambers of Commerce and Industry (FICCI) presented by Deloitte on “Indian Medical Electronics Industry Outlook 2020,” the Indian demographic factors offer the opportunity for huge growth in medical electronics due to potential demand for healthcare. The Health Ministry has launched for the elderly “National Program for the Health Care of the Elderly” (NPHCE) in India with a provision of INR 288 crores to invest for the same in 2010–2025. A major health

problem that is change in disease profile—noncommunicable diseases (NCDs) is the leading cause of death. Sedentary lifestyles have led to an increase in lifestyle/NCDs such as CVD, diabetes, cancer, etc. Lifestyle diseases such as obesity, CVD, and diabetes are also forecasted to become more pervasive. The Government of India has initiated the National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases, and Stroke. A growing number of medical devices are becoming potential wearables in India, including ECG monitors, glucose monitors, blood pressure monitors, and pulse oximeters.

Whereas in the developed nations, technologies such as Preventive's BodyGuardian remote monitoring system or Avery Dennison's Metria Wearable Technology are setting the stage to deliver patients data to doctors seamlessly. Bluetooth is key in systems such as 9solutions IPCS, which uses it to track elderly patient's movement and send health measurements to caregivers. BodyTel uses Bluetooth to allow patients to send body measurements to their doctors wirelessly. Similarly, in a country like India where diabetic patients are high, continuous glucose monitors have a wide scope to monitor the glucose level in human bodies and help sustain at the desired level by injecting insulin from time to time. C8 Medisensor is a wearable product that conducts noninvasive optical glucose monitoring by transmitting a pulse of light through the skin and continuously updates the data to a smartphone via Bluetooth.

## 15.2 Health-tech verticals for start-ups

To control the spread of coronavirus, AI and IoT start-ups leverage the tools and solutions to help the crisis. There is a start-up called Indian Robotics, providing its robots with screening and diagnostics. These robots help to collect the data from the patients, symptoms exhibited, and validation. These robots enable a video conference with a doctor from rural locations to help out the people who are facing symptoms like high fever etc. AI and IoT are becoming primary weapons for tracking and tracing the cases.

Medikabazaar is the start-up that is providing the online B2B platform only for doctors and hospitals. The supply chain of this start-up is in Tier II cities, Tier III cities, and remote locations. They provide all medical equipment, masks, thermometers, test kits, body covers, etc. for doctors online. MyLab, Bione, Redcliffe Life Sciences are the start-ups with low-cost manufacturing ventilators for COVID patients to develop AR-based solutions in India. With respect to COVID, it has been found by [Bhatnagar et al. \(2020\)](#) that age is not a significant factor for a person to be infected by COVID.

Noida-based biotech start-up DNA experts have also developed testing kits, increasing the total number of tests by reducing the time taken per test. While most testing kits used in India are taking around 2.5 hours for the result, DNA experts claim its COVID test takes just 58 minutes to test a

sample. The start-up is incubated at the state-run Centre for Cellular and Molecular Platforms.

In this scenario, a large number of Medtech start-ups are working on diagnostic solutions and preventive healthcare, and some as healthcare aggregators. There are two broad categories of Medtech start-ups. First, that is, harnessing technologies like AI and the IoT to change India's healthcare landscape. According to the Indian start-up ecosystem, the second category, traversing the maturity cycle report 2017, is a multiple health-tech start-up in the subverticles of medical solutions like a marketplace for health services, health lab aggregators, wellness platforms, online pharmacies, e-diagnostic and ambulance aggregators. Among the health-tech start-ups 87% are B2C and 26% are B2B.

### 15.3 Research gap

There lies a huge gap between the available healthcare start-up services and the adoption by prospective customers seeking affordable healthcare solutions. This conceptual study provides a framework to understand the present real-time analytics-based healthcare start-up solutions and suitable approaches to extend their availability during COVID-19.

### 15.4 Aim of the study

To categorically identify the framework of healthcare start-ups in India and how real-time analytics-based start-ups can meet remotely located patients' demand.

To explore which healthcare start-ups would meet the diagnostics demand of Tiers II and III places during COVID-19.

### 15.5 Research methodology

#### 15.5.1 Problem statement

This research would be exploratory, diagnostic, and conclusive. The study would be exploratory as it would explore the various real-time analytics-based health start-ups in India. The methodology used in this study is based on system thinking. The methodological framework used in this study consists of two phases. First, an attempt was made to structure the problem. Second, a causal loop model was developed to capture feedback loops to explain the system (Elias, 2019). This study was limited to qualitative modeling based on system dynamics (Cavana & Mares, 2004).

The study would also be conclusive as it would provide meaningful strategies and approaches toward a sustainable healthcare model in India. The study provides a holistic view of start-ups that have reduced healthcare service costs by leveraging technologies.

### 15.5.2 Type of research

In this study, the maximum start-up funding has been observed in the health-tech verticals of “tech-enabled diagnostic services” and “anomaly detection and disease monitoring.” However, their availability is limited to Tier I. This research attempts to study the contributions made by real-time analytics systems to make them affordable/accessible for Tiers II and III, especially during COVID-19.

### 15.5.3 Secondary data

This study is conducted with secondary data available from various sources like IoT World Congress Report, Deloitte, Nasscom publications, FICCI Report, and research articles that are very relevant to this field.

### 15.5.4 Data analysis methods

Data analysis would be done using inferential analysis for drawing inferences and interpretations in this study. Python has been used to do extrapolation through plots and determine the potential medical devices required during COVID-19 (Tables 15.1 and 15.2).

**TABLE 15.1** Healthcare start-ups based on real-time analytics/advanced analytics.

Category:	Start-up name	Services
Real-time analytics		
Cloud analytics	Bagmo or “Blood Bag Monitoring Device”	Blood Bag Monitoring Device monitors the temperature of the blood bag during the transportation and storage.
Genetic analytics	Prantae Solutions	EyeRA for early detection of preeclampsia, which is a pregnancy disorder. Received the CII-IPR award.
Advanced analytics	Waferchip Techno Solution	Continuous monitoring of ECG data and capturing through Bluetooth through wearable device called Biocalculus.
Cloud analytics	EzeRX	Device called AJO measures anemia, jaundice, and oxygen saturation from noninvasive IoT device.
Cloud analytics/predictive analytics	CardioTrack	The device EMR App captures ECG data through Bluetooth, calculates average heart rate, and helps in doing predictive analysis for upcoming heart disease.

**TABLE 15.2** Healthcare start-ups based on healthcare aggregator services.

Category: Healthcare aggregators	Start-up name	Services
Hyperlocal health services	Medikoe	It is a platform connecting hyperlocal market to facilitate them with healthcare and wellness services (partners include Manipal Hospitals, Jiyo Healthcare, NM Medical Diagnostics, and Positive Homeopathy).
Home healthcare	Medwell Ventures	Offering home healthcare and palliative care to middle-aged and geriatric patients.
Pharmacy aggregators	Care24	Its services include from prescription to complete recovery, nursing at home, physiotherapy at home, infant care at home etc.
B2B digital health-tech platform	Medikabazaar	It offers medical devices and machine delivery through catalog enlisting of over 25,000 products to above 20,000 pin codes including Tiers II and III hospitals.

**15.6 Health-tech category I Indian start-ups**

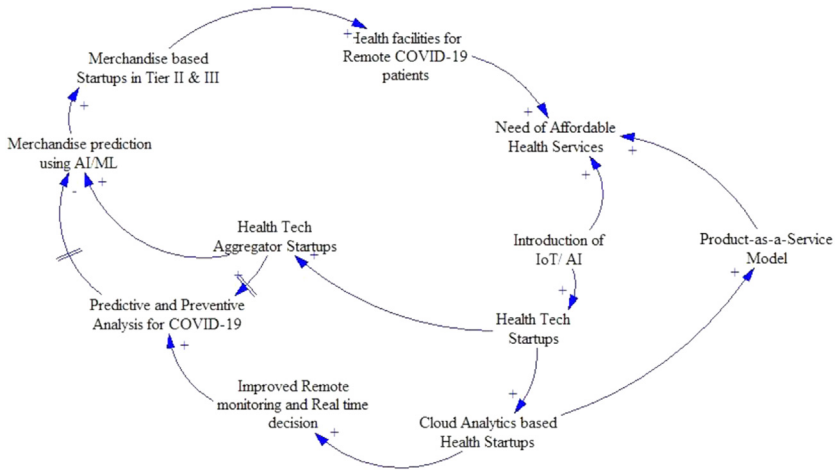
**15.6.1 Health-tech category II Indian start-ups**

*15.6.1.1 Inferences*

Out of the two healthcare start-up categories, real-time analytics start-ups leverage cloud platforms to offer remote healthcare solutions. This category emphasizes using the products-as-a-service model and thus can make its service remotely accessible during COVID-19. They use a service-driven business model through AI/IoT healthcare solutions.

**15.6.2 Variables gathered from stakeholder interviews**

Further, as an analysis of our interviews with the health service providers reinforced the fact that with the introduction of IoT/AI into businesses and society, there is a promise of productivity and efficiency by improving real-time decision making, solving critical problems, and creating new innovative services and experiences in the COVID times. However, insights have been received on how Tiers II and III can leverage existing health start-up services through affordable, innovative services. They emphasized the product-as-a-service subscription model wherein the remote medical device user is charged only if they opt to share his medical data for predictive/preventive analysis. The future



**FIGURE 15.1** Causal loop model.

scope of devices are based on a subscription model for yielding recurring revenue at an affordable cost for Tiers II and III customers. However, there are very few start-ups in the healthcare aggregators category, which leverage AI/machine learning (ML) implementation in merchandizing prediction and procurement cost reduction to reach in Tiers II and III. (Fig. 15.1).

### 15.6.3 Causal loop model

Adaptive AI and ML technologies not only have the potential to optimize device performance in real-time but also to forecast the demand for the diagnostics devices in Tiers II and III primary healthcare centers.

Diagnostics, IV Diagnostics, and other devices have a maximum import dependency in India. Diagnostic imaging (e.g., CT scan, X-Ray, MRI, USG, X ray-tubes), IV Diagnostic (lab equipment and reagents, etc.), and other medical devices (ECG, optional equipment, heart – lung machine, etc.) form 70% of total import in India in FY1613.

To identify the future potential of the segment-wise medical devices in India, joint plots are made using python coding. It has been done to extrapolate the future demand of these medical devices and identify the most promising potential demand segments.

Coding is specified in the respective figures (Figs. 15.2, 15.3, 15.4, 15.5, 15.6, 15.7, 15.8).

Thus these plots provide the scope of opportunities in the manufacturing of the devices. As per the plots, the maximum demand potential is Diagnostic Imaging, IV Diagnostics, and others. Currently, out of the 750 medical device manufacturers present in India, a majority are Small and



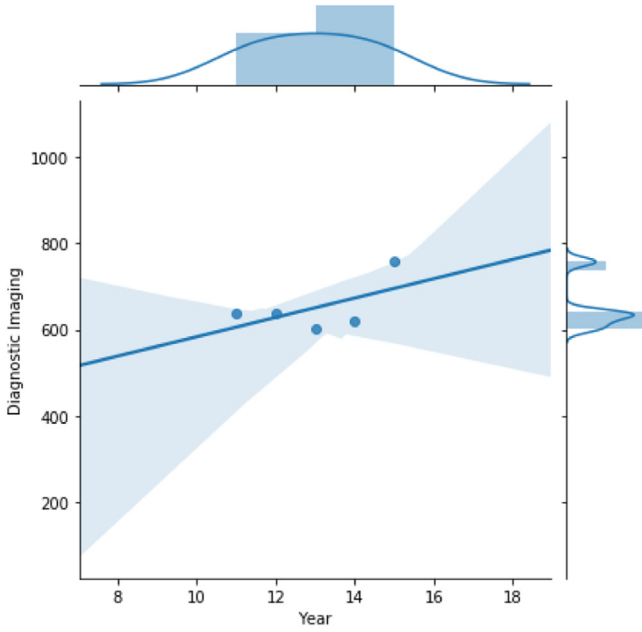


FIGURE 15.2 Diagnostic imaging plot.

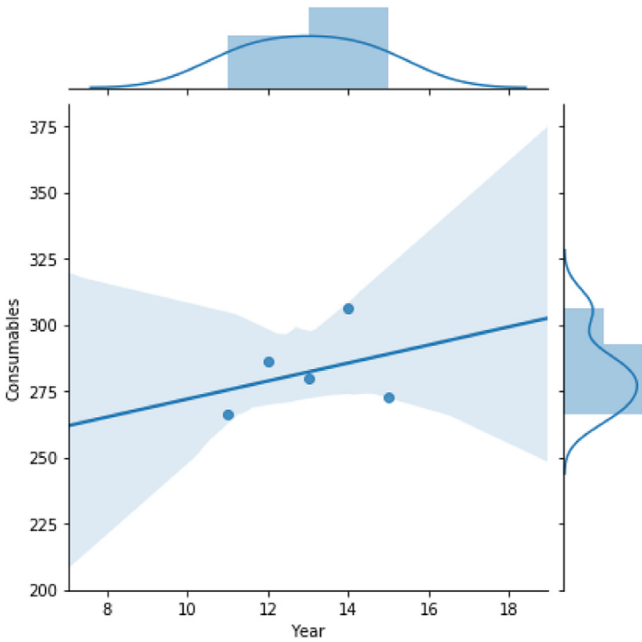


FIGURE 15.3 Consumables plot.

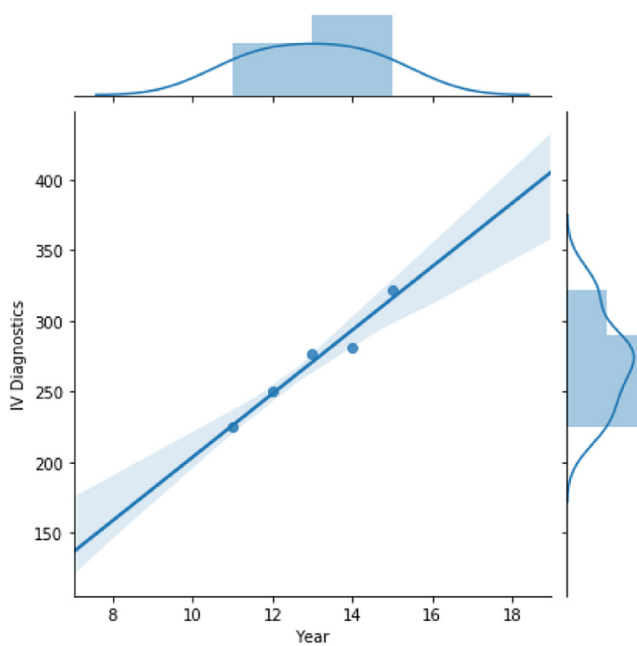


FIGURE 15.4 IV Diagnostics plot.

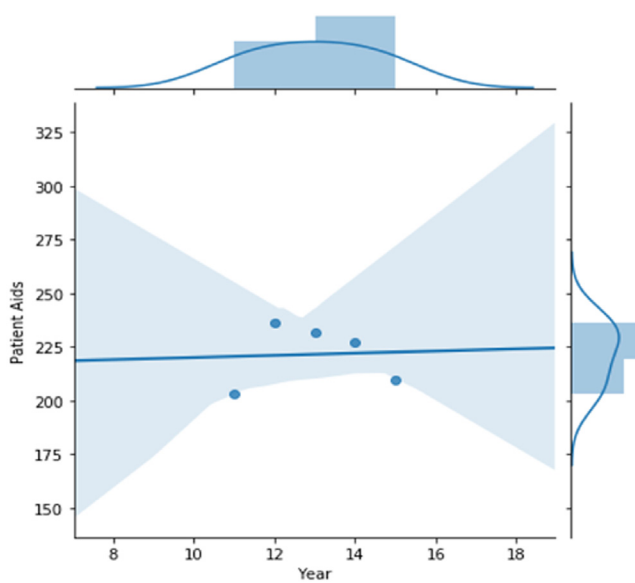


FIGURE 15.5 Patient aids plot.

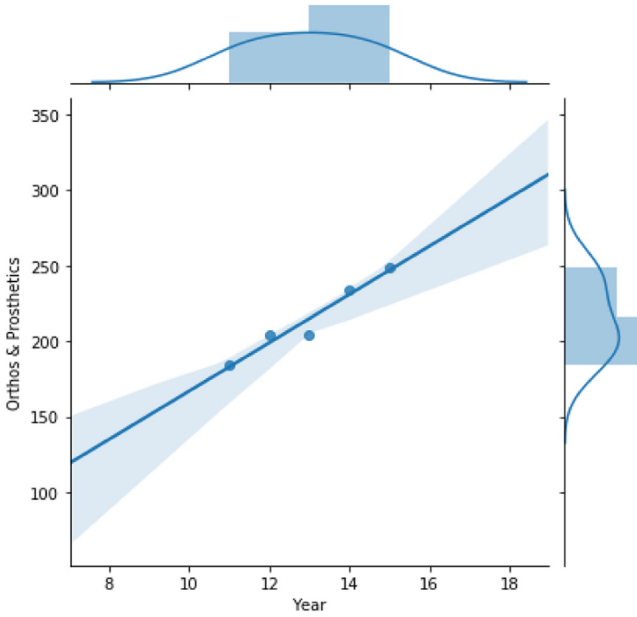


FIGURE 15.6 Orthos and prosthetics.

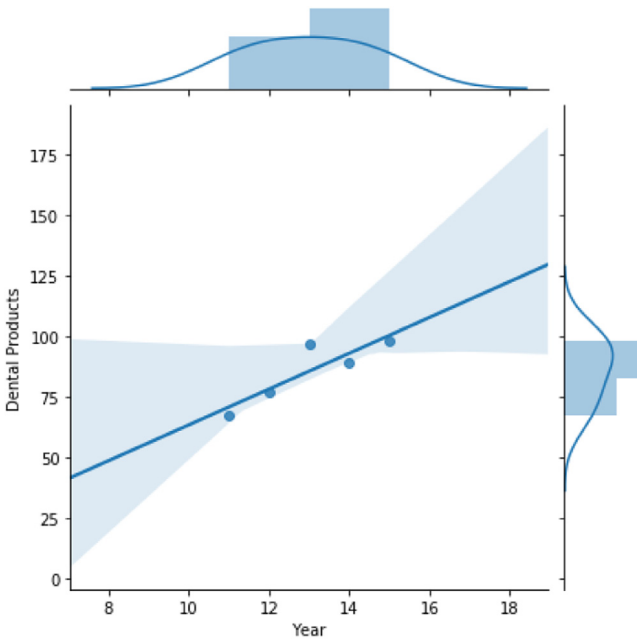
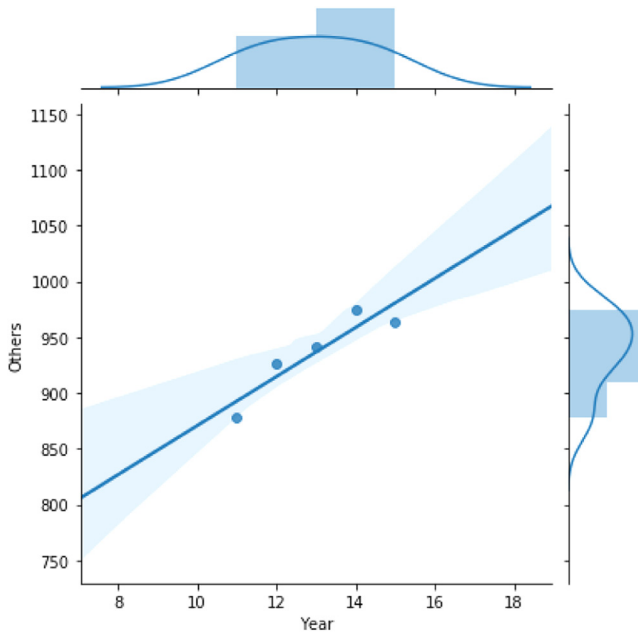


FIGURE 15.7 Dental products.



**FIGURE 15.8** Other plot.

Medium Enterprises (SMEs) and Micro, Small and Medium Enterprises (MSMEs) (90% have an annual turnover of less than USD 10 million) and contribute 30% (USD 1.1 billion) to the Indian medical devices market (Deloitte, NatHealth, 2016). Simultaneously, indigenous medical devices start-up manufacturers are yet to scale up for bulk production for Tiers II and III.

## 15.7 Conclusions

IoT/AI in healthcare has a vast potential, but the market penetration is quite low in the Indian market. IoT/AI-enabled health start-ups have the ability to customize their services following the local demand, especially during COVID-19. The demand for mobile health solutions is driven by a remotely located population where the immediate reachability of the medical devices and services is a challenge. Despite identified COVID, vulnerable zone health-based merchandise could not reach on time. The AI/ML-based merchandise prediction solutions for diagnostics and critical care devices in Tiers II and III can reduce patients' burden to commute to big cities for immediate care.

These patients are also looking for affordable, innovative health solutions. The above study deals with the systems thinking approach to deal with the

availability gap of affordable health services to the remotely located patient. In the causal loop model (Fig. 15.1), there are two reinforcing loops and one balancing loop. It tries to identify how IoT/AI/ML-based start-ups can benefit COVID-19 patients through start-ups based on cloud analytics or AI/ML-based health device merchandise providers.

The product-as-a-service solution attracts the start-ups in India with an idea to provide open access to their data collection practices and its analysis for preventive strategies during COVID-19. This model not only eases postaberration care but also reduces the risk stances by real-time monitoring/diagnosing the health patterns and generating alerts to stakeholders based on the threshold limits. However, in the model's balancing loop, a delay has been observed in the merchandise facilitating health start-ups in Tiers II and III locations.

There is a considerable scope to capture the cloud data from Tiers II and III through the seamless integration of IoT/AI/ML start-ups and clinical practitioners to perform customized medical research. Also, the critical disease profile varies with every country, and so does the supplementary supporting services of healthcare aggregators who make the core healthcare service accessible. Through the above healthcare start-up and funding initiatives, a shift in need has been observed from the healthcare category I present in Tier I to its availability/accessibility in Tiers II and III. Thus this study suggests the companies implement its proprietary AI and ML tools to report accurate stock projections for medical establishments in these areas and leverage products as a service model to make the devices affordable.

In the critical COVID-19 patients, a need was predicted for the ventilators in the remote areas. AI/ML in machine delivery and medicines supply chain/operative care has the potential to timely deliver the required critical devices. Thus there is a vast potential for start-ups manufacturing Diagnostics Imaging & IV Diagnostics devices for Tiers II and III places.

## References

- Bhatnagar, V., Poonia, R. C., Nagar, P., Kumar, S., Singh, V., Raja, L., & Dass, P. (2020). Descriptive analysis of COVID-19 patients in the context of India. *Journal of Interdisciplinary Mathematics*, 1–16.
- Cavana, R. Y., & Mares, E. D. (2004). Integrating critical thinking and systems thinking: From premises to causal loops. *System Dynamics Review*, 20(3), 223–235. Available from <https://doi.org/10.1002/sdr.294>.
- Deloitte, NatHealth (2016). Medical devices making in India—A leap for Indian healthcare, available at: <https://www2.deloitte.com/content/dam/Deloitte/in/Documents/life-sciences-health-care/in-lshc-medical-devices-making-in-india-noexp.pdf> (accessed July 23, 2020).
- Doughty, K., & Appleby, A. (2016). Wearable devices to support rehabilitation and social care. *Journal of Assistive Technologies*, 10(1), 51–63. Available from <https://doi.org/10.1108/jat-01-2016-0004>.
- Elias, A. A. (2019). Strategy development through stakeholder involvement: A New Zealand study. *Global Journal of Flexible Systems Management*, 20, 313–322. Available from <https://doi.org/10.1007/s40171-019-00217-6>.

- Ferguson, I., et al. (2016). Mobile health: The power of wearables, sensors, and app to transform clinical trials. *Annals of New York Academy of Sciences*, 1375, 3–18, ISSN 0077-8923.
- Kish, L. J., & Topol, E. J. (2015). Unpatients—Why patients should own their medical data. *Nature Biotechnology*, 33, 921–924.
- Nanda, S. and Khattar, K. and Nanda, S. (2019). Internet of Things based remote wearable health solutions: Prospects and area of research (February 22, 2019). Proceedings of International Conference on Sustainable Computing in Science, Technology and Management (SUSCOM), Amity University Rajasthan, Jaipur - India, February 26–28. Available at SSRN: <https://ssrn.com/abstract=3351034> or <http://doi.org/10.2139/ssrn.3351034>.