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THE IMPACT OF THE DIGITAL PLATFORM ON EMERGENCY HEALTHCARE DELIVERY DURING COVID-19 OUTBREAK: A CASE STUDY OF BUSINESS MODEL INNOVATION

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ABSTRCT

Background: The COVID-19 pandemic has resulted in the acute shortage of medical devices that is required for respiratory intensive care of severely ill patients. With the help of digital platforms, it is feasible to connect unmatched demand-side patients and supply-side healthcare service providers to address the emergency care challenge. **Purpose:** The purpose of this paper is to contribute to the existing literature on the use of digital platforms by illustrating how such developments in the internet and digital technologies can enable the emergence of novel business models to deliver emergency healthcare services. **Methodology:** The paper reports a qualitative case study of an Indian start-up to deeply understand the evolution of business model innovation in the healthcare industry through digital platforms. **Findings:** The study results showed that the adoption of digital platforms improved the efficiency of healthcare services, in particular those emergency services that can be caused by the shortage of medical devices. In particular, using digital platforms, innovative business models were able to make healthcare services more efficient and accessible, with many benefits for several actors, including healthcare service providers, medical doctors, and patients. **Unique contribution to theory, practice, and policy:** The paper contributes to a deeper understanding of business model innovation based on digital platforms and opens many avenues to research their interplay with ecosystems. This paper also provides healthcare industry executives with a road map to better respond to the COVID-19 pandemic challenges by innovating their business models to take advantage of the various possibilities and growth opportunities provided by digital platforms.

KEYWORDS: *Digital Platforms; Business Model Innovation; COVID-19; Healthcare; India*.

INTRODUCTION

The pandemic COVID-19 is an infectious disease caused by a novel coronavirus. It is a highly contagious disease that began in Wuhan, China, in late December 2019.[1] It now has spread to more than 213 countries and territories around the world, in a brief span of six months, affecting more than 6.42 million people and causing death in over 383,000 patients.[2] It may pose a severe infection as a mild infection like a common cold to a breathing disease like pneumonia. The leading causes for coronavirus transmission are the droplets of saliva and the discharge from the infected person's nose when sneezing. There is no definite treatment or vaccine currently available for this illness. Severely ill patients with COVID-19 require respiratory assistance because the coronavirus harms their lungs and induces breathing difficulties. In such cases, Ventilators are necessary to supply adequate oxygen (O2) to their lungs and also to remove carbon dioxide (CO2) as a lifesaving aid. The ventilators are one of the most critical medical devices needed to keep COVID-19 patients alive. The number of patients affected by the COVID-19 pandemic in hospitals and ICUs worldwide has risen dramatically. Nonetheless, there are currently not enough ventilators available in hospitals.

The healthcare sector currently faces many challenges, such as the rapid evolution of technology, the escalation of healthcare costs, and the lack of accessible healthcare services and medical devices in a complex healthcare system. Among these problems, the rise of innovation proposes a complete redefinition of the landscape. Innovation in healthcare remains a guiding force in the effort to balance cost reduction, healthcare products and services available, and the quality of healthcare. Innovation is seen as a critical component of organizational growth and competitive survival.[3] Technological innovations present vast opportunities for 1) product innovation – the introduction of new kinds of products and services for the outward market and 2) process innovation – improvement of the business model and internal production processes for products and services.[4] Internet and digital technologies are revolutionizing health care and creating unforeseen

opportunities for innovation and development of existing business processes. There has been a sharp division of business process innovation that allows and facilitates the matching of healthcare demand, the so-called digital platforms.[5]

The digitally-enabled business models which bring together producers and consumers in high-value exchanges have recently been recognized with the term "Digital Platforms."[6] Digital platforms can connect users, providers, and resources to facilitate core business-to-consumer interactions and to ensure greater management efficiency. In general, these businesses serve as intermediaries, creating and running an aggregation network for the same kind of products and services. Their main assets are information and interactions, which together are also the source of the value they create and the competitive advantage they bring. There is a revolution in the way demand and supply meet in many sectors, and, given the tremendous success of this type of digital platform in recent years, the digital platform has become crucial in healthcare sectors. Accurately, in hospitals, as there is a need for medical devices required to treat COVID-19 patients admitted in the ICU units of the hospitals.

The aim of this paper was, therefore, to gain a higher level of understanding of digital platforms in the healthcare industry. i.e. how the business models of innovative organizations based on digital platforms have evolved by analyzing the availability, procurement, and increasing supply of Ventilators to meet the ever-growing need for health care systems in India. The study adopted a case study research design in which qualitative technique was used to study the phenomenon in its real-life context[7] enabling study to capture practical knowledge and gain new insight.[8] The paper is structured as follows. First, the challenges in meeting COVID-19 patient's urgent requirement for Ventilators are described. Second, the evolution of business models in the healthcare industry, highlighting how medical device companies and healthcare services providers were compelled to review their value proposition to their patient's shifting requirements are examined. This section also focused on the integration of business models in healthcare and the implications of adopting digital platforms for business model innovation, the need for healthcare providers to offer better quality and short response times to deliver the Ventilators to COVID-19 patients. Third, the approach employed in the analysis is described, and the case examined, Indian start-up is reported. Finally, conclusions and implications are discussed in the final section.

1. Challenges in meeting urgent need of ventilators for covid-19 patients

The Ventilator is a medical device used to provide respiratory assistance to patients whose lungs are severely compromised by an infection resulting in severe breathing difficulties. The Ventilator uses a positive pressure to supply oxygen through the inner ways in the lungs and adequately regulate the patient's respiration process. The lungs of patients that need ventilation due to COVID-19 are so inflamed that when a patient breathes, the oxygen cannot enter the alveoli. The mechanical Ventilator serves to force the flow of oxygen to these small passages of air under pressure. Ventilation is basically of two types: a) invasive ventilation and b) non-invasive ventilation. The invasive ventilation uses an endotracheal tube that is inserted through the patient's lungs to trachea for oxygen supply, while the non-invasive ventilation does not require an internal tube. Also used in the management of less severe COVID-19 patients are non-invasive ventilation devices such as continuous positive airway pressure (CPAP) device[9], to avoid the need for invasive ventilators.

According to the WHO[10], one in six COVID-19 patients have significant breathing difficulties and may require support from a ventilator. A study from Imperial College London reports that it is estimated that 30 percent of patients admitted to hospitals due to COVID-19 will need Ventilators.[11] Another study conducted in Wuhan, China of the COVID-19 patients who were admitted to ICU, 56% of their patient's required non-invasive ventilation at admission, and out of these 76% further needed invasive ventilation.[12] The mortality rate among non-invasive ventilation individuals was 79 percent and 86 percent for those needing invasive mechanical ventilation. However, past studies have shown that intensive care units (ICU) will not have sufficient resources to treat all patients during a massive pandemic who require ventilator support.[13] The COVID-19 pandemic outbreak has brought about a drastic rise in the number of patients in need of respiratory treatment. Health care systems globally are facing the extreme shortage of particularly ventilators and their components. Most countries that are hugely affected by this pandemic have already experienced a shortage of ventilators.[14] One of the main reasons for ventilator shortages is the problems relating to their supply chain.

The COVID-19 pandemic has caught everyone unacquainted with the need for emergency instruments and protocols such as lifesaving Ventilators. The European Union has issued a declaration that its utmost priority should be to help and support existing ventilator manufacturers to increase their production.[15] Around the world, thousands of experts, entrepreneurs, and volunteers are developing a different potential solution.[16] Fortunately, with the recent development and widespread use of small-scale open-source manufacturing technologies[17], there is now another way – mass distributed production. Based on such mass-scale collaborative manufacturing, there appears to be a significant opportunity to innovate the business model to make the medical device available to everyone through digital platforms. In the current situation, this would, in general, at least partially overcome shortages of medical devices, and specifically for Ventilators.

2. Business model innovation in the healthcare industry and digital platforms

Innovation can be defined as intentional introduction and application of ideas, processes, products or procedures within a role, group, or organization, new to the relevant adoption unit, designed to benefit the individual, group, or wider society significantly.[18] This description is generally accepted by researchers in the field, as it encompasses the three most crucial innovation characteristics: (a) novelty, (b) an application component, and (c) intended benefit.[19] In line with this definition, innovations are typically new services, new ways of working and/or new technologies in healthcare organizations.[20] For the patient, the expected benefits are either improved health or decreased suffering from illness.[21] The needs of patients and the healthcare professionals and providers who offer care are at the very core of healthcare innovation. Healthcare organizations often become innovators by relying on new or existing information technology. The universal shortage of medical devices and other products is further advancing the argument in favor of more healthcare innovation.

Healthcare innovation can be defined as introducing a new concept, idea, service, process, or product to improve treatment, diagnosis, education, outreach, prevention and research, and with the long-term goals of enhancing the quality, safety, outcomes, efficiency, and cost. Information technology remains a key driver of healthcare innovation.[22] Although hospitals and other health care providers have long been able to implement cutting-edge technology in medical equipment, procedures, and treatments, far less attention has been paid to communications technologies. Innovations in health care are associated to product, process, or structure.[23] The product is what the patient pays for and typically consists of goods or services (such as innovations in clinical procedures). Innovation in processes involves changes in the method of production or delivery. Usually, the patient does not pay for the process directly, but the process is required to deliver a product or service. Therefore, a process innovation would be a novel change in the act of providing the product, which allows a significant increase in the value given to one or more stakeholders. Typically, structural disruption impacts internal and external infrastructure, generating new business models.

2.1. The concept of business model and business model innovation

A business model is a conceptual tool that encompasses a set of elements and their relationships and makes it possible to express the business logic of a specific healthcare establishment.[24] The most critical elements are value creation and value capture and various sub-categories of these components. The Healthcare industry is continuously changing. In the healthcare sector, business models are ways to improve the performance of the healthcare establishment under uncertain conditions.[25] The more relevant innovation becomes, to position the organization on the market, the more appropriate business model. Competitive advantage and technology can be seen as crucial links between strategy, organizational processes, and innovation, facilitating communication and sharing of knowledge between business models. Several global trends, such as service personalization (patient-oriented), population aging, and electronic health systems, mean that these specific business models need to be very flexible and adapt quickly to market trends.[26]

The affordable and access to healthcare is a desired phenomenon. Limited access to healthcare services and medical devices increases the exposure to the disease-prone environment and contributes to reduced life expectancy. One of the root causes of ineffective healthcare access is the cost of medical treatments, equipment, and healthcare expenditures. In order to increase access to healthcare and ensure a healthier population, new business models of delivery of healthcare are needed.[27] The fundamental human right of hundreds of millions of people to have access to primary health care provides an unparalleled motivation for economic actors to design, develop, implement, and support new health care, business model.[28] In brief, the business model construct describes how healthcare providers set up and organize their business systems to compete in their markets. The business models have traditionally been used to describe the healthcare business system. A related set of principles and constructs have been developed that describe how healthcare providers are competing and how they are positioning their business models to provide affordable and accessible healthcare.

The challenge of developing the healthcare business model, however, was not only related to its complex and ever-changing nature.[29] The intense levels of regulation in healthcare and interactions between networks and various players also pose problems for the business model. The health system is a national network that is directly regulated and managed by government or governmental organizations in most countries. Having a business model suitable for the healthcare segment in these circumstances seems exceptionally critical, as several stakeholders are seeking the maximum benefit from the business model.[30]

The related concept, which also tackles the implementation of business models, is *business model innovation*. Business model innovation can be described as "changes in business logic that are new to the organization, but not necessarily new to the world, leading to measurable changes in business model practices."[31] Over recent years, the application of business model innovation has expanded in the healthcare industry.[32] Innovative business models were identified across a variety of industries, from the worldwide web-enabled new business development to new approaches to urban mobility[33], to microcredit.[34]

The researchers concentrated on developments in business models that lead to better product marketing and technical innovations.[35] At the same time, innovation in the business model is more confined in the service and healthcare sectors in particular. Despite its relevance, there are rare studies on innovation in the business model to ensure effective and efficient delivery of emergency health care services. Business model innovation tends to be a feasible solution to solving recent healthcare issues; while at the same time understanding that the use of business model innovation in an enterprise system as complex as healthcare can theoretically add value to business model literature.

2.2. Introduction to digital platforms

A platform is a business which enables interactions between external producers and consumers, which build value.[36] The platform provides for these interactions with an open, participatory network, and sets conditions for governance. The overarching purpose of the platform: to consummate matches between users and facilitate the exchange of goods, services, or social currency, thus creating value for all participants. The platforms are defined as "digital infrastructure (hardware and/or software) on which different applications can run, or (by broader definition) allowing for a finite set of uses that are clearly defined."[37] This approach suggests the platform has a technical interpretation. Platforms are also defined as a new business model that uses technology to connect people, organizations, and resources in an collaborative ecosystem that creates and exchanges incredible amounts of value.[38]

Digital platforms are conceptualized based on a technical view that focuses on the technical elements and processes interacting to create a digital platform. A digital platform is defined as "A building block which provides an essential function for a technological system and serves as a basis on which to develop complementary products, technologies or services."[39] Studies are embracing this definition focus on the technological innovations and functions that form the foundation upon which complementary products and services can be created, i.e., building on the top of the technical core provided and facilitated by a platform owner. Other studies have conceptualized digital platforms based on a non-technical view that presents platforms as a commercial network or market enabling business-to-Business (B2B), business-to-customer (B2C), or even customer-to-customer (C2C) transactions.[40] In this perspective, the emphasis is on the interactions between the various groups that join a network as users or providers of products and services.

Digital platforms offer several characteristics that explain their attractiveness as an organizing model. *First*, digital platforms contribute to significant transaction cost reductions, including costs for distribution, search, contracting, and monitoring.[41] For example, aggregation platforms such as TripAdvisor and Expedia collect and combine travel information from multiple sources into one platform, thereby reducing the cost of information searching and of using intermediary agent services. *Second*, Digital platforms help to organize and coordinate complementary product technology development through modularity and appropriate governance structures.[42] Apple's iOS and Google's Android platforms, for example, give independent software developers a technological and regulatory framework that promotes and encourages their participation in application development. In addition to these characteristics, other attributes in terms of broader concepts such as generativity and cross-side network effects have been discussed.[43] *Generativity* is defined as a technology's capability to generate new results determined by significant, heterogeneous users.[44] For example, the generativity of crowdsourcing platforms helps them to create new approaches to daunting issues based on a large number of participant's contributions. *Cross-side* network effects reflect the fact that, as the number of participants on the other side increases, the platform value for a participant on the one hand increases. For example, in e-commerce platforms like eBay or Amazon, when there are more buyers on the other side, the value of the platform for the seller increases, and vice versa.

2.3. The importance of digital platforms in new business models

The widespread penetration of digital technology has exposed a platform's key role as one of the most important traits of innovation processes and has made it the central focus of the innovation activities of many businesses.[45] As platforms have been around for many decades, businesses are tailoring their business models in the sense of platform use. Several researchers analyzed the digital platform's business model, aiming to identify innovative aspects of the business model.[46] The business model aims to answer four key questions, and companies adopt platforms to innovate in the context of business models. First, to whom organization creates value? Second, what organization is offering to the end-users? Third, how the organization creates value? Fourth, what kind of cost and revenue involved?

Analyzing the business models of digital platforms requires an understanding of the business model as a unit of analysis. The definition of the business model can be differentiated from other analytical units by its systematic emphasis on dimensions of *value creation*, *value capture*, *value delivery*, and *customer* dimension.[47] The customer dimension contains the elements for a group of defined target customers that generate value.

The business model concept addresses segments of customers as valuable as companies aim to meet the needs of selected segments. Digital platforms allow us to reach any end-user segment in the global market from one hand; however, the platforms will be used by

different types of users. Four types of users.[48] can be distinguished: (1) Owners of digital platforms - These organizations have their own platform, and are responsible for the development and operation of the platform. (2) Key Partners - Organizations engaged in platform activities and offering digital platform owners' opportunities to expand value creation and delivery options. (3) Producers - Various organizations are contributing to value-added network initiatives and finding ways to boost their value offerings and gain additional revenues. (4) End Users - Individuals or organizations act as digital platforms end-users and get value out of platform use. End users are the typical segment approach companies in the traditional business model, but value platform offerings also target producers and key partners. Satisfying the needs of these users leads to the successful implementation of a business model through the digital platform.

The dimension of value creation refers to the mechanisms that ultimately allow customers to deliver value. Relevant business model attributes for digital platforms relate primarily to the core functions of platforms as identified by creating trust and supporting the discovery of an acceptable price between potential transaction partners. The platform also encompasses the main type of technology (purely web-based or mobile app) as well as the key activity of the company, such as data services, community building, or content creation and curation. The value-capture element or benefit formula explains how the business turns the value given to customers into income and profit.[49] The revenue stream options for digital platforms can be distinguished between the commission model, subscription model, advertising model, and service sales.[50] The business model for the digital platforms is further developed by the decision to monetize supply-side participants, demand-side participants, or a third party.

Digital platforms offer new value creation, value capture, and value delivery opportunities, so organizations reinvent their business models by value reconfiguration and disintermediation. Several organizations manage successful digital platforms, but most organizations need to find out how digital platforms can be adopted. Digital platforms are treated as a new opportunity for business model innovations. Organizations explore possible opportunities and attempt to innovate their business model to succeed; several critical factors need to be analyzed.

3. Case Study Analysis

The case study method is widely used to investigate health care innovations from a service ecosystem perspective and to describe the theoretical findings obtained.[51] This approach is well adapted for practical fields and addresses the study question. The case study methodology supports a better understanding of the complex business model, such as contributing multi-actors to service innovation in a critical domain such as healthcare. The scholars considered qualitative methods more suited to the in-depth investigation of a new phenomenon, such as the emergence of innovations in the healthcare business model.[52] The research centered on a single case study within the Indian healthcare system and its approach to service innovation, focusing on the relationships of multiple players at digital platforms and encouraging new or creative value propositions capable of co-creating shared value. The study uses secondary data, collected from documents and archival information, found on the official website, business reports, and qualified magazine and journal papers. This took into account both official records and technical and scientific documents. The case study analysis followed the following three steps: (1) description of the research methodology; (2) case selection; (3) analysis of business model innovation in the case organization.

3.1. Research methodology

This paper is constructed on a qualitative approach, using the method of the case study. Respectful than others, the case study has become one of the most widely used qualitative methods in research into technology management and studies of information systems.[53] There were choices for evaluating many company's business models that adopted digital platforms to assist healthcare systems as a framework for the case study. The main characteristics of the company were defined to choose from: (a) the specialized COVID-19 treatment services delivered, (b) an innovative business model which describes organizations that redefine the meaning of health services, (c) by adopting digital platforms, networks and infrastructure to healthcare, (d) focusing their strategies in the healthcare market capturing opportunities offered to patients and providers by the gaps in new digital solutions. The company analyzed in the study is Octaware Technologies Limited.[54] The company is a software development and enterprise solutions firm with a delivery center in India located in SEEPZ-SEZ, Mumbai serving global customers in healthcare[55], government, and finance sectors. Founded in 2005, this socially-motivated and information technology company specializes in digital transformation and telemedicine systems intending to improve access to healthcare in India and the developing world.

The purpose of empirical research requires observing and examining several aspects, such as understanding innovation in healthcare business model, adopting digital platforms, how new technologies can support the effective delivery of healthcare services, making them more efficient and, at the same time, delivering better quality and reducing response times. The below steps were followed to describe the case better:

Firstly, the actors involved in delivering healthcare services were identified: medical doctors, hospitals, medical device owners, and patients. The delivery of emergency services in the field of healthcare depends on

the work of doctors, nurses, hospitals, equipment suppliers, and technicians. There is a strong need for cooperation between people from different fields. Therefore, it is necessary to consider which people are involved in the examined case, the degree to which they are involved in business model innovation, and how they function together. The next step was that of collecting data. The primary source of data used in the study was archival documents. Studies, papers, meetings, and notes for the conference, resolutions, journal articles, and books have been reviewed and analyzed. To this end, information about digital platforms and equipment such as Ventilators used to make healthcare facilities more available to all patients have been collected, as well as information about the company's aggregator application. A detailed examination of the events in the case company, healthcare service providers, and the community experienced was conducted. Lastly, the innovation involved in the business model has been analyzed how the business model innovation can benefit from the adoption of digital platforms. Thus, in order to get a clearer understanding of what happened, why, and what was done about it, a systematic way of looking at the collected data has been implemented.

3.2. Air-venti digital platform to manage ventilators

Octaware Technologies Limited has launched a new digital platform, Air-Venti[56], an aggregator for emergency healthcare services that offers Ventilators to healthcare service providers, doctors, and patients. In order it to be readily available by all users and in line with technical advancement, the new platform is also usable from all forms of digital devices (PC, laptop, smartphone). The mobile application is also uploaded and available through the App store of Google[57] and Apple. Air-Venti digital platform is made up of several components, as shown in Figure 1.

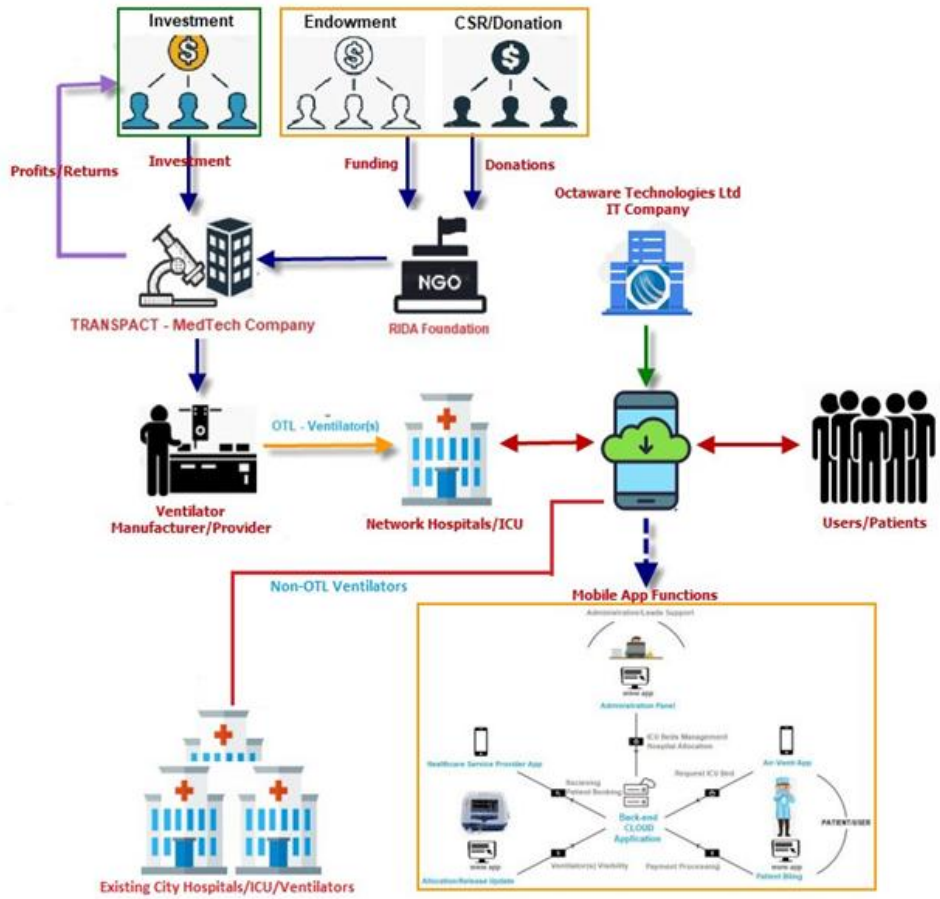

Figure 1: The architecture of the Air-Venti system.

The spread of tablets and smartphones is revolutionizing medical and scientific communications. This means supplying equipment for emergency healthcare to healthcare service providers and patient care programs to treat their disease. The idea is to make the Ventilators available anytime, anywhere that responds to emergency needs properly. Air-Venti business model is that of a market place aggregator that used technology to disrupt the current network of healthcare service providers to help patients connect to all forms of hospitals and emergency care, including ICU beds and Ventilators. Unlike traditional medical device companies, Air-Venti uses a market place digital platform and does not own medical equipment.

There are four constructs in the architecture of Air-Venti grouped in two sets: (a) those describe the key elements of the business model and (b) those assessing the sustainability of the business. The Air-Venti architecture of sharing the medical device through digital platforms are described using these constructs:

- *Owners of digital platforms* – Octaware Technologies Limited is the owner of the software application developed for the Air-Venti digital platform. The aggregator application is designed to work on the Android and iOS mobile operating systems.

- *Key Partners* – Ventilators are sourced to the Air-Venti platform through Transpact Enterprises Limited.[58] The company provides the opportunity for direct investment into a single venture for sourcing and funding the Ventilators. Equipment is also sourced in the form of "Donation-based" and "Endowment-based" through a Mumbai based non-profit organization RIDA Foundation.[59] The medical device owners and donors termed as contributors to the system.

Producers – Hospitals, medical device manufacturers, distributors, and Biotech organizations are contributing to the Air-Venti network to deliver emergency healthcare initiatives to the patients.

- *End Users* – COVID-19 patients act as digital platforms end-users.

Air-venti mobile application, operations, and ventilators delivery

The mobile application was developed using the rapid application development (RAD) process.[60] Using RAD methodology for developing software, the development processes are divided into three main phases: prototyping, development, and deployment. The app was then submitted to the Google Play Store after all the development steps were completed. The end-users and hospitals can download the applications and install them on the mobile phone. Figure 2 shows example screenshots of the end-user mobile app.

Finding an ICU bed or Ventilator in the hospitals during the COVID-19 pandemic is terrible. However, with the Air-Venti app for Android and iPhone, locating and booking an ICU Bed or ICU Bed with Ventilator is now a matter of swiping a finger across a smartphone. The app connects patients in need of emergency ICU beds with healthcare service providers that have vacant ICU Beds or Ventilators. Not only can end-user book the nearest ICU Beds/Ventilators registered with Air-Venti platform, but the app also allows end-user to monitor its occupancy in the app, along with information such as booking confirmation, hospital name, number of ICU Beds with Ventilators and without Ventilators, distance and time taken to reach the healthcare service providers location. Registered users can also block the ICU Beds through the app with a credit card and or directly pay to the healthcare service provider at the time of admission to the hospital. Healthcare service providers affiliated with Air-Venti are equipped with Hospital versions of the mobile app, which enable them to update the status of the ICU Bed and Ventilators occupancy. Air-Venti is currently operational in Mumbai and will launch in the pan India level later this year.

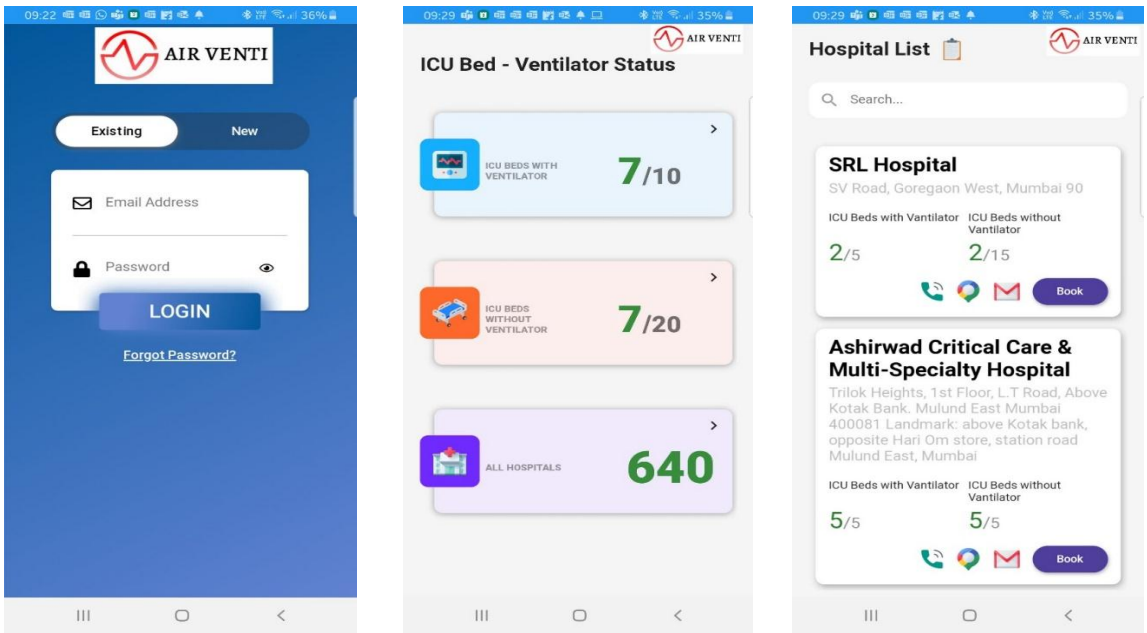

Figure 2: Exemplar of Air-Venti Mobile Phone Application screenshots.

Air-Venti is the first medical device aggregator based on mobile apps and has well over 9,500 registered hospitals that appear on its user app. The users can view, book, and track the availability of ICU beds in real-time through the mobile app. A user has the option to book through the mobile app or can also use the website. There is no need for a user to register or have an account to book or use full service available with the mobile app. Like other digital aggregators, the company has adopted an 'asset-light' model where device ownership is not intended that requires investment and daily maintenance costs. The Ventilators are sourced to the digital platforms through the crowdfunding model from the contributors. There are three models of sourcing: "Investment-based", "Donation-based", and "Endowment-based". In return for its funding to an Air-Venti platform on a crowdfunding model, the contributor could benefit from revenue sharing and a priority ICU Bed service. A contributor can attach his medical device to the platform after a verification process and joins the network. And if the contributor joins the network, he can use the Ventilator for himself when the emergency occurs to him. This facility addressed the peace of mind of the contributor during the pandemic.

The important tasks that need to be taken care of are Ventilator delivery optimization, ICU bed allocation, and bed occupation management. A critical success factor for the Air-Venti digital platform is managing and expanding the available Ventilator inventory while striking a balance between demand and supply with insights from analytics. Transpact needs to continuously increase sourcing so that more Ventilators can be added to its network.

Air-venti business model dimensions

The process of analysis followed a procedure for reviewing the Air-Venti business model. Table 1 gives an overview of the Air-Venti business model attributes. The first four attributes are part of the value proposition & delivery dimension, the subsequent four are part of the value creation model, and the final three represent the value capture dimension. These business model attributes and their potential specifications are essential to developing a framework for analysis, a common approach in the business model study. This paper considers only those attributes which seem highly important in the context of the digital platform.

Table 1: Business model attributes of air-venti digital platform.

	Business Model Attributes	**Specification**			
Value Creation	**Platform Type**	**Mobile**		**Web**	
	Key Activities	Software App Development	Hospitals/Ventilators Placement	Investors/Donors Connections	Patient Acquisition
	Pricing	Fixed By Hospitals	Fixed By Physicians		Discounted Price
	Feedback System	Patient Review	Doctors Review		Hospitals Review
Value Delivery	Value Proposition	ICUBedsVisibility/Availability	Access to Ventilators and Patients		Money making Social Value
	Transaction	Product		Service	
	Marketplace Participant	B2C		B2B	
	Geography	Local	Regional		Global
Value Capture	Revenue Stream	Device Rental	ICU Bed Profit Sharing		Patient Referral fees
	Revenue Source	Hospitals		Patients	
	Price Mechanism	Fixed Price	Hospital Price		App Price

The value creation aspect refers to the value architecture and mechanisms of the organization, which enable the value proposition to be generated. For Air-Venti, related business model attributes primarily concern key digital platform functions: creating trust and helping end-users find an available ICU Beds/Ventilator. Locating ICU Bed/Ventilator mechanisms can build on a system in which (a) the Air-Venti platform or (b) the healthcare service provider sets the availability of the ICU Beds/Ventilator. Digital platforms generate trust primarily by providing a review of previous transactions by end-users. If the digital platform serves as a delivery channel for the value proposition of the company, it can also be viewed as part of the value proposition & delivery dimension.[24] However, since Air-Venti presents the key resources of the digital platform, it is considered part of the value-creating dimension of the system.

The value delivery component includes the attributes generating value for a given target group of customers. In order to empirically categorize the value proposition, the system distinguishes between three forms of perceived value: (a) financial value through revenue sharing benefits; (b) emotional value through saving the patient life associated with Ventilators; and (c) social value through offering Ventilators to healthcare services provider in need. The value delivered further depends on the type of transaction product versus service; For Air-Venti, the combination of these two attributes defined whether the digital platform offered product (Ventilator), or service (ICU bed). The value-capture dimension or

profit formula describes how the company transforms the value provided to customers into income and profit. For Air-Venti, revenue stream described are device rentals, ICU bed revenue sharing, and patient referral fees.

3.3. Business Model Innovation in Air-Venti

The digital platforms model was a disruptive innovation that Internet companies brought and was accelerated by the increase in smartphones and the wider use of online payment facilities.[61] As elsewhere in the world, this model has seen the emergence of travel aggregator expedia.com and tripadvisor.com, online trade sites amazon.com and ebay.com, and cab aggregator uber.com and lyft.com, etc. Taking advantage of the aggregation model, these businesses redefined the conventional way of doing business in the respective sectors by redefining market structure in their favor. Aggregation in the healthcare industry is a new trend even globally, and strong business models have not yet emerged. Medical aggregation companies have linked medical professionals or doctors to a large number of patients by giving them better opportunities to use their otherwise consulting time effectively. Using web-based and mobile technologies, aggregators boosted the doctor's chances of more patients a day. On the other hand, patients were assured of the best healthcare services through the power of digital technologies.

In this section, the innovation of Air-Venti digital platform leading to diversity of business models, including value creation such as benefit source; value delivery such as visibility and availability of ICU Beds allocation; and value capture such as ICU Beds revenue sharing, device rentals, and patient referral fees are highlighted.

First, concerning the value creation, contributors received 50% of the revenue earned by the Air-Venti system. Hospitals worldwide struggle with the shortage of Ventilator machines when they are most needed. The Air-Venti system provides these Ventilators to hospitals through crowdsourced funding from contributors. The emergency healthcare services offered to underprivileged through “donation-based” and “endowment-based” funds received discounted care. The Ventilators allocated to the hospitals are available on the priority that contributors may use when in need of emergency healthcare services. The Air-Venti system expects referral fees from the hospitals to connect the patients through the mobile application. However, the maximum number of hospitals do not give referral fees at the beginning of the launch of the system. Furthermore, in the case of app advertisement revenue planned in the future, the Air-Venti has made provision in the system to incorporate the revenue stream. Pairing the digital platform with healthcare business models is what led to more enormous benefit sources through disruptive innovation in value creation.

Second, as for value delivery, Air-Venti offers a system model that connects the end-users and the healthcare service providers via a digital platform. Air-Venti has two different ICU Bed allocation system to deliver emergency healthcare services to end-users. The first is ICU Bed with Ventilators, and the other is that the Air-Venti allocates patient ICU Bed without Ventilators. The exchanged services are delivered through offline channels. The innovativeness of the business model depends on the degree to which it creates new or changes the current process of delivery. After a sustainable aggregation of a vast network of end-users with common interests of Ventilators, Air-Venti created unique emergency healthcare delivery ecosystems. The interplay between a digital platform and its ecosystem, therefore, provided new insights into the innovativeness of a business model.

Third, the value capture element of the Air-Venti is revenue generated through the Ventilator's rented to the hospitals based on revenue sharing or monthly lease. Another revenue streams are the mobile app subscription fee, listing fees, and advertisement revenue through the platform. The value capture dimension or profit formula describes how the organization converts the value delivered to end-users into income and profit. The Air-Venti is delivering value propositions that are separate from those of hospitals and doctor’s practices at a lesser cost and with higher quality. By embedding the digital platform that simplified the intricate work done into their business models, the disruptive Air-Venti fit its resources and innovative profit formulas together in ways that do exceed hospital's and doctor’s practices.

CONCLUSIONS

This paper explored the role of digital platforms in fostering innovative business models in terms of value proposition and the intermediating supply and demand in emergency healthcare delivery during the COVID-19 pandemic. Digital platform trend has become increasingly relevant, and businesses needed to reconsider their business models according to the epidemic situation to take advantage of opportunities that platforms offer. Empirical evidence from our case study supported some common trends and features already highlighted by existing literature of this form of business. These include the importance of the community of end-users/ healthcare service providers, the presence of aggregator effects, business scalability, and the possibility of unlocking new sources of value creation, the strong dematerialization of digital platforms, and their essential role in intermediating supply and demand.

In this study, the digital platform was analyzed in the Air-Venti case to investigate the subsequent effects of instituting innovation in the business model within the organization. The findings demonstrated significant improvements in healthcare delivery, simplify systems and procedures, made them more productive, and, at the same time, provided higher quality and the reducing

response times. The innovation process outlined in this paper illustrated both the thought and practical steps that many healthcare organizations had taken in exploring the benefits of innovation. There was no question that Air-Venti had introduced an innovation not only as a digital platform but as a business model through which hospitals reached out to support patients with Ventilators' vital needs. Air-Venti's business model was a disruptive effect on the healthcare industry as patients could use the app in their smartphones, and they could locate and book a Ventilator by merely tapping a button on the phone anytime, from anywhere.

Moreover, this study provided both academic and practitioner contributions. In theory, given the presence of a large number of studies on the business model innovation, recent studies are mostly based on conventional manufacturing or service sectors. In contrast, business model innovation in healthcare is somewhat sluggish, although the quality of treatment seems to need to be enhanced. Besides, the healthcare sector faces challenges that make it essential to change these business models. In such a context, our research aims to contribute to the theoretical literature by exploring opportunities for the healthcare industry offered by digital platforms. More specifically, starting with the way new business model innovations are changing in the healthcare sector, we are exploring how greater use of digital platforms could support medical treatment in the healthcare industry.

Practitioner's implications emerge from the case, too. While innovation plays a key role in healthcare system sustainability, which can be seen a grand challenge, practitioners should understand that emerging digital platforms – healthcare-based solutions can deliver long-term economic benefits that they expect. Practitioners should be strongly encouraged to employ new digital platforms and innovative business models capable of reducing the investment of hospitals and promoting patient care with greater safety and efficiency. From a practitioner perspective, it emerges that digital platforms are more likely to convey improved medical treatments and devices availability and better quality of healthcare services and open up to new user segments. Furthermore, healthcare digital platforms could ensure that ICU Beds and Ventilators information is available correctly, thus enhancing the patient experience and creating substantial changes in the healthcare landscape.

In conclusion, digital platform adoption in COVID-19 outbreaks able to ensure efficient healthcare delivery. Digital platforms establishing innovation in the business model obtain benefits, such as improved collaboration between patients and hospitals and Ventilators shortage problem, delivering high quality of healthcare services.

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