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Evolving uncertainty in healthcare service interactions during COVID-19: Artificial Intelligence - a threat or support to value cocreation?

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6.1 Introduction

Healthcare is highly complex, yet the most fertile field for service research (Berry & Bendapudi, 2007). The transforming nature of the healthcare environment is characterized by a change in the working style, adoption of modern practices, advanced technology, empowering patients, and an increasing number of stakeholders. Adding to this list, information asymmetry and healthcare services’ credence make it more complicated and turbulent (Bloom, Standing, & Lloyd, 2008). The technology revolution happening since the past few decades has been transforming healthcare services (Duplaga, Zieliński, & Ingram, 2004). Earlier, the healthcare consumer simply used to play a passive role because of a low level of access to health information. They are now empowered through digital information and interaction services and have become more demanding. This transformation has increased customer expectations and created tensions in the service interaction environment. As a result, the overall situation challenges the service provider’s way of designing and offering services. To reduce this tension in healthcare service interactions, researchers have proposed a cocreation approach where both the actors, for example, service provider and service recipient, cocreate the value equally (Barile, Saviano, & Polese, 2014). In other words, using the cocreation approach, the service provider (i.e., the doctor) and the healthcare consumer (i.e., the patient) cocreate value for each other to realize their real wellbeing (McColl-Kennedy, Vargo, Dagger,
Sweeney, & Kasteren, 2012). McColl-Kennedy et al. (2012) have beautifully defined cocreation within healthcare as benefit realized from integration of resources through activities and interactions with collaborators in the customer’s service network. Here activity means any “doing” by either patients or doctors/service providers. This cocreation phenomenon is emerged from a well popular logic within service marketing, the service dominant logic (SDL) (Vargo & Lusch, 2004). SDL states that service is the basis of exchange in any economy where each actor acts as a resource integrator and creates value for each other. This “value for each other” results in “cocreated value” and the process is coined as “value cocreation” (Vargo & Lusch, 2004). Resource integration involves optimally combining several tangible and intangible resources from various sources of service providers and consumers. For example, consumers may use their resource (like their knowledge and skills) and combine it with the public resources (like the information available on the internet), along with the resources provided by the hospitals (e.g., an expert consultation, diagnostic and treatment facilities) to cocreate health outcomes in the best possible way.

Unfortunately, healthcare value cocreation (VCC) interaction spaces get disrupted during the pandemic’s difficult time like COVID-19. Increasing health risks and a lack of appropriate response desired from the healthcare systems are giving rise to fear and anxiety worldwide. Several healthcare uncertainties emerge radically during the pandemic and hinder the effective practices of VCC (Han, Klein, & Arora, 2011). For instance, doctors may avoid direct interaction with the patients and prefer to spend less time with them than the legitimate normal due to the fear of chronic communicable infections. The mutual “trust” that is essentially required between a doctor and a patient for a successful cocreation in a service encounter is severely affected by the pandemic. Healthcare consumers often start doubting the service provider’s (doctors) honesty, fairness, and communication intention. Lack of procedural justice, conflict of interest, lack of empathetic communication, and ethical perception toward service pose challenges to cocreation practices. Some of these issues, which were already hidden in the healthcare service system, have now been exaggerated due to pandemic situations.

In parallel to the above-discussed background, recently, the experts around the world are advocating to deploy Artificial Intelligence (AI) as a magical tool to solve all the uncertainties of healthcare services during COVID-19 (Nguyen, 2020). Nguyen (2020) completed a comprehensive survey on AI use during COVID-19 and finds the possibility of its application into many areas such as medical image processing (through deep learning methods), pandemic modeling (by using data science), medical devices (by AI and the Internet of Things), text mining and natural language processing (NLP), and in computational biology and medicine. In the VCC context, Robinson et al. (2020) proposed the AI-empowered service encounter framework, where authors deliberate over AI-enabled interactions in a dyadic
service exchange. Much of the growing research to date primarily focuses only on applying AI in a broader service system.

The larger question that needs attention is how AI influences the “co-creation process” within the healthcare service system. A similar question was earlier raised by Kaartemo and Helkkula’s study, who reviewed the role of AI & robots in VCC (Kaartemo & Helkkula, 2018). Augmenting further, Čaić, Odekerken-Schröder, and Mahr (2018) observe that AI (such as in the form of service robots) may also result in value codestruction and may spoil the overall service experience, especially in the context to healthcare services. Thus, it becomes imperative to critically explore AI’s role, that is, observe the negative side of AI from a balanced perspective. Based on the above discussions, the primary question posed in this work is, “Is the present AI system capable enough to solve the uncertainties (due to pandemic) underlying cocreative service interactions and support the healthcare VCC?” This chapter focuses on conceptualizing this question in the light of interdisciplinary studies from services marketing, healthcare and technology literature. We try to answer some of the interrelated questions like how AI can resolve the issues of trust, social support, and negative ethical perceptions that emerged due to the pandemic. Without questioning the technical competence of AI, it is critical to question the applications of AI guided by a phenomenological view.

First of all, we identify the natural uncertainties emerging from COVID-19 in cocreative healthcare service interactions and then explore AI’s role as an advocated solution. This work is a conceptual study presenting an exciting viewpoint about the role of “AI” in combating COVID-19, which intersects with a niche theoretical understanding of VCC in healthcare services. We balance the literature by highlighting the lesser focused side of AI, that is, adverse effects of AI on VCC, which is likely to have undesired outcomes. Our discussion will follow the line of thoughts of Čaić et al. (2018), LaRosa and Danks (2018), and Xu, Shieh, van Esch, and Ling (2020), who present the second side of the coin, that is, reflecting the spill-over effect of AI in healthcare services. Overall, the contribution of this work is threefold. First, it opens up discussing possible value codestruction in AI-enabled services, especially in healthcare. Second, this study helps to understand the dynamics of healthcare uncertainties evolved during pandemic like COVID-19. Third, it elaborates the AI’s potential to combat service uncertainty from social science perspectives by adopting the consumer’s view instead of AI’s technical competence. Further, the complete study is organized as follows: First, discussing the SDL in marketing; second, talking about service interactions and cocreated wellbeing; third, presenting uncertainty due to pandemic; fourth, highlighting uncertainty in healthcare; fifth, elaborating the emerging role of AI; sixth, focusing upon AI combating uncertainty and supporting VCC in healthcare interactions; seventh, discussing the spill-over effect of AI; and eighth, summarizing overall work through conclusion along with limitations and future research directions.
6.2 Service dominant logic in marketing

Marketing’s true philosophy is rooted in the notion that *customer is the king* and company should offer *relevant value to their customers* (Kotler, 1994). However, the way value is offered changed with time. Earlier, where the value was offered through the product has now changed to value through service (Sheth & Uslay, 2007; Vargo & Lusch, 2004). Pioneers of SDL, Ramaswamy (Prahalad & Ramaswamy, 2004) and Vargo (Vargo & Lusch, 2004) agree that even a tangible product offered to customers perform services to fulfill the customer’s need. For example, a car is not seen as an automobile product but as a comfortable transport service coupled with luxury, esthetics, status, power, and even self-esteem for a few customers. This notion gets stronger with the wide adoption of the premises of SDL. This logic simply believes that every market transaction is concerned with service, and service is the primary basis of exchange in the economy. It implies that the customer who enjoys the logistic service of the purchased car results from an engineering service that turns raw material into finished automobile products. This idea replaces the traditional concept of exchange of goods to the modern concept of exchange of services (Lusch, Vargo, & O’Brien, 2007). Since then, several premises of SDL have augmented the service approach of marketing. One of the important premises directly relevant in context to this study (talking about value in service interactions) is *The customer is always a cocreator of value*. This implies that a firm cannot deliver value but can only offer a value proposition. It is also implied from here that customer plays an active role in the service interaction. Another essential SDL premise relevant for our study is, *Value is always uniquely and phenomenologically determined by the beneficiary*. This implies that the service provider’s offered value would be worthwhile for the beneficiary only when it is infixed with his active involvement. The customer finally realizes the value in any service interaction using his operant resources like knowledge and skills (Vargo & Lusch, 2004, 2016).

Drawing from this SDL, it could be said that every actor (while consuming the services) creates value not only for himself but also for other actors in the service network. Relating this thought (of creating value for other actors in the network) in healthcare, it is observed that healthcare actors (doctor, patient, paramedical staff, information and communications technology team, back-office personnel) create value for each other using both operant and operand resources (Hau, 2019). Although, earlier SDL studies focus more on operant resources (customer knowledge, skills, compliance, psychological states) contrary to operand resources (technology) in healthcare VCC (Robertson, Polonsky, & McQuilken, 2014). Considering this opportunity, the current study focuses on the possible role of AI (an emerging technology) in healthcare VCC (rooted in service-dominant healthcare interactions). In addition, the context of COVID-19 demands more investigation into the
above issue as the pandemic poses several challenges (physical, psychological, social, and technological) to effective cocreation of value (Finsterwalder & Kuppelwieser, 2020).

6.3 Service interactions and cocreated wellbeing

The service interactions in any industry are oriented toward an outcome, which may be “profit for service provider” or “value for money” for the customer. However, such outcomes may be contradictory, and achieving the real harmonious outcome is challenging. Here, harmony means the outcome that emerged in service interaction should be considered equally valuable by both the provider and the consumer. This challenge gets further critical in healthcare services because of its complex nature (Verleye et al., 2017). To better understand, let us take an example. A patient may be actively participating, such as understanding the health issues in more detail by referring to alternative (though not always credible) information sources, using specific drugs without consultation, etc. to realize self-empowerment or self-control value creation processes. This may endanger the doctor’s role to make patients strictly compliant with the suggested line of treatment. Literature asserts that there are several reasons for such challenges in healthcare service interactions. Some of these are the credence trait of healthcare services (Darby & Karni, 1973), information asymmetry in healthcare (Barile et al., 2014), and power imbalance in healthcare (Verleye et al., 2017).

The role of cocreation in healthcare services becomes vital to address these challenges. In healthcare service encounters, whenever one actor perceives other actors to be participating, his cocreation efforts are enhanced, which results in a synergistic outcome that is mutually satisfying in nature (Tari Kasnakoglu, 2016). Several other studies discuss VCC at a dyadic or systemic level in healthcare services (Janamian, Crossland, & Wells, 2016; Kim, 2019; Osei-Frimpong, Wilson, & Owusu-Frimpong, 2015; Virlée, Hammedi, & van Riel, 2020). More recently, Sharma, Conduit, and Hill (2017) identify that healthcare consumers derive different types of personal wellbeing (hedonic and eudemonic wellbeing) from cocreation activities. Extending this cocreation and wellbeing dynamics, Chen et al. (2020) explore the cocreation of wellbeing itself, as wellbeing is the critical outcome expected by all the actors in the healthcare services. It may be said that within healthcare service encounters, doctors try to enhance the patient’s medical knowledge so that he can participate, realizing his sense of achievement or eudemonic wellbeing. This wellbeing of the patient fosters a doctor’s wellbeing because a doctor can feel a sense of ownership for the patient’s improved condition. Thus it is implied that SDL-rooted cocreative service interaction is directly associated with cocreated wellbeing in healthcare.
6.4 Uncertainty due to pandemic

Any kind of pandemic often exaggerates the typical complexity or uncertainty inherent in society. Before moving further, it is necessary to understand that uncertainty and risk are two different concepts. Interestingly, Sharma, Leung, Kingshott, Davcik, and Cardani (2020) differentiate between risk and uncertainty, elaborating that risks can be evaluated up to a certain extent compared to uncertainty, which is difficult to comprehend in advance. This study will mainly talk about uncertainty only. Elaborating over the nature of uncertainties, MacPhail (2010) categorizes uncertainty as scientific, situational, and strategic uncertainty. Liang, Laosethakul, Lloyd, and Xue (2005) observe that uncertainty emerges either from an actor’s opportunistic behavior or due to information asymmetry in any relationship. Shiu, Walsh, Hassan, and Shaw (2011) proposed a multidimensional view of uncertainty, that is, knowledge uncertainty, choice uncertainty, and evaluation uncertainty. Karlsen and Kruke (2018) talk about the uncertainty of the source, evolution, and solutions to the pandemic.

Ultimately, based on a selective review of studies on uncertainty, the critical uncertainties or issues that emerged during a pandemic are identified. For details, refer to Table 6.1.

6.5 Uncertainty in healthcare

Uncertainty is inherent in healthcare services since its inception because there is a significant knowledge gap among focal actors (doctor and patient) in this industry. However, this information asymmetry is reduced to a certain extent, with the advent of ICT (Information & communication technologies) supporting patients’ health literacy (D’Cruz & Kini, 2007). Still, there are many other uncertainties as per Han et al. (2011), visible in healthcare service consumption, listed below:

- Ambiguity: regarding patient’s evaluation of their state of illness.
- Credence trait of services: due to which consumer could not ascertain the actual quality of services even after consumption.
- Unpredictability: due to a change in the patient’s condition during the complete course of treatment.
- Lay epistemology: patient’s subjective interpretation of available information.
- Existential issue: influence of patient’s condition on his personal life (Han et al., 2011).

It is evident that healthcare services are filled with uncertainties, even in regular times. For example, if a person is diagnosed with cancer, he may start experiencing anxiety/fear or loss of control over life. All this creates uncertainty in the patient’s mind and affects his quality of life or overall
### TABLE 6.1 Brief about key uncertainties identified in earlier studies, along with primary focus and COVID-19 issues discussed in the study.

| S. no. | Study reference | Key uncertainty identified in the study | Main focus of study | COVID-19 issues discussed or implied in the study |
|--------|-----------------|-----------------------------------------|---------------------|--------------------------------------------------|
| 1      | Sharma et al. (2020) | Economic uncertainty, political uncertainty, cultural uncertainty, technological uncertainty, behavioral uncertainty, demand uncertainty, disruptions in supply chain | Focus on an extensive review of international business literature to find the key uncertainties, their antecedents, and outcomes | The study especially highlights the “discontinuous uncertainty” representing the COVID-19 associated uncertainty, thereby suggesting relevant uncertainty management strategies. |
| 2      | Shiu et al. (2011) | Knowledge uncertainty, choice uncertainty, evaluation uncertainty | Focus on understanding uncertainty through a multidimensional lens and offering a new theoretical model within consumer behavior | The theoretical framework of the study proposes a certain dimension (knowledge uncertainty, ambiguity, and credibility) that rightly fits into COVID-19 circumstances. |
| 3      | Karlsen and Kruke (2018) | Uncertainty related to the source of the problem, uncertainty related to the problem evolution, uncertainty about the possible solutions to the problem, increasing fear and stigma in society | Focus on understanding the impact of uncertainty as an enabler of “non-decision-making,” especially on actions that could have slowed the rate of pandemic escalation | It mainly discusses how pandemic-led uncertainty is socially constructed. Although it talks about the Ebola virus, it is equally applicable here because of its high similarity with COVID-19. |

(Continued)
| S. no. | Study reference | Key uncertainty identified in the study | Main focus of study | COVID-19 issues discussed or implied in the study |
|-------|-----------------|----------------------------------------|---------------------|--------------------------------------------------|
| 4     | Quintal, Lee, and Soutar (2010) | Financial uncertainty, physical uncertainty, uncertainty about performance, psychological uncertainty, uncertainty of leisure in life, uncertainty of travel and loss of emotional support | Focus on observing the influence of perceived uncertainty and risk on consumers’ decision-making using theory of planned behavior | It talks explicitly about “uncertainty avoidance” (which measures the extent to which people get scared by unknown situations) that has a direct implication for the COVID-19 uncertainty study. |
| 5     | Brashers (2001) | Uncertainty about self or other’s communication skills, uncertainty about affective state of individual, uncertainties about own beliefs, behavior, and values, revival uncertainty (experienced in chronic illness), micro-interactional uncertainty, temporal uncertainty, and the social uncertainty | Focus on understanding the uncertainty and the underlying communication processes, thereby explaining the overall uncertainty management | It primarily discusses issues (uncertainty experience, emotion in uncertainty management, and the psychological response to uncertainty), which has implications for COVID-19 uncertainty studies. |
| 6     | Usher, Durkin, and Bhullar (2020) | Intolerance of uncertainty, increasing fear, decreasing sense of meaning or purpose in life, feeling of loss of | Focus on evaluating the pandemic-led uncertainties/panic (adopting the psychosocial viewpoint) and | It elaborates upon the several forms of psychosocial uncertainties emerged due to pandemic (COVID-19) and |

(Continued)
wellbeing. Under such circumstances, if patients receive appropriate support from healthcare interactions, they may experience a lesser disruption in wellbeing (Arora, 2003). Here, supportive healthcare interactions could be reflected through key activities like active listening of the patient, estimating patient’s information curiosity, empowering patients through shared decision making, offering emotional support to patients and his family, offering psychosocial support postconsultation, offering spiritual support in critical stage, enhancing esthetics in the hospital setting, and creating an environment of trust based on interpersonal relationships. All this reflects that service providers can add value to the patient’s efforts toward their wellbeing (Sweeney, Danaher, & McColl-Kennedy, 2015). Healthy service interactions can result in wellbeing cocreation, and this is also evident in the emerging literature on transformative service research (Kuppelwieser & Finsterwalder, 2016). Unfortunately, cocreation’s fundamental dynamics get disturbed during the pandemic as it directly hurts the healthcare service interactions. It implies
that there is a two-way attack on the patient. One is the increase in their anxiety level or perceived uncertainty, and second is the decline in the quality of healthcare interactions.

6.5.1 Impact of pandemic-led uncertainty on a patient’s mind

During a pandemic situation, healthcare consumers often experience a state of knowledge uncertainty because of the rumors or contradictory information in the environment. Pandemic imbibes a feeling of insecurity, anxiety, fear, and culpability (Rubin & Wessely, 2020; Usher et al., 2020). Gopalan and Misra (2020) reported deteriorated social relationships and a lack of emotional support due to the pandemic. Wagner-Egger et al. (2011) asserted that during a pandemic, not only just individuals but also the collectives (like whole nation or society) are worse affected. They explore the lay perception of collectives during pandemic (H1N1 outbreak) and frame them as heroes (doctor and researchers), victims (less developed societies), and villains (pharmaceutical firms and media). Adding further, studies assert that pandemic may influence normal patients and patients suffering from chronic noncommunicable diseases (NCDs). Actually, during a pandemic, NCD patients may develop an inactive or sedentary lifestyle (because of lockdown), resulting in their poor physical and mental health.

6.5.2 Impact of pandemic-led uncertainty on service interactions

It is evident in studies that crucial service providers, that is, doctors, may show an unwillingness to continue their work probably due to concern for their family members’ health or own health (Ives et al., 2009). Due to government obligation in many countries, several doctors could not discontinue their work despite having a low willingness to treat their patients. This affects their engagement level and quality of services offered by them. Few healthcare professionals, especially nursing staff or paramedical persons, often show unwillingness for work due to nonpersonal reasons like transport problems or lack of trust in management (Ives et al., 2009). Another issue in a pandemic is the lack of social support in healthcare service consumption. Due to fear of a pandemic, patient’s relatives or friends may not accompany them while visiting the healthcare facility. Thus consumers may lose a critical resource required for the service encounter, that is, a social resource (Lee, Ozanne, & Hill, 1999). This directly affects consumer VCC, as social support is one of the critical antecedents for healthcare VCC (Hau, 2019). Adding to this list of uncertainty in the pandemic, another issue is the lack of reciprocity or governance support to the healthcare system, directly affecting doctors and staff. Whenever doctors and patients perceive low reciprocity (in terms of exchanging information by government bodies, financial, and legal support), they may feel less enthusiastic in their participation in
cocreation activities. This affects their participation at different healthcare ecosystem levels and thus indirectly hurt each other’s wellbeing. This also represents a link between macro, meso, and micro levels of cocreation between actors in the healthcare ecosystem (Frow, McColl-Kennedy, & Payne, 2016). Lastly, pandemic often hurts interpersonal trust and consumer ethical perceptions. Both trust and ethics are an essential element of the successful service encounter. Healthcare studies confirm that trust plays an essential role in the doctor—patient service relationship. Patients who perceive high interpersonal trust in healthcare interactions often experience high responsiveness and better quality of services. This interpersonal trust is accessed based on honesty, fairness, and communication (Topp & Chipukuma, 2016). However, there is a significant decline in consumer trust during a pandemic, both institutional and interpersonal (Esaiasson, Sohlberg, Ghersetti, & Johansson, 2020). Thus, it is implied that during a pandemic, the patient may feel more skeptical or doubt the doctor’s communication, honesty, and fairness while interacting for cocreation.

### 6.6 The emerging role of Artificial Intelligence

AI could be understood as machines performing human-like functions and trying to imitate human intelligence in the simplest form. AI has already served society in multiple fields like education, defense, agriculture, manufacturing, finance, and healthcare (Dwivedi et al., 2019). It has emerged rapidly in the last decade, solving complexities in our day-to-day activities. Looking deeper into AI and consumer services, it is evident that AI is embedded in today’s service encounters and plays a positive role in consumer service consumption. Here, service encounters could be understood as direct contact (preferably face to face) between the customer and the service provider. Within this encounter, AI plays a vital role at different touch points like assisting frontline service personnel (back office), emerged as a tool to interact with customers (robot in services), and directly offering service to customers (self-service technology). Such roles are labeled as AI supporter, AI-augmented, and AI performer (Ostrom, Fotheringham, & Bitner, 2019).

Understanding with an example, like Chatbot (a popular form of AI), has a remarkable capacity to solve customer service issues and also update itself (means self-learn) based on its experience of solving similar issues (Xu et al., 2020). It is possible due to advanced deep learning and NLP trait of AI (Kaplan & Haenlein, 2019). Elaborating more about AI’s role in services, Huang and Rust (2018) present an ordered development of AI based on human traits required for effective services. It mainly proposes four types of intelligence that AI has developed over time, that is, mechanical intelligence, analytical intelligence, intuitive intelligence, and empathetic intelligence.

Discussing within healthcare, AI is crucial for patient disease diagnosis, electronic health records (EHR), health insurance claim, patient self-service
technology, clinical trials, drug compliance, postsurgery recovery, palliative care, patient empowerment practices, and significant physician—patient interaction (Combi, 2017; Kahn, 2017; Khanna, Sattar, & Hansen, 2013; Thesmar et al., 2019; Zandi, Reis, Vayena, & Goodman, 2019). Apart from the above-discussed importance of AI in standard time, AI’s role is highly influential and fruitful during a pandemic. Talking specifically about COVID-19, Nguyen (2020) explores in detail how AI is playing a vital role in the fight against the pandemic and its additional potential that can be harnessed in the future. On the same line, Mahomed (2020) explores how AI can empower the healthcare system during pandemic. Exploring deeper, it is observed that scientists are using emerging AI techniques for combating COVID-19 (Vafea et al., 2020). For example, machine learning models are designed based on genomic signatures to identify the COVID-19 viral sequence; use of “Stereographic Brownian Diffusion Epidemiology Model” for analyzing the spread of the virus; using “Unmanned Aerial Vehicles” for thermal scanning; 3D printing for producing ventilator splitters; “Deep Convolutional Neural Network” for medical imaging and diagnosis; and “Hybrid Wavelet-autoregressive integrated moving average model” for early forecasting of COVID-19 cases (Lalmuanawma, Hussain, and Chhakchhuak, 2020; Vafea et al., 2020). Recently, related researches (focusing on the emerging role of advanced mathematical modeling, big data mining, and emerging AI against COVID-19) have initiated within developing countries (like India and South Africa) as well (Bhatnagar et al., 2020; Kumari et al., 2020; Priyanka Harjule, Agarwal, & Poonia, 2020; Singh et al., 2020).

6.7 AI combating uncertainty and supporting value cocreation in healthcare interactions

We first discuss how AI can be used for combating uncertainty in cocreative service interactions evolved due to the pandemic. As already discussed earlier, a pandemic can affect healthcare services in multiple ways like doctor’s unwillingness to treat their patients due to concern for their own safety, low level of service provider’s engagement in services, emerging lack of interpersonal trust, lack of social support, or low level of social resource within service encounters due to stigma, lack of reciprocity, poor governance support, negative ethical perceptions, low level of perceived honesty, perceived fairness and perceived communication ability.

We will first look into these aspects and try to find theoretically (based on literature) if AI can resolve them directly or indirectly:

- AI can partially resolve the issue of doctor’s unwillingness to treat their patients. AI-based self-diagnostic tools and medical decision support systems can facilitate the virtual encounter between doctor and patient, reducing physical touch length in service encounters. Thus the risk posed
to a healthcare professional is reduced (Reddy, Fox, & Purohit, 2019). This reduced risk may result in the reduced unwillingness of doctors to treat their patients during a pandemic.

- Regarding the low level of provider engagement in service offerings, AI can work indirectly in this context. Organizations can measure their employees’ social media activities using predictive analytics, which helps monitor their overall engagement level (King, Tonidandel, Cortina, & Fink, 2015). This monitoring helps in managing employee engagement in the workplace. This employee engagement can foster customer engagement in services. Thus AI may indirectly influence the engagement level of service employees and customers as well.

- Lack of interpersonal trust in services is another essential concern that emerged during the pandemic. AI can partially resolve this issue as consumers report a high level of cognitive trust within a virtual environment, that is, while interacting with AI-based Chatbots (Kanawattanachai & Yoo, 2002). Cognitive trust is based on the rational judgment of the actor’s competence and knowledge (Butler, 1991), which is generally very high among virtual actors than the real actor. In addition, this effect (high perceived cognitive trust in virtual context) is often amplified. Most companies do not even disclose to their customers that they are talking to a virtual actor. Although on the other hand, there exists a doubt on “affective trust” experienced by consumers in online service interactions. However, recently advanced AI tools like “Avatars,” often equipped with empathetic intelligence, signal the prospect of “affective trust development” within virtual service encounters (Bente, Rüggenberg, Krämer, & Eschenburg, 2008).

- Another critical issue is the lack of social support because of stigma evolved during the pandemic. This is tackled up to a certain extent through AI-based interactive platforms that provide informational and social support to consumers (Coulson, 2005; Pfeil & Zaphiris, 2009). Even the healthcare communities act as a social resource for healthcare consumers where other patients and extended network share information and their own healthcare experiences (Nambisan, 2011).

- Lack of reciprocity is always a problem in healthcare due to information asymmetry. AI faces difficulty in solving this problem, as consumers often doubt the service interaction with Chatbots. However, if AI is planned effectively, for example, if a Chatbot discloses important information about itself, then there is a high probability that the consumer will also disclose his key facts with the machine and reciprocate positively (Chattaraman, Kwon, Gilbert, & Ross, 2019; Nambisan, 2011).

- Negative ethical perceptions imbibed in the mind of consumers are also a key concern within service interactions. Although AI still seems inexpert to resolve this issue. AI is itself encapsulated with ethical concerns like consumer’s concern for data privacy and conflict of interest (Dignum,
Focusing on this line, Fukawa and Erevelles (2014) explore the role of service provider’s morals in service delivery’s perceived reasonableness. However, establishing this moral or ethical norm within service provision is a challenging task (Ruane & Nallur, 2020).

Apart from AI playing a crucial role in combating uncertainty (because of the pandemic), it is also supporting VCC in healthcare services. This is reflected in Kaartemo and Helkkula (2018), which reviews the role of AI and robots in VCC. The researchers categorize the AI literature into four themes: generic field advancement, supporting service providers, enabling resource integration between service providers and beneficiaries, and supporting beneficiaries’ wellbeing. Van Doorn et al. (2017) and Fan, Wu, Laurie, and Mattila (2016) explicitly mention that AI can assist the actors in integrating the resources during VCC. To better understand in context to healthcare, let us take an example: suppose some person meets with an accident and reaches the trauma center. In this case the patient’s close one (care person) provides information about how the damage happened and his prior medical condition. This information (which is an essential resource for cocreation) is used for the early diagnosis and deciding the line of treatment. However, there is a high probability of this information being wrongly integrated. This is where AI can help. Using brain—computer interfaces, it is possible to decode patients’ neural activities, and information can be obtained from the direct source, that is, patient (Bresnick, 2018). Moving on the same line, Čaić et al. (2018) recently explore the different ways AI (significantly socially assisted robots) can assist the vulnerable healthcare consumers (old age patients). Čaić et al. (2018) mainly identify three crucial ways, that is, providing security, social support, and cognitive support to old age patients. VCC literature within healthcare (Sweeney et al., 2015; Chen et al., 2020) asserts that knowledge and skills are the critical operant resources required for effective cocreation. AI directly affects both of these resources, like advanced mobile applications can enhance actor’s healthcare knowledge (e.g., drug compliance knowledge) and skills (self-diagnosis skills) as evident in the literature (Barrett et al., 2019; Davey & Grönroos, 2019). The healthcare services interaction occurs at multiple levels, such as individual, dyadic, and an ecosystem (Sweeney et al., 2015). This essential prerequisite of cocreation is the interaction among involved actors, which is directly influenced by the level of AI used in healthcare services (Lee, 2019). AI-based technical devices or advanced applications can trigger the patient’s interaction with essential healthcare services (Hoyer, Chandy, Dorotic, Krafft, & Singh, 2010; Lee, 2019). After the interaction, patients’ engagement level directly affects their cocreation with the healthcare service providers (Hardyman, Daunt, & Kitchener, 2015). AI-based self-care tools (like wrist bands measuring calories, respirometer to keep daily records of asthma condition) provoke healthcare consumers to take part in their wellbeing actively.
and subsequently enhance the patient engagement (Davenport & Kalakota, 2019; Triberti & Barello, 2016). Finally, the patient experience directly affects their cocreation level and overall wellbeing outcome, as evident in the literature (Hardyman et al., 2015; Osei-Frimpong et al., 2015). In the same line, Daouk-Öyry, Alameddine, Hassan, Laham, and Soubra (2018) identify three essential pillars of patient experience, that is, employees, processes, and setting. All these components (employees, processes, and settings) are seen positively influenced by AI applications looking in AI literature. For example, the customized message (sent by AI-based Chatbots) received by the patient directly in his/her mobile phone enhances their medical care experience. The EHR shared across caregivers enhances the communication quality within service encounters, ultimately improving the patient perception of interpersonal relationships and perceived quality of care (Werder, 2015). All the above discussion shows how the varied forms of AI support healthcare VCC.

6.8 The spill-over effect of Artificial Intelligence

Based on the above discussions, it is clear that AI plays an augmented role in healthcare services, especially during a pandemic. However, there is another side of the picture as well. AI can result in negative outcomes and hinder the effective cocreation of value. This is reflected in recent studies that talk about AI and value codestruction (Čaić et al., 2018; Canhoto & Clear, 2020; Castillo, Canhoto, & Said, 2020; Neuhofer, 2016; Smith, 2013). Plé (2016) itself has elaborated on the reasons for value codestruction in a service setting, who is the pioneer of value codestruction (Plé & Chumpitaz Cáceres, 2010). Laud et al. (2019) explain the process of resource misintegration to elucidate the codestruction process in services. Laud et al. (2019) mention that customers may experience a resource loss or can unintentionally act as resource disintegrator. Interestingly, Castillo et al. (2020) observe a similar phenomenon of resource deficiency/resource loss and resource misintegration in AI-empowered service interactions. For example, the author noted that whenever the customer doubts the interaction (like if he doubts if he is talking to Chatbot or human), he may feel deceptive, resulting in deceptive integration of resources. Similarly, whenever the customer talks to Chatbot, he may feel unnecessary to be expressive in communication. The machine is smart and can automatically understand the issue, resulting in an unwillingness to integrate the resources (Castillo et al., 2020). Talking particularly in healthcare, Čaić et al. (2018) noted in their study that elderly patients often develop a feeling of “giving up” or “losing control” in their treatment because of the use of the socially assisted robot in their home. The author terms this as the “deactivator role of AI,” that is, AI deactivates the focal actor (patient) by reducing their engagement. The same study also mentions another negative aspect of AI at an individual level, that is, “AI acting
as an intruder.” Here, intruder means a machine trying to invade the patient’s privacy by continuous monitoring. This results in the skeptical response of elderly patients by contributing to a low level of personal resources for VCC (Čaić et al., 2018).

During the pandemic time, the issues with AI (as discussed above like consumer privacy issue, reducing consumer engagement, consumer loss of resources, actor’s unwillingness to integrate the resources, deceptive integration of resources) could be amplified as reflected in AI studies (Hu et al., 2020; Naudé, 2020). The consumer often looks for more trust, ethics, personal identity, privacy, social support, human touch, and individual value protection in service interactions (Holt, 2020). However, AI may not seem to play a fair role in each of these aspects. Therefore, we will look into these aspects and try to find if AI can offer it:

- **Trust:** Miller (2019) argued that AI machines are mostly designed by researchers to interact in an ideal manner. However, the human being does not behave ideally; there is always some bias and social expectation attached to human behavior. This is the reason that AI fails to generate trust among consumers during service interactions (Miller, 2019).
- **Ethics:** Criticizing further recently, Carter et al. (2020) argue that AI, although claimed to be neutral, actually encodes values inevitably, which are generally very difficult to discern. One such example is ethical bias developed by AI machines by automatically learning the pattern from the dataset. It means if the particular section of a patient community like transgender cancer cases is underrepresented within AI datasets, then AI systems will automatically start producing biased outputs (less diagnosis of breast cancer cases for transgender patients) for the same patients (Carter et al., 2020).
- **Personal identity:** Buchanan-Oliver and Cruz (2011), while relating technology with liminality, claim that consumer’s understanding of machine depends upon his understanding of himself and the increased use of technology (like technology as a prosthesis) can threaten the personal identity of “consumer as human” and ignite the fearful reactions in consumers.
- **Privacy:** Talking about the pitfalls of AI during COVID-19, Naudé (2020) recently argued that AI could hamper citizen’s privacy as governments can continue this extraordinary surveillance of their citizens even after the pandemic.
- **Social support:** Emphasizing the importance of social support within healthcare services, researchers assert that AI can support medical services but cannot replace the social support offered by service providers, that is, doctors, nurses, and other paramedical staff (Vuorimies, Rosenius, Nirkkonen, Haakana, & Kuittinen, 2019).
- **Individual actor’s value:** Vuorimies et al. (2019) claim that AI can hurt the healthcare service provider’s value, that is, the value of autonomy.
Generally, doctors love to rely on their intuition and skills to diagnose the disease. If they feel like their freedom to use this skill is threatened due to AI, they may negatively react toward AI, which directly affects patient wellbeing.

- Human touch/support: It is recognized that although AI can resolve many issues during a pandemic (like offering contactless services through robots, faster medical diagnosis etc), but may also negatively affect the dynamics of human touch or empathy which is required for the mental wellbeing of recovering patients (Figueroa & Aguilera, 2020). Although the government has made different mental healthcare apps offering emotional support to patients, but its not effective because the vulnerable patients (old age patients) are not competent enough to use the smartphone apps (Figueroa & Aguilera, 2020).

### 6.9 Conclusion and future work

Overall this study made progress in highlighting the emerging role of AI (both positive and negative) in healthcare service interactions. While elaborating this service interaction, it focuses on the VCC process rooted in SDL. The study uses the context of the pandemic environment and pinpoints several uncertainties faced by healthcare services. The study elucidates the key uncertainties that could be managed by AI tools and result in the wellbeing of actors. In parallel, it also highlights the challenges that could not be solved effectively or entirely by the present AI tools. Although the study does not claim AI to be technically inferior, it only comments on its usage/perception/effect on the consumer using the social science approach. The study contributes knowledge to existing work by exploring the role of AI in cocreative healthcare interactions, especially during a pandemic. In addition, it highlights the spill-over effect of AI while consuming services. It mentions several ways AI-empowered interactions can fail to cope with the evolving uncertainty during COVID-19. However, the study focuses on COVID-19 but is equally applicable to any other pandemic or natural disaster. Studies also indicate a good number of ways; the present AI-based technology helps the healthcare service system cope with uncertainty during the pandemic. It can act as a guiding tool for policymakers and healthcare industrialists associated with planning or implementing AI usage (within healthcare) during a pandemic.

This study is restricted to the healthcare sector, but similar work could be explored in the education sector as both areas share a common trait, that is, credence nature of services. This study has used AI as a broader concept; future work could be focused on specific AI tools like robots or Chatbot. This work is purely conceptual. Future work could be planned to test the empirical relationships (like the relation between AI-based trust and cocreation intention, the relation between perceived uncertainty and AI-originated trust).
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