Role of artificial intelligence and robotics to foster the touchless travel during a pandemic: a review and research agenda

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Abstract

Purpose – The hospitality industry experienced an unanticipated challenge from the COVID-19 pandemic. However, research in this area is scarce. Accordingly, this study aims to unfold a three-angled research agenda to intensify the knowledge advancement in the hospitality sector. It proposes a theoretical framework by extending the protection motivation theory (PMT) to explain the guest's intent to adopt artificial intelligence (AI) and robotics as a protective measure in reaction to COVID-19.

Design/methodology/approach – The research is centered on outlining the pertinent literature on hospitality management practices and the guest's transformed behavior during the current crisis. This study intends to identify a research agenda based on investigating hospitality service trends in today's changing times.

Findings – The study sets out a research agenda that includes three dimensions as follows: AI and robotics, cleanliness and sanitation and health care and wellness. This study's findings suggest that AI and robotics may bring out definite research directions at the connection of health crisis and hospitality management, taking into account the COVID-19 crisis.

Practical implications – The suggested research areas are anticipated to propel the knowledge base and help the hospitality industry retrieve the COVID-19 crisis through digital transformation. AI and robotics are at the cusp of invaluable advancement that can revive the hotels while re-establish guests' confidence in safe hotel practices. The proposed research areas are likely to impart pragmatic lessons to the hospitality industry to fight against disruptive situations.

Originality/value – This study stands out to be pioneer research that incorporated AI and robotics to expand the PMT and highlights how behavioral choices during emergencies can bring technological revolution.

Keywords Hospitality, Artificial intelligence and robotics, COVID-19 pandemic, Cleanliness and sanitation, Health care and wellness

Paper type Research paper

1. Introduction

The COVID-19 crisis has compelled the implementation of travel policies that have badly affected the global economy, significantly impacting the fields of travel, tourism and hospitality (Pillai *et al.*, 2021). According to the World Economic Forum (2020)

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(COVID Action Platform), nearly 100 million tourism and hospitality jobs are in jeopardy due to the pandemic's effects. These sectors are fighting to survive, let alone thrive. Travel and tourism have a symbiotic relationship with the hotel industry, and therefore, the collapse of traveling on the outbreak of COVID-19 hindered the tourism and hospitality-related businesses. Hotels are particularly susceptible to decreased tourism and travel in parallel with the decline in economic affairs (Shin and Kang, 2020). As events worldwide dropped or were delayed, hotel bookings plunged, giving the hoteliers a tough time. For instance, revenue at Marriot hotels dropped by almost 90% in Greater China in February 2020 and 25% in different Asia Pacific regions (Jiang and Wen, 2020). It is anticipated that revenue in the US, Europe and Asia will further continue to drop as holiday and business trips are mainly postponed or dropped (Jiang and Wen, 2020).

Generally, COVID-19 follows unforeseen and undesirable events, giving significantly less time to organize. This unprecedented crisis also implies a shortage of time for planning and the customary response strategies are deficient (Sharma *et al.*, 2020). Previous hospitality and tourism research studies on a crisis such as severe acute respiratory syndrome (SARS), Ebola and Influenza pandemics (Novelli *et al.*, 2018), provide comparable patterns to COVID-19 but on a very small scale. Although tourist behavior articles help analyze the current development, the safety perceptions of the guests and tourists during the crisis are not studied extensively (Zenker and Kock, 2020). Hygiene and cleanliness play a significant role in hotel operations after the previous health crisis. These have become more important after the SARS 2003 health crisis (Kim *et al.*, 2005). However, the severity of COVID-19 has changed people's perceptions. Many people are unwilling to travel for leisure and avoid staying at hotels (Gursoy and Chi, 2020). Moreover, people's lifestyle change due to fear motivates them to be involved in health and wellness programs (Majeed and Ramkissoon, 2020). To recover from the pandemic, hospitality businesses need to bring significant changes in their operations. This involves the guests' health and safety, which can amplify guests' inclination to return to hotels (Gössling *et al.*, 2020). COVID-19 is probably going to affect the research agenda on hospitality and management research substantially. With these exceptional threats suffered by the hospitality and tourism sector during COVID-19, researchers are required to formulate effective solutions to recover from the crisis.

Crises can give birth to high-tech innovations. Therefore, in this current COVID-19 turmoil, the hotel sector should consider the possible advantages of artificial intelligence (AI) and its applications such as robotics in the industry setting (Zeng *et al.*, 2020). Previously, hospitality scholars have been examining the applicability of various automation and advancements in service delivery for many years; however, most of those examinations have concentrated on adopting poor technology (Gursoy and Chi, 2020). The new developments in AI and service robots have led to the embracing AI-driven technology in service delivery (Belanche *et al.*, 2020a). This pandemic can instigate the importance of this innovation for public well-being reasons. Therefore, it is significant to figure out what will make the guests return, which requires immense research efforts. This discussion puts across the following gaps:

- The outbreak of COVID-19 brought enormous challenges for the hospitality and tourism industry. However, research on what measures can drive back the guests to the hospitality businesses is scarce.
- There are poor customary response strategies on the outbreak of COVID-19.

- Cleanliness and health well-being are critical to hospitality and tourism operations. However, literature in this area is limited in number.
- Technology integration into hospitality operations such as AI and robotics during the current crisis is under-researched and requires extensive investigation.

In view of the literature on the impact of an earlier health crisis such as SARS in 2003 and the current crisis faced by the hoteliers caused by the outbreak of COVID-19, along with these identified gaps, the current article presents particular areas to present a meaningful vision to the academicians and practitioners to explore hotel management practices post COVID-19. The present research focuses on AI and robotics as a critical theme for the hospitality industry. It highlights the protective measures about the technological advancements in response to the COVID-19 health threats and details the necessity to adopt AI and robotics. While projecting the hotel industry's revival after Covid-19, health and cleanliness should be the prime focus. Therefore, there is a need to examine how hotel service providers can team up with AI-driven robotics to enhance cleanliness and hygiene goals. The hospitality industry is now expected to make significant changes in its operations to ensure hotel guests' and employees' health and safety and reinforce customers' willingness to patronize the operations (Gössling *et al.*, 2020). This pandemic is likely to have an unprecedented challenge for the hospitality industry, and scholars and experts are anticipated to develop solutions for the industry.

Considering the above aspects, the article discusses the possible effect of COVID-19 on the hospitality sector and undertakes two objectives. (*RQ1*) How the research intent provided from three dimensions, namely, (AI and robotics), (cleanliness and sanitation) and (health care and wellness) will foster research and knowledge development in the hospitality sector? (*RQ2*) How will the proposed theoretical framework aid the guest's intent to adopt AI and robotics as a protective measure for service delivery, in response to the COVID-19 pandemic? The rest of the article is systematized as follows: Section 2 details the review of the literature. Section 3 comprises the methodology followed by the results depicted in Section 4. Section 5 presents the future research agenda. Section 6 includes the conclusions, theoretical and practical implications and limitations and future research.

2. Review of literature

2.1 Review of global hospitality industry and disruptions

The hospitality and tourism industry is susceptible to threats and global crises. COVID-19 has all the earmarks of being another worldwide disaster such as the 1918 Spanish influenza, particularly in the hospitality and tourism industry (Foroudi *et al.*, 2020). A similar scenario appeared in 2003 due to the outbreak of SARS that caused a massive decline in gross domestic product amounting to $20bn in China, Singapore, Hong Kong, Vietnam and the Far East, witnessing a drop of 70% in tourism flow (McKercher and Chon, 2004). The present state of this pandemic is full of uncertainties, and its effects are much more severe than the previous pandemics (Gössling *et al.*, 2020). The fear and shock caused due to the pandemic have resulted in negative perception and ambiguity for hospitality and tourism destinations (Foroudi *et al.*, 2020). During the Ebola 2014 epidemic, hospitality and tourism were severely affected due to travel restrictions. People were not ready to travel to Africa's regions free from infection (Mizrachi and Fuchs, 2016). Therefore, during the global disaster and worldwide travel restrictions and quarantine, the hospitality industry experiences severe implications.

As the hotel industry is susceptible to risks caused due to unforeseen blows such as terrorist attacks, epidemics and natural disasters, hoteliers need to take measures to deal with such a crisis. Table 1 lists some of the hoteliers' measures from different countries for facing the earlier crisis.

Table 1. Measures taken by the hoteliers during earlier crisis

Citation	Measures taken by the hoteliers during the earlier crisis
Chan and Lam (2013)	In Hong Kong, the hoteliers carried robust security by advancing the closed-circuit television systems and heightening security training for the staff post 9/11 attacks
Kim *et al.* (2005)	After the SARS crisis, the Korean hotel industry incorporated new cleanliness training regarding health education to their employees
Nguyen *et al.* (2017)	After the destruction brought about by the Great East Japan Earthquake and Tsunami in 2011, the hotels at the coastline in Japan offered shelter to the refugees

2.1.1 Review of previous theories on disruptions in hospitality and tourism literature. Theories from different fields have given insights into disaster and crisis management literature. From the tourism and hospitality literature, generally, researchers are inspired by management-related theories. For instance, Nguyen *et al.* (2017) applied the collaborative planning theory to examine the hotel stakeholder's perception and setbacks of collaboration. Few, socio-psychological theories in hospitality and tourism were also applied in the context of crisis and disaster. For example, Wang and Wu (2018) adopted the theory of planned behavior to develop an iceberg model that depicts the causes of implicit beliefs and psychological factors on crisis planning and provides actions focusing on cultural diversity.

Moreover, interdisciplinary theories are also previously implemented. Brown *et al.* (2017) formulated a disaster management framework of natural, human, physical, economic, social and cultural capital by applying the adaptive system theory. On the other hand, Ritchie (2008) adopted the chaos theory analyzing disaster management in tourism. The United Nations (2004) designed a framework for disaster risk reduction. Its key factors were knowledge development, early warning, risk factors, risk assessment and recovery measures, regardless of the models and frameworks mentioned above. A new framework is required because the existing frameworks are not aligned with the health-related disaster and do not incorporate technological advancements into the theories.

2.2 Theoretical foundation: Protection motivation theory

As many people worldwide are exposed to this deadly COVID-19 disease, comprehending this risk will be a motivating factor for the individuals to adapt their behavior toward a more protective and safer medium of stay at the hotels. Few health behavior models such as protection motivation theory (PMT) (Rogers, 1975) and the theory of planned behavior (Ajzen, 2011) presents frameworks for understanding behavioral choices during pandemics. However, theories such as the technology acceptance model, theory of planned behavior and Chaos theory are insufficient to gauge guests' behavioral change toward adopting AI and robotics when confronted with a health threat.

This paper adopts PMT as a theoretical foundation to develop a framework for the hospitality industry. The framework incorporates the components of PMT formed by Ronald Rogers in the year 1975 that describes how people get motivated to change in a self-protective way near a perceived health threat. As per PMT, the fear appeal would give rise to the cognitive mediating process, which will trigger the protection motivation. Severity, vulnerability, response effectiveness and self-efficacy can give rise to fear appeal among hotel

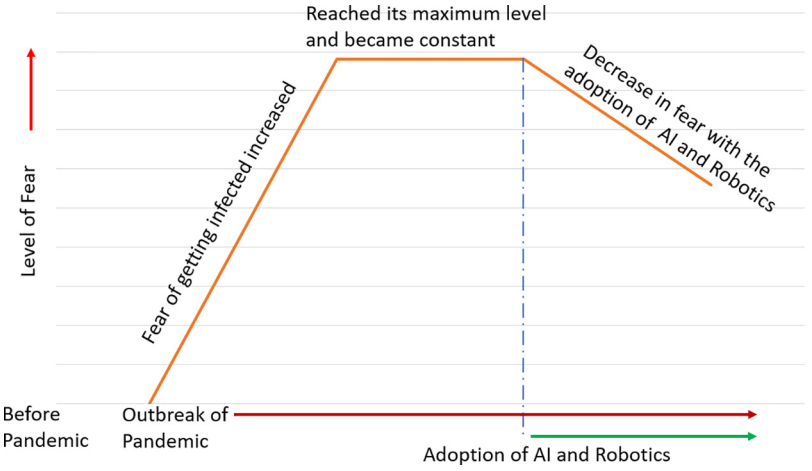

Figure 1.
Graph depicting the level of fear among the hotel guests

guests, leading to adopt technologies such as AI and robotics as a protective response to fight against the global pandemic. The fear appeal persuades the individuals to adopt techniques that can minimize the human touch. Touchless options such as a contactless fingerprint, face recognition, contactless data entry can reduce the chances of spreading the virus (Park, 2020). Figure 1 depicts the level of fear among individuals due to the outbreak of COVID-19.

2.3 Digital areas of transformation in the hospitality industry

To begin with, the ongoing situation of the COVID-19 pandemic has given a lot of scope to scholars to intensify their knowledge toward AI and robotics and augment the literature in this area (Dwivedi *et al.*, 2021; Huang and Rust, 2020). As COVID-19 is profoundly infectious (Chan *et al.*, 2020), it is vital to follow physical distancing. Therefore, this is the right time for hoteliers to fasten the adoption of AI and robotics into the hospitality industry. Throughout the world, the hotel service scenario is taking a shift toward AI and robotics (Huang and Rust, 2020). Gradually hospitality firms have started introducing robots for providing frontline services to their guests (Belanche *et al.*, 2020b). These frontline robots will enhance service experience and reduce the hospitality firms' operational costs (Belanche *et al.*, 2020c).

AI is bringing revolution for the businesses by impacting trade and management practices in different sectors that provide growingly sustainable and competitive products and services (Di Vaio *et al.*, 2020b). Previous studies have discussed the role of AI and robotics in hotels from varied points. For instance, Kuo *et al.* (2017) stated that service automation with service robots' could boost hotel competitiveness. These service robots are viewed as future workers in hotels who can assist the hotel staff. For example, in Japan, Henn-na Hotel, which is recognized as the first robot-working hotel by Guinness World Records, uses robots instead of human staff at the front desk, housekeeping, butler and room services (Choi *et al.*, 2020). Table 2 highlights the benefits of adopting AI and robotics in the hospitality industry stated by different authors.

Second, the significance of cleanliness has significantly increased after the COVID-19 pandemic, as this disease can widely spread by contacting the surfaces defiled with the virus (WHO, 2020). Considering this, few branded hotels such as Marriott, Hyatt and Hilton have already adopted technology for minimizing interactions between the guests and the employees. They have introduced a robot cleaning system, mobile check-in facilities and

Table 2.
Role of AI and robotics in service automation in hotels

Citation	Role	Benefits
de Kervenoael *et al.* (2020)	Novelty can trigger sales	The novelty of seeing robots delivering food and drinks can trigger excitement which may lead to more room service orders
	Image of an innovative company	A positive word of mouth can be generated for the company by using hi-tech technology for serving the customers
Ivanov and Webster (2019)	Enhancing the employees	Robots can act as technological extensions and tools for the employees and can perform repetitive jobs
Huang and Rust (2020)	Enhancing service quality	It can enhance the service delivery process through new interactive and appealing service delivery methods and engaging and communicating with the customers
Kuo *et al.* (2017)	Saves employees time from performing repetitive tasks	Employees can focus on more inventive and revenue-generating exercises by saving time from performing tedious and repetitive tasks

kiosk check-in machines for the hotel guests. They have modified their cleaning and disinfection practices and upgraded to improved disinfection procedures such as electrostatic sprayers and ultraviolet-light technology (Sharma *et al.*, 2021). The cleanliness of rooms and restrooms in the hotels is a central aspect of a hotel's reputation. Numerous studies have considered cleanliness and hygiene a key determinants when choosing a hotel (Zemke *et al.*, 2015). However, the researchers never discussed the cleanliness of specific areas and corners in the hotel (Park *et al.*, 2019).

Therefore, our current study suggests that researchers need to move beyond the regular perspectives on the antecedents of hygiene and cleanliness in this sector. They need to deeply dig into the guests' view of cleaning and disinfection measures such as cleaning of key cards, television remotes, surfaces that receive frequent human contact possess a higher chance of getting contaminated through touch and can be a medium to transmit infectious diseases such as COVID-19 (Chen *et al.*, 2020). Third, COVID-19 brought massive changes in people's lifestyles concerning their health (Wang *et al.*, 2020). This increasing well-being and health trend can provide many opportunities to the hoteliers to attract customers by promoting intensely relaxing and wellness-focused programs such as balanced diet programs, preventive health-care programs, fasting and detoxing programs. These programs focus on holidays in wellness will reduce the stress and anxiety among the guests. As stated by Majeed and Ramkissoon (2020), in the future, the provision of wellness services will be essential because guest's priority will take a move toward health-related tourism post-COVID-19.

3. Methodology

Our methodology used a qualitative approach concentrating on the content of AI-driven technologies that provide contactless services, cleanliness and safety to hotel guests. As this topic is recent, the spectrum of research resources also included pertinent news articles and reports. The insights from the book by Hall (2012) assisted a lot in improving the structure of the article. Further, the review of the introduction, methods, results, and discussion format assisted in organizing the main ideas and critical elements in the article (Day, 1989). We only considered articles in the English language in journals having impact Factor 1 and above. The impact factor criteria were open for both options cite score and SCImago journal rank (SJR) of the journals. We performed a comprehensive literature search in the Google Scholar and Scopus databases. Choosing Scopus was mainly because of its extensive

coverage of management studies as a research field (Martín-Martín *et al.*, 2018). Google Scholar is a revolutionist in the information market and was preferred compared to the conventional databases, as it indexes data from the academic web.

To address the research questions, we referred to the preferred reporting items for systematic reviews and meta-analyses guidelines. Our database undertook a manual search on Google Scholar and Scopus, checking references of other pertinent academic journals. The initial search resulted in listing 800 records. Next, we removed the duplicate articles and were left with 782 records. After that, a formal screening process was carried. The inclusion criteria embodied all conceptual, empirical and qualitative articles that revolved around AI and robotics and health crises. This left us with 450 articles. We excluded all the articles that discussed the architecture and design of AI-driven technologies. Next, specifically, more articles were extracted from few journals as compared to others, as they are known to invite publications of empirical and theoretical nature on topics associated with AI, robotics, digital transformation, service automation, health/hygiene, epidemics in the hospitality, tourism and other service industry.

We then used various keywords differently, combined among them and following our research questions. Notably, we combined "conceptual frameworks" and "AI," "robotics" and "contactless services," "social distancing." Next, from time to time, these keywords were combined with other keywords, namely, "COVID-19," "wellness," "health care," "protection motivation," "cleanliness," "travel," "robots," "pandemic." The secondary sources, which did not have free access and posters, were also excluded from the database. Next, we spotted the relevant articles and analyzed all the documents. To remove the chances of bias, all authors independently read the title, abstracts and conclusion of the identified records. This led to the inclusion of only 149 records on the consensus of all the authors. Further, these records were thoroughly analyzed to focus on our research's integral aspects. The articles that were not enough relating to the research questions were secluded from the database with mutual agreement. All authors compared their results from the analysis and further wrote different sections of the article. The methods adopted in prior review and research agenda papers (Di Vaio *et al.*, 2020d) assisted in forming our methodology approach. Finally, we had 61 citations for the article. Figure 2 depicts the methodology approach.

4. Results

All included articles are from journals having impact factor 1 and above (cite score or SJR). The impact factor Table 3 summarizes the number of articles, chapters and reports cited in the current article.

As the articles are cited from different journals, the below-mentioned Figure 3 illustrates the journals' names and the number of articles cited from those journals.

To give a more descriptive presentation to the manuscript, details of the broad topics covered in different journals and insights about the topics covered in all articles are depicted in Table 4.

To generate a better picture of the included articles, a map depicting the co-occurrence of terms in the title and abstract is illustrated in Figure 4. The colorful nodes and the specific terms are associated with each other. The size of the nodes depicts the frequency of the term that has occurred. While the link between two nodes represents the co-occurrence of the terms. The figure illustrates that the frequently co-occurring terms create clusters and appear closer to the same color. A first look at this map of the co-occurrence terms shows the central cluster (grey color) with terms including AI, service robots, COVID-19, travel, health, hospitality, tourism, crisis and cleanliness.

4.1 Findings from the articles

The analysis of the articles has highlighted the massive change in guests' behaviors due to the outbreak of the pandemic. Scholars have evidenced that the downfall in the hotel

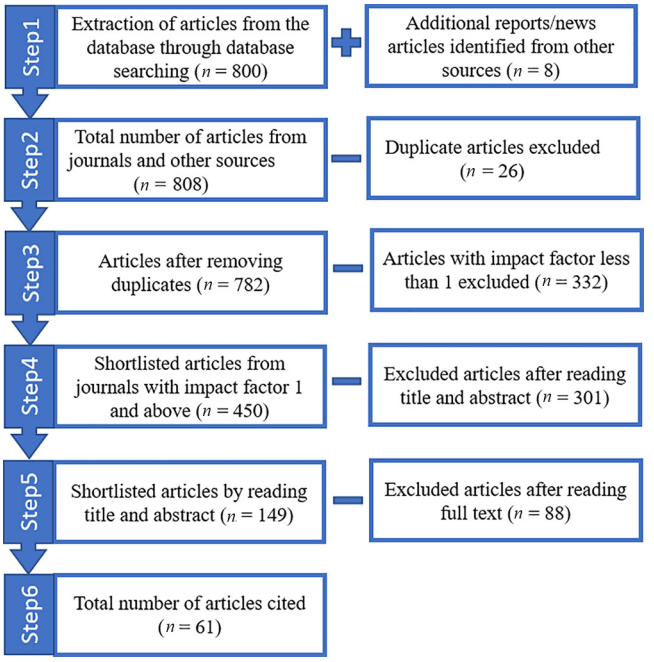

Figure 2.
Methodology Approach

Study type	Count
Papers with impact factor more than 1	55
Impact factor range	
1 to 2	5
2 to 3	9
3 to 4	3
4 to 5	19
5 to 6	9
7 to 8	5
More than 8	5
Chapters from books	2
News article	1
Reports	3
Total	61

Table 3.
Impact factor of journals

businesses and collapse of global tourism needs immediate attention. There is an urgent need for the hospitality and tourism sectors to devise recovery strategies. In total, 25 articles out of the total reviewed articles specifically emphasize the need to adopt AI and robotics in the hospitality and tourism sector in the future. The topics covered in the articles such as the trust in services of robots, new technological innovations in hotels, Robots for the rescue of guests during Covid, AI-driven technologies to reduce health risk among guests, etc. depict the inclination of the researchers toward the adoption of AI and robotics (Mariani and Perez Vega, 2020). As per some scholars, AI will also balance the unavailability of the human workforce during the Covid-19 crisis.

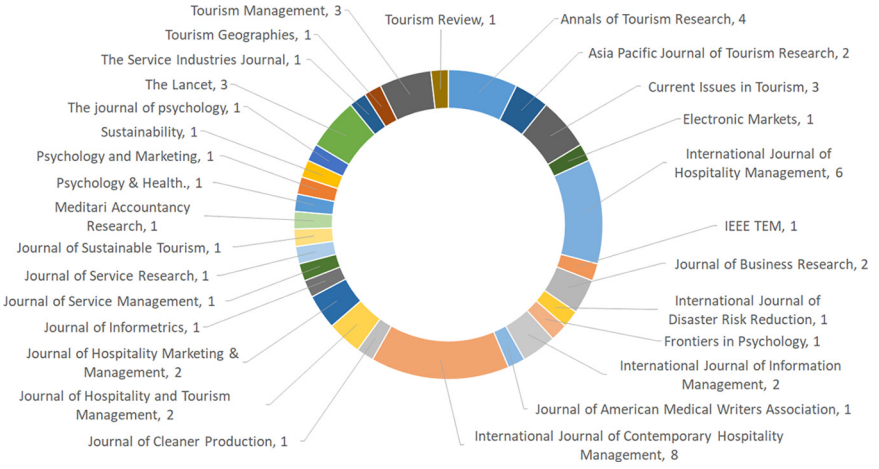

Figure 3.
Publication source of included articles

In addition, the findings of few articles on AI and robotics detail how the adoption of service robots in hospitality and tourism can reduce operational costs and enhance services. Therefore, the adoption of AI and robotics appears as a notable change for hospitality practitioners. Indeed, technological innovations can reduce health risks among guests. These findings show that technical measures can help minimize the transmission of COVID-19 and attract guests. For instance, few articles state that service robots can act as a technological shield between the hotel guests and employees, reducing the chances of infection (Seyitoğlu and Ivanov, 2020). Consequently, new strategies have to be adopted and redesigned around AI and robotics to deal with the effects of Covid-19. Scholars suggested the need to modify international strategies after this global crisis and insist on the relative importance of safety facilities at the hotels (Chen *et al.*, 2020).

Some scholars emphasized the importance of disaster planning and suggested the hospitality and tourism companies develop effective policies. Scholars have identified in the articles about the changed guest's perception and behavior on the outbreak of Covid-19. Some articles state the growing demand for health and wellness tourism. This article also contributes to the previous studies on epidemics and crisis management in the hospitality and tourism industry. The research supports the previous studies that state that crisis brings changes in customers' mindsets and inclines them toward the use of technology. Previous epidemic studies have suggested measures for preparedness during a crisis in the hospitality and tourism industry, but these methods lacked devoted technology. Thus, the current article extends the literature on pandemic preparedness in the hospitality and tourism sectors.

4.2 Comparative analysis of previous studies on the hospitality and tourism sector after the outbreak of COVID-19

During this face of COVID-19, various studies are conducted in the hospitality and tourism industry. The analysis of research into hospitality and tourism literature during the ongoing COVID-19 crisis can help identify the findings of all relevant articles on this sector. The results of various studies are as follows: Gössling *et al.* (2020) compared COVID-19 with earlier pandemics and global crises and stated how COVID-19 could change tourism practices in the future. Baum and Hai (2020) conducted a real-time assessment of the impact

Journal	The broad range of topics covered in the journals
Annals of Tourism Research	Business tourism, leisure and hospitality management
Asia Pacific Journal of Tourism Research	Technologies to planning and development, hospitality management, issues in tourism
Current Issues in Tourism	Disciplinary and interdisciplinary range of critical approaches available to the study of tourism
Electronic Markets	New forms of social change, electronic "market" issues, information technologies
Frontiers in Psychology	Cognition, comparative psychology, cultural psychology
IEEE Transactions on Engineering Management	Technological innovation, technology assessment
International Journal of Contemporary Hospitality Management	Operations, marketing, finance and personnel hospitality, hospitality management strategies
International Journal of Disaster Risk Reduction	Environmental and social sciences; technological and intentional disaster
International Journal of Hospitality Management	Human resources management; consumer; business forecasting and applied economics; technological developments
International Journal of Information Management	Business intelligence, knowledge management, information design and delivery, information for health care
Journal of American Medical Writers Association	Medical advertising, publication ethics, regulatory writing
Journal of Business Research	Buyer behavior, organizational theory, risk and insurance, international business
Journal of Cleaner Production	Environment and sustainability assessment, corporate sustainability
Journal of Hospitality and Tourism Management	Consumer behavior, HRM, guests experiences and expectations
Journal of Hospitality Marketing & Management	Hospitality marketing, branding, ethical concerns, reputation management
Journal of Informetrics	Topics in bibliometrics, scientometrics, webometrics
Journal of Service Management	Service strategy, excellence, and innovation
Journal of Service Research	Service marketing, global issues, and quality, E-service
Journal of Sustainable Tourism	Economic, social, cultural, political aspects of tourism
Meditari Accountancy Research	Social impacts of accounting, sustainability and risk management
Psychology & Health	Psychological and psychosocial attributes of physical illnesses
Psychology and Marketing	Psychological theories and techniques to marketing
Sustainability	Sustainable tourism, waste technology, disaster management
The Journal of psychology	Psychology of health and illness
The Lancet	Digital health, infectious diseases, public health
Tourism Management	Tourism regional tourism, ecotourism
Tourism Review	Business models, mobility in tourism, sustainable tourism
A broad overview of the topics covered in the articles reviewed	
The collapse of global tourism and hospitality businesses	
Technological innovations in the hospitality industry post COVID-19	
Disaster planning/crisis management	
Previous health crisis/epidemics	

Table 4.
Topics covered in journals and articles

(*continued*)

Journal	The broad range of topics covered in the journals
	Adoption of AI-driven technology
	Service robots in hospitality and tourism
	COVID-19 and changed guest and travel behavior
	Health, wellness and tourism
	Cleanliness in hotels
	AI and sustainability of hotels
	Hotel health-care practices
	Service robots and guest's experiences
	Protection motivation among travelers
	Employees and service automation
	Hospitality and tourism recovery strategies
	Internet of Things and big data analytics in hospitality, tourism and travel

Table 4.

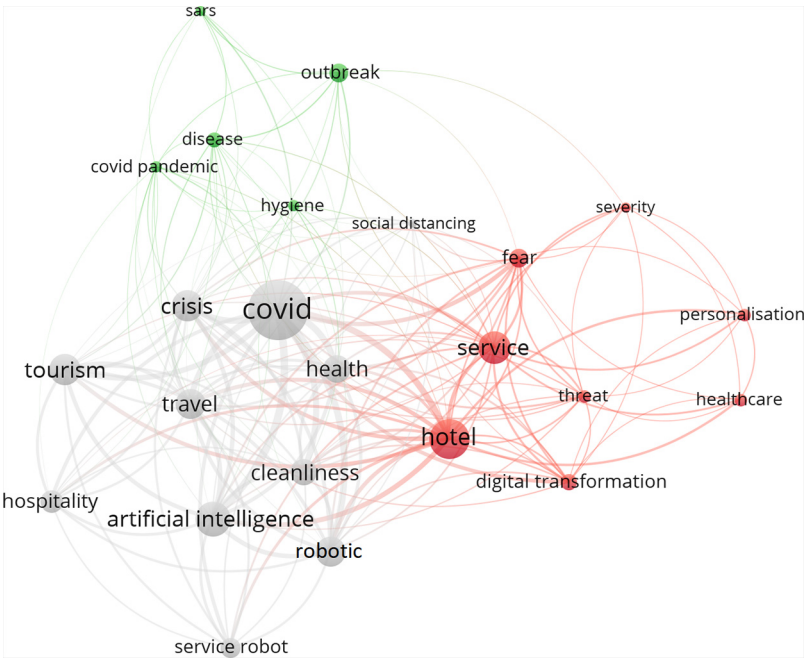

Figure 4.
Map of the co-occurrence terms

of COVID-19 and the threat to the right to participate in tourism and hospitality practices. They found that parts of Asia, North America and Europe are facing enormous challenges. Wen *et al.* (2020) analyzed the changes in Chinese tourists' lifestyle during COVID-19 and found that tourists will now focus more on health and wellness tourism. Jones and Comfort (2020) gave insights on the change in the relationship between hospitality and sustainability on the outbreak of COVID-19. They found that this crisis could provide a vision for a more sustainable future.

Lai and Wong (2020) compared how the hotel practices were different during the initial stage of the crisis and the pandemic stage and highlighted strategies such as pricing

adopted by the hotels during these two stages. Im *et al.* (2021) analyzed 57 chief executive officer letters published during the pandemic by the hospitality companies; the findings reveal that hospitality organizations primarily relied upon defensive approaches and powerful tactics during COVID-19. Baum *et al.* (2020) studied the immediate impact of COVID-19 on the hospitality workforce at three levels, macro, meso and micro. This study was conducted between April 2020 to June 2020 The findings suggest that hospitality stakeholders, the industry, consumers and the government, will revive the pandemic with a tremendous changed attitude for the hospitality workers. Garrido-Moreno *et al.* (2021) identified critical drivers for the recovery of the hotels using a survey method. He found that ways such as digital marketing involving social media campaigns, discounted packages and offers on social media can help win back customers' confidence.

5. Future research agenda

The literature review sheds light on the growing necessity of AI and robotics in the hospitality industry, particularly during the COVID-19 crisis. Therefore, this article presents three research agenda that needs to be addressed to prepare the hospitality industry to face the changes that are certain to come due to outbreak of COVID-19 and based on the research agenda about AI and robotics, proposes a theoretical framework for the hospitality industry.

5.1 Artificial intelligence and robotics

It is crucial to understand the guest's experiences and thoughts concerning the robots' contactless services (Di Vaio *et al.*, 2020a). The areas to be addressed in the future can focus on developing robot-friendly hospitality measures, which could help provide adequate services. There are visibly many changes in the traveler's demand due to the outbreak of COVID-19 (Wen *et al.*, 2020). Therefore, future research can inquire into the relevance of applying techniques such as deep learning to personalize hotel services. Furthermore, researchers can explore how big data and analytical AI can be used to pull down the individual choices in service preferences (Huang and Rust, 2020). Di Vaio *et al.* (2021) stated that digital transformation encourages information and proficient practices using big data. The hoteliers should harness big data's power for establishing their competitive advantage by providing personalized guest services (Mariani and Perez Vega, 2020).

COVID-19 has developed fear in the customer's mind. It is essential to build trust during the current challenging time and show empathy toward the hotel guests (Jiang and Wen, 2020). Therefore, the researchers must investigate AI's role in delivering customer services in hotels. Considering the positive and negative prospects around AI in hotel services, researchers should evaluate the hotel's return on investment concerning the adoption of service robots. Further, it can be investigated that the adoption of service robots in hotels is limited to promotional stunts or fully used concerning their service performance. Apart from the stated research agendas, it is also essential to study the ethics involved in adopting AI and robotics in the hospitality industry.

As Huang and Rust (2020) stated, the increasing use of AI can replace human labor, leading to the absence of human employees at the hotels and a completely different service experience by the guests. However, the effects of service automation in hotels depend on how AI is implemented. For example, process automation that includes updating files (customer information) in the computer systems does not pose a big threat to the hotel staff (Ivanov and Webster, 2019). With these given trends in hospitality management practices, it is pivotal for future studies to explore how process automation and cognitive engagement can be used by the hotels to address the problems caused by COVID-19 and to examine the ways through which AI solutions can be applied for dealing with the challenges such as

COVID-19. Furthermore, future research should also focus on the following areas in robotics, as mentioned in below list:

Future directions toward the adoption of Robotics:

- Affirmation and application toward robots' use by the distinctive categories and generations of hotel guests. As a general presumption, are older customers more hesitant to adopt service robots than young customers?
- The adequate level of acceptance of robotization in the hospitality sector.
- In what capacity should robots be designed to offer convenient services to the guests?
- To what degree do youngsters give relevant possibilities to test and create service robots compared to older ones?
- Do men and women desire diverse robot designs and features?
- Customers' propensity to trust and experience a sense of safety about service delivery by the hospitality industry's robots.
- The role of customer culture in accepting the services offered by a service robot.
- Operations and tasks in the hospitality services to show a positive attitude in accepting robotization.
- Customer's preferment concerning the robots' appearance, narration and distinct features essential for framing an optimistic opinion toward them.

5.2 Cleanliness and health

Regarding the growing demand for hotel hygiene after the outbreak of COVID-19, future research can focus on how the cleanliness and sanitization procedures followed at the hotels can be used as a selling point for hoteliers in the future. A study by Zemke *et al.* (2015) stated that women of all ages and youngsters would preferably pay a higher amount of money for improved disinfection of the guestrooms. In light of their work, future researchers can study that "are the hotel guests of different segments willing to pay a premium amount for better sanitization and disinfection facilities at the hotels." In addition, as the advanced level of sanitization may require huge capital for equipment and technology, future research should consider the degree to which sanitization practices should be improved at the hotels.

In the specific circumstance of COVID-19, AI can be applied to perform cleaning and sanitization tasks (Jiang and Wen, 2020). de Kervenoael *et al.* (2020) found that visitors are inclined to use social robots in the travel and hospitality industry. Zhong *et al.* (2020) experimented to determine the impact of service robots on hotel guests' purchasing behavior. The findings revealed that people who watched videos of hotel service robots had a higher booking intention than those who watched traditional service videos. Thus, it is noteworthy to inspect the impact of robots on clients' cordiality experience. Areas to consider in the future include cleaning and disinfection procedures at hotel properties that can be carried out by AI-driven robotics and implications could be imparted to experts to enhance service robot design to improve customer relationship management. Another research direction in pandemics' particular setting is how the hotels can generate real-time data to create a prediction and alert system for infectious disease dependent on big data and AI as a team with computers and researchers.

5.3 Health care and wellness retreats

Under Covid-19 conditions, it is desirable to examine further, how the hoteliers can plan and design customized products to magnify their experience. In particular, researchers could think about how to constructively use the guests' social data and their consumption patterns such as their visit to the hotel's fitness center and the variety of food ordered (Mariani and Perez Vega, 2020). Using predictive analytics by using the information of the guests can help the hoteliers design personalized health-related services. As of now, the mainstream focus of hotels will be on personalization, health and wellness. Even though the term wellness may have various implications, giving a protected place for relaxation with personalization can reduce travel-related anxiety and pull in the hotel guests smartly. As the hospitality industry plans for a comeback with greater strength, they should redesign the wellness programs to fulfill the new wellness-determined guests. Human well-being starts from the strength of nature. This pandemic has compelled people to recognize the power of nature. This crisis will give rise to environmentally sustainable tourism forms and promote harmony between humans and nature (Di Vaio and Varriale, 2020). Eco-friendly strategies and green practices can be a new norm for hotels to attract customers.

Future studies can investigate the guests' attitude toward adopting green hotel attributes and extending the literature. There is also a need to investigate the prospects for hospitality practitioners to work together with the guests to co-create green value. Furthermore, future studies should also examine how medical services with expert medical staff can provide better value to the hotel guests, increasing their occupancy rate post-COVID-19. For example, Le Bijou, a Swiss hospitality company, provides quarantine-friendly facilities such as automatic check-in and in-room medical facilities to its guests (Lastoe, 2020). Furthermore, it is relevant to explore the growing relationship between the hotel sector and the health-care sector. The viability of converting hotels into quarantine centers during a crisis should be further explored with empirical data. Nguyen *et al.* (2017) studied the cooperation between the hotel sector and the local government to minimize disaster risk in the coastal areas. The findings revealed that hotels could play a significant role in providing shelter during such a crisis.

5.4 Theoretical framework for hospitality industry

Amidst the review and research agenda, the study proposes a theoretical framework by extending the PMT to use AI and robotics in the hospitality industry during the COVID-19 crisis. This framework depicts how the threat appraisal and coping appraisal give way to protection motivation among the guests. Pre-COVID-19, there was a direct link between the (hotels and guests). However, the disruptions caused by COVID-19 created a gap. Figure 5 depicts how the layer of protective measures in emerging technology can fill in this gap. The dropped guest volume can be increased and the hotels with deserted hallways can get better. This proposed framework can give way to a new paradigm wherein the service providers can facilitate better services to their customers during and after the COVID-19 pandemic.

6. Discussion and conclusions

6.1 Conclusion

The research agenda submitted in this article (AI and robotics) (cleanliness and sanitation) and (health and Wellness) fosters research and knowledge development in the hospitality sector. As fearful guests are unwilling to stay or dine at hotels, it drastically affects their survival. Therefore, figuring out what measures can make the guests return requires extensive research. This article addresses this aspect by presenting the research agenda from three dimensions as stated above and proposes a theoretical framework incorporating

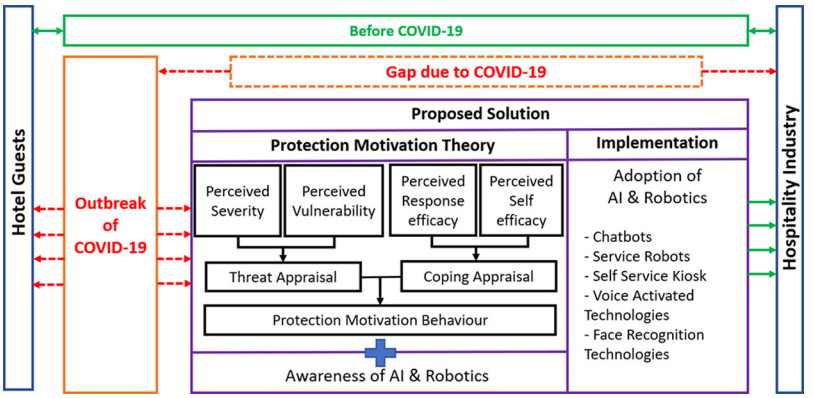

Figure 5.
Theoretical Framework for Hospitality Industry

AI and robotics as a protective measure for providing service delivery to rebuild the guest's confidence.

Compelling strategies are required to boost guests' confidence and help hospitality businesses quickly recover from this crisis. The hotels' resilience and sustainability can be improved by addressing guest's growing concerns and converting adversity into opportunity. The past pandemics emphasized the importance of hygiene and cleanliness for the survival of hotels. As technology can help provide effective cleanliness measures during COVID-19, this study addresses AI and robotics' roles in giving guests contactless services. The article highlights that implementing AI and robotics as depicted in the theoretical framework can create a technological shield that can provide contactless services, provide a competitive advantage to the hotels during and post COVID-19. Furthermore, the emerging trends among guests such as wellness and environmental conservation must be addressed.

6.2 Theoretical implications

This study consists of several theoretical implications. First, this study contributed by extending the PMT and incorporating AI and robotics to develop a new framework for the hospitality industry. The study highlights how behavioral choices during emergencies can bring technological revolution and how hospitality practitioners can embrace these changes to recover from the pandemic. Second, while fear and uncertainty in guest's decision-making have been an essential topic of research, there is still a necessity for an orderly comprehension of how hospitality customers see health risks and how this impacts their choice of visiting a hotel. The current study filled this research gap by analyzing the notable effect of apparent health risks on guest's decision to visit hotels during the outbreak of COVID-19. Third, the study details that robots are an appropriate option for performing repetitive, routine and dangerous jobs such as cleaning and disinfection during pandemics. This will reduce the physical contact between the hotel staff and the guests and help minimize the spread of disease. Furthermore, employees can use their skills to perform tasks that require creativity.

6.3 Practical implications

The COVID-19 pandemic has brought a massive change in the hospitality sector's working in terms of safety. Significantly, digital transformation will be the frontier in hospitality practices. In this context, the current study proposes useful, practical implications. First,

hotels need to give assurance about the effectiveness of their safety measures by incorporating AI and robotics technologies to maintain social distancing. The focus should be on providing contactless services such as self-check-in and check-out facilities, face recognition systems, cleaning robots and digital key services. Adopting advanced technologies such as electrostatic sprayers, germ-destroying robots and ultraviolet light should be preferred. As the hotel facilities are shared with other customers, it is vital to disinfect the other high touch surfaces in the hotel properties apart from the rooms' disinfection.

Second, providing appropriate information to the guests regarding the hotels' risk reduction strategies will assure the guests of their safety, assisting them in the decision-making process. Accurate information provided to the customers by the company can affect customer's decision-making. Therefore, the hotels need to keep the hospitality customers informed about the hotels' strategies to protect their guests' health. Third, the outbreak of COVID-19 is bringing changes in the marketing strategies of the hoteliers. They need to move toward environmentally friendly ways of tourism. The hospitality practitioners should shift toward eco-friendly practices as demanded by the guests. Moreover, they should focus on well-being and health-related holiday programs for the guests.

6.4 Limitations and future research

The current article has limitations in the context of generalizability. The research is limited to the sectors of hospitality only, such as hotels and restaurants. Another limitation is the analysis of the researched articles based on specific keywords to answer the research questions. As the authors have used particular keywords for the research process, there is a possibility that few items might be missed during screening. Further, this article did not consider ethical issues such as data privacy while proposing the theoretical framework. However, the issues revolving around data security and privacy can be resolved using future AI technologies. For example, incorporating robust blockchain technologies can ensure data privacy and security (Di Vaio and Varriale, 2020c). In the future, scholars can explore the advantages of big data and other emerging techniques such as text mining and image analytics. Future studies must consider using big data and analytics concerning cleanliness and health practices in the hospitality context regarding the industry's ongoing technological revolution.

Apart from the research agenda discussed in the article, another critical area to explore is crisis management. As the hospitality sector is a noticeable victim of pandemics, the hospitality companies must prepare a contingency plan for such a crisis. Future research studies should also explore how service industries and government agencies can form crisis management schemes. COVID-19 has disturbed the functioning and operations of global hospitality companies. Both practitioners and researchers should come together to analyze the impact of this crisis and improve industry practices. Empirical data from the industry could assist the researchers in making accurate predictions. To address the issues depicted in the article, future research could include different approaches such as focus groups, in-depth interviews and a mixed-method approach. The authors anticipate that the research agenda detailed in this article will further elucidate pertinent topics of interest and stimulate further study.

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