Distance is no longer a barrier to healthcare services: Current state and future trends of telehealth research

Abstract

Purpose – Taking a business lens of telehealth, this article aims to review and provide a state-of-the-art overview of telehealth research.

Design/methodology/approach – This research conducts a systematic literature review using the SPAR-4-SLR protocol and a collection of bibliometric analytical techniques (i.e., performance analysis, keyword co-occurrence, keyword clustering, and content analysis).

Findings – Using performance analysis, this article unpacks the publication trend and the top contributing journals, authors, institutions, and regions of telehealth research. Using keyword co-occurrence and keyword clustering, this article reveals 10 major themes underpinning the intellectual structure of telehealth research: design and development of personal health record systems, health information technology for public health management, perceived service quality among mobile health users, paradoxes of virtual care versus in-person visits, internet of things in healthcare, guidelines for e-health practices and services, telemonitoring of life-threatening diseases, change management strategy for telehealth adoption, knowledge management of innovations in telehealth, and technology management of telemedicine services. The article proposes directions for future research that can enrich our understanding of telehealth services.

Originality/value – This article offers a seminal state-of-the-art overview of the performance and intellectual structure of telehealth research from a business perspective.

Keywords: Telehealth; Telemedicine; m-health; e-health; Online healthcare; Systematic literature review.

Paper type Research paper

1. Introduction

The society is reeling from the effects of the coronavirus disease 2019 (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) outbreak, which the World Health Organization (WHO) declared as a global pandemic in 2020 (Lim, 2021b; Sohrabi *et al.*, 2020). The pandemic, which remains ongoing at the time of writing, has led to the birth of a new normal, where significant changes in societal practices such as the donning of face masks, physical distancing, and navigating activities around travel restrictions have become omnipresent (Lim, 2022b; Nicola *et al*., 2020; Wright and Caudill, 2020). The pandemic has also created an economic climate that is more volatile, uncertain, complex, and ambiguous, yet presenting immense transformative opportunities for firms, institutions, and societies to evolve into more adaptive, agile, and resilient entities (Baudier *et al*., 2021; Wang and Wu, 2020). Of particular interest in this article is healthcare services, which have been severely impacted by the COVID-19 pandemic.

Access to healthcare is a basic human right, but the operational constraint that the COVID-19 pandemic has exerted on healthcare, which is to prioritize treatment for infected patients, has impacted the provision of health and care for the society at large worldwide (Hollander and Carr, 2020; Markus and Brainin, 2020). As most healthcare practitioners are not prepared to work remotely using innovative medical technologies, and with most hospitals lacking such cutting-edge technological infrastructure (Hasson *et al*., 2021; Hollander and Carr, 2020; Krist *et al*., 2020), the vulnerability associated with social interaction from physical visits has become one of the biggest threats in the general hospital environment, posing the risk of COVID-19 infection to both practicing healthcare professionals and visiting patients (Greven *et al.*, 2020; Nicola *et al.*, 2020). Concerns have been also raised about the physical functioning of the healthcare system in providing medical consulting services due to the lack of adequate protective gear, operational capacity, and technological infrastructure to handle a large number of patients during the pandemic (Prasad *et al.*, 2020). As a result, alternative solutions are required to simultaneously satisfy the urgent medical needs of infected patients, as well as the important medical needs of patients who may not be infected but are in need of treatment for other illnesses (Baudier *et al*., 2021; Burmeister *et al*., 2019; Oborn *et al*., 2021). Although technological solutions to meet such healthcare demands during the COVID-19 pandemic would be multifaceted (Cobelli *et al.*, 2021), telehealth has emerged as one of the most effective methods that leverages mainstream information and communication technology (ICT) to facilitate optimal patient care while eliminating the risk of contracting a contagious disease from physical interactions (Hollander and Carr, 2020; Lazarus and Soejono, 2022; Quévat and Heinze, 2020; Wang and Wu, 2020; Waqas *et al*., 2020).

Between the 1850s and the 1900s, telegraph and radio were initially utilized as mass consultation instruments (e.g., radio doctor), and from 1900 to 1970, analogue telephone and television were used to provide medical advice to the general public (Jagarapu and Savani, 2021). Evidence of one-on-one physician-patient consultation through the internet has been documented since the 1980s, when computers first became widely available for home use. Thereafter, the burgeoning popularity of smartphones combined with the worldwide advancement in the diffusion of internet services have led to the rise of mobile apps, resulting in the agile curation and adoption of a broad range of mobile services by providers for consumers (Mao *et al*., 2020; Paramastri *et al*., 2020; Peng *et al*., 2020). A powerful, functional, and user-friendly smartphone is one with superior processing and storage capabilities, a convenient operating system, front- and rear-facing cameras, large screen sizes, and the immense variety of embedded and third-party applications. Thus, with the development of smartphones, smart wearables, and mobile applications, critical healthcare concerns may be addressed and patients can have access to healthcare remotely (Waqas *et al.*, 2020).

Various scholars around the world describe telehealth as mobile health applications (m-health) that employ ICT to support public health such as remote healthcare, wellness education, and community health management (Duarte and Pinho, 2019; Lee *et al*., 2018;Yanicelli *et al*., 2020). Telehealth provides patient-centered solutions, such as improved healthcare responsiveness, which is critical to the delivery of high-quality healthcare services (Daskalopoulou *et al*., 2020; Liu and Varshney, 2020; Sims, 2018). With real-time medical consultations, patients can deal with health issues promptly and gain timely knowledge about treatment choices available (Giovanna Capponia, 2022; Lu *et al.*, 2021; Xing *et al.*, 2019). The Statista Global Consumer Survey indicates that the proportion of users who use health apps grew by 65 percent in China, 63 percent in India, 46 percent in Australia, and 44 percent in the United States in 2020, which reflects the fact that, due to strict physical distancing and a lack of viable treatment options during the COVID-19 pandemic, telehealth has emerged as the least risky communicative mechanism between patients and physicians (Chauhan *et al.*, 2022; Cobelli *et al.*, 2021; Hirko *et al.*, 2020; Krist *et al.*, 2020; Wu *et al.*, 2022).

Although telehealth has its merits and is projected to increase substantially over the next decades, its diffusion and use remain susceptible to technological and operational challenges for healthcare (Bakshi and Tandon, 2021; Biswas *et al*., 2020; Zobair *et al.*, 2020; Yang *et al*., 2015). For example, when patients use on-demand telehealth services that connect them with a random healthcare professional, care continuity suffers (Vesselkov *et al*., 2018; Vlahu-Gjorgievska *et al*., 2019) because the next medical practitioner may not necessarily have access to patient information from prior visits and thus ends up with a patient's incomplete medical history. Shuffling of a service provider raises the chances of a physician not understanding or acquiring information about a patient's medical history (Akter *et al*., 2013a; Green *et al*., 2016). Given the possibility of a lack of care continuity that would result in poor service quality and patient discontent, telehealth service providers must use exemplary data management systems to keep patient information up to date and accessible to physicians for appropriate and efficient diagnosis (Vlahu-Gjorgievska *et al*., 2019; Wang *et al*., 2020). Furthermore, another crucial criterion for attaining the radical changes advocated by telehealth service providers is the preparedness and willingness of physicians to implement it (Bakshi and Tandon, 2021; Sims, 2018). Moreover, telehealth service providers must provide rigorous technical training and continuing support in order to foster technology acceptance among physicians and patients (Paul *et al*., 1999; Standing *et al*., 2018a; Standing *et al*., 2018b), which would be a resource-intensive endeavor (Bakshi and Tandon, 2021). Other significant impediments to deploying such services include security certification, online transactions, and insurance (Hollander and Carr, 2020; Kim and Kwon, 2019).

Telehealth has emerged as a new-age necessity because it reduces healthcare costs and non-necessary hospitalization while improving public health and wellbeing by allowing patients to seek guidance on their health concerns and medical conditions in real time via digital interactions with healthcare professionals, with increasing evidence of the willingness to continue using telehealth after the COVID-19 pandemic by patients and healthcare providers (Andrews *et al.*, 2020; Drago *et al.*, 2021; Smith *et al.*, 2020). Furthermore, applications of telehealth can help improve the health of rural communities by establishing connections between inhabitants of rural areas and healthcare experts in urban areas, providing them with specialized care, increasing accessibility, reducing long commute times, and significantly improving quality of healthcare services in such remote regions (Barjis *et al*., 2013; Burmeister *et al*., 2015; Drago *et al*., 2021; Hampshire *et al*., 2021; Ishfaq and Raja, 2015; Lazarus and Soejono, 2022; Zobair *et al*., 2020). Keeping up with the latest revelations and advancements in the field of telehealth can be daunting, especially among business scholars who are increasingly seen to venture into the field of healthcare (Lim, 2021a). Systematic literature reviews represent a nuance solution to address this limitation, wherein literature in the field is reviewed using a set of systematic procedures, thereby providing a consolidation of insights in that field in a way that is transparent and replicable (Kraus *et al*., 2022; Lim *et al*., 2022a; Paul *et al*., 2021). Bibliometric analysis, which encapsulates the use of quantitative techniques to analyze a vast volume of published research in a field (Donthu *et al*., 2021; Mukherjee *et al*., 2022), can serve as a rigorous technique to enhance the objectivity of systematic literature reviews intending to present a summary of research trends for others to use as a roadmap for future research (Baker *et al*., 2020; Moral-Muñoz *et al*., 2020; Lim *et al*., 2022a). Noteworthily, current reviews on telehealth remains limited (Standing *et al*., 2018a), with the majority of existing reviews taking a medical informatics lens (Armfield *et al*., 2014; Pai and Alathur, 2021; Peng *et al*., 2020; Waqas *et al*., 2020). In this regard, the performance and intellectual structure of telehealth research in emerging fields outside medicine, such as business, have yet to receive review attention. With the amalgamation of the healthcare industry, the role of business as a linchpin in this integration, and the importance of business knowledge for ensuring the sustainability of integrated healthcare services (Lim, 2021a), it is important to take stock of the contributions of business scholars to telehealth in order to chart the field's future progress from a business lens in line with the goal for conducting fresh reviews of the literature (Lim *et al*., 2022a; Paul *et al*., 2021). Moreover, it is important to conduct reviews of high-quality research, especially when public health is concerned (i.e., it would be better for business recommendations for public health to come from higher than lower quality research—e.g., findings from business journals ranked "A*" and "A" as opposed to "B" and "C") (Paul *et al*., 2021). Therefore, this article aims to systematically review and provide a state-of-the-art overview of telehealth research published in top-tier business journals using bibliometric analysis, contributing seminal insights to the following research questions (RQs):

> RQ1. What is the publication trend and which are the top contributing journals, authors, institutions, and regions for telehealth research in top-tier business journals?
>
> RQ2. What are the major themes and topics that characterize the intellectual structure of telehealth research in top-tier business journals, and what insights can business scholars gleaned from earlier research to enrich understanding on telehealth through future research from a business perspective?

Drawing on prior research (Baker *et al*., 2020; Donthu *et al*., 2020; Kumar *et al*., 2021), this study conducts a systematic literature review on telehealth using the scientific procedures and rationales for systematic literature reviews (SPAR-4-SLR) protocol (Paul *et al*., 2021) and a range of bibliometric analysis techniques, including a performance analysis, a science mapping via keyword co-occurrence and keyword clustering, and a content analysis (Donthu *et al*., 2021; Mukherjee *et al*., 2022). These widely-used tools are appropriate to address the aforementioned RQs. Following previous studies, this study analyzes the bibliographic data collected from the Scopus database using software packages such as VOSviewer (Gaviria-Marin *et al*., 2018; Kumar *et al*., 2021; Peng *et al*., 2020) and Biblioshiny in Bibliometrix on R (Kim and Jeong, 2021; Moral-Muñoz *et al*., 2020; Nasir *et al*., 2020). Noteworthily, the performance analysis for RQ1 offers the benefits of ascertaining reach for coverage claims, identifying social dominance or hidden biases for improvement, detecting anomalies for further examination, and evaluating relative performance for equitable decision-making while the science mapping and content analysis for RQ2 provides the value of clarifying nomological networks, tracking evolutionary nuances, and recognizing crucial knowledge gaps to situate future research directions (Donthu *et al*., 2021; Mukherjee *et al*., 2022). The structure of this study is summarized in Figure 1.

[Insert Figure 1 about here]

2. Methodology

This study adopts the SPAR-4-SLR protocol to guide its systematic literature review of telehealth research in top-tier business journals. Unlike alternative review protocols such as the PRISMA protocol, the SPAR-4-SLR protocol emerged from business research and thus facilitates reviews through a business perspective. The SPAR-4-SLR is essentially a three-step process of assembling (concentrates on data collection), arranging (deals with data presentation), and assessing (focuses on data analysis and reporting) (Paul *et al*., 2021). The protocol is also supplemented by the use of bibliometric analysis, which strengthens the objectivity of the systematic literature review (Donthu *et al*., 2021; Kraus *et al*., 2022; Lim *et al*., 2022a; Mukherjee *et al*., 2022). Some observations of telehealth research published in conference proceedings are also provided as an alternative for comparison against the main insights derived from top-tier business journals. The methodology of this study is detailed in the Appendix and summarized in Figure 2.

[Insert Figure 2 about here]

3. Findings

3.1. Performance analysis

3.1.1. Publication trend for telehealth research in top-tier business journals

The year-on-year publication trend for telehealth research in top-tier business journals is presented in Figure 3. Additional evidence on publishing trends in conference proceedings is also included in the figure for comparison. Since 1996, a total of 174 articles on telehealth research have been published in top-tier business journals. In contrast, a total of 256 articles on telehealth research have been published as conference proceedings. This shows that telehealth research published in conference proceedings is greater than top-tier business journals. Nevertheless, the publishing patterns in both categories show that the rate of publication of telehealth research is growing. When focused on top-tier business journals, the proliferation of research in the field in the double digits has only begun since 2015.The highest total number of articles published in a full year is 38 articles for the year 2021, and this is expected to be exceeded in 2022 given that 11 articles have already been published as of February 23, 2022. However, the same cannot be said about the publishing activity of telehealth research in conference proceedings, with the highest total number of articles published in a full year occurring in 2011 (29 articles), and no full year, to date, has surpassed this publishing performance. Taken collectively, these findings may imply that though many studies on telehealth research are being conducted, they do not necessarily end up in top-tier business journals, which typically require the highest level of clarity, novelty, and rigor (Lim, 2021c; Lim, 2022a).

[Insert Figure 3]

3.1.2. Top contributing journals for telehealth research in top-tier business journals

The top contributing journals for telehealth research in top-tier business journals ranked by publications and citations are presented in Table A1 and Table A2, respectively. Table A1 indicates that the most prolific top-tier business journals in the field of telehealth research are *Technological Forecasting and Social Change* (*n*=25), followed by *International Journal of Information Management* (*n*=13), *Decision Support Systems* (*n*=11), *Information and Management* (*n*=10), and *Information Systems Research* (*n*=9), whereas Table A2 shows the most influential top-tier business journals in the field of telehealth research are *Journal of Management Information Systems* (1,845 citations), *Information and Management* (942 citations), *Decision Sciences* (862 citations), *International Journal of Information Management* (643 citations), and *Information Systems Research* (451 citations). In addition, Table A1 indicates that the *European Conference on E Government* is the most active outlet for conference proceedings on telehealth research (14 articles), while Table A2 shows that the *International Conference on Information and Knowledge Management* is the most influential outlet for conference proceedings on telehealth research (122 citations from 8 articles). This implies that the outlets with the greatest productivity (publication) and impact (citation) for telehealth research are top-tier business journals rather than conference proceedings.

Prior to 2014, *Decision Support Systems* emerges as the most prolific top-tier business journal publishing telehealth research (*n*=6), though *Technological Forecasting and Social Change* has taken over the mantle in recent years, with 25 publications between 2014 and 2022 (Table A1). The average citations for *Decision Sciences* are also noteworthy, with an average of 287.33 citations for three publications, thereby illustrating the high impact of articles published by this journal (Table A2). The publications by *Decision Support Systems*, *International Journal of Information Management*, and *Technological Forecasting and Social Change* are most consistently cited, as seen through its *h*-index of nine in the field, thereby indicating that nine of the journal's publications have received at least nine citations (Table A2).

Noteworthily, the majority of top-tier business journals on telehealth research are classified as information systems journals (i.e., field of research (FOR) code = 0806; e.g., *Decision Support Systems*, *International Journal of Information Management*, and *Journal of Management Information Systems*) by the Australian Business Deans Council in the 2019 Journal Quality List, though representation from other business fields such as management (i.e., FOR code = 1503; e.g., *British Journal of Management*, *Decision Sciences*) and marketing (i.e., FOR code = 1505; e.g., *Journal of Consumer Marketing*) are also present. The list of business journals that publish telehealth research also includes those endorsed by Financial Times (FT 50) and University of Texas at Dallas (UTD 24), which represent the lists of premier journals in the business field.

3.1.3. Top contributing authors for telehealth research in top-tier business journals

In total, 167 authors have published telehealth research in top-tier business journals, with the top contributing authors presented in Table A3. The table indicates that P.Y.K. Chau, who has two articles in *Journal of Management Information Systems* and one article each in *Decision Sciences* and *Information and Management* (Chau and Hu, 2001, 2002a, 2002b; Hu *et al*., 1999), and X. Guo, who has one article each in *Decision Support Systems*, *International Journal of Electronic Commerce*, *Information Systems Research*, and *Information and Management* (Wang *et al*., 2020; Xiaofei *et al*., 2021; Yang *et al*., 2015; Zhang *et al*., 2019), are observed as the most prolific authors with four articles published between 1992 and 2002 and 2015 and 2021, respectively, followed by S. Akter, I. R. Bardhan, J. D'Ambra, P.J.H. Hu, L. Mathiassen, D. Nicolini, P. Ray, and Y. Tan, who have published three articles each. Noteworthily, S. Akter, J. D'Ambra, and P. Ray collaborated on two articles (Akter *et al*., 2010; Akter *et al.*, 2013b) published in *Electronic Markets* and one article (Akter *et al.*, 2013a) published in *Information and Management*. Table A3 also shows that the most prolific authors who publish in top-tier business journals vary significantly from the most prolific authors who publish in conference proceedings. With four conference articles each, H.L. Chang, L. Erasmus, G.B. Fanta, and K. Mehta are the most prolific authors for conference proceedings in the field. This suggests that telehealth research published in conference proceedings does not necessarily end up in top-tier business journals.

This study also sheds light on Dominance Index (DI), which is a ratio that calculates the proportion of occasions an author is the first author in co-authored research publications, thereby demonstrating the author's dominance in the articles that were published by the author (Peidu, 2019). S. Akter has the highest dominance index (DI=1) with three articles. Some authors have the same dominance index (DI=1) namely: D. Nicolini with three articles in *Human Relations* (Nicolini, 2007), *Organization Studies* (Nicolini, 2009), and *British Journal of Management* (Nicolini, 2010), A. Baker with two articles in *Review of Industrial Organization* (Baker *et al*., 2020, 2021), O. Burmeister with two articles in *Australasian Journal of Information Systems* (Burmeister *et al.*, 2015, 2019), J.G. Cegarra-Navarro with two articles in *International Journal of Information Management* (Cegarra-Navarro and Sánchez-Polo, 2010) and *Knowledge Management Research and Practice* (Cegarra-Navarro *et al*., 2012), and S. Cho with two articles in *European Journal of Information Systems* (Cho and Mathiassen, 2007) and *Journal of Information Technology* (Cho *et al.*, 2007).

3.1.4. Top contributing institutions for telehealth research in top-tier business journals

In total, 160 institutions have published telehealth research in top-tier business journals, with the top contributing institutions presented in Table A4. The most prolific institutions with six articles are Georgia State University (Bardhan *et al*., 2015; Cho *et al*., 2007; Cho and Mathiassen, 2007; Liu and Varshney, 2020; Singh *et al*., 2018; Sneha and Varshney, 2009), and Indiana University Bloomington (Baker *et al*., 2020; Liu *et al*., 2019; Wang *et al*., 2020; Yan *et al*., 2019; Yan *et al*., 2015; Yan and Tan, 2014), followed by The University of New South Wales (Akter *et al.*, 2010; Akter *et al.*, 2013a; Akter *et al.*, 2013b; Biswas *et al.*, 2020; Schuster *et al.*, 2015) with five articles and University of Washington and Harbin Institute of Technology with four articles each (Wang *et al*., 2020; Xiaofei *et al*., 2021; Yang *et al*., 2015; Zhang *et al*., 2019). In contrast, the leading contributing institutions publishing in conference proceedings vary significantly from authors publishing in top-tier business journals. Top contributing institutions publishing in conference proceedings are Pennsylvania State University (six articles), University of Pretoria (six articles), and RMIT University (six articles). The most influential institutions in terms of citations are University of Warwick with 511 citations for three articles published in *Organization Studies* (1 article), *British Journal of Management* (1 article), and *Information and Organization* (1 article), followed by The University of New South Wales with 393 citations for five articles published in *Electronic Markets* (2 articles), *Information and Management* (1 article), *Journal of Services Marketing* (1 article), and *IEEE Transactions on Engineering Management* (1 article), and Georgia State University with 326 citations for six articles published in *European Journal of Information Systems* (1 article), *Journal of Information Technology* (1 article), *Decision Support Systems* (2 articles), *Information Systems Research* (1 article), and *Information and Organization* (1 article). In contrast, the citations of conference proceedings were generally low (below 100 citations). These findings reaffirm the productivity (publication) and impact (citation) of top-tier business journals in shaping telehealth research.

3.1.5. Top contributing regions for telehealth research in top-tier business journals

In total, 39 countries/territories located across five continents and 19 regions where institutions are located have published telehealth research in top-tier business journals, with country/territory collaborations shown in Table A5, and the top contributing regions or countries/territories shown in Table A6. Most collaborations occur between authors from institutions in the United States and China (i.e., nine articles) (Table A5). Noteworthily, most articles published in top-tier business journals have been contributed by North America (the United States and Canada) (*n*=64, 36.78%), followed by East Asia (China, Hong Kong, Taiwan, Japan, Macao, and South Korea) (*n*=57, 32.76%) and Western Europe (the United Kingdom, Netherlands, and Belgium) (*n*=30, 17.24%). Taken collectively, there is a healthy spread of contributions to telehealth research in top-tier business journals by authors and institutions across the world, though new research from regions that are absent (e.g., South America) or under-researched (e.g., West Asia) are encouraged.

3.2 Science mapping

Science mapping involves the discovery and mapping of knowledge clusters in a field of research. To do so, this study conducts a *co-occurrence analysis* using keywords (or a *keyword co-occurrence analysis*), wherein *keywords that appear together* form *a mutual network*, and a *clustering analysis* using keywords (or a *keyword clustering analysis*), wherein *articles that share common keywords* are *grouped into clusters* (Donthu *et al.*, 2021). To put it simply, co-occurrence refers to the common existence, frequency of recurrence, and close proximity of comparable keywords across a network of all keywords derived from articles in the review corpus. A co-occurrence network of keywords is a text-analysis technique that includes a graphic representation of probable links between keywords contained in textual content. In doing so, this study unpacks the major themes (clusters) and topics (keywords) that underpin the intellectual structure of telehealth research in top-tier business journals, wherein the two bibliometric analysis techniques (i.e., keyword co-occurrence and keyword clustering) enable a triangulation of findings, and thus, strengthening the conclusions made in this study (Kraus *et al*., 2022; Lim *et al*., 2022a). Many previous reviews have provided inspiration and support for employing such a triangulated method (Kumar *et al.*, 2022; Sureka *et al.*, 2022).

3.2.1 Keyword co-occurrence

VOSviewer is a software for constructing and visualizing bibliometric information (Donthu *et al*., 2021; van Eck and Waltman, 2010; Yu *et al.*, 2020). The present study utilized the *co-occurrence analysis* of *keywords* option in VOSviewer to develop a visual representation of the network (or connections) between keywords (topics) that occurred at least four times to unpack the intellectual structure of telehealth research in top-tier business journals. As seen in Figure 4, each keyword (topic) is represented by a node, with (1) the size of the node indicating the occurrence of that keyword, wherein the larger the node, the greater its occurrence, (2) the thickness of the link between nodes indicating the occurrence of keywords in that link co-occurring together, wherein the thicker the link, the greater their co-occurrences, and (3) the color of the node indicating keywords that form a cluster, and thus, reflecting a common theme (Donthu *et al*., 2021; van Eck and Waltman, 2010; Xu *et al*., 2021). The occurrences and total link strength for each keyword (topic) are presented in Table A7, which indicates that "health care", "telemedicine", "ehealth", and "mhealth" are the most frequently occurring keywords with the strongest total link strength, and thus, highlighting their prominent role as a linchpin in telehealth research in top-tier business journals. Figure 4 indicates that the keywords (topics) in Table A7 manifest across five clusters (themes).

[Insert Figure 4 about here]

Cluster 1 (red) comprises 10 keywords with "covid-19", "health services" and "healthcare services" (*n*=10 each) being most prominent, followed by "internet of things" and "technology adoption" (*n*=8 each), and "information and communication technology", "public health", "smartphones", "surveys" and "telecommunication" (*n*=6 each). This cluster consists of telehealth research involving the "information and communication technology" and the "internet of things" for "public health" utilizing the "smartphones" and "telecommunication" means for providing "healthcare services" during "covid-19" through "surveys". In this regard, the theme of this cluster can be broadly assigned as *telehealth, technology, and public health.*

Cluster 2 (green) contains 10 keywords with "mhealth" (*n*=34) being most prominent, followed by "information systems" and "mobile health" (*n*=9 each), "developing countries" (*n*=8), "diseases" and "internet" (*n*=7 each), "patient treatment" and "service quality" (*n*=6 each), and "diagnosis" and "quality of service" (*n*=5 each). This cluster includes telehealth research involving "internet" and "mobile health" through "information systems" in providing "service quality" and "patient treatment" with "diagnosis" of "diseases" in "developing countries". In this regard, the theme of this cluster can be labelled as *telehealth and service quality*.

Cluster 3 (blue) contains nine keywords with "telemedicine" (*n*=53) being most prominent, followed by "medical computing" (*n*=13), "information technology" (*n*=9), "decision making" (*n*=8), "innovation" and "sustainable development" (*n*=7 each), "sustainability" and "telehealth" (*n*=6 each), and "behavioral research" (*n*=5). This cluster aims at achieving “sustainability” through “medical computing”, “information technology” and “innovation” for “decision making” in the field of “telemedicine” and “telehealth” through “behavioral research”. Thus, the theme of this cluster can be broadly assigned as *telehealth and sustainable development*.

Cluster 4 (yellow) comprises seven keywords with “health care” (*n*=40) being most prominent, followed by “healthcare” (*n*=12) (i.e., implying that “health care” is more commonly used than “healthcare”), “health” (*n*=11), “online healthcare communities” (*n*=10), “economic and social effects” (*n*=9), and “social networking (online)” and “technology acceptance model” (*n*=5 each). This cluster concentrates on improving “healthcare” for the public through “online healthcare communities” and “social networking (online)” while considering “social and economic effects” as a result of technology adoption of telehealth through the lens of the “technology acceptance model”. In this regard, the theme of this cluster can be labelled as *telehealth and socio-economic effect.*

Cluster 5 (purple) comprises five keywords with “ehealth” (*n*=31) being the most prominent, followed by “hospitals” (*n*=13), “records management” and “electronic health record” (*n*=8 each), and “information management” (*n*=7). This cluster explores the utilization of “ehealth” in “hospitals” focusing on “electronic health record” and how the information of patients can be collected, kept, and used through “information management” and “records management”. In this regard, the theme of this cluster can be broadly labelled as *telehealth and information management*.

3.2.2 Keyword clustering

Biblioshiny in Bibliometrix on R is another software for constructing and visualizing bibliometric information that was used in this study. The use of multiple software for bibliometric analysis is encouraged by Donthu *et al*. (2021) because it enables researchers to leverage on the strength of one software to overcome the shortcoming of another software. The present study performed a clustering analysis of articles sharing a common set of keywords using Biblioshiny to supplement the insights derived from the co-occurrence analysis of keywords using VOSviewer. The “bibliographic coupling” tool in Biblioshiny was used for this (*keyword clustering*) analysis, with the criteria of author-indexed keywords and global citations chosen as the parameters for this assessment. This analysis produced a four-quadrant map with the parameter “centrality” on the *x*-axis and the parameter “impact” on the *y*-axis, and generated keyword information for various clusters along with the articles within each cluster. In total, 10 clusters (themes) converged through the keyword clustering analysis. This is augmented with PageRank analysis conducted in Gephi software, which assists in identifying notable articles within each knowledge (thematic) cluster. The PageRank algorithm measures the importance of each node (i.e., article) within the network of articles (i.e., review corpus) based on the number of incoming relationships and the importance of the corresponding source nodes (Baker *et al*., 2020; Goyal and Kumar, 2021; Tandon *et al*., 2021).

Figure 5 depicts a visualization map of 10 clusters characterized by centrality (*x*-axis) and impact (*y*-axis), and Table A8 provides the list of top articles identified through PageRank for each cluster along with relevant metrics. The degree of centrality provides a significance value based on the number of linkages possessed by each cluster inside the network cluster of articles, while the degree of impact calculates the frequency with which articles in each cluster are connected to articles in other clusters as well (Bretas and Alon, 2021; Derviş, 2020). Specifically, centrality assesses the importance while impact measures the influence of each cluster or theme in the field. The upper left quadrant indicates low centrality and high impact, which comprises 24 articles from Cluster 3 (articles = 20, centrality = 0.499, impact = 2.743) and Cluster 7 (articles = 4, centrality = 0.389, impact = 3.570). The bottom left quadrant reflects low centrality and low impact, which contains nine articles from Cluster 1 (articles = 3, centrality = 0.354, impact = 1.201), Cluster 6 (articles = 3, centrality = 0.287, impact = 1.051) and Cluster 10 (articles = 3, centrality, 0.331, impact = 1.637). The upper right quadrant signifies high centrality and high impact, which consists of 111 articles from Cluster 2 (articles = 31, centrality = 0.719, impact = 2.310), Cluster 5 (articles = 34, centrality = 0.806, impact = 2.262), and Cluster 8 (articles = 46, centrality = 1.051, impact = 2.218). Finally, the bottom right quadrant suggests high centrality and low impact, which is made up of 13 articles from Cluster 4 (articles = 3, centrality = 0.699, impact = 1.006) and Cluster 9 (articles = 10, centrality = 0.526, impact = 1.935).

[Insert Figure 5 about here]

Noteworthily, the clusters (themes) and keywords (topics) emerging from keyword co-occurrence and keyword clustering illustrated in Figure 5 share notable similarities, though the clusters (themes) in the former appear to be broader than the latter. Nonetheless, the clusters (themes) from keyword clustering can be mapped to those from keyword co-occurrence, thereby indicating a form of triangulation, as presented in Table A9. Moving forward, this study concentrates on the finer-grained clusters (themes) emerging from keyword clustering, wherein a summary of each cluster (theme) is discussed in the next sections.

Cluster 1: Design and development of personal health record systems. The first cluster comprises three articles and is located at the bottom left quadrant of Figure 5, indicating low centrality and low impact. The most common keywords characterizing this cluster are "personal health record" (66.7%), "sustainability" (66.7%), and "activity theory" (33.3%) (Table A8). In today's healthcare industry, digitized management of personal health records (PHR) is gaining momentum (García-Berná *et al.*, 2021; Pang *et al.*, 2020). However, the extent to which consumers and caregivers utilize PHR is determined by how useful PHR is perceived (Gimpel *et al.*, 2021). PHR differs from electronic medical records (EMR) or electronic health records (EHR), whereby the former is a collection of health information managed by a person (García-Berná *et al.*, 2021; Gimpel *et al.*, 2021), whereas the latter is owned or maintained by a healthcare service provider (Gu *et al*., 2019; Kim and Kwon, 2019). Articles in this cluster shed light on how people collect, manage, and reflect on personal health data (e.g., physical activity, nutrition, weight) using software-enabled detection technologies (or sensors) to gain a better understanding of their own body, health behavior, and psychological interaction with the world around them (García-Berná *et al*., 2021; Gimpel *et al*., 2021; Jung *et al*., 2019). With rising incidences of chronic illnesses becoming one of the world's most pressing problems in recent decades, successful trials show that PHR-based intervention effectively assists people in losing body weight and improving their lifestyle behavior with lifelog data collection via smartphone-based health applications such as Apple Health and Samsung S-Health (Jung *et al*., 2019; Kim *et al*., 2019). All three articles in this cluster concentrate on system development for PHR management, with an emphasis on attaining energy efficiency in PHR management software (García-Berná *et al.*, 2021), cross-country assessment of PHR software features (Gimpel *et al.*, 2021), and market sustainability of new service development (Lin and Hsieh, 2014).

Cluster 2: Health information technology for public health management. The second cluster contains 31 articles and is located at the upper right quadrant of Figure 5, indicating high centrality and high impact. The most common keywords describing this cluster are "e health" (100%), "electronic health records" (77.4%), and "health information technology" (70.1%) (Table A8). The articles in this cluster explain and propose deployment frameworks that take into account technical and social factors when transforming e-health initiatives from pilot to large-scale implementation across economic conditions (Duclos, 2016; Menschner *et al.*, 2011; Mountford, 2019). Noteworthily, this cluster encapsulates a broad scope of health information technology (HIT) in e-health, which includes computers, hardware, software, networking, programming, sensors/trackers, data storage, and security (Duclos, 2016; Lennefer *et al*., 2020; Menschner *et al*., 2011; Simons *et al*., 2014). HIT is changing the healthcare industry by documenting and integrating health information across computerized systems, enabling secure data exchange between patients, medical-providers, insurers, and quality regulators (Bardhan and Thouin, 2013; Burmeister *et al*., 2015; Islam *et al*., 2020). Accelerating HIT deployment is a primary focus of developed nations (Lolich *et al*., 2019; Seddon and Currie, 2017) because of its potential to increase the operational productivity and overall cost effectiveness of providing high-quality healthcare services (Dehling and Sunyaev, 2014; Fox and Connolly, 2018). A major component of HIT is EHR, which represents digital forms of patient records that include patient information such as personal contact information, medical history, allergies, test results, and treatment plan (Kim and Kwon, 2019; Klecun *et al*., 2019; Watterson *et al*., 2020). In addition, the security and privacy of patient data must be protected by medical organizations, which must comply with strict government-specific laws (e.g., HIPAA and HITECH) to ensure medical information is safeguarded (Gu *et al*., 2019; Kim and Kwon, 2019; Savage and Savage, 2020; Shah and Khan, 2020). Technologies that simplify procedures and management can free up valuable time for higher-value tasks that directly affect patient experience, for example, physicians spending more time with patients and administrators giving preemptive scheduling and pricing information (Watterson *et al*., 2020; Xing *et al*., 2019; Zhang *et al*., 2019).

Cluster 3: Perceived service quality among mobile health users. The third cluster consists of 20 articles and is located at the top left quadrant of Figure 5, indicating low centrality and high impact. The most common keywords describing this cluster are "mobile health" (45%), "continuance intention" (55%), and "service quality" (60%) (Table A8). The majority of studies in this cluster employ a survey-based methodology to evaluate service quality among mobile health consumers, drawing on the SERVQUAL model (Akter *et al*., 2010; Akter *et al*., 2013a), expected confirmation model (Akter *et al*., 2013b), UTAUT2 model (Duarte and Pinho, 2019), and the house of quality (Miao *et al.*, 2017). Mobile health (m-health) is another domain that is revolutionizing the healthcare industry by providing people with access to vital services, personal data monitoring, and physicians no matter where they are (Akter *et al*., 2010; Liu *et al*., 2019; Hirano *et al*., 2020). As the variety of health applications for handheld and wearable digital devices increases, more people will rely on them to manage their own healthcare (Akter *et al*., 2013b; Duarte and Pinho, 2019). Diabetes apps for measuring blood sugar levels, pregnancy apps for tracking baby's development, and chronic illness apps for recording symptoms over time are among some of the most popular healthcare apps on smartphones today (Duarte and Pinho, 2019; Khasha *et al*., 2018; Liu and Varshney, 2020; Rolim *et al*., 2021). New developments in m-health also account for dynamic illness, such as the software tool developed by Khasha *et al*. (2018) that helps patients understand and control their asthma in potentially dangerous areas and places by providing daily monitoring maps of asthma attacks that take environmental factors such as air pollution and meteorological factors into account. While the penetration of ICT in everyday life draws significant attention to the success of m-health services (Birkmeyer *et al.*, 2021), the long-term sustainability of an m-health service is reliant on its repeated use rather than its first use (Akter *et al*., 2013a; Khasha *et al*., 2018; Liu and Varshney, 2020). Consequently, the articles in this cluster also seek to identify the different factors that influence both user acceptability and continuity with m-health services. In this context, Liu and Varshney (2020) proposed a carrot and stick intervention design in their study to improve medication adherence among m-health users. They considered two methods to offer technological and behavioral interventions for both accidental and deliberate non-adherence, namely negative reinforcement and positive reinforcement. They highlighted in their findings how negative reinforcement leads to greater m-health adoptability and how positive reinforcement may lead to increased user sustainability of the service.

Cluster 4: Paradoxes of virtual care versus in-person visits. The fourth cluster encapsulates three articles and is located at the bottom right quadrant of Figure 5, indicating high centrality and low impact. The most common keywords characterizing this cluster are “telehealth” (66.7%), “adoption barriers” (33.3%), and “paradoxes” (33.3%) (Table A8). The articles in this cluster represent the different functional possibilities, dilemmas, and challenges that the aggregators and the caregivers of telehealth service encounter. The potential of telehealth rests in its capacity to become a real care delivery alternative or practice extension for treating patients with chronic medical diseases and co-morbidities (Lolich *et al*., 2019; Wani and Malhotra, 2018). Despite its potential and necessity, telehealth is still in its early stages of acceptance in most parts of the world, and it is not yet a standard component of healthcare service (Ben Arfi *et al*., 2021; Kamal *et al*., 2020; Razmak and Bélanger, 2018). In the midst of rapid ICT development and competitive market scenario, service aggregators are required to address technical readiness, equipment reliability, software friendliness, functional transparency, and data security concerns for their users in order to ensure that both caregivers and caretakers have high confidence in the use of telehealth services, reducing the risk of user separation (Green *et al*., 2016). While interacting with a caregiver on a computer/smartphone screen can appear less compassionate than a face-to-face meeting and thus creating a distance barrier (Standing *et al.*, 2018b; Waqas *et al.*, 2020), service providers should explore for service design opportunities that allow patients to feel like they are talking to their physician in-person rather than via a remote virtual connection (Green *et al*., 2016; Standing *et al*., 2018b). Moreover, though telehealth can be appropriate for a wide range of healthcare needs such as treating the common cold, flu, headache, insect bites, sore throats, and post-diagnosis follow up, there may be situations that necessitate in-person consultation (Akter *et al.*, 2013b). In such cases, physicians or caregivers should use their best judgment and follow any protocol laid down by service aggregators to decide when and how to arrange an in-person session (Green *et al*., 2016; Standing *et al*., 2018a). Such information regarding in-person consultations can be integrated into a hospital’s EHR management system (Gu *et al.*, 2019) so that all associated caregivers are better prepared to schedule the required diagnostic test during in-person visits, making the process seamless and reducing staff burnout (Melnick *et al.*, 2020). To mitigate the detrimental consequences of telehealth services on patients, hospitals should establish procedures for in-person examinations that include scheduling, coordinating, billing, and a contact-free check in. Simultaneously, doctors and caregivers must explain the aspect of the diagnostic test that will take place, as well as follow-up considerations and other preparations on the telehealth platform (LeBlanc *et al*., 2020; Standing *et al*., 2018a). Although transitioning a telehealth consultation to an in-person examination is not always the best choice for patients, comprehensive communication about the scope of treatment through telehealth platforms and simplifying the check-in process can substantially minimize any adverse impact on service satisfaction. Furthermore, there is an increased risk of misdiagnosis when considering telehealth in comparison to in-person consultations (Pan *et al*., 2019; Tarakci *et al*., 2009). Given the dynamic nature of the aforementioned prospects and their transformative potential for integrating telehealth into the mainstream health care system, the paradoxes faced by telehealth service providers may serve as motivation to improve research in service design. As a consequence, when new technologies are introduced in service delivery design across increasingly high cognitive dimensions with reduced modalities (Green *et al*., 2016), service providers must constantly evaluate their service delivery model for tailored solutions and engage in knowledge management activities to improve consumer acceptance (Standing *et al*., 2018a; Standing *et al*., 2018b).

Cluster 5: Internet of things in healthcare. The fifth cluster encompasses 34 articles and is located at the top right quadrant of Figure 5, indicating high centrality and high impact. The most common keywords characterizing this cluster are “mhealth” (100%), “healthcare” (35.3%), and “internet of things” (23.5%) (Table A8). The articles in this cluster are mainly concerned with the internet of medical things. Prior to the internet of things (IoT), patients’ communications with physicians were restricted to in-person appointments, as well as videoconferencing and text messages. There was no mechanism for physicians or hospitals to constantly evaluate patients’ health and make appropriate suggestions. Remote diagnostics and monitoring in healthcare are now possible due to the increasing prevalence of IoT-connected medical devices and other related technology such as machine learning, artificial intelligence, cloud computing, and blockchain, which serve to keep patients safe and healthy while enabling medical professionals to provide better care (Biswas *et al*., 2020; Khalemsky and Schwartz, 2017; Vesselkov *et al*., 2018). As interactions with physicians have grown simpler and more efficient, telehealth through IoT has also improved patient involvement and satisfaction (Khodadad-Saryazdi, 2021). Also, the health monitoring of patients remotely shortens their time in the hospital and decreases the likelihood of their return for hospitalized treatment. As a consequence, IoT reduces healthcare expenses while improving overall treatment outcomes (Khodadad-Saryazdi, 2021). Prior research has shown that IoT has application areas that benefit patients, communities, physicians, healthcare facilities, and insurance providers (Hsiao *et al*., 2019; Khalemsky and Schwartz, 2017; Pan *et al*., 2019; Schwartz *et al*., 2017; Sneha and Varshney, 2009). Wearable technologies such as fitness trackers and other wirelessly linked devices such as cardiovascular monitoring devices and glucometers enable patients to get customized treatment (Aboelmaged *et al*., 2021; Vesselkov *et al*., 2018). These gadgets can be programmed to remind users of calorie counts, activity checks, medical appointments, and blood pressure changes, among others (Ben Arfi *et al*., 2021; Pan *et al*., 2019). Furthermore, IoT has transformed the lives of many people, particularly elderly patients and patients who live alone, by allowing continuous monitoring of their medical conditions (Almobaideen *et al*., 2017; Eze *et al*., 2019; Meng *et al*., 2020; Schwartz *et al*., 2017). For example, IoT-based sensing mechanism automatically notifies family members and physicians when a person's normal health condition is disturbed, thereby alerting them of potential health complications (Almobaideen *et al*., 2017; Go Jefferies *et al*., 2019; Khalemsky and Schwartz, 2017). That is to say, granting medical personnel more authority makes them more attentive and involved with their patients, which can result in improvements in determining the most effective treatment, and thus, ensuring continuity of care and achieving the targeted outcomes (Go Jefferies *et al*., 2019; Khodadad-Saryazdi, 2021). Apart from monitoring patients' health, hospitals can benefit from IoT devices in a variety of ways (Biswas *et al.*, 2020). Sensor-enabled IoT devices such as RFID can be used to track real-time location of medical/diagnostic instruments (e.g., wheel chairs, ventilators, nebulizers) as well as medical personnel (Khalemsky and Schwartz, 2017; Khodadad-Saryazdi, 2021). A hospital's e-health system built on blockchain technology empowered by IoT can also provide safeguards for patient's privacy, data integrity, and overall system transparency (Biswas *et al*., 2020; Meng *et al*., 2020). Infection transmission is another major concern for hospital patients, though such concerns can be alleviated using IoT-enabled hygiene monitoring devices that assist in infection prevention (Dong and Yao, 2021). IoT devices can also support inventory management and environmental monitoring of medical assets, such as checking stock levels of pharmaceutical drugs and refrigeration temperatures of medical samples, as well as controlling the requisite humidity and temperature levels automatically and remotely (Lakkis and Elshakankiri, 2017). Lastly, insurers can utilize data gathered by IoT-based health monitoring devices for underwriting and claims processing (Gimpel *et al.*, 2021). Such data can help health insurers identify false claims and improve transparency between insurers and customers in the underwriting, pricing, claims processing, and risk assessment processes.

Cluster 6: Guidelines for e-health practices and services. The sixth cluster includes three articles and is located at the bottom left quadrant of Figure 5, indicating low centrality and low impact. The most common keywords explaining this cluster are "electronic health record" (100%), "adoption" (33.33%), and "clinical guidelines" (33.33%) (Table A8). The articles in this cluster highlight the need for regulatory authorities to introduce clinical guidelines for the adoption of e-health practices and services. Some countries have enacted legal restrictions, while others use non-legislative measures such as guidelines to conduct telehealth. In the United States, for example, the Health Insurance Portability and Accountability Act (HIPAA) is a law that sets standards for the confidentiality of patient health information and medical records to protect individual privacy (Bhate *et al*., 2020; Moore and Frye, 2020; Savage and Savage, 2020). HIPAA compliance standards include provisions from a number of other legislative acts, including the Public Health Service Act and the Health Information Technology for Economic and Clinical Health (HITECH) Act (Wani and Malhotra, 2018). Guidelines are regarded as professional standards in many developed nations, and medical practitioners are expected to adhere to them (Moore and Frye, 2020). As a result of these guidelines, practitioners are encouraged to consider telehealth as a standard component of their routine practice, which can help them pursue a sound course of treatment to provide safe and efficacious medical care based on recent records, available resources, and patient needs in order to ensure the social and economic security of both the caregiver and the caretaker (Eze *et al.*, 2019; Gagnon *et al.*, 2016; Saifee *et al.*, 2019). According to existing research, a lack of established clinical standards in most developing countries has resulted in considerable uncertainty among registered medical professionals and patients in need, casting aspersions on the use of telehealth (Aboelmaged *et al*., 2021; Bakshi and Tandon, 2021; Barjis *et al*., 2013; Saifee *et al*., 2019). Furthermore, telehealth services are classified as credence products because they are a kind of service that customers cannot observe following payment, making it challenging to ascertain their usefulness

(Saifee *et al.*, 2019). As a result, having a framework and established standards will assist the community in realizing the full potential of telehealth practices and services as technology advances for healthcare delivery. Clinical guidelines prepared by regulatory authorities can address issues such as medical record management involving cross-hospital exchange of medical records, patient data privacy and security, medication, diagnoses, reimbursement, and health education and counselling. Such guidelines should also specify how technologies and the transmission of voice, pictures, and information should be utilized in combination with other clinical standards, policies, and procedures for the provision of treatment. The technology utilized for telehealth services, like any other technology, can be misused (Baudier *et al*., 2021; Ben Arfi *et al*., 2021; Fox and Connolly, 2018), though its risks, disadvantages, and constraints can be minimized with proper training and enforcement of standards, procedures, and guidelines. Telehealth will continue to progress in the mainstream healthcare system and be embraced in varying forms by more healthcare practitioners and patients, and these clinical guidelines will play a key role in fostering its evolution and widespread adoption throughout hospital networks (Alrahbi *et al*., 2021; Chang *et al.*, 2009; Duclos, 2016). To determine whether physicians adhere to clinical standards when administering treatment, hospital administration must create a mechanism (online/offline) to collect patient's feedback so that necessary actions can be taken to improve healthcare services rendered through telehealth (Saifee *et al.*, 2019).

Cluster 7: Telemonitoring of life-threatening diseases. The seventh cluster contains four articles and is located at the top left quadrant of Figure 5, indicating low centrality and high impact. The most common keywords characterizing this cluster are "congestive heart failure" (50%), "telemonitoring" (50%), and "communities of practice" (25%) (Table A8). The articles in this cluster revolve around the remote monitoring of patient health, including patients with chronic illness and rural healthcare systems. Congestive heart failure is one of the most common chronic diseases, with a significant morbidity and fatality rate (Bardhan and Thouin, 2013; Jung *et al*., 2019). Congestive heart failure, as the name implies, is a complex chronic condition in which the heart pumps blood poorly and thus the blood's circulating ability is reduced, leading to a range of cardiovascular disease issues such as heart attack, coronary artery disease, and cardiomyopathy (Vlahu-Gjorgievska *et al*., 2019). This is why cardiovascular disease is the leading cause of death globally, a rising concern and a growing burden on the healthcare system as patients need frequent hospitalization (Bardhan *et al*., 2015; Vlahu-Gjorgievska *et al*., 2019), and a significant cause of social and economic repercussions on the afflicted patient (Jung *et al.*, 2019). Deaths from cardiovascular disease are projected to cost the governments of major economies such as the United States and the European Union $100 billion and $231 billion per year, respectively (Grustam *et al.*, 2018; Pekmezaris *et al*., 2018). To address such issues, the Centers for Medicare and Medicaid Services (CMS) in the United States began penalizing hospitals in 2012 for avoidable readmissions linked to chronic illnesses such as heart failure or pneumonia (Bardhan *et al*., 2015; Pekmezaris *et al*., 2018). According to published evidence, one novel approach is to utilize home tele-monitoring, which is described as an automated procedure for transmitting data on a patient's health condition from the patient's home to a health care facility (Bardhan *et al*., 2015; Barjis *et al.*, 2013; Vlahu-Gjorgievska *et al.*, 2019). The use of ICT and IoT-based medical devices (e.g., cardiac defibrillators, pacemakers, blood pressure monitors) in the provision of care for patients with cardiovascular illnesses has proven to be an effective approach in reducing re-hospitalization (Bardhan *et al.*, 2015; Schwartz *et al.*, 2017). Nonetheless, though IoT-enabled tele-monitoring can assist patients who are geographically far from a healthcare facility, the same cannot be said for rural populations owing to a lack of adequate ICT infrastructure, raising concerns about the long-term sustainability of such telehealth programs in rural regions (Sims, 2018). Some of these challenges include lower literacy, inability to pay for services, limited access to high-speed internet, low smartphone usage, and restricted exchange of electronic health information, among others (Barjis *et al*., 2013; Sims, 2018). This implies that new service models, such as virtual communities of practice, must be developed to address such issues, which may bring together volunteering medical professionals and healthcare workers who are united by common goals and purpose, and who can work collaboratively to share their knowledge in order to improve healthcare provision in rural areas. Sims (2018) verified in his study that communication or technological richness is not necessary for sustaining communities of practice. A similar rural healthcare model has been proposed by Barjis *et al*. (2013), whereby local healthcare workers monitor patients' status on a routine basis (instead of in real time as in urban settings) and transmit health data to a far-away medical expert to expedite their decision-making and take necessary action.

Cluster 8: Change management strategy for telehealth adoption. The eighth cluster is made up of 46 articles and is located at the top right quadrant of Figure 5, indicating high centrality and high impact. The most common keywords describing this cluster are "telemedicine" (100%), "ict" (17.4%), and "organizational change" (15.2%) (Table A8). The articles in this cluster are focused on bringing institutional reforms to the healthcare industry in order to facilitate digital transformation. Providing in-person medical care to patients in the midst of disasters and epidemics poses unique challenges (Oborn *et al*., 2021). In this regard, technology has been utilized throughout history to address society's most pressing issues (Sun *et al.*, 2020; Tarakci *et al.*, 2009; Wang and Wu, 2020). For example, the usage of telehealth increased during the COVID-19 outbreak as healthcare institutions, service aggregators, and physicians looked for reliable and safe ways to reach and treat patients in need (Baudier *et al.*, 2021; Oborn *et al.*, 2021). This necessity-driven transition was made possible by increasing willingness of both consumers and service providers to utilize telehealth technologies, as well as legislative reforms that allowed for more access and compensation (Steinhauser *et al.*, 2020; Wang *et al.*, 2021). Despite the desire of physicians and patients to utilize telehealth platforms, most hospitals and private clinics are not yet equipped to offer care through telehealth, which is a significant obstacle to its large-scale adoption (Lam *et al.*, 2021; Oborn *et al.*, 2021). If a healthcare institution wishes to effectively adopt new technology, particularly telehealth technologies, it must first develop a change management strategy (Barlow *et al.*, 2006; Peltier *et al.*, 2020; Oborn *et al.*, 2021). Firstly, organizations that establish telehealth capabilities will, by default, need internal administrative support services (Chau and Hu, 2002a; Hu *et al.*, 1999; Zobair *et al.*, 2020). Administrative support units dedicated only to telehealth programs, as well as existing administrative employees from each functional department of the hospital, should therefore be involved (LeRouge *et al.*, 2007; Robinson *et al.*, 2003). Second, telehealth requires consistent connection regardless of the location of the physician or patient, emphasizing the need of ICT infrastructure (Chen and Xie, 2015; Ishfaq and Raja, 2015; Overby *et al.*, 2010), especially broadband internet access and medical imaging or healthcare peripherals (Tulu and Chatterjee, 2008). Although ICT is obviously important in telehealth, the practical telehealth solutions are often supplied by third-party software suppliers (Pan *et al.*, 2019; Singh *et al.*, 2018), and because telehealth programs are hardware centric, hospital administration and software providers should collaborate to ensure that diagnostics software is equipped with the appropriate technology to ensure accuracy and mitigate misdiagnosis (Lam *et al.*, 2021). Thirdly, healthcare institutions that want to go the distance with telehealth must execute a systematic transformation program that includes digital training for proficient software uptake and use among both employees and patients (Linderoth, 2017). Any improvements to workflow that may be needed should be addressed by the organization (Constantinides and Barrett, 2006; Peters *et al.*, 2015; Øvrelid and Bygstad, 2019), and employees should be appropriately trained, if necessary (Paul, 2006). A training program should also be implemented to transform novice patients into expert patients, both in terms of technology usage and self-management of disease (Chandwani *et al.*, 2018; Paul *et al.*, 1999). Lastly, healthcare providers must conduct regular tests, introduce new services, and improve existing service models to strengthen patient's trust and engagement in telehealth (Lu *et al.*, 2021; Ozdemir, 2007; Zobair *et al.*, 2020). As healthcare models evolve, new technologies will unavoidably disrupt existing relationships with patients (Brown *et al.*, 2004). This implies that in order to support these new service models, customer service roles must also evolve (Peltier *et al.*, 2020). Employees in any organization are accountable for change management; thus, healthcare companies must inspire, engage, and educate their employees in order to enable them to drive progress (DelliFraine *et al.*, 2006; Peters *et al.*, 2015). Otherwise, employees may be resistant to change, resulting in the failure of telehealth initiatives (Barlow *et al.*, 2006; Constantinides and Barrett, 2006; Zobair *et al.*, 2020).

Cluster 9: Knowledge management of innovations in telehealth. The ninth cluster includes 10 articles and is located at the bottom right quadrant of Figure 5, indicating high centrality and low impact. The most common keywords explaining this cluster are "innovation" (70%), "knowledge management" (40%), and "knowledge acquisition" (30%) (Table A8). The cluster's articles have emphasized various knowledge management models or systems that organizations use for exchanging information internally and externally, which translates into an innovation ecosystem that meets the needs of both physicians and patients. Telehealth encompasses many methods of providing healthcare, such as telemedicine, telecare, e-health, and m-health, and as such, all of these are innovations that offer new ways to deliver healthcare in the comfort of one's own home and support independent living (Drago *et al.*, 2021; Jiang, 2022; Lolich *et al.*, 2019; Nicolini, 2007, 2010). As a result of several empirical assessments and audits, it has been discovered that users and patients are generally satisfied with telehealth technology (Alsohime *et al.*, 2019; Rizzi *et al.*, 2020). This virtual care technology has evolved through a series of iterations that have taken into account the needs of customers, cultural and economic sensitivity, regulatory requirements, and institutional constraints at each stage of the process (Kodama, 2005; Nicolini, 2007, 2010). The greatest performance benefits of any telehealth project are expected via service reconfiguration or skill-mix adjustments that encourage technology-assisted virtual counselling/diagnosis and workload management as a means of avoiding expensive hospitalizations and increasing patient autonomy (Leung *et al.*, 2021; Sun *et al.*, 2020; Vlahu-Gjorgievska *et al.*, 2019). Innovation occurs when an idea or the result of a creative process (e.g., a brainstorming session or a knowledge management program) is successfully implemented in practice to achieve the desired performance benefits (Oderanti and Li, 2018; Shaw and Allen, 2018). For example, Kodama (2005) described how community leaders from Japan created networked strategic communities in which universities, hospitals, private companies, and non-profit groups cooperated to build a new integrated video transmission system for monitoring cattle's health. To add to the debate, Nicolini (2007) acknowledges in a longitudinal study conducted in the Italian context that by better distributing the work done by human and non-human components in a socio-technical structure, the capacity of the telehealth model can be expanded.

Cluster 10: Technology management of telemedicine services. The tenth and final cluster is made up of three articles and is located at the bottom left quadrant of Figure 5, indicating low centrality and low impact. The most common keywords characterizing this cluster are "professional users" (66.7%), "technology management" (66.7%), and "acceptance of information technology" (33.3%) (Table A8). Telehealth offers the ability to alleviate the difficulties associated with time-space constraints that have hindered modern healthcare. Nonetheless, the success of telehealth in becoming a viable alternative that complements or selectively replaces traditional in-person service arrangements requires efficient technology management (Sheng *et al.*, 1999). The most challenging aspect for healthcare organizations is ensuring that new telehealth technologies are adopted in a systematic manner by concerned stakeholders. Patients, for example, may be eager to embrace technological solutions, but progress may be stymied by practitioners who must also be convinced of the benefits, and vice versa. From a psychological standpoint, technology acceptance can be defined as a person's voluntary or intentional usage of a specific technology (Bunduchi *et al.*, 2015). Given the rapid emergence of futuristic technological innovations aimed at physicians and patients, it is critical to assess or predict their ability to adopt telehealth technologies. In this regard, Chau and Hu (2001, 2002b) examined physicians' adoption of telehealth technology using intention-based models drawn from the conceptual underpinnings of the Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB). Their findings suggest that the TAM model is capable of explaining physicians' decisions to accept or reject a technology, as these professionals seem to be fairly autonomous in making technology acceptance decisions. Furthermore, because new technologies are always developed in accordance with a product development life cycle that includes idea generation, conceptualization, prototyping, market testing, technology development, technology transfer, and commercialization, keeping up with the pace of evolving new technologies is another difficult challenge confronting healthcare organizations. As evidenced by an increasing number of technologies emerging from research that are being deployed in hospital settings for clinical trial purposes, current telehealth technology is somewhere between technology development and technology transfer, and gradually moving towards large-scale commercialization. In light of this, Sheng *et al.* (1999) provided a decision-making viewpoint for organizational management of telehealth technologies that took into consideration the technology life-cycle model, which postulates that technology management can be suitably engaged by planning, developing, and implementing the technical capabilities needed to define and accomplish the organization's strategic goals.

4. Forging the way forward for telehealth research

Building on the science mapping of telehealth research in top-tier business journals, this study conducts a two-stage content analysis, wherein the first stage comprises all 174 articles and second stage contains articles that have been segmented into clusters or themes from keyword clustering. In doing so, this study ascertains the knowledge gaps that are cluster or theme specific and the gaps that transcend across clusters and themes to inform the directions for future telehealth research from a business perspective. In the future, business scholars may explore the following future research avenues (FRA) in order to contribute to the realm of telehealth from a business perspective.

FRA1: Establishing sustainable telehealth service and business models. The content analysis reveals that most scholars advocate for future research that builds on well-known factors such as accessibility and affordability to identify and investigate a wider range of contextual and situational factors that can encourage greater user acceptance and adoption of telehealth technologies (Gimpel *et al.*, 2021; Islam *et al.*, 2020; Pan *et al.*, 2019; Xing *et al.*, 2019; Zhang *et al.*, 2019), and to evaluate the actual utility of telehealth services among the wider population (Duarte and Pinho, 2019; Liu and Varshney, 2020). Some scholars have also emphasized the need for new strategies to design and develop the business model of telehealth platforms (e.g., e-health, m-health) that will lead to service sustainability (Lolich *et al.*, 2019; Urueña *et al.*, 2016; Watterson *et al.*, 2020). The use of social media is omnipresent in many industries and has been earmarked as a potential tool for telehealth (Baudier *et al.*, 2021; Gimpel *et al.*, 2021; Liu *et al.*, 2019; Peltier *et al.*, 2020), and thus, future research that explains how healthcare providers can leverage on social media to provide telehealth services in ethical and secure ways will be highly promising (Khalemsky and Schwartz, 2017; Wang *et al.*, 2020).

FRA2: Electronic health record integration and healthcare interoperability. The content analysis makes clear that public health organizations are increasingly embedding and using telehealth in their primary healthcare arrangements to reduce healthcare expenses while enhancing supervision of patient health (Chandwani *et al.*, 2018; Khodadad-Saryazdi, 2021; Vlahu-Gjorgievska *et al.*, 2019). To enhance patient care, it is suggested that additional research is done on mechanisms that can enable the integration of EHR data across medical facilities (Green *et al.*, 2016; Standing *et al.*, 2018a), which can be pursued by business scholars with expertise in data analytics, information systems, and management operations. Other options include establishing platforms that are scalable and interoperable, guaranteeing a consistent experience for patients, physicians, and EHR providers, or developing a business model (Lennefer *et al.*, 2020; Mountford, 2019; Watterson *et al.*, 2020). As an additional research avenue, business scholars might look at how stakeholders (healthcare consumers and providers) under different critical scenarios (e.g., natural disaster, accident, crisis) could benefit from an economic and social wellbeing perspective through the integration of EHRs into the national healthcare system.

FRA3: Understanding behavioral traits of users in a virtual care environment. Several scholars have also remarked on the critical need for further research to provide an understanding of the adoption traits of telehealth users and to develop smartphone-based (or wearables-based) solutions for wellness and medical conditions given the healthcare constraints witnessed during the COVID-19 pandemic (Aboelmaged *et al*., 2021; Gimpel *et al*., 2021). Patients' willingness to utilize an e-health system is largely influenced by their expectations about how convenient it will be to use, and this is also true for physicians on the other end of the equation. Thus, business scholars may investigate the social and economic motivations for using a virtual care arrangement model as opposed to a physical counterpart. In this regard, future research can be conducted using quantitative and qualitative approaches to evaluate the acceptability, practicality, scalability, productivity, opportunities, and adoption challenges of telehealth applications for enhancing digital experience for virtual healthcare arrangements (Duarte and Pinho, 2019; Liu and Varshney, 2020; Miao *et al*., 2017). Distinct service delivery models must also be developed to improve virtual care arrangements for conditions such as cardiovascular disease, psychological health, cancer, and diabetes, among others (Green *et al.*, 2016; Øvrelid and Bygstad, 2019; Schwartz *et al*., 2017), and thus, highlighting the need for business scholars to also collaborate with medical scholars. It is also imperative that more research is done to better understand how healthcare providers (or health aggregators) should root their telehealth strategies at the confluence of patient requirements and preferences, as well as clinical issues, in order to provide the most appropriate service solution via telehealth (Watterson *et al*., 2020; Xing *et al*., 2019; Zhang *et al*., 2019).

FRA4: Strengthening remote healthcare services. Other scholars have shed light on the significance of telehealth for people of all ages from rural and urban regions, as well as the capacity of the telehealth platform to fulfill the community's requirements (Eze *et al*., 2019; Jeffrey *et al*., 2019; Khalemsky and Schwartz, 2017). Good governance is critical to institutionalizing telehealth in primary healthcare delivery (Oborn *et al*., 2021). A possible solution might be to form a telehealth governance group inside or as a subcommittee of the healthcare organization or clinical governance institutions (Klecun *et al.*, 2019). This governance group will need strong leadership to improve practice knowledge across healthcare organizations and to ensure that clinical policies are implemented efficiently and effectively (Kodama, 2005). Governance structures at both the micro and macro levels are also required for effective professional collaboration and seamless digital communication among healthcare providers (Gagnon *et al.*, 2016; Saifee *et al.*, 2019; Zobair *et al.*, 2020). The governing structures for such purposes should create standards for telehealth procedures and protocols in hospitals and community healthcare facilities, such as exchanging information on equipment settings, diagnostic assistance, and clinical practices (Saifee *et al.*, 2019). As a consequence, future research in this direction should concentrate on the need of establishing effective governance structures (or mechanisms) to achieve the full potential of telehealth technologies to improve patient access to healthcare, lower clinical risk, and make better use of medical administrative resources (Bardhan *et al*., 2015).

FRA5: Policy framework for telehealth regulation. Furthermore, the effectiveness of regulatory interventions have been established across demographic groups, though implementing regulatory interventions has proven to be a challenging endeavor for both public and commercial healthcare institutions in remotely located regions (Burmeister *et al*., 2015; Sims, 2018; Wang *et al*., 2021). As a result, additional research is required to propose suggestions for establishing frameworks and governance structures for the deployment of telehealth programs in such areas to improve its impact on quality, accessibility, and efficiency in service delivery (Vesselkov *et al*., 2018; Zobair *et al*., 2020).

FRA6: Emerging technologies in m-health services. For patients and their physicians, gadgets and smartphone applications have come to play an essential role in monitoring and preventing chronic illnesses. Integrating IoT and HIT innovation has led to the creation of a new Internet of Medical Things (IoMT) (Meng *et al*., 2020). Several articles illustrate the experimental or nascent capabilities of such IoMT technologies, demonstrating their growing potential for mainstream medical practice and remote clinical care (Almobaideen *et al*., 2017; Biswas *et al*., 2020; Lakkis and Elshakankiri, 2017). Nonetheless, additional research remains necessary to develop comprehensive autonomous IoT-based healthcare facilities with suitable security and control mechanisms that need minimal human intervention, which should also include the integration of operational tasks such as customer relationship management and finance, to fully expand the facility, utility, and seamlessness of IoMT (Go Jefferies *et al*., 2019). Additionally, big data generated by e-health systems presents a number of privacy and data security concerns that must be addressed (Dehling and Sunyaev, 2014; Walsh *et al*., 2021). It is projected that e-health systems would be dynamical accessible environments linking a wide range of healthcare services to patients or subscribers. Given that e-health systems must be connected to the internet, issues of security, privacy, and confidentiality may be at risk (Kim and Kwon, 2019; Zobair *et al*., 2021). Undoubtedly, the fear of cyberattacks has a detrimental impact on medical service digitalization (Meng *et al.*, 2020). In addition, rules safeguarding health data are circumscribed in coverage in certain underdeveloped and even developed countries (Duarte and Pinho, 2019; Vesselkov *et al*., 2018). As a result, e-health systems have the additional challenge of protecting patient data in digital environments that span multi-region boundaries, which may be scrutinized by business scholars in the future.

FRA7: Automation in telehealth platforms. The COVID-19 pandemic is a noteworthy phenomenon that is worth mentioning as it has accelerated digital transformation and accentuated the importance of new-age technologies such as artificial intelligence, blockchain, and IoT for economic and societal functioning (Lim, 2021b, 2022c). Specifically, new-age technologies can facilitate precise predictions regarding a patient's or a community's health risks based on secured and verified data collected from blockchain-enabled IoT devices, which is helpful in volatile, uncertain, complex, and ambiguous environments (Wang and Wu, 2020). For example, there was a rise in the adoption of artificial intelligence (AI)-powered technologies that might be utilized to perform automated interactions with patients in the absence of a clinician. Although AI-powered healthcare chatbots may save time when integrated with medical information such as symptoms, medications, treatments, and diseases, they are not always effective. In this context, business scholars in collaboration with computer science and medical scholars have the opportunity to explore and develop techniques or models that increase the efficacy of such technologies (Khalemsky and Schwartz, 2017; Vesselkov *et al*., 2018). In addition, business scholars should think about the policy perspective, which has been used to advise regulatory bodies such as the Food and Drug Administration (FDA) to exercise appropriate control over third-party developers in order to prevent clients of the latter from providing any misleading information or diagnostics solution that has a negative impact on patient health. That is to say, though new technologies offer enormous promise as risk compensators, without effective regulation, they may exacerbate the digital gap in society (Burmeister *et al.*, 2015; Lolich *et al.*, 2019), which needs to be addressed, and thus, requiring further study. Specifically, IoMT technologies are linked to a range of privacy and security issues (Biswas *et al*., 2020; Kim and Kwon, 2019; Klecun *et al*., 2019), and thus, further research is needed to create worldwide agreement on security regulations for IoMT use in healthcare platforms. Other potentially fruitful research avenues in this direction include the identification, modeling, adoption, and managing of advanced database technologies, cutting-edge computing infrastructure, and front-line analytics tools that can be used in personal healthcare management (Gimpel *et al.*, 2021), hospital administration (Lennefer *et al*., 2020; Mountford, 2019), and pharmaceutical distribution as well as inventory management. In addition, business scholars can explore how virtual reality and augmented reality can help in engaging (Lim *et al*., 2022b) and training healthcare professionals to plan medical procedures, as well as developing service platforms that can enhance physician-patient interaction (Chandwani *et al*., 2018; Øvrelid and Bygstad, 2019).

Taken collectively, this study finds that telehealth research has been informed by a wide range of business perspectives, such as information systems, management, and marketing. Therefore, business scholars who wish to pursue the future research directions that are curated herein and summarized in Table A10 should adopt a multidisciplinary lens and collaborate both within and beyond business disciplines in order to engage in translational research that will not only enrich understanding of telehealth but also translates that understanding into real-world impact.

5. Conclusion

To this end, it is clear that telehealth is an important component of healthcare with far-reaching implications for general health management and modern healthcare facilities, and their advancement with the input from business scholars can pave the way to more efficient and sustainable economies given that economic health is dependent on public health, as witnessed during the COVID-19 pandemic (Lim, 2021b). In this regard, this article serves not only as a consolidation of extant knowledge but also as a wake-up call for healthcare service providers and policymakers to take proactive actions to improve telehealth deployment as a mainstream healthcare practice in order to improve the physical and psychological wellbeing of all stakeholders, leading to good public health.

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Zobair, K.M., Sanzogni, L., Houghton, L., Sandhu, K. and Islam, M.J. (2021), "Health seekers' acceptance and adoption determinants of telemedicine in emerging economies", *Australasian Journal of Information Systems*, Vol. 25, pp. 1–30.

Zobair, K.M., Sanzogni, L. and Sandhu, K. (2020), "Telemedicine healthcare service adoption barriers in rural Bangladesh", *Australasian Journal of Information Systems*, Vol. 24, pp. 1–24.

Figure 1. Structure of study

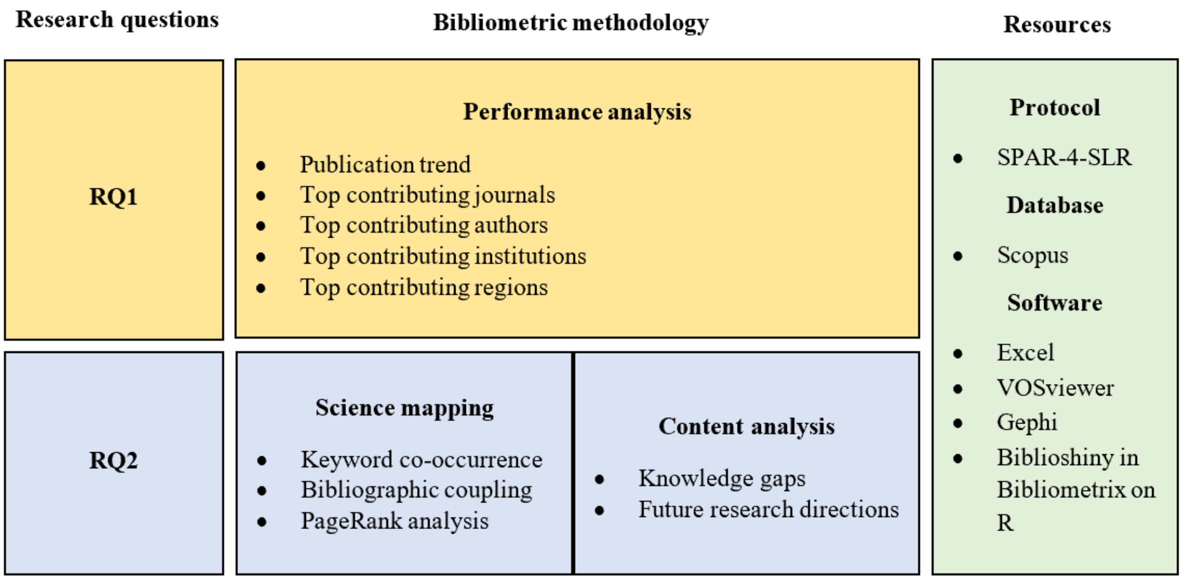
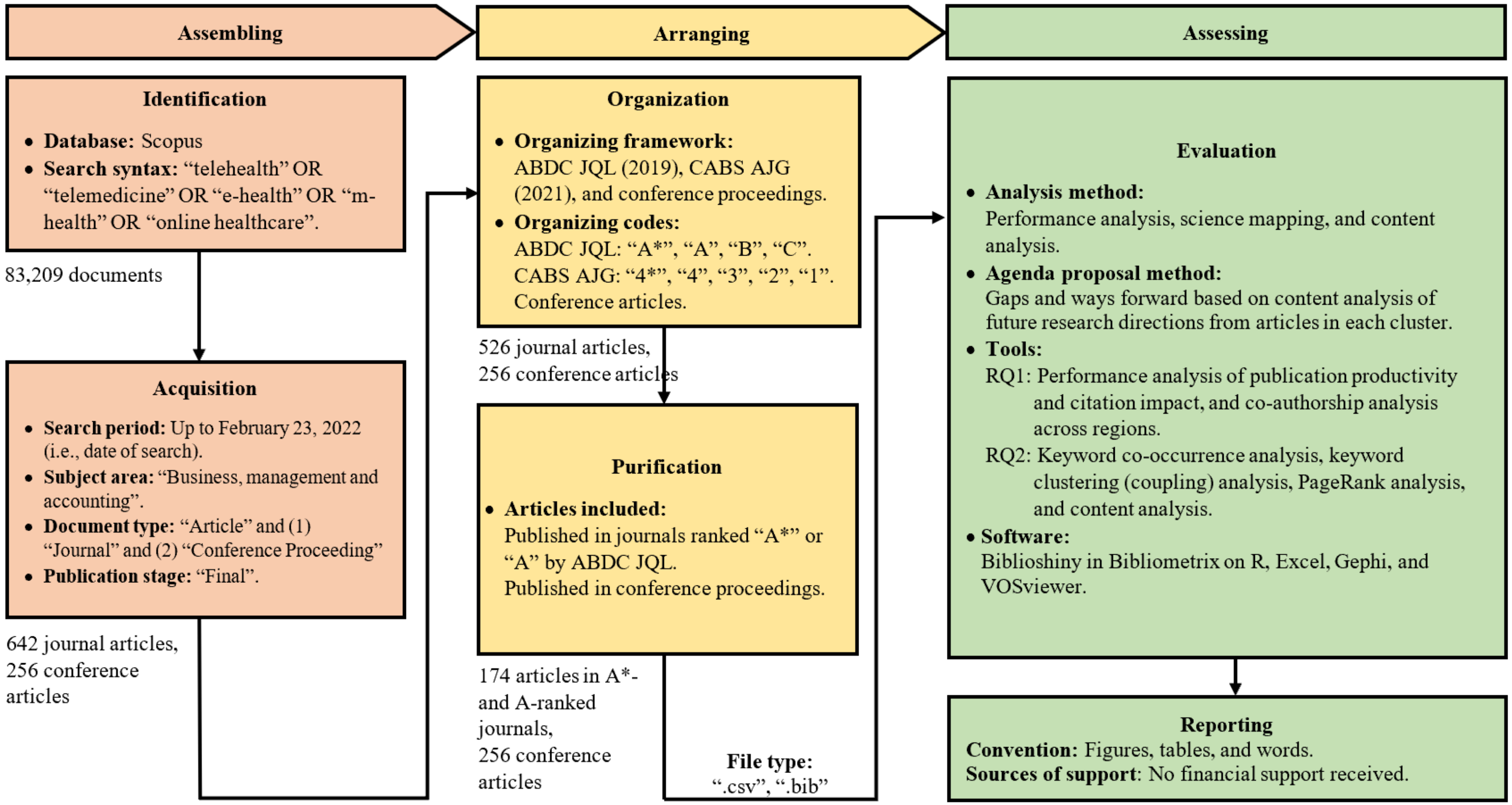


Figure 2. Methodology of study



Notes: ABDC JQL = Australian Business Deans Council Journal Quality List. CABS AJG = Chartered Association of Business Schools Academic Journal Guide.

Figure 3. Year-wise publication trend for telehealth research in top-tier business journals and conference proceedings

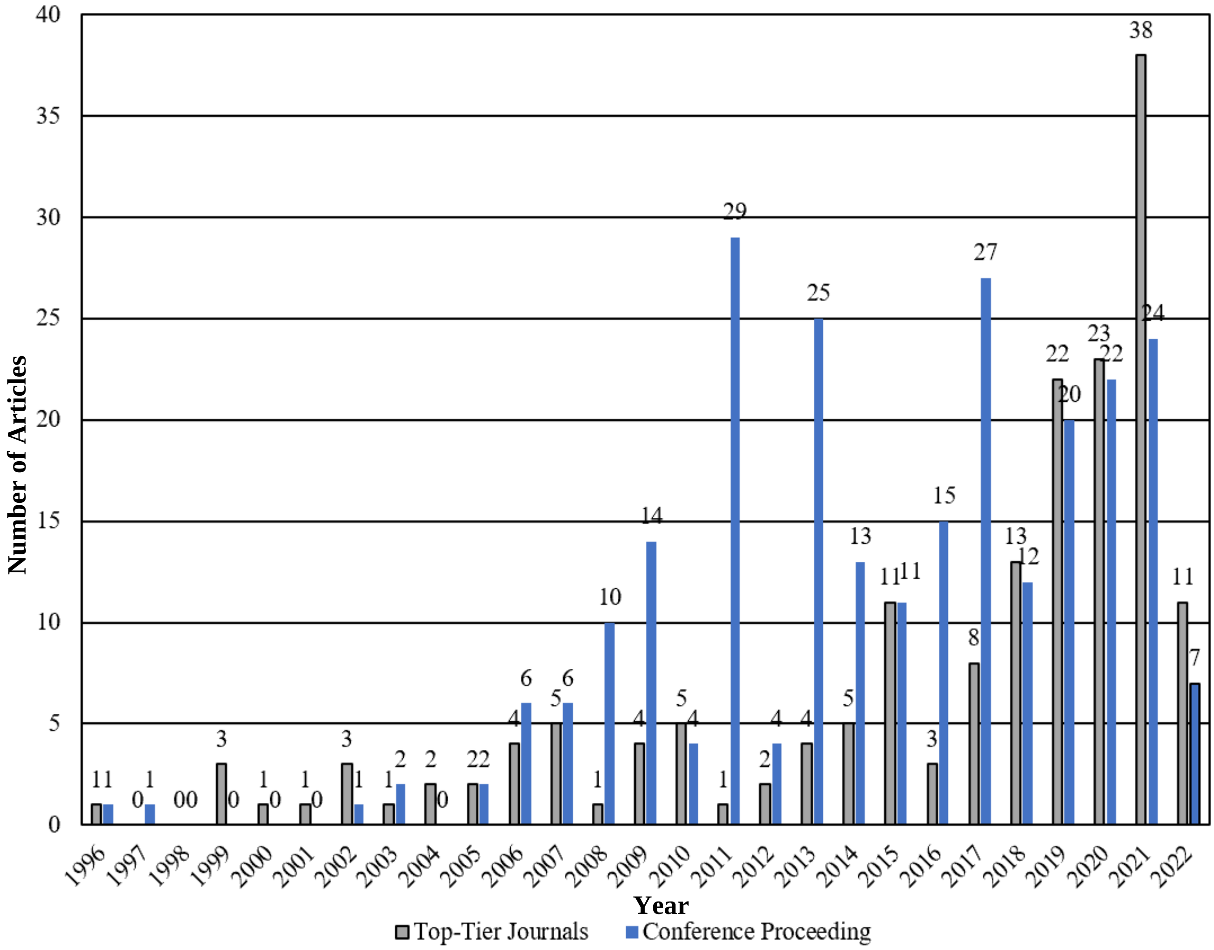


Figure 4. Keyword co-occurrence network for telehealth research in top-tier business journals

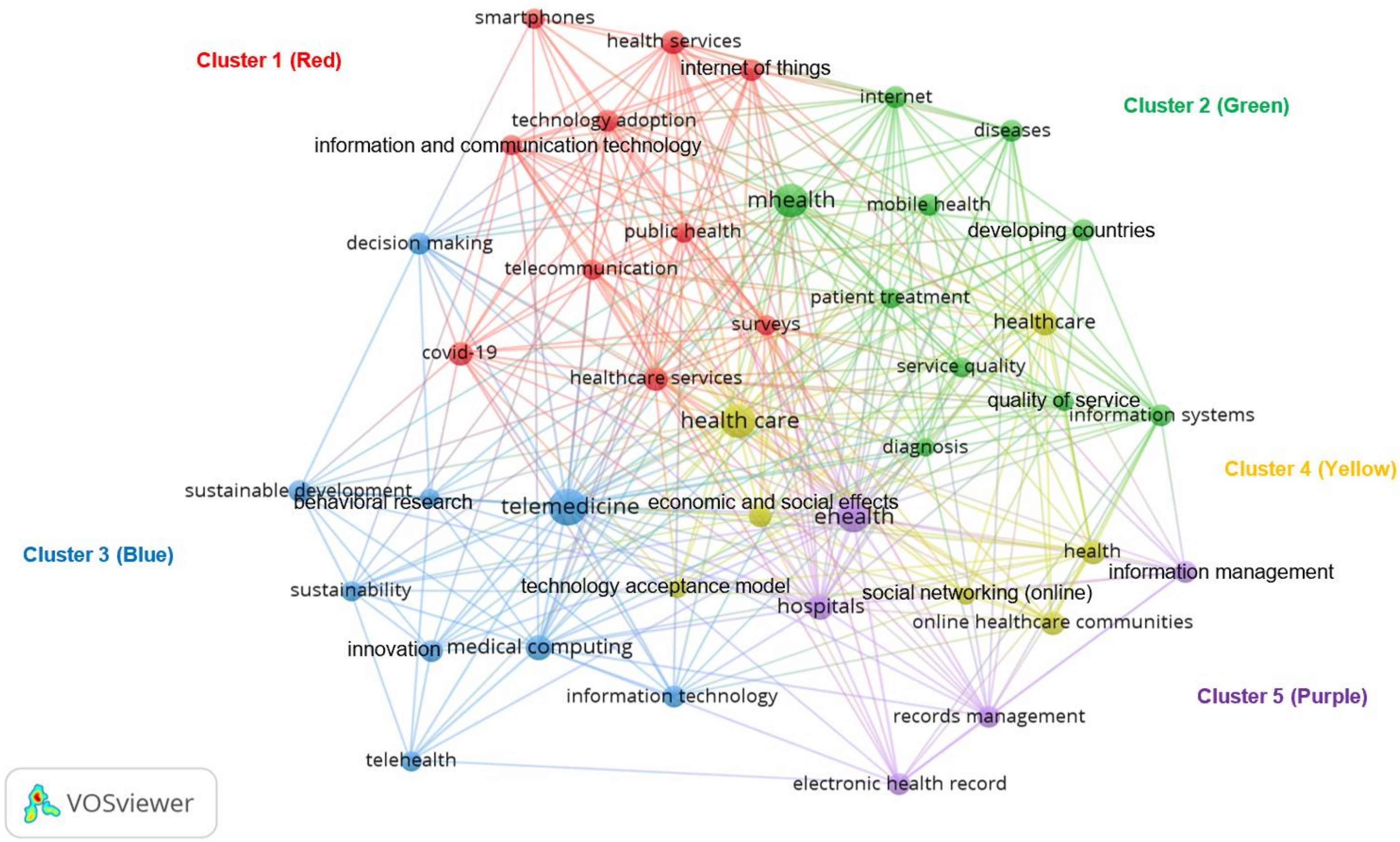
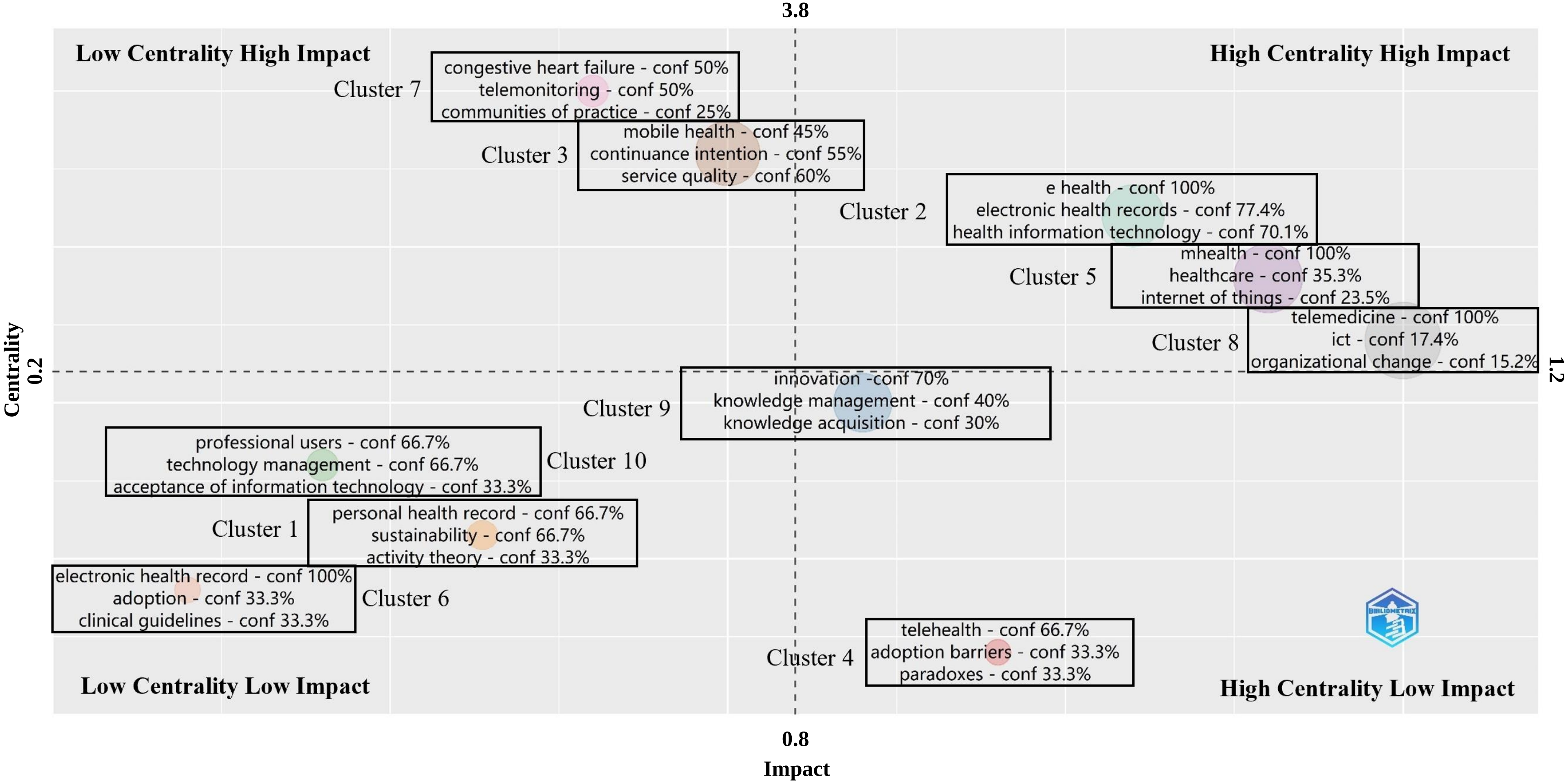


Figure 5. Bibliographic coupling map for telehealth research in top-tier business journals



Appendix I. Review protocol

Assembling

The *assembling* stage has two sub-stages: identification and acquisition (Paul *et al*., 2021). Primarily, the goal of the *identification* sub-stage is to locate publications on telehealth through a scientific database. Due to the fact that Scopus includes a wider variety of publications than other databases such as Web of Science (Bretas and Alon, 2021; Cruz-Cárdenas *et al*., 2021), this review has opted to use Scopus as the scientific database of choice to source for telehealth publications relevant to answer its research questions (RQ1, RQ2). The terms "telehealth", "telemedicine", "e-health", "m-health", and "online healthcare" are identified through brainstorming among co-authors and used as keywords for the document search on Scopus, resulting in the return of 83,209 documents.

Next, in accordance with the SPAR-4-SLR protocol, refinement parameters such as search period, subject area, document type, and publication stage were used in the *acquisition* sub-stage (Paul *et al*., 2021). More specifically, the start date of the search was left open but the end date of the search period was limited to February 23, 2022, which was the date of the search, in order to include all relevant articles at the time of the search. The subject area of "business, management and accounting" was chosen because of its direct relevance for the scope of this study (i.e., telehealth from the business perspective). This resulted in the identification of 898 documents that comprised 642 articles in journals and 256 articles in conference proceedings. Following the SPAR-4-SLR guidelines, we categorized the data into two types, one concentrating on journal articles and the other on conference proceedings, since quality screening is required in the latter phases of refining. Following assembling approach suggested by prior studies (Kraus *et al*., 2022; Paul *et al*., 2021), the "finalized" documents that are classified as "articles" published in "journals" have been considered because they represent the final version of documents with empirical findings that have received the highest-level of peer scrutiny (as compared to overlapped findings and lower-level of peer scrutiny in non-articles such as reviews and editorials or non-journal sources, respectively). This refinement resulted in 526 articles in journals, which were acquired and progressed to the next stage. The 256 articles in conference proceedings were also retained for descriptive reporting in relation to conference outlets, authors, and institutions, and they acted as a base for comparison against the journal articles.

Arranging

The *arranging* stage consists of two-substages: organization and purification (Paul *et al*., 2021). In the *organization* sub-stage, the two main codes were used for organizing the 526 journal articles acquired from the acquisition sub-stage: the Australian Business Deans Council (ABDC) 2019 Journal Quality List (JQL), and the Chartered Association of Business Schools (CABS) 2021 Academic Journal Guide (AJG). ABDC JQL and CABS AJG are commonly used as organizing codes to prepare the review corpus for purification, which is the next sub-stage. According to ABDC JQL, 2,682 journals have been ranked under the four categories that reflect journal quality: "A*" (199 journals, 7.41%), "A" (651 journals, 24.27%), "B" (850 journals, 31.69%), and "C" (982 journals, 36.61%). Similarly, CABS AJG covers a variety of journal ratings such as "4*", "4", "3", "2", and "1", where "4*" signals superior quality and "1" signifies acceptable quality (Baker *et al*., 2020; Goyal and Kumar, 2021; Paul *et al*., 2021).

Next, in the *purification* sub-stage, the 526 journal articles acquired from the acquisition sub-stage that have been organized according to journals and journal rank in the organization sub-stage are purified, whereby only articles published in journals ranked "A*" and "A" in ABDC JQL were included. The decision to purify articles using ABDC JQL instead of CABS AJG (or a combination of both) was based on a pragmatic evaluation of curating an adequate yet manageable and representative review corpus of high quality (i.e., using CABS AJG or both ABDC JQL and CABS AJG would have led to a very small review corpus). Noteworthily, this purification technique is in line with the recommendation by Paul *et al*. (2021) for high-quality purification, and thus, receives external support. The recommendations of peer reviewers were also considered, which led to the signaling of journals in two other reputable journal lists, namely the Financial Times list of the top 50 premier business journals (FT 50) and the University of Texas at Dallas list of top 24 premier business journals (UTD 24) (e.g., Table A1 and Table A2). Thus, the purification sub-stage, which primarily selects articles published in journals ranked "A*" and "A" by ABDC JQL, have led to the final corpus of 174 journal articles in addition to the 256 conference articles, whose bibliometric records on Scopus were saved in ".bib" and ".csv" files for assessment in the next stage.

Assessing

The *assessing* stage is made up of two sub-stages: evaluation and reporting. In the *evaluation* sub-stage, the 174 journal articles published in 38 "A*" and "A" journals finalized in the purification sub-stage were subjected to performance analysis and science mapping; the 256 conference articles were only subjected to descriptive reporting in relation to conference outlets, authors, and institutions—they were not subjected to full fledge analysis (e.g., science mapping) due to several pragmatic reasons (e.g., incomplete bibliographic records, potential repetition in knowledge if extended version of articles in conference proceedings get published in top-tier business journals). In essence, *performance analysis* pertains to the assessment of publication productivity and citation impact of the field and its contributors (e.g., journals, authors, institutions, regions), whereas *science mapping* relates to the discovery of knowledge clusters (e.g., major themes, topics) in the field (Donthu *et al*., 2021; Mukherjee *et al*., 2022). In particular, the performance analysis was carried out using Microsoft Excel and Biblioshiny in Bibliometrix on R to analyze the publication and citation trend and pick out the top journals, authors, institutions, and regions in telehealth research in top-tier business journals (RQ1), thereby providing high-quality reference points for gaining insights into the field's trajectory, major contributors, and potential collaborators (Castillo-Vergara *et al*., 2018; Donthu *et al*., 2020; Wang and Tian, 2021). Following that, Biblioshiny in Bibliometrix on R, Gephi, and VOSviewer were used to conduct science mapping to identify the themes and topics characterizing the intellectual structure of telehealth research from the business perspective (RQ2), thereby providing key insights to the major streams of research and its body of knowledge in the field (Kumar *et al.*, 2021; Kutluk and Danis, 2021; Pai and Alathur, 2021; Shen *et al*., 2018). Noteworthily, the use of bibliometric analysis techniques (i.e., performance analysis and science mapping) also strengthens the insights derived from systematic literature reviews as it provides a method of evaluating the progression of scholarly contribution objectively rather than subjectively (Armfield *et al*., 2014; Donthu *et al*., 2021; Gu *et al*., 2019; Lim *et al*., 2022a; Mukherjee *et al*., 2022; Nasir *et al*., 2020). Specifically, this study conducts science mapping using *keyword co-occurrence* and *keyword clustering* via VOSviewer and Biblioshiny in Bibliometrix on R, respectively, to reveal the major themes (clusters) and topics (keywords) in the intellectual structure of telehealth research in top-tier business journals. Following that, this study conducts a *PageRank analysis* as part of science mapping using Gephi to identify notable articles in the intellectual structure of telehealth research in top-tier business journals. Finally, this study performs a *content analysis* of articles clustered in each major theme to identify extant gaps and curate a collection of research directions for future telehealth research from a business perspective. The guidelines for performing a bibliometric analysis, specifically using tools such as keyword co-occurrence, keyword clustering, PageRank analysis, and content analysis, were derived from the work of Donthu *et al*. (2021), which provided a clear structure for the present review. Noteworthily, a comprehensive bibliometric review commences with performance analysis before moving onto scientific mapping, which should be backed by a content analysis to reveal key insights in the field (Baker *et al*., 2020; Donthu *et al*., 2020, 2021; Goyal and Kumar, 2021; Lim *et al*., 2022a). Keyword co-occurrence and keyword clustering, which are discussed in the main sections of the article, represent two popular bibliometric analytical techniques that are commonly used to identify the intellectual structure of a field (Donthu *et al.*, 2021). The usage of both keyword co-occurrence and keyword clustering can provide a means for triangulation to confirm the identification and establishment of diverse intellectual clusters (Kraus *et al*., 2022; Lim *et al*., 2022a). Furthermore, keyword clustering can reveal the articles associated with each cluster, whilst PageRank analysis aids in picking out the most prominent articles for each cluster based on algorithmic calculations for publication prestige in the field (Donthu *et al*., 2021). Moreover, the use of content analysis is necessary to provide qualitative context to the quantitative findings revealed through keyword co-occurrence and keyword clustering, thereby leading to a holistic understanding of the field's body of knowledge (Kraus *et al*., 2022; Lim *et al*., 2022a).

Finally, in terms of *reporting*, this article follows the convention of previous systematic literature reviews using bibliometric analytical techniques (Baker *et al*., 2020; Goodell *et al*., 2021; Goyal and Kumar, 2021). Thus, this article uses a combination of figures (network visualization), tables (bibliographic summaries), and words (narratives) to describe and explain its findings. No external support nor funding was received for this study.

Appendix II. Bibliometric results

Table A1. Top contributing A*/A-ranked journals and conferences proceedings for telehealth research ranked by number of publications

Code	**Journal Title**	**Article(s) (n)**	**ABDC Journal Rank**	**CABS Ranking**	**Yearly Distribution**									
					<2014	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
TFSC	Technological Forecasting and Social Change	25	A	3			1		1	4	1		13	5
IJIM	International Journal of Information Management	13	A*	2	2		1	1			4	3	2	
DSS	Decision Support Systems	11	A*	3	6		1		1			2	1	
IAM	Information and Management	10	A*	3	3	1	1		1			3	1	
ISR	Information Systems Research (FT 50, UTD 24)	9	A*	4	1	1	2				3	2		
AJIS	Australasian Journal of Information System	8	A	1			1		2		3	1	1	
IEEE	IEEE Transactions on Engineering Management	8	A	3	2				1			3	2	
JMIS	Journal of Management Information Systems (FT 50)	8	A*	4	4		1				1	1	1	
TCHN	Technovation	8	A	3	3	1							2	2
EM	Electronic Markets	7	A	2	3	2							2	
JBR	Journal of Business Research	6	A	3	1			1			3	1		
HCMR	Health Care Management Review	4	A	2	3							1		
IMDS	Industrial Management and Data Systems	4	A	2						1		2	1	
IJPR	International Journal of Production Research	4	A	3			1		1		1		1	
JIT	Journal of Information Technology	4	A*	4	1			1			2			
JSM	Journal of Services Marketing	4	A	2			1				1	1	1	
DS	Decision Sciences	3	A*	3	1		1						1	
IAO	Information and Organization	3	A*	3	1					1			1	
JCP	Journal of Cleaner Production	3	A	2						2			1	
POM	Production and Operations Management (FT 50, UTD 24)	3	A*	4						1	1		1	
SRBS	Systems Research and Behavioral Science	3	A	2						2				1
EJIS	European Journal of Information Systems	2	A*	4	1									1
HR	Human Relations (FT 50)	2	A*	4	2									
IJEC	International Journal of Electronic Commerce	2	A	3	1						1			
JCM	Journal of Consumer Marketing	2	A	1								1	1	
JSTP	Journal of Service Theory and Practice	2	A	1										2
KMRP	Knowledge Management Research and Practice	2	A	1	1								1	
OS	Organization Studies (FT 50)	2	A*	4	1								1	
PAM	Psychology and Marketing	2	A	3						2				
RIO	Review of Industrial Organization	2	A	2								1	1	
BJM	British Journal of Management	1	A	4	1									
CMR	California Management Review	1	A	3									1	
CME	Construction Management and Economics	1	A	2					1					
EJWOP	European Journal of Work and Organizational Psychology	1	A	3								1		
IS	Information Society	1	A	3	1									
IJCHM	International Journal of Contemporary Hospitality Management	1	A	3									1	
IJPE	International Journal of Production Economics	1	A	3							1			
IJPM	International Journal of Project Management	1	A	2	1									
Total		**174**			**40**	**5**	**11**	**3**	**8**	**13**	**22**	**23**	**38**	**11**

UTD 24 – Quality Journals endorsed by University of Texas at Dallas, FT 50 – Quality Journals endorsed by Financial Times, ABDC– Quality Journals endorsed by Australian Business Dean Council, and CABS– Quality Journals endorsed by Chartered Association of Business Schools

Code	**Conference Title**	**Article(s) (n)**	**Yearly Distribution**									
			<2014	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
ECEG	The European Conference on E Government	14	9	1	1		2		1			
IBIMA	International Business Information Management Association Conference	13	11		1			1				
GHTC	IEEE Global Humanitarian Technology Conference	11	7	4								
PICMET	Portland International Conference on Management of Engineering and Technology	9	3	2		2			2			
ICIKM	International Conference on Information and Knowledge Management	8	8									
ICEB	The International Conference on Electronic Business	8	4	1			3					
IBIMAC	International Business Information Management Association Conference	5	5									
ICIEOM	The International Conference on Industrial Engineering and Operations Management	5				1			2	1	1	
ICIEEM	IEEE International Conference on Industrial Engineering and Engineering Management	4						2	1	1		
IAMOT	International Association for Management of Technology Conference	4			1	1				2		
ECBIOS	IEEE Eurasia Conference on Biomedical Engineering, Healthcare and Sustainability	3							1		2	
ICST	IEEE International Conference on Smart Technologies	3					3					
RTSI	IEEE International Forum on Research and Technologies for Society and Industry	3					3					
IHTC	IEEE International Humanitarian Technology Conference	3					3					
ICEG	International Conference on E Government	3	3									
ICHONET	International Conference on High-Capacity Optical Networks and Emerging Technologies	3	3									
IJCSS	International Joint Conference on Service Sciences	3	3									
CBI	IEEE Conference on Business Informatics	2					2					
ICCSE	IEEE International Conference on Computational Science and Engineering	2					2					
ICEUC	IEEE International Conference on Embedded and Ubiquitous Computing	2					2					
ICETICE	IEEE International Conference on Enabling Technologies Infrastructure for Collaborative Enterprises	2					2					
R10HCT	IEEE Region 10 Humanitarian Technology Conference	2	2									
IC2IE	International Conference on Computer and Informatics Engineering IT Based Digital Industrial Innovation for the Welfare of Society	2									2	
ICEG	International Conference on E Government	2	2									
ICE2T	International Conference on Engineering Technology and Technopreneuship	2	2									
ICRIIS	International Conference on Research and Innovation in Information Systems	2	2									
ICETE	International Joint Conference on E Business and Telecommunications Proceedings	2	2									
IMETI	International Multi Conference on Engineering and Technological Innovation	2	2									
Total		**124**	**68**	**8**	**3**	**4**	**22**	**3**	**7**	**4**	**5**	**0**

Note: The list of conferences is restricted to conferences with a minimum of two publications on telehealth research.

Table A2. Top contributing A*/A-ranked journals and conferences proceedings for telehealth research ranked by citations

Code	Journal Title	Article(s) (n)	Citation(s)	h-index	Average citations per article	Yearly distribution					
						<2018	2018	2019	2020	2021	2022
JMIS	Journal of Management Information Systems (FT 50)	8	1845	6	230.63	1370	106	107	114	127	21
IAM	Information and Management	10	942	7	94.20	594	73	71	92	95	17
DS	Decision Sciences	3	862	2	287.33	617	63	62	51	62	7
IJIM	International Journal of Information Management	13	643	9	49.46	89	51	97	147	208	51
ISR	Information Systems Research (FT 50, UTD 24)	9	451	6	50.11	88	68	65	90	117	23
DSS	Decision Support Systems	11	449	9	40.82	204	44	49	62	76	14
OS	Organization Studies (FT 50)	2	440	2	220.00	199	60	44	62	61	14
EM	Electronic Markets	7	297	5	42.43	119	25	32	53	58	10
TCHN	Technovation	8	225	5	28.13	141	18	11	19	22	14
TFSC	Technological Forecasting and Social Change	25	223	9	8.92	6	16	28	39	93	41
HR	Human Relations (FT 50)	2	199	2	99.50	121	26	19	21	9	3
IEEE	IEEE Transactions on Engineering Management	8	135	6	16.88	83	1	4	12	32	3
JBR	Journal of Business Research	6	129	5	21.50	9	2	8	26	62	22
JIT	Journal of Information Technology	4	88	4	22.00	45	6	10	10	17	0
IAO	Information and Organization	3	83	3	27.67	47	4	6	8	14	4
IJPR	International Journal of Production Research	4	69	4	17.25	9	3	6	18	25	8
BJM	British Journal of Management	1	67	1	67.00	36	8	6	11	6	0
HCMR	Health Care Management Review	4	63	3	15.75	53	1	1	5	2	1
AJIS	Australasian Journal of Information System	8	53	4	6.63	10	5	12	13	12	1
EJIS	European Journal of Information Systems	2	45	1	22.50	34	6	2	3	0	0
IMDS	Industrial Management and Data Systems	4	38	2	9.50	0	2	6	13	13	4
IJPE	International Journal of Production Economics	1	38	1	38.00	0	1	5	12	16	4
POM	Production and Operations Management (FT 50, UTD 24)	3	38	2	12.67	0	0	5	8	19	6
SRBS	Systems Research and Behavioral Science	3	34	1	11.33	2	1	8	8	13	2
IJPM	International Journal of Project Management	1	20	1	20.00	17	1	1	1	0	0
PAM	Psychology and Marketing	2	20	2	10.00	0	1	2	7	8	2
IJEC	International Journal of Electronic Commerce	2	18	2	9.00	5	0	1	5	6	1
JSM	Journal of Services Marketing	4	17	2	4.25	1	2	3	3	5	3
JCP	Journal of Cleaner Production	3	14	2	4.67	0	0	6	5	3	0
KMRP	Knowledge Management Research and Practice	2	14	2	7.00	5	1	3	1	3	1
CME	Construction Management and Economics	1	9	1	9.00	2	1	3	2	1	0
IJCHM	International Journal of Contemporary Hospitality Management	1	4	1	4.00	0	0	0	0	4	0
JCM	Journal of Consumer Marketing	2	2	1	1.00	0	0	0	0	2	0
CMR	California Management Review	1	0	0	0	0	0	0	0	0	0
EJWOP	European Journal of Work and Organizational Psychology	1	0	0	0	0	0	0	0	0	0
IS	Information Society	1	0	0	0	0	0	0	0	0	0
JSTP	Journal of Service Theory and Practice	2	0	0	0	0	0	0	0	0	0
RIO	Review of Industrial Organization	2	0	0	0	0	0	0	0	0	0

Code	Conference Title	Article(s) (n)	Citation(s)	h-index	Average citations per article	Yearly distribution <2018	2018	2019	2020	2021	2022
ICIKM	International Conference on Information and Knowledge Management	8	122	3	15.25	68	16	17	10	8	3
ICIKM	IEEE International Conference on Smart Technologies	3	81	2	27.00	0	9	27	23	14	8
ICICM	International Conference on Information Communication and Management	1	45	1	45.00	2	5	9	7	12	10
CBI	IEEE Conference on Business Informatics	2	36	2	18.00	0	6	8	15	6	1
GHTC	IEEE Global Humanitarian Technology Conference	11	36	4	3.27	19	5	4	3	4	1
IBIMA	International Business Information Management Association Conference	13	29	1	2.23	17	1	1	3	2	5
ICRIIS	International Conference on Research and Innovation in Information Systems	2	29	2	14.50	22	3	0	1	1	2
CSCWD	IEEE International Conference on Computer Supported Cooperative Work in Design	1	28	1	28.00	8	3	6	4	5	2
IC4E	International Conference on E-Education, E-Business, E-Management and E-Learning	1	27	1	27.00	15	0	3	4	5	0
ICHONET	International Conference on High-Capacity Optical Networks and Emerging Technologies	3	26	3	8.67	8	4	6	3	4	1
PICMET	Portland International Conference on Management of Engineering and Technology	9	22	3	2.44	3	4	6	5	1	3
ECBIOS	IEEE Eurasia Conference on Biomedical Engineering, Healthcare and Sustainability	3	18	2	6.00	0	0	0	1	10	7
ICEMIS	International Conference on Engineering and MIS	1	16	1	16.00	0	0	6	5	4	1
ICETE	International Joint Conference on E Business and Telecommunications Proceedings	2	16	1	8.00	8	2	2	1	1	2
IAMOT	International Association for Management of Technology Conference	4	15	2	3.75	4	0	1	6	3	1
RTSI	IEEE International Forum on Research and Technologies for Society and Industry	3	14	2	4.67	1	5	4	1	3	0
ICETICE	IEEE International Conference on Enabling Technologies Infrastructure for Collaborative Enterprises	2	11	1	5.50	0	0	1	6	3	1
CISTI	Iberian Conference on Information Systems and Technologies	1	10	1	10.00	8	1	0	0	1	0

Note: The list of journals contains all A*- and A-ranked journals publishing telehealth research. The list of conferences is restricted to conferences with telehealth research cited at least 10 times.

Table A3. Top contributing authors for telehealth research in top-tier business journals

Authors Publishing in A*/A Rated Journals	TP	FA	DI	TC	C/P	Measure				
Chau, P.Y.K.	4	3	0.75	3025	756.25	Year(s)	1999	2001	2002	2002
						Journal Title(s)	JMIS	DS	JMIS	IAM
Guo, X.	4	0	0.00	108	27.00	Year(s)	2015	2019	2020	2021
						Journal Title(s)	DSS	IJEC	ISR	IAM
Akter, S.	3	3	1.00	374	124.67	Year(s)	2010	2013	2013	
						Journal Title(s)	EM	EM	IAM	
Bardhan, I.R.	3	2	0.67	203	67.67	Year(s)	2013	2015	2019	
						Journal Title(s)	DSS	ISR	JMIS	
D'Ambra, J.	3	0	0.00	374	124.67	Year(s)	2010	2013	2013	
						Journal Title(s)	EM	EM	IAM	
Hu, P.J.H.	3	0	0.00	1507	502.33	Year(s)	1999	2001	2002	
						Journal Title(s)	IEEE	DS	IAM	
Mathiassen, L.	3	0	0.00	114	38.00	Year(s)	2007	2007	2018	
						Journal Title(s)	EJIS	JIT	IAO	
Nicolini, D.	3	3	1.00	630	210.00	Year(s)	2007	2009	2010	
						Journal Title(s)	HR	OS	BJM	
Ray, P.	3	0	0.00	374	124.67	Year(s)	2010	2013	2013	
						Journal Title(s)	EM	EM	IAM	
Tan, Y.	3	0	0.00	278	92.67	Year(s)	2014	2015	2019	
						Journal Title(s)	ISR	ISR	POM	
Baker, A.	2	2	1.00	0	0.00	Year(s)	2020	2021		
						Journal Title(s)	RIO	RIO		
Brogan, P.	2	0	0.00	0	0.00	Year(s)	2020	2021		
						Journal Title(s)	RIO	RIO		
Burmeister, O.	2	2	1.00	31	15.50	Year(s)	2015	2019		
						Journal Title(s)	AJIS	AJIS		
Cegarra-Navarro, J.G.	2	2	1.00	25	12.50	Year(s)	2010	2012		
						Journal Title(s)	IJIM	KMRP		
Cho, S.	2	2	1.00	106	53.00	Year(s)	2007	2007		
						Journal Title(s)	EJIS	JIT		
Currie, W.L.	2	1	0.50	72	36.00	Year(s)	2014	2017		
						Journal Title(s)	IAM	IAM		
DeGraba, P.	2	0	0.00	0	0.00	Year(s)	2020	2021		
						Journal Title(s)	RIO	RIO		
Deng, Z.	2	0	0.00	8	4.00	Year(s)	2020	2020		
						Journal Title(s)	IAM	IMDS		
Go Jefferies, J.	2	1	0.50	17	8.50	Year(s)	2019	2020		
						Journal Title(s)	JBR	JSM		
Gururajan, R.	2	0	0.00	34	17.00	Year(s)	2018	2018		

Journal Title(s)	SRBS	SRBS

Note(s): TP=total publications. FA=first-authored publications. DI= author's dominance index (i.e. number of articles as first authored publications/number of multi-authored publications). TC=total citations. C/P= citations per publications, JMIS=Journal of Management Information Systems, DS=Decision Sciences, IAM=Information and Management, DSS=Decision Support Systems, IJEC=International Journal of Electronic Commerce, ISR=Information Systems Research, EM=Electronic Markets, IEEE=IEEE Transactions on Engineering Management, EJIS=European Journal of Information Systems, JIT=Journal of Information Technology, IAO=Information and Organization, HR=Human Relations, OS=Organization Studies, BJM=British Journal of Management, POM= Production and Operations Management, RIO=Review of Industrial Organization, AJIS=Australasian Journal of Information System, IJIM=International Journal of Information Management, KMRP=Knowledge Management Research And Practice, IMDS=Industrial Management and Data Systems, JBR=Journal of Business Research, JSM=Journal of Services Marketing, SRBS=Systems Research And Behavioral Science. The top leading authors publishing in conference proceedings with a minimum of two articles are: (1) Chang, H.L. – four articles, (2) Erasmus, L. – four articles, (3) Fanta, G.B. – four articles, (4) Mehta, K. – four articles, (5) Pretorius, L. – four articles, (6) Athavale, Y. – three articles, (7) Krishnan, S. – three articles, (8) Alameh, K. – two articles, (9) Alanazi, H.A. – two articles, (10) Alanezi, F.A. – two articles, (11) Anshari, M. – two articles, (12) Bennani, A.E. – two articles, (13) Bouamrane, M.M.– two articles, (14) Chen, Y.– two articles, (15) Fan, J. – two articles, (16) Hussain, F.– two articles, (17) Ilin, I.V.– two articles, (18) Inchingolo, P.– two articles, (19) Kitsiou, S.– two articles, (20) Kokkinaki, A.– two articles, (21) Markos, A.– two articles, (22) Oleshchuk, V.A.– two articles, (23) Patsioura, F.– two articles, (24) Peyton, L. – two articles, (25) Pussewalage, H.S.G.. – two articles, (26) Ray, P.K. – two articles, (27) Rossignoli, C.– two articles, (28) Sandkuhl, K.– two articles, (29) Stephanie, L.– two articles, (30) Tiporlini, V.– two articles, (31) Vatta, F.– two articles, (32) Vintar, M.– two articles, (33) Wickramasinghe, N.– two articles, and (34) Yu, H.Q.– two articles.

Table A4. Top contributing institutions for telehealth research in top-tier business journals

Institution	**Measure**							**Total**
Georgia State University, United States	Year(s)	2007	2007	2009	2015	2018	2020	6 articles
	Journal title(s)	EJIS	JIT	DSS	ISR	IAO	DSS	5 journals
	Citation(s)	45	61	109	101	8	2	326 citations
Indiana University Bloomington, United States	Year(s)	2014	2015	2019	2019	2020	2020	6 articles
	Journal title(s)	ISR	ISR	POM	ISR	ISR	RIO	3 journals
	Citation(s)	199	55	24	3	3	0	284 citations
The University of New South Wales, Australia	Year(s)	2010	2013	2013	2015	2020		5 articles
	Journal title(s)	EM	EM	IAM	JSM	IEEE		4 journals
	Citation(s)	125	98	151	11	8		393 citations
Harbin Institute of Technology, China	Year(s)	2015	2019	2020	2021			4 articles
	Journal title(s)	DSS	IJEC	ISR	IAM			4 journals
	Citation(s)	87	7	3	11			108 citations
University of Washington, United States	Year(s)	2014	2015	2019	2020			4 articles
	Journal title(s)	ISR	ISR	POM	ISR			2 journals
	Citation(s)	199	55	24	3			281 citations
Hong Kong Polytechnic University, Hong Kong	Year(s)	2019	2021	2021				3 articles
	Journal title(s)	IJPR	IAM	TFSC				3 journals
	Citation(s)	38	11	3				52 citations
National University of Singapore, Singapore	Year(s)	2017	2019	2020				3 articles
	Journal title(s)	IEEE	JIT	IAM				3 journals
	Citation(s)	8	8	5				21 citations
Queensland University of Technology, Australia	Year(s)	2015	2022	2022				3 articles
	Journal title(s)	JSM	JSTP	JSTP				2 journals
	Citation(s)	11	0	0				11 citations
The University of Alabama, United States	Year(s)	2002	2003	2015				3 articles
	Journal title(s)	JBR	HCMR	DS				3 journals
	Citation(s)	10	41	15				66 citations
The University of Texas at Dallas, United States	Year(s)	2013	2015	2019				3 articles
	Journal title(s)	DSS	ISR	JMIS				3 journals
	Citation(s)	99	101	3				203 citations
University of California, United States	Year(s)	2020	2021	2021				3 articles
	Journal title(s)	HCMR	CMR	RIO				3 journals
	Citation(s)	3	0	0				3 citations
University of South Florida, United States	Year(s)	1999	2007	2020				3 articles
	Journal title(s)	IEEE	DSS	IEEE				2 journals
	Citation(s)	16	43	0				59 citations
University of Warwick, United Kingdom	Year(s)	2009	2010	2021				3 articles
	Journal title(s)	OS	BJM	IAO				3 journals
	Citation(s)	437	67	7				511 citations
University of Wollongong, Australia	Year(s)	2013	2013	2019				3 articles
	Journal title(s)	EM	IAM	AJIS				3 journals

	Citation(s)	98	151	3	252 citations
Xi'an Jiaotong University, China	Year(s)	2020	2020	2020	3 articles
	Journal title(s)	IAM	DSS	IMDS	3 journals
	Citation(s)	6	9	2	17 citations

Note(s): EJIS-European Journal of Information Systems, JIT= Journal of Information Technology, DSS= Decision Support Systems, ISR= Information Systems Research, IAO= Information and Organization, POM= Production and Operations Management, RIO= Review of Industrial Organization, EM= Electronic Markets, IAM= Information and Management, JSM=Journal of Services Marketing, IEEE=IEEE Transactions on Engineering Management, IJEC=International Journal of Electronic Commerce, IJPR=International Journal of Production Research, TFSC=Technological Forecasting and Social Change, JMIS=Journal of Management Information Systems, JSTP=Journal of Service Theory and Practice, AJIS=Australasian Journal of Information System, IMDS= Industrial Management and Data Systems, OS=Organization Studies, BJM=British Journal of Management, HCMR=Health Care Management Review, CMR=California Management Review, JBR=Journal of Business Research, DS=Decision Sciences. The top leading institutions publishing in conference proceedings with a minimum of three articles are: (1) Pennsylvania State University, United States (six articles, 26 citations), (2) University of Pretoria, South Africa (six articles, 24 citations), (3) RMIT University, Australia (six articles, eight citations), (4) Portland State University, United States (four articles, 15 citations), (5) National Chengchi University, China (four articles, seven citations), (6) Covenant University, Nigeria (four articles, eight citations), (7) The University of Macedoni, Greece (three articles, 51 citations), (8) Stellenbosch University, South Africa (three articles, seven citations), (9) Peter the Great St. Petersburg Polytechnic University, Russia (three articles, 13 citations), (10) University of Twente, Netherlands (three articles, 27 citations), (11) University of New South Wales, Australia (three articles, five citations), (12) University of Ottawa, Canada (three articles, five citations), (13) Ryerson University, Canada (three articles, six citations), (14) University of Ljubljana, Slovenia (three articles, no citations), and (15) Imam Abdulrahman Bin Faisal University, Saudi Arabia (three articles, one citation).

Table A5. Country/territory collaboration for telehealth research in top-tier business journals

From	To	Frequency	From	To	Frequency
Australia	Singapore	4	Netherland	Belgium	1
Australia	Germany	1	Netherland	New Zealand	1
Australia	Hong Kong	1	Netherland	Singapore	1
Australia	Netherlands	1	Netherland	South Africa	1
Australia	New Zealand	1	Singapore	New Zealand	1
Bangladesh	Portugal	1	Spain	Greece	1
Canada	Iran	1	Spain	Ireland	1
Canada	Israel	1	Spain	Israel	1
Canada	Kuwait	1	United Kingdom	Canada	2
China	Hong Kong	5	United Kingdom	Israel	2
China	United Kingdom	5	United Kingdom	Italy	2
China	Australia	4	United Kingdom	Azerbaijan	1
China	Singapore	3	United Kingdom	France	1
China	Azerbaijan	1	United Kingdom	Greece	1
China	Bangladesh	1	United Kingdom	India	1
China	Canada	1	United Kingdom	Iran	1
China	Italy	1	United Kingdom	Ireland	1
China	Lithuania	1	United Kingdom	Japan	1
China	Netherland	1	United Kingdom	Singapore	1
France	India	1	United Kingdom	Spain	1
Germany	Switzerland	2	United States	China	9
Germany	Denmark	1	United States	Hong Kong	4
Germany	Netherland	1	United States	United Kingdom	4
Germany	New Zealand	1	United States	Australia	2
Hong Kong	Canada	2	United States	Canada	2
Hong Kong	Denmark	1	United States	Greece	2
Hong Kong	Korea	1	United States	Israel	2
India	Korea	1	United States	Bangladesh	1
Israel	Greece	1	United States	India	1
Italy	Azerbaijan	1	United States	Iran	1
Italy	Greece	1	United States	Italy	1
Italy	Israel	1	United States	Singapore	1
Italy	Netherland	1	United States	South Africa	1
Italy	Nigeria	1	United States	Spain	1
Italy	Spain	1			
Italy	Sweden	1			

Table A6. Regional spread for telehealth research in top-tier business journals

Continent	**Region (Countries)**	**Articles (n)**	**Percentage (%)**
Africa	Southern Africa (South Africa)	2	1.15
	Western Africa (Nigeria)	1	0.57
America	North America (United States, Canada)	64	36.78
Asia	East Asia (China, Hong Kong, Taiwan, Japan, Macao, South Korea)	57	32.76
	South Asia (India, Bangladesh)	9	5.17
	Middle East Asia (Israel, Iran, Egypt, Kuwait)	8	4.60
	South East Asia (Singapore, Brunei)	6	3.45
	West Asia (Jordan, United Arab Emirates)	2	1.15
Europe	Western Europe (United Kingdom, Netherlands, Belgium)	30	17.24
	North Western Europe (France, Ireland)	12	6.90
	North Central Europe (Germany)	11	6.32
	South Western Europe (Spain, Portugal)	9	5.17
	Southern Europe (Italy)	8	4.60
	North Europe (Norway, Denmark, Finland, Sweden)	7	4.02
	Central Europe (Switzerland)	2	1.15
	South East Europe (Greece)	2	1.15
	Eastern Europe (Azerbaijan)	1	0.57
	North Eastern Europe (Lithuania)	1	0.57
Oceania	Oceania (Australia, New Zealand)	21	12.07
Not specified	Not specified	4	2.30

Table A7. Major keywords (topics) from keyword co-occurrence of telehealth research in top-tier business journals

Keywords	Occurrences	TLS	Keywords	Occurrences	TLS
telemedicine	53	103	diseases	7	23
health care	40	135	information management	7	15
mhealth	34	68	innovation	7	16
ehealth	31	78	internet	7	31
hospital	13	49	sustainable development	7	19
medical computing	13	39	information and communication technology	6	28
healthcare	12	38	patient treatment	6	24
health	11	33	public health	6	26
covid-19	10	26	service quality	6	15
health services	10	38	smartphones	6	14
healthcare services	10	40	surveys	6	28
online healthcare communities	10	24	sustainability	6	20
economic and social effects	9	31	telecommunication	6	25
information systems	9	21	telehealth	6	16
information technology	9	21	behavioral research	5	13
mobile health	9	22	diagnosis	5	19
decision making	8	22	quality of service	5	18
developing countries	8	22	social networking (online)	5	19
electronic health records	8	28	technology acceptance model	5	11
internet of things	8	27			
records management	8	32			
technology adoption	8	31			

Note(s): TLS = total link strength reported from results of co-occurrences of all keywords in VOSviewer. Cluster 1 (ten keywords) **=** covid-19, health services, healthcare services, information and communication technology, internet of things, public health, smartphones, surveys, technology adoption, telecommunication. Cluster 2 (ten keywords) = developing countries, diagnosis, diseases, information systems, internet, mhealth, mobile health, patient treatment, quality of service, service quality. Cluster 3 (nine keywords) = behavioral research, decision making, information technology, innovation, medical computing, sustainability, sustainable development, telehealth, telemedicine. Cluster 4 (seven keywords) = economic and social effect, health, healthcare, health care, online healthcare communities, social networking (online), technology acceptance model. Cluster 5 (five keywords) = ehealth, electronic health records, hospital, information management, records management.

Table A8. Major themes and topics from keyword clustering of telehealth research in top-tier business journals

Cluster	Theme	Prominent keywords (topics) (% of occurrence)	Centrality	Impact	Article(s)	Citation(s) (PageRank Score)
1	Design and development of personal health record systems	personal health record (66.7%), sustainability (66.7%), activity theory (33.3%)	0.354	1.201	3	Gimpel *et al*. (2021) (0.006192); Lin and Hsieh (2014) (0.004885); García-Berná *et al*. (2021) (0.001271).
2	Health information technology for public health management	e health (100%), electronic health records (77.4%), health information technology (70.1%)	0.719	2.310	31	Xing *et al*. (2019) (0.054392); Urueña *et al*. (2016) (0.018526); Islam *et al*. (2020) (0.011378); Klecun *et al*. (2019) (0.009353); Watterson *et al*. (2020) (0.00815); Zhang *et al*. (2019) (0.007939); Bardhan and Thouin (2013) (0.007649); Kim and Kwon (2019) (0.006649); Menschner *et al*. (2011) (0.006644); Duclos (2016) (0.006362).
3	Perceived service quality among mobile health users	mobile health (45%), continuance intention (55%), service quality (60%)	0.499	2.743	20	Miao *et al*. (2017) (0.016026); Liu and Varshney (2020) (0.008631); Duarte and Pinho (2019) (0.006963); Cegarra-Navarro and Sánchez-Polo (2010) (0.6460); Akter *et al*. (2010) (0.005479); Akter *et al*. (2013a) (0.004971); Akter *et al*. (2013b) (0.004666); Khasha *et al*. (2018) (0.004032); Castillo-Vergara *et al*. (2021) (0.003285); Daskalopoulou *et al*. (2020) (0.002104).
4	Paradoxes of virtual care versus in-person visits	telehealth (66.7%), adoption barriers (33.3%), paradoxes (33.3%)	0.699	1.006	3	Standing, *et al*. (2018b) (0.027362); Standing *et al*. (2018a) (0.013366); Green *et al*. (2016) (0.002402).
5	Internet of things in healthcare	mhealth (100%), healthcare (35.3%), internet of things (23.5%)	0.806	2.262	34	Pan *et al*. (2019) (0.013416); O'Connor *et al*. (2017) (0.010294); Liu *et al*. (2019) (0.009306); Hsiao *et al*. (2019) (0.008631); Go Jefferies *et al*. (2019) (0.07942); Almobaideen *et al*. (2017) (0.007666); Ben Arfi *et al*. (2021) (0.006608); Schwartz *et al*. (2017) (0.005496); Eze *et al*. (2019) (0.004885); Khalemsky and Schwartz (2017) (0.004666)
6	Guidelines for e-health practices and services	electronic health record (100%), adoption (33.3%), clinical guidelines (33.3%)	0.287	1.051	3	Gagnon *et al*. (2016) (0.007522); Chang *et al*. (2009) (0.004666); Saifee *et al*. (2019) (0.001647).
7	Telemonitoring of life-threatening diseases	congestive heart failure (50%), telemonitoring (50%), communities of practice (25%)	0.389	3.570	4	Barjis *et al*. (2013) (0.008352); Bardhan *et al*. (2015) (0.006649); Sims (2018) (0.006598); Vlahu-Gjorgievska *et al*. (2019) (0.004666).
8	Change management strategy for telehealth adoption	telemedicine (100%), ict (17.4%), organizational change (15.2%)	1.051	2.218	46	Zobair *et al*. (2020) (0.021732); Peltier *et al*. (2020) (0.019411); Oborn *et al*. (2021) (0.014107); Peters *et al*. (2015) (0.011450); Wang *et al*. (2020) (0.011404); Constantinides and Barrett (2006) (0.008352); Paul *et al*. (1999) (0.008631); Steinhauser *et al*. (2020) (0.006649); Linderoth (2017) (0.00655); Lam *et al*. (2021) (0.006187).
9	Knowledge management of innovations in telehealth	innovation (70%), knowledge management (40%), knowledge acquisition (30%)	0.526	1.935	10	Paul (2006) (0.010233); Drago *et al*. (2021) (0.007970); Kodama (2005) (0.007970); Nicolini (2007) (0.006649); Lu et al. (2021) (0.005796); Shaw and Allen (2018) (0.004666); Oderanti and Li (2018) (0.002447); Jiang (2022) (NA); Cobelli *et al*. (2021) (NA).

10	Technology management of telemedicine services	professional users (66.7%), technology management (66.7%), acceptance of information technology (33.3%)	0.331	1.637	3	Chau and Hu (2001) (0.009306); Chau and Hu (2002b) (0.008763); Sheng *et al*. (1999) (0.005479).

Note: PageRank Scores are used to indicate 10 leading articles in Clusters 2, 3, 5, and 8, and up to 10 leading articles for the other clusters. NA = not available

Table A9. Triangulation of clusters (themes) from keyword co-occurrence and keyword clustering of telehealth research in top-tier business journals

Keyword co-occurrence	**Keyword clustering**
Cluster 1: Telehealth, technology, and public health	Cluster 2: Health information technology for public health management Cluster 5: Internet of things in healthcare Cluster 6: Guidelines for e-health practices and services
Cluster 2: Telehealth and service quality	Cluster 3: Perceived service quality among mobile health users
Cluster 3: Telehealth and sustainable development	Cluster 4: Paradoxes of virtual care versus in-person visits Cluster 8: Change management strategy for telehealth adoption Cluster 9: Knowledge management of innovations in telehealth
Cluster 4: Telehealth and socio-economic effect	Cluster 7: Telemonitoring of life-threatening diseases Cluster 10: Technology management of telemedicine services
Cluster 5: Telehealth and information management	Cluster 1: Design and development of personal health record systems

Table A10. Future research questions for telehealth research

Cluster	Theme	Future research questions
1	Design and development of personal health record systems	▪ What are the emerging technical developments in the PHR domain (Gimpel *et al.*, 2021)? ▪ How do user preferences for managing PHR vary across countries, and what features should be introduced to improve user satisfaction in each context (Gimpel *et al.*, 2021)? ▪ What are the different service design activities that service developers should engage in to create service prototypes that take into account the sustainability of newly developed services and the contradictions (tensions) among stakeholders in service systems (Lin and Hsieh, 2014)? ▪ What role do international regulatory organizations play in educating system developers about the need of developing PHR software and hardware that are sustainable and energy efficient (García-Berná *et al.*, 2021)? ▪ What should international regulatory organizations do to establish auditing procedures for certifying measuring instruments for accuracy and energy efficiency (García-Berná *et al.*, 2021)?
2	Health information technology for public health management	▪ What are the emerging HIT technologies (or platform) for monitoring personal health behavior (Menschner *et al.*, 2011; Simons *et al.*, 2014; Mountford, 2019; Lennefer *et al.*, 2020)? ▪ Does including a wide group of stakeholders in the design and development of new e-health services contribute to service sustainability (Menschner *et al.*, 2011; Simons *et al.*, 2014; Urueña *et al.*, 2016; Mountford, 2019)? ▪ Is it possible to enhance the ease of use of EHRs among primary care physicians via interventions such as better software or training, and what are the various adoption barriers and enablers that may transpire and how can they be overcome and leveraged, respectively (Watterson *et al.*, 2020)? ▪ What are the factors that affect the effectiveness or quality of an e-health service (Xing *et al.*, 2019; Zhang *et al.*, 2019)? ▪ What role do socio-demographic factors (e.g., education, e-health literacy, and gender) and trust play in determining consumers' choices for online health services (Islam *et al.*,2020)? ▪ In the case of healthcare providers, what are the relationships between information technology expenditure, HIT use, and process/organizational metrics of quality and cost control (Bardhan and Thouin, 2013)? ▪ How can e-health platforms increase access to quality healthcare services for people living in remote (or rural) areas (Burmeister *et al.*, 2015)? ▪ How can e-health platforms help elderly people who are less technically savvy to get access to high-quality healthcare services (Lolich *et al.*, 2019)? ▪ How should global e-health networks be developed and deployed effectively (Dehling and Sunyaev, 2014; Duclos, 2016)? ▪ How can information security and privacy be preserved in multinational patient-centered healthcare services in the face of changing operational HIT maturity, regulatory frameworks, and cultural environments (Dehling and Sunyaev, 2014; Duclos, 2016; Kim and Kwon, 2019; Klecun *et al.*, 2019; Seddon and Currie, 2017; Xing *et al*., 2019)?
3	Perceived service quality among mobile health users	▪ Is there a variation in perceived service quality metrics among m-health consumers across various countries, and how can such variation, if any, be managed (Akter *et al*., 2010, 2013a, 2013b)? ▪ Does the quality of service and consumer trust contribute to the long-term viability of m-health services, and how can they be managed (Akter *et al.*, 2013b)? ▪ Does contextual elements such as demographic characteristics (e.g., education, gender, income) and situational factors (e.g., usage frequency, cost) influence the relationship between technical attributes of an m-health platform and perceived service quality among users, and how can they be managed (Akter *et al*., 2010, 2013a)?

Cluster	Theme	Future research questions
		▪ How can the profile of an m-health adopter be matched to a special setting of circumstances to enhance the acceptability and adoption rate of m-health solutions (Duarte and Pinho, 2019; Miao *et al*., 2017)? ▪ How could a low m-health usage rate for current users be improved by analyzing their historical usage behavior (Miao *et al.*, 2017)? ▪ How practicable is it to include different m-health interventions into decision support systems for patients, caregivers, and practitioners in assessing and providing tailor-made solutions while taking into account various kinds of negative and positive reinforcement (Liu and Varshney, 2020)?
4	Paradoxes of virtual care versus in-person visits	▪ What kinds of issues could telehealth service providers face in a real-world scenario or in a wide variety of contexts (Green *et al*., 2016; Standing *et al.*, 2018a)? ▪ What are the mechanisms that can be employed for team building, knowledge management, and social communication activities to allow better telehealth outcomes (Standing, *et al.*, 2018b)? ▪ What are the implications of segregating telehealth services across medical specialties and fusing different kinds of technology into service delivery (Green *et al.*, 2016)?
5	Internet of things in healthcare	▪ How can emerging IoT technologies be employed in hospital e-health management organizations to enhance user engagement, malicious software detection, and user privacy (Biswas *et al*., 2020; Hsiao *et al*., 2019; Meng *et al*., 2020; Sneha and Varshney, 2009)? ▪ What impact could IoT-based mobile technology have on the efficacy (cost-benefit) of medical emergency response software in different scenarios (Khalemsky and Schwartz, 2017; Schwartz *et al*., 2017)? ▪ What are the differences in the adoption behaviors of mobile health apps across users (caregivers/caretakers) with various demographic profiles, such as culture, occupation, educational background (educated versus uneducated), age (young children versus mid-age adults versus old adults), citizenship status (native versus immigrant) and geographic location (urban versus rural) (Aboelmaged *et al.*, 2021; Ben Arfi *et al.*, 2021; Eze *et al.*, 2019; O'Connor *et al.*, 2017; Sengupta *et al.*, 2020)? ▪ What are the aspects or mechanisms that service providers can employ to encourage users to use mobile health services more actively (Liu *et al.*,, 2019; Pan *et al.*, 2019)? ▪ What are the challenges that service aggregators encounter when engaging diverse actors in the health data aggregation process (Vesselkov *et al.*, 2018)? ▪ Given the varied nature of mobile network coverage in various tourist locations, how should a m-health solution be devised for geographical routing of mobile tourists with chronic diseases to direct them to the nearest health facility in case of medical emergency (Almobaideen *et al.*, 2017)? ▪ What are the factors that contribute to a successful e-health deployment in a hospital (Khodadad-Saryazdi, 2021)? ▪ What impact does a patient's medical condition, medication compatibility, mode of transportation, user density in a particular area, caregiver arrival time, and other important factors play in the effectiveness of emergency response services offered via an m-health platform (Schwartz *et al.*, 2017)? ▪ What legal frameworks and regulatory reforms must be addressed to encourage m-health members to participate in emergency response services (Schwartz *et al.*, 2017)? ▪ What legal frameworks and policy changes are needed to explain the legal status of IoT-based consumer wearables, the privacy issues of m-health users, and reimbursement problems (Vesselkov *et al.*, 2018)?
6	Guidelines for e-health practices and services	▪ What guidelines should be established for the sharing of electronic medical records between hospitals (Chang *et al.*, 2009)? ▪ What government regulations and incentive mechanisms should be enforced to accelerate and scale the widespread use of electronic health records (Gagnon *et al.*, 2016)?

Cluster	Theme	Future research questions
		▪ How should patients be involved in the monitoring of physician compliance with clinical guidelines (Saifee *et al.*, 2019)?
7	Telemonitoring of life-threatening diseases	▪ How does the use of different types of HIT influences the efficacy of treatment for different patient and illness groups (Bardhan *et al*., 2015)? ▪ How could an alert system for identifying chronically ill individuals with a high likelihood of rehospitalization be developed using predictive analytics (Bardhan *et al*., 2015)? ▪ What are the different healthcare technologies that should be developed to improve healthcare quality, minimize inefficiencies, enhance decision-making support, and offer accurate alerting of emergency situations of people living in remote areas (Barjis *et al*., 2013)? ▪ What are the various types of virtual social networking strategies that can be utilized to encourage more information sharing among healthcare professionals spread across diverse locations to better serve local communities (Sims, 2018)? ▪ How does a patient's awareness of the various possibilities of telemonitoring technology gained via health literacy programs influence their participation in health care activities (Vlahu-Gjorgievska *et al.*, 2019)?
8	Change management strategy for telehealth adoption	▪ In a telehealth service model, which tasks should be performed digitally and which should be performed physically (Overby *et al.*, 2010)? ▪ In a telehealth-based service model, who should design and implement virtual mechanisms for patient's care (Overby *et al.*, 2010)? ▪ When do patients use virtual processes to substitute and supplement physical processes (and vice versa), and why (Overby *et al*., 2010; Øvrelid and Bygstad, 2019)? ▪ Does a patient's behavior in virtual processes vary from that in physical processes in a telehealth-based service model, and if so, how (Overby *et al.*, 2010)? ▪ What are the risks of transferring a healthcare process from a physical to a virtual environment in a telehealth-based service model (Overby *et al.*, 2010; Tarakci *et al.*, 2009)? ▪ How can customer-to-customer interactions via social media (e.g., like, comment, share) influence usage behavior and perception of service innovations (Peltier *et al.*, 2020)? ▪ How should the telehealth paradigm be designed for asynchronous systems such as teleradiology and telepathology (Chandwani *et al.*, 2018)? ▪ What mechanisms enable asynchronous and synchronous systems, how are they different or similar, and how should they be managed (Chandwani *et al.*, 2018)? ▪ With regard to establishing a telehealth model for patients in need of domestic care services, what change management approach should be adopted (Lam *et al.*, 2021)? ▪ What hinders the implementation of telehealth services in rural hospitals (Zobair *et al*., 2020)? ▪ What kind of training should be provided to healthcare professionals to enhance the quality of telehealth services and their capacity to embrace telehealth technologies (LeRouge *et al.*, 2007)? ▪ Is there a relationship between the amount of money spent on technology and the communication quality in telehealth services (Ozdemir, 2007)? ▪ What role does digital innovation play in maintaining organizational responses to emergencies in the long run (Oborn *et al*., 2021)? ▪ How can organizational culture be used to foster digital innovation in crisis (or emergency) situations, either internally or with the help of a broad group of stakeholders (Oborn *et al*., 2021)? ▪ How are new system models for providing telehealth services evolving to provide necessary services while integrating user value into the healthcare network (Peters *et al.,* 2015)? ▪ How does the use of telehealth technologies in hospital emergency rooms impact healthcare delivery (Sun *et al*., 2020)?

Cluster	Theme	Future research questions
		▪ How can e-health networks be transformed such that they gain functionalities that go beyond the assumptions that were embedded into their original design (Ishfaq and Raja, 2015)?
9	Knowledge management of innovations in telehealth	▪ Which management (or leadership) style is required for a healthcare organization to effectively manage knowledge assets throughout its strategic alliance business networks in order to foster technological innovation (Kodama, 2005)? ▪ What are the various consequences or implications of restructuring clinical practice and working arrangements with technological advances in a healthcare setting (Nicolini, 2007)? ▪ How can virtual teams collaborate in virtual environments to make better decisions to deliver effective telehealth services (Paul, 2006)? ▪ How do the composition and membership patterns of virtual teams concerned with the design of telehealth services impact their effectiveness (Paul, 2006)? ▪ How can knowledge management strategies in healthcare organizations be created and applied to reduce the negative effects of externalities such as pandemics (Wang and Wu, 2020)?
10	Technology management of telemedicine services	▪ How can healthcare organizations define and model the roles and responsibilities of their stakeholders for effective technology management of telehealth services, and what benefits are they likely to gain or tradeoffs are they likely to encounter by adopting these adaptations (Barlow *et al.*, 2006; Sheng *et al.*, 1999)? ▪ What strategies could healthcare organizations use to integrate existing organizational knowledge and information systems with new sources of information or knowledge discovery to enhance technology management of telehealth services (Sheng *et al.*, 1999)? ▪ When using telehealth services, does technology acceptability vary among users, and what changes in users' relative importance and key acceptability factors while utilizing telehealth services can be seen over time (Chau and Hu, 2001, 2002b)?