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# Review of Research on Technostress in Healthcare Literature Review

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## ABSTRACT
The rapid advancement of medical health information technologies, such as electronic health records, telemedicine, and smart wearables, has transformed healthcare services. However, these innovations also introduce challenges related to implementation, data management, privacy, and integration with traditional practices, leading to technostress. This study conducts a comprehensive literature review using databases like Web of Science, Scopus, PubMed, and ACM Digital, alongside bibliometric analysis via CiteSpace software, to construct visual knowledge maps that highlight key trends, prominent scholars, and research hotspots, offering insights for future studies.

*Keywords*: Technostress, healthcare, CiteSpace, visual analysis.

## INTRODUCTION
The rapid advancement of healthcare information technologies has led to the widespread adoption of technologies such as electronic health records (EHR), telemedicine, and smart wearables in the medical field. While the theoretical application of next-generation information technologies promises to enhance healthcare delivery (Hoque and Sorwar, 2017), their practical implementation is accompanied by numerous challenges. Elderly users face significant barriers to adopting mobile healthcare services (Guo et al. 2013), while EHR usability issues remain a persistent problem in the healthcare domain, impacting medical errors, patient safety, and clinician burnout (Khairat et al., 2019a). Moreover, physician resistance to change is prevalent, as they often resist technology when it is perceived as a threat to their clinical workflow (Hossain et al. 2019; Lapointe & Rivard 2005). The comprehensive implementation of healthcare information technologies in healthcare faces substantial challenges, including technology implementation, data management, privacy protection, and integration with traditional medical practices. These challenges constitute the core of technostress in this domain.

Technostress, or technology-related stress, is conceptually defined "a modern disease of adaption caused by an inability to cope with new computer technologies in a healthy manner" (Brod, 1984, p.16). In information systems (IS) discipline, scholars have increasingly focused on the phenomenon of technostress in diverse research contexts. Zheng et al. (2022) examined technostress among educators engaged in online teaching during the COVID-19 pandemic, Nisafani et al. (2020) summarized technostress experienced by employees, and Marsh et al. (2021) provided a comprehensive review of the dark side of technostress in the digital workplace. Within the healthcare domain, Walle et al. (2023) conducted a systematic literature review to assess facilitators and barriers to the sustainable adoption of electronic health system in Ethiopia, while Khaleel et al. (2020) reviewed and identified measurement approaches, predictors, and interventions related to consumer health information overload. Aiming to identify factors influencing work-related technostress, Virone et al. (2021) explored the impact of autonomy, competence, role clarity, time pressure, attitude, safety, and ergonomics on healthcare workers' job stress. Additionally, Lucena et al. (2021) analyzed coping strategies employed by nurses to alleviate work-related technostress. Although most technostress research conceptualizes technostress as negative experiences, a closer look at lasts literature reveals that technostress may also be positive, depending on how an individual appraise the stressor (Cliff, 2020, 2022).

While the literature on technostress in healthcare has grown rapidly in recent years, a thorough, system literature review is missing. In the face of complex, interdisciplinary, and evolving phenomena, emerging literature emphasizes drawing insights from early foundational theoretical concepts and structures to guide further research (Webster & Watson, 2002). Therefore, it is useful to critically assess the extant literature and track the evolution process within the field, clarify what we already know and predict the future research direction. Considering that it is difficult to objectively and vividly explore the internal relationships among authors, references and research topics by relying solely on qualitative approaches (C. Chen, 2006), this study adopts quantitative approaches, such as bibliometric analysis, to help chart and track the development of technostress literature in healthcare for further knowledge acquisition (Zhu et al., 2019). To address this gap, this study roots in an extensive reviewing of technostress research in healthcare by carrying out a visualized bibliometric analysis to present the current research development, hot topics and future trends and aims to explore the following aspects of existing research on technostress in healthcare.

(1) What is the general trend of technostress research in healthcare?
(2) What are the major topics covered by technostress in healthcare research?
(3) What are the implications and main directions for future research of technostress in healthcare?

To answer these research questions, employing CiteSpace, a versatile bibliometric analysis tool, we meticulously scrutinize 81 curated articles culled from four prominent databases: Web of Science, Scopus, PubMed, and ACM Digital. Our comprehensive examination encompasses a multifaceted approach, encompassing the following: Publication Trend Analysis, Collaboration Networks of Core Institutions and Authors, Co-Citation Analysis, and Clustering and Burst Analysis of Keywords. Our overarching objective is to provide a panoramic view of the research landscape surrounding technostress in healthcare, shedding light on its trajectory, identifying its core contributors, and illuminating its most salient themes. By synthesizing these insights, we aim to offer valuable prognostications regarding the field's future trajectory, thereby fostering informed discussions and guiding strategic research agendas.

## METHODS

### Data Sources and Sample

Technostress, a pervasive phenomenon within healthcare domain, transcends the boundaries of traditional academic disciplines. To comprehensively capture the essence of this intricate issue, we meticulously adhered to the database selection criteria outlined by Pearce (Pearce, 2018), employing four prominent databases: Web of Science, Scopus, PubMed, and ACM Digital. Web of Science stands as a global powerhouse of scholarly information, encompassing a vast array of disciplines, from natural sciences and engineering to biomedical research. It meticulously curates a collection of the most influential academic journals across these domains. Scopus, in turn, offers a panoramic view of research findings spanning 240 diverse disciplines, including science, technology, medicine, social sciences, arts, and humanities. PubMed, a specialized biomedical database, boasts a comprehensive repository of literature and powerful retrieval capabilities. Finally, ACM, the world's oldest and largest computer education, research, and application organization, is dedicated to advancing the frontiers of information technology education, research, and application. We took two steps to identify relevant studies. First, based on the definitions of technostress and the major types of technostress discussed in the literature (Tarafdar et al., 2017), we constructed a list of keywords, including technostress, insecurity, overload, invasion, uncertainty, complexity and healthcare, internet hospital, e-healthcare, medical, Healthcare IT, healthcare information technology, and HIT. Next, following prior research (e.g., Kapoor et al. 2018), we used the combination of the keywords to search for relevant studies in the four databases. We limited the language to English and the document type to articles in the literature published in the last two decades (2005-2024). We screened 1,293 articles from the database, selecting 81 based on the following criteria: (1) published in SSCI, SCI, or EI-indexed journals, and (2) mentioning "technostress" and "healthcare" in the title, abstract, keywords, or introduction. These 81 articles were then fully reviewed.

### Analytical Methods

To comprehensively analyze the research landscape of technostress in the healthcare, this study focuses on the co-citation analysis, co-occurrence analysis, and clustering. The analysis encompassed a temporal span of 2005 to February 2024, with a time slice set to 1 and other parameters adhering to default settings. The study meticulously constructed a series of knowledge maps, including journal co-citation, country and institutions co-occurrence, keyword co-occurrence, and keyword clustering. Additionally, the "Keyword Bursts" function was utilized to generate keyword prominence data. By leveraging a national co-occurrence knowledge graph, we gain insights into the underlying factors shaping publication trends. Next, a keyword co-occurrence and clustering knowledge graph is employed to identify the primary research directions within the field. Finally, keyword prominence analysis is utilized to discern emerging research hotspots and their trajectories. This multifaceted approach enables a holistic understanding of research trends, knowledge structure, and hotspot dynamics in medical technology research.

## BIBLIOMETRIC ANALYSES AND RESULTS

### Annual Variations of Publication

To delve into the evolving landscape of healthcare technostress research, we conducted a bibliometric analysis of 81 retrieved publications, charting the annual publication trend from 2005 to February 2024 (see Figure 1). As evident from Figure 1, the exploration of technostress in healthcare commenced in 2005, with Lapointe et al. (2005) pioneering research on physician resistance to hospital information system adoption. Notably, a surge in publications emerged from 2019 to 2023, with 18 articles related to healthcare technology stress in 2023. This upsurge may be attributed to two primary factors: the increasing maturity of relevant technologies, such as electronic health records (EHR), and the global health crisis posed by the COVID-19 pandemic, which has intensified research focus on the pressures and challenges faced by healthcare systems.

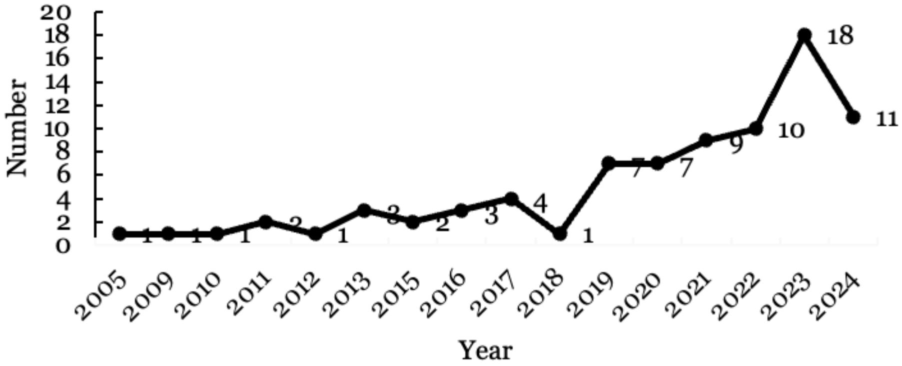


Figure 1. Annual Variations of Publication on Technostress in Healthcare

**Journal Co-citation Analysis**

Journal co-citation analysis shows the co-citation relationships among journals and indicates the significant journals of the field (Zhu et al., 2019). The journal co-citation network shows only the most co-citation journal (see Figure 2), where each node represents one journal and each line represents the co-citation relationship of two journals. The results from Figure 2 that the top five influential journals in technostress research in healthcare include MIS Quarterly (MIS QUART), Information system research (INFORM SYST RES), Computers in human behavior (COMPUT HUM BEHAV), BMC medical informatics and decision making (BMC MED INFORM DECIS), and Journal of management information system (J MANAGE INFORM SYST).

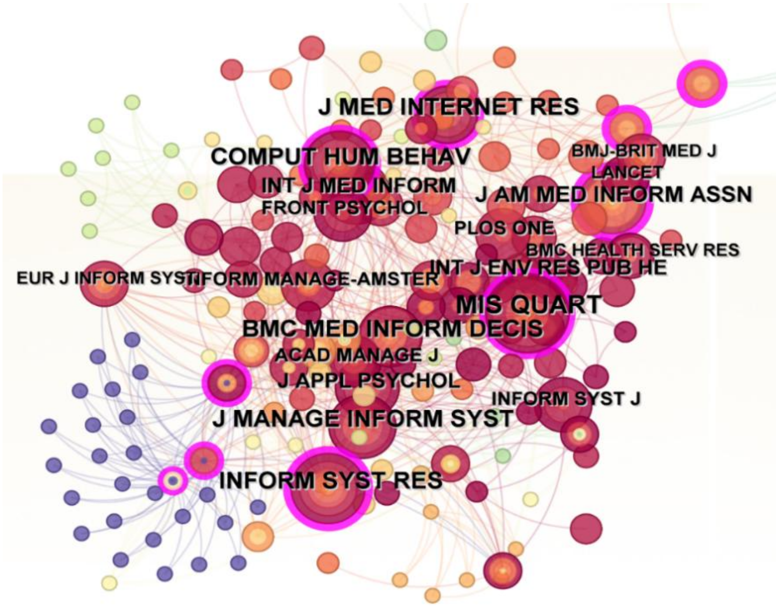


Figure 2. Journal Co-citation Network

In addition, according to the number of citations of journals, the top 5 journal in order from highest to lowest are MIS Quarterly, International Journal of Medical Informatics, Computers in Human Behavior, BMC Medical Informatics and decision making and PLos One. MIS Quarterly stands out for its exceptional performance in highly cited publications, with its articles accounting for 20% of the top 10 most cited papers. One of its articles has been cited 667 times, while another has surpassed 100 citations. The density of co-citation links between journals further reveals the formation of research clusters and subfields, providing insights into the interdisciplinarity of this research domain.

**Cooperative Analysis of Authors**

The visualization map objectively presents the collaborative relationships established among different researchers by providing information on influential research groups and potential collaborators (Qin et al. 2022). From the publication volume data, Mache, Stefanie ranks first with 4 publications, followed by Harth, Volker, who collaborated with Mache, Stefanie and contributed to 3 publications. Among the author groups with two publications each, Golz, Christoph, Hahn, Sabine, and Zwakhalen, Sandra M G, collaborate, while Bick, Markus, and Kummer, Tyge-F also form collaborative relationships. According to CiteSpace analysis of author relationships, a total of 320 authors were extracted from 81 publications. Based on Price's famous assertion regarding the core author group, i.e., M ≈ 0.749* √Nmax (where √Nmax is the publication quantity of the most prolific author in the domain), the criterion for determining the number of core authors is M = 1.498. According to statistics, there are 13 authors with two or more publications, totaling 29 publications, accounting for 35.8%, which is below Price's 50% standard (Li and Li 2024). Therefore, the study of technostress in the medical health domain has yet to form a truly core author group, and its research is still in the exploration stage. From the relationship graph of authors, it can be observed that the connectivity among authors is not strong, and the collaborative relationships are relatively loose, indicating the absence of a large-scale research collaboration community (Li and Tinmaz 2024).

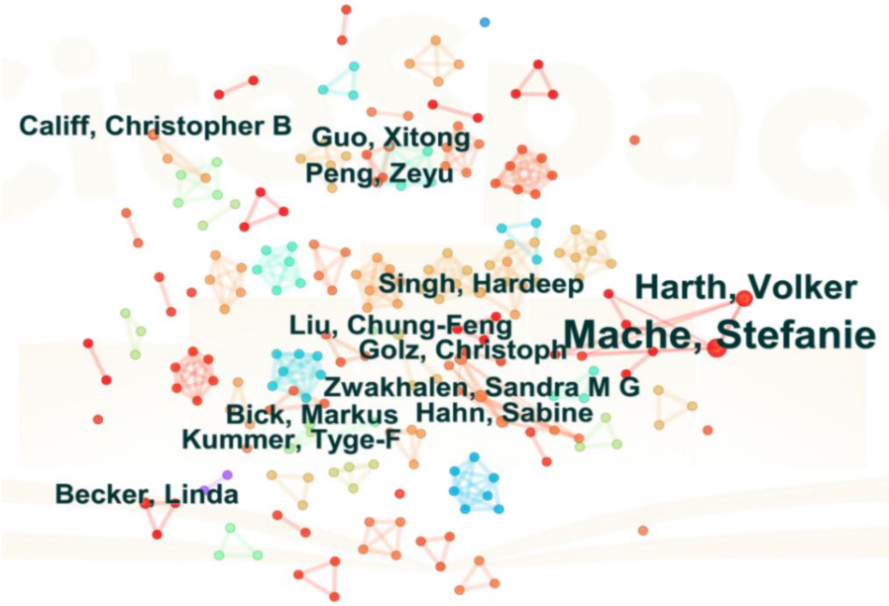


Figure 3. Author Co-occurrence Network

**Major Research Countries and Institutions**

Country statistics of publications can reflect the contribution of each country to technostress research in healthcare; this is helpful for understanding the popularity of healthcare technostress research worldwide. From 2005 to 2024, a total of 70 countries globally have contributed articles in this field. The United States ranks first in publication volume with 21 papers, followed by Germany in second place with 13 papers, and the United Kingdom in third place with 9 papers, while China ranks fourth with 8 papers.

Collaboration among institutions can elucidate organizational information and interactions between disciplines. Globally, 252 institutions have made contributions to this field through publications. We have sorted institutions collaborating in networks based on publication volumes exceeding 2 papers (see Figure 4). Institutions with four papers include the University of Hamburg and the University Medical Center Hamburg-Eppendorf. Those with more than three papers include Chia Nan University of Pharmacy & Science, Linkoping University, and the University of Texas System. The centrality of all institutions is less than 0.1, indicating the absence of stable cooperative circles among global research institutions. A collaborative relationship has been formed between the University Medical Center Hamburg-Eppendorf and the University of Hamburg, both of which have published four papers. The primary focus of research is on how technostress leads to anxiety and strategies for alleviating stress and promoting mental well-being. Among institutions with more than three papers, collaboration exists between the University of Texas System and Linkoping University. Their research primarily explores the impact of technostress on mental health. The University of Texas System, which includes multiple campuses such as the University of Texas at Austin, appears prominently, indicating a significant contribution to the field. This prominence could be due to a combination of factors including a strong emphasis on research in the healthcare domain, substantial funding, and a concentration of expertise in managing technostress.

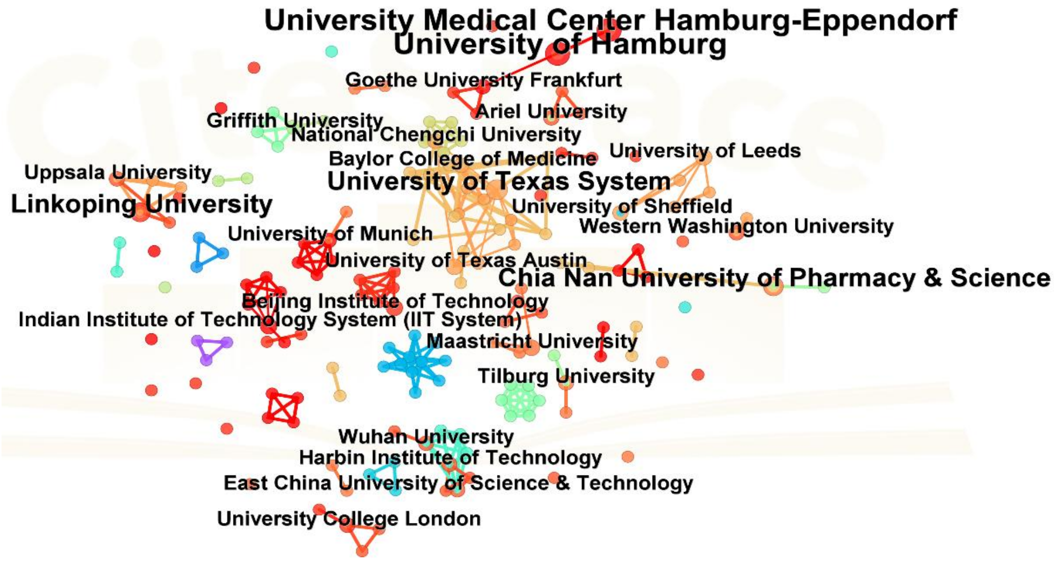


Figure 4. Institutional Co-authorship Network

**Keyword Frequency and Centrality Analysis**

Co-occurrence analysis was performed on the keywords of the sample data to identify general characteristics and hot topics. By selecting the top 10% of keywords in frequency for each time slice (1 year), a co-occurrence graph was generated to depict the knowledge map of key terms under the technostress within the healthcare domain (see Figure 5). The size of the nodes in the graph represents the frequency of the keywords, with larger nodes indicating more frequent occurrences in the literature. The lines between nodes represent co-occurrence relationships among keywords. The central nodes in the network, including "information technology," "care," "technostress," and "electronic health records," signify the primary focus areas of the research, indicating the close association between technostress and the use of information technology in healthcare services. The positioning of "Electronic health records" in the graph underscores its significance at the intersection of technology and healthcare delivery. As the widespread implementation of electronic health record systems continues, managing the associated pressures and user acceptance becomes a crucial issue. "Computer anxiety" and "information overload" represent specific issues related to technological pressure, while the presence of "model" suggests a research inclination towards exploring theoretical frameworks and models. Furthermore, in recent years, "technostress" and its associated outcomes such as "performance," "burnout," and "impact" have emerged as prominent research topics.

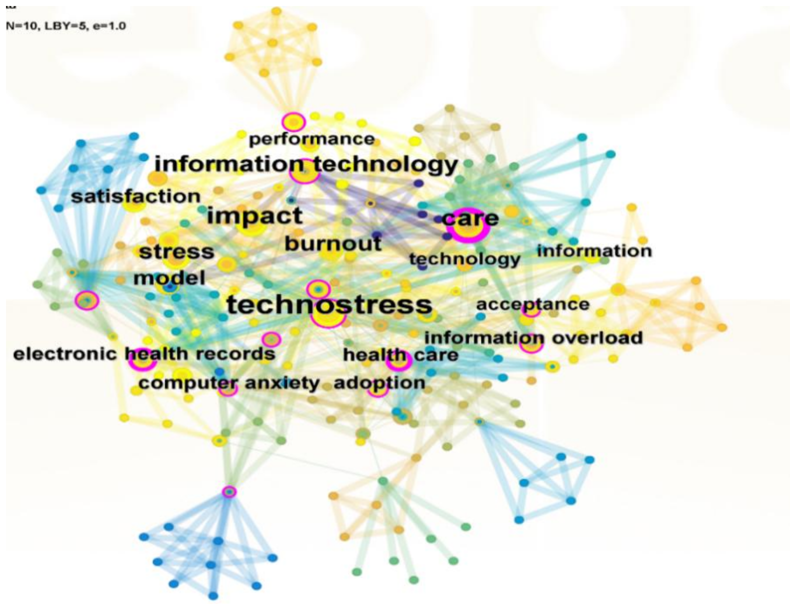


Figure 5. Co-occurrence of Keywords

Keyword centrality measures the importance and influence of a keyword within the entire keyword network. A higher centrality indicates that the keyword has more connections with other keywords and holds a more significant position within the overall keyword network. Keywords with centrality > 0.1 are considered as key nodes, acting as bridges facilitating information exchange between nodes (C. Chen, 2020). According to the table, the highest centrality is attributed to "care" with a value of 0.47, indicating its core role in the keyword network, possibly serving as a nexus for many other keywords. Other keywords with relatively high centrality include "health care" (0.24) and "electronic health records" (0.21), suggesting that research on technological stress in the healthcare predominantly revolves around electronic health records. "Computer anxiety" first appeared in 2009, signifying the beginning of attention towards computer anxiety research, while "adoption" emerged in 2019, highlighting increased focus on technology adoption and application in recent years.

Table 1. Top 10 Keywords by Centrality Ranking

| Keywords | Count | Centrality |
|---|---|---|
| care | 12 | 0.47 |
| health care | 6 | 0.24 |
| electronic health records | 6 | 0.21 |
| health | 4 | 0.2 |
| computer anxiety | 6 | 0.19 |
| technostress | 19 | 0.18 |
| adoption | 6 | 0.12 |
| experience | 3 | 0.12 |
| community | 2 | 0.12 |
| information technology | 10 | 0.11 |
| information overload | 6 | 0.11 |
| consequences | 4 | 0.11 |

**Keywords Cluster Analysis**

Through cluster analysis of keywords, a multiple category of technostress research in healthcare is appeared. The contents of each cluster are presented in Table 2, where size indicates the size of the cluster, i.e., the number of keywords it contains. The Silhouette score is used to evaluate the quality of clustering, ranging from [-1, 1], with a value closer to 1 indicating better clustering results. According to our results, the clustering quality of this study is good.

Table 2. Hot research topics in technostress in healthcare

| Hot topics | Size | Silhouette | Top Term |
|---|---|---|---|
| #0 Hospital information system | 29 | 0.90 | hospital information system, adoption model, external factor, emphasis framing, clinical decision-making process |
| #1 German hospital nurses | 26 | 0.78 | German hospital nurses, cross-sectional study, health-oriented leadership emotional exhaustion, work-privacy conflict, ICT demand |
| #2 Ehr-arche project | 24 | 0.96 | Ehr-arche project, ihe xd, shared electronic health record system, archetype, satisfying clinical information |
| #3 Chronic patient | 23 | 0.89 | Chronic patient, health information overload, health consumer, information overload, behavioral intention |
| #4 Double-edged sword | 21 | 0.90 | Double-edged sword, empowering leadership, influencing medical practitioners' resistance, internet hospital, investigating factor |
| #5 Elderly acceptance | 21 | 0.89 | Elderly acceptance, preventive mobile health service, sensor-based technology, Australian hospital, cultural influence |
| #6 Physician performance | 20 | 0.86 | Physician performance, patient safety, information chao, nature therapy, the-art review |
| #7 Multilevel model | 20 | 0.76 | Multilevel model, stressing affordance, hospital nurses, electronic medical record system, case study |
| #8 Situ monitoring | 19 | 0.91 | situ monitoring, understanding factor, UTAUT model, social media health-misinformation, empirical evaluation |
| #9 Clinician burnout | 19 | 0.89 | Clinician burnout, record-integrated patient-generated health data, electronic health, low-grade inflammation, work burnout symptoms hair |
| #10 Technostress | 10 | 1.00 | Technostress |
| #11 Covid-19 stressor | 8 | 1.00 | Covid-19 stressor, role, healthcare professional, psychological well-being, information overload |
| #12 Health information technologies | 7 | 1.00 | Health information technologies, dark side, information overload, digital stress perception, multilevel model |

Each cluster represents a central theme of the research area and its related keywords, reflecting the research directions and key issues within that domain. Clusters #0 to #6 cover topics ranging from the adoption of hospital information systems to physician performance, situational awareness, technological pressure, and the impact of COVID-19 on healthcare information technology. Clusters #7 and #8 discuss the advantages and disadvantages of IT use, potential management and security issues, focusing respectively on the acceptance and adoption of mobile healthcare services by the elderly. Cluster #9 examines burnout among clinical staff in the use of technology, particularly the psychological stress related to electronic health records and patient data management. Cluster #10 focuses specifically on the manifestation and impact of technological pressure in the healthcare sector. Cluster #11 explores the psychological stress, information overload, and the effects of technological pressure on healthcare professionals during COVID-19.Cluster #12 focuses on optimizing hospital information systems to meet healthcare demands and address adoption barriers, emphasizing improvements needed in information systems to accommodate healthcare environments and overcome adoption obstacles. These clusters not only reveal the challenges and potential negative impacts faced by modern healthcare information technology but also provide important directions for future research and practice.

**Timeline Visualization of Keyword Co-occurrence Clustering Analysis**

Timeline graphs(Figure 7) can be used to analyze how different research topics evolve over time. This study divides the research into stages based on an analysis of timeline graphs of keyword clusters. The initial stage (2005-2015) saw concentrated research efforts primarily focused on the early exploration of medical information technology, emphasizing the development and initial application of technology, and also saw the emergence of new research topics such as digital stress among medical personnel. The deepening phase (2016-2020) explored the use and impact of medical information technology more thoroughly, especially concerning elderly users of health devices, with negative aspects such as information overload and technology anxiety becoming increasingly apparent. Subsequently, in 2020, an article by Califf et al. (2022)conceptualized the impacts of technology use into positive and negative sub-processes, providing important guidance and practical significance for subsequent research. Factors influencing patients' and healthcare providers' acceptance and adoption of technology became a research focus. In the detailed phase (2021 to present), research has become more abundant, influenced by the COVID-19 pandemic, with some studies focusing on the impact of this event on the quality of life and working conditions of medical personnel. These studies concentrate on the levels of technostress among healthcare professionals and the different types of technostress sources, and through empirical research using various theories and models, they have greatly enriched the research content in this field and proposed strategies to mitigate the effects of stress (Bail et al. 2023).

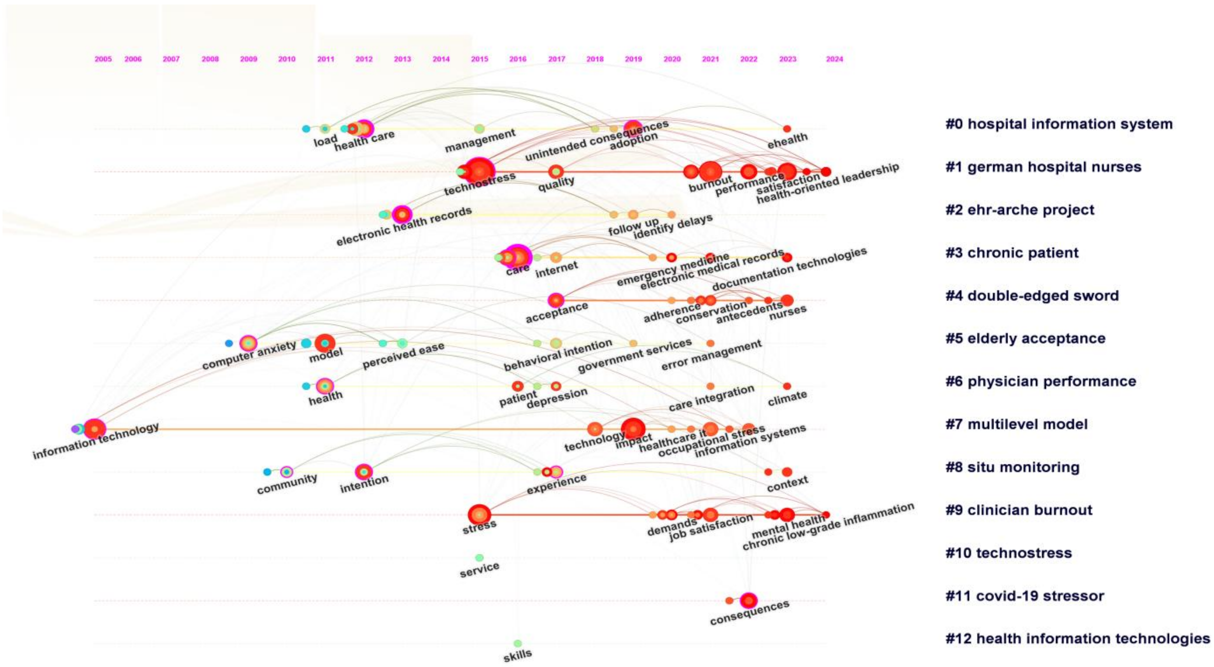


Figure 7. Timeline of Keyword Cluster Evolution

Caption:The purple line represents time from 2005 to 2023. Larger nodes indicate higher keyword frequency. Node positions correspond to research hotspots over time, and lines between nodes show co-citation relationships between keywords.

**Burst Analysis of Keywords**

Burst analysis of keywords can show the change of research focus and the latest research trends. Figure 8 highlights key trends in keywords related to technostress in healthcare from 2005 to 2024, focusing on the 18 most impactful keywords. "Technostress," "burnout," and "acceptance" emerged as significant terms between 2022 and 2024, suggesting their prominence in ongoing research. "Information overload" saw a sharp rise in citations between 2016 and 2017, indicating a peak in interest that may have since stabilized. Starting in 2021, "occupational stress" and "burnout" gained traction, reflecting an increased academic focus on stress and burnout among healthcare professionals. The term "health" showed notable citation increases in 2020, likely driven by research related to the COVID-19 pandemic. Continuously cited terms like "adoption" and "conservation" emphasize the persistent relevance of technology adoption in healthcare, indicating long-term research themes. This analysis illustrates evolving research priorities and highlights areas of sustained interest within the field.

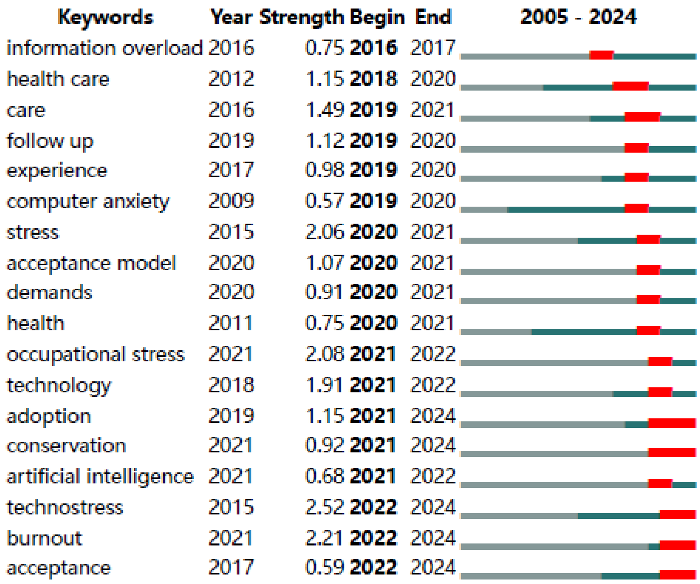


Figure 8. Top 18 keywords with the strongest citation bursts

Caption: "Year" shows the keyword's first appearance. "Begin" and "End" indicate its frontier period. "Strength" represents burst intensity, with red indicating high usage, light blue showing consistent use, and dark blue indicating less prominence.

This paper analyzes research trends in healthcare technostress through keyword frequency, centrality, clustering, and timeline visualization. Keyword co-occurrence across different time periods reveals evolving topics and research hotspots. Frequency and centrality analyses highlight the core role of technostress in healthcare, with “care” as a central term and a strong link between “electronic health records” (EHRs) and technostress. These keywords reflect the importance of health IT and associated negative effects, such as "computer anxiety" and "information overload." Clustering provides further insights into diverse research topics. For instance, Cluster #9 discusses technostress among chronic disease patients due to overwhelming health information, while Cluster #11 focuses on "burnout" in healthcare professionals, intensified by the COVID-19 pandemic. Timeline visualization reveals that early studies centered on IT development, while recent bursts in keywords like "technostress" and "burnout" (2022-2024) indicate these are now key research areas. This shows a shift from early IT adoption to concerns about user experience, burnout, and the adoption process. In summary, by integrating keyword frequency, centrality, clustering, and burst analysis, the paper outlines the evolving research landscape of technostress in healthcare, from early IT implementation to current issues like user experience and burnout.

## DISCUSSION

This study employs CiteSpace software for visual analysis, using methods such as keyword co-occurrence and cluster analysis, to systematically analyze current research hotspots. By thoroughly examining the original literature, we have organized the research themes and content to clarify the research focus and reveal future research directions, proposing four current hot topics. These discussions not only emphasize the complex impacts of technology in healthcare but also highlight critical issues and potential solutions that future research should explore in depth.

### Discussion of Hot Topics

### Hot Topic 1: Factors Influencing The Resistance and Acceptance of Medical Health Technology

Technostress is also influenced by user backgrounds. For instance, older medical personnel with language barriers or negative attitudes toward technology may face greater challenges (Thunberg et al. n.d.). low levels of education, health literacy, and socioeconomic status can contribute to health information overload (Khaleel et al. 2020).

In early studies on the implementation of information technology, resistance was considered a key influencing factor. Lapointe et al. (2005) suggested that in the early stages of clinical information system implementation, the main resistance was against the system itself and its features; later, it shifted to the meaning of the system or its advocates. Past studies have widely discussed factors about technological, organizational, and individual levels that affect technology acceptance and resistance (Lee et al. 2012). From the system design perspective, accessibility, perceived ease of use, perceived usefulness, and compatibility are considered key factors promoting technology acceptance, whereas sunk costs of system use, transaction costs, inertia, and anxiety are associated with resistance to the system (Lin et al. 2020; Tsai et al. 2019). Medical professionals may feel frustrated by difficulties in finding patient information, and the usability of EHRs remains a key challenge in healthcare (Khairat et al. 2019b).

From a user perception perspective, individual factors such as personal innovativeness and habitual practices play significant roles in the adoption and effective use of EMR systems, influencing their deeper integration into healthcare practices (Chen and Hsiao 2021). Performance expectations, effort expectations, social influence, technology anxiety, and resistance to change significantly affect users' willingness to adopt mobile healthcare services (Hoque and Sorwar 2017). The acceptance and use of mobile healthcare services by the elderly are considered key research topics, including the use of various smartphones, wearable devices, and smart healthcare services. Fanbo Meng et al.(2022) examined the impact of technology anxiety and health anxiety on emotional and cognitive trust, found that both forms of trust significantly enhance elderly users' continued engagement with mobile healthcare services. Moreover, the advent of artificial intelligence (AI) is revolutionizing the healthcare sector. Studies by Helmi Issa et al. suggest that the unpredictability of technology presents a novel source of technostress (Issa et al. 2024).

In short, the factors affecting users' acceptance and resistance to different information technologies may also vary. Resistance factors for telemedicine include sunk costs, transaction costs, inertia, anxiety, social influence, facilitation conditions, doctor-patient trust, and perceived risks. Facilitating factors for sustainable acceptance of electronic health systems include expected effort, performance expectations, facilitation conditions, social influence, personal attitudes, computer literacy, user age, perceived enjoyment, education level, duration of mobile device use, organizational culture, and habits.

**Hot Topic 2: Management of Technostress in Medical Health Information Technology**

The management of technostress is pivotal in today’s healthcare settings. Cristina Virone et al. (2021) highlight critical factors such as autonomy, competence, understanding of roles, time pressure, attitudes, safety, and ergonomics that are essential for alleviating technostress. These elements not only enhance the comfort and efficiency of medical professionals when engaging with new technologies but also improve their overall job satisfaction. Regarding employee mindfulness, studies indicate that focusing on prevention and promotion can mediate the relationship between mindfulness and proactive strategies for coping with technostress (Tuan 2022). This suggests that modifying an individual's internal psychological state can greatly influence their approach to handling technostress. Weisha Wang et al. (2021) further assert that autonomy, beneficence, explainability, fairness, and non-maleficence are crucial in boosting medical professionals’ receptiveness to artificial intelligence technologies. Moreover, individuals with higher educational attainment tend to manage personal and familial health more effectively, underscoring the role of education in facilitating technology adaptation (Stadin et al. 2020). Interpersonal training has also been shown to significantly lessen the anxiety associated with technology use among the elderly (Lin et al. 2020), while standardized medical information formats are vital in preventing overload from health apps (van Velsen et al. 2013). Skypes and Aljafari (2022) found that friendship network ties could reduce or aggravate strain as doctors and paraprofessionals.

Effectively managing technostress in healthcare involves a multifaceted approach that includes enhancing professional autonomy and satisfaction, optimizing user experiences, and improving educational and training programs. Additionally, standardizing information processing is essential. Adopting clear and purposeful email practices, along with effective resource management and IT support, can alleviate technostress (Stadin et al., 2020). Laker et al. (2018) demonstrated that focusing on specific aspects of exchanged information can reduce cognitive load and enhance decision-making efficiency in the context of information overload. By integrating these strategies comprehensively, we can significantly advance technology acceptance and usage efficiency, thereby optimizing healthcare processes and elevating the quality of patient care.

**Hot Topic 3: The Impact of Technostress on The Quality of Healthcare Services**

Information chaos is recognized as a critical issue in primary care, significantly impacting patient safety and increasing the workload for doctors (Beasley et al. 2011). Compounding this issue, usability problems with Electronic Health Record (EHR) systems are known to exacerbate medical errors, compromise patient safety, and contribute to physician burnout (Khairat et al. 2019b). Additionally, technology innovation and information overload not only heighten emotional fatigue among caregivers but also diminish the quality of care (Biancone et al. 2023), and adversely affect the quality and timeliness of clinical decision-making (Attipoe et al. 2023). Despite these dark sides, the dual nature of technological advancements, particularly artificial intelligence (AI), brings both concerns and opportunities. While AI applications may increase workloads and raise security concerns, they also hold the potential to reduce task burdens and enhance work efficiency, thereby improving the overall quality of medical services, offer innovative design methods and broad application scopes that are crucial for optimizing medical processes (Schneider-Kamp 2021; Ye 2021). information overload is considered a key factor affecting the emergency medicine field, and it may increase over time(Sbaffi et al. 2020). Moreover, it could also influence the behavioral intention of information seekers to stop using online health information searches due to its impact on their psychological state (Swar et al. 2017). Information overload refers to the excessive amount of information and the complexity of health education materials, which can cause psychological stress for patients, leading them to abandon self-management of their health (Liu & Kuo, 2016). When patient data is sent directly to doctors through electronic information systems, it can lead to information overload for the doctors. Additionally, since clinical decisions require checking multiple data sources, any delay in retrieving data can affect the accuracy of decisions, causing anxiety for patients (Ye, 2021).

These elements underscore the complex interplay between technology and healthcare delivery, highlighting the need for strategic management to harness technological benefits while mitigating associated risks.

**Future Directions for Research**

Given the significant impact of technostress on healthcare providers and administrators, Table 3 shows a proposed framework for future research in this fields.

High levels of stress related to using EHR systems are referred to as technostress (Califf et al., 2020). The concept of technostress originates from the socio-technical systems theory, where organizations are composed of two aspects: the social aspect (people's skills, attitudes, and values) and the technical aspect (the work performed using technology; Tarafdar et al., 2007). Technostress occurs at the intersection of these two aspects within organizations. Role theory also plays a significant role in the technostress model, as new technologies affect social roles and require dynamic adaptation (Tarafdar et al., 2007). Most technostress studies have conceptualized it negatively, framing it as harmful to individuals or organizations. Hence, technostress is widely considered a "dark side" phenomenon related to technology (Califf et al., 2020).
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There has been limited research on the "bright side" of technology, i.e., the opportunities it presents. Tarafdar et al. proposed a new holistic model that addresses both the pressures and opportunities of technostress, conceptualizing two types of technostress: techno-eustress (positive stress) and techno-distress (negative stress; Tarafdar et al., 2019). Techno-eustress interprets the process of individual technology assessment as both challenging and threatening, generating both positive and negative stress, which motivates coping behaviors and leads to either positive or negative outcomes (Tarafdar et al., 2019). Building on this research, Attipoe et al. studied EHR systems, concluding that they bring both convenience and stress to healthcare professionals (Attipoe et al., 2023). Unlike most literature that views technostress through a fixed cause-and-effect lens, Califf applies appraisal theory, offering a non-deterministic, dynamic, and context-dependent perspective on the relationship between technology and stress (Califf, 2022).
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Most of the existing research uses cross-sectional data, which has limitations compared to panel or longitudinal data in revealing time series effects and making cross-time comparisons (Alshammari & Alenezi, 2023; Bail et al., 2023; Deng et al., 2023; Golz et al., 2021; Liu & Kuo, 2016).

Based on the reviewed literature, 53 studies focus on healthcare professionals. These studies can be roughly divided into two categories: one examines the sources of technological stress on healthcare workers, while the other explores the impacts and coping strategies resulting from the perceived technological stress associated with using IT systems. The causes of technological stress can be categorized into two main groups. First, personal factors such as health literacy, education level, and cognitive effort impact how healthcare workers respond to technological pressure (Khaleel et al., 2020). Some studies also consider age and gender as moderating factors. Training programs and relevant policies can help mitigate technological stress (Thunberg et al., 2023). Second, external factors such as poor ICT system user experience are identified as sources of technological stress (Stadin et al., 2020). Organizational culture, the complexity of healthcare information systems, and operational difficulty also influence the adoption of these systems (Lee et al., 2012). Technological stress can be alleviated through team training, social support, and technological integration (Alshammari & Alenezi, 2023; Liu et al., 2019; Pacutova et al., 2023; Saunders et al., 2016).On the other hand, technological stress negatively impacts healthcare workers' performance and job satisfaction, and its "dark side" leads to resistance in using information systems (Bail et al., 2023; Walle et al., 2023). Although much research has focused on the negative impact of technological stress, there are studies that address mitigating this impact. Laker et al. suggest using cognitive strategies based on framing to help healthcare professionals reduce the effects of information overload in clinical decision-making (Laker et al., 2018). To cope with technological stress, actions related to culture, norms, social support, and personal or organizational resources can also be implemented (Stadin et al., 2020).In addition to healthcare workers, research also predicts the challenges faced by older adults in using information systems (Kang et al., 2010), where technological anxiety can lead to resistance (Lin et al., 2020). Healthcare providers and managers also experience varying degrees of technological stress. Healthcare providers, in particular, must use standardized medical information formats, which helps prevent health applications from becoming overloaded (van Velsen et al., 2013).

Table 3. Research Agenda

| Dimension | Current State | Future Research Directions |
|---|---|---|
| Research focused areas | Research predominantly targets individual healthcare professionals like doctors and nurses, who are directly impacted by medical information technology. The elderly, as key end-users, are crucial due to their acceptance levels and coping strategies. | Research should broaden to include multiple collective levels within healthcare, from frontline staff to administration, utilizing individual, team, and organizational analyses to fully understand technostress impacts and mechanisms. |
| Research | Technostress studies mainly use quantitative | There is a need to incorporate qualitative methods and |

| | | |
|---|---|---|
| methods | approaches, including surveys and statistical analysis, to measure stress perceptions, mental health, and job satisfaction.Most current studies are cross-sectional, analyzing data at a single point in time. | diversify methodologies, including Natural Language Processing for emotional analysis in survey responses, addressing the limitations of Structural Equation Modeling.Longitudinal methods are recommended to track technostress dynamics over time, observing both immediate and long-term effects, which can vary with career stages and cultural backgrounds. |
| Research theories | Existing research on technostress in healthcare lacks comprehensive theoretical frameworks for stress antecedents, consequences, and regulation. | Future studies should adopt interdisciplinary frameworks from psychology, sociology, and management to deepen understanding. Research should also balance the exploration of both positive and negative effects of technostress, considering organizational support, technological training, and psychological adjustments. |
| Antecedents and outcomes of technostress | Current research results mainly focus on job outcomes and the adoption and acceptance of information technology. | Studies should include a broader range of variables influencing technostress, such as personality traits, leadership styles, and organizational culture. New technologies and their emerging stressors also warrant exploration. |

## CONCLUSION

This study comprehensively reviews the academic literature related to technostress in healthcare. Through an in-depth literature analysis, we have revealed the developmental dynamics of key indicators such as publication volume, journal distribution, authors and their collaboration networks, institutional and national distribution, keyword frequency, research hotspots, and trends. These analyses help us to more comprehensively understand the current state of research on technostress in this field and the directions for future development. In terms of publication volume, since 2019, the number of publications on technostress in healthcare has shown an increasing trend year by year. This reflects the growing academic interest in this issue. In terms of author collaboration, although collaboration among researchers is relatively dispersed and has not formed a large-scale network, it also highlights the widespread distribution of research globally. There is limited cooperation between institutions, lacking leading figures and influential institutions, resulting in a certain fragmentation of research outcomes. Therefore, closer academic cooperation is urgently needed to promote resource sharing and the integration of research findings. In keywords co-occurrence and cluster analysis, research hotspots are mainly focused on the technostress experienced by medical personnel and the elderly when using medical devices, as well as studies on the resistance and adoption of information technology. The latest emergent keyword analysis shows that the impact of artificial intelligence on the medical health field has become a recent research focus. Although current research has made some progress, there is still significant room for improvement in building collaboration networks, deepening theory, and extending applications. Future research should pay more attention to introducing interdisciplinary methods and further integrating empirical research and theoretical models to promote scientific development and technological innovation in this field.

This paper differs from other studies on technological pressure in the healthcare sector in terms of research objectives, data collection, and analysis methods. It focuses more on the statistical analysis of literature data, revealing the current development trends, research hotspots, and influence in studies of technological pressure in healthcare. Through charts, statistical data, and visual maps, the paper presents the development trends, key topics, and evolutionary patterns in the field. This provides valuable insights for researchers investigating factors affecting technological pressure on healthcare workers and key research issues. For healthcare managers, offering training and support for healthcare workers to better utilize new computer systems and information technology can help the entire team optimize their use of these systems.

This study has some limitations. First, relying on data from specific academic databases may lead to the omission of significant non-English or grey literature, thus impacting the comprehensiveness of the review. Second, the analysis by CiteSpace is dependent on the citation and co-citation relationships among the literature, which may limit the discussion on the depth and complex relationships of the content and might overlook research in emerging or marginal areas. Additionally, the interpretation of the visual network diagrams generated by CiteSpace relies on the subjective judgment of the researchers, which could introduce interpretative biases. Lastly, the timeliness of the study may also be affected by the update frequency of the literature databases. Future research should consider integrating various literature review tools and methods to enhance the precision and depth of the study.

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