

From Command to Care: A Scoping Review on Utilization of Smart Speakers by Patients and Providers

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Abstract

Smart speakers have gained considerable consumer adoption and research interests. Despite their innovative interaction capabilities, a notable void exists in the literature, with no comprehensive scoping review that scrutinizes and consolidates the usage of smart speakers by providers and patients. This study performed a scoping review to explore the standalone use of smart speakers in health settings, focusing on their potential to support providers and empower patients to manage their health and well-being. Following Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, a comprehensive search from January 2014-September 2023, using select keywords, was performed across PubMed, Web of Science, Medline, IEEE, ACM, JAMIA, Embase, CINHAL, EBSCO, and Cochrane. The literature search yielded 1546 articles, of which 59 met the inclusion criteria. The identified studies are categorized into helping patients (n=54) with themes of independent living, reducing loneliness and improving social life, aiding in patient self-care and self-management, promoting physical activity, rethinking health care and service delivery, remote patient monitoring and communication, health information queries and helping providers (n=24) with themes recording and accessing medical information, and reducing provider workload. These research studies, performed in a controlled environment with limited patients, have found smart speakers' high feasibility, acceptability, and positive reception in patient care and support providers. Furthermore, the findings showcase opportunities to leverage and challenges to address for a future of integrating and using smart speakers seamlessly in health settings.

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Consumers increasingly use smart speakers, such as Amazon Echo and Google Home, in their daily tasks. Powered by artificial intelligence-based voice recognition, smart speakers allow consumers to interact with them using natural language and even have small conversations as humans do. The global smart speaker market is projected to grow to \$24.8 billion by 2027.¹ Across the available products, Amazon Echo and its variants dominate the market share, followed by Google, Apple, and others (Baidu, Alibaba, Huawei, etc.).² The explosive growth and adoption of smart speakers can be attributed to ease of use (interaction without the need for traditional interfaces), interactive communication using natural language (intuitive and interactive communication style has made integration of smart speakers in daily lives seamless), accessibility (users can control

various devices and access a wide range of services using voice), and affordability, to name a few. Furthermore, smart speaker providers provide software development kits (eg, Amazon Skills and Google Dialogflow) that allow developers to build applications, allowing businesses to connect with consumers through diverse channels. Presently, consumers use smart speakers to assist them in daily tasks (eg, reminders, alarms, etc.), information search (eg, weather, news, etc.), control devices, and entertainment (eg, listening to music, jokes, etc.).^{3,4} Researchers are studying the usage of smart speakers in education,^{5,6} marketing,^{7,8} privacy and confidentiality,^{9,10} consumer perception,^{9,11} and more.

Given the explosive growth and adoption of smart speakers in daily life and the existing knowledge gap regarding their use in health



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ARTICLE HIGHLIGHTS

- This systematic review identified 59 studies on using commercial smart speakers to support patients and providers. Studies primarily focused on the feasibility of the technology in health settings, with positive outcomes for acceptability and usability.
- For patients, smart speakers found promise in areas, such as independent living, reducing loneliness, remote monitoring, and delivery of health care and services to promote self-reliance and improve efficiency, accessibility, and affordability.
- For providers, smart speakers enable easy access to medical information, improve clinical efficiency, and reduce workload by handling trivial and nonclinical tasks.
- Challenges remain around speech recognition, education on how to use smart speakers and formulate commands, integration and security issues with health care IT systems, and regulatory compliance.

care, social care, and related areas, a comprehensive scoping review is warranted.¹² This scoping review presents a comprehensive overview of the current usage of smart speakers in enhancing patient care and their overall well-being, improving health services, and supporting providers¹³ (refers to individuals, such as doctors, nurse practitioners, specialists, social workers, etc., who provide health care and services to patients in any setting). The review also identifies opportunities to seize and challenges to address for integrating smart speakers into health settings.

METHODS

Protocol

The guidance for this scoping review is drawn from Arksey and O'Malley¹⁴ scoping framework, and Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews¹⁵ guided the scoping review reporting structure.

Search Strategy

The research study searched standard sources: PubMed, Web of Science, Medline, IEEE Explore, ACM Digital Health, JAMIA, Embase, CINAHL, EBSCO, and Cochrane, using the following query.

("Amazon Echo" OR "Google Home" OR "Apple Homepod" OR "smart speaker" OR "conversational agent") AND ("health" OR "clinical" OR "patient")

The study used conversational agents to broaden the search and reduce the risk of missing published works relevant to the scoping review, as some authors referred to smart speakers as intelligent conversational agents. The search included all available fields, including title, abstract, full text, metadata, and other relevant information. The terms Amazon Echo, Google Home, and Apple HomePod are used as these commercial smart speakers dominate the market.² Our search strategy was formulated incrementally, beginning with our initial search in August 2022. We subsequently performed a second search in December 2022, a third search in March 2023, and our final search in September 2023.

Eligibility Criteria

Table 1 summarizes the inclusion and exclusion criteria. Amazon Echo was the first smart speaker released in 2014, and Amazon Skills Kit, the software development kits for developing the applications, was released in 2018. Google Home was released in 2016, and Apple Homepod in 2018. Thus, we searched for published works from 2014 to September 2023. The search included only standalone use of smart speakers and excluded studies that use digital assistants (eg, Amazon Alexa, Google Home, Apple Siri, etc.) on smartphones, smart speakers built using custom hardware, and intelligent assistive technologies.

Study Selection Methods

The authors searched the selected sources independently using the agreed search query and started screening the publications by reviewing titles and abstracts, independently assessing eligibility for full-paper review. In cases where there was a disagreement between the authors regarding the eligibility of a publication, it was marked for full-paper review to ensure a comprehensive assessment. Next, the authors independently reviewed the full text of the selected papers and finalized the inclusion or exclusion for the study. Any disagreements were resolved by discussion that required consensus from both authors.

TABLE 1. Inclusion and Exclusion Criteria		
Criterion	Inclusion	Exclusion
Types of published work	Journals and conferences published in peer-reviewed venues	Letter, editorial, abstract, workshop, clinical trial, white paper, and thesis
Timeline	From 2014 to September 2023	Before 2014 and after September 2023
Language	English	Other languages
Interest	Use of smart speakers by health care providers and patients to manage their health and overall well-being.	All other interests
Device	Commercially smart speakers	Intelligent voice agents ¹⁶ and digital assistants used on smartphones and custom smart speakers

Data Extraction and Variable Definitions

The following data points, as listed in Table 2, from the included articles: title, country, device used, audience, aim(s), study design, population, condition, and outcomes facilitated the narrative synthesis of the scoping review.

RESULTS

Study Selection

Figure 1 showcases the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews workflow, illustrating the article selection process for this scoping review. The initial search resulted in 1546 publications and removed duplicates (n=533). Using the agreed inclusion and exclusion criteria (Table 1), the authors screened the publications (n=1013) abstract and title, identifying eligible publications (n=173) for a full-text review. After thoroughly examining the eligible publications, the scoping study comprised 59 publications, with the consensus reached by both authors.

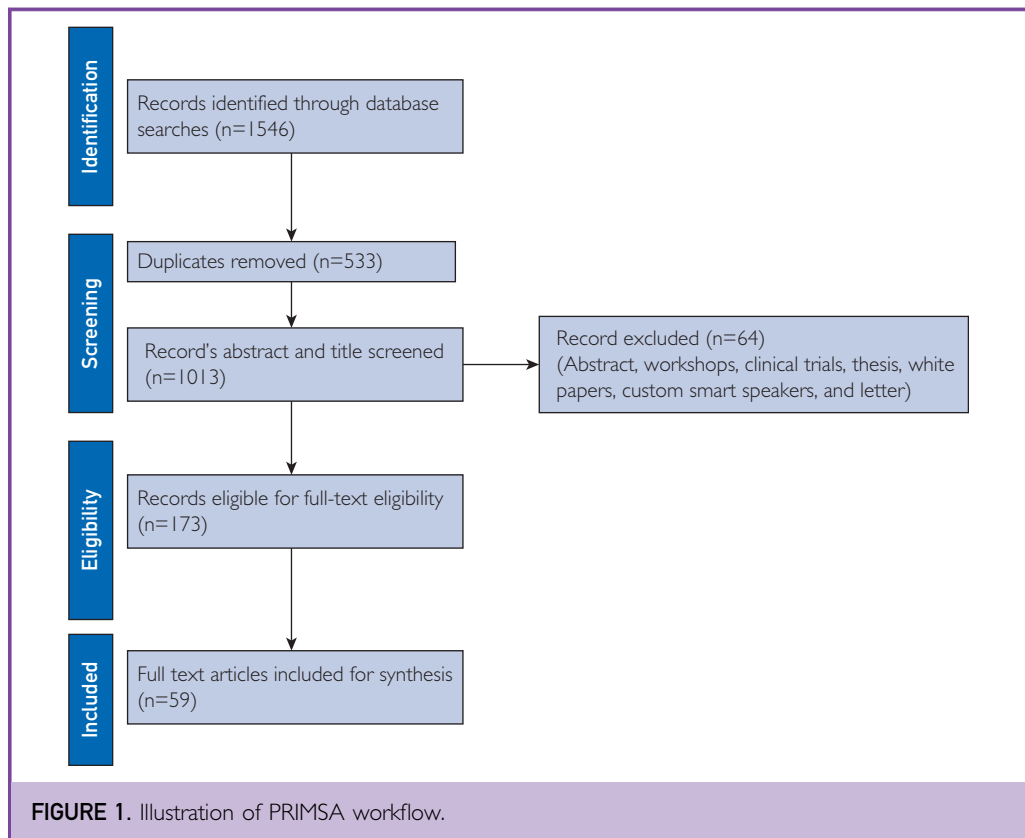
Characteristics of Included Studies

Supplemental document (Appendix 1, available online at <https://www.mcpcdigitalhealth.org/>) enumerates the data points for included individual studies, and Table 3^{17–77} summarizes the data characteristics. Figure 2 reports the distribution of publications over time and the trend, signifying a growing interest among researchers in exploring the usage of smart speakers in health settings.

Synthesis of Eligible Studies

Using natural language for interactions, smart speakers reduce the technological burden, making engagement with smart speakers natural and effortless. A plethora of research has been published and is ongoing to gain a deeper understanding of various facets of smart speakers.^{11,78,79} This scoping review summarized 59 studies eligible into 2 categories — Helping patients (n=54) and Helping providers (n=24) with multiple themes derived based on the research study’s primary aim(s) and conclusion(s) of the eligible studies. Smart speakers hold the potential to support patients (eg, independent living,

TABLE 2. Extracted Data Points and their Description	
Data Point	Description
Identifier	Identifier for the publication, such as Digital Object Identifier (DOI) or PubMed Identifier (PMID)
Title	Title of the publication
Country	Location of the study
Device	Smart speaker used for the study
Audience	Primary group using the device. Patient, Provider, and Caregiver
Aim	Goal of the research study
Study design	Methodology used to collect research data to support outcomes
Population	Demographic characteristics of the study participants
Population Condition	Health care condition(s) of the study patients
Outcomes	Outcome of the research study



enabling self-care and self-management, providing a voice, communication, etc.) and providers (eg, handling repetitive and trivial tasks, information on demand, etc.).

Helping Patients

Independent Living. Independent living is the ability of individuals to live independently in their own homes with minimal assistance while maintaining control over their lives. However, health issues, specifically related to cognitive decline and disabilities, and other health conditions, such as chronic conditions, hinder independent living and performing activities of daily living. Researchers are exploring smart speakers as an assistive technology, either standalone or combined with other digital technologies, to facilitate and support independent living. Dharan et al,²³ Firth et al,⁶⁹ and Balasubramanian et al⁷⁰ research reports that smart speakers are feasible and efficient in assisting dementia patients to complete basic ADL or other activities without

assistance. Van Wingerden et al,³³ Smith et al,⁷² Corbett et al,⁴⁰ McCloud et al,⁴² Wright,⁷⁵ and O'Brien et al⁴³ studies reported participants using smart speakers for communication, entertainment, information retrieval, keeping them engaged, and other self-reliance factors that support independent living. Edwards et al⁷¹ and Kadylak et al³⁹ reported the benefits for the community housing residents, including enhanced engagement with home activities, enjoyment, calming effects, and skills acquisition. Using smart speakers, Kim³⁶ reported the feasibility of promoting and improving positive health behavior among older adults. These findings collectively report that smart speakers support independent living.

Reduce Loneliness and Improving Social Life. Human beings are inherently social beings. Our community relations, engagements, and healthy social interactions drive our mental health and well-being. Researchers are

TABLE 3. Scoping Review Study Characteristics

Eligible Articles Characteristics
Research conducted
Australia (4) ^{17–20}
Canada (5) ^{21–25}
Denmark (1) ²⁶
India (1) ²⁷
Ireland (1) ²⁸
Italy (3) ^{29–31}
Macedonia (1) ³²
Netherlands (1) ³³
South Korea (4) ^{34–37}
Switzerland (1) ³⁸
United States (30) ^{39–68}
United Kingdom (7) ^{69–75}
Patient primary condition
Autism (1) ³⁷
Affective Disorders (1) ²⁶
Breast Cancer (3) ^{52,54,62}
Cardiovascular Disorder (1) ⁶¹
Cancer (2) ^{50,51}
Chronic Conditions (3) ^{17,18,70}
Cognitive Impairment (2) ^{28,31}
COVID-19 (5) ^{22,24,25,56,58}
Dementia (2) ^{23,69}
Diabetes (3) ^{44,46,70}
Intellectual Disability (5) ^{19,20,33,72,73}
Heart Conditions (1) ³²
Heart Failure (3) ^{21,47,68}
Hypertension (1) ⁴⁶
Visual impairments (1)
Device
Amazon Echo (14) ^{29,39–42,45,46,50,51,54,55,58,61,69,72–75}
Amazon Echo Show (17) ^{17,18,21,22,24,25,28,30,38,39,52,56,57,62,64,65,70}
Amazon Echo Dot (13) ^{29,32,38,47,49,60,61,63,66,68,69,76,77}
Amazon Echo Spot (1) ⁷¹
Google Home Mini (4) ^{23,29,48,53}
Google Nest Mini (2) ^{26,38}
Google Home (12) ^{19,20,27,28,31,33,42–44,67,72,73}
Apple Homepod Mini (2) ^{29,38}
NUGU (3) ^{34,35,37}
Aim/goal(s)
Support independent living (11) ^{23,33,36,39,40,42,43,69–72}

Continued on next column

TABLE 3. Continued

Eligible Articles Characteristics
Aim/goal(s), continued
Reduce loneliness (6) ^{33,39,41–43,71}
Self-care and self-management (6) ^{21,37,44,47,62,68}
Medication adherence (1) ⁴⁵
Remote patient monitoring (4) ^{32,46,68,75}
Patient data collection and reporting (6) ^{22,32,46,60,61,68}
Improve patient and provider communication (7) ^{22,32,46,56–58,68}
Digital healthcare services (10) ^{19,20,26,34,35,53–55,72,75}
Search medical information (3) ^{29,38,67}
Promote and engage in physical activity (10) ^{17,18,27,48–52,66,74}
Assist providers to retrieve and record medical information (2) ^{60,61}
Reduce provider burden (16) ^{19,20,22,24–26,34,35,54–58,64,65,73}
Reduce caregiver burden (6) ^{23,28,30,31,69,70}

leveraging smart speakers' voice interaction model to reduce loneliness and improve social interactions. Jones et al⁴¹ developed a proof-of-concept smart speaker application that allows aging adults friendly greetings and polite interaction, considerably reducing loneliness. Van Wingerden et al,³³ McCloud et al,⁴² Kadylak et al,³⁹ Edwards et al,⁷¹ and O'Brien et al⁴³ research studies found that smart speakers can serve as companions, a voice to talk to for adults living alone. These studies revealed that participants found value in having a voice to interact with and talk to daily, providing a sense of companionship and reducing feelings of isolation. Postresearch interviews and surveys revealed participants' desire to continue using smart speakers for various daily tasks, reporting the potential of smart speakers to assist and engage older adults.^{33,41}

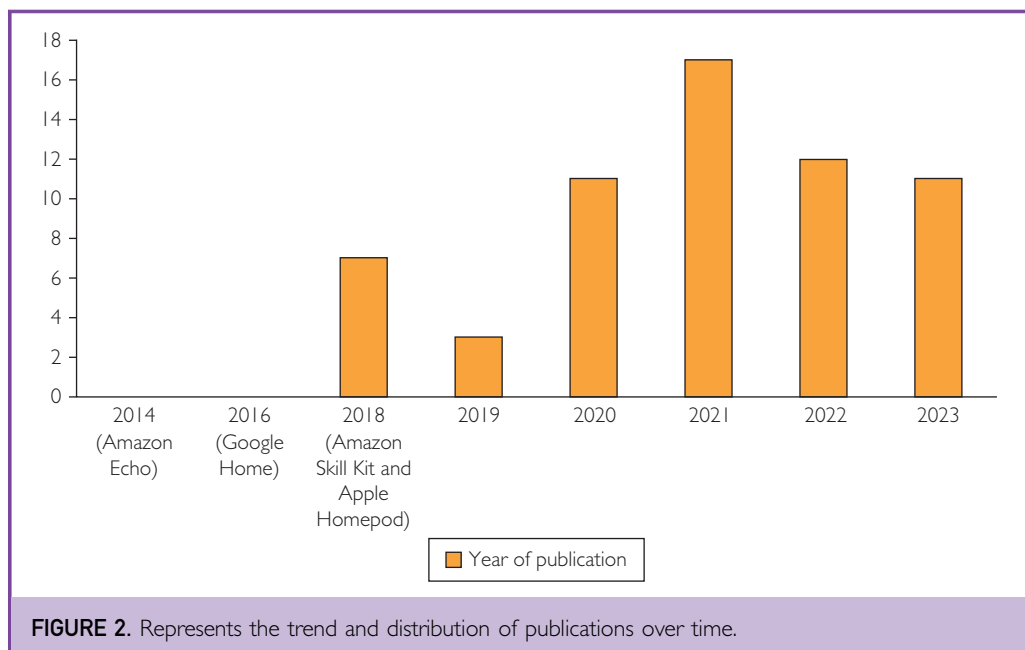
Self-Care and Self-Management. There is a growing emphasis on encouraging patients to take an active role in their self-care and self-management, particularly among the increasing population dealing with chronic condition(s).^{80,81} Researchers are investigating whether smart speakers to support patients to

effectively monitor symptoms, follow treatment plans, and embrace healthy lifestyle practices. Cheng et al⁴⁴ developed an innovative Healthy Coping with Diabetes application, compliant with the American Association of Diabetic Educators guidelines, to assist patients with diabetes with self-management. The study participants found the application highly usable, with a user interface facilitating natural and seamless conversations. To better manage the symptoms of patients with metastatic breast cancer and to reduce the symptom burden, Gordon et al⁶² has translated Nurse Addressing Metastatic Individuals Everyday,⁸² a proven tablet-based digital tool, into a smart speaker application and reported the feasibility and acceptability of the technology in managing metastatic breast cancer symptoms. Corbett et al⁴⁵ designed a medication adherence application and reported a decrease in missed medication doses compared with their baseline before using the smart speaker. The participants also expressed positive attitudes toward the usability and usefulness of the application, reporting its effectiveness in managing their medication schedules. Shara et al,⁶⁸ Apergi et al,⁴⁷ and Barbaric et al²¹ reported the feasibility of using smart speakers for sustainable delivery of self-

care and self-management instructions. These studies concluded that voice technology would profoundly affect the quality of life for in-home, independent, and assisted-living patients. Cha et al³⁷ found that smart speakers could be an engaging and empowering tool that supports adolescents with autism spectrum disorder in addressing their needs, promoting self-care, regulating negative emotions, and practicing conversational skills.

Encouraging, Engaging, and Supporting Physical Activity.

Experts concur that physical activity has various health benefits for all age groups. However, the solution(s) to encourage and engage individuals in physical activity must be scalable, cost-effective, and customizable to the individual's lifestyle. Carlin et al,⁷⁴ Chin et al,⁴⁸ Smolyak et al,⁶⁶ Luo et al,⁴⁹ Hassoon et al,^{50,51} Jansons et al,^{17,18} and Caru et al⁵² explored smart speakers to deliver physical activity programs. These studies examined the feasibility, usability, and effectiveness of using smart speakers as a remote delivery method for physical activity programs and compared their novel approach with other delivery mechanisms. Carlin et al⁷⁴ delivered physical activity- and diet-related messages to families through



smart speakers and reported high levels of engagement and acceptance of the technology from the participants. Chin et al,⁴⁸ Smolyak et al,⁶⁶ and Luo et al⁴⁹ delivered exercise programs to older adults and reported the novel delivery model to be more engaging and motivating when compared with the other digital delivery models. Jansons et al¹⁸ provided pragmatic and tailored physical activity routines for older adults using smart speakers and subsequently delivered exercise-snacking interventions to older adults using the novel technology.¹⁷ Both studies found that the participants generally liked the flexibility and convenience offered by this novel approach. Vora et al²⁷ developed a proof-of-concept using cloud computing, edge processing, and a smart speaker, showcasing the feasibility of delivering personalized exercise routines to individuals. Hassoon et al^{50,51} and Caru et al⁵² used smart speakers for personalized physical activity in a study group (many with breast cancer) and reported a significant increase in physical activity while using smart speakers compared with other digital interventions. These studies report that smart speakers can be the digital platform capable of delivering physical activity programs and interventions in a feasible, scalable, and accessible form to meet individual needs.

Rethinking the Delivery of Health Care and Services. The traditional health care model, centered around hospitals and clinics, has been the primary avenue for delivering health care services. As the demand grows, the resources within the traditional health care model face limitations, making it impractical to provide high-quality health care services consistently and effectively to everyone at scale, necessitating innovative health care and service delivery approaches. Wright⁷⁵ reported that local authorities in London piloted small-scale initiatives to use smart speakers to offer telemedicine and related services to achieve sustainable care in response to the nation's challenges in adult care. Patients with disabilities often face challenges in social interactions, which are crucial for managing daily tasks. However, social programs designed to support them are generally underfunded, and employing support staff to assist these patients can be costly. To this end,

Smith et al⁷³ and Greuter^{19,20} investigated using smart speakers to assist patients with disabilities in improving social skills. Smith et al⁷³ delivered related health services to individuals with intellectual disabilities and reported that smart speakers can improve speech intelligibility among participants. Similarly, Greuter et al¹⁹ developed social games and interactive storytelling experiences to engage and enhance social interactions among patients with disability. The study reported that smart speakers are a feasible and cost-effective alternative to paid support. In another study, Greuter et al²⁰ facilitates training and practice of social skills among adults with intellectual disabilities, allowing participants to explore the outcomes of various choices in diverse social situations. Compared with the conventional method of relying on a speech therapist, this novel approach presented immediate rewards, spaced practice, enhanced autonomy, intrinsic motivation, and reduced social barriers. Kim et al³⁴ and Maharjan et al²⁶ provided emotional and mental support to patients in need through smart speakers, traditionally provided by a specialist at a location. Kim et al³⁴ provided emotional support to teenagers and reported the features of smart speakers, such as being good listeners, nonjudgmental, maintaining confidentiality, and offering suggestions or assistance, effectively helping teenagers manage stress. Maharjan et al²⁶ smart speaker application, Sofia, allowed participants to self-report mental health by answering the WHO-5 questionnaire. The study reported high levels of engagement and acceptance, reporting the participant's willingness to self-report mental health and well-being. Xu et al⁵³ delivered dialogic reading experiences effectively for children through a smart speaker, yielding similar benefits to those achieved with a human specialist(s), and observed reduced irrelevant vocalizations and improved story comprehension. Kim et al³⁵ confirmed the smart speaker efficiency and feasibility in delivering metamemory training, generally offered by experts at specialized centers. Similarly, Arem et al⁵⁴ reported the feasibility, satisfaction, and acceptance of using smart speakers to provide cognitive behavioral therapy for insomnia to patients with breast

cancer experiencing insomnia. Ismail et al⁵⁵ studied the feasibility of an autonomously administered visual acuity examination using a smart speaker device in a clinical setting and reported that the differences in the reported data between the device and human values were statistically significant but were clinically insignificant.

Remote Patient Monitoring and Communication. Smart speakers can facilitate telehealth, as telehealth benefits patients and providers with outcomes equal to in-person care and reduces health costs. Rabbani et al⁴⁶ used the voice interaction model, compared with textual input in other digital mHealth tools, to collect patient data and report it to the provider(s). The study reported a simplified data reporting approach that improved communication and information exchange between patient and provider(s). Dojchinovski et al³² proof-of-concept application monitors, reports, and retrieves patients' medical information, allowing near real-time data communication between patient and provider(s). Apergi et al⁴⁷ used smart speakers to collect responses to questions, focusing on compliance and heart failure symptoms, as a proactive measure to monitor heart failure patients and potentially reduce hospitalization. Dunn et al,⁵⁶ Franco et al,⁵⁷ and Ganni et al²² proved the feasibility of using smart speakers (with display) to monitor and communicate with patients diagnosed with coronavirus disease 2019 (COVID-19). Dhakal et al⁵⁸ research reported their ability to help users self-assess COVID and monitor patients' symptoms.

Accessing Health Information. As smart speakers continue to be used for information retrieval, Berube et al³⁸ studied the reliability of the smart speaker responses to common questions on specific noncommunicable diseases. Napolitano et al²⁹ evaluated smart speakers to assess their ability to recognize and respond to questions related to male sexual health. Owens et al⁶⁷ performed a similar evaluation, but the focus was on the topic of prostate cancer. These studies reported the feasibility of delivering medical information and emphasized the necessity for enhanced collaboration between health care experts and smart speaker manufacturers to ensure

consistent and reliable responses to health-related questions.

Helping Providers

Reporting Patient Medical Information. Although the implementation of electronic health record (EHR) has brought numerous benefits, it has also presented challenges for providers.^{83,84} Notably, the time spent by providers updating EHR could be spent directly interacting with patients and building rapport. Bhatt et al⁶⁰ designed and developed a voice agent, DocPal, to reduce physician screen time and facilitate EHR interaction through voice commands. The initial testing of DocPal found promising results, reporting its success and feasibility in reducing screen time and improving workflow efficiency. Similarly, Jadczyk et al⁶¹ developed CardioCube, a smart speaker application that can verbally collect patients' medical data, integrate it into the EHR, and auto-generate summarized medical reports. The goal is to assist medical professionals in streamlining the time-consuming paperwork involved in patient registration processes.

Reduce Provider Burden. An increased demand and workforce shortage in health settings has led to provider burnout. Researchers are leveraging smart speakers to deliver services traditionally provided by providers, directly or indirectly reducing their burden and burnout. Franco et al⁵⁷ and Hain et al⁶³ explored the use of smart speakers in attending to trivial patient needs, such as playing music, providing entertainment, and controlling nonmedical devices in the room. Offloading these nonmedical tasks allowed nurses to focus on the patient's needs. Hain et al⁶³ has also reported improved clinical and workflow efficiency. Liu et al⁶⁵ extended the caring for caregivers online platform to smart speakers to provide guidance, self-care suggestions, and a voice to talk to for the well-being of caregivers, as caregivers tend to downplay their health needs and have difficulty accessing support. Health care services, such as metamemory training,³⁵ cognitive behavioral therapy for insomnia,⁵⁴ assessing visual acuity,⁵⁵ helping patients with disabilities improve social skills,^{19,20,73} and

supporting patient's emotional health delivered to meet different patient^{26,34} needs through smart speakers, have reported to reduce provider workload and burden. Davitt et al,⁶⁴ Sharma et al,²⁴ Dhakal et al,⁵⁸ Oulousian et al,²⁵ Dunn et al,⁵⁶ and Ganni et al²² developed voice agents that allowed patients to report their symptoms and get a diagnosis or recommendation during the COVID-19 pandemic, easing workload and protecting providers. Dharan et al,²³ and Balasubramanian et al⁷⁰ aided patients with dementia with ADL and other activities, reporting the possibility of reducing the caregiver burden by providing guidance, reminders, and prompts. Masina et al³¹ reported that smart speakers can assist individuals with disabilities in their daily tasks, reducing the workload on caregivers, particularly automatable tasks. However, their study established that patients require a certain level of cognitive and linguistic capabilities to fully use smart speakers. Alemi et al²⁸ leveraged smart speakers to implement distributed caregiving, reducing primary caregiver burnout and burden. In addition, the smart speakers engaged patients and provided information to the caregivers on demand, enhancing the support for the elderly and easing the responsibilities of the primary caregiver. Similarly, Alloatti et al³⁰ used smart speakers that assist caregivers by providing care instructions based on recipient conditions(s), accessing information on demand, setting reminders, etc. These studies highlight the potential of smart speakers to reduce the burden on health care professionals by delivering services and interventions to patients in a convenient and accessible manner.

DISCUSSION

In this review, we explored the application of smart speakers—an innovative technology bringing potent audio speakers with natural language processing and advanced artificial intelligence—in health settings. Our analysis scrutinized 59 studies investigating addressing diverse issues, such as supporting patient care and well-being, enhancing delivery and accessibility to services, optimizing care efficiency and clinical workflows, reducing provider burden, and facilitating telehealth services.

The usage of smart speakers in health care is still in its early stages, as evident by the focus of all the studies on understanding the feasibility, usability, and acceptance of this technology. Numerous studies also reported innovative ideas and approaches using smart speakers for delivering care. Although there is enthusiasm regarding the potential of smart speakers as a cost-effective means to enhance health care access and services, studies have also brought attention to practical challenges and barriers individuals or organizations face with the technology.

Comprehending the Feasibility, Acceptability, and Usability of the Technology

Novel digital technologies are disruptive, prompting researchers to conduct feasibility studies to understand their potential, features, and technology usage for specific problem(s). As these technologies become more feasible, acceptable, and mature, they are adapted to provide digital services in various fields, including health, which is the focus of this review. The primary goal(s) of all the research studies (n=59) is to explore the feasibility of using this new technology. The included studies assess the technology's viability and serve as a guide for extensive randomized clinical trials with broader goals that considerably effect the community. In addition to feasibility, some research studies have also investigated the acceptability^{17,21,33,39,54,62,63,71,74,75,85} of this novel technology by patients and providers. Across all the studies, researchers report positive findings regarding feasibility, acceptability, and attitude toward use. These outcomes are attributed to the technology's user-friendliness, ease of use, communication capabilities, and accessibility. However, it is essential to note that the outcomes reported have small participant pool and controlled environment, warranting further research with larger populations to assess the generalizability of smart speakers in health setting. Nonetheless, the initial evidence suggests that smart speakers show great promise in health care.

Opportunity to Push the Boundaries of Telehealth

Smart speakers have proven to be an efficient mHealth tool to deliver remote health care

and services, effectively bridging geographic gaps between patients and providers and improving accessibility. Studies have reported smart speakers' ability to monitor patient health remotely—which supports proactive health management, specifically chronic conditions,^{32,46,68,75} delivering interventions^{44,50,51,62,74} and custom physical activity programs, communicating efficiently,^{22,32,46,56,57} and removing the constraints of physical proximity for care and services.^{26,34} As technology advances, the synergy between telehealth and mHealth holds great promise for developing a more patient-centric, accessible, and efficient health care and services ecosystem.

Opportunity to Improve Efficiency and Experience of Health Care and Services

Rising health care costs and the traditional model of providing health services at specific, physical locations have raised concern, driving experts to seek cost-effective, innovative approaches to assist the growing population. Studies have found individual/patient(s) to have positive and pleasant experiences while using smart speakers during hospital stays,^{56,57,63} which extends to individual/patient(s) living in senior living communities. Smart speakers also positively affect provider efficiency^{57,60,61,63} and assist individual/patient(s) in diagnosis.^{24,25,58,68} Furthermore, smart speaker-delivered health care and services.^{19,20,26,34,35,53–55,72,73} can be more efficient in some scenarios compared with traditional health care service model(s) that necessitate individuals to visit a clinic or specialized providers. Compared with commonly used mHealth devices, such as smartphones and wearables, smart speakers offer a more affordable hardware option. The smart speaker, as a powerful mHealth tool that can interact using natural language and pilot studies reporting positive experience and improved efficiency, makes the device a promising tool for providing personalized care, services, and interventions to a wide range of individuals.

Challenges Interacting with the Technology in Natural Language

The included studies have identified challenges associated with smart speakers in health care. Although users use natural language with these devices, they must follow a specific

structured format with designated trigger words, posing a problem for older adults who require training to use smart speakers effectively.⁷¹ Researchers have observed instances in which participants grew frustrated when their commands were not structured as expected and smart speakers failed to respond appropriately.^{31,37,42,85} Participants faced difficulties in understanding and giving commands,^{30,33,45} maintaining extended conversations,⁶⁵ using trigger words,^{19,20} understanding responses,⁴⁹ lack of feedback and acknowledgment from the device,³⁹ and the speed of response narration,^{33,44} collectively contributed to their frustration. Moreover, participants' long pauses^{26,31} caused interruptions, as the smart speaker mistakenly interpreted the pause as the end of the command or conversation, leading to overlapping conversations, confusion, and further frustration. These findings underscore the importance of providing sufficient training and guidance to individuals, especially older adults, to overcome these challenges and ensure smart speakers are efficient digital health tools. Improving user understanding of trigger words, command structure, and expected responses can enhance the user experience and reduce frustration.

Challenges Integrating the Novel Technology with Existing Health Technology and Infrastructure

Smart speakers' untapped potential holds immense promise in digital health care, proven by studies showcasing feasibility, acceptability, and future possibilities. Nevertheless, these studies have also identified barriers to overcome and fully use their potential in health care. Currently, smart speakers are primarily designed for individual consumer use and cannot be effectively deployed across enterprise health care organizations.^{56,63,64,71,75,76} For instance, they may not comply with federal and state health laws and lack tools for remote management, configuration, and monitoring capabilities.^{64,71,76} Compared with mature software systems with well-established tools and processes for remote management and monitoring, the software powering smart speakers offers a different level of control, leading to security, privacy, and reliability challenges

within health care organizations' software and information ecosystems. Addressing these challenges will require collaboration between smart speaker manufacturers, health care organizations, and regulatory bodies. It will be necessary to develop standards and guidelines specific to the health care context, establish robust security and privacy measures, and design smart speakers with the needs and requirements of health care organizations in mind.

Strengths and Limitations

Our review has several notable strengths. First, we followed a rigorous process for searching, screening, and selecting pertinent literature, ensuring the validity and reliability of the included studies.^{14,15} Second, our search had recent papers up to September 2023, used diverse data sources, and employed broad search terms to enhance the comprehensiveness of our scoping review. This inclusive perspective allows for a more nuanced and insightful analysis of the subject matter, bolstering the overall strength of our scoping review. Although it is essential to acknowledge that our study did not critically appraise the literature or conduct a meta-analysis, our methods align with the aims and purpose of a scoping review.¹² Nonetheless, it is essential to recognize that by limiting our search to well-known databases and studies written in English, our scoping review may have overlooked valuable papers written in other languages, studies with varying terminology, unpublished and in-progress studies, and published in alternative sources. In addition, the authors reviewed the studies' acknowledgment and conflict of interest to report the studies directly funded or supported by smart speaker vendors. However, studies indirectly supported by the vendors, studies with adverse outcomes and not published, or those failing to report funding sources could introduce bias in the review. Considering these limitations and biases is important when interpreting our review's findings and potential implications.

CONCLUSION

This study presents a scoping review of the literature on smart speakers in health care, examining their use by patients to manage

their health and assist health care providers. The review identified various health conditions and issues that were targeted, and the research study goals, outcomes, and challenges associated with using smart speakers in health care. The findings indicated that the current studies primarily focused on assessing the feasibility and usability of smart speakers in health care, often with limited participants, a logical step for understanding the technology itself. However, the review also identified several strengths across these studies, including the ability to deliver health care services with high feasibility and acceptability. Smart speakers are perceived as an affordable and engaging digital tool that offers artificial intelligence capabilities and a novel interaction modality, which could help overcome the limitations of the current health care delivery model. This work serves as a valuable reference for researchers seeking to comprehensively understand smart speaker use in health settings. This work provides a strong foundation for future research on smart speakers in health care, such as further research and validation by independent informaticists and stakeholders to enhance the validity and value.

POTENTIAL COMPETING INTERESTS

The authors report no competing interests.

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SUPPLEMENTAL ONLINE MATERIAL

Supplemental material can be found online at <https://www.mcpcdigitalhealth.org/>. Supplemental material attached to journal articles has not been edited, and the authors take responsibility for the accuracy of all data.

Abbreviations and Acronyms: EHR, electronic health records; mHealth, mobile health

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