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Chatbots utility in the healthcare industry: An umbrella review

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A B S T R A C T

Introduction: Chatbots, computer programs emulating natural language conversations, have gained attention in healthcare. Recent advances address issues like obesity, dementia, oncology, and insomnia. A comprehensive assessment of their utility is essential for widespread adoption. This study aims to summarize chatbots' role in healthcare.

Material and Methods: The methodology involved a systematic review of English-language literature up to May 8, 2023, from databases of Embase, PubMed, Web of Science, and Scopus. Selection followed a two-step process based on inclusion/exclusion criteria. The PRISMA checklist and AMSTAR-2 tool ensured quality.

Results: The review encompassed 38 articles. Findings reveal chatbots primarily promote healthy lifestyles, improving mental well-being. They are widely used for treatment, education, and screening due to their accessibility.

Conclusion: Chatbots hold transformative potential in healthcare, especially in mental health, cancer management, and public health. They are poised to revolutionize the industry, offering innovative solutions and improving patient outcomes.

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INTRODUCTION

Conversational agents are becoming more widely available and being used increasingly in many parts of our daily lives, thanks to developments in natural language processing (NLP), the capacity to understand and analyze both written and spoken language and machine learning (ML), a statistical technique for using data to train models so they can generate forecasts based on several features [1-4].

Conversational agents, also known as chatbots, chatter robots, and digital assistants, are computer programs designed to converse or interact automatically with human users through speech, text, or both [5]. These digital tools aim to emulate humanlike behaviors using artificial intelligence [6] [7] and hold an intimate conversation with people to

address their queries or concerns [8, 9]. The intellectual foundation of human-computer communication was laid sixty years ago when Joseph Weizenbaum of Massachusetts instate of technology created "Eliza", the first established chatbot [10]. Eliza was a program capable of imitating Rogerian psychotherapists via neural language processing [11]. This intellectual agent prompted the creation of the first generation of chatbots: PARRY, developed in 1972, mimicking a person with paranoid schizophrenia counseled by Eliza [12]; GURU was a psychologic conversational agent emulating informal human conversations created in 1990 [13], and ALICE (artificial linguistic internet computer entity) a revamped version of Eliza program with improved flexibility and comprehensibility [14].

Most of the earliest conversational systems were merely generated to pass the Turning test, in which human participants were asked to carry on conversations with systems and determine whether or not they were conversing with a human or a machine [1]. Over the past three decades, there has been evidence pointing to the potential advantages of employing embodied conversational agents for achieving several health-related objectives, such as increasing physical activity hours, improving diet, and accessibility to online health information. However, most prior conversational agents only accepted counterstained user input and could not process natural language input [15-18]. Recent advancements in artificial intelligence, particularly natural-language-related techniques and rapid growth in machine learning technology, led to the development of chatbots with the ability for more complicated conversations and improved dialogue flexibility [19, 20]. Furthermore, notable progress in speech recognition and voice-activated technology resulted in virtual personal assistants on smartphones and smart home devices such as Google Home, Microsoft's Cortana, IBM Watson, and messengers like Facebook [21, 22]. Nowadays, chatbots are accessible either as hardware (e.g., Alexa as an in-home smart echo device) or software (e.g., web-based messengers, mobile applications, Google Assistant, and iPhone's Siri) [6, 23-25]. They are used to assist individuals in meeting daily needs and duties, including customer services, entertainment, education, social support systems, business, and commercials [26, 27]. For instance, a smart bot named "NBC" allows newsreaders to easily browse through the breaking news, or another chatbot called "Imperson" facilitates the development of a marketing network and e-commerce as well as customer support services [28]. Chatbots are available anytime, anywhere. They keep working continuously throughout the year without getting tired or requiring rest. They are programmed to be non-judgmental, which may put people, particularly those uncomfortable revealing their feelings to a human being, at ease to open up without hesitation or fear of being stigmatized [29, 30].

Owing to the abovementioned benefits of chatbots, they have made their way into the healthcare industry. They have capabilities beyond just responding to queries from users. They assist practitioners in diagnosis and counseling, support patients in managing their chronic disorders and scheduling medical appointments, aid people to assess their physical, behavioral, and mental health status, and enhance self-adherence to medications [26, 31, 32]. In light of the opportunities presented by this theology, some healthcare costs could be reduced, healthcare providers' efficiency may improve, and patients will probably have easier access to medical services resulting in better outcomes [33, 34]. The COVID-19 pandemic accelerated the utilization of chatbots and telemedicine. In this era, chatbots assist people in obtaining information about coronavirus transmission, signs and symptoms of the disease, preventive measures to avoid infection, and any facts and updates concerning the disease [35]. They enabled medical professionals to provide timely and accurate care, maintain social distances, avoid exposure to infection, and home-based assessment and observation of suspicious individuals to COVID-19. Besides, chatbots enabled clinicians not only to allocate more resources to COVID-19 medical necessities but also to ensure ongoing follow-ups care and therapeutic interventions for patients with chronic medical conditions [36].

In recent years, chatbots have made significant advancements in addressing a range of health concerns and prominent topics such as obesity and weight control [37], dementia (e.g., Endurance is a companion chatbot developing intimate conversations with people with Alzheimer's disease) [38], substance use disorders [39, 40], oncology care [41], insomnia (e.g., Casper is a chatbot designed to help people who have trouble sleeping) [42], prenatal services [43], HIV and sexual health [44], and depression and anxiety [45]. Chatbots have also shown promising use in the mental health field. They have played a key role in suicide prevention [46], virtual cognitive-behavioral therapy [47], and psychoeducation [48]. The purpose of this study was to identify and summarize the research on the utility of chatbots in the healthcare industry.

MATERIAL AND METHODS

In this umbrella review, we have explored systematic review publications that investigate the application of chatbots in the healthcare domain and the therapeutic utilities of these tools. To substantiate the study outcomes, we utilized the preferred reporting items for systematic reviews and meta-analyses (PRISMA) checklist. Additionally, we appraised the

selected studies methodologically by deploying the a measurement tool to assess systematic reviews 2 (AMSTAR-2) quality assessment tool.

Data sources

Embase, PubMed/MEDLINE, Web of Science (WoS), and Scopus were the online sources of publications through which we looked up the defined keywords of the study. In order to achieve all relatable publications, comprehensive search queries were constructed combining the relevant keywords by Boolean operators. The search inquiry was completed on May 8, 2023. Here is an example of a search inquiry in PubMed/MEDLINE database:

("chatbot"[Title/Abstract] OR "ChatGPT" [Title/Abstract] OR "embodied conversational agents"[Title/Abstract] OR "automated conversational agents"[Title/Abstract] OR "smart conversational agents"[Title/Abstract]) AND (meta-analysis [Filter] OR review [Filter] OR systematic review [Filter])

We gathered the curated articles in an EndNote file and, after removing duplicated articles, proceeded with the steps of screening, selection, and extraction of data.

Study selection

This step consisted of two separate parts. In the first part, two researchers screened the titles and abstracts of the articles to assess their pertinence to the study concept. During the second part, two other researchers thoroughly examined the full texts of the screened articles. Publications that met the eligibility criteria were considered for data extraction.

Inclusion criteria: The study must be written in the English language and follow a systematic review or systematic review and meta-analysis structure. Additionally, it should be published in peer-reviewed journals

Exclusion Criteria: Original articles, non-human investigations, case series, case reports, duplicated publications, abstracts without accessible full-texts, conference abstracts, opinions, editorial letters, and preprints.

Data extraction

Systematic review publications that met the eligibility criteria during the second part of the selection process were considered for data extraction. Two researchers performed the extraction process. The accuracy and reliability of the extracted data were controlled by other researchers.

Quality and risk of bias assessment

The quality and bias risk of the selected studies were critically appraised by utilizing the AMSTAR-2. Table 1 presents the evaluation of the included studies by this tool. To evaluate individual studies, this tool applies 16 items.

Table 1: Quality assessment of included studies by AMSTAR-2

Ref.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
[5]		*		*		*	*	*		*				*	*	*
[35]		*			*		*	*		*				*	*	*
[38]		*					*	*	*	*			*	*	*	*
[39]		*					*	*		*				*	*	*
[40]		*				*	*	*	*	*			*	*	*	*
[42]		*		*			*	*		*	*	*		*	*	*
[48]		*					*	*	*	*			*		*	
[49]		*					*	*	*	*			*		*	
[50]		*					*	*	*	*			*		*	*
[51]		*					*	*								*
[52]		*			*		*	*		*					*	*
[53]		*		*	*	*	*	*	*	*			*	*	*	
[54]		*			*	*	*	*	*	*			*	*	*	*
[55]		*			*	*	*	*	*	*			*	*	*	
[56]		*					*	*	*	*			*	*	*	
[57]		*					*	*		*	*	*			*	*
[58]		*					*	*	*	*			*	*	*	
[59]		*			*	*	*	*	*	*			*	*	*	
[60]		*			*	*	*	*		*			*	*	*	*
[61]		*					*	*		*			*		*	*
[62]		*		*	*	*	*	*	*	*			*	*	*	*
[63]		*					*	*	*	*	*	*	*	*		*
[64]		*			*	*	*	*	*	*			*	*	*	*
[65]		*					*	*		*	*	*				
[66]		*					*	*	*	*			*	*	*	*
[67]		*			*	*	*	*		*					*	*
[68]		*			*		*	*	*	*			*	*	*	*
[69]		*				*	*	*		*				*	*	*
[70]		*			*		*	*	*	*			*	*	*	*
[71]		*					*	*		*				*	*	*
[72]		*					*	*		*				*	*	*
[73]		*					*	*	*	*			*	*	*	*
[74]		*					*	*		*				*	*	*
[75]		*			*		*	*		*				*	*	*
[76]		*					*	*		*				*	*	*
[77]		*			*		*	*		*				*	*	*
[78]		*					*	*		*				*	*	*
[79]		*					*	*		*				*	*	*

Items of quality assessment by AMSTAR-2:

1. Did the research questions and inclusion criteria for the review include the components of PICO?
2. Did the report of the review contain an explicit statement that the review methods were established prior to conduct of the review and did the report justify any significant deviations from the protocol?
3. Did the review authors explain their selection of the study designs for inclusion in the review?
4. Did the review authors use a comprehensive literature search strategy?
5. Did the review authors perform study selection in duplicate?

6. Did the review authors perform data extraction in duplicate?
7. Did the review authors provide a list of excluded studies and justify the exclusions?
8. Did the review authors describe the included studies in adequate detail?
9. Did the review authors use a satisfactory technique for assessing the risk of bias (RoB) in individual studies that were included in the review?
10. Did the review authors report on the sources of funding for the studies included in the review?
11. If meta-analysis was justified did the review authors use appropriate methods for statistical combination of results?
12. If meta-analysis was performed did the review authors assess the potential impact of RoB in individual studies on the results of the meta-analysis or other evidence synthesis?
13. Did the review authors account for RoB in individual studies when interpreting/ discussing the results of the review?
14. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?
15. If they performed quantitative synthesis did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?
16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?

RESULTS

The database search yielded 375 studies. After removing duplicates, and following the screening, a total of 38 studies were included in this umbrella review (Fig 1). Table 2 presents the summary of the studies related to Chatbots utility in the healthcare industry; the table illustrates the name of the first author, the year and country of study, the aim of the study, the number of included studies, and the main findings.

The number of published systematic reviews on the utility of Chatbots in the healthcare industry has seen a significant increase from 2017 to 2023. Of 38 articles, only 7 (18.4%) of articles published before 2020. This could be due to the COVID-19 pandemic and the valuable role played by chatbots during that period. In total 1,833 studies were included in our enrolled systematic reviews, and they included a total of 1132 articles (included studies) (Table 2).

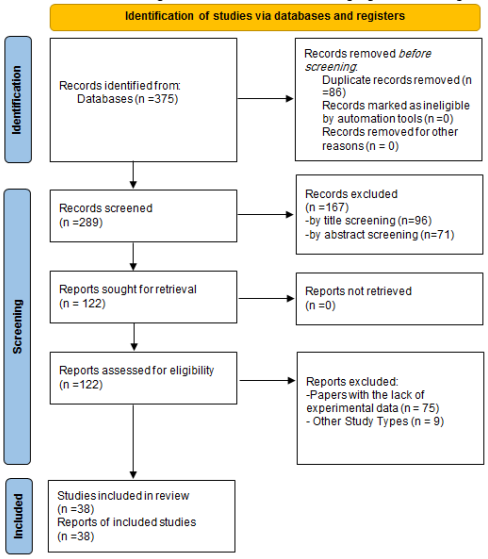

Fig 1: PRISMA flow diagram of study retrieval process

The included studies were carried out in a wide range of countries including the USA (n=9), Qatar (n=6), Singapore (n=4), UK (n=3), Australia (n=3), and Netherlands (n=2). The following countries were each subject to one study: Peru, Saudi Arabia, Germany, Switzerland, Hungary, Norway, China, Spain, Indonesia, New Zealand, and Canada.

Table 2: Description of findings reported in the eligible studies

Ref	First Author, Year, Country	Aim	Included studies	Main finding
[5]	Vaidyam, 2019, USA	Survey of chatbots and conversational agents in mental health	8	Early evidence speaks to patient outcomes and acceptance of chatbots. Chatbots offer the potential for an effective new psychiatric tool, provided they are implemented properly and ethically.
[35]	Tudor Car, 2020, Singapore	Survey of conversational agents in health care	47	Most conversational agents reported in the literature to date are text-based, machine learning-based, and mobile application-based.
[38]	Ruggiano, 2021, USA	Chatbots to support people with dementia and their caregivers	6	Although chatbots offer the potential of an attractive technology that can benefit people with dementia and their caregivers, more work is needed to develop evidence-based chatbots that can be easily used by these populations.
[39]	Ogilvie, 2022,	Use of chatbots as	6	Reduction in substance consumption was reported in a number of

Ref	First Author, Year, Country	Aim	Included studies	Main finding
	UK	supportive agents for people seeking help with substance use disorder		people. Furthermore, it was found that a strong cautionary message needs to be conveyed to the extent that expert input is needed to safely use available data, such as big data from social media or what the market has access to.
[42]	Pereira, 2019, Spain	Using health chatbots for behavior change	30	It was classified as a disease, competence, and technical enabler. Then, solutions for the healthcare-chatbot space were presented. First, in the field of health care mental and physical health, and nutritional and metabolic disorders, Second, "influence" and "cognition" are the human competencies most sought after by chatbots to achieve behavior change.
[48]	Abd-alrazaq, 2019 , Qatar	A review of the characteristics of chatbots for individuals' mental condition as documented in the literature	53	chatbots were commonly used for therapy, training, and screening. Rule-based and standalone software were the majority of chatbots included in the study. Though input was mostly written language, outputs were mainly the combination of written, spoken, and visual languages. Most included chatbots focused on subjects like depression and autism and most had virtual representation Mental health chatbot research is new.
[49]	Abd-Alrazaq, 2020 , Qatar	To identify the technical (nonclinical) metrics used by previous studies to evaluate healthcare chatbots.	65	Survey designs and worldwide usability metrics dominated the health chatbot study. Chatbots were studied in different files such as response generation, understanding, and errors. Technical metrics had a vast diversity (chatbots usability was evaluated through 27 metrics). Health chatbot performance is hard to assess due to a lack of standards and objective criteria, which could slow advancement.
[50]	Abd-Alrazaq, 2021, Qatar	A review of patient's opinions and perceptions on the usage of chatbots for their mental well-being	37	Patients viewed included chatbots in the mental health field positively. The chatbots' linguistic abilities should be promoted to handle unexpected user input, make high-quality responses, and demonstrate high variability.
[52]	Aggarwal, 2023, USA	To assess the efficacy, feasibility, and intervention features of chatbots using AI for elevating change in health behavior	15	AI chatbots promoted treatment adherence, smoking cessation, substance usage, and healthy lifestyles. Included studies showed mixed Feasibility, acceptability, and usability. , monitoring Goal setting, on-demand support, spontaneous reinforcement, or feedback were developed for AI chatbots using selected behavior change theories and expert input. Personalized services were provided using collected user preferences and behavioral performance instantaneously. AI chatbots showed scalability Through smartphones and Facebook Messenger. Participants in studies also stated that in sensitive communication, AI chatbots provided a nonjudgmental venue.
[53]	Albites-Tapia, 2022, Peru	To assess the modern usage of chatbots and their influence on COVID-19 diagnosis from 2020	101	The four most commonly used methodologies for developing chatbots included: sentence order prediction, mask language modelling, Next sentence prediction, and earning-based. chatbots were applied to 5 areas including: Health, Education, Retail, Banks, Tourism. The most common cause of using a chatbot for COVID-19 was its high availability.DialogFlow was the most common tool to develop the chatbot, and Python was used for the development of the majority of chatbots
[54]	Almalki, 2020 , Saudi Arabia	Identify and define these developing technologies and their applications fighting COVID-19	9	The majority of included research described chatbot creation and design, although there were some empirical studies exploring user experience. This article found five main uses for health chatbots in included studies: disseminating health information and knowledge; self-triage and personal risk assessment; monitoring exposure and notifications; tracking COVID-19 symptoms and health aspects; and combating misinformation and fake news. These technologies can also ask and answer inquiries, construct health records and usage histories, complete forms and generate reports, and perform simple actions
[55]	Amiri, 2022 , USA	To find chatbot usages employed for public health response in Covid-19 pandemic	61	Public health response use cases and design grouped chatbots in this study. Risk assessment, information distribution, surveillance, post-Covid eligibility screening, distributed coordination, and vaccination scheduling were six public health response use cases with 15 use cases. Decision-tree structures and prepared response possibilities were employed due to the need for speedy deployment also they concentrated on a small selection of simple activities.
[56]	Bendig, 2019 , Deutschland	To conceptualize the extent and to check the present state of chatbots	6	N/A

Ref	First Author, Year, Country	Aim	Included studies	Main finding
		aiming to promote mental health		
[57]	Boumans, 2022, Netherlands	To assess cutting-edge experimental publications that use virtual agents on a screen capable of linguistic interactions aimed the older persons with amnesia.	8	The meta-analysis includes 8 research articles. Overall Conversations were brief. In general, Usability was stated to be positive. Most of the included studies detected human utterances by using short words or phrases which were predefined in the agent's speech recognition algorithm.
[58]	Chew, 2022, Singapore	AI chatbot usage in weight reduction, To assess the critical components for increasing user engagement	23	Included AI chatbots focused on different fields but mostly on promoting both having a healthy diet and exercising, lifestyle data collection and obesity risk assessment, and promoting a healthy diet, exercise, and stress management altogether. Over half of the included articles used smartphones while others used only text-based AI chatbots and fitness wearable or Internet of Things appliance data. AI chatbots provided personalized recommendations, motivational quotes and messages, gamification, and emotional support as their primary aim. User engagement was raised by combing Speech- and augmented-reality–based chatbots with text-based ones. Also Enabling conversations on many platforms and devices improved user engagement. Increased chatbot user engagement was seen in chatbots using Interactivity and empathy. Text-based chatbots also employed personally and culturally appropriate both colloquial tones and content, emojis that mimic human emotions, positively framed words, citations of trustworthy sources of information, personification, validation, and prompt, fast, and reliable recommendations.
[59]	Denecke, 2022 , Switzerland	Assessing metrics, study designs, and tools used to evaluate its helpfulness in health Conversational agents	66	Most included articles reported usability tests. SUS, UEQ, and individual questionnaires were used. Scenario-based studies measure real-world usage too. There were rarely documented Exploratory setups in studies.
[60]	Fgaier, 2023, Hungary	To perform a systematic review of cost-effectiveness studies using healthcare chatbots in terms of their methods and outcomes	2	This article discusses two studies. Investigators performed a descriptive summary of included studies. The reporting quality of both studies was poor. Both studies reported poorly. Although both studies showed study-based cost-effectiveness, only one article talked about real expenses.
[61]	Gabarron, 2020, Norway	To offer an overview of the current scientific literature on the usage of chatbots for public health, such as why the study deployed chatbots, and whether health-related ending points and results have been reported	15	Overall, eight developmental studies and seven interventional studies were found. All interventional investigations showed using chatbots would lead to improved health.
[62]	Garg, 2018, USA	To review the probable clinical impact of digital health in cancer as they pertain to key domains, such as patient education, patient outcomes, quality of life, and health care value.	--	Digital health is the integration of various technologies with health care, each having its own set of data gathering and information flow mechanisms. Using these technologies in clinical practice has resulted in Applications used across various stages of healthcare, including cancer screening, treatment management, and survivorship.
[63]	He, 2023, China	1) Overview of the characteristics of Conversational Agent Interventions available for various mental health conditions 2) Evaluating effectiveness 3) Running a meta-analysis of randomized controlled trials to assess the moderators that were statistically significant.	32	Statistically significant short-term effects of Conversational Agent Interventions (CAIs) were seen on various symptoms such as depressive symptoms, generalized anxiety symptoms, specific anxiety symptoms, mental disorder symptoms, and psychosomatic disease symptoms. Also, this agent has effects on quality of life or well-being, and general distress. Most mental health outcomes were not affected significantly over time. Personalization and empathy helped reaching more efficacy. An increase in Pooled effect sizes with engagement duration elongation was seen.
[64]	Hoermann, 2017, Australia	To evaluate the current evidence for the effectiveness and	24	The intervention included various designs and aimed at different targets such as anxiety, distress, depression, eating disorders, and addiction. mental health outcomes improved significantly in the

Ref	First Author, Year, Country	Aim	Included studies	Main finding
		feasibility of mental health online one-on-one interventions which use text-based simultaneous chat.		synchronous text-based intervention compared to the waitlist condition and post-treatment improvement was comparable to treatment as usual Feasibility studies using trained volunteers and chatbots show significant innovation in mental health treatments.
[65]	Lim, 2022, Singapore	Evaluate the effects of psychotherapy delivered by a chatbot in reducing depressive symptoms in adults with anxiety or depression	11	A combination of input and output formats, samples of clinically diagnosed anxiety or depression, chatbots with an embodiment, problem-solving therapy, offline platforms, less than 10 sessions, and in different US geographical regions displayed bigger effect sizes than others. In this article, no significant covariates in depression symptoms were seen through Meta-regression.
[66]	Martinengo, 2022 , Singapore	To describe Conversational agents (CAs) behaviour change interventions, To find the behaviour change techniques (BCTs) and thesis that guide each of their designs.	47	Included papers focusing on chronic diseases, lifestyle modification medications, and mental health. Conversational agents were embodied and 27 (57%) were female. rule-based Conversational agents were 34/47 (72%) of all. 63 behaviour change techniques were used in Experimental treatments and comparisons included 32 behaviour change techniques such as social support, Problem-solving, and Instruction on how to perform a behaviour were the most common ones. The Trans theoretical Model and Social Cognitive Theory informed 26% of studies on behaviour change. Different behaviour change techniques were used in Behaviour change theory studies.
[67]	Milne-Ives, 2020, UK	To understand conversational agents' usability and effectiveness in healthcare	31	Included studies contained, interactive voice response calls, contextual question-answering agents, speech recognition screening systems, voice chatbots, virtual patients, and voice recognition triage systems. Effectiveness was mostly positive or mixed. Usability and satisfaction were mostly high in studies. The conversational agents studied were usually effective, usable, and satisfactory, but qualitative user perceptions were mixed.
[68]	Oh, 2021, USA	Survey of artificial intelligence chatbots for promoting physical activity, healthy diet, and weight loss	9	Theoretical frameworks that can capture the unique factors of human-chatbot interaction for behavioral change should be developed and used to guide future AI chatbot interventions.
[69]	Provoost, 2017, Netherlands	Survey of embodied conversational agents in clinical psychology	49	It was characterized by great diversity in all aspects: type of intervention, target behavior, platform, communication methods, states of mind of embodied conversational agents, and study design. Currently, the clinical practice appears to benefit from a greater focus on a low-tech approach based on the basics of enabling embodied conversational agents, which can progress more rapidly through the development and testing phases, and therefore, it can be more easily proven to be safe and effective for routine clinical practice.
[70]	Safi, 2020, Qatar	Survey of technical aspects of developing chatbots for medical applications	45	The most common language used for chatbot communication is English. Chatbots usually consist of 4 main components: a text understanding module, a conversation manager, a database layer, and a text generation module. The most common technique for developing chatbots is to use a string-matching algorithm and a set of scripts that contain sample inputs and outputs.
[71]	Sallam, 2023, USA	Survey of ChatGPT utility in healthcare education, research, and practice	60	Considering the valid concerns raised regarding its potential misuse, appropriate guidelines, and regulations are urgently needed with the engagement of all stakeholders involved to ensure the safe and responsible use of ChatGPT powers. The proactive embrace of large language model (LLM) technologies with careful consideration of the possible ethical and legal issues can limit potential future complications. If properly implemented, ChatGPT, among other LLMs, has the potential to expedite innovation in health care and can aid in promoting equity and diversity in research by overcoming language barriers.
[72]	Tjiptomongsoguno, 2020, Indonesia	Survey of medical chatbot techniques	27	Most algorithms for a chatbot are natural language processing and machine learning. The string format that is usually processed by the neuro-linguistic programming (NLP) method is converted into a tokenized format. The tokenized format can be easily processed for the program instead of the string format. After the user input is encoded, it can be processed by machine learning such as classifiers to process the symptoms and match the disease in the classifier training. Therefore, from our point of view, the most suitable algorithm for building a chatbot is NLP and machine learning.
[73]	Vaidyam, 2021, USA	Changes to the psychiatric chatbot landscape in	7	Given that patients can access a wide range of conversational agents on their mobile devices at any time, clinicians should

Ref	First Author, Year, Country	Aim	Included studies	Main finding
		serious mental illness		carefully evaluate the quality and efficacy of these options given such heterogeneity of available data.
[74]	Wang, 2023, USA	The use of chatbots in oncological care	21	Chatbots are highly acceptable to patients and are also effective in automating tasks related to cancer screening, prevention and risk stratification, treatment and symptom management, and survival. By facilitating patient-centered communication, increasing access to care, reducing operational costs, and saving time for nurses and physicians, chatbots have great potential for future implementation and commercialization.
[75]	White, 2022, Australia	Survey of user experience of COVID-19 chatbots	10	The COVID-19 pandemic posed a unique and specific challenge to digital health interventions, as design and implementation were required at a rapid pace as the adoption of digital health services around the world accelerated.
[76]	Whittaker, 2022, New Zealand	Chatbots for smoking cessation	10	It should compare chatbots with proven text messaging and other cessation interventions to determine whether they can be more effective than current programs. Authors should use consistent terminology in their descriptions of chatbots and in keywords to ensure that their studies are easily searchable for future reviews.
[77]	Wilson, 2022, Australia	The development and use of chatbots in public health	32	Research into recent advances in artificial intelligence that allow conversational agents to interact more realistically with humans is still in its infancy in the field of public health. Most chatbots used in support areas such as counseling and therapy services are still experimental. There is considerable variation in the effectiveness of chatbots.
[78]	Xu, 2021, Canada	Chatbot for health care and oncology applications using artificial Intelligence and machine learning	95	N/A
[80]	Abd-alrazaq, 2020 , Qatar	To evaluate the safety and effectiveness of utilizing chatbots to promote mental health by summarizing and aggregating the findings of prior studies	12	Chatbots may boost mental wellness as included evidence in improving depression, stress, acrophobia, and distress. There were conflicting results about this new technology's effects on anxiety characteristics such as its severity. Since there was a lack of clinically meaningful evidence, a paucity of studies examining each outcome, a substantial risk of bias in those studies, and conflicting results for several outcomes, this study could not definitively establish this.
[81]	Boucher, 2021, UK	Survey of automated conversational agents for post-intervention follow-up	10	A wide range of chatbot constructions and applications were identified. Further investigation of acceptability, effectiveness, and mechanistic evaluation in ambulatory care pathways may support implementation in routine clinical care.

There was a variety of focused subjects in included articles such as describing technical aspects and survey design, mental health, public health, and COVID-19-related tasks. In Table 3, different utilities of chatbots in healthcare tools including healthy lifestyle, mental health, weight control, oncology care, education, COVID-19, amnesia, public health focusing on metrics, health care, and cost-effectiveness were described. Chatbots related to mental health were the most common tools in included studies.

According to the research, chatbots are mostly used to encourage a healthy lifestyle and enhance the mental well-being of individuals. Other common uses of chatbots are treatment, education, and screening. A noteworthy result is that the majority of reviewed studies cited the most common reason to use chatbots is that they are readily available.

The findings of the present study showed that utilities such as mental health (n=17), weight control (n=2), oncology care (n=3), education (n=8), COVID-19 (n=5), amnesia (n=2), and public health (n=13) were among the most important utilities of chatbots in healthcare. We also identified other utilities of chatbots that have been used in the healthcare industry such as tools for self-management, health behavior change, general overview, psychotherapy, health assistant, smoking cessation, healthy lifestyle, and diagnosis.

DISCUSSION

The use of chatbots has increased in the healthcare industry in recent years, experiencing a significant surge after the COVID-19 pandemic. Chatbots are primarily utilized for disease diagnosis, treatment, and educational purposes.

In our umbrella review, we analyzed 38 systematic reviews that examined different aspects of chatbot implementation in healthcare. The majority of these reviews focused on the utilization of chatbots in psychological and mental disorders, including depression, anxiety, eating disorders, phobias, psychosomatic disorders, and autism [5, 40, 48, 50,

51, 56, 63-66, 73, 80-83].

Table 3: Different utilities of Chatbots in healthcare

Ref.	Chatbots utility in healthcare							
	Mental health	Weight control	Oncology care	Education	COVID-19	Amnesia	Public health	Other
[5]			✓					
[33]				✓			✓	
[36]				✓		✓	✓	
[38]	✓			✓				Healthy lifestyle
[39]	✓							
[42]	✓						✓	
[47]							✓	Self-management
[48]	✓							Health behaviour change
[49]	✓							
[51]				✓	✓			
[52]					✓		✓	
[53]					✓		✓	
[54]	✓							
[55]						✓		
[56]		✓						
[57]							✓	General overview
[58]							✓	
[59]							✓	
[60]			✓	✓				
[61]	✓							
[62]	✓							
[63]	✓							Psychotherapy
[64]	✓							Behaviour changes techniques (BCTs)
[65]							✓	
[66]	✓							
[67]		✓						
[68]	✓							
[69]				✓			✓	
[70]							✓	Health assistance
[71]	✓							
[72]	✓							
[73]					✓			
[74]					✓			Smoking cessation
[75]							✓	
[76]			✓	✓				Diagnosis
[77]	✓			✓				
[78]	✓							

Considering the importance of a healthy lifestyle, one of the service areas of chatbot technology is to encourage a healthy lifestyle and enhance the mental well-being of individuals. Findings from a systematic review and meta-analysis indicate that chatbot interventions are efficacious for increasing physical activity, fruit and vegetable consumption, sleep duration, and sleep quality. Chatbot interventions were efficacious across a range of populations and age groups, with both short- and longer-term interventions, and chatbot-only and multicomponent interventions being efficacious [84].

By employing advanced algorithms and decision tree structures, chatbots generate tailored responses for various situations [35, 70, 72]. Their personalized and empathetic communication proves highly valuable in mental health consultations. Some of these chatbots have shown promise in the treatment of substance abuse [39, 52], obesity [58], and diabetes through lifestyle [66] and behavioral changes facilitated by conversational agent interventions. Text-based chatbots also utilize appropriate informal language, emojis that convey human emotions, positive words, and citations from reliable sources, providing quick and reliable recommendations. Chatbots have been successful in promoting exercise, diet, and stress management through smartphone applications, text-based platforms, and social media [52, 58]. These interventions rely on natural language processing and machine learning algorithms and have demonstrated significant innovation in mental health treatment and consultation [64].

Based on the findings of the present study, chatbots are beginning to appear in the area of mental health. People living in rural communities, or shift workers, may have problems accessing mental health care appointments, and chatbots could be used as a potential solution to this. The results of a related study to assess the usability of a chatbot for mental health care within a social enterprise showed that Chatbots can be used to provide guided self-assessment, and tips for the following areas: stress, anxiety, depression, sleep, and self-esteem [85].

While there is considerable diversity in the effectiveness of chatbots, they have also shown potential for effective use in public health situations [55, 57, 61, 77]. They have been employed successfully in smoking cessation programs [76], COVID risk assessment, monitoring exposure analysis and notifications, and even vaccination purposes [53-55, 75]. Chatbots have proven useful in self-triage, personal risk assessment, and disseminating health information and knowledge [54, 67]. Chatbots have also demonstrated promise in enhancing digital health. They have been widely used to combat misinformation and fake news during the COVID-19 pandemic. They can be utilized in cancer screening, survivorship, and post-treatment follow-up, automating tasks related to screening, prevention, risk stratification, treatment, symptom management, and survival [62, 74]. Patients find chatbots highly acceptable, and they contribute to better communication abilities between healthcare professionals and patients. However, further research is necessary to explore and enhance the use of chatbot technologies in specific populations, such as individuals with dementia [38]. Research programs focusing on improving interactions between conversational agents and humans are still in the early stages.

The linguistic abilities of chatbots need to be improved to generate high-quality responses. While most chatbots used in support areas like counseling and therapy services are considered experimental, their effectiveness is steadily improving [28]. However, there are several other aspects related to chatbot language design and performance that have been explored in research.

CONCLUSION

Chatbots play a crucial role in diverse areas of the healthcare sector. Their remarkable and indisputable impact on various realms within healthcare, including mental health, behavioral health, cancer care, and public health, will profoundly transform the future landscape of this field. By leveraging the potential of chatbots, addressing challenges in healthcare systems, promoting interprofessional collaboration, embracing diversity and inclusion, and fostering leadership that values inclusiveness, the future of healthcare can be shaped to provide equitable and effective care for all.

AUTHOR'S CONTRIBUTION

All authors contributed to the literature review, design, data collection and analysis, drafting the manuscript, read and approved the final manuscript.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest regarding the publication of this study.

FINANCIAL DISCLOSURE

No financial interests related to the material of this manuscript have been declared.

ETHICS APPROVAL

Not Applicable.

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