

Titre: Roles, users, benefits and limitations of chatbots in health care :
Title: rapid review

Auteurs: Moustafa Laymouna, Yuanchao Ma, David Lessard, Tibor Schuster,
Authors: Kim Engler, & Bertrand Lebouché

Date: 2024

Type: Article de revue / Article

Référence: Laymouna, M., Ma, Y., Lessard, D., Schuster, T., Engler, K., & Lebouché, B. (2024).
Citation: Roles, users, benefits and limitations of chatbots in health care : rapid review.
Journal of Medical Internet Research, 26. <https://doi.org/10.2196/56930>

 Document en libre accès dans PolyPublie
Open Access document in PolyPublie

URL de PolyPublie:
PolyPublie URL: <https://publications.polymtl.ca/58810/>

Version: Version officielle de l'éditeur / Published version
Révisé par les pairs / Refereed

Conditions d'utilisation:
Terms of Use: Creative Commons Attribution 4.0 International (CC BY)

 Document publié chez l'éditeur officiel
Document issued by the official publisher

Titre de la revue: Journal of Medical Internet Research (vol. 26)
Journal Title:

Maison d'édition: JMIR Publications Inc.
Publisher:

URL officiel: <https://doi.org/10.2196/56930>
Official URL:

Mention légale:
Legal notice:

Review

Roles, Users, Benefits, and Limitations of Chatbots in Health Care: Rapid Review

Moustafa Laymouna^{1,2,3}, MD, MSc; Yuanchao Ma^{2,3,4,5}, MScA; David Lessard^{2,3,4}, PhD; Tibor Schuster¹, PhD; Kim Engler^{2,3,4}, PhD; Bertrand Lebouché^{1,2,3,4}, MD, PhD

¹Department of Family Medicine, Faculty of Medicine and Health Sciences, McGill University, Montreal, QC, Canada

²Centre for Outcomes Research and Evaluation, Research Institute of the McGill University Health Centre, Montreal, QC, Canada

³Infectious Diseases and Immunity in Global Health Program, Research Institute of McGill University Health Centre, Montreal, QC, Canada

⁴Chronic and Viral Illness Service, Division of Infectious Disease, Department of Medicine, McGill University Health Centre, Montreal, QC, Canada

⁵Department of Biomedical Engineering, Polytechnique Montréal, Montreal, QC, Canada

Corresponding Author:

Bertrand Lebouché, MD, PhD

Centre for Outcomes Research and Evaluation

Research Institute of the McGill University Health Centre

D02.4110 – Glen Site, 1001 Decarie Blvd

Montreal, QC, H4A 3J1

Canada

Phone: 1 514 843 2090

Email: bertrand.lebouché@mcgill.ca

Abstract

Background: Chatbots, or *conversational agents*, have emerged as significant tools in health care, driven by advancements in artificial intelligence and digital technology. These programs are designed to simulate human conversations, addressing various health care needs. However, no comprehensive synthesis of health care chatbots' roles, users, benefits, and limitations is available to inform future research and application in the field.

Objective: This review aims to describe health care chatbots' characteristics, focusing on their diverse roles in the health care pathway, user groups, benefits, and limitations.

Methods: A rapid review of published literature from 2017 to 2023 was performed with a search strategy developed in collaboration with a health sciences librarian and implemented in the MEDLINE and Embase databases. Primary research studies reporting on chatbot roles or benefits in health care were included. Two reviewers dual-screened the search results. Extracted data on chatbot roles, users, benefits, and limitations were subjected to content analysis.

Results: The review categorized chatbot roles into 2 themes: *delivery of remote health services*, including patient support, care management, education, skills building, and health behavior promotion, and *provision of administrative assistance to health care providers*. User groups spanned across patients with chronic conditions as well as patients with cancer; individuals focused on lifestyle improvements; and various demographic groups such as women, families, and older adults. Professionals and students in health care also emerged as significant users, alongside groups seeking mental health support, behavioral change, and educational enhancement. The benefits of health care chatbots were also classified into 2 themes: *improvement of health care quality and efficiency and cost-effectiveness in health care delivery*. The identified limitations encompassed ethical challenges, medicolegal and safety concerns, technical difficulties, user experience issues, and societal and economic impacts.

Conclusions: Health care chatbots offer a wide spectrum of applications, potentially impacting various aspects of health care. While they are promising tools for improving health care efficiency and quality, their integration into the health care system must be approached with consideration of their limitations to ensure optimal, safe, and equitable use.

(*J Med Internet Res* 2024;26:e56930) doi: [10.2196/56930](https://doi.org/10.2196/56930)

KEYWORDS

chatbot; conversational agent; conversational assistant; user-computer interface; digital health; mobile health; electronic health; telehealth; artificial intelligence; AI; health information technology

Introduction

Background

In the dynamic landscape of IT and digital communication, chatbots—known as *conversational agents*—stand at the forefront, revolutionizing interactions between technology and human users. Chatbots are computer programs designed to simulate conversation through text, image, audio, or video messaging with human users on platforms such as websites, smartphone apps, or stand-alone computer software [1-47]. Originating from the concept *ChatterBot*, coined in 1994 [48], chatbots have undergone substantial evolution in their functionality and application.

The evolution of chatbots represents a significant technological leap, transitioning from reliance on predefined, rule-based scripted conversations to the sophisticated use of natural language processing and artificial intelligence (AI). By leveraging natural language processing and AI, chatbots have become capable of understanding and appropriately responding to user requests [49,50]. Their versatility has facilitated applications in a variety of sectors such as education, e-commerce, finance, news, health care, and entertainment. Popular instances of these applications include Amazon's Alexa [51], Apple's Siri [52], Google Assistant [53], Microsoft's Cortana [54], and Samsung's Bixby [55].

A notable advancement in the field of chatbots has been the integration of generative AI and large language models (LLMs) such as ChatGPT [56-58]. They have the capability to generate human-like text, enabling more natural and informative interactions [56-58]. However, their application in health care is still emerging. The risk of misinformation and errors is a significant concern [59,60], particularly in health care where accuracy is critical. The *one-size-fits-all* approach of LLMs may not align well with the nuanced needs of patient-centered care in the health sector [59].

The promise of chatbots in health care is considerable, offering potential for more efficient, cost-effective, and high-quality care [61-65], as well as their broad spectrum of uses and acceptability [66,67]. The use of chatbots to access and deliver health care services seems to be on the rise [23,68-70], granting them multiple potential roles in prevention, diagnosis, and support with care and treatment, with possible impacts on the whole health care system.

Despite the potential benefits, health care chatbots face unique challenges [71-74]. The need for highly specialized and context-sensitive advice is paramount. Generic responses from current chatbot models often overlook individual health profiles and local health contexts, which are crucial for patient care [75].

While a wide range of health care chatbot reviews have been conducted—demonstrating the versatility of chatbots in areas such as genetic cancer risk assessment [44]; oncological care [9,11,24,25]; sexual and reproductive health [35,45]; preconception, pregnancy, and postpartum health [36]; support for smoking cessation [38]; management of weight [39] and chronic conditions [6,9,20,40]; vaccine communication [26]; and broader health care acceptability [27]—these reviews often

exhibit significant limitations in scope and depth. They tend to concentrate narrowly on specific applications such as rehabilitation for neurological conditions [28], mental health support [4,8,12-17,29,30,41,42], health behavior change [31-33,37], the language used in health communication by chatbots [43], and the use of chatbots in the COVID-19 public health response [44], leading to a fragmented understanding of chatbots' roles in health care; for instance, while some reviews [3,7] offer insights, they do not encompass a comprehensive evaluation of the broader implications of chatbots, particularly in diverse contexts. By contrast, other reviews [5,30] concentrate extensively on technical aspects and AI algorithms [24,25,75,76]; yet, this focus tends to overshadow a detailed exploration of the impact these technologies have on health care outcomes.

Objectives

This approach has left significant gaps in the literature. There is an evident need for an integrative overview that thoroughly analyzes the varied roles of chatbots across different health care applications, capturing new trends and advancements. Furthermore, the interactions and benefits of health care chatbots for diverse demographic groups, especially those who are underrepresented, are underexplored. There is also a conspicuous absence of a deeper understanding of the potential benefits and practical limitations of health care chatbots in various contexts.

Therefore, the objectives of this review are to bridge these existing knowledge gaps. Our review aims to provide a comprehensive exploration of chatbots' functional roles, analyze the specific populations they serve, and examine in detail their potential and reported benefits, as well as the limitations of these innovative tools in health care. This endeavor will offer a more holistic and nuanced understanding of chatbots in the health care sector, addressing critical areas overlooked in previous studies.

Methods

Design and Search Strategy

This study is a rapid review, which refers to an accelerated, resource-efficient process of knowledge synthesis through streamlining or omitting specific methods associated with more traditional review processes [77-79]. Hence, a rapid review assesses what is already known in a given area within a relatively short period.

Our search strategy, detailed in [Textbox 1](#), was developed in collaboration with a health sciences librarian and performed within the MEDLINE and Embase databases on February 5, 2022. Recognizing the dynamic nature of our study field, we conducted 2 subsequent updates to our search: the first on April 22, 2022, and the second on October 30, 2023. The strategy also included searches within reference lists and websites (eg, Google Scholar) for relevant material. We exported our search records to EndNote (Clarivate).

Our search was limited to records published in English, as suggested by the Cochrane rapid reviews guide [80], from 2017 to 2023. This time frame was chosen based on preliminary searches that indicated that the largest number of relevant

articles was published during this period [81]. Furthermore, it allowed us to focus on chatbots incorporating more recent technological advancements. No limitations were set based on the study population.

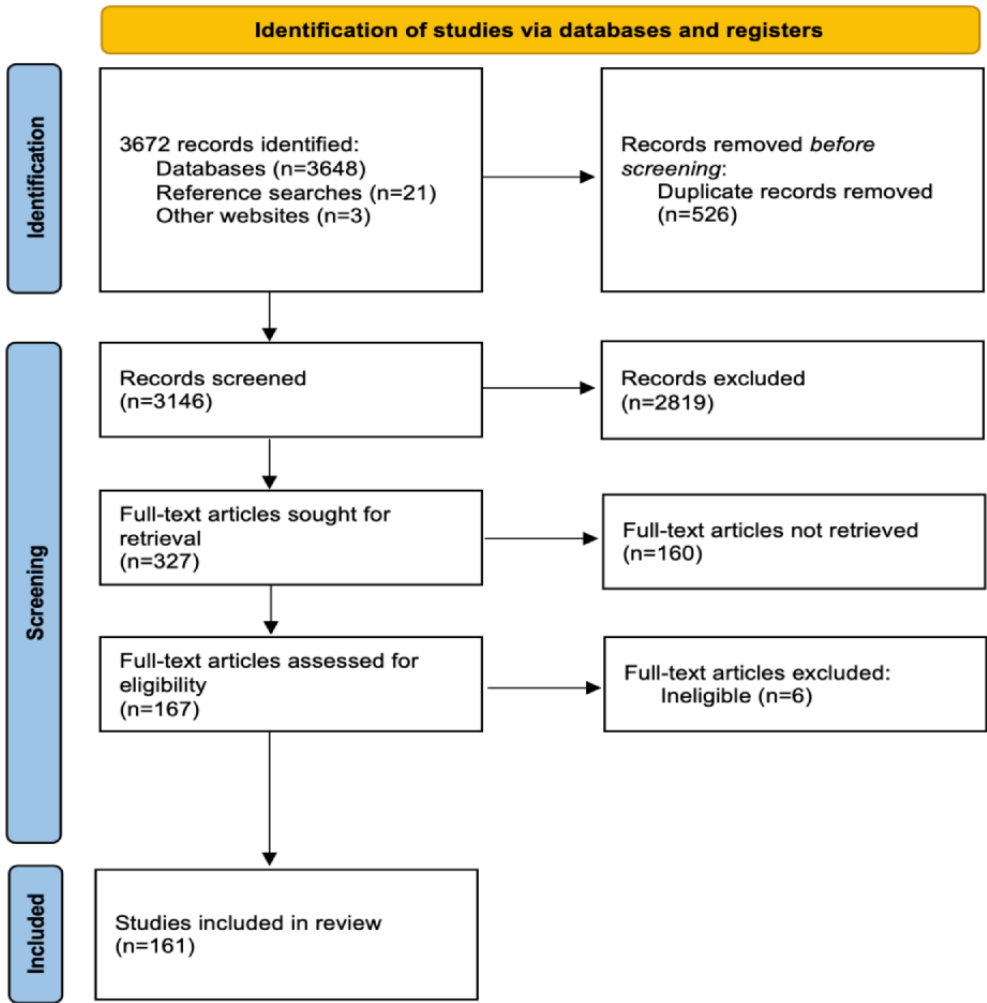
Our rapid review adheres to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, as depicted in Figure 1 [82].

Textbox 1. Search strategy for MEDLINE and Embase.

Search terms

- user-computer interface/or (Chatbot* or chat bot* or User-Computer Interface* or (conversational adj2 (agent* or assistant*))).mp
- Limit 1 to yr = "2017 - Current"
- Limit 2 to English

Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart showing the number of studies identified, screened, assessed for eligibility, and included in the final analysis.



Study Selection

We included primary research studies that used text- or voice-based tailored chatbots as interventions within the health care system or as a means to deliver interventions. These studies report original data on the roles and benefits of chatbots in the health care setting.

Studies not meeting the inclusion criteria were excluded, as were studies reporting any of the following: engineering or computer science data, preintervention data about future initiatives such as protocols, and studies in the preintervention

or predevelopment phase. We also excluded interventions based solely on nonbehavioral actions such as gestures and facial expressions without text or voice interaction, interactions with an actual robot (as opposed to a conversational interface), and virtual reality chatbots. In addition, abstracts lacking sufficient details were excluded.

Data Extraction and Synthesis

Two reviewers (ML and YM) dual-screened 15% of the titles and abstracts and full texts to calculate the percentage agreement and interrater reliability, using Cohen κ [83]. Any discrepancies

were resolved through discussion. ML conducted all remaining screenings. Data extraction was performed using Microsoft Office 365 (Excel and Word), capturing key study characteristics, including title, authors, month and year of publication, journal, study design, chatbot users, the chatbot's medical specialty, whether the chatbot uses AI or is animated, and country of origin. In addition, we extracted information about the roles of chatbots, their benefits to health care, and their limitations. We categorized the source data into empirical and indicative data. This distinction reflects the 2-fold impact of contributions to the field: the actual findings demonstrate concrete evidence about the roles, users, benefits, and limitations of existing chatbots, while the authors' discussion extends the conversation beyond current applications, providing perspective on the potential impacts, challenges, and future directions of health care chatbots, thus more comprehensively rounding out our assessment.

To synthesize these diverse pieces of information, relevant data underwent content analysis to generate subcategories, categories, and overarching themes [84].

While our research centers on chatbots, we have chosen to use the number of studies, rather than the chatbots themselves, as the basis for presenting most of our results. This approach accounts for the diverse adaptations to the identified chatbots across different contexts. Many of the chatbots we studied were modified to serve varied roles; cater to different user groups; and, in some cases, were given entirely different names in separate studies, as indicated in the *Results* section. Importantly, we noticed that a given study could contribute to multiple categories, indicating the flexible and interconnected characteristics of chatbot roles, users, benefits, or limitations. By focusing on the individual studies, we capture a more detailed and context-specific understanding of each chatbot's functionality and versatility, which would be obscured if we merely counted each chatbot once, regardless of its various adaptations.

Results

Database Searches

Our search yielded 3672 records (databases: $n=3146$, 85.68%; reference searches: $n=21$, 0.57%; and other websites: $n=3$, 0.08%). After removing 526 (14.32%) duplicates from the 3672 records, 3122 (85.02%) records remained for title and abstract screening. During this screening phase, we achieved a 97% agreement rate and a Cohen κ value of 0.85, indicating substantial agreement beyond chance. Subsequently, of the 3146 records, 327 (10.39%) full texts were reviewed [85-245] (Figure 1), with 94% agreement and a Cohen κ value of 0.88 among the reviewers. Interrater reliability between the 2 reviewers,

covering both the screening and final study inclusion as well as the data extraction process, ranged from 64% to 81%, indicating strong agreement [83]. This ensures the reliability and validity of the study selection and data extraction phases of our review.

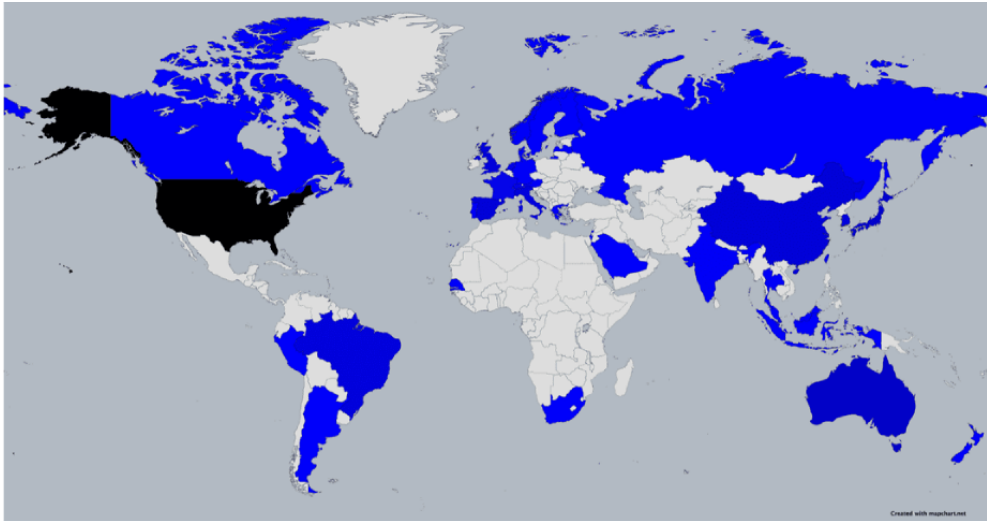
After reviewing the 327 full texts, we ultimately included 161 (49.2%) studies that reported the roles and benefits of chatbots. All 161 studies reported on the roles of chatbots, 157 (97.5%) mentioned their benefits, and 157 (97.5%) addressed their limitations. Each study also reported on the user group or groups of focus that the chatbot was designed to assist.

Origins of the Included Studies

More than a quarter of the studies originated from the United States (46/161, 28.6%; Figure 2). China (15/161, 9.3%), Australia (10/161, 6.2%), Japan (9/161, 5.6%), and Spain (7/161, 4.3%) followed. Of the 161 studies, Italy, Switzerland, the United Kingdom, Singapore, Brazil, and South Korea each contributed 6 (3.7%), France and the Netherlands each contributed 4 (2.5%), while New Zealand, Greece, Russia, Norway, Malaysia, India, Senegal, Peru, Portugal, Canada, Latvia, South Africa, Indonesia, Argentina, Thailand, Saudi Arabia, Germany, and Austria each contributed 1 (0.6%) study. Notably, some studies were multinational; for instance, 1 (0.6%) of the 161 studies included Switzerland, Austria, and Germany; another included Northern Ireland, the Republic of Ireland, Scotland, Sweden, and Finland; yet another included Thailand, China, and Singapore; another study included India, North America, and the United Kingdom; a study included Finland, Denmark, and the Netherlands; another included Norway and Switzerland; and an additional study included the Netherlands and Scotland. Collectively, these 7 multinational studies account for 4.3% of the 161 included studies.

In our review of 161 studies, certain chatbots were the focus of multiple studies, particularly in the United States, Australia, South Korea, Switzerland, New Zealand, and Singapore; for instance, 2 specific chatbots were each the subject of 4 (2.5%) of the 161 studies (Gabby [94,99,101,114] and Woebot [86,92,119,173]). In addition, 11 chatbots were each studied twice (Todaki [90,102], GAMBOT [97,133], Laura [98,121], Vik [108,186], Termbot [151,195], ChatPal [158,168], a chatbot in a virtual ward [180,194], Corowa-kun [181,197], Dokbot [189,192], BotMaria [193,205], and COUCH [236,237]). Among these, a unique situation was observed in 5 (3.1%) of the 161 studies where the same original chatbot was presented under 5 different names [89,104,107,124,240]. These studies often shared several coauthors, indicating a common origin but with adaptations for different populations and roles. However, it is important to note that not all studies with mutual coauthors clearly indicated a shared origin of the chatbots.

Figure 2. Map showing the countries that contributed the studies.



Chatbot Roles

Overview

All studies stated the role or roles of the chatbot used, with at least 1 role per study. Our analysis yielded 14 subcategories of

primary roles (presented in *italics*), grouped into 5 categories, which were organized into 2 overarching themes, as summarized in [Table 1](#).

Table 1. Health care chatbot roles (n=161).

Theme, category, and subcategory	Studies, n (%)
Delivery of remote health services	
Patient support and care management	
Mental health support	46 (28.6)
Counseling and treatment advice	26 (16.1)
Self-management and monitoring for chronic conditions	22 (13.7)
Triaging, screening, risk assessment, and referral	14 (8.7)
Self-care and monitoring for COVID-19 symptoms	8 (5)
Rehabilitation guidance	8 (5)
Reminders	7 (4.3)
Education and skills building	
Health literacy	23 (14.3)
Medical education and clinical skills for health care professionals and medical students	12 (7.5)
Psychoeducation	5 (3)
Health behavior promotion	
Healthy lifestyle behavior	30 (18.6)
Self-monitoring for health behavior change	6 (3.7)
Provision of administrative assistance to health care providers	
Health-related administrative tasks	
Data collection and storage in patient electronic medical records	6 (3.7)
Research purposes	
Recruitment and data collection	3 (1.9)

Theme 1: Delivery of Remote Health Services

This theme refers to health services offered at a distance as an alternative or complement to the usual on-site modes of care delivery. It includes 3 categories and 7 subcategories of roles, with 158 (98.1%) of the 161 studies contributing to this theme.

Patient Support and Care Management

This category refers to the facilitation of medical consultations or the delivery of advice or support by providing counseling or treatment advice, triaging patients' complaints, and fostering self-management and monitoring.

Overall, 103 (65.2%) of the 158 studies contributed to this category. Of these 103 studies, 46 (44.7%) mentioned using chatbots for *mental health support*, 26 (25.2%) reported providing *counseling and treatment advice* through chatbots, while 22 (21.4%) included chatbot use for improving *self-management or monitoring for chronic conditions*. Furthermore, of the 103 studies, 14 (13.6%) described chatbot use for *triaging, screening, risk assessment, and referral*; 8 (7.8%) studies each reported chatbot use for *self-care and monitoring for COVID-19 symptoms* and *rehabilitation guidance*; whereas 7 (6.8%) studies used chatbots to provide *reminders*.

Education and Skills Building

This category included the dissemination of educational material or medical information or skills development material (eg, exercising and using a medical device) for users, including patients, health care providers, or nursing and medical students.

In all, 41 (25.9%) of the 158 studies contributed to this category. Of these 41 studies, 23 (56%) reported promoting *health literacy* of the targeted population with the chatbot, 12 (29%) reported using chatbots in *medical education and clinical skills for health care professionals and medical students*, and *psychoeducation* was reported by 5 (12%) studies to enhance mental well-being.

Health Behavior Promotion

This category included the promotion of healthy lifestyles such as physical activity, a healthy diet, or stress management. Of

the 158 studies, 39 (24.7%) contributed to this category. Of these 39 studies, *healthy lifestyle behavior* was encouraged through the chatbot in 30 (77%), while 6 (15%) reported *self-monitoring for health behavior change* as a chatbot role.

Theme 2: Provision of Administrative Assistance to Health Care Providers

This theme refers to all types of administrative work carried out by the chatbots, grouped within 2 categories—health-related administrative tasks and research purposes—with 9 (5.6%) of the 161 studies contributing to this theme.

Health-Related Administrative Tasks

This category included the completion of health care providers' routine administrative work, such as data collection (eg, medical history taking), data entry, or transferring data to patients' medical records. Of the 9 studies, 6 (67%) reported using the chatbot for *data collection and storage in patient electronic medical records* and charts, as well as for patient-reported outcome data, which could be captured by chatbots to replace collection by health care providers.

Research Purposes

This category refers to chatbot use for the completion of research-related work such as participant recruitment, the consent process, or data collection through surveys. Of the 9 studies, 3 (33%) contributed to this category, reporting the use of chatbots for participants' *recruitment and data collection* through a self-administered questionnaire, in addition to obtaining electronic consent from individuals to participate in the study.

Chatbot Users

Overview

All 161 studies specified the intended chatbot user population. The content analysis yielded 21 subcategories of chatbot users (presented in *italics*), grouped into 8 broader categories of users, as summarized in [Table 2](#).

Table 2. Intended health care chatbot users (n=161).

Category and subcategory	Studies, n (%)
Health condition–focused groups	
Individual seekers of mental health support	23 (14.3)
Patients with chronic conditions	10 (6.2)
Patients with cancer	7 (4.3)
Recovering patients	6 (3.7)
Lifestyle and general well-being enthusiasts	
Healthy adults	44 (27.3)
General public	16 (9.9)
Lifestyle-improvement seekers	9 (5.6)
Demographic and family-centric groups	
Women	14 (8.7)
Parents and children	7 (4.3)
Families	4 (2.5)
Age-based user groups	
Older adults	11 (6.8)
Young seekers of mental health support	8 (5)
Children	4 (2.5)
Underserved populations	
Culturally diverse groups	14 (8.7)
Individuals with disabilities	8 (5)
Health care professionals and students	
Medical and nursing students	8 (5)
Health care professionals	7 (4.3)
Health-related–behavior-change seekers	
Behavioral change seekers	8 (5)
Individuals in addiction recovery	7 (4.3)
Educational and skills enhancement seekers	
Nonmedical professionals	8 (5)
Health care training users	7 (4.3)

Lifestyle and General Well-Being Enthusiasts

This category, with 69 (42.9%) of the 161 studies, addressed individuals aiming to improve or maintain their health and well-being. Of these 69 studies, 44 (64%) focused on *healthy adults* (adults who are in good health, without any significant or chronic medical conditions). *General public* (16/69, 23%) targeted the broader and more inclusive population that encompasses all segments of the population, regardless of their health status. *Lifestyle-improvement seekers*, encompassing 9 (13%) of the 69 studies, included individuals motivated to change their lifestyle.

Health Condition–Focused Groups

This category, comprising 46 (28.6%) of the 161 studies, included patients with specific health conditions across 4 subcategories. Of these 46 studies, individuals seeking mental

health support, the largest subcategory with 23 (50%) studies, referred to adults with conditions such as attention-deficit and panic symptoms. *Patients with chronic conditions* (10/46, 22%) focused on individuals with conditions such as irritable bowel syndrome and hypertension. *Patients with cancer* (7/46, 15%) targeted those with breast cancer and those at risk for hereditary cancer. *Recovering patients* (6/46, 13%) focused on patients in various stages of recovery.

Demographic and Family-Centric Groups

Addressing specific demographic groups and family dynamics, this category comprised 15.5% (25/161) of the included studies. *Women* (14/25, 56%) focused on women’s health issues. *Parents and children* (7/25, 28%) centered on the health issues of children and adolescents. *Families* (4/25, 16%) looked at family dynamics and health.

Unlike age-based groups that are defined solely by the age of individuals, demographic and family-centric groups consider a wider range of factors, including gender, family roles, and the interplay of relationships within a family unit.

Age-Based User Groups

With 23 (14.3%) of the 161 studies, this category targeted specific age groups or life stages. *Older adults* (11/23, 48%) focused on older adults and age-related health concerns. Young seekers of mental health support (8/23, 35%) focused on mental health support for young adults. *Children* (4/23, 17%) targeted health issues specific to children.

Underserved Populations

With 22 (13.7%) of the 161 studies, this category focused on inclusive and accessible health care. *Culturally diverse groups* (14/22, 64%) targeted ethnic and cultural groups. *Individuals with disabilities* (8/22, 36%) focused on the unique health care needs of people with disabilities.

Health Care Professionals and Students

Encompassing 15 (9.3%) of the 161 studies, this category targeted health care professionals and students. *Medical and nursing students* (8/15, 53%) covered educational aspects for students in medical and nursing fields. Health care professionals (7/15, 47%) focused on training and professional development with this group.

Health-Related–Behavior-Change Seekers

Comprising 15 (9.3%) of the 161 studies, this category focused on behavioral health and lifestyle changes. *Behavioral change seekers* (8/15, 53%) included studies on individuals seeking to change health-related behaviors. *Individuals in addiction recovery* (7/15, 47%) targeted those dealing with addictions.

Educational and Skills Enhancement Seekers

Comprising 15 (9.3%) of the 161 studies, this category involved the use of chatbots for educational purposes. *Nonmedical professionals* (8/15, 53%) focused on skills enhancement for various professionals. *Health care training users* (7/15, 47%) were concerned about chatbots being used to train health care professionals.

While the *health care professionals* subcategory within the *health care professionals and students* category focuses on the professional development and training of individuals in the health care field, the *educational and skills enhancement seekers* category addresses a broader spectrum of users, including nonmedical professionals, and emphasizes the role of chatbots as a tool for educational purposes across various sectors.

Health Care Chatbot Benefits

Overview

Most of the studies (157/161, 97.5%) described the benefits of using chatbots in health care. The content analysis yielded 7 different subcategories of benefits (presented in italics), grouped into 5 categories, which were organized into 2 broad themes, as summarized in [Table 3](#).

Table 3. Reported health care chatbot benefits (n=157).

Theme, category, and subcategory	Studies, n (%)
Improvement of health care quality	
Improvement in health outcomes and patient management	
Improved mental health and well-being	42 (26.8)
Enhanced self-management	15 (9.6)
Improved physical health	8 (5.1)
Promotion of patient-centered care and health equity	
Increased accessibility and reach of health care	60 (38.2)
Engaged and satisfied users	16 (10.2)
Supported groups considered vulnerable and reduced biases in health care delivery	4 (2.5)
Efficiency and cost-effectiveness in health care delivery	
Optimization of resources	
Saved time and cost of health interventions	75 (47.8)
Scalability of health interventions	4 (2.5)
Data quality and research support	4 (2.5)

Theme 1: Improvement of Health Care Quality

This theme refers to the processes of enhancing the standards, personalization, and accessibility of health care services delivered to the targeted chatbot users. It included 6 subcategories grouped into 2 categories of benefits, with 121

(77.1%) of the 157 studies contributing to the overarching theme.

Improvement in Health Outcomes and Patient Management

Of the 121 studies in this category, 65 (53.7%) addressed the benefits of chatbots to improve health outcomes and patient

management. Of these 65 studies, 42 (65%) reported on *improved mental health and well-being*, 15 (23%) reported on *enhanced self-management*, and 8 (12.3%) reported on *improved physical health* as outcomes of using chatbots.

Personalization Through Patient-Centered and Equitable Care

Of the 121 studies, 62 (51.2%) reported on promoting personalization through patient-centered and equitable care. Chatbot personalization refers to customizing its interactions, content, and functionalities to suit individual needs and preferences, ensuring that it provides relevant, user-specific advice and support, enhancing its effectiveness and user experience. Health equity refers to minimizing disparities and inequality based on the social determinants of health, including differences between groups in terms of socioeconomic factors, gender, and ethnicity [246]. Patient-centered care addresses patients' specific health care needs and concerns, improving the quality of personal, professional, and organizational relationships and aiding patients to actively participate in their own care [247,248].

Of the 62 studies, 60 (97%) discussed chatbot use benefits in terms of *increased accessibility and reach of health care* by helping engage diverse populations to access health services for minor health concerns that do not require emergency visits, with convenience and 24/7 availability.

Moreover, 16 (26%) of the 62 studies discussed using a chatbot to achieve *engaged and satisfied users*. In these studies, user acceptance was assessed by measuring the users' positive feedback and their willingness to use the chatbot. This was often gauged through surveys or user feedback sessions after the interaction. The studies also highlighted that friendly interactions facilitated by the chatbot could enhance self-disclosure, further contributing to user satisfaction and engagement.

Of the 62 studies, 4 (6%) described chatbot use benefits for *supported groups considered vulnerable and reduced biases in health care delivery*, particularly for groups considered marginalized (eg, Black women and older users) facing stigma in health care settings and for people with low technological literacy.

Theme 2: Efficiency and Cost-Effectiveness in Health Care Delivery

Overview

This theme refers to chatbot use as favoring efficient care for targeted users. Providing efficient care means producing desired results with minimal or no waste of time, costs, materials, or personnel [249]. Three categories of benefits contributed to this overarching theme.

Optimization of Resources

In all, 75 (47.8%) of the 157 studies indicated reduced administrative or financial burdens for the health care system through chatbots because they can help relieve the burden of managing chronic health conditions, staffing shortage, and overwhelmed primary care settings. These studies indicated that chatbots could provide *saved time and cost of health interventions*, especially compared to other routine interventions.

Scalability of Health Interventions

Of the 157 studies, 4 (2.5%) indicated the feasibility of using chatbots for the implementation of large-scale health interventions to capture and assess large-scale public health situations, providing evidence for researchers and policy makers. The studies also addressed the significance of user data collected during the COVID-19 pandemic to evaluate the public health situation and aid decision-making by policy makers, public health authorities, and researchers.

Data Quality and Research Support

Of the 157 studies, 4 (2.5%) pointed out the benefits of enhancing data collection and clinical research quality by chatbots, providing timely, consistent, and standardized data collection, reducing human error, increasing patient engagement, and assisting in recruiting a diverse participant pool.

Health Care Chatbot Limitations

Overview

Most of the studies (157/161, 97.5%) identified specific limitations of chatbots in health care, presented as 12 subcategories grouped into 5 categories, as summarized in [Table 4](#).

Table 4. Reported health care chatbot limitations (n=157).

Category and subcategory	Studies, n (%)
Challenges in user experience and overreliance	
Overconfidence and overreliance	154 (98.1)
Usability and accessibility issues	135 (86)
Technical challenges	
Complexity of effective language and communication processing	24 (15.3)
Limitations in empathy and personal connection	17 (10.8)
Challenges with resource allocation and cost efficiency	2 (1.3)
Medicolegal and safety concerns	
Regulatory and legal issues	3 (1.9)
Concerns about content and information quality	2 (1.3)
Challenges in emergency response and expertise	2 (1.3)
Societal and economic challenges	
Social, economic, and political challenges	5 (3.2)
Issues of inequality in accessibility	4 (2.5)
Ethical challenges	
Privacy and confidentiality concerns	2 (1.3)
Ethical and safety concerns	2 (1.3)

Challenges in User Experience and Overreliance

A total of 157 (97.5%) of the 161 studies contributed to this category, addressing the tendency of *overconfidence and overreliance* among users who overestimate the capabilities of chatbots or rely excessively on them for health care needs, as noted in 154 (98.1%) studies. Overconfidence in chatbots can lead to users substituting professional medical advice with chatbot suggestions, while overreliance might result in users neglecting other essential aspects of health care or disregarding the need for human health care professional intervention. This subcategory highlights the importance of maintaining a balanced perspective on the capabilities and limitations of chatbots in health care contexts.

In addition, this category encompasses the *usability and accessibility issues* related to the ease with which users can interact with chatbots and the extent to which these chatbots are accessible to a diverse range of users, as referred to in most of the studies (135/157, 86%). It includes considerations of user interface design, the intuitiveness of chatbot interactions, the chatbots’ adaptability to different user needs, and their accessibility to individuals with varying levels of technology savviness or disabilities. Challenges in this category can lead to user dissatisfaction, reduced effectiveness of the chatbot, and potentially lower engagement with the health care service it provides.

Technical Challenges

This category refers to the broad spectrum of technological difficulties encountered in the design, development, and implementation of these systems, with 32 (20.1%) of the 157 studies contributing to it. This category underscores the need for sophisticated technology that can handle the nuances of

health care communication and patient interaction while being accessible and practical for real-world application.

It includes the *complexity of effective language and communication processing*, as noted in 24 (75%) of the 32 studies, to ensure accurate and relevant medical information, as well as the chatbot’s ability to understand and respond to a range of user inputs, including those related to emotional states and complex health care queries.

The limitations extend to *challenges in empathy and personal connection*, which refer to the difficulties chatbots face in simulating human conversations and establishing rapport with users. This is a critical aspect in health care settings where patient trust and comfort are paramount, as highlighted in 17 (53%) of the 32 studies.

In addition, this category involves considering the *challenges with resource allocation and cost efficiency* of developing and maintaining these systems to ensure that they are not only technologically advanced but also financially viable and sustainable, as indicated in 2 (6%) of the 32 studies.

Medicolegal and Safety Concerns

With 6 (3.8%) of the 157 contributing studies, this category includes *regulatory and legal issues* encompassing the implications of chatbot advice and overall patient safety, as highlighted in 3 (50%) studies. These issues include chatbots’ compliance with health care regulations and patient privacy laws, liability for misdiagnosis or inadequate advice, and the need for specific regulatory guidelines for their development and application.

Furthermore, challenges extend to *concerns about content and information quality*, such as the medical accuracy of information

provided by chatbots (eg, the potential for misdiagnosis) and the reliability of medical content. It also concerns limitations tied to the chatbot's *challenges in emergency response and expertise* capabilities. Each of these subcategories was noted in 2 (33%) of the 6 studies.

Societal and Economic Challenges

This category refers to the wider implications of health care chatbots on the broader societal context and the economy, with 5 (3.2%) of the 157 contributing studies. It covers the influence of social, political, and economic factors on the adoption and effectiveness of chatbots in different communities.

It includes *social, economic, and political challenges* and considerations, as noted in all 5 studies. This subcategory scrutinizes the challenges arising from the integration of chatbots into the health care system, such as potential shifts in social norms, and the influence on economic policies and political decision-making in health care.

This category also includes *issues of inequality in accessibility*, as highlighted in 4 (80%) of the 5 studies. This subcategory delves into the challenges related to unequal access to chatbot technology. It focuses on how chatbots might inadvertently exacerbate existing disparities in health care, particularly for groups considered underprivileged, thereby highlighting the need for equitable distribution and accessibility of these technologies.

Ethical Challenges

This category deals with the ethical implications of using chatbots in health care, with 3 (1.9%) of the 157 studies contributing to it. It includes patient *privacy and confidentiality concerns* related to the use of patient data. This category also includes *ethical and safety concerns* encompassing the need to maintain transparency with users about the chatbot being a nonhuman agent and ensuring ethical standards in patient interactions. Each of these 2 subcategories was discussed in 2 (67%) of the 3 studies.

Discussion

Principal Findings

This rapid review revealed that chatbot roles in health care are diverse, ranging from patient support to administrative tasks, and they show great promise in improving health care accessibility, especially for groups considered marginalized. It also highlighted critical gaps in the literature, which are addressed in the following subsections.

Global Trends in Chatbot Research Indicate Its Predominance in Higher-Income Countries and Opportunities in Lower-Income Regions

With 35 countries represented by the studies in this review, the topic is clearly of global interest. However, more than a quarter of the included studies (46/161, 28.6%) originated from the United States, with the remainder conducted in high- or upper-middle-income countries across North America, Europe, and parts of Asia [250]. The concentration of chatbot research in high-income countries reflects underlying disparities with

low- or lower-middle-income countries, particularly in parts of Africa, South America, and certain regions in Asia, in terms of technology access and health care investment. This gap highlights the need for more research focused on these regions, considering their unique digital infrastructure and resource challenges, to democratize health technology and address chronic conditions and health literacy [20,251-254].

Chatbots Have Varied Roles in the Enhancement of Health Care Delivery and User-Centric Services

Our review underscores the transformative roles of chatbots in health care, particularly in delivering remote health services and enhancing patient support, care management, and mental health support. Consistent with previous literature [254-257], our findings affirm chatbots' potential to improve health care accessibility and patient management. The findings' emphasis on education and skills building, particularly to enhance health literacy (which aligned with past literature [255,258]) and to support behavioral change (also highlighted by past research [255]), aligns with the growing need for patient empowerment in health care. The administrative efficiency of chatbots, noted in our review, resonates with previous findings [23,35,255,258] on the importance of resource optimization in health care settings.

Our findings indicate that chatbots also play a key role in facilitating clinical research, consistent with past work [259], a potential that needs further exploration, especially considering AI's evolving role in health care [72,259-262].

The Diverse User Base of Chatbots Shows Their Potential to Support Equity and Bridge the Access Gap in Health Care Services

Our analysis indicates a broad and diverse user base for health care chatbots. From individuals focused on general well-being to those with specific health conditions, chatbots have been designed to cater to a wide array of needs. Notably, their use by demographic and family-centric groups and their accessibility to underserved populations underline the inclusive capacity of chatbots and their role in enhancing health care access and equity, especially for groups considered marginalized, in line with existing research [12,67,255,263-265].

In addition, our findings show the significant use of chatbots in mental health support for various age groups, reflecting the pressing need for accessible mental health services highlighted by others [4,8,12-17,29,30].

Furthermore, chatbots have emerged as tools for reducing stigma [12,265], linking users to health services [266-268], and protecting sensitive information [269]. Their empathetic and multilingual capabilities, as seen in our results [107,111,112,120,122,126-128,132] and past literature [270-276], are vital to reach diverse populations. They are particularly critical in light of the digital divide and the need for inclusive and accessible health care solutions [254,258,263,277,278].

The Use of AI in Chatbots Is a Promising but Still Evolving Field

The studies included in our review show a substantial number of AI-based chatbots, with fewer relying on non-AI platforms. AI in health care is recognized for its potential to improve health outcomes and the quality of life globally [260]. Given advances in machine learning and AI, expanding the scope of chatbots is expected to cause a mutation in their role in the health care system to assist clinicians and potentially take over some of their duties [72,261,262]. The synergy between big data and AI, coupled with the increasing availability of data in health care, suggests that AI-based chatbots could effectively use extensive health care data [259,279]. This aligns with 1 (0.6%) of the 161 included studies [94], which discusses the use of collected data as a key benefit of chatbots. However, ethical considerations such as data privacy and algorithmic biases must be addressed for responsible AI deployment, crucial for maintaining trust and fairness [73].

Studies included in this review indicate that using avatars in these chatbots to simulate social behaviors can enhance user engagement and trust. This form of chatbot technology is particularly appealing in patient interactions and medical education to establish trust and therapeutic alliances between health care professionals and patients and to improve the communication skills of medical students and health care professionals [118,123,130,131,280].

Balancing AI's benefits to enhance data use and user interactions with its ethical concerns, including data privacy and algorithmic bias, is crucial for its implementation, shaping the future of patient care and medical education in an innovative and ethically sound way.

Despite the Potential Revolutionary Roles of Chatbots in Health Care, Critical Challenges and Limitations Exist

This review stresses that despite chatbots' roles and benefits, their use comes with various challenges, including ethical, technical, medicolegal, and user experience concerns, as also discussed in past literature [3-5,23,25,30,72,74,95,281,282].

While the studies included in our review have highlighted chatbot use to address minor health concerns and provide off-hour information, there is a noticeable gap in evaluating their technical limitations, especially in complex health care scenarios, as underscored by past literature [3-5,23,25,30,72,74,95,281,282]. This raises concerns about patient safety and the accuracy of health management, emphasizing the need for comprehensive assessment and iterative improvement of chatbot technologies [22,25,68,72,95,254,283].

The findings in our review indicate the regulatory and ethical landscape for chatbots as another area of concern. This agrees with past studies highlighting the need for ethical use, data privacy, and transparent communication about chatbots' capabilities and limitations [4,73,74,254,281,284,285]. The absence of specific laws and regulations addressing health care chatbot use introduces risks around liability and medicolegal issues [72,286,287]. These challenges are further complicated

by ethical dilemmas, such as privacy and confidentiality in nonanonymous interactions [71,72,288,289] and safety concerns in medical emergencies due to limited chatbot expertise [72].

Technical issues identified by this review, including difficulty in language processing and a lack of empathic response, can lead to trust issues and increased clinical workload and align with past literature [3-5,68,72,73,280,290]. Overreliance on chatbots for self-diagnosis and health care decisions may lead to misjudgments, potentially exacerbating health issues [4,68,73]. In addition, the financial motives of private companies in the health sector raise ethical concerns about the primary purpose and application of health chatbots [73]. The requirement for sophisticated AI technology also implies increased demands on human resource expertise and storage services, potentially escalating costs [73,287].

Our results indicate that chatbots serve a wide range of populations from various groups in terms of age, gender, ethnicity, and socioeconomic and educational status due to their promising acceptability and usability [291]. However, the digital divide [292-294], algorithmic ethical concerns [295], and the potential misuse of chatbots in replacing established health services [296] present risks. These factors, along with social, economic, and political influences [297], could inadvertently widen health disparities, highlighting the importance of inclusive and equitable chatbot development and deployment.

The discussion on health care chatbots is fundamentally about their potential and promise, grounded in our exploration of current studies and developments. These digital tools could significantly enhance health care access, service quality, and efficiency. However, realizing their full potential hinges on addressing challenges such as ethical AI use, data privacy, and integration with health care systems.

Efforts moving forward should concentrate on incorporating AI responsibly and designing chatbots that cater to all user demographics, ensuring equitable health care access. Collaboration across technology, health care, and policy sectors is crucial to establish ethical guidelines and confirm chatbots' efficacy and safety. Successfully navigating these challenges will enable chatbots to fulfill their promising role in health care, contributing to a more accessible and patient-focused system.

Limitations

This review, while insightful, is not without its limitations. Although rapid and systematic reviews are often considered comparable in their conclusions, each methodology has its own set of constraints [289,298]. Specifically, this rapid review was limited by a noncomprehensive search strategy that included only 2 databases. In addition, the inclusion criteria were restricted by date and language, which potentially led to the exclusion of some pertinent studies. Another limitation was the concentration of screening and analysis tasks on a single reviewer (ML), which might have introduced bias or overlooked nuances in the data. Moreover, a formal quality appraisal of the included studies was not conducted due to the descriptive nature of this review. Consequently, this limitation may affect the depth of understanding and the strength of the conclusions drawn.

One critical aspect of our methodology was the combination of empirical findings and opinion-based data from the discussions in the included studies. We did not distinguish between these 2 types of data but rather treated them as a unified source of information. This approach, while allowing for a comprehensive overview of chatbots in health care, might have led to a potential bias in favor of chatbot benefits because both empirical results and positive speculative insights were reported together. However, this potential bias is somewhat mitigated by our consistent reporting of the challenges associated with chatbots, as identified in the included studies. By presenting both the potential benefits and the challenges, we aimed to offer a balanced view, reducing the likelihood of a 1-sided interpretation favoring chatbot benefits.

In addition, this review might have overestimated the results due to the dependence on the discussion sections of each study, which may have overcounted the results and miscounted those that may have disagreed or contradicted the results of these included studies. However, this did not significantly impact the study's aim to provide an exploratory and descriptive overview of health care chatbots, mapping out the landscape of their applications in health care. In such a context, a broad, inclusive approach that captures diverse opinions and trends is more important than precise quantification.

Moreover, one of the potential limitations of this review is the exclusion of generative AI and LLMs such as ChatGPT. However, among the studies we reviewed, a standout comparison involved a health care chatbot, specialized in medical terminology, and ChatGPT. This unique comparison

serves to highlight the advanced capabilities of LLMs such as ChatGPT in enhancing the delivery and accuracy of remote health services [59,75]. Nonetheless, a significant challenge persists in guaranteeing the contextual relevance and appropriateness of chatbot responses, particularly in intricate medical scenarios [59,60]. In addition, the personalization of health care interactions and the precision of information provided by these AI-driven systems are critical areas necessitating extensive future research and rigorous evaluation of their outputs [59,60,299].

Finally, the results were presented solely as a narrative summary [77], which might limit the breadth of perspectives and interpretations that a more diverse methodological approach could have provided. Nevertheless, the inclusion of both benefits and challenges in our reporting suggests that the review may not be significantly biased toward a positive portrayal of chatbots, providing a more nuanced understanding of their role in health care.

Conclusions

This review underscores the significant potential of chatbots in health care, evident in their diverse roles, benefits, and user populations. In addition, it explores the current limitations and challenges of chatbot development and implementation in health care. Finally, it underscores significant research gaps in the field. As such, this review aims to contribute to academic discourse on this important topic and offer insights into the effective design, implementation, and investigation of chatbots in health care.

Acknowledgments

BL is supported by 2 career awards—a Senior Salary Award from Fonds de recherche du Québec–Santé (311200) and the Lettre d'Entente (LE) 250 from Québec's Ministry of Health for researchers in family medicine—and holds a Canadian Institutes for Health Research Strategy for Patient-Oriented Research Mentorship Chair in Innovative Clinical Trials. ML is supported by a Graduate Excellence Fellowship Award from the Department of Family Medicine at McGill University and a McGill Centre for Viral Diseases studentship. YM was supported by a doctoral scholarship from the Fonds de recherche du Québec–Nature et Technologies given in partnership with the Strategy for Patient-Oriented Research Support Unit of Québec. YM is supported by a postgraduate scholarship—doctoral program given through the Natural Sciences and Engineering Research Council of Canada.

Authors' Contributions

ML and YM dual-screened 15% of the titles and abstracts and the full texts. ML performed all other screenings. ML analyzed and interpreted the results and wrote the manuscript. DL reviewed the results. All authors reviewed and edited the manuscript and approved the final version.

Conflicts of Interest

None declared.

References

1. Kocaballi AB, Berkovsky S, Quiroz JC, Laranjo L, Tong HL, Rezazadegan D, et al. The personalization of conversational agents in health care: systematic review. *J Med Internet Res*. Nov 07, 2019;21(11):e15360. [FREE Full text] [doi: [10.2196/15360](https://doi.org/10.2196/15360)] [Medline: [31697237](https://pubmed.ncbi.nlm.nih.gov/31697237/)]
2. Luo TC, Aguilera A, Lyles CR, Figueroa CA. Promoting physical activity through conversational agents: mixed methods systematic review. *J Med Internet Res*. Sep 14, 2021;23(9):e25486. [FREE Full text] [doi: [10.2196/25486](https://doi.org/10.2196/25486)] [Medline: [34519653](https://pubmed.ncbi.nlm.nih.gov/34519653/)]
3. Laranjo L, Dunn AG, Tong HL, Kocaballi AB, Chen J, Bashir R, et al. Conversational agents in healthcare: a systematic review. *J Am Med Inform Assoc*. Sep 01, 2018;25(9):1248-1258. [FREE Full text] [doi: [10.1093/jamia/ocy072](https://doi.org/10.1093/jamia/ocy072)] [Medline: [30010941](https://pubmed.ncbi.nlm.nih.gov/30010941/)]

4. Vaidyam AN, Wisniewski H, Halamka JD, Kashavan MS, Torous JB. Chatbots and conversational agents in mental health: a review of the psychiatric landscape. *Can J Psychiatry*. Jul 21, 2019;64(7):456-464. [[FREE Full text](#)] [doi: [10.1177/0706743719828977](https://doi.org/10.1177/0706743719828977)] [Medline: [30897957](#)]
5. Milne-Ives M, de Cock C, Lim E, Shehadeh MH, de Pennington N, Mole G, et al. The effectiveness of artificial intelligence conversational agents in health care: systematic review. *J Med Internet Res*. Oct 22, 2020;22(10):e20346. [[FREE Full text](#)] [doi: [10.2196/20346](https://doi.org/10.2196/20346)] [Medline: [33090118](#)]
6. Bin Sawad A, Narayan B, Alnefaie A, Maqbool A, Mckie I, Smith J, et al. A systematic review on healthcare artificial intelligent conversational agents for chronic conditions. *Sensors (Basel)*. Mar 29, 2022;22(7):2625. [[FREE Full text](#)] [doi: [10.3390/s22072625](https://doi.org/10.3390/s22072625)] [Medline: [35408238](#)]
7. Tudor Car L, Dhinakaran DA, Kyaw BM, Kowatsch T, Joty S, Theng YL, et al. Conversational agents in health care: scoping review and conceptual analysis. *J Med Internet Res*. Aug 07, 2020;22(8):e17158. [[FREE Full text](#)] [doi: [10.2196/17158](https://doi.org/10.2196/17158)] [Medline: [32763886](#)]
8. Vaidyam AN, Linggonegoro D, Torous J. Changes to the psychiatric chatbot landscape: a systematic review of conversational agents in serious mental illness: changements du paysage psychiatrique des chatbots: une revue systématique des agents conversationnels dans la maladie mentale sérieuse. *Can J Psychiatry*. Apr 16, 2021;66(4):339-348. [[FREE Full text](#)] [doi: [10.1177/0706743720966429](https://doi.org/10.1177/0706743720966429)] [Medline: [33063526](#)]
9. Geoghegan L, Scarborough A, Wormald JC, Harrison CJ, Collins D, Gardiner M, et al. Automated conversational agents for post-intervention follow-up: a systematic review. *BJS Open*. Jul 06, 2021;5(4):zrab070. [[FREE Full text](#)] [doi: [10.1093/bjsopen/zrab070](https://doi.org/10.1093/bjsopen/zrab070)] [Medline: [34323916](#)]
10. Allouch M, Azaria A, Azoulay R. Conversational agents: goals, technologies, vision and challenges. *Sensors (Basel)*. Dec 17, 2021;21(24):8448. [[FREE Full text](#)] [doi: [10.3390/s21248448](https://doi.org/10.3390/s21248448)] [Medline: [34960538](#)]
11. Bibault JE, Chaix B, Nectoux P, Pienkowsky A, Guillemasse A, Brouard B. Healthcare ex Machina: are conversational agents ready for prime time in oncology? *Clin Transl Radiat Oncol*. May 2019;16:55-59. [[FREE Full text](#)] [doi: [10.1016/j.ctro.2019.04.002](https://doi.org/10.1016/j.ctro.2019.04.002)] [Medline: [31008379](#)]
12. Abd-Alrazaq AA, Alajlani M, Alalwan AA, Bewick BM, Gardner P, Househ M. An overview of the features of chatbots in mental health: a scoping review. *Int J Med Inform*. Dec 2019;132:103978. [[FREE Full text](#)] [doi: [10.1016/j.ijmedinf.2019.103978](https://doi.org/10.1016/j.ijmedinf.2019.103978)] [Medline: [31622850](#)]
13. Pacheco-Lorenzo MR, Valladares-Rodríguez SM, Anido-Rifón LE, Fernández-Iglesias MJ. Smart conversational agents for the detection of neuropsychiatric disorders: a systematic review. *J Biomed Inform*. Jan 2021;113:103632. [[FREE Full text](#)] [doi: [10.1016/j.jbi.2020.103632](https://doi.org/10.1016/j.jbi.2020.103632)] [Medline: [33276112](#)]
14. Provoost S, Lau HM, Ruwaard J, Riper H. Embodied conversational agents in clinical psychology: a scoping review. *J Med Internet Res*. May 09, 2017;19(5):e151. [[FREE Full text](#)] [doi: [10.2196/jmir.6553](https://doi.org/10.2196/jmir.6553)] [Medline: [28487267](#)]
15. Rampioni M, Stara V, Felici E, Rossi L, Paolini S. Embodied conversational agents for patients with dementia: thematic literature analysis. *JMIR Mhealth Uhealth*. Jul 16, 2021;9(7):e25381. [[FREE Full text](#)] [doi: [10.2196/25381](https://doi.org/10.2196/25381)] [Medline: [34269686](#)]
16. Gaffney H, Mansell W, Tai S. Conversational agents in the treatment of mental health problems: mixed-method systematic review. *JMIR Ment Health*. Oct 18, 2019;6(10):e14166. [[FREE Full text](#)] [doi: [10.2196/14166](https://doi.org/10.2196/14166)] [Medline: [31628789](#)]
17. Bérubé C, Schachner T, Keller R, Fleisch E, V Wangenheim F, Barata F, et al. Voice-based conversational agents for the prevention and management of chronic and mental health conditions: systematic literature review. *J Med Internet Res*. Mar 29, 2021;23(3):e25933. [[FREE Full text](#)] [doi: [10.2196/25933](https://doi.org/10.2196/25933)] [Medline: [33658174](#)]
18. Chew HS. The use of artificial intelligence-based conversational agents (Chatbots) for weight loss: scoping review and practical recommendations. *JMIR Med Inform*. Apr 13, 2022;10(4):e32578. [[FREE Full text](#)] [doi: [10.2196/32578](https://doi.org/10.2196/32578)] [Medline: [35416791](#)]
19. Kramer LL, Ter Stal S, Mulder BC, de Vet E, van Velsen L. Developing embodied conversational agents for coaching people in a healthy lifestyle: scoping review. *J Med Internet Res*. Feb 06, 2020;22(2):e14058. [[FREE Full text](#)] [doi: [10.2196/14058](https://doi.org/10.2196/14058)] [Medline: [32022693](#)]
20. Schachner T, Keller R, V Wangenheim F. Artificial intelligence-based conversational agents for chronic conditions: systematic literature review. *J Med Internet Res*. Sep 14, 2020;22(9):e20701. [[FREE Full text](#)] [doi: [10.2196/20701](https://doi.org/10.2196/20701)] [Medline: [32924957](#)]
21. Reger GM, Norr AM, Gramlich MA, Buchman JM. Virtual standardized patients for mental health education. *Curr Psychiatry Rep*. Jul 15, 2021;23(9):57. [doi: [10.1007/s11920-021-01273-5](https://doi.org/10.1007/s11920-021-01273-5)] [Medline: [34268633](#)]
22. Safi Z, Abd-Alrazaq A, Khalifa M, Househ M. Technical aspects of developing chatbots for medical applications: scoping review. *J Med Internet Res*. Dec 18, 2020;22(12):e19127. [[FREE Full text](#)] [doi: [10.2196/19127](https://doi.org/10.2196/19127)] [Medline: [33337337](#)]
23. Abd-Alrazaq A, Safi Z, Alajlani M, Warren J, Househ M, Denecke K. Technical metrics used to evaluate health care chatbots: scoping review. *J Med Internet Res*. Jun 05, 2020;22(6):e18301. [[FREE Full text](#)] [doi: [10.2196/18301](https://doi.org/10.2196/18301)] [Medline: [32442157](#)]
24. Wang A, Qian Z, Briggs L, Cole AP, Reis LO, Trinh QD. The use of chatbots in oncological care: a narrative review. *Int J Gen Med*. May 1, 2023;16:1591-1602. [[FREE Full text](#)] [doi: [10.2147/IJGM.S408208](https://doi.org/10.2147/IJGM.S408208)] [Medline: [37152273](#)]

25. Xu L, Sanders L, Li K, Chow JC. Chatbot for health care and oncology applications using artificial intelligence and machine learning: systematic review. *JMIR Cancer*. Nov 29, 2021;7(4):e27850. [[FREE Full text](#)] [doi: [10.2196/27850](#)] [Medline: [34847056](#)]
26. Passanante A, Pertwee E, Lin L, Lee KY, Wu JT, Larson HJ. Conversational AI and vaccine communication: systematic review of the evidence. *J Med Internet Res*. Oct 03, 2023;25:e42758. [[FREE Full text](#)] [doi: [10.2196/42758](#)] [Medline: [37788057](#)]
27. Wutz M, Hermes M, Winter V, Köberlein-Neu J. Factors influencing the acceptability, acceptance, and adoption of conversational agents in health care: integrative review. *J Med Internet Res*. Sep 26, 2023;25:e46548. [[FREE Full text](#)] [doi: [10.2196/46548](#)] [Medline: [37751279](#)]
28. Hocking J, Oster C, Maeder A, Lange B. Design, development, and use of conversational agents in rehabilitation for adults with brain-related neurological conditions: a scoping review. *JBIS Evid Synth*. Feb 01, 2023;21(2):326-372. [doi: [10.11124/JBIES-22-00025](#)] [Medline: [35976047](#)]
29. He Y, Yang L, Qian C, Li T, Su Z, Zhang Q, et al. Conversational agent interventions for mental health problems: systematic review and meta-analysis of randomized controlled trials. *J Med Internet Res*. Apr 28, 2023;25:e43862. [[FREE Full text](#)] [doi: [10.2196/43862](#)] [Medline: [37115595](#)]
30. Abd-Alrazaq AA, Rababeh A, Alajlani M, Bewick BM, Househ M. Effectiveness and safety of using chatbots to improve mental health: systematic review and meta-analysis. *J Med Internet Res*. Jul 13, 2020;22(7):e16021. [[FREE Full text](#)] [doi: [10.2196/16021](#)] [Medline: [32673216](#)]
31. Lin X, Martinengo L, Jabir AI, Ho AH, Car J, Atun R, et al. Scope, characteristics, behavior change techniques, and quality of conversational agents for mental health and well-being: systematic assessment of apps. *J Med Internet Res*. Jul 18, 2023;25:e45984. [[FREE Full text](#)] [doi: [10.2196/45984](#)] [Medline: [37463036](#)]
32. Aggarwal A, Tam CC, Wu D, Li X, Qiao S. Artificial intelligence-based chatbots for promoting health behavioral changes: systematic review. *J Med Internet Res*. Feb 24, 2023;25:e40789. [[FREE Full text](#)] [doi: [10.2196/40789](#)] [Medline: [36826990](#)]
33. Martinengo L, Jabir AI, Goh WW, Lo NY, Ho MH, Kowatsch T, et al. Conversational agents in health care: scoping review of their behavior change techniques and underpinning theory. *J Med Internet Res*. Oct 03, 2022;24(10):e39243. [[FREE Full text](#)] [doi: [10.2196/39243](#)] [Medline: [36190749](#)]
34. Webster EM, Ahsan MD, Perez L, Levi SR, Thomas C, Christos P, et al. Chatbot artificial intelligence for genetic cancer risk assessment and counseling: a systematic review and meta-analysis. *JCO Clin Cancer Inform*. Sep 2023;7:e2300123. [[FREE Full text](#)] [doi: [10.1200/CCCI.23.00123](#)] [Medline: [37934933](#)]
35. Mills R, Mangone ER, Lesh N, Mohan D, Baraitser P. Chatbots to improve sexual and reproductive health: realist synthesis. *J Med Internet Res*. Aug 09, 2023;25:e46761. [[FREE Full text](#)] [doi: [10.2196/46761](#)] [Medline: [37556194](#)]
36. Chua JY, Choolani M, Chee CY, Chan YH, Lalor JG, Chong YS, et al. Insights of parents and parents-to-be in using chatbots to improve their preconception, pregnancy, and postpartum health: a mixed studies review. *J Midwifery Womens Health*. Feb 03, 2023;68(4):480-489. [doi: [10.1111/jmwh.13472](#)] [Medline: [36734375](#)]
37. Singh B, Olds T, Brinsley J, Dumuid D, Virgara R, Matricciani L, et al. Systematic review and meta-analysis of the effectiveness of chatbots on lifestyle behaviours. *NPJ Digit Med*. Jun 23, 2023;6(1):118. [[FREE Full text](#)] [doi: [10.1038/s41746-023-00856-1](#)] [Medline: [37353578](#)]
38. He L, Balaji D, Wiers RW, Antheunis ML, Krahmer E. Effectiveness and acceptability of conversational agents for smoking cessation: a systematic review and meta-analysis. *Nicotine Tob Res*. Jun 09, 2023;25(7):1241-1250. [[FREE Full text](#)] [doi: [10.1093/ntr/ntac281](#)] [Medline: [36507916](#)]
39. Noh E, Won J, Jo S, Hahm DH, Lee H. Conversational agents for body weight management: systematic review. *J Med Internet Res*. May 26, 2023;25:e42238. [[FREE Full text](#)] [doi: [10.2196/42238](#)] [Medline: [37234029](#)]
40. Thoumrungroje P, Chainarong A, Namwaing P, Pitiruangsit L, Sittichanbuncha Y, Ngamjarus C, et al. Chatbot intervention in asthma and obstructive sleep apnea: a systematic review. *J Med Assoc Thai*. 2023;106:S134. [[FREE Full text](#)] [doi: [10.35755/jmedassochai.2023.S01.13741](#)]
41. Lim SM, Shiau CW, Cheng LJ, Lau Y. Chatbot-delivered psychotherapy for adults with depressive and anxiety symptoms: a systematic review and meta-regression. *Behav Ther*. Mar 2022;53(2):334-347. [doi: [10.1016/j.beth.2021.09.007](#)] [Medline: [35227408](#)]
42. Ogilvie L, Prescott J, Carson J. The use of chatbots as supportive agents for people seeking help with substance use disorder: a systematic review. *Eur Addict Res*. Aug 30, 2022;28(6):405-418. [[FREE Full text](#)] [doi: [10.1159/000525959](#)] [Medline: [36041418](#)]
43. Shan Y, Ji M, Xie W, Qian X, Li R, Zhang X, et al. Language use in conversational agent-based health communication: systematic review. *J Med Internet Res*. Jul 08, 2022;24(7):e37403. [[FREE Full text](#)] [doi: [10.2196/37403](#)] [Medline: [35802407](#)]
44. Amiri P, Karahanna E. Chatbot use cases in the COVID-19 public health response. *J Am Med Inform Assoc*. Apr 13, 2022;29(5):1000-1010. [[FREE Full text](#)] [doi: [10.1093/jamia/ocac014](#)] [Medline: [35137107](#)]
45. Balaji D, He L, Giani S, Bosse T, Wiers R, de Bruijn GJ. Effectiveness and acceptability of conversational agents for sexual health promotion: a systematic review and meta-analysis. *Sex Health*. Oct 2022;19(5):391-405. [[FREE Full text](#)] [doi: [10.1071/SH22016](#)] [Medline: [35863761](#)]

46. Christopherjames JE, Saravanan M, Thiyam DB, Surendhar S PA, Sahib MY, Ganapathi MV, et al. Natural language processing based human assistive health conversational agent for multi-users. In: Proceedings of the 2021 2nd International Conference on Electronics and Sustainable Communication Systems. 2021. Presented at: ICESC '21; August 4-6, 2021:1414-1420; Coimbatore, India. URL: <https://ieeexplore.ieee.org/document/9532913> [doi: [10.1109/icesc51422.2021.9532913](https://doi.org/10.1109/icesc51422.2021.9532913)]
47. Imtiaz MT, Kennington C. Incremental unit networks for distributed, symbolic multimodal processing and representation. In: Proceedings of the 13th International Conference, DHM 2022, Held as Part of the 24th HCI International Conference on Digital Human Modeling and Applications in Health, Safety, Ergonomics and Risk Management for Health, Operations Management, and Design. 2022. Presented at: HCII '22; June 26-July 1, 2022:344-363; Virtual Event. URL: https://link.springer.com/chapter/10.1007/978-3-031-06018-2_24 [doi: [10.1007/978-3-031-06018-2_24](https://doi.org/10.1007/978-3-031-06018-2_24)]
48. Mauldin ML. Chatterbots, TinyMuds, and the Turing test: entering the Loebner prize competition. In: Proceedings of the 25th AAAI National Conference on Artificial Intelligence. 1994. Presented at: AAAI '94; August 1-4, 1994:16-21; Seattle, WA. URL: <https://dl.acm.org/doi/abs/10.5555/2891730.2891733>
49. Nuruzzaman M, Hussain OK. A survey on chatbot implementation in customer service industry through deep neural networks. In: Proceedings of the 2018 IEEE 15th International Conference on e-Business Engineering. 2018. Presented at: ICEBE '18; October 12-14, 2018:54-61; Xi'an, China. URL: <https://ieeexplore.ieee.org/document/8592630> [doi: [10.1109/icebe.2018.00019](https://doi.org/10.1109/icebe.2018.00019)]
50. Kumar VM, Keerthana A, Madhumitha M, Valliammai S, Vinithasri V. Sanative chatbot for health seekers. *Int J Eng Comput Sci*. Mar 29, 2016;5(03):16022-16025. [FREE Full text] [doi: [10.18535/ijecs/v5i3.28](https://doi.org/10.18535/ijecs/v5i3.28)]
51. Alexa developer portal. Amazon. 2014. URL: <https://www.developer.amazon.com/en-US/alexa/> [accessed 2022-12-22]
52. Siri. Apple. 2010. URL: <https://www.apple.com/siri/> [accessed 2022-12-22]
53. Google Assistant, your own personal Google. Google. 2016. URL: <https://assistant.google.com/> [accessed 2022-12-22]
54. Cortana- your personal productivity assistant. Microsoft. 2014. URL: <https://www.microsoft.com/en-us/cortana/> [accessed 2022-12-22]
55. Bixby: apps and services. Samsung. 2017. URL: <https://www.samsung.com/in/apps/bixby/> [accessed 2022-12-22]
56. Introducing ChatGPT. OpenAI. URL: <https://openai.com/blog/chatgpt> [accessed 2022-12-22]
57. Ouyang L, Wu J, Jiang X, Almeida D, Wainwright CL, Mishkin P, et al. Training language models to follow instructions with human feedback. *arXiv. Preprint posted online March 4, 2022*. [FREE Full text]
58. OpenAI. GPT-4 technical report. *arXiv. Preprint posted online March 15, 2023*. 2023. [FREE Full text]
59. Thirunavukarasu AJ, Ting DS, Elangovan K, Gutierrez L, Tan TF, Ting DS. Large language models in medicine. *Nat Med*. Aug 17, 2023;29(8):1930-1940. [doi: [10.1038/s41591-023-02448-8](https://doi.org/10.1038/s41591-023-02448-8)] [Medline: [37460753](https://pubmed.ncbi.nlm.nih.gov/37460753/)]
60. Thirunavukarasu AJ, Hassan R, Mahmood S, Sanghera R, Barzangi K, El Mukashfi M, et al. Trialling a large language model (ChatGPT) in general practice with the applied knowledge test: observational study demonstrating opportunities and limitations in primary care. *JMIR Med Educ*. Apr 21, 2023;9:e46599. [FREE Full text] [doi: [10.2196/46599](https://doi.org/10.2196/46599)] [Medline: [37083633](https://pubmed.ncbi.nlm.nih.gov/37083633/)]
61. Huisman L, van Duijn SM, Silva N, van Doeveren R, Michuki J, Kuria M, et al. A digital mobile health platform increasing efficiency and transparency towards universal health coverage in low- and middle-income countries. *Digit Health*. Apr 11, 2022;8:20552076221092213. [FREE Full text] [doi: [10.1177/20552076221092213](https://doi.org/10.1177/20552076221092213)] [Medline: [35433018](https://pubmed.ncbi.nlm.nih.gov/35433018/)]
62. Osipov VS, Skryl TV. Impact of digital technologies on the efficiency of healthcare delivery. In: Marques G, Bhoi AK, de Albuquerque VH, Hareesha KS, editors. *IoT in Healthcare and Ambient Assisted Living*. Singapore, Singapore. Springer; 2021:243-261.
63. Jones SP, Patel V, Saxena S, Radcliffe N, Ali Al-Marri S, Darzi A. How Google's 'ten things we know to be true' could guide the development of mental health mobile apps. *Health Aff (Millwood)*. Sep 2014;33(9):1603-1611. [doi: [10.1377/hlthaff.2014.0380](https://doi.org/10.1377/hlthaff.2014.0380)] [Medline: [25201665](https://pubmed.ncbi.nlm.nih.gov/25201665/)]
64. Chandrashekar P. Do mental health mobile apps work: evidence and recommendations for designing high-efficacy mental health mobile apps. *Mhealth*. Mar 2018;4:6. [FREE Full text] [doi: [10.21037/mhealth.2018.03.02](https://doi.org/10.21037/mhealth.2018.03.02)] [Medline: [29682510](https://pubmed.ncbi.nlm.nih.gov/29682510/)]
65. Tanielian T, Jaycox LH. *Invisible Wounds of War: Psychological and Cognitive Injuries, Their Consequences, and Services to Assist Recovery*. Santa Monica, CA. RAND Corporation; 2008.
66. Nadarzynski T, Miles O, Cowie A, Ridge D. Acceptability of artificial intelligence (AI)-led chatbot services in healthcare: a mixed-methods study. *Digit Health*. Aug 21, 2019;5:2055207619871808. [FREE Full text] [doi: [10.1177/2055207619871808](https://doi.org/10.1177/2055207619871808)] [Medline: [31467682](https://pubmed.ncbi.nlm.nih.gov/31467682/)]
67. Abd-Alrazaq AA, Alajlani M, Ali N, Denecke K, Bewick BM, Househ M. Perceptions and opinions of patients about mental health chatbots: scoping review. *J Med Internet Res*. Jan 13, 2021;23(1):e17828. [FREE Full text] [doi: [10.2196/17828](https://doi.org/10.2196/17828)] [Medline: [33439133](https://pubmed.ncbi.nlm.nih.gov/33439133/)]
68. Kretzschmar K, Tyroll H, Pavarini G, Manzini A, Singh I, NeurOx Young People's Advisory Group. Can your phone be your therapist? Young people's ethical perspectives on the use of fully automated conversational agents (Chatbots) in mental health support. *Biomed Inform Insights*. Mar 05, 2019;11:1178222619829083. [FREE Full text] [doi: [10.1177/1178222619829083](https://doi.org/10.1177/1178222619829083)] [Medline: [30858710](https://pubmed.ncbi.nlm.nih.gov/30858710/)]

69. Cheng Y, Jiang H. AI - Powered mental health chatbots: examining users' motivations, active communicative action and engagement after mass - shooting disasters. *J Conting Crisis Man*. Sep 29, 2020;28(3):339-354. [doi: [10.1111/1468-5973.12319](https://doi.org/10.1111/1468-5973.12319)]
70. Boucher EM, Harake NR, Ward HE, Stoeckl SE, Vargas J, Minkel J, et al. Artificially intelligent chatbots in digital mental health interventions: a review. *Expert Rev Med Devices*. Dec 31, 2021;18(sup1):37-49. [doi: [10.1080/17434440.2021.2013200](https://doi.org/10.1080/17434440.2021.2013200)] [Medline: [34872429](https://pubmed.ncbi.nlm.nih.gov/34872429/)]
71. Luxton DD, Anderson SL, Anderson M. Ethical issues and artificial intelligence technologies in behavioral and mental health care. In: Luxton DD, editor. *Artificial Intelligence in Behavioral and Mental Health Care*. Washington, DC. Academic Press; 2016:255-276.
72. Denecke K, Abd-Alrazaq A, Househ M. Artificial intelligence for chatbots in mental health: opportunities and challenges. In: Househ M, Borycki E, Kushniruk A, editors. *Multiple Perspectives on Artificial Intelligence in Healthcare: Opportunities and Challenges*. Cham, Switzerland. Springer; 2021:115-128.
73. Parviainen J, Rantala J. Chatbot breakthrough in the 2020s? An ethical reflection on the trend of automated consultations in health care. *Med Health Care Philos*. Mar 04, 2022;25(1):61-71. [FREE Full text] [doi: [10.1007/s11019-021-10049-w](https://doi.org/10.1007/s11019-021-10049-w)] [Medline: [34480711](https://pubmed.ncbi.nlm.nih.gov/34480711/)]
74. Palanica A, Flaschner P, Thommandram A, Li M, Fossat Y. Physicians' perceptions of chatbots in health care: cross-sectional web-based survey. *J Med Internet Res*. Apr 05, 2019;21(4):e12887. [FREE Full text] [doi: [10.2196/12887](https://doi.org/10.2196/12887)] [Medline: [30950796](https://pubmed.ncbi.nlm.nih.gov/30950796/)]
75. Chang Y, Wang X, Wang J, Wu Y, Yang L, Zhu K, et al. A survey on evaluation of large language models. *ACM Trans Intell Syst Technol*. Mar 29, 2024;15(3):1-45. [doi: [10.1145/3641289](https://doi.org/10.1145/3641289)]
76. Mohanta B, Das P, Patnaik S. Healthcare 5.0: a paradigm shift in digital healthcare system using artificial intelligence, IOT and 5G communication. In: *Proceedings of the 2019 International Conference on Applied Machine Learning*. 2019. Presented at: ICAML '19; May 25-26, 2019:191-196; Bhubaneswar, India. URL: <https://ieeexplore.ieee.org/document/8989306> [doi: [10.1109/icaml48257.2019.00044](https://doi.org/10.1109/icaml48257.2019.00044)]
77. Tricco AC, Antony J, Zarin W, Striffler L, Ghassemi M, Ivory J, et al. A scoping review of rapid review methods. *BMC Med*. Sep 16, 2015;13(1):224. [FREE Full text] [doi: [10.1186/s12916-015-0465-6](https://doi.org/10.1186/s12916-015-0465-6)] [Medline: [26377409](https://pubmed.ncbi.nlm.nih.gov/26377409/)]
78. Hamel C, Michaud A, Thuku M, Skidmore B, Stevens A, Nussbaumer-Streit B, et al. Defining Rapid Reviews: a systematic scoping review and thematic analysis of definitions and defining characteristics of rapid reviews. *J Clin Epidemiol*. Jan 2021;129:74-85. [doi: [10.1016/j.jclinepi.2020.09.041](https://doi.org/10.1016/j.jclinepi.2020.09.041)] [Medline: [33038541](https://pubmed.ncbi.nlm.nih.gov/33038541/)]
79. Tricco AC, Langlois EV, Straus SE. Rapid reviews to strengthen health policy and systems: a practical guide. World Health Organization. 2017. URL: <https://iris.who.int/bitstream/handle/10665/258698/9789241512763-eng.pdf?sequence=1> [accessed 2024-04-29]
80. Garritty C, Gartlehner G, Nussbaumer-Streit B, King VJ, Hamel C, Kamel C, et al. Cochrane rapid reviews methods group offers evidence-informed guidance to conduct rapid reviews. *J Clin Epidemiol*. Feb 2021;130:13-22. [FREE Full text] [doi: [10.1016/j.jclinepi.2020.10.007](https://doi.org/10.1016/j.jclinepi.2020.10.007)] [Medline: [33068715](https://pubmed.ncbi.nlm.nih.gov/33068715/)]
81. Denecke K, May R. Developing a technical-oriented taxonomy to define archetypes of conversational agents in health care: literature review and cluster analysis. *J Med Internet Res*. Jan 30, 2023;25:e41583. [FREE Full text] [doi: [10.2196/41583](https://doi.org/10.2196/41583)] [Medline: [36716093](https://pubmed.ncbi.nlm.nih.gov/36716093/)]
82. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. Mar 29, 2021;372:n71. [FREE Full text] [doi: [10.1136/bmj.n71](https://doi.org/10.1136/bmj.n71)] [Medline: [33782057](https://pubmed.ncbi.nlm.nih.gov/33782057/)]
83. McHugh ML. Interrater reliability: the Kappa statistic. *Biochem Med (Zagreb)*. 2012;22(3):276-282. [FREE Full text] [Medline: [23092060](https://pubmed.ncbi.nlm.nih.gov/23092060/)]
84. Elo S, Kyngäs H. The qualitative content analysis process. *J Adv Nurs*. Apr 18, 2008;62(1):107-115. [doi: [10.1111/j.1365-2648.2007.04569.x](https://doi.org/10.1111/j.1365-2648.2007.04569.x)] [Medline: [18352969](https://pubmed.ncbi.nlm.nih.gov/18352969/)]
85. Nazareth S, Hayward L, Simmons E, Snir M, Hatchell KE, Rojahn S, et al. Hereditary cancer risk using a genetic chatbot before routine care visits. *Obstet Gynecol*. Dec 01, 2021;138(6):860-870. [FREE Full text] [doi: [10.1097/AOG.0000000000004596](https://doi.org/10.1097/AOG.0000000000004596)] [Medline: [34735417](https://pubmed.ncbi.nlm.nih.gov/34735417/)]
86. Prochaska JJ, Vogel EA, Chieng A, Baiocchi M, Maglalang DD, Pajarito S, et al. A randomized controlled trial of a therapeutic relational agent for reducing substance misuse during the COVID-19 pandemic. *Drug Alcohol Depend*. Oct 01, 2021;227:108986. [FREE Full text] [doi: [10.1016/j.drugalcdep.2021.108986](https://doi.org/10.1016/j.drugalcdep.2021.108986)] [Medline: [34507061](https://pubmed.ncbi.nlm.nih.gov/34507061/)]
87. Söderström A, Shatte A, Fuller-Tyszkiewicz M. Can intelligent agents improve data quality in online questionnaires? A pilot study. *Behav Res Methods*. Oct 05, 2021;53(5):2238-2251. [doi: [10.3758/s13428-021-01574-w](https://doi.org/10.3758/s13428-021-01574-w)] [Medline: [33821454](https://pubmed.ncbi.nlm.nih.gov/33821454/)]
88. Anan T, Kajiki S, Oka H, Fujii T, Kawamata K, Mori K, et al. Effects of an artificial intelligence-assisted health program on workers with neck/shoulder pain/stiffness and low back pain: randomized controlled trial. *JMIR Mhealth Uhealth*. Sep 24, 2021;9(9):e27535. [FREE Full text] [doi: [10.2196/27535](https://doi.org/10.2196/27535)] [Medline: [34559054](https://pubmed.ncbi.nlm.nih.gov/34559054/)]
89. Stasinaki A, Büchter D, Shih CH, Heldt K, Güsewell S, Brogle B, et al. Effects of a novel mobile health intervention compared to a multi-component behaviour changing program on body mass index, physical capacities and stress parameters

- in adolescents with obesity: a randomized controlled trial. *BMC Pediatr*. Jul 09, 2021;21(1):308. [FREE Full text] [doi: [10.1186/s12887-021-02781-2](https://doi.org/10.1186/s12887-021-02781-2)] [Medline: [34243738](https://pubmed.ncbi.nlm.nih.gov/34243738/)]
90. Jang S, Kim JJ, Kim SJ, Hong J, Kim S, Kim E. Mobile app-based chatbot to deliver cognitive behavioral therapy and psychoeducation for adults with attention deficit: a development and feasibility/usability study. *Int J Med Inform*. Jun 2021;150:104440. [doi: [10.1016/j.ijmedinf.2021.104440](https://doi.org/10.1016/j.ijmedinf.2021.104440)] [Medline: [33799055](https://pubmed.ncbi.nlm.nih.gov/33799055/)]
91. Hunt M, Miguez S, Dukas B, Onwude O, White S. Efficacy of Zemedy, a mobile digital therapeutic for the self-management of irritable bowel syndrome: crossover randomized controlled trial. *JMIR Mhealth Uhealth*. May 20, 2021;9(5):e26152. [FREE Full text] [doi: [10.2196/26152](https://doi.org/10.2196/26152)] [Medline: [33872182](https://pubmed.ncbi.nlm.nih.gov/33872182/)]
92. Prochaska JJ, Vogel EA, Chieng A, Kendra M, Baiocchi M, Pajarito S, et al. A therapeutic relational agent for reducing problematic substance use (Woebot): development and usability study. *J Med Internet Res*. Mar 23, 2021;23(3):e24850. [FREE Full text] [doi: [10.2196/24850](https://doi.org/10.2196/24850)] [Medline: [33755028](https://pubmed.ncbi.nlm.nih.gov/33755028/)]
93. Echeazarra L, Pereira J, Saracho R. TensioBot: a chatbot assistant for self-managed in-house blood pressure checking. *J Med Syst*. Mar 15, 2021;45(4):54. [doi: [10.1007/s10916-021-01730-x](https://doi.org/10.1007/s10916-021-01730-x)] [Medline: [33723721](https://pubmed.ncbi.nlm.nih.gov/33723721/)]
94. Gardiner P, Bickmore T, Yinusa-Nyahkoon L, Reichert M, Julce C, Sidduri N, et al. Using health information technology to engage African American women on nutrition and supplement use during the preconception period. *Front Endocrinol (Lausanne)*. Jan 19, 2020;11:571705. [FREE Full text] [doi: [10.3389/fendo.2020.571705](https://doi.org/10.3389/fendo.2020.571705)] [Medline: [33584534](https://pubmed.ncbi.nlm.nih.gov/33584534/)]
95. Fan X, Chao D, Zhang Z, Wang D, Li X, Tian F. Utilization of self-diagnosis health chatbots in real-world settings: case study. *J Med Internet Res*. Jan 06, 2021;23(1):e19928. [FREE Full text] [doi: [10.2196/19928](https://doi.org/10.2196/19928)] [Medline: [33404508](https://pubmed.ncbi.nlm.nih.gov/33404508/)]
96. Maeda E, Miyata A, Boivin J, Nomura K, Kumazawa Y, Shirasawa H, et al. Promoting fertility awareness and preconception health using a chatbot: a randomized controlled trial. *Reprod Biomed Online*. Dec 2020;41(6):1133-1143. [doi: [10.1016/j.rbmo.2020.09.006](https://doi.org/10.1016/j.rbmo.2020.09.006)] [Medline: [33039321](https://pubmed.ncbi.nlm.nih.gov/33039321/)]
97. So R, Furukawa TA, Matsushita S, Baba T, Matsuzaki T, Furuno S, et al. Unguided ChatBot-delivered cognitive behavioural intervention for problem gamblers through messaging app: a randomised controlled trial. *J Gambl Stud*. Dec 11, 2020;36(4):1391-1407. [doi: [10.1007/s10899-020-09935-4](https://doi.org/10.1007/s10899-020-09935-4)] [Medline: [32162075](https://pubmed.ncbi.nlm.nih.gov/32162075/)]
98. Gong E, Baptista S, Russell A, Scuffham P, Riddell M, Speight J, et al. My diabetes coach, a mobile app-based interactive conversational agent to support type 2 diabetes self-management: randomized effectiveness-implementation trial. *J Med Internet Res*. Nov 05, 2020;22(11):e20322. [FREE Full text] [doi: [10.2196/20322](https://doi.org/10.2196/20322)] [Medline: [33151154](https://pubmed.ncbi.nlm.nih.gov/33151154/)]
99. Jack BW, Bickmore T, Yinusa-Nyahkoon L, Reichert M, Julce C, Sidduri N, et al. Improving the health of young African American women in the preconception period using health information technology: a randomised controlled trial. *Lancet Digit Health*. Sep 2020;2(9):e475-e485. [FREE Full text] [doi: [10.1016/S2589-7500\(20\)30189-8](https://doi.org/10.1016/S2589-7500(20)30189-8)] [Medline: [33328115](https://pubmed.ncbi.nlm.nih.gov/33328115/)]
100. Yoneoka D, Kawashima T, Tanoue Y, Nomura S, Ejima K, Shi S, et al. Early SNS-based monitoring system for the COVID-19 outbreak in Japan: a population-level observational study. *J Epidemiol*. Aug 05, 2020;30(8):362-370. [FREE Full text] [doi: [10.2188/jea.JE20200150](https://doi.org/10.2188/jea.JE20200150)] [Medline: [32475884](https://pubmed.ncbi.nlm.nih.gov/32475884/)]
101. Bickmore T, Zhang Z, Reichert M, Julce C, Jack B. Promotion of preconception care among adolescents and young adults by conversational agent. *J Adolesc Health*. Aug 2020;67(2S):S45-S51. [FREE Full text] [doi: [10.1016/j.jadohealth.2019.09.006](https://doi.org/10.1016/j.jadohealth.2019.09.006)] [Medline: [32718515](https://pubmed.ncbi.nlm.nih.gov/32718515/)]
102. Oh J, Jang S, Kim H, Kim JJ. Efficacy of mobile app-based interactive cognitive behavioral therapy using a chatbot for panic disorder. *Int J Med Inform*. Aug 2020;140:104171. [doi: [10.1016/j.ijmedinf.2020.104171](https://doi.org/10.1016/j.ijmedinf.2020.104171)] [Medline: [32446158](https://pubmed.ncbi.nlm.nih.gov/32446158/)]
103. Anthony CA, Rojas EO, Keffala V, Glass NA, Shah AS, Miller BJ, et al. Acceptance and commitment therapy delivered via a mobile phone messaging robot to decrease postoperative opioid use in patients with orthopedic trauma: randomized controlled trial. *J Med Internet Res*. Jul 29, 2020;22(7):e17750. [FREE Full text] [doi: [10.2196/17750](https://doi.org/10.2196/17750)] [Medline: [32723723](https://pubmed.ncbi.nlm.nih.gov/32723723/)]
104. Kramer JN, Künzler F, Mishra V, Smith SN, Kotz D, Scholz U, et al. Which components of a smartphone walking app help users to reach personalized step goals? Results from an optimization trial. *Ann Behav Med*. Jun 12, 2020;54(7):518-528. [FREE Full text] [doi: [10.1093/abm/kaa002](https://doi.org/10.1093/abm/kaa002)] [Medline: [32182353](https://pubmed.ncbi.nlm.nih.gov/32182353/)]
105. Bennion MR, Hardy GE, Moore RK, Kellett S, Millings A. Usability, acceptability, and effectiveness of web-based conversational agents to facilitate problem solving in older adults: controlled study. *J Med Internet Res*. May 27, 2020;22(5):e16794. [FREE Full text] [doi: [10.2196/16794](https://doi.org/10.2196/16794)] [Medline: [32384055](https://pubmed.ncbi.nlm.nih.gov/32384055/)]
106. Piao M, Ryu H, Lee H, Kim J. Use of the healthy lifestyle coaching ChatBot app to promote stair-climbing habits among office workers: exploratory randomized controlled trial. *JMIR Mhealth Uhealth*. May 19, 2020;8(5):e15085. [FREE Full text] [doi: [10.2196/15085](https://doi.org/10.2196/15085)] [Medline: [32427114](https://pubmed.ncbi.nlm.nih.gov/32427114/)]
107. Hauser-Ulrich S, Künzli H, Meier-Peterhans D, Kowatsch T. A smartphone-based health care chatbot to promote self-management of chronic pain (SELMA): pilot randomized controlled trial. *JMIR Mhealth Uhealth*. Apr 03, 2020;8(4):e15806. [FREE Full text] [doi: [10.2196/15806](https://doi.org/10.2196/15806)] [Medline: [32242820](https://pubmed.ncbi.nlm.nih.gov/32242820/)]
108. Bibault JE, Chaix B, Guillemassé A, Cousin S, Escande A, Perrin M, et al. A chatbot versus physicians to provide information for patients with breast cancer: blind, randomized controlled noninferiority trial. *J Med Internet Res*. Nov 27, 2019;21(11):e15787. [FREE Full text] [doi: [10.2196/15787](https://doi.org/10.2196/15787)] [Medline: [31774408](https://pubmed.ncbi.nlm.nih.gov/31774408/)]
109. Greer S, Ramo D, Chang YJ, Fu M, Moskowitz J, Haritatos J. Use of the chatbot "Vivibot" to deliver positive psychology skills and promote well-being among young people after cancer treatment: randomized controlled feasibility trial. *JMIR Mhealth Uhealth*. Oct 31, 2019;7(10):e15018. [FREE Full text] [doi: [10.2196/15018](https://doi.org/10.2196/15018)] [Medline: [31674920](https://pubmed.ncbi.nlm.nih.gov/31674920/)]

110. Fadhil A, Wang Y, Reiterer H. Assistive conversational agent for health coaching: a validation study. *Methods Inf Med*. Jun 22, 2019;58(1):9-23. [doi: [10.1055/s-0039-1688757](https://doi.org/10.1055/s-0039-1688757)] [Medline: [31117129](https://pubmed.ncbi.nlm.nih.gov/31117129/)]
111. Abdullah AS, Gaehde S, Bickmore T. A tablet based embodied conversational agent to promote smoking cessation among veterans: a feasibility study. *J Epidemiol Glob Health*. Dec 2018;8(3-4):225-230. [FREE Full text] [doi: [10.2991/j.jegh.2018.08.104](https://doi.org/10.2991/j.jegh.2018.08.104)] [Medline: [30864768](https://pubmed.ncbi.nlm.nih.gov/30864768/)]
112. Auriacombe M, Moriceau S, Serre F, Denis C, Micoulaud-Franchi JA, de Sevin E, et al. Development and validation of a virtual agent to screen tobacco and alcohol use disorders. *Drug Alcohol Depend*. Dec 01, 2018;193:1-6. [doi: [10.1016/j.drugalcdep.2018.08.025](https://doi.org/10.1016/j.drugalcdep.2018.08.025)] [Medline: [30321739](https://pubmed.ncbi.nlm.nih.gov/30321739/)]
113. King AC, Campero I, Sheats JL, Castro Sweet CM, Garcia D, Chazaro A, et al. Testing the comparative effects of physical activity advice by humans vs. computers in underserved populations: the COMPASS trial design, methods, and baseline characteristics. *Contemp Clin Trials*. Oct 2017;61:115-125. [FREE Full text] [doi: [10.1016/j.cct.2017.07.020](https://doi.org/10.1016/j.cct.2017.07.020)] [Medline: [28739541](https://pubmed.ncbi.nlm.nih.gov/28739541/)]
114. Gardiner PM, McCue KD, Negash LM, Cheng T, White LF, Yinusa-Nyahkoon L, et al. Engaging women with an embodied conversational agent to deliver mindfulness and lifestyle recommendations: a feasibility randomized control trial. *Patient Educ Couns*. Sep 2017;100(9):1720-1729. [FREE Full text] [doi: [10.1016/j.pec.2017.04.015](https://doi.org/10.1016/j.pec.2017.04.015)] [Medline: [28495391](https://pubmed.ncbi.nlm.nih.gov/28495391/)]
115. Hajna S, Sharp SJ, Cooper AJ, Williams KM, van Sluijs EM, Brage S, et al. Effectiveness of minimal contact interventions: an RCT. *Am J Prev Med*. Mar 2021;60(3):e111-e121. [FREE Full text] [doi: [10.1016/j.amepre.2020.10.010](https://doi.org/10.1016/j.amepre.2020.10.010)] [Medline: [33612170](https://pubmed.ncbi.nlm.nih.gov/33612170/)]
116. Ali R, Hoque E, Duberstein P, Schubert L, Razavi SZ, Kane B, et al. Aging and engaging: a pilot randomized controlled trial of an online conversational skills coach for older adults. *Am J Geriatr Psychiatry*. Aug 2021;29(8):804-815. [FREE Full text] [doi: [10.1016/j.jagp.2020.11.004](https://doi.org/10.1016/j.jagp.2020.11.004)] [Medline: [33308893](https://pubmed.ncbi.nlm.nih.gov/33308893/)]
117. Reger GM, Norr AM, Rizzo AS, Sylvers P, Peltan J, Fischer D, et al. Virtual standardized patients vs academic training for learning motivational interviewing skills in the US Department of Veterans Affairs and the US Military: a randomized trial. *JAMA Netw Open*. Oct 01, 2020;3(10):e2017348. [FREE Full text] [doi: [10.1001/jamanetworkopen.2020.17348](https://doi.org/10.1001/jamanetworkopen.2020.17348)] [Medline: [33057643](https://pubmed.ncbi.nlm.nih.gov/33057643/)]
118. Lorenz N, Heim E, Roetger A, Birrer E, Maercker A. Randomized controlled trial to test the efficacy of an unguided online intervention with automated feedback for the treatment of insomnia. *Behav Cogn Psychother*. May 2019;47(3):287-302. [doi: [10.1017/S1352465818000486](https://doi.org/10.1017/S1352465818000486)] [Medline: [30185239](https://pubmed.ncbi.nlm.nih.gov/30185239/)]
119. Fitzpatrick KK, Darcy A, Vierhile M. Delivering cognitive behavior therapy to young adults with symptoms of depression and anxiety using a fully automated conversational agent (Woebot): a randomized controlled trial. *JMIR Ment Health*. Jun 06, 2017;4(2):e19. [FREE Full text] [doi: [10.2196/mental.7785](https://doi.org/10.2196/mental.7785)] [Medline: [28588005](https://pubmed.ncbi.nlm.nih.gov/28588005/)]
120. Abujarad F, Ulrich D, Edwards C, Choo E, Pantaloni MV, Jubanyik K, et al. Development and usability evaluation of VOICES: a digital health tool to identify elder mistreatment. *J Am Geriatr Soc*. Jun 21, 2021;69(6):1469-1478. [FREE Full text] [doi: [10.1111/jgs.17068](https://doi.org/10.1111/jgs.17068)] [Medline: [33615433](https://pubmed.ncbi.nlm.nih.gov/33615433/)]
121. Baptista S, Wadley G, Bird D, Oldenburg B, Speight J, My Diabetes Coach Research Group. Acceptability of an embodied conversational agent for type 2 diabetes self-management education and support via a smartphone app: mixed methods study. *JMIR Mhealth Uhealth*. Jul 22, 2020;8(7):e17038. [FREE Full text] [doi: [10.2196/17038](https://doi.org/10.2196/17038)] [Medline: [32706734](https://pubmed.ncbi.nlm.nih.gov/32706734/)]
122. Hirsh AT, Miller MM, Hollingshead NA, Anastas T, Carnell ST, Lok BC, et al. A randomized controlled trial testing a virtual perspective-taking intervention to reduce race and socioeconomic status disparities in pain care. *Pain*. Oct 10, 2019;160(10):2229-2240. [FREE Full text] [doi: [10.1097/j.pain.0000000000001634](https://doi.org/10.1097/j.pain.0000000000001634)] [Medline: [31568099](https://pubmed.ncbi.nlm.nih.gov/31568099/)]
123. Kim YJ, DeLisa JA, Chung YC, Shapiro NL, Kolar Rajanna SK, Barbour E, et al. Recruitment in a research study via chatbot versus telephone outreach: a randomized trial at a minority-serving institution. *J Am Med Inform Assoc*. Dec 28, 2021;29(1):149-154. [FREE Full text] [doi: [10.1093/jamia/ocab240](https://doi.org/10.1093/jamia/ocab240)] [Medline: [34741513](https://pubmed.ncbi.nlm.nih.gov/34741513/)]
124. Kowatsch T, Schachner T, Harperink S, Barata F, Dittler U, Xiao G, et al. Conversational agents as mediating social actors in chronic disease management involving health care professionals, patients, and family members: multisite single-arm feasibility study. *J Med Internet Res*. Feb 17, 2021;23(2):e25060. [FREE Full text] [doi: [10.2196/25060](https://doi.org/10.2196/25060)] [Medline: [33484114](https://pubmed.ncbi.nlm.nih.gov/33484114/)]
125. Loveys K, Sagar M, Broadbent E. The effect of multimodal emotional expression on responses to a digital human during a self-disclosure conversation: a computational analysis of user language. *J Med Syst*. Jul 22, 2020;44(9):143. [doi: [10.1007/s10916-020-01624-4](https://doi.org/10.1007/s10916-020-01624-4)] [Medline: [32700060](https://pubmed.ncbi.nlm.nih.gov/32700060/)]
126. Loveys K, Sagar M, Pickering I, Broadbent E. A digital human for delivering a remote loneliness and stress intervention to at-risk younger and older adults during the COVID-19 pandemic: randomized pilot trial. *JMIR Ment Health*. Nov 08, 2021;8(11):e31586. [FREE Full text] [doi: [10.2196/31586](https://doi.org/10.2196/31586)] [Medline: [34596572](https://pubmed.ncbi.nlm.nih.gov/34596572/)]
127. Ly KH, Ly AM, Andersson G. A fully automated conversational agent for promoting mental well-being: a pilot RCT using mixed methods. *Internet Interv*. Dec 2017;10:39-46. [FREE Full text] [doi: [10.1016/j.invent.2017.10.002](https://doi.org/10.1016/j.invent.2017.10.002)] [Medline: [30135751](https://pubmed.ncbi.nlm.nih.gov/30135751/)]
128. Morse KE, Ostberg NP, Jones VG, Chan AS. Use characteristics and triage acuity of a digital symptom checker in a large integrated health system: population-based descriptive study. *J Med Internet Res*. Nov 30, 2020;22(11):e20549. [FREE Full text] [doi: [10.2196/20549](https://doi.org/10.2196/20549)] [Medline: [33170799](https://pubmed.ncbi.nlm.nih.gov/33170799/)]

129. O'Rourke SR, Branford KR, Brooks TL, Ives LT, Nagendran A, Compton SN. The emotional and behavioral impact of delivering bad news to virtual versus real standardized patients: a pilot study. *Teach Learn Med*. Aug 22, 2020;32(2):139-149. [doi: [10.1080/10401334.2019.1652180](https://doi.org/10.1080/10401334.2019.1652180)] [Medline: [31437006](https://pubmed.ncbi.nlm.nih.gov/31437006/)]
130. Schario ME, Bahner CA, Widenhofer TV, Rajaballe JI, Thatcher EJ. Chatbot-assisted care management. *Prof Case Manag*. 2022;27(1):19-25. [doi: [10.1097/NCM.0000000000000504](https://doi.org/10.1097/NCM.0000000000000504)] [Medline: [34846321](https://pubmed.ncbi.nlm.nih.gov/34846321/)]
131. Dhinakaran DA, Sathish T, Soong A, Theng YL, Best J, Tudor Car L. Conversational agent for healthy lifestyle behavior change: web-based feasibility study. *JMIR Form Res*. Dec 03, 2021;5(12):e27956. [FREE Full text] [doi: [10.2196/27956](https://doi.org/10.2196/27956)] [Medline: [34870611](https://pubmed.ncbi.nlm.nih.gov/34870611/)]
132. Troitskaya O, Batkhina A. Mobile application for couple relationships: results of a pilot effectiveness study. *Fam Process*. Jun 14, 2022;61(2):625-642. [doi: [10.1111/famp.12733](https://doi.org/10.1111/famp.12733)] [Medline: [34904235](https://pubmed.ncbi.nlm.nih.gov/34904235/)]
133. So R, Emura N, Okazaki K, Takeda S, Sunami T, Kitagawa K, et al. Guided versus unguided chatbot-delivered cognitive behavioral intervention for individuals with moderate-risk and problem gambling: a randomized controlled trial (GAMBOT2 study). *Addict Behav*. Feb 2024;149:107889. [doi: [10.1016/j.addbeh.2023.107889](https://doi.org/10.1016/j.addbeh.2023.107889)] [Medline: [37857043](https://pubmed.ncbi.nlm.nih.gov/37857043/)]
134. An J, Ferrante JM, Macenat M, Ganesan S, Hudson SV, Omene C, et al. Promoting informed approaches in precision oncology and clinical trial participation for Black patients with cancer: community-engaged development and pilot testing of a digital intervention. *Cancer (Forthcoming)*. Oct 13, 2023. [doi: [10.1002/cncr.35049](https://doi.org/10.1002/cncr.35049)] [Medline: [37837177](https://pubmed.ncbi.nlm.nih.gov/37837177/)]
135. Coelho J, Pecune F, Levavasseur Y, De Sevin E, D'incieu E, Sagaspe P, et al. From improved sleep regularity to reduced sleep complaints and mental health conditions: a population-based interventional study using a smartphone-based virtual agent. *Sleep*. Sep 08, 2023;46(9):zsad165. [doi: [10.1093/sleep/zsad165](https://doi.org/10.1093/sleep/zsad165)] [Medline: [37282717](https://pubmed.ncbi.nlm.nih.gov/37282717/)]
136. Siglen E, Vetti HH, Augestad M, Steen VM, Lunde Å, Bjorvatn C. Evaluation of the rosa chatbot providing genetic information to patients at risk of hereditary breast and ovarian cancer: qualitative interview study. *J Med Internet Res*. Sep 01, 2023;25:e46571. [FREE Full text] [doi: [10.2196/46571](https://doi.org/10.2196/46571)] [Medline: [37656502](https://pubmed.ncbi.nlm.nih.gov/37656502/)]
137. Griffin AC, Khairat S, Bailey SC, Chung AE. A chatbot for hypertension self-management support: user-centered design, development, and usability testing. *JAMIA Open*. Oct 2023;6(3):ooad073. [FREE Full text] [doi: [10.1093/jamiaopen/ooad073](https://doi.org/10.1093/jamiaopen/ooad073)] [Medline: [37693367](https://pubmed.ncbi.nlm.nih.gov/37693367/)]
138. Nadarzynski T, Lunt A, Knights N, Bayley J, Llewellyn C. "But can chatbots understand sex?" Attitudes towards artificial intelligence chatbots amongst sexual and reproductive health professionals: an exploratory mixed-methods study. *Int J STD AIDS*. Oct 03, 2023;34(11):809-816. [FREE Full text] [doi: [10.1177/09564624231180777](https://doi.org/10.1177/09564624231180777)] [Medline: [37269292](https://pubmed.ncbi.nlm.nih.gov/37269292/)]
139. Alkoudmani RM, Ooi GS, Tan ML. Implementing a chatbot on Facebook to reach and collect data from thousands of health care providers: PharmindBot as a case. *J Am Pharm Assoc (2003)*. Sep 2023;63(5):1634-42.e3. [doi: [10.1016/j.japh.2023.06.007](https://doi.org/10.1016/j.japh.2023.06.007)] [Medline: [37327997](https://pubmed.ncbi.nlm.nih.gov/37327997/)]
140. Morato JE, do Nascimento JW, Roque GD, de Souza RR, Santos IC. Development, validation, and usability of the Chatbot ESTOMABOT to promote self-care of people with intestinal ostomy. *Comput Inform Nurs*. Dec 01, 2023;41(12):1037-1045. [doi: [10.1097/CIN.0000000000001075](https://doi.org/10.1097/CIN.0000000000001075)] [Medline: [37725781](https://pubmed.ncbi.nlm.nih.gov/37725781/)]
141. Al-Hilli Z, Noss R, Dickard J, Wei W, Chichura A, Wu V, et al. A randomized trial comparing the effectiveness of pre-test genetic counseling using an artificial intelligence automated chatbot and traditional in-person genetic counseling in women newly diagnosed with breast cancer. *Ann Surg Oncol*. Oct 11, 2023;30(10):5990-5996. [doi: [10.1245/s10434-023-13888-4](https://doi.org/10.1245/s10434-023-13888-4)] [Medline: [37567976](https://pubmed.ncbi.nlm.nih.gov/37567976/)]
142. Hsu MH, Chen YH. Personalized medical terminology learning game: guess the term. *Games Health J*. Apr 01, 2024;13(2):84-92. [doi: [10.1089/g4h.2023.0054](https://doi.org/10.1089/g4h.2023.0054)] [Medline: [37699207](https://pubmed.ncbi.nlm.nih.gov/37699207/)]
143. Escobar-Viera CG, Porta G, Coulter RW, Martina J, Goldbach J, Rollman BL. A chatbot-delivered intervention for optimizing social media use and reducing perceived isolation among rural-living LGBTQ+ youth: development, acceptability, usability, satisfaction, and utility. *Internet Interv*. Dec 2023;34:100668. [FREE Full text] [doi: [10.1016/j.invent.2023.100668](https://doi.org/10.1016/j.invent.2023.100668)] [Medline: [37746640](https://pubmed.ncbi.nlm.nih.gov/37746640/)]
144. Cheng CI, Lin WJ, Liu HT, Chen YT, Chiang CK, Hung KY. Implementation of artificial intelligence chatbot in peritoneal dialysis nursing care: experience from a Taiwan medical center. *Nephrology (Carlton)*. Dec 12, 2023;28(12):655-662. [doi: [10.1111/nep.14239](https://doi.org/10.1111/nep.14239)] [Medline: [37698229](https://pubmed.ncbi.nlm.nih.gov/37698229/)]
145. Wang Z, Chan PS, Fang Y, Yu FY, Ye D, Zhang Q, et al. Chatbot-delivered online intervention to promote seasonal influenza vaccination during the COVID-19 pandemic: a randomized clinical trial. *JAMA Netw Open*. Sep 05, 2023;6(9):e2332568. [FREE Full text] [doi: [10.1001/jamanetworkopen.2023.32568](https://doi.org/10.1001/jamanetworkopen.2023.32568)] [Medline: [37695585](https://pubmed.ncbi.nlm.nih.gov/37695585/)]
146. de Queiroz DA, Passarello RS, de Moura Fé VV, Rossini A, da Silveira EF, de Queiroz EA, et al. A wearable chatbot-based model for monitoring colorectal cancer patients in the active phase of treatment. *Healthc Anal*. Dec 2023;4:100257. [FREE Full text] [doi: [10.1016/j.health.2023.100257](https://doi.org/10.1016/j.health.2023.100257)]
147. Chow JS, Blight V, Brown M, Glynn V, Lane B, Larkin A, et al. Curious thing, an artificial intelligence (AI)-based conversational agent for COVID-19 patient management. *Aust J Prim Health*. Aug 2023;29(4):312-318. [doi: [10.1071/PY22045](https://doi.org/10.1071/PY22045)] [Medline: [36683166](https://pubmed.ncbi.nlm.nih.gov/36683166/)]
148. Marrs JC, Orlando ST, Saseen JJ, Novins-Montague S, Sandy LC, Waughtal J, et al. Description of patient questions received by clinical pharmacists in the Nudge Study. *Am J Health Syst Pharm*. Sep 07, 2023;80(18):1247-1254. [FREE Full text] [doi: [10.1093/ajhp/xxad139](https://doi.org/10.1093/ajhp/xxad139)] [Medline: [37353220](https://pubmed.ncbi.nlm.nih.gov/37353220/)]

149. Rainey JP, Blackburn BE, McCutcheon CL, Kenyon CM, Campbell KJ, Anderson LA, et al. A multilingual chatbot can effectively engage arthroplasty patients who have limited english proficiency. *J Arthroplasty*. Jul 2023;38(7 Suppl 2):S78-S83. [doi: [10.1016/j.arth.2023.04.014](https://doi.org/10.1016/j.arth.2023.04.014)] [Medline: [37068567](https://pubmed.ncbi.nlm.nih.gov/37068567/)]
150. El Ayadi AM, Singh P, Duggal M, Kumar V, Kaur J, Sharma P, et al. Feasibility and acceptability of Saheli, a WhatsApp Chatbot, on COVID-19 vaccination among pregnant and breastfeeding women in rural North India. *BMJ Innov*. Aug 22, 2023;9(4):195-206. [doi: [10.1136/bmjinnov-2022-001012](https://doi.org/10.1136/bmjinnov-2022-001012)]
151. Hsu MH. Mastering medical terminology with ChatGPT and Termbot. *Health Educ J*. Sep 04, 2023. [FREE Full text] [doi: [10.1177/00178969231197371](https://doi.org/10.1177/00178969231197371)]
152. Mahlkecht A, Engl A, Piccoliori G, Wiedermann CJ. Supporting primary care through symptom checking artificial intelligence: a study of patient and physician attitudes in Italian general practice. *BMC Prim Care*. Sep 04, 2023;24(1):174. [FREE Full text] [doi: [10.1186/s12875-023-02143-0](https://doi.org/10.1186/s12875-023-02143-0)] [Medline: [37661285](https://pubmed.ncbi.nlm.nih.gov/37661285/)]
153. Xu J, Yang L, Guo M. Designing and evaluating an emotionally responsive virtual patient simulation. *Simul Healthc* (Forthcoming). May 18, 2023. [doi: [10.1097/SIH.0000000000000730](https://doi.org/10.1097/SIH.0000000000000730)] [Medline: [37651599](https://pubmed.ncbi.nlm.nih.gov/37651599/)]
154. Gupta S, Gupta SS, McMath K, Sugandh S. Enhancing complex wound care by leveraging artificial intelligence: an artificial intelligence chatbot software study. *Wounds*. Aug 2023;35(8):E265-E267. [FREE Full text] [doi: [10.25270/wnds/23073](https://doi.org/10.25270/wnds/23073)] [Medline: [37643453](https://pubmed.ncbi.nlm.nih.gov/37643453/)]
155. Beavers J, Schell RF, VanCleave H, Dillon RC, Simmons A, Chen H, et al. Evaluation of inpatient medication guidance from an artificial intelligence chatbot. *Am J Health Syst Pharm*. Dec 05, 2023;80(24):1822-1829. [doi: [10.1093/ajhp/xxad193](https://doi.org/10.1093/ajhp/xxad193)] [Medline: [37611187](https://pubmed.ncbi.nlm.nih.gov/37611187/)]
156. Larizza C, Bosoni P, Quaglini S, Chasseur M, Bevolo V, Zuccotti G, et al. V-care: An application to support lifestyle improvement in children with obesity. *Int J Med Inform*. Sep 2023;177:105140. [doi: [10.1016/j.ijmedinf.2023.105140](https://doi.org/10.1016/j.ijmedinf.2023.105140)] [Medline: [37463558](https://pubmed.ncbi.nlm.nih.gov/37463558/)]
157. Suharwardy S, Ramachandran M, Leonard SA, Gunaseelan A, Lyell DJ, Darcy A, et al. Feasibility and impact of a mental health chatbot on postpartum mental health: a randomized controlled trial. *AJOG Glob Rep*. Aug 2023;3(3):100165. [FREE Full text] [doi: [10.1016/j.xagr.2023.100165](https://doi.org/10.1016/j.xagr.2023.100165)] [Medline: [37560011](https://pubmed.ncbi.nlm.nih.gov/37560011/)]
158. Potts C, Lindström F, Bond R, Mulvenna M, Booth F, Ennis E, et al. A multilingual digital mental health and well-being chatbot (ChatPal): pre-post multicenter intervention study. *J Med Internet Res*. Jul 06, 2023;25:e43051. [FREE Full text] [doi: [10.2196/43051](https://doi.org/10.2196/43051)] [Medline: [37410537](https://pubmed.ncbi.nlm.nih.gov/37410537/)]
159. Babington-Ashaye A, de Moerloose P, Diop S, Geissbuhler A. Design, development and usability of an educational AI chatbot for people with haemophilia in Senegal. *Haemophilia*. Jul 22, 2023;29(4):1063-1073. [doi: [10.1111/hae.14815](https://doi.org/10.1111/hae.14815)] [Medline: [37347648](https://pubmed.ncbi.nlm.nih.gov/37347648/)]
160. Taylor JJ, Subramanian A, Freitas A, Ferreira DM, Dickinson CM. What do individuals with visual impairment need and want from a dialogue-based digital assistant? *Clin Exp Optom*. Aug 29, 2023;106(6):656-665. [doi: [10.1080/08164622.2022.2159791](https://doi.org/10.1080/08164622.2022.2159791)] [Medline: [36709512](https://pubmed.ncbi.nlm.nih.gov/36709512/)]
161. Santa-Cruz J, Moran L, Tovar M, Peinado J, Cutipe Y, Ramos L, et al. Mobilizing digital technology to implement a population-based psychological support response during the COVID-19 pandemic in Lima, Peru. *Glob Ment Health (Camb)*. Jul 28, 2022;9:355-365. [FREE Full text] [doi: [10.1017/gmh.2022.36](https://doi.org/10.1017/gmh.2022.36)] [Medline: [36618717](https://pubmed.ncbi.nlm.nih.gov/36618717/)]
162. Chun-Hung L, Guan-Hsiung L, Wu-Chuan Y, Yu-Hsin L. Chatbot-assisted therapy for patients with methamphetamine use disorder: a preliminary randomized controlled trial. *Front Psychiatry*. Jul 7, 2023;14:1159399. [FREE Full text] [doi: [10.3389/fpsy.2023.1159399](https://doi.org/10.3389/fpsy.2023.1159399)] [Medline: [37484677](https://pubmed.ncbi.nlm.nih.gov/37484677/)]
163. Mane HY, Channell Doig A, Marin Gutierrez FX, Jasczynski M, Yue X, Srikanth NP, et al. Practical guidance for the development of Rosie, a health education question-and-answer chatbot for new mothers. *J Public Health Manag Pract*. 2023;29(5):663-670. [FREE Full text] [doi: [10.1097/PHH.0000000000001781](https://doi.org/10.1097/PHH.0000000000001781)] [Medline: [37478093](https://pubmed.ncbi.nlm.nih.gov/37478093/)]
164. Cho K, Foo YM, Dalziel B, Hu W. Chatbot-mediated learning of cardiac auscultation. *Intern Med J*. Dec 17, 2022;52(12):2176-2180. [doi: [10.1111/imj.15971](https://doi.org/10.1111/imj.15971)] [Medline: [37133367](https://pubmed.ncbi.nlm.nih.gov/37133367/)]
165. Bruijnes M, Kesteloo M, Brinkman WP. Reducing social diabetes distress with a conversational agent support system: a three-week technology feasibility evaluation. *Front Digit Health*. Jun 13, 2023;5:1149374. [FREE Full text] [doi: [10.3389/fdgh.2023.1149374](https://doi.org/10.3389/fdgh.2023.1149374)] [Medline: [37383944](https://pubmed.ncbi.nlm.nih.gov/37383944/)]
166. van der Schyff EL, Ridout B, Amon KL, Forsyth R, Campbell AJ. Providing self-led mental health support through an artificial intelligence-powered chat bot (Leora) to meet the demand of mental health care. *J Med Internet Res*. Jun 19, 2023;25:e46448. [FREE Full text] [doi: [10.2196/46448](https://doi.org/10.2196/46448)] [Medline: [37335608](https://pubmed.ncbi.nlm.nih.gov/37335608/)]
167. Guo N, Luk TT, Wu YS, Guo Z, Chu JC, Cheung YT, et al. Effect of mobile interventions with nicotine replacement therapy sampling on long-term smoking cessation in community smokers: a pragmatic randomized clinical trial. *Tob Induc Dis*. Mar 24, 2023;21(March):44-13. [FREE Full text] [doi: [10.18332/tid/160168](https://doi.org/10.18332/tid/160168)] [Medline: [36969982](https://pubmed.ncbi.nlm.nih.gov/36969982/)]
168. Booth F, Potts C, Bond R, Mulvenna M, Kostenius C, Dhanapala I, et al. A mental health and well-being chatbot: user event log analysis. *JMIR Mhealth Uhealth*. Jul 06, 2023;11:e43052. [FREE Full text] [doi: [10.2196/43052](https://doi.org/10.2196/43052)] [Medline: [37410539](https://pubmed.ncbi.nlm.nih.gov/37410539/)]
169. Anmella G, Sanabra M, Primé-Tous M, Segú X, Caverio M, Morilla I, et al. Vickybot, a chatbot for anxiety-depressive symptoms and work-related burnout in primary care and health care professionals: development, feasibility, and potential

- effectiveness studies. *J Med Internet Res*. Apr 03, 2023;25:e43293. [FREE Full text] [doi: [10.2196/43293](https://doi.org/10.2196/43293)] [Medline: [36719325](https://pubmed.ncbi.nlm.nih.gov/36719325/)]
170. Fabian KE, Foster KT, Chwastiak L, Turner M, Wagenaar BH. Adapting a transdiagnostic digital mental health intervention for use among immigrant and refugee youth in Seattle: a human-centered design approach. *Transl Behav Med*. Nov 05, 2023;13(11):867-875. [doi: [10.1093/tbm/ibad041](https://doi.org/10.1093/tbm/ibad041)] [Medline: [37418614](https://pubmed.ncbi.nlm.nih.gov/37418614/)]
171. Massa P, de Souza Ferraz DA, Magno L, Silva AP, Greco M, Dourado I, et al. A transgender chatbot (Amanda Selfie) to create pre-exposure prophylaxis demand among adolescents in Brazil: assessment of acceptability, functionality, usability, and results. *J Med Internet Res*. Jun 23, 2023;25:e41881. [FREE Full text] [doi: [10.2196/41881](https://doi.org/10.2196/41881)] [Medline: [37351920](https://pubmed.ncbi.nlm.nih.gov/37351920/)]
172. Tapolin FM, Liaskos J, Zoulias E, Mantas J. A conversational web-based chatbot to disseminate COVID-19 advisory information. *Stud Health Technol Inform*. Jun 29, 2023;305:483-486. [doi: [10.3233/SHTI230538](https://doi.org/10.3233/SHTI230538)] [Medline: [37387072](https://pubmed.ncbi.nlm.nih.gov/37387072/)]
173. Durden E, Pirner MC, Rapoport SJ, Williams A, Robinson A, Forman-Hoffman VL. Changes in stress, burnout, and resilience associated with an 8-week intervention with relational agent "Woebot". *Internet Interv*. Sep 2023;33:100637. [FREE Full text] [doi: [10.1016/j.invent.2023.100637](https://doi.org/10.1016/j.invent.2023.100637)] [Medline: [37635948](https://pubmed.ncbi.nlm.nih.gov/37635948/)]
174. Pereira DS, Falcão F, Nunes A, Santos N, Costa P, Pêgo JM. Designing and building OSCEBot® for virtual OSCE - performance evaluation. *Med Educ Online*. Dec 22, 2023;28(1):2228550. [FREE Full text] [doi: [10.1080/10872981.2023.2228550](https://doi.org/10.1080/10872981.2023.2228550)] [Medline: [37347808](https://pubmed.ncbi.nlm.nih.gov/37347808/)]
175. Brinsley J, Singh B, Maher CA. A digital lifestyle program for psychological distress, wellbeing and return-to-work: a proof-of-concept study. *Arch Phys Med Rehabil*. Nov 2023;104(11):1903-1912. [doi: [10.1016/j.apmr.2023.04.023](https://doi.org/10.1016/j.apmr.2023.04.023)] [Medline: [37209933](https://pubmed.ncbi.nlm.nih.gov/37209933/)]
176. Matheson EL, Smith HG, Amaral AC, Meireles JF, Almeida MC, Linardon J, et al. Using chatbot technology to improve Brazilian adolescents' body image and mental health at scale: randomized controlled trial. *JMIR Mhealth Uhealth*. Jun 19, 2023;11:e39934. [FREE Full text] [doi: [10.2196/39934](https://doi.org/10.2196/39934)] [Medline: [37335604](https://pubmed.ncbi.nlm.nih.gov/37335604/)]
177. Walters NL, Lindsey-Mills ZT, Brangan A, Savage SK, Schmidlen TJ, Morgan KM, et al. Facilitating family communication of familial hypercholesterolemia genetic risk: assessing engagement with innovative chatbot technology from the IMPACT-FH study. *PEC Innov*. Dec 2023;2:100134. [FREE Full text] [doi: [10.1016/j.pecinn.2023.100134](https://doi.org/10.1016/j.pecinn.2023.100134)] [Medline: [37214500](https://pubmed.ncbi.nlm.nih.gov/37214500/)]
178. Jackson-Triche M, Vetal D, Turner EM, Dahiya P, Mangurian C. Meeting the behavioral health needs of health care workers during COVID-19 by leveraging chatbot technology: development and usability study. *J Med Internet Res*. Jun 08, 2023;25:e40635. [FREE Full text] [doi: [10.2196/40635](https://doi.org/10.2196/40635)] [Medline: [37146178](https://pubmed.ncbi.nlm.nih.gov/37146178/)]
179. Nehme M, Schneider F, Perrin A, Sum Yu W, Schmitt S, Violot G, et al. The development of a chatbot technology to disseminate post-COVID-19 information: descriptive implementation study. *J Med Internet Res*. Jun 05, 2023;25:e43113. [FREE Full text] [doi: [10.2196/43113](https://doi.org/10.2196/43113)] [Medline: [37195688](https://pubmed.ncbi.nlm.nih.gov/37195688/)]
180. Ko SQ, Chua CM, Koh SH, Lim YW, Shorey S. Experiences of patients and their caregivers in a virtual ward in Singapore: a descriptive qualitative study. *Int J Med Inform*. Sep 2023;177:105111. [FREE Full text] [doi: [10.1016/j.ijmedinf.2023.105111](https://doi.org/10.1016/j.ijmedinf.2023.105111)] [Medline: [37307721](https://pubmed.ncbi.nlm.nih.gov/37307721/)]
181. Kobayashi T, Tomoi H, Nishina Y, Harada K, Tanaka K, Sasaki S, et al. Effect of a mobile app chatbot and an interactive small-group webinar on COVID-19 vaccine intention and confidence in Japan: a randomised controlled trial. *BMJ Glob Health*. May 29, 2023;8(5):e010370. [FREE Full text] [doi: [10.1136/bmjgh-2022-010370](https://doi.org/10.1136/bmjgh-2022-010370)] [Medline: [37247873](https://pubmed.ncbi.nlm.nih.gov/37247873/)]
182. Lee KY, Dabak SV, Kong VH, Park M, Kwok SL, Silzle M, et al. Effectiveness of chatbots on COVID vaccine confidence and acceptance in Thailand, Hong Kong, and Singapore. *NPJ Digit Med*. May 25, 2023;6(1):96. [FREE Full text] [doi: [10.1038/s41746-023-00843-6](https://doi.org/10.1038/s41746-023-00843-6)] [Medline: [37231110](https://pubmed.ncbi.nlm.nih.gov/37231110/)]
183. Sabour S, Zhang W, Xiao X, Zhang Y, Zheng Y, Wen J, et al. A chatbot for mental health support: exploring the impact of Emohaa on reducing mental distress in China. *Front Digit Health*. May 4, 2023;5:1133987. [FREE Full text] [doi: [10.3389/fdgth.2023.1133987](https://doi.org/10.3389/fdgth.2023.1133987)] [Medline: [37214342](https://pubmed.ncbi.nlm.nih.gov/37214342/)]
184. Wang Q, Peng S, Zha Z, Han X, Deng C, Hu L, et al. Enhancing the conversational agent with an emotional support system for mental health digital therapeutics. *Front Psychiatry*. Apr 17, 2023;14:1148534. [FREE Full text] [doi: [10.3389/fpsy.2023.1148534](https://doi.org/10.3389/fpsy.2023.1148534)] [Medline: [37139323](https://pubmed.ncbi.nlm.nih.gov/37139323/)]
185. Beatty C, Malik T, Meheli S, Sinha C. Evaluating the therapeutic alliance with a free-text CBT conversational agent (Wysa): a mixed-methods study. *Front Digit Health*. Apr 11, 2022;4:847991. [FREE Full text] [doi: [10.3389/fdgth.2022.847991](https://doi.org/10.3389/fdgth.2022.847991)] [Medline: [35480848](https://pubmed.ncbi.nlm.nih.gov/35480848/)]
186. Bézie A, Morisseau V, Rolland R, Guillemassé A, Brouard B, Chaix B. Using a chatbot to study medication overuse among patients suffering from headaches. *Front Digit Health*. Mar 17, 2022;4:801782. [FREE Full text] [doi: [10.3389/fdgth.2022.801782](https://doi.org/10.3389/fdgth.2022.801782)] [Medline: [35373183](https://pubmed.ncbi.nlm.nih.gov/35373183/)]
187. Moilanen J, van Berkel N, Visuri A, Gadiraju U, van der Maden W, Hosio S. Supporting mental health self-care discovery through a chatbot. *Front Digit Health*. Mar 7, 2023;5:1034724. [FREE Full text] [doi: [10.3389/fdgth.2023.1034724](https://doi.org/10.3389/fdgth.2023.1034724)] [Medline: [36960179](https://pubmed.ncbi.nlm.nih.gov/36960179/)]
188. Burger F, Neerincx MA, Brinkman WP. Using a conversational agent for thought recording as a cognitive therapy task: feasibility, content, and feedback. *Front Digit Health*. Jul 19, 2022;4:930874. [FREE Full text] [doi: [10.3389/fdgth.2022.930874](https://doi.org/10.3389/fdgth.2022.930874)] [Medline: [35928046](https://pubmed.ncbi.nlm.nih.gov/35928046/)]

189. Soni H, Ivanova J, Wilczewski H, Bailey A, Ong T, Narma A, et al. Virtual conversational agents versus online forms: patient experience and preferences for health data collection. *Front Digit Health*. Oct 13, 2022;4:954069. [FREE Full text] [doi: [10.3389/fdgth.2022.954069](https://doi.org/10.3389/fdgth.2022.954069)] [Medline: [36310920](https://pubmed.ncbi.nlm.nih.gov/36310920/)]
190. Crovari P, Pidò S, Pinoli P, Bernasconi A, Canakoglu A, Garzotto F, et al. GeCoAgent: a conversational agent for empowering genomic data extraction and analysis. *ACM Trans Comput Healthc*. Oct 15, 2021;3(1):1-29. [doi: [10.1145/3464383](https://doi.org/10.1145/3464383)]
191. Dwyer T, Hoit G, Burns D, Higgins J, Chang J, Whelan D, et al. Use of an artificial intelligence conversational agent (Chatbot) for hip arthroscopy patients following surgery. *Arthrosc Sports Med Rehabil*. Apr 2023;5(2):e495-e505. [FREE Full text] [doi: [10.1016/j.asmr.2023.01.020](https://doi.org/10.1016/j.asmr.2023.01.020)] [Medline: [37101866](https://pubmed.ncbi.nlm.nih.gov/37101866/)]
192. Wilczewski H, Soni H, Ivanova J, Ong T, Barrera JF, Bunnell BE, et al. Older adults' experience with virtual conversational agents for health data collection. *Front Digit Health*. Mar 15, 2023;5:1125926. [FREE Full text] [doi: [10.3389/fdgth.2023.1125926](https://doi.org/10.3389/fdgth.2023.1125926)] [Medline: [37006821](https://pubmed.ncbi.nlm.nih.gov/37006821/)]
193. Montenegro JL, da Costa CA, Janssen LP. Evaluating the use of chatbot during pregnancy: a usability study. *Healthc Anal*. Nov 2022;2:100072. [doi: [10.1016/j.health.2022.100072](https://doi.org/10.1016/j.health.2022.100072)]
194. Ko SQ, Kumar SK, Jacob J, Hooi BM, Soo M, Nashi N, et al. Technology-enabled virtual ward for COVID management of the elderly and immunocompromised in Singapore: a descriptive cohort. *BMC Infect Dis*. Feb 21, 2023;23(1):102. [FREE Full text] [doi: [10.1186/s12879-023-08040-2](https://doi.org/10.1186/s12879-023-08040-2)] [Medline: [36809977](https://pubmed.ncbi.nlm.nih.gov/36809977/)]
195. Hsu MH, Chan TM, Yu CS. TermBot: a chatbot-based crossword game for gamified medical terminology learning. *Int J Environ Res Public Health*. Feb 26, 2023;20(5):4185. [FREE Full text] [doi: [10.3390/ijerph20054185](https://doi.org/10.3390/ijerph20054185)] [Medline: [36901193](https://pubmed.ncbi.nlm.nih.gov/36901193/)]
196. Epalte K, Tomsone S, Vētra A, Bērziņa G. Patient experience using digital therapy "Vigo" for stroke patient recovery: a qualitative descriptive study. *Disabil Rehabil Assist Technol*. Feb 06, 2023;18(2):175-184. [doi: [10.1080/17483107.2020.1839794](https://doi.org/10.1080/17483107.2020.1839794)] [Medline: [33155507](https://pubmed.ncbi.nlm.nih.gov/33155507/)]
197. Kobayashi T, Nishina Y, Tomoi H, Harada K, Tanaka K, Matsumoto E, et al. Corowa-kun: a messenger app chatbot delivers COVID-19 vaccine information, Japan 2021. *Vaccine*. Jul 30, 2022;40(32):4654-4662. [FREE Full text] [doi: [10.1016/j.vaccine.2022.06.007](https://doi.org/10.1016/j.vaccine.2022.06.007)] [Medline: [35750541](https://pubmed.ncbi.nlm.nih.gov/35750541/)]
198. Chin H, Lima G, Shin M, Zhunis A, Cha C, Choi J, et al. User-chatbot conversations during the COVID-19 pandemic: study based on topic modeling and sentiment analysis. *J Med Internet Res*. Jan 27, 2023;25:e40922. [FREE Full text] [doi: [10.2196/40922](https://doi.org/10.2196/40922)] [Medline: [36596214](https://pubmed.ncbi.nlm.nih.gov/36596214/)]
199. Albers N, Hizli B, Scheltinga BL, Meijer E, Brinkman WP. Setting physical activity goals with a virtual coach: vicarious experiences, personalization and acceptance. *J Med Syst*. Jan 30, 2023;47(1):15. [FREE Full text] [doi: [10.1007/s10916-022-01899-9](https://doi.org/10.1007/s10916-022-01899-9)] [Medline: [36710276](https://pubmed.ncbi.nlm.nih.gov/36710276/)]
200. Kaywan P, Ahmed K, Ibaida A, Miao Y, Gu B. Early detection of depression using a conversational AI bot: a non-clinical trial. *PLoS One*. Feb 3, 2023;18(2):e0279743. [FREE Full text] [doi: [10.1371/journal.pone.0279743](https://doi.org/10.1371/journal.pone.0279743)] [Medline: [36735701](https://pubmed.ncbi.nlm.nih.gov/36735701/)]
201. He Y, Yang L, Zhu X, Wu B, Zhang S, Qian C, et al. Mental health chatbot for young adults with depressive symptoms during the COVID-19 pandemic: single-blind, three-arm randomized controlled trial. *J Med Internet Res*. Nov 21, 2022;24(11):e40719. [FREE Full text] [doi: [10.2196/40719](https://doi.org/10.2196/40719)] [Medline: [36355633](https://pubmed.ncbi.nlm.nih.gov/36355633/)]
202. Castilla E, Escobar JJ, Villalonga C, Banos O. HIGEA: an intelligent conversational agent to detect caregiver burden. *Int J Environ Res Public Health*. Nov 30, 2022;19(23):16019. [FREE Full text] [doi: [10.3390/ijerph192316019](https://doi.org/10.3390/ijerph192316019)] [Medline: [36498092](https://pubmed.ncbi.nlm.nih.gov/36498092/)]
203. Chen T, Chen L, Li S, Du J, Su H, Jiang H, et al. Virtual digital psychotherapist app-based treatment in patients with methamphetamine use disorder (Echo-APP): single-arm pilot feasibility and efficacy study. *JMIR Mhealth Uhealth*. Jan 31, 2023;11:e40373. [FREE Full text] [doi: [10.2196/40373](https://doi.org/10.2196/40373)] [Medline: [36719727](https://pubmed.ncbi.nlm.nih.gov/36719727/)]
204. Dosovitsky G, Bunge E. Development of a chatbot for depression: adolescent perceptions and recommendations. *Child Adolesc Ment Health*. Feb 11, 2023;28(1):124-127. [doi: [10.1111/camh.12627](https://doi.org/10.1111/camh.12627)] [Medline: [36507594](https://pubmed.ncbi.nlm.nih.gov/36507594/)]
205. Montenegro JL, da Costa CA, da Rosa Righi R, Farias ER, Matté LB. Development and validation of conversational agent to pregnancy safe-education. *J Med Syst*. Jan 10, 2023;47(1):7. [doi: [10.1007/s10916-022-01903-2](https://doi.org/10.1007/s10916-022-01903-2)] [Medline: [36626106](https://pubmed.ncbi.nlm.nih.gov/36626106/)]
206. Ntinga X, Musiello F, Keter AK, Barnabas R, van Heerden A. The feasibility and acceptability of an mHealth conversational agent designed to support HIV self-testing in South Africa: cross-sectional study. *J Med Internet Res*. Dec 12, 2022;24(12):e39816. [FREE Full text] [doi: [10.2196/39816](https://doi.org/10.2196/39816)] [Medline: [36508248](https://pubmed.ncbi.nlm.nih.gov/36508248/)]
207. Rodriguez-Arrastia M, Martinez-Ortigosa A, Ruiz-Gonzalez C, Roperio-Padilla C, Roman P, Sanchez-Labraca N. Experiences and perceptions of final-year nursing students of using a chatbot in a simulated emergency situation: a qualitative study. *J Nurs Manag*. Nov 18, 2022;30(8):3874-3884. [FREE Full text] [doi: [10.1111/jonm.13630](https://doi.org/10.1111/jonm.13630)] [Medline: [35411629](https://pubmed.ncbi.nlm.nih.gov/35411629/)]
208. Han JW, Park J, Lee H. Analysis of the effect of an artificial intelligence chatbot educational program on non-face-to-face classes: a quasi-experimental study. *BMC Med Educ*. Dec 01, 2022;22(1):830. [FREE Full text] [doi: [10.1186/s12909-022-03898-3](https://doi.org/10.1186/s12909-022-03898-3)] [Medline: [36457086](https://pubmed.ncbi.nlm.nih.gov/36457086/)]
209. Singh E, Bompelli A, Wan R, Bian J, Pakhomov S, Zhang R. A conversational agent system for dietary supplements use. *BMC Med Inform Decis Mak*. Jul 07, 2022;22(Suppl 1):153. [FREE Full text] [doi: [10.1186/s12911-022-01888-5](https://doi.org/10.1186/s12911-022-01888-5)] [Medline: [35799177](https://pubmed.ncbi.nlm.nih.gov/35799177/)]

210. Andriani SP, Adhyanacarira P, Fuad A, Pertiwi AA. Comparison of non-AI and AI-enabled mHealth platforms for COVID-19 self screening in Indonesia. *Stud Health Technol Inform*. Jun 29, 2022;295:226-229. [doi: [10.3233/SHTI220703](https://doi.org/10.3233/SHTI220703)] [Medline: [35773849](https://pubmed.ncbi.nlm.nih.gov/35773849/)]
211. Olano-Espinosa E, Avila-Tomas JF, Minue-Lorenzo C, Matilla-Pardo B, Serrano ME, Martinez-Suberviola FJ, et al. Dejal@ Group. Effectiveness of a conversational chatbot (Dejal@bot) for the adult population to quit smoking: pragmatic, multicenter, controlled, randomized clinical trial in primary care. *JMIR Mhealth Uhealth*. Jun 27, 2022;10(6):e34273. [FREE Full text] [doi: [10.2196/34273](https://doi.org/10.2196/34273)] [Medline: [35759328](https://pubmed.ncbi.nlm.nih.gov/35759328/)]
212. Rizzato Lede DA, Inda D, Rosa JM, Zin Y, Tentoni N, Médici MM, et al. Tana, a healthcare chatbot to help patients during the COVID-19 pandemic at a university hospital in Argentina. *Stud Health Technol Inform*. Jun 06, 2022;290:301-303. [doi: [10.3233/SHTI220083](https://doi.org/10.3233/SHTI220083)] [Medline: [35673022](https://pubmed.ncbi.nlm.nih.gov/35673022/)]
213. Denecke K, Lombardo P, Nairz K. Digital medical interview assistant for radiology: opportunities and challenges. *Stud Health Technol Inform*. May 16, 2022;293:39-46. [FREE Full text] [doi: [10.3233/SHTI220345](https://doi.org/10.3233/SHTI220345)] [Medline: [35592958](https://pubmed.ncbi.nlm.nih.gov/35592958/)]
214. Ben-Shabat N, Sharvit G, Meimis B, Joya DB, Sloma A, Kiderman D, et al. Assessing data gathering of chatbot based symptom checkers - a clinical vignettes study. *Int J Med Inform*. Dec 2022;168:104897. [FREE Full text] [doi: [10.1016/j.ijmedinf.2022.104897](https://doi.org/10.1016/j.ijmedinf.2022.104897)] [Medline: [36306653](https://pubmed.ncbi.nlm.nih.gov/36306653/)]
215. Fitzsimmons-Craft EE, Chan WW, Smith AC, Firebaugh ML, Fowler LA, Topooco N, et al. Effectiveness of a chatbot for eating disorders prevention: a randomized clinical trial. *Int J Eat Disord*. Mar 28, 2022;55(3):343-353. [doi: [10.1002/eat.23662](https://doi.org/10.1002/eat.23662)] [Medline: [35274362](https://pubmed.ncbi.nlm.nih.gov/35274362/)]
216. Pithpornchaiyakul S, Naorungroj S, Pupong K, Hunsrisakhun J. Using a chatbot as an alternative approach for in-person toothbrushing training during the COVID-19 pandemic: comparative study. *J Med Internet Res*. Oct 21, 2022;24(10):e39218. [FREE Full text] [doi: [10.2196/39218](https://doi.org/10.2196/39218)] [Medline: [36179147](https://pubmed.ncbi.nlm.nih.gov/36179147/)]
217. Yang LW, Ng WY, Lei X, Tan SC, Wang Z, Yan M, et al. Development and testing of a multi-lingual natural language processing-based deep learning system in 10 languages for COVID-19 pandemic crisis: a multi-center study. *Front Public Health*. Feb 13, 2023;11:1063466. [FREE Full text] [doi: [10.3389/fpubh.2023.1063466](https://doi.org/10.3389/fpubh.2023.1063466)] [Medline: [36860378](https://pubmed.ncbi.nlm.nih.gov/36860378/)]
218. Suárez A, Adanero A, Díaz-Flores García V, Freire Y, Algar J. Using a virtual patient via an artificial intelligence chatbot to develop dental students' diagnostic skills. *Int J Environ Res Public Health*. Jul 18, 2022;19(14):8735. [FREE Full text] [doi: [10.3390/ijerph19148735](https://doi.org/10.3390/ijerph19148735)] [Medline: [35886584](https://pubmed.ncbi.nlm.nih.gov/35886584/)]
219. Ogawa M, Oyama G, Morito K, Kobayashi M, Yamada Y, Shinkawa K, et al. Can AI make people happy? The effect of AI-based chatbot on smile and speech in Parkinson's disease. *Parkinsonism Relat Disord*. Jun 2022;99:43-46. [FREE Full text] [doi: [10.1016/j.parkreldis.2022.04.018](https://doi.org/10.1016/j.parkreldis.2022.04.018)] [Medline: [35596975](https://pubmed.ncbi.nlm.nih.gov/35596975/)]
220. Vasileiou MV, Maglogiannis IG. The health chatbots in telemedicine: intelligent dialog system for remote support. *J Healthc Eng*. Oct 6, 2022;2022:1-12. [doi: [10.1155/2022/4876512](https://doi.org/10.1155/2022/4876512)]
221. Danieli M, Ciulli T, Mousavi SM, Silvestri G, Barbato S, Di Natale L, et al. Assessing the impact of conversational artificial intelligence in the treatment of stress and anxiety in aging adults: randomized controlled trial. *JMIR Ment Health*. Sep 23, 2022;9(9):e38067. [FREE Full text] [doi: [10.2196/38067](https://doi.org/10.2196/38067)] [Medline: [36149730](https://pubmed.ncbi.nlm.nih.gov/36149730/)]
222. Luk TT, Lui JH, Wang MP. Efficacy, usability, and acceptability of a chatbot for promoting COVID-19 vaccination in unvaccinated or booster-hesitant young adults: pre-post pilot study. *J Med Internet Res*. Oct 04, 2022;24(10):e39063. [FREE Full text] [doi: [10.2196/39063](https://doi.org/10.2196/39063)] [Medline: [36179132](https://pubmed.ncbi.nlm.nih.gov/36179132/)]
223. Martinengo L, Lum E, Car J. Evaluation of chatbot-delivered interventions for self-management of depression: content analysis. *J Affect Disord*. Dec 15, 2022;319:598-607. [doi: [10.1016/j.jad.2022.09.028](https://doi.org/10.1016/j.jad.2022.09.028)] [Medline: [36150405](https://pubmed.ncbi.nlm.nih.gov/36150405/)]
224. Shah J, DePietro B, D'Adamo L, Firebaugh ML, Laing O, Fowler LA, et al. Development and usability testing of a chatbot to promote mental health services use among individuals with eating disorders following screening. *Int J Eat Disord*. Sep 18, 2022;55(9):1229-1244. [FREE Full text] [doi: [10.1002/eat.23798](https://doi.org/10.1002/eat.23798)] [Medline: [36056648](https://pubmed.ncbi.nlm.nih.gov/36056648/)]
225. De Marchi F, Serio M, Collo A, Belotti EG, Alloati F, Biroli G, et al. A telehealth intervention for nutritional counseling in amyotrophic lateral sclerosis patients. *J Clin Med*. Jul 23, 2022;11(15):4286. [FREE Full text] [doi: [10.3390/jcm11154286](https://doi.org/10.3390/jcm11154286)] [Medline: [35893377](https://pubmed.ncbi.nlm.nih.gov/35893377/)]
226. Rabinowitz AR, Collier G, Vaccaro M, Wingfield R. Development of RehaBot-a conversational agent for promoting rewarding activities in users with traumatic brain injury. *J Head Trauma Rehabil*. 2022;37(3):144-151. [doi: [10.1097/HTR.0000000000000770](https://doi.org/10.1097/HTR.0000000000000770)] [Medline: [35293365](https://pubmed.ncbi.nlm.nih.gov/35293365/)]
227. Alturaiki AM, Banjar HR, Barefah AS, Alnajjar SA, Hindawi S. A smart chatbot for interactive management in beta thalassemia patients. *Int J Telemed Appl*. May 11, 2022;2022:9734518-9734513. [FREE Full text] [doi: [10.1155/2022/9734518](https://doi.org/10.1155/2022/9734518)] [Medline: [35601050](https://pubmed.ncbi.nlm.nih.gov/35601050/)]
228. Terblanche N, Molyn J, de Haan E, Nilsson VO. Comparing artificial intelligence and human coaching goal attainment efficacy. *PLoS One*. Jun 21, 2022;17(6):e0270255. [FREE Full text] [doi: [10.1371/journal.pone.0270255](https://doi.org/10.1371/journal.pone.0270255)] [Medline: [35727801](https://pubmed.ncbi.nlm.nih.gov/35727801/)]
229. Nam KH, Kim DY, Kim DH, Lee JH, Lee JI, Kim MJ, et al. Conversational artificial intelligence for spinal pain questionnaire: validation and user satisfaction. *Neurospine*. Jun 2022;19(2):348-356. [FREE Full text] [doi: [10.14245/ns.2143080.540](https://doi.org/10.14245/ns.2143080.540)] [Medline: [35577340](https://pubmed.ncbi.nlm.nih.gov/35577340/)]

230. Nißen M, Rüegger D, Stieger M, Flückiger C, Allemann M, V Wangenheim F, et al. The effects of health care chatbot personas with different social roles on the client-chatbot bond and usage intentions: development of a design codebook and web-based study. *J Med Internet Res*. Apr 27, 2022;24(4):e32630. [FREE Full text] [doi: [10.2196/32630](https://doi.org/10.2196/32630)] [Medline: [35475761](https://pubmed.ncbi.nlm.nih.gov/35475761/)]
231. Larbi D, Denecke K, Gabarron E. Usability testing of a social media chatbot for increasing physical activity behavior. *J Pers Med*. May 20, 2022;12(5):828. [FREE Full text] [doi: [10.3390/jpm12050828](https://doi.org/10.3390/jpm12050828)] [Medline: [35629252](https://pubmed.ncbi.nlm.nih.gov/35629252/)]
232. Ritchie JB, Frey LJ, Lamy JB, Bellcross C, Morrison H, Schiffman JD, et al. Automated clinical practice guideline recommendations for hereditary cancer risk using chatbots and ontologies: system description. *JMIR Cancer*. Jan 31, 2022;8(1):e29289. [FREE Full text] [doi: [10.2196/29289](https://doi.org/10.2196/29289)] [Medline: [35099392](https://pubmed.ncbi.nlm.nih.gov/35099392/)]
233. Hope DL, Grant GD, Rogers GD, King MA. Virtualized gamified pharmacy simulation during COVID-19. *Pharmacy (Basel)*. Mar 26, 2022;10(2):41. [FREE Full text] [doi: [10.3390/pharmacy10020041](https://doi.org/10.3390/pharmacy10020041)] [Medline: [35448700](https://pubmed.ncbi.nlm.nih.gov/35448700/)]
234. Munsch N, Guarin S, Nateqi J, Lutz T, Binder M, Aberle JH, et al. Symptoms associated with a COVID-19 infection among a non-hospitalized cohort in Vienna. *Wien Klin Wochenschr*. May 13, 2022;134(9-10):344-350. [FREE Full text] [doi: [10.1007/s00508-022-02028-9](https://doi.org/10.1007/s00508-022-02028-9)] [Medline: [35416543](https://pubmed.ncbi.nlm.nih.gov/35416543/)]
235. Minutolo A, Damiano E, De Pietro G, Fujita H, Esposito M. A conversational agent for querying Italian patient information leaflets and improving health literacy. *Comput Biol Med*. Feb 2022;141:105004. [doi: [10.1016/j.combiomed.2021.105004](https://doi.org/10.1016/j.combiomed.2021.105004)] [Medline: [34774337](https://pubmed.ncbi.nlm.nih.gov/34774337/)]
236. Hurmuz MZ, Jansen-Kosterink SM, Beinema T, Fischer K, Op den Akker H, Hermens HJ. Evaluation of a virtual coaching system eHealth intervention: a mixed methods observational cohort study in the Netherlands. *Internet Interv*. Mar 2022;27:100501. [FREE Full text] [doi: [10.1016/j.invent.2022.100501](https://doi.org/10.1016/j.invent.2022.100501)] [Medline: [35198411](https://pubmed.ncbi.nlm.nih.gov/35198411/)]
237. Beinema T, Op den Akker H, Hurmuz M, Jansen-Kosterink S, Hermens H. Automatic topic selection for long-term interaction with embodied conversational agents in health coaching: a micro-randomized trial. *Internet Interv*. Mar 2022;27:100502. [FREE Full text] [doi: [10.1016/j.invent.2022.100502](https://doi.org/10.1016/j.invent.2022.100502)] [Medline: [35198412](https://pubmed.ncbi.nlm.nih.gov/35198412/)]
238. Liu H, Peng H, Song X, Xu C, Zhang M. Using AI chatbots to provide self-help depression interventions for university students: a randomized trial of effectiveness. *Internet Interv*. Mar 2022;27:100495. [FREE Full text] [doi: [10.1016/j.invent.2022.100495](https://doi.org/10.1016/j.invent.2022.100495)] [Medline: [35059305](https://pubmed.ncbi.nlm.nih.gov/35059305/)]
239. Morgan KM, Hamilton JG, Symecko H, Kamara D, Jenkins C, Lester J, et al. Targeted BRCA1/2 population screening among Ashkenazi Jewish individuals using a web-enabled medical model: an observational cohort study. *Genet Med*. Mar 2022;24(3):564-575. [FREE Full text] [doi: [10.1016/j.gim.2021.10.016](https://doi.org/10.1016/j.gim.2021.10.016)] [Medline: [34906490](https://pubmed.ncbi.nlm.nih.gov/34906490/)]
240. Dhinakaran DA, Martinengo L, Ho MH, Joty S, Kowatsch T, Atun R, et al. Designing, developing, evaluating, and implementing a smartphone-delivered, rule-based conversational agent (DISCOVER): development of a conceptual framework. *JMIR Mhealth Uhealth*. Oct 04, 2022;10(10):e38740. [FREE Full text] [doi: [10.2196/38740](https://doi.org/10.2196/38740)] [Medline: [36194462](https://pubmed.ncbi.nlm.nih.gov/36194462/)]
241. Schmidlen T, Jones CL, Campbell-Salome G, McCormick CZ, Vanenkevort E, Sturm AC. Use of a chatbot to increase uptake of cascade genetic testing. *J Genet Couns*. Oct 26, 2022;31(5):1219-1230. [doi: [10.1002/jgc4.1592](https://doi.org/10.1002/jgc4.1592)] [Medline: [35616645](https://pubmed.ncbi.nlm.nih.gov/35616645/)]
242. Wang WT, Tan N, Hanson JA, Crubaugh CA, Hara AK. Initial experience with a COVID-19 screening chatbot before radiology appointments. *J Digit Imaging*. Oct 13, 2022;35(5):1303-1307. [FREE Full text] [doi: [10.1007/s10278-022-00650-7](https://doi.org/10.1007/s10278-022-00650-7)] [Medline: [35562634](https://pubmed.ncbi.nlm.nih.gov/35562634/)]
243. Rathnayaka P, Mills N, Burnett D, De Silva D, Alahakoon D, Gray R. A mental health chatbot with cognitive skills for personalised behavioural activation and remote health monitoring. *Sensors (Basel)*. May 11, 2022;22(10):3653. [FREE Full text] [doi: [10.3390/s22103653](https://doi.org/10.3390/s22103653)] [Medline: [35632061](https://pubmed.ncbi.nlm.nih.gov/35632061/)]
244. Miura C, Chen S, Saiki S, Nakamura M, Yasuda K. Assisting personalized healthcare of elderly people: developing a rule-based virtual caregiver system using mobile chatbot. *Sensors (Basel)*. May 18, 2022;22(10):3829. [FREE Full text] [doi: [10.3390/s22103829](https://doi.org/10.3390/s22103829)] [Medline: [35632238](https://pubmed.ncbi.nlm.nih.gov/35632238/)]
245. Asensio-Cuesta S, Blanes-Selva V, Conejero A, Portolés M, García-Gómez M. A user-centered chatbot to identify and interconnect individual, social and environmental risk factors related to overweight and obesity. *Inform Health Soc Care*. Jan 02, 2022;47(1):38-52. [doi: [10.1080/17538157.2021.1923501](https://doi.org/10.1080/17538157.2021.1923501)] [Medline: [34032537](https://pubmed.ncbi.nlm.nih.gov/34032537/)]
246. Braveman P. Health disparities and health equity: concepts and measurement. *Annu Rev Public Health*. Apr 01, 2006;27(1):167-194. [doi: [10.1146/annurev.publhealth.27.021405.102103](https://doi.org/10.1146/annurev.publhealth.27.021405.102103)] [Medline: [16533114](https://pubmed.ncbi.nlm.nih.gov/16533114/)]
247. Epstein RM, Street RL. The values and value of patient-centered care. *Ann Fam Med*. Mar 14, 2011;9(2):100-103. [FREE Full text] [doi: [10.1370/afm.1239](https://doi.org/10.1370/afm.1239)] [Medline: [21403134](https://pubmed.ncbi.nlm.nih.gov/21403134/)]
248. Shaller D. Patient-centered care: what does it take? The Commonwealth Fund. 2007. URL: <https://www.commonwealthfund.org/publications/fund-reports/2007/oct/patient-centered-care-what-does-it-take> [accessed 2024-04-29]
249. Efficient definition and meaning. Merriam-Webster. 2022. URL: <https://www.merriam-webster.com/dictionary/efficient> [accessed 2024-04-29]
250. The world by income and region. The World Bank. 2022. URL: <https://datatopics.worldbank.org/world-development-indicators/the-world-by-income-and-region.html> [accessed 2024-04-29]
251. Primary health care. World Health Organization. URL: <https://www.who.int/health-topics/primary-health-care> [accessed 2024-04-29]

252. Frangoudes F, Hadjjaros M, Schiza EC, Matsangidou M, Tsivitanidou O, Neokleous K. An overview of the use of chatbots in medical and healthcare education. In: Proceedings of 8th International Conference, LCT 2021, Held as Part of the 23rd HCI International Conference, HCII 2021 on Learning and Collaboration Technologies: Games and Virtual Environments for Learning. 2021. Presented at: HCII '22; July 24-29, 2021:170-184; Virtual Event. URL: https://link.springer.com/chapter/10.1007/978-3-030-77943-6_11 [doi: [10.1007/978-3-030-77943-6_11](https://doi.org/10.1007/978-3-030-77943-6_11)] [doi: [10.1007/978-3-030-77943-6_11](https://doi.org/10.1007/978-3-030-77943-6_11)]
253. Thakre K, Rothe PR, Kukade S, Shinde P, Madame K. Health care chatbot using NLP and flask. *Ijaset Int J Res Appl Sci Eng Technol*. May 31, 2022;10(5):2632-2654. [doi: [10.22214/ijaset.2022.42854](https://doi.org/10.22214/ijaset.2022.42854)]
254. Sheth A, Yip HY, Shekarpour S. Extending patient-chatbot experience with internet-of-things and background knowledge: case studies with healthcare applications. *IEEE Intell Syst*. Jul 1, 2019;34(4):24-30. [FREE Full text] [doi: [10.1109/mis.2019.2905748](https://doi.org/10.1109/mis.2019.2905748)] [Medline: [34690576](https://pubmed.ncbi.nlm.nih.gov/34690576/)]
255. Roca S, Sancho J, García J, Alesanco Á. Microservice chatbot architecture for chronic patient support. *J Biomed Inform*. Feb 2020;102:103305. [FREE Full text] [doi: [10.1016/j.jbi.2019.103305](https://doi.org/10.1016/j.jbi.2019.103305)] [Medline: [31622802](https://pubmed.ncbi.nlm.nih.gov/31622802/)]
256. Vryoni V, Bailey S. Chatbots in healthcare: connecting patients to information: emerging health technologies. Canadian Agency for Drugs and Technologies in Health. 2024. URL: <https://www.ncbi.nlm.nih.gov/books/NBK602381/> [accessed 2024-04-29]
257. Jadczyk T, Wojakowski W, Tendera M, Henry TD, Egnaczyk G, Shreenivas S. Artificial intelligence can improve patient management at the time of a pandemic: the role of voice technology. *J Med Internet Res*. May 25, 2021;23(5):e22959. [FREE Full text] [doi: [10.2196/22959](https://doi.org/10.2196/22959)] [Medline: [33999834](https://pubmed.ncbi.nlm.nih.gov/33999834/)]
258. Fadhil A. Beyond patient monitoring: conversational agents role in telemedicine and healthcare support for home-living elderly individuals. *arXiv*. Preprint posted online March 3, 2018. [FREE Full text]
259. Bidve V, Virkar A, Raut P, Velapurkar S. NOVA-a virtual nursing assistant. *Indones J Electr Eng Comput Sci*. Apr 01, 2023;30(1):307-315. [doi: [10.11591/ijeecs.v30.i1.pp307-315](https://doi.org/10.11591/ijeecs.v30.i1.pp307-315)]
260. Stone P, Brooks R, Brynjolfsson E, Calo R, Etzioni O, Hager G, et al. Artificial intelligence and life in 2030: the one hundred year study on artificial intelligence. *arXiv*. Preprint posted online October 31, 2022. [FREE Full text] [doi: [10.48550/arXiv.2211.06318](https://doi.org/10.48550/arXiv.2211.06318)]
261. Nishida T, Nakazawa A, Ohmoto Y, Mohammad Y. Conversational Informatics: A Data-Intensive Approach with Emphasis on Nonverbal Communication. Cham, Switzerland. Springer; 2014.
262. Wolters MK, Kelly F, Kilgour J. Designing a spoken dialogue interface to an intelligent cognitive assistant for people with dementia. *Health Informatics J*. Dec 26, 2016;22(4):854-866. [FREE Full text] [doi: [10.1177/1460458215593329](https://doi.org/10.1177/1460458215593329)] [Medline: [26276794](https://pubmed.ncbi.nlm.nih.gov/26276794/)]
263. Tzelios C, Contreras C, Istenes B, Astupillo A, Lecca L, Ramos K, et al. Using digital chatbots to close gaps in healthcare access during the COVID-19 pandemic. *Public Health Action*. Dec 21, 2022;12(4):180-185. [FREE Full text] [doi: [10.5588/pha.22.0046](https://doi.org/10.5588/pha.22.0046)] [Medline: [36561900](https://pubmed.ncbi.nlm.nih.gov/36561900/)]
264. Vijayarani M, Balamurugan G. Chatbot in mental health care. *Indian J Psychiatry Nurse*. 2019;16(2):126-128. [doi: [10.4103/iopn.iopn_34_19](https://doi.org/10.4103/iopn.iopn_34_19)]
265. Peng ML, Wickersham JA, Altice FL, Shrestha R, Azwa I, Zhou X, et al. Formative evaluation of the acceptance of HIV prevention artificial intelligence chatbots by men who have sex with men in Malaysia: focus group study. *JMIR Form Res*. Oct 06, 2022;6(10):e42055. [FREE Full text] [doi: [10.2196/42055](https://doi.org/10.2196/42055)] [Medline: [36201390](https://pubmed.ncbi.nlm.nih.gov/36201390/)]
266. Koulouri T, Macredie RD, Olakitan D. Chatbots to support young adults' mental health: an exploratory study of acceptability. *ACM Trans Interact Intell Syst*. Jul 20, 2022;12(2):1-39. [doi: [10.1145/3485874](https://doi.org/10.1145/3485874)]
267. Ahmed A, Hassan A, Aziz S, Abd-Alrazaq AA, Ali N, Alzubaidi M, et al. Chatbot features for anxiety and depression: a scoping review. *Health Informatics J*. Jan 24, 2023;29(1):14604582221146719. [FREE Full text] [doi: [10.1177/14604582221146719](https://doi.org/10.1177/14604582221146719)] [Medline: [36693014](https://pubmed.ncbi.nlm.nih.gov/36693014/)]
268. Mehta A, Virkar S, Khatri J, Thakur R, Dalvi A. Artificial intelligence powered chatbot for mental healthcare based on sentiment analysis. In: Proceedings of the 2022 5th International Conference on Advances in Science and Technology. 2022. Presented at: ICAST '22; December 2-3, 2022:185-189; Mumbai, India. URL: <https://ieeexplore.ieee.org/document/10039548> [doi: [10.1109/icast55766.2022.10039548](https://doi.org/10.1109/icast55766.2022.10039548)]
269. Lucas GM, Gratch J, King A, Morency LP. It's only a computer: virtual humans increase willingness to disclose. *Comput Human Behav*. Aug 2014;37:94-100. [doi: [10.1016/j.chb.2014.04.043](https://doi.org/10.1016/j.chb.2014.04.043)]
270. Trost MJ, Chrysilla G, Gold JJ, Matarić M. Socially-assistive robots using empathy to reduce pain and distress during peripheral IV placement in children. *Pain Res Manag*. Apr 09, 2020;2020:7935215-7935217. [FREE Full text] [doi: [10.1155/2020/7935215](https://doi.org/10.1155/2020/7935215)] [Medline: [32351642](https://pubmed.ncbi.nlm.nih.gov/32351642/)]
271. Suzuki Y, Galli L, Ikeda A, Itakura S, Kitazaki M. Measuring empathy for human and robot hand pain using electroencephalography. *Sci Rep*. Nov 03, 2015;5:15924. [doi: [10.1038/srep15924](https://doi.org/10.1038/srep15924)] [Medline: [26525705](https://pubmed.ncbi.nlm.nih.gov/26525705/)]
272. Chita-Tegmark M, Ackerman JM, Scheutz M. Effects of assistive robot behavior on impressions of patient psychological attributes: vignette-based human-robot interaction study. *J Med Internet Res*. May 19, 2019;21(6):e13729. [FREE Full text] [doi: [10.2196/13729](https://doi.org/10.2196/13729)] [Medline: [31199297](https://pubmed.ncbi.nlm.nih.gov/31199297/)]
273. Bulla C, Parushetti C, Teli A, Aski S, Koppad S. A review of AI based medical assistant chatbot: research and applications of web development and design. *Res Appl Web Develop Des*. 2020;3(2):1-4. [FREE Full text]

274. Liu B, Sundar SS. Should machines express sympathy and empathy? Experiments with a health advice chatbot. *Cyberpsychol Behav Soc Netw*. Oct 2018;21(10):625-636. [doi: [10.1089/cyber.2018.0110](https://doi.org/10.1089/cyber.2018.0110)] [Medline: [30334655](https://pubmed.ncbi.nlm.nih.gov/30334655/)]
275. Kao CH, Chen CC, Tsai YT. Model of multi-turn dialogue in emotional chatbot. In: *Proceedings of the 2019 International Conference on Technologies and Applications of Artificial Intelligence*. 2019. Presented at: TAAI '19; November 21-23, 2019:1-5; Kaohsiung, Taiwan. URL: <https://ieeexplore.ieee.org/document/8959855> [doi: [10.1109/taai48200.2019.8959855](https://doi.org/10.1109/taai48200.2019.8959855)]
276. Purushotham K, Priya KS, Jayasree K, Sekhar GS, Jaswanth N, Kumar KK. Automated conversation chatbot for multiple languages for hospitals. *Int J Adv Res Sci Commun Technol*. Jan 10, 2023;3(1):209-217. [FREE Full text] [doi: [10.48175/ijarsct-7859](https://doi.org/10.48175/ijarsct-7859)]
277. Hernández-Neuta I, Neumann F, Brightmeyer J, Ba Tis T, Madaboosi N, Wei Q, et al. Smartphone-based clinical diagnostics: towards democratization of evidence-based health care. *J Intern Med*. Jan 12, 2019;285(1):19-39. [FREE Full text] [doi: [10.1111/joim.12820](https://doi.org/10.1111/joim.12820)] [Medline: [30079527](https://pubmed.ncbi.nlm.nih.gov/30079527/)]
278. Iancu I, Iancu B. Interacting with chatbots later in life: a technology acceptance perspective in COVID-19 pandemic situation. *Front Psychol*. Jan 16, 2022;13:1111003. [FREE Full text] [doi: [10.3389/fpsyg.2022.1111003](https://doi.org/10.3389/fpsyg.2022.1111003)] [Medline: [36726494](https://pubmed.ncbi.nlm.nih.gov/36726494/)]
279. Jiang F, Jiang Y, Zhi H, Dong Y, Li H, Ma S, et al. Artificial intelligence in healthcare: past, present and future. *Stroke Vasc Neurol*. Dec 21, 2017;2(4):230-243. [FREE Full text] [doi: [10.1136/svn-2017-000101](https://doi.org/10.1136/svn-2017-000101)] [Medline: [29507784](https://pubmed.ncbi.nlm.nih.gov/29507784/)]
280. Brown JE, Halpern J. AI chatbots cannot replace human interactions in the pursuit of more inclusive mental healthcare. *SSM Mental Health*. Dec 2021;1:100017. [doi: [10.1016/j.ssmmh.2021.100017](https://doi.org/10.1016/j.ssmmh.2021.100017)]
281. Whitby B. The ethical implications of non-human agency in health care. In: *Proceedings of the 2014 Machine Ethics in the Context of Medical and Care Agents*. 2014. Presented at: MEMCA '14; April 1-4, 2014:1-4; London, UK. URL: <https://doc.gold.ac.uk/aisb50/AISB50-S17/AISB50-S17-Whitby-Paper.pdf>
282. Chaix B, Guillemassé A, Nectoux P, Delamon G, Brouard B. Vik: a chatbot to support patients with chronic diseases. *Health*. 2020;12(07):804-810. [doi: [10.4236/health.2020.127058](https://doi.org/10.4236/health.2020.127058)]
283. Srilakshmi V, Prathima V. Disease prediction and diagnosis using machine learning. *Int J Res Appl Sci Eng Technol*. Jul 31, 2022;10(7):1594-1597. [doi: [10.22214/ijraset.2022.45450](https://doi.org/10.22214/ijraset.2022.45450)]
284. Jovanovic M, Baez M, Casati F. Chatbots as conversational healthcare services. *IEEE Internet Comput*. May 2021;25(3):44-51. [doi: [10.1109/mic.2020.3037151](https://doi.org/10.1109/mic.2020.3037151)]
285. Murtarelli G, Gregory A, Romenti S. A conversation-based perspective for shaping ethical human-machine interactions: the particular challenge of chatbots. *J Bus Res*. May 2021;129:927-935. [doi: [10.1016/j.jbusres.2020.09.018](https://doi.org/10.1016/j.jbusres.2020.09.018)]
286. Følstad A, Araujo T, Law EL, Brandtzaeg PB, Papadopoulos S, Reis L, et al. Future directions for chatbot research: an interdisciplinary research agenda. *Computing*. Oct 19, 2021;103(12):2915-2942. [doi: [10.1007/s00607-021-01016-7](https://doi.org/10.1007/s00607-021-01016-7)]
287. Cameron G, Cameron D, Megaw G, Bond RR, Mulvenna MD, O'Neill S, et al. Best practices for designing chatbots in mental healthcare: a case study on iHelp. In: *Proceedings of the 32nd International BCS Human Computer Interaction Conference*. 2018. Presented at: HCI '18; July 4-6, 2018:1-5; Belfast, UK. URL: <https://dl.acm.org/doi/10.14236/ewic/HCI2018.129> [doi: [10.14236/ewic/hci2018.129](https://doi.org/10.14236/ewic/hci2018.129)]
288. Stiefel S. 'The chatbot will see you now': mental health confidentiality concerns in software therapy. *SSRN Journal*. Preprint posted online July 19, 2018. [FREE Full text] [doi: [10.2139/ssrn.3166640](https://doi.org/10.2139/ssrn.3166640)]
289. Watt A, Cameron A, Sturm L, Lathlean T, Babidge W, Blamey S, et al. Rapid versus full systematic reviews: validity in clinical practice? *ANZ J Surg*. Nov 21, 2008;78(11):1037-1040. [doi: [10.1111/j.1445-2197.2008.04730.x](https://doi.org/10.1111/j.1445-2197.2008.04730.x)] [Medline: [18959712](https://pubmed.ncbi.nlm.nih.gov/18959712/)]
290. Kandpal P, Jasnani K, Raut R, Bhorge S. Contextual chatbot for healthcare purposes (using deep learning). In: *Proceedings of the 2020 4th World Conference on Smart Trends in Systems, Security and Sustainability*. 2020. Presented at: WorldS4 '20; July 27-28, 2020:625-634; London, UK. URL: <https://ieeexplore.ieee.org/document/9210351> [doi: [10.1109/worlds450073.2020.9210351](https://doi.org/10.1109/worlds450073.2020.9210351)]
291. Pernencar C, Saboia I, Dias JC. How far can conversational agents contribute to IBD patient health care-a review of the literature. *Front Public Health*. Jun 30, 2022;10:862432. [FREE Full text] [doi: [10.3389/fpubh.2022.862432](https://doi.org/10.3389/fpubh.2022.862432)] [Medline: [35844879](https://pubmed.ncbi.nlm.nih.gov/35844879/)]
292. Ramsetty A, Adams C. Impact of the digital divide in the age of COVID-19. *J Am Med Inform Assoc*. Jul 01, 2020;27(7):1147-1148. [FREE Full text] [doi: [10.1093/jamia/ocaa078](https://doi.org/10.1093/jamia/ocaa078)] [Medline: [32343813](https://pubmed.ncbi.nlm.nih.gov/32343813/)]
293. Lorence DP, Park H, Fox S. Racial disparities in health information access: resilience of the Digital Divide. *J Med Syst*. Aug 7, 2006;30(4):241-249. [doi: [10.1007/s10916-005-9003-y](https://doi.org/10.1007/s10916-005-9003-y)] [Medline: [16978003](https://pubmed.ncbi.nlm.nih.gov/16978003/)]
294. Cornejo Müller A, Wachtler B, Lampert T. Digital divide-social inequalities in the utilisation of digital healthcare. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz*. Feb 08, 2020;63(2):185-191. [FREE Full text] [doi: [10.1007/s00103-019-03081-y](https://doi.org/10.1007/s00103-019-03081-y)] [Medline: [31915863](https://pubmed.ncbi.nlm.nih.gov/31915863/)]
295. Tett G. When algorithms reinforce inequality. *Financial Times*. 2018. URL: <https://www.ft.com/content/fb583548-0b93-11e8-839d-41ca06376bf2> [accessed 2024-04-29]
296. Fiske A, Henningsen P, Buyx A. Your robot therapist will see you now: ethical implications of embodied artificial intelligence in psychiatry, psychology, and psychotherapy. *J Med Internet Res*. May 09, 2019;21(5):e13216. [FREE Full text] [doi: [10.2196/13216](https://doi.org/10.2196/13216)] [Medline: [31094356](https://pubmed.ncbi.nlm.nih.gov/31094356/)]

297. Kim HW, Kankanhalli A. Investigating user resistance to information systems implementation: a status quo bias perspective. *MIS Q.* 2009;33(3):567-582. [doi: [10.2307/20650309](https://doi.org/10.2307/20650309)]
298. Best L, Stevens A, Colin-Jones D. Rapid and responsive health technology assessment: the development and evaluation process in the South and West region of England. *J Clin Eff.* 1997;2(2):51-56. [doi: [10.1108/eb020865](https://doi.org/10.1108/eb020865)]
299. Gravel J, D'Amours-Gravel M, Osmanliu E. Learning to fake it: limited responses and fabricated references provided by ChatGPT for medical questions. *Mayo Clin Proc Digit Health.* Sep 2023;1(3):226-234. [FREE Full text] [doi: [10.1016/j.mcpdig.2023.05.004](https://doi.org/10.1016/j.mcpdig.2023.05.004)]

Abbreviations

AI: artificial intelligence

LLM: large language model

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

Edited by Yu-Hsuan Lin; submitted 02.02.24; peer-reviewed by J Xie, R Forsyth; comments to author 18.03.24; revised version received 07.04.24; accepted 12.04.24; published 23.07.24

Please cite as:

Laymouna M, Ma Y, Lessard D, Schuster T, Engler K, Lebouché B

Roles, Users, Benefits, and Limitations of Chatbots in Health Care: Rapid Review

J Med Internet Res 2024;26:e56930

URL: <https://www.jmir.org/2024/1/e56930>

doi: [10.2196/56930](https://doi.org/10.2196/56930)

PMID:

©Moustafa Laymouna, Yuanchao Ma, David Lessard, Tibor Schuster, Kim Engler, Bertrand Lebouché. Originally published in the Journal of Medical Internet Research (<https://www.jmir.org>), 23.07.2024. This is an open-access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in the Journal of Medical Internet Research (ISSN 1438-8871), is properly cited. The complete bibliographic information, a link to the original publication on <https://www.jmir.org/>, as well as this copyright and license information must be included.