Review Article Open Access

Archives Of Breast Cancer

DOI: 10.32768/abc.2958670413-529

The Role of Artificial Intelligence in Breast Cancer Patient Education: A Scoping Review

Maria Kurnyata Rante Kada[a], Saldy Yusuf*[b], Hasniati Haeruddin[a,c], Selviana Anwar[d], Eka Suprapti[c,e]

[a]STIKES Panakkukang, Makassar, Indonesia

[b]Faculty of Nursing, Hasanuddin University, Makassar, Indonesia

[c]Doctoral Program, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia

[d]Magister Program, Faculty of Nursing, Hasanuddin University, Makassar, Indonesia

[e]Kurnia Jaya Persada University, Palopo, Indonesia

ARTICLE INFO

Received:
20 May 2025
Revised:
21 June 2025
Accepted:
19 July 2025

Keywords:
artificial intelligence, education, breast neoplasm, scoping review

ABSTRACT

Background: Breast cancer is one of the most common cancers worldwide. Effective patient education is essential to improve understanding of diagnosis, treatment options, and self-care. Advances in artificial intelligence (AI), particularly large language models (LLMs) such as ChatGPT, offer opportunities to deliver interactive, personalized health education.

Methods: This study used a scoping review approach guided by the Arksey and O'Malley framework and Joanna Briggs Institute recommendations and is reported in accordance with the PRISMA-ScR checklist. Literature searches were conducted in PubMed, ProQuest, and Scopus for full-text, English-language articles published between January 2020 and July 2025. The PRISMA flowchart was used to document study selection.

Results: Fourteen studies met the inclusion criteria, involving patients with breast cancer at different stages, women in screening programs, and expert evaluators. Eight studies directly included patients, totaling 3417 participants. Interventions comprised chatbots/LLMs, messaging platforms, and QR code modules. Most studies showed improvements in knowledge, comprehension, and satisfaction. Randomized controlled trials demonstrated gains in knowledge, reduced chemotherapy side effects, better self-care, and lower preoperative anxiety, though some effects varied by subgroup. Additional findings reported enhanced readability of medical information and moderate to high accuracy of AI responses, with variability underscoring the need for clinical oversight.

Conclusion: AI-based technologies are promising for breast cancer education by improving understanding, reducing anxiety, and supporting self-care. Successful implementation requires clinical oversight, inclusivity, and adherence to evidence-based standards.

INTRODUCTION

Breast cancer is one of the most common types of cancer among women worldwide.[1] According to the latest report from GLOBOCAN 2022, breast cancer is the second most frequently diagnosed cancer globally, following lung cancer. It accounts for 11.6%

***Address for correspondence:**
Saldy Yusuf., PhD,
Faculty of Nursing, Hasanuddin University, Makassar, Indonesia
Email: saldy_yusuf@yahoo.com

of all new cancer cases and ranks as the fourth leading cause of cancer-related death, contributing to 666 000 deaths (6.9% of all cancer deaths).[2] Variations in breast cancer incidence and mortality across different regions of the world reflect differences in risk factors, access to health care services, and public awareness regarding early detection and treatment.[3] Early diagnosis and a comprehensive understanding of the disease can significantly improve recovery prospects and enhance patients' quality of life.[4] However, many patients struggle to comprehend complex medical information, including their diagnosis, treatment options, and the potential side effects of therapy.[5,6] Limited access to accurate information and a lack of adequate education remain substantial barriers in disease management.[7] In response to these challenges, advancements in technology have introduced artificial intelligence (AI) as a potential source of accessible and reliable health information.

Patient education for individuals diagnosed with breast cancer plays a vital role in enhancing their understanding of the disease, treatment pathways, and effective coping strategies. Through appropriate educational interventions, patients can better comprehend their diagnosis, available therapeutic options, potential treatment side effects, and the importance of self-care and social support.[8] Nevertheless, several challenges hinder the implementation of effective educational programs for patients with breast cancer. One major issue is low health literacy, which can make it difficult for patients to grasp medical information provided by health care professionals.[9] Additional challenges include limited time available for providers to deliver education, a scarcity of easily understandable educational materials, and disparities in access to reliable health information, particularly in areas with limited medical infrastructure.[10] Therefore, more effective and innovative educational strategies are needed. These may include multimedia-based approaches, digital health applications, and the empowerment of peer support groups to improve patient understanding.[11] Peer support has been shown to help the transition of patients with breast cancer from maladaptive psychological responses, such as denial and depression, toward more adaptive responses, such as acceptance and resilience.[12] With continued technological advances, AI is being increasingly used as an interactive and accessible source of health information for patients with breast cancer.

Artificial intelligence has evolved rapidly across multiple sectors, including health care.[13] The integration of AI in the health care sector offers new opportunities for enhancing patient education.[14] Applications of AI in health care are diverse, including image analysis, automated diagnosis, intelligent pharmaceutical systems, and personalized medicine.[15] Furthermore, AI has demonstrated its potential to transform service delivery, diagnostic processes, and decision-making in treatment planning.[16] AI aims to achieve 4 primary objectives: improving patient health and well-being, expanding access to health care services, increasing cost-effectiveness, and enhancing the quality of life for health care professionals.[17] It can also alleviate the workload of medical personnel and improve the accuracy and quality of care, while simultaneously empowering patients to take a more active role in managing their health, ultimately reducing unnecessary hospital admissions.[18] The integration of AI in patient education, particularly when combined with peer support, can further amplify these benefits by delivering personalized, accurate information that reduces uncertainty and strengthens patient empowerment.[19] Given these advantages, the implementation of AI holds great potential to transform the health care landscape into a more efficient, precise, and patient-centered system.

AI presents significant opportunities for improved health care, particularly for individuals diagnosed with breast cancer. One key application involves using AI to educate patients about their condition, available therapies, treatment processes, and related concerns. AI-driven educational interventions may take the form of chatbot programs, mobile applications, GPT-based tools, and virtual assistants, all of which can help enhance patient understanding, alleviate anxiety, and provide reliable information.[20] AI has also demonstrated potential in supporting the development of clinical guidelines for breast cancer care by generating responses aligned with expert recommendations. It can offer insights into risk factors, interpret diagnostic outcomes, clarify treatment choices, and convey useful information regarding recovery, side effects, and quality of life following a cancer diagnosis.[21] Through such technologies, patients are more likely to access comprehensible and relevant information that meets their individual needs.[22]

Although AI offers numerous advantages in educating patients with breast cancer, several implementation challenges remain. These include limited access and infrastructure, particularly for individuals in rural areas or with low socioeconomic status, as the use of AI requires stable internet connectivity, digital devices (such as smartphones or computers), and a basic level of technological literacy.[23] Additionally, data quality and validation must be carefully considered. AI technologies carry the risk of disseminating inaccurate information if not properly managed; therefore, medical professionals must review AI-generated content to ensure its

accuracy and reliability.[6] Another critical issue is safeguarding patient medical data, including information about personal habits, medical conditions, and psychological states, which must be protected in accordance with applicable data protection regulations.[13]

Although several systematic reviews and meta-analyses have examined the use of AI, including chatbots and large language models, in patient education for cancer, most have focused on various cancer types collectively or evaluated clinical patient outcomes, such as anxiety reduction and satisfaction, without specifically analyzing the quality, readability, and appropriateness of educational content for patients with breast cancer.[24] For example, a recent meta-analysis assessed the effectiveness of chatbots on patient outcomes, while a randomized controlled trial evaluated the impact of a chatbot on patient anxiety.[24, 25] However, these studies have not comprehensively mapped non-clinical dimensions such as content relevance, readability, and ethical considerations in breast cancer patient education.

This scoping review offers a novel contribution by focusing on mapping the current evidence regarding the role of AI, particularly large language models such as ChatGPT, in educating patients with breast cancer, including the types of applications used, reported benefits, implementation challenges, and ethical and practical implications. This approach aims to address knowledge gaps that have not been thoroughly explored in previous reviews and to provide insights for developing more effective, patient-centered, AI-based educational strategies.

METHOD

This scoping review was conducted to explore and analyze the role of AI in breast cancer patient education. The methodology adopted follows the established framework, adheres to the Joanna Briggs Institute (JBI) guidelines for conducting scoping reviews, and was reported according to the PRISMA-ScR checklist.[26] The process involved the following stages: identifying the research question, systematically searching the literature, selecting studies based on predefined inclusion and exclusion criteria, extracting relevant data, and synthesizing the findings.

Identifying the research question

The primary research question addressed in this scoping review is: "What is the role of artificial intelligence in educating patients with breast cancer?"

Literature search

A comprehensive literature search was conducted in 3 electronic databases: PubMed, ProQuest, and Scopus. All articles included were peer-reviewed publications from reputable international journals, published within the last 5 years (January 2020 to July 2025). Inclusion and exclusion criteria were determined using the Population, Concept, Context (PCC) model (Table 1).

Table 1. Article Eligibility Criteria Based on the PCC Model

Population	Patients diagnosed with breast cancer
Concept	Artificial intelligence in patient education
Context	Healthcare or oncology settings

Because each database uses different indexing systems and field codes, the search syntax was adapted accordingly. While the Boolean logic and core concepts remained consistent across databases—covering artificial intelligence, machine learning, chatbots, large language models, natural language processing, patient education, and breast cancer—the formatting was adjusted to optimize retrieval in each platform (Table 2).

This adaptation ensured conceptual equivalence while accounting for database-specific indexing features, such as the use of Medical Subject Headings (MeSH) in PubMed, abstract field tags (AB) in ProQuest, and TITLE-ABS-KEY searches in Scopus, thereby maximizing the precision and relevance of retrieved articles.

Study selection

Following the search and filtering process, study selection was conducted based on predefined inclusion and exclusion criteria. The reporting process adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) checklist.[27] The PRISMA flow diagram (Figure 1) illustrates the procedures undertaken during screening, the number of studies identified and excluded, as well as the criteria applied throughout the selection process.

All identified studies were imported into the Rayyan AI application to facilitate screening. Titles and abstracts were independently reviewed to assess their relevance to the research topic. During this stage, studies unrelated to health care or educational applications of AI in the context of breast cancer were excluded.

Articles were included in the review if they met the following criteria:

1. The study population included patients diagnosed with breast cancer.
2. The content focused on the use of AI in educating patients with breast cancer.
3. The publication was written in English.
4. The study was published within the last 5 years (January 2020 to July 2025).

Table 2. Search Strategies Used (Access Date: July 30, 2025)

Database	Syntax	Initial No. of articles
PubMed	(("artificial intelligence"[Title/Abstract] OR "AI"[Title/Abstract] OR "machine learning"[Title/Abstract] OR "chatbot"[Title/Abstract] OR "ChatGPT"[Title/Abstract]) AND ("education"[MeSH Terms] OR "health education"[Title/Abstract] OR "digital education"[Title/Abstract] OR "patient engagement"[Title/Abstract]) AND ("breast cancer"[Title/Abstract] OR "breast neoplasms"[MeSH Terms] OR "breast cancer patients"[Title/Abstract]) AND ("humans"[MeSH Terms] OR "patients"[Title/Abstract]))	68
ProQuest	("artificial intelligence" OR "AI" OR "machine learning" OR "chatbot" OR "ChatGPT" OR "language model" OR "digital assistant") AND ("patient education" OR "health education" OR "health literacy" OR "digital education" OR "patient engagement" OR "patient empowerment") AND ("breast cancer" OR "breast neoplasm" OR "mammary carcinoma" OR "breast cancer patients") AND (humans OR patients OR "clinical trial" OR "qualitative study" OR "case study")	37 940
Scopus	(TITLE-ABS-KEY("artificial intelligence") OR TITLE-ABS-KEY("AI") OR TITLE-ABS-KEY("machine learning") OR TITLE-ABS-KEY("chatbot") OR TITLE-ABS-KEY("ChatGPT") OR TITLE-ABS-KEY("Language model") OR TITLE-ABS-KEY("Large language model") OR TITLE-ABS-KEY("natural language processing")) AND (TITLE-ABS-KEY(" patient education") OR TITLE-ABS-KEY("health education") OR TITLE-ABS-KEY("health literacy") OR TITLE-ABS-KEY("digital education") OR TITLE-ABS-KEY("patient engagement") OR TITLE-ABS-KEY("patient empowerment")) AND (TITLE-ABS-KEY("breast cancer") OR TITLE-ABS-KEY("breast neoplasms") OR TITLE-ABS-KEY("mammary carcinoma") OR TITLE-ABS-KEY("breast cancer patients")) AND (TITLE-ABS-KEY("humans") OR TITLE-ABS-KEY("patients") OR TITLE-ABS-KEY("clinical trial") OR TITLE-ABS-KEY("case study"))	455

5. Full text was available.

Articles were excluded if they were duplicate publications, not relevant to AI-based patient education in breast cancer, not available in full text or behind a paywall without access, or were editorials, letters, or conference abstracts without sufficient data. Disagreements between reviewers were resolved through discussion until consensus was reached. Although formal interrater reliability statistics (e.g., Cohen κ) were not calculated, all stages involved an independent dual review followed by consensus discussion. The selection process and eligibility assessment followed the PRISMA-ScR guidelines (Figure 1).

Data extraction and analysis

The data extraction and analysis stages in this scoping review were conducted systematically to identify patterns, evaluate research trends, and present relevant evidence on the role of AI in breast cancer patient education. After completing the study selection process, data from each eligible study were collected using a structured extraction form to ensure consistency and comprehensiveness.

The extracted data included:

- Bibliographic information: author(s), year of publication, and country of study.
- Study characteristics: research design, sample size, and population.
- Intervention details: type and version of AI-based tool (e.g., chatbot, large language model, AI-assisted application), delivery mode (e.g., text-based question and answer, QR code, video education), and educational focus (e.g., treatment side effects, self-care behaviors, anxiety reduction).
- Outcome measures: accuracy, reliability, readability, comprehension, knowledge improvement, anxiety reduction, self-care behavior changes, patient empowerment, satisfaction, and usability.
- Evaluation methods: assessment tools such as Flesch–Kincaid Grade Level, DISCERN, Patient Activation Measure (PAM), System Usability Scale (SUS), Amsterdam Preoperative Anxiety and Information Scale (APAIS), and Likert scales, as well as expert panel reviews.
- Main findings: key results including statistical measures (e.g., mean differences, *P* values, confidence intervals) when reported.
- Conclusions: author-reported implications, highlighting benefits, limitations, and recommendations for practice or future research.
- Ethical considerations: privacy, data protection, risk of misinformation, and the need for professional oversight.

All extracted data were compiled into a synthesis table (Table 3) and analyzed thematically.

Table 3. Synthesis of 14 Articles on the Role of Artificial Intelligence in Education for Patients with Breast Cancer

Author, year, country	Title	Purpose	Methods	Sample population	Intervention	Results	Conclusion
Lukac *et al.*[28] 2025 Germany	ChatGPT, Google, or PINK? Who Provides the Most Reliable Information on Side Effects of Systemic Therapy for Early Breast Cancer?	To compare the accuracy of side effect information from ChatGPT, Google, and PINK.	Quantitative comparative study	19 breast cancer drugs, 5 side effect categories	Comparison of outputs from ChatGPT 3.5, ChatGPT 4.0, PINK, and Google	Accuracy: ChatGPT 3.5 (67.5%), ChatGPT 4.0 (67.0%), PINK (59.5%), Google (40.0%); AI outperformed Google.	AI and professional platforms provide more reliable data; oversight still required.
Gummadi *et al.*[29] 2024 India	Evaluating the Accuracy of Large Language Model (ChatGPT) in Providing Information on Metastatic Breast Cancer	To evaluate the accuracy and completeness of ChatGPT responses to standard breast cancer queries.	Descriptive evaluation	4 experts	Expert assessment of ChatGPT responses	Of 100 answers: 5 inaccurate, 22 partially accurate, 42 accurate but incomplete, 31 very accurate.	ChatGPT has high potential but requires professional review for medical use.
Ma *et al.*[30] 2025 China	Effect of AI-Based Pre-Hospital Health Education via QR Code on APAIS Scores in Patients with Breast Nodules	To measure the effect of AI-based QR code education on preoperative anxiety and information needs.	Retrospective comparative study	718 patients with breast nodules	AI-based education using QR codes	Reduced anxiety ($\beta = -5.31$; 95% CI, −6.03 to −4.59; $P = 0.001$) and reduced information needs ($\beta = -1.40$; 95% CI, −1.63 to −1.18; $P = 0.001$).	AI-based education reduces anxiety and improves satisfaction.
Haver *et al.*[31] 2024 USA	Evaluating the Use of ChatGPT to Accurately Simplify Patient-Centered Information about Breast Cancer	To determine if ChatGPT can simplify breast cancer information for patients.	Retrospective analysis	25 breast cancer questions	ChatGPT simplification of medical content	Improved comprehension (46 → 70, $P < 0.001$), reduced reading level (grade 13 → grade 8.9, $P < 0.001$), fewer words (193 → 173, $P < 0.001$).	ChatGPT can simplify information effectively but needs physician oversight.
Pesapane *et al.*[13] 2023 Italy	Women's Perceptions and Attitudes Toward the Use of AI in Breast Cancer Screening	To assess women's perceptions and attitudes towards AI in screening.	Prospective survey	800 women undergoing mammography	Questionnaire on AI knowledge, attitudes, opinions	51% aware of AI; 88% positive opinion; higher education correlated with positivity (OR, 4.69); 94% wanted radiologists to report independently.	AI is supported as a second reader; radiologists remain essential.
Leung *et al.*[32] 2023 France	The Extent to Which Artificial Intelligence Can Help Fulfill	To examine the impact of AI-based chatbots on information	Mixed methods (surveys and focus groups)	42 patients (36 completed)	AIPL educational chatbot	No significant change in PAM scores; good usability scores.	AI chatbots can provide basic support but do not

	Metastatic Breast Cancer Patient Healthcare Needs	and emotional support for metastatic breast cancer patients.					improve activation levels.
Tawfik *et al.*[33] 2023 Egypt	A Nurse Versus a Chatbot: The Effect of an Empowerment Program on Chemotherapy-Related Side Effects	To compare chatbot-based education with nurse-led education.	Randomized controlled trial	150 women with breast cancer	ChemoFreeBot vs nursing education vs routine care	Chatbot group showed reduced symptoms and improved self-care ($P < 0.001$).	Chatbots are effective in managing chemotherapy side effects.
Shaban *et al.*[34] 2025 Egypt	Empowering Breast Cancer Clients Through AI Chatbots	To evaluate chatbot impact on knowledge, empowerment, and attitudes.	Randomized controlled trial	122 breast cancer patients	AI-based chatbot education	Significant improvement in knowledge and attitudes ($P < 0.001$).	Chatbots enhance patient knowledge and empowerment.
Liu *et al.*[35] 2025 China	Large Language Models as a Consulting Hotline for Patients with Breast Cancer and Specialists in China	To evaluate accuracy and utility of ChatGPT and ERNIE Bot.	Cross-sectional study	15 patient questions + 15 specialist questions	ChatGPT-E, ChatGPT-C, ERNIE Bot	ChatGPT-E more accurate than others ($P < 0.001$); all produced generic answers for expert-level questions.	ChatGPT-E is useful for patients but not yet for expert-level diagnosis.
Cheese *et al.*[36] 2025 UK	Using NLP to Explore Patient Perspectives on AI Avatars	To explore perceptions of AI avatars in educational videos.	Patient survey	98 breast cancer patients	AI avatar educational videos	Majority positive but some found avatars impersonal.	AI avatars can improve communication but should be made more personal.
Lin *et al.*[24] 2024 Taiwan	Chatbots for Breast Cancer Education: A Systematic Review and Meta-Analysis	To assess chatbot effectiveness in breast cancer education.	Systematic review and meta-analysis	6 studies, 1342 women	Chatbot interventions	Satisfaction, 85%–99%; increased knowledge (90.8%); symptom reduction better than routine care.	Chatbots provide personalized, interactive education.
Roldan-Vasquez *et al.*[37] 2024 USA	Reliability of AI Chatbot Responses to Breast Surgical Oncology FAQs	To evaluate ChatGPT reliability in surgical oncology FAQs.	Expert evaluation	4 breast oncology surgeons	ChatGPT answers to 9 FAQ items	Reliability score, 3.98/5; understandable, actionable, minor inaccuracies.	ChatGPT provides clear, reliable information but should not replace medical advice.
Park *et al.*[38] 2024 Malaysia	Generative AI as a Source of Breast Cancer Information: Proceed with Caution	To evaluate ChatGPT 3.5 accuracy, clinical appropriateness, and readability.	Structured evaluation	20 patient questions	ChatGPT 3.5 responses	Accuracy, 1.88/4; low readability; 41% false references.	ChatGPT should be used cautiously for medical information.
Lee *et al.*[25] 2024 South Korea	A Study on Breast Cancer Patient Care Using Chatbot and Video Education for Radiation Therapy	To assess chatbots/videos in reducing radiotherapy anxiety.	Randomized controlled trial	145 postoperative breast cancer patients	Video + chatbot vs paper-based	No significant difference overall; younger patients benefited more.	Digital media may reduce anxiety in younger patients.

AIPL, Artificial Intelligence Patient Librarian; APAIS, Amsterdam Preoperative Anxiety and Information Scale; CI, confidence interval; FAQ, frequently asked question; NLP, natural language processing; OR, odds ratio; PAM, Patient Activation Measure; Q, question.

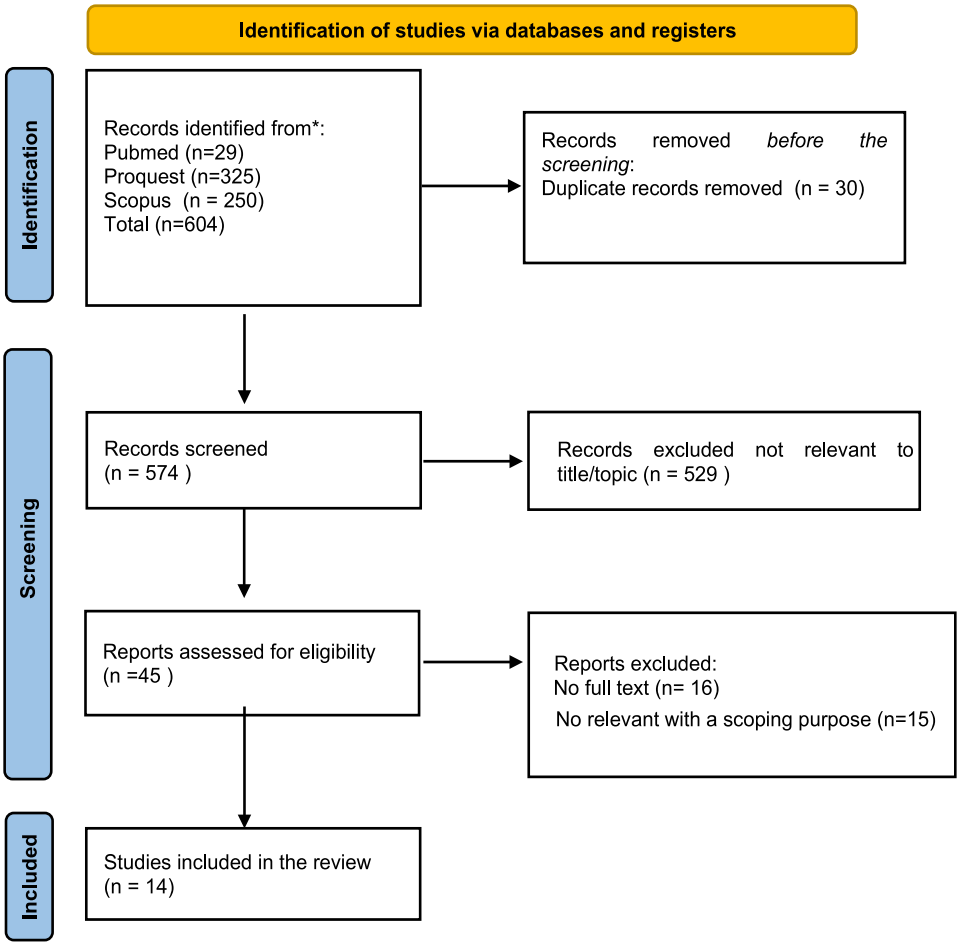

Figure 1. Flowchart of Study Search and Selection Based on PRISMA-ScR for the Role of Artificial Intelligence in Breast Cancer Patient Education

The analysis identified recurring themes including:

1. Accuracy and reliability of AI-generated content
2. Readability and comprehension improvements
3. Impact on patient knowledge, empowerment, and anxiety
4. Usability and patient perceptions of AI tools
5. Ethical and implementation challenges

This structured approach enabled meaningful cross-study comparisons and facilitated the identification of research gaps and opportunities to optimize AI use in breast cancer patient education.

Thematic summary and key findings

The thematic summary and key findings represent the final stage of this scoping review, aimed at identifying patterns, emerging trends, and existing research gaps based on the analysis of the selected studies. In this phase, the synthesized data were categorized into major themes that reflect the diverse roles of AI in the education of patients with breast cancer. These themes provide a comprehensive overview of how AI technologies have been applied to enhance patient understanding, support decision-making, and improve the overall quality of educational interventions. The thematic analysis also highlights areas where further research is needed to optimize the integration of AI into patient education strategies.

RESULT

Study characteristics

Fourteen studies included in our updated scoping review were conducted across diverse geographical regions, from Europe (Germany, Italy, France, the United Kingdom), Asia (China, India, Taiwan, Malaysia, South Korea), Africa (Egypt), and North America (United States). The United States, China, and Egypt each contributed 2 studies, while Germany, Italy, France, the United Kingdom, Malaysia, South Korea, India, and Taiwan each contributed 1 study.

The research settings were equally varied, spanning academic institutions, hospitals, cancer referral centers, professional conferences, and multi-institutional collaborations. Some studies took place in highly controlled environments, such as RCTs, while others were conducted in real-world settings, such as breast cancer screening centers, online patient communities, and multicenter health networks.

This breadth of geographical and contextual representation underscores the global interest in exploring the role of AI in breast cancer patient education, encompassing both high-income and middle-income countries.

Study design

The synthesized studies demonstrated methodological variation in evaluating the role of AI in breast cancer patient education. The research designs included:

- Randomized controlled trials (RCTs): used to evaluate the effectiveness of ChemoFreeBot and patient education chatbots.[25,33,34]
- Quasi-experimental and retrospective designs: for example, QR code–based education was assessed among patients with breast nodules.[30]
- Cross-sectional surveys: patient perceptions of AI in screening and consultation were examined.[13,35]
- Descriptive expert evaluations: the accuracy of ChatGPT responses was analyzed.[29,37,38]
- Systematic review and meta-analysis: chatbot interventions were confirmed to improve patient knowledge and satisfaction.[24]
- Mixed-methods approaches: surveys combined with focus group discussions were used to evaluate the needs of metastatic breast cancer patients.[32]

This methodological diversity reflects the complexity of evaluating AI, with outcomes ranging from reductions in perioperative anxiety and improvements in patient knowledge to perceptions and acceptability of technology

Population and sample

The populations in the fourteen studies analyzed were highly diverse, encompassing breast cancer patients at various stages of the disease, healthy women undergoing screening, and expert panels evaluating AI outputs. Some studies recruited large samples, such as 718 preoperative patients and 800 women undergoing mammography screening, while others involved only small groups, including four oncology experts or 25 simulated questions.[29,31,37] Breast cancer patients constituted the dominant population, whether in the context of chemotherapy, postoperative radiotherapy, or metastatic disease.[25,32,33] Other studies included 98 patients evaluating AI avatars and 122 patients engaged in chatbot-based education.[34,36] A meta-analysis combined data from 1342 women, providing a broader overview of AI interventions.[24]

This diversity demonstrates that the benefits of AI can be experienced across different population segments. However, the findings also reveal variations in response: patients with higher educational levels or younger age tended to be more receptive to technology, while those with limited digital literacy remain underrepresented, raising the risk of inequitable adoption.[13,25]

Key results

Synthesis of research findings based on the Table

Based on the synthesis table of research findings, several studies have evaluated the use of digital technology in improving the care of breast cancer patients. Each study demonstrates the role of technology in supporting patient education and enhancing awareness regarding breast cancer management.

ChatGPT and PINK provided more accurate information on the side effects of breast cancer therapy compared to Google, although accuracy varied depending on the type of therapy (chemotherapy, targeted therapy, endocrine therapy). This indicates that AI technology can deliver more precise information, yet maintaining consistency across different platforms remains a challenge.[28]

AI-based education using QR codes reduced anxiety among patients with breast nodules and decreased their informational needs. This highlights the effectiveness of technology in alleviating preoperative anxiety, indicating the potential of digital solutions to enhance patient experience throughout treatment.[30]

Most women supported the use of AI in breast cancer screening, although they preferred reports to be generated by radiologists. This suggests a gap between the acceptance of technology and trust in human roles within medical processes.[13]

The ChemoFreeBot chatbot effectively reduced chemotherapy side effects and improved self-care behaviors among breast cancer patients. This demonstrates that AI-based technologies can support patient self-care, although such interventions require professional oversight to maximize their benefits.[33]

Other studies further confirmed the positive contribution of AI, including significant improvements in patient empowerment, enhanced comprehension through simplified medical texts, and high satisfaction levels in a systematic review and meta-analysis on chatbot interventions.[24,31,34]

Critical comparison across studies

In contrast, although AI tools such as ChatGPT and PINK may provide more accurate information, misinformation can still occur, particularly in the context of cancer therapy management.[28]

AI-based interventions demonstrated the effectiveness of technology-driven education in

reducing anxiety and improving self-care practices.[30,33] However, other studies revealed that ChatGPT's responses were not always fully accurate, necessitating professional supervision.[29,34]

Patient diversity plays a critical role in interpreting these findings. For example, higher educational levels were associated with more positive views toward AI use in screening, whereas patients with lower educational backgrounds tended to have a more skeptical perception.[13]

Discussion on the digital divide and ethical considerations for underserved populations

The digital divide remains a major barrier to the implementation of digital health technologies. While technology can enhance patient education, limited access to digital devices among underserved populations hinders equitable adoption. This underscores the need for digital literacy programs and technology training for socioeconomically disadvantaged women.[28,30]

Ethical considerations in the use of health technologies, particularly AI and chatbots, must be addressed, especially regarding data privacy and the risk of misinformation. For instance, AI-based interventions can help reduce anxiety and provide medical information, but professional oversight is essential to ensure accuracy and ethical delivery of patient information.[13,33]

Attention to ethnic and socioeconomic diversity is crucial to ensuring fairness in technology use. For example, while AI avatars have been shown to improve patient communication, they should be culturally tailored to better align with patients' backgrounds and needs[36]. Similarly, evaluations of AI-driven tools such as the Artificial Intelligence Patient Librarian (AIPL) were perceived as usable and reliable, although their evaluation in predominantly affluent and highly educated patients limits generalizability, underscoring the need for equitable design and accessibility across diverse populations.[32]

Refining the conclusions and addressing patient diversity

The evidence indicates that AI-based education for breast cancer remains in its early stages, with most studies focusing on efficacy and perceptions rather than large-scale adoption.[25,33,34]. While chatbots and LLMs can improve knowledge, readability, and self-care, variability in accuracy and completeness underscores the need for clinical oversight.[29,37,38] Patient diversity strongly shapes outcomes: higher education and younger age are linked to greater benefits, whereas studies in predominantly affluent settings limit generalizability.[13,25,32] Cultural tailoring and equitable implementation through digital literacy support, multilingual content, low-bandwidth delivery, and human-in-the-loop models are essential to ensure fairness and trust across underserved populations.[30, 36]

DISCUSSION

Role of AI in breast cancer patient education

Specifically, AI has shown significant potential in supporting breast cancer patient education. ChatGPT was reported to outperform other platforms in terms of accuracy when providing information about treatment side effects.[28] Nevertheless, expert reviews indicated that not all answers had sufficient clinical depth, thereby necessitating validation by medical professionals.[29, 37] ChatGPT has also been shown to simplify medical texts and improve readability, which is particularly useful for patients with lower educational backgrounds, though oversimplification may risk omitting essential clinical detail.[31]

ChatGPT in simplifying medical information for patients

One of the main challenges in patient education is simplifying medical information to make it more comprehensible, especially for patients with lower educational backgrounds. A study using a set of 25 simulated breast cancer questions demonstrated that ChatGPT was able to reduce the reading difficulty level of medical texts and enhance comprehension, aligning with international recommendations, including those of the American Medical Association, that health education materials should be written at a lower reading level.[31]

However, while simplification may improve accessibility, oversimplification risks omitting clinically important details that are necessary for informed decision-making.[13] This concern is consistent with expert evaluations, which found ChatGPT responses to be understandable and actionable but sometimes incomplete or slightly inaccurate. Therefore, although ChatGPT shows promise in simplifying language for patients, strict medical supervision is required to balance accessibility with accuracy and ensure that essential clinical information is not lost in the process.[37]

Ethical challenges in using AI for breast cancer patient education

The integration of AI into breast cancer patient education introduces important ethical considerations. AI avatars in educational videos improved communication, but some patients perceived them as impersonal, raising concerns about the extent to which technology can substitute for human interaction in sensitive health care contexts.[36] Additionally, privacy and data security are concerns that may arise when patients interact with AI. While ChatGPT does not directly collect personal data, it may generate or handle sensitive information that could compromise safety if inadequately managed.[38] These findings underscore the importance of robust privacy safeguards and continuous professional oversight to ensure that AI-based educational interventions remain both effective and ethically responsible.

Limitations

Several limitations of the current body of research should be acknowledged. The wide variation in sample sizes—from small expert panels to large-scale patient populations—makes generalization difficult. Study designs were also heterogeneous, ranging from randomized controlled trials and retrospective analyses to surveys and systematic reviews, thus limiting the strength of the evidence presented. Most studies examined short-term outcomes only, leaving the long-term impact of AI interventions on patient quality of life unclear. In addition, the accuracy of AI remains imperfect, with risks of incomplete or misleading information. Finally, patients with limited digital literacy or from marginalized groups remain underrepresented, raising concerns about a widening digital divide.

Recommendations

Future research should prioritize large, multicenter randomized controlled trials and longitudinal designs to evaluate the long-term effects of AI-based interventions on clinical outcomes and quality of life. Standardized outcome measures are also necessary to enable comparability across studies. AI integration into clinical practice must always be supervised by health care professionals to minimize misinformation. Efforts to promote digital literacy are critical, especially among socioeconomically disadvantaged patients, to ensure equitable access to technological innovations. Policymakers should establish clear regulations addressing ethics, privacy, and data security, while developers should design culturally sensitive and personalized educational content to enhance patient engagement and trust.

CONCLUSION

Based on the synthesis of the reviewed studies, it can be concluded that AI-based digital technologies, such as chatbots, QR code modules, large language models, and AI-assisted educational platforms, hold substantial potential to improve patient understanding, reduce anxiety, and support self-care in breast cancer care. These interventions have also shown promise in enhancing patient engagement and satisfaction with health education. Nevertheless, their use requires strict professional oversight to ensure the accuracy, completeness, and security of information provided. Furthermore, attention to issues of equity and inclusivity is essential to ensure that the benefits of AI-driven education can be accessed fairly across diverse patient populations.

ACKNOWLEDGMENTS

None.

CONFLICT OF INTEREST

The authors declare that they have no financial interests or competing personal relationships that could influence the work reported in this paper.

FUNDING

None.

DATA AVAILABILITY

This article is a scoping review. All the data analyzed during the study are included within this published article and the references cited herein. No new primary data were generated or analyzed in this study.

ETHICAL CONSIDERATIONS

Not applicable.

AI DISCLOSURE

No artificial intelligence was used in the preparation of this study.

AUTHOR CONTRIBUTIONS

MK: Conceptualization, Methodology, Software, Validation, Formal Analysis, Writing – Original Draft, Visualization. SY: Data Curation, Supervision, Project Administration, Writing – Review & Editing. HH, SA and ES: Validation, Supervision, Software and Formal Analysis.

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How to Cite This Article

Kada MLR, Yusuf S, Haeruddin H, Anwar S, Suprapti E. The Role of Artificial Intelligence in Breast Cancer Patient Education: A Scoping Review. Arch Breast Cancer. 2025; 12(4):379-91.
Available from: https://www.archbreastcancer.com/index.php/abc/article/view/1133