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Review

A scoping review of deep learning in cancer nursing combined with augmented reality: The era of intelligent nursing is coming

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ABSTRACT

Artificial intelligence has been developing greatly in the field of medicine. As a new research hotspot of artificial intelligence, deep learning (DL) has been widely applied in the fields of cancer risk assessment, symptom recognition, and cancer detection. Therefore, nursing care issues in terms of consuming time and energy, lower accuracy, and lower efficiency can be solved with applying DL in caring cancer patients. In addition, augmented reality (AR) has great navigation potential through combining computer-generated virtual elements with the real world. Thus, DL + AR may facilitate patients with cancer to possess a brand-new model of nursing care that is more intelligent, mobile, and adapted to the information age, compared to traditional nursing. With the advent of the era of intelligent nursing, future nursing models can not only learn from the DL + AR model to meet the needs of patients with cancer but also reduce nursing workload, save healthcare resources, and improve work efficiency, the quality of nursing care, as well as the quality of life for cancer patients.

Introduction

Globally, about 19.3 million new cancer cases and nearly 10 million cancer deaths occurred in 2020.[1] In 2022, 1,918,030 new cancer cases and 609,360 cancer deaths are projected to occur within the United States.[2] However, with the increasing incidence of cancer such as lung cancer, stomach cancer, and breast cancer,[2] nursing resources are becoming increasingly scarce, and the traditional nursing is facing great challenges. Professional cancer nursing has a close relation with the treatment and rehabilitation of patients with cancer. Without high-quality nursing services, the quality of life of patients with cancer will be seriously affected. The patients are also eager for the help from the cooperation between cancer nursing and information technology. Thus, it is a chance for intelligent nursing to demonstrate excellence in cancer care in such situation. In recent decades, the rapid rise in information technology has accelerated the development of the field of medicine. It is reported that emerging technologies such as augmented reality (AR), artificial intelligence (AI) as well as its branches of machine learning (ML), and deep learning (DL) have solved quite a few problems related to disease management and nursing, especially since the outbreak of COVID-19.[3] There is a great possibility that DL & AR can be the backbone of implementing intelligent nursing due to its outstanding performance in meeting patients' demands.

Proposed by John McCarthy in 1955, AI refers to a branch of computer science that aims to create intelligent machines.[4] Nowadays, AI has entered the DL period after going through the inference period, the knowledge period, and the ML period. As a sub-domain of ML, DL has several representative models, including convolutional neural network (CNN) and recurrent neural network (Fig. 1).[5] For example, fully convolutional network upgraded on the basis of CNN performs well in semantic segmentation.[6] As a more advanced algorithm, DL has made revolutionary progress in many fields such as ML and computer vision.[7] Besides, DL is perfect for implementing statistical analysis of biomedical big data and addressing other related problems[8] due to its abilities of automatic learning, identification characteristics, and strong feature extraction. Therefore, DL has been widely used in surgical robots,[9] disease risk assessment and prediction, symptom identification, computer-aided diagnosis, and so on.[10–12] So far, various DL models have been developed to predict the risk of developing critical illness for patients with COVID-19 so as to ensure that they receive appropriate care as

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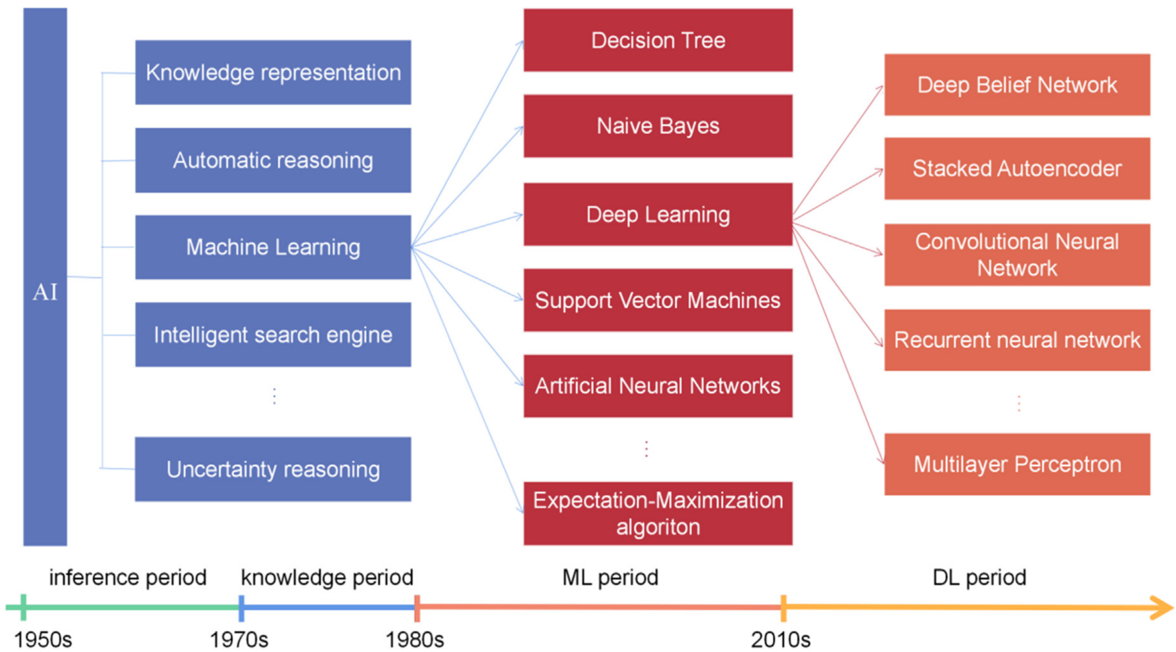

Fig. 1. The development course and the research branch of AI. AI, artificial intelligence; DL, deep learning; ML, machine learning.

soon as possible,[13] to predict postoperative complications to assist clinical decision making along the perioperative care continuum,[14] and to facilitate effective classification of nursing care in unstructured information in adverse events.[15]

AR, a new technology, can skillfully combine virtual information with the real world to supplement and improve the real world.[16] Currently, the rapid development of network technology and computer visualization technology has promoted the maturity and popularity of AR, and this has already reached a certain peak in 2016, called "the first year of AR/VR", which makes AR turn into the next-generation computing platform, ranking second only to computers and smartphones. To date, AR has been widely applied in various fields including games for entertainment, military sector,[17] education,[18] and medicine.[19] Take the navigation potential of AR, for example, in recent years, it has greatly improved the effectiveness and accuracy of clinical treatment in terms of rehabilitation training,[20] stomatology department,[21] orthopedics,[22,23] and various types of cancer surgery like brain cancer,[24] lung cancer,[25] and breast cancer.[26] In nursing, AR is mainly applied in teaching and education.[27] It provides nursing students with a more realistic and immersive environment when they are practicing clinical skills, thus contributing to their command of professional knowledge and skills.[28,29] Some AR telehealth glasses[30] and simulation applications[31] have been developed to guide and assist the students to complete the simulated intubation in a manikin or train them to identify the symptom of stroke of the mannequin patient and act accordingly. As a result, the advantages of AR such as visualization, immediate feedback, and innovative methods should never be underestimated.

Importantly, it is inevitable to develop intelligent nursing based on AR. First, with the scarce nursing resources and the increasing number of patients with cancer, it is difficult to provide personalized service for patients and guarantee the accuracy of clinical nursing work.[32] In addition, the two critical steps in clinical cancer nursing are nursing assessment and nursing intervention. The former involves critical thinking skills and data collection, aiming to solve the health problems, and the latter is the process of putting nursing plans into practice to promote the rehabilitation of service recipients.[33] However, the traditional nursing assessment and nursing intervention lack related tech support and comprehensive, systematic, and standardized indicators, which results in consuming time and energy, lower accuracy, and lower efficiency in nursing implementation.[34] Therefore, to solve such problems or at least alleviate such situation requires the development of intelligent nursing.

DL and AR are more likely to be the backbone of implementing intelligent nursing due to its outstanding performance in meeting patients' demands. However, simply relying on DL or AR is far from enough. There is still a big gap between the current research and the goal of implementing intelligent cancer nursing. Therefore, a more advanced, innovative, and information-based nursing model is required, composed of DL and AR that can better adapt to the intelligence and information era.

The development of DL + AR in cancer is still in its early stages. In order to avoid the extensive efforts that would be needed to conduct studies aimed at answering specific questions, we consider it necessary to perform a scoping review to broadly summarize all the available evidence presented to date on the applications of DL + AR. The aim of this scoping review is to address the problem: does the DL + AR model have development potential and application prospects in the field of cancer care? This will provide new ideas for the optimization and development of cancer care, which helps improve nurses' work efficiency and better meet the needs of patients with cancer.

Methods

Methodology to conduct scoping reviews by the Joanna Briggs Institute was followed[35] and the studies in the final sample were reported using the checklists of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR).[36]

Search strategy

The electronic databases, including the Cochrane Library, Medline, EBSCOhost, Embase, Web of Science, and PubMed, were searched for relevant articles published during June 2022 with no restriction on the date of publication. The following search terms were utilized for data searches for each database: "Neoplasms/cancer/tumor/malignancy/cancer survivor", "DL/deep belief network/stacked autoencoder/

convolutional neural network/recurrent neural network/multilayer perceptron/artificial intelligence/AI/DL", "augmented reality/augmented realities/realities, augmented/reality, augmented/AR". The search strategy can be found in Appendix A.

Inclusion and exclusion criteria

Articles were included in this review (1) if a study included patients with cancer; (2) if the contents of the study were related to the application of DL + AR; (3) if the language of publications was limited to English; (4) if the literature was published for nearly 10 years. And articles were excluded if the article was repeated publication, its information was incomplete or not accessible to the full-text.

Search outcome

The selection process is shown in Fig. 2. Of 1224 citations, 71 citations were identified after a title and abstract review, and 6 citations were confirmed after a full-text review. A table was created and included the information on authors, years of publication, types of cancer, and the application of DL + AR. At least two team members independently conducted the verification of data accuracy. Two researchers screened the titles and abstracts and then full texts of the remaining articles according to the inclusion and exclusion criteria. Any disagreements were resolved by consensus and consultation with the third reviewer when required.

Results

Study characteristics

This review found 6 publications reporting the application of the DL + AR model in medical detection, diagnosis, and classification from August 2019 to February 2022. The studies reviewed were conducted in the China ($n = 4$), US ($n = 1$), and Italy ($n = 1$). Of 6 studies, four studies were diagnostic study,[37–40] one study was report,[41] and the study design of the rest one is unclear.[42] All of the included studies conducted the application development of DL + AR. Five studies[37–41] developed the microscopes based on the DL method and AR module to improve the accuracy and efficiency of cancer diagnosis, and the rest one[42] established a two-steps automatic system to improve accuracy in locating the tumor tissue with biopsy of radical prostatectomy. The reported types of

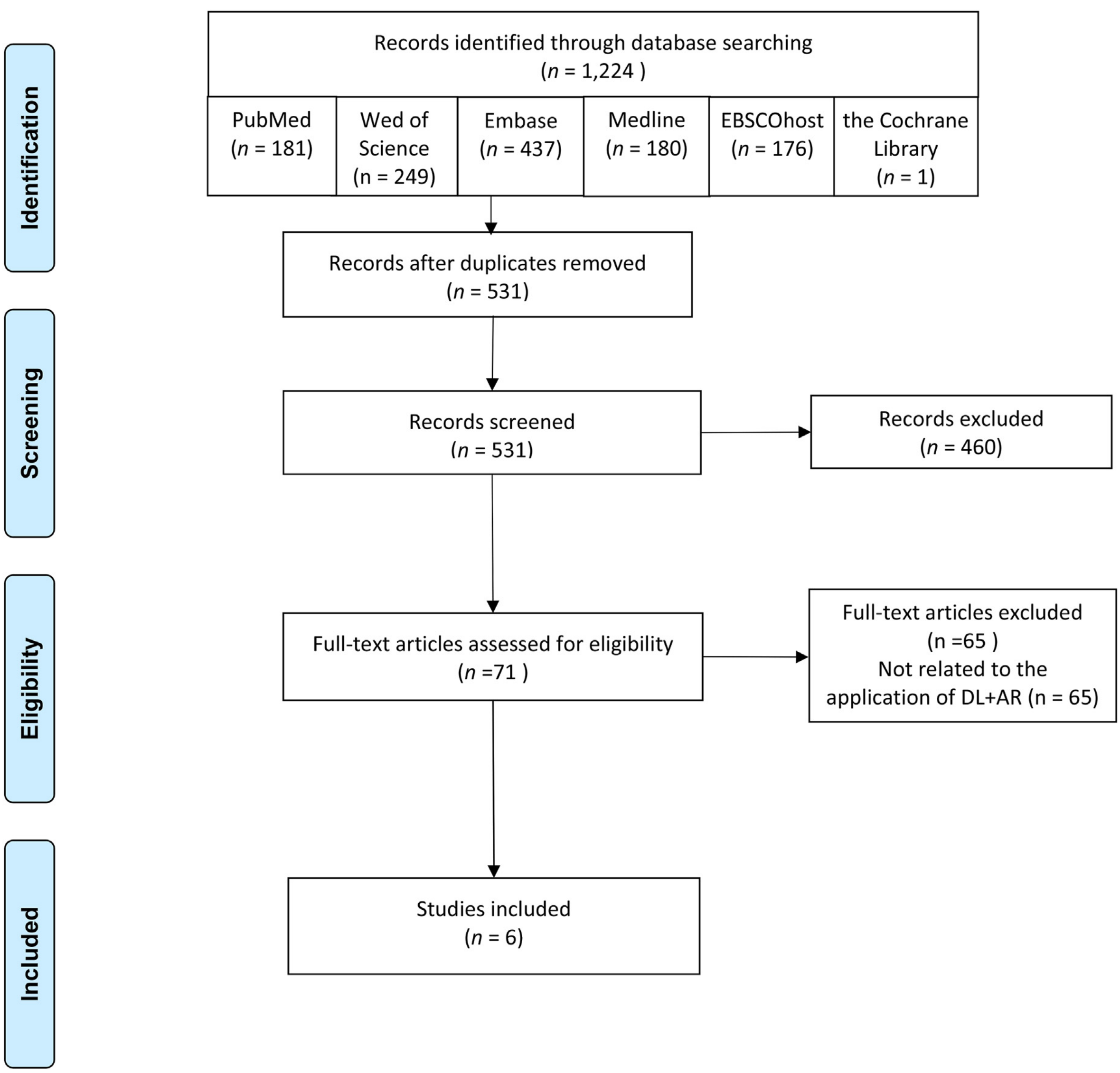

Fig. 2. PRISMA-ScR flow diagram for the study selection process. PRISMA-ScR, Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews; DL, deep learning; AR, augmented reality.

Table 1
Study characteristics ($n = 6$).

Author (year)	Country	Study design	Sample (n)	Type of cancer	Applications	Primary objective
Tang et al (2021)[37]	America	Diagnostic study	Cervical cytology slides ($n = 486$)	Cervical cancer	AI microscope	To validate the effectiveness of this AI microscope that can provide onsite diagnostic assistance for cervical cytology screening in real-time
Cai et al (2021)[38]	China	Diagnostic study	Ki67 stained slides ($n = 100$)	Breast cancer	AI-empowered microscope	To improve nuclear proliferation biomarker Ki67 scoring concordance
Yue et al (2021)[39]	China	Diagnostic study	HER2 IHC staining slides ($n = 50$)	Breast cancer	AI-assisted microscope	Propose an AI-assisted microscope to improve the HER2 assessment accuracy and reliability
Liu et al (2022)[40]	China	Diagnostic study	Bone marrow specimens ($n = 70$)	Leukemia	AR microscope	To reduce work intensity, error probability and improves work efficiency for morphological examination of bone marrow cells
Chen et al (2019)[41]	China	Report	Lymph node slides ($n = 50$) prostate slides ($n = 34$)	Breast cancer, prostate cancer	AR microscope	To improve the accuracy and efficiency of cancer diagnosis
Tanzi et al (2020)[42]	Italy	Unclear	5 videos from different surgical procedures	Prostate cancer	A two-steps automatic system	To improve the accuracy in locating the tumor tissue for surgeons during the procedure

AI, artificial intelligence; AR, augmented reality.

cancers varied including the cervical cancer, breast cancer, prostate cancer, and leukemia. Other data fields were showed in Table 1. In addition, three studies carried out reader study[37–39] and two studies reported clinical tests[40,42] to validate the performance of DL + AR model they developed, while the remaining study has not verified the developed ARM.[41] For specific information on the application and validation of DL + AR in the included studies, we conducted further data extraction (Table 2).

The application of the DL + AR model focuses on cancer diagnosis and tumor location

The application of the DL + AR model in cancer detection and diagnosis is in full swing. The combination of these two technologies can effectively enhance the automation diagnosis of cancer pathological sections and reduce the consumption of human resources. Five included studies[37–41] mainly established AI microscopes that were built on top of a conventional microscope with an add-on, AR display, and an AI-empowered computer unit. They can simplify workflow and facilitate clinical diagnosis. For example, Liu[40] established a new morphological diagnosis system of bone marrow cells based on the DL object detection framework and built an AR system, with clinical test showing that the newly developed diagnosis system can respond more rapidly than a well-trained expert for diagnosis. In addition, DL + AR is also applied well in surgeries to help accurately localize tumors. One included study[42] implemented a two-steps automatic system which aligned a 3D virtual ad-hoc model of a patient's organ with its 2D endoscopic image, to assist surgeons to locate the tumor tissue with biopsy during the radical prostatectomy procedure.

Technical development of DL + AR

In the stage of technology development in these studies, first of all, when the DL model was constructed, a certain number of samples were selected, and the selected data were then marked by professionals to form a dataset. Second, the data were randomly split into training and a test set. The training set was used for the development of DL, and the test set is used to test the performance of the final optimal model after training. The application of the DL algorithm comprises two phases: training and inference. The training phase involves training an algorithm using a large data set, while the inference phase involves processing an image with the trained DL algorithm. Finally, the trained and tested DL model will be combined with AR. In the five studies that developed the AI microscope,[37–41] the results identified by the AI system were then projected into the original optical path by an AR technique. In one study that implemented a two-steps automatic system,[42] after selecting the best combination of segmentation architecture and CNN, it finally extracted 100 frames from a separate dataset to test the overlay precision and performances of the AR framework. The above all combined the functions of data feature extraction of DL, multi-image fusion, and 3D interaction of AR so as to achieve DL automatic analysis with AR navigation for the purpose.

Real-time and higher detection capability

All the included studies have shown that the DL algorithm and AR technology newly developed have real-time characteristics, including real-time capture, real-time display, and real-time supervision and quality control.[37–42] These AI-empowered microscopes are developed by equipping a conventional microscope with an AR module and AI algorithms. The AR module consists of a microdisplay and a beam splitter, which combines the light from objective and microdisplay. Therefore, the AI result can display on the eyepiece in real-time. Tang et al.[37] indicated that the total processing time of 1 FOV for the AI system was approximately 200 ms, which meant almost real-time assistance for cytopathologists. Besides, with AI assistance, the sensitivities for the detection of cancer cell were significantly improved. Chen et al.[41]

Table 2
Characteristics of studies regarding the applications of DL + AR in cancer (n = 6).

Author (year)	Technology	Test	Groups	Test index	Key finding	Limitation
Tang et al (2021)[37]	DL (CNN)+AR	Reader study: 2 rounds	With AI versus without AI	Sensitivity, specificity, accuracy	The consistency of diagnosis between different cytopathologists can be improved with the assistance of AI microscope	The real- time AI microscope may finally be affected by the speed of the viewer's reading, the light intensity, and the clarity of the FOV
Cai et al (2021)[38]	DL (FCN)+AR	Ring studies: three rounds ring study	Conventional microscopes versus with reference cards versus AI-empowered microscope	Reproducibility, accuracy	Helps pathologists to obtain a higher consistency and for the Ki67 assessment	Unclear
Yue et al (2021)[39]	DL (FCN)+AR	Reader study: three rounds ring studies	WSIs versus conventional microscope versus AI microscope	Overall reading results, accuracy, concordance, acceptance of AI results (+AI scoring algorithm)	Improved the precision of immunohistochemistry 3 + and 2 + scoring while ensuring the recall of fluorescent in situ hybridization (FISH)–positive results in IHC 2 +. Also, the average acceptance rate of AI for all pathologists was 0.90, demonstrating that the pathologists agreed with most AI scoring results.	Unclear
Liu et al (2022)[40]	DL (CNN) +AR	Clinical test	With diagnosis system versus without the system	Response speed	Establish a new morphological diagnosis system of bone marrow cells based on the deep learning object detection framework	(1) a variety of bone marrow cell types are not included in the training set; (2) these cell types are only from a single center; (3) the model cannot effectively learn rare sample
Chen et al (2019)[41]	DL (FCN)+AR	Unclear	Unclear	ROC curves, AUC, accuracy, precision, recall	The utility of ARM in the detection of metastatic breast cancer and the identification of prostate cancer, with latency compatible with real-time use.	The ARM system is not appropriate for all tasks
Tanzi et al (2020)[42]	DL (CNN)+AR	Clinical test	With two-steps automatic system versus without the system	Accuracy, speed	A two-steps automatic system to align a 3D virtual ad-hoc model of a patient's organ with its 2D endoscopic image	The tests needed to be confirmed using a larger number of cases

AI, artificial intelligence; DL, deep learning; AR, augmented reality; CNN, convolutional neural network; ROC, receiver operating characteristic curve; AUC, area under curve.

leverages custom software pipelining to maximize the utilization of different hardware components for different tasks and to improve responsiveness, without incurring the workflow changes and delays associated with digitization. The combination of pipelining and fully conventional network improved the latency of the ARM system, from 2126 to 296 ms, and the frame rate from 0.94 frames per second (fps) to 6.84 fps,[41] which has obvious advantages in clinical workflow including enabling real-time updating of the augmented information to support a rapid workflow. Tanzi et al.[42] picked U-Net with MobileNet as the most performing ensemble for performance and speed and the frame rate of the real-time application was acceptable if they kept the number of iterations per second (it/s) greater than 10: with 11.04 it/s, on the hardware used for testing, it is able to reach a frame rate of approximately 8fps, which is a good value for a medical application. In addition to the characteristics of high-speed analysis, Liu et al.[40] proposed a general score ranking loss, which would weaken the impact on the correctly ranked positive samples and provided extra optimization to make positive samples with larger prediction score, and improve the detection accuracy.

DL + AR models improve the accuracy and efficiency of cancer diagnosis and tumor location

In cancer, the microscopic examination of samples is the gold standard for the diagnosis of cancer and autoimmune diseases. As a form of image interpretation, these examinations are subjective, which exhibited considerable inter- and intra-observer variability. After the development of the AI microscopes, these studies have carried out some studies and test to validate the effectiveness of their AI microscopes. Three studies conducted reader studies. Tang et al.[37] was the 2-round, and Cai et al.[38] and Yue et al.[39] were 3-rounds of rings study. In addition, these studies that developed the AI microscope evaluated the results with the same indicators, including concordance, and consistency. Other indicators included accuracy, sensitivity, reproducibility, and so on. These indicators showed that the results of AI-assisted microscopes or systems in the pathological diagnosis of cancer have a substantial agreement in comparison with the results after pathologists' review. Thus, the AI and AR assisted by microscope is a practical tool for pathologists for making diagnosis and can be seamlessly integrated with the current clinical workflow. DL algorithm may possibly be fully applied in the field of cancer pathology detection. Besides, DL + AR is making a significant contribution in surgery. A two-steps automatic system established by Tanzi et al.[42] showed an increased accuracy in cancer biopsies after the evaluation performed on two equal groups of patients; 70% showed an improvement in accuracy in locating the tumor tissue with biopsy thanks to the positioning operated by the system, compared to 50% of the previous approach, which means the preliminary results are encouraging.

Discussion

A total of 6 studies met inclusion criteria and informed this review. One study[42] has proved that the two-steps automatic system based on DL + AR can align a 3D virtual ad-hoc model of a patient's organ with its 2D endoscopic image to assist surgeons for tumor localization during the procedure. In the preoperative evaluation, semi-automatic detection, recognition of specific patterns or segmentation of organs and lesions, is applied to preoperative imaging through typical DL tasks, and then the computer-generated 3D model is superimposed on the anatomical structure of real patients to solve the limited vision and depth information through AR so that DL + AR can help doctors to eliminate dynamic interference and perform surgery in real-time and intuitively, thus improving the accuracy of surgery as well as reducing the incidence of surgery and complications.[43,44] Five studies[37–41] have proved that AI microscope can be used in efficient intelligent diagnosing, screening, and classifying a variety of cancer cells. It is confirmed that the ability of DL to present three-dimensional scenes with continuous depth sensation has a profound impact on AR,[45] so the innovative application of DL algorithm can also promote the better realization of AR.[46] These studies have demonstrated that it is feasible to use DL for evaluation and use AR to display and navigate the results of the assessment.

Clinical tests showed that with the assistance from the newly developed diagnosis system, the researchers could finish 200 fields of analyses within 16 min, 4.8 s for each image. And as a reference, a well-trained expert needs around 40–50 s to perform a diagnosis for each field.[40] There is no doubt that it is difficult for humans to achieve such great achievements at present. The application of the DL + AR model in the fields above has proved that the form of DL combined with AR is completely effective and innovative. More importantly, it promotes the role of medical information technology into a new height and also provides a new and reliable paradigm for integrating DL + AR into cancer nursing. The reasoning ability of automatic detection and assessment of DL can fully assist patients in the completion of nursing assessment tasks, solve the problems like consuming time and energy, and low precision, and even provide a higher accuracy and efficiency than manual evaluation. The navigation performance of AR can also provide more intuitive training and guidance for nurses and improve the quality of nursing. In addition, nowadays, patients' demand for disease-related knowledge is gradually increasing, and nurses can use the software based on DL + AR to provide patients with automated disease analysis and fun, situational and targeted health education guidance, so as to increase patient compliance, and it is suitable for auxiliary nursing intervention because it greatly reduces the risk of exposure.[47] As a result, it can liberate nurses from repetitive and time-consuming health education, thus saving more time for them to solve more complex nursing problems and improve nursing quality.[27] Moreover, with the rapid development of mobile terminals, the presentation of AR effect no longer only depends on AR glasses, and the popularity of smartphones as well as tablet computers also provides a solid material foundation for the practical application and effective presentation of AR technology, which will increase the applicability of AR in cancer nursing.[48,49] Therefore, according to the successful application of the DL + AR model in AI microscope and surgeries, this review puts forward the idea of combining cancer nursing with the DL + AR mode for the first time.

Limitations

In this scoping review, after rigorous screening and review, we have included only 6 studies that met the criteria for inclusion, which is a relatively rare situation. On the premise of ensuring that this scoping review adopts appropriate retrieval strategies and standardized methods, we believe that the main reason for this phenomenon is that the subject of this research is very innovative, the application form of DL + AR technology is still in the preliminary stage of development in medicine, and there are not enough and extensive original research to be included in the analysis. Therefore, it is suggested that relevant scholars should further explore the development and original research of DL + AR technology in cancer medicine or cancer nursing, promote the better application of DL + AR in cancer, and also contribute to the full development of subsequent scope review or meta-analysis.

Conclusions

This scoping review summarized current evidence concerning the application of DL + AR model. The identified applications of DL + AR are mainly developed in cancer detection and diagnosis in pathology and tumor localization during the procedure. Given the results of these reviews, the DL

+ AR model provides a new idea for the development of intelligence and informatization of cancer nursing. Future research needs to keep exploring the application of the DL + AR model in cancer nursing so as to implement intelligent nursing, solve the problems emerging in cancer nursing today, and improve nursing services for patients with cancer.

Author contributions

Yulan Ren: Writing- original draft, conceptualization. **Yao Yang:** Visualization, writing-review and editing. **Jiani Chen:** Writing- original draft, writing-review and editing. **Ying Zhou:** Writing-original draft, conceptualization, software. **Jiamei Li:** Conceptualization, Resources. **Rui Xia:** Resources, visualization. **Yuan Yang:** Resources, cConceptualization. **Qiao Wang:** Funding acquisition, supervision. **Xi Su:** Writing-review and editing, supervision.

Declaration of competing interest

None declared.

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Appendix A
Search strategy

Set number	Query
Database: PubMed	
1	(neoplasms [MeSH Terms]) OR (cancer [Title/Abstract] OR tumor [Title/Abstract] OR malignancy [Title/Abstract] OR cancer survivor [Title/Abstract])
2	(deep learning [MeSH Terms]) OR (deep belief network [Title/Abstract] OR stacked autoencoder [Title/Abstract] OR convolutional neural network [Title/Abstract] OR recurrent neural network [Title/Abstract] OR multilayer perceptron [Title/Abstract] OR artificial intelligence [Title/Abstract] OR AI [Title/Abstract] OR DL [Title/Abstract])
3	(augmented reality [MeSH Terms]) OR (augmented realities [Title/Abstract] OR realities, augmented [Title/Abstract] OR reality, augmented [Title/Abstract] OR AR [Title/Abstract])
4	#1 AND #2 AND #3
Database: Web of science	
1	(TS=(neoplasms)) OR AB=(cancer or tumor or malignancy or cancer survivor)
2	(TS=(deep learning)) OR AB=(deep belief network or stacked autoencoder or convolutional neural network or recurrent neural network or multilayer perceptron or artificial intelligence or AI or DL)
3	(TS=(augmented reality)) OR AB=(augmented realities or realities, augmented or reality, augmented or AR)
4	#1 AND #2 AND #3
	Database: EBSCOhost
1	SU neoplasms OR AB (cancer or tumor or malignancy or cancer survivor)
2	SU deep learning OR AB (deep belief network or stacked autoencoder or convolutional neural network or recurrent neural network or multilayer perceptron or artificial intelligence or AI or DL)
3	SU augmented reality OR AB (augmented realities or realities, augmented or reality, augmented or AR)
4	#1 AND #2 AND #3
Database: Embase	
1	'neoplasm'/de OR 'cancer'.ti,ab, kw OR 'tumor'.ti,ab, kw OR 'malignancy'.ti,ab, kw OR 'cancer survivor'.ti,ab,kw
2	'deep learning'/de OR 'deep belief network'.ti,ab, kw OR 'stacked autoencoder'.ti,ab, kw OR 'convolutional neural network'.ti,ab, kw OR 'recurrent neural network'.ti,ab, kw OR 'multilayer perceptron'.ti,ab, kw OR 'artificial intelligence'.ti,ab, kw OR 'AI'.ti,ab, kw OR 'DL'.ti,ab,kw
3	'augmented reality'/de OR 'augmented realities'.ti,ab, kw OR 'realities, augmented'.ti,ab, kw OR 'reality, augmented'.ti,ab, kw OR 'AR'.ti,ab,kw
4	#1 AND #2 AND #3
Database: MEDLINE	
1	(MHX=(neoplasms)) OR AB=(cancer or tumor or malignancy or cancer survivor)
2	(MHX=(deep learning)) OR AB=(deep belief network or stacked autoencoder or convolutional neural network or recurrent neural network or multilayer perceptron or artificial intelligence or AI or DL)
3	(MHX=(augmented reality)) OR AB=(augmented realities or realities, augmented or reality, augmented or AR)
4	#1 AND #2 AND #3
Database: the Cochrane Library	
1	MeSH descriptor: [Neoplasms] this term only OR (cancer or tumor or malignancy or cancer survivor):ti,ab,kw
2	MeSH descriptor: [Deep Learning] this term only OR (deep belief network or stacked autoencoder or convolutional neural network or recurrent neural network or multilayer perceptron or artificial intelligence or AI or DL):ti,ab,kw
3	MeSH descriptor: [Augmented Reality] this term only OR augmented realities or realities, augmented or reality, augmented or AR
4	#1 AND #2 AND #3

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