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# Artificial Intelligence in Cancer Care: Emerging Applications in Early Detection, Treatment Decision-Making, And Oncology Nursing Practice — A Narrative Review

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***ABSTRACT***
***Background:*** *Artificial intelligence (AI) is rapidly transforming cancer care through emerging applications in early detection, diagnostic imaging, digital pathology, treatment planning, precision oncology, and clinical decision support. Machine learning, deep learning, and natural language processing offer opportunities to analyze complex healthcare information and support personalized treatment strategies. Oncology nurses and advanced practice providers are increasingly likely to encounter AI-supported technologies in clinical practice.*
***Objective:*** *To examine current and emerging applications of artificial intelligence in cancer diagnosis and treatment, with particular emphasis on symptom management, clinical decision-making, patient safety, and the evolving role of oncology nurses and advanced practice providers.*
***Methods:*** *This narrative review synthesizes selected peer-reviewed research, clinical trials, methodological literature, and professional guidance concerning AI applications across the cancer care continuum. Evidence is organized into diagnostic, therapeutic, supportive care, nursing practice, and ethical domains. The review distinguishes clinically evaluated interventions from technologies that remain investigational.*
***Results and Discussion:*** *AI-assisted technologies have demonstrated promising performance in breast cancer screening, pulmonary nodule assessment, and digital pathology. Emerging approaches may support treatment selection, molecular interpretation, radiation planning, and prediction of treatment-related complications. Electronic patient-reported outcome systems provide evidence that structured symptom monitoring can improve selected patient outcomes, although these systems should not automatically be classified as AI. In oncology nursing, AI may support clinical assessment, documentation, patient education, and care coordination. However, algorithmic bias, limited generalizability, data privacy, inaccurate outputs, and excessive reliance on automated recommendations remain important concerns.*
***Conclusion:*** *Artificial intelligence has considerable potential to improve the efficiency and personalization of oncology care. Safe implementation requires rigorous clinical validation, interdisciplinary collaboration, appropriate regulatory oversight, and continued human judgment. Oncology nurses and advanced practice providers have important roles in evaluating these technologies and ensuring that their use remains ethical, evidence-based, and patient-centered.*
***Keywords:*** *Artificial Intelligence; Cancer Care; Oncology Nursing; Machine Learning; Precision Oncology; Cancer Treatment; Clinical Decision Support; Symptom Management.*

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## I. INTRODUCTION

Cancer remains a significant global health challenge and continues to create substantial clinical, economic, and psychosocial burdens for patients, families, and healthcare systems. Advances in cancer treatment have improved outcomes for many patients, but modern oncology has become increasingly complex. Clinical teams must integrate diagnostic imaging, histopathological findings, molecular biomarkers, laboratory investigations, treatment guidelines, comorbidities, and individual patient preferences when developing care plans.

Artificial intelligence has emerged as a potentially valuable tool for managing this complexity. AI refers to computational systems capable of performing tasks such as pattern recognition, classification, prediction, and language processing. Machine learning allows algorithms to identify relationships within data, while deep learning uses multilayered neural networks to analyze complex information, including medical images and digitized tissue specimens [1,2].

Recent developments have expanded AI research beyond image interpretation into precision oncology, treatment planning, clinical decision support, and patient monitoring [3,4]. These applications may help healthcare professionals identify important clinical information more efficiently and improve the consistency of selected diagnostic and administrative processes. However, technological innovation must be distinguished from demonstrated clinical benefit. A model that performs accurately in a retrospective dataset may not necessarily improve patient outcomes when implemented in a real-world clinical environment. Differences in patient populations, data quality, clinical workflows, and professional oversight can influence performance.

Oncology nurses and advanced practice providers play essential roles throughout the cancer care continuum. Their responsibilities include comprehensive assessment, patient education, treatment toxicity monitoring, symptom management, care coordination, and recognition of clinical deterioration. Consequently, the integration of AI into oncology has important implications for nursing practice, professional education, and patient safety.

This review explores the emerging applications of AI in cancer care, evaluates selected evidence, and discusses opportunities and challenges for oncology nursing and advanced practice practice.

## II. OBJECTIVES

The objectives of this narrative review are:

1. To explain the fundamental concepts of artificial intelligence relevant to cancer care.
2. To examine applications of AI in cancer screening, diagnosis, and risk assessment.
3. To explore the role of AI in treatment planning, precision oncology, and systemic cancer therapy.
4. To evaluate opportunities for AI-assisted symptom monitoring and recognition of treatment-related complications.
5. To discuss implications for oncology nurses and advanced practice providers.
6. To identify ethical, regulatory, and implementation challenges.
7. To recommend priorities for future research and nursing education.

## III. REVIEW METHODOLOGY

### 3.1 Review Design

This article adopts a narrative review design to synthesize selected evidence concerning artificial intelligence across the cancer care continuum.

A narrative approach is appropriate because AI applications in oncology encompass diverse technologies, clinical settings, research designs, and outcomes. The review incorporates diagnostic accuracy studies, randomized trials, reviews, and professional guidance.

### 3.2 Literature Selection

The manuscript draws on selected peer-reviewed publications and authoritative healthcare guidance, including research accessible through PubMed and major scientific journals.

Topics considered include AI-assisted medical imaging, digital pathology, molecular oncology, treatment decision support, electronic symptom monitoring, clinical implementation, and healthcare equity. Priority was given to influential foundational studies, clinically relevant investigations, and recent publications describing advances in oncology AI.

This review does not claim to be a systematic review. No exhaustive database search, independent duplicate screening, or formal risk-of-bias assessment was performed. The included publications are intended to provide a representative clinical synthesis rather than a comprehensive account of all available evidence.

## IV. FUNDAMENTAL CONCEPTS OF ARTIFICIAL INTELLIGENCE IN ONCOLOGY

### 4.1 Machine Learning

Machine learning is a branch of AI that enables computational systems to identify patterns in data and develop predictions without requiring a separate manually programmed rule for every situation. In oncology, machine learning models may analyze demographic information, tumor characteristics, laboratory values, molecular findings, and treatment histories to estimate clinical risks.

Potential applications include predicting disease recurrence, treatment response, adverse events, and healthcare utilization. However, model performance depends on the quality and representativeness of training data. A system developed in a highly specialized cancer center may not perform equally well in a community oncology practice [1,2].

### 4.2 Deep Learning

Deep learning uses artificial neural networks with multiple computational layers to recognize complex patterns. It has been particularly influential in radiology and digital pathology, where large quantities of image-based information are available. Deep learning models have demonstrated promising performance in detecting abnormalities in mammograms, chest computed tomography scans, and digitized pathology slides [5–9].

Nevertheless, clinical interpretation involves more than pattern recognition. Imaging findings must be evaluated in relation to symptoms, medical history, prior investigations, and other diagnostic results.

**4.3 Natural Language Processing**

Natural language processing enables computational systems to analyze, organize, and generate information expressed in human language. Potential applications in oncology include summarizing clinical records, extracting relevant information from pathology reports, assisting with documentation, and developing educational materials. Generative AI systems may also support the preparation of clinical summaries and explanations. However, generated information can contain factual errors, unsupported conclusions, or omissions. Professional verification is therefore essential before using such information in patient care.

**4.4 Predictive Analytics**

Predictive analytics uses available data to estimate the likelihood of future events. In oncology, predictive models may be designed to identify patients at increased risk of hospitalization, treatment-related complications, or disease progression. Such tools may support prioritization of clinical assessment and follow-up. However, predictions should not replace direct patient evaluation or established clinical management protocols.

## V. APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN CANCER DETECTION AND DIAGNOSIS

**5.1 AI-Assisted Breast Cancer Screening**

Breast cancer screening is one of the most extensively investigated clinical applications of AI. Mammography interpretation requires the identification of potentially malignant abnormalities, often within large screening populations. AI-supported systems can assist radiologists by highlighting suspicious findings, estimating the likelihood of malignancy, and supporting the prioritization of examinations. The Mammography Screening with Artificial Intelligence (MASAI) trial evaluated AI-supported screening compared with standard double reading [5].

Subsequent analyses reported increased cancer detection and reduced screen-reading workload in the AI-supported screening group [6]. A later analysis of interval cancers demonstrated noninferior interval cancer rates and improved sensitivity with AI-supported screening compared with standard double reading [7]. These findings provide evidence that carefully evaluated AI systems can contribute to screening efficiency and diagnostic performance. However, benefits may depend on the particular algorithm, screening protocol, radiologist involvement, and patient population.

**5.2 AI in Lung Cancer Detection**

Lung cancer screening frequently involves low-dose computed tomography, which can identify pulmonary nodules requiring further evaluation. Deep learning models have been developed to analyze three-dimensional CT images and estimate lung cancer risk. Ardila and colleagues demonstrated the potential of deep learning for lung cancer screening using low-dose chest CT [8].

AI-assisted systems may help clinicians recognize suspicious pulmonary lesions and evaluate patterns across imaging studies. Nevertheless, false-positive findings can lead to unnecessary testing, while false-negative results may delay diagnosis. AI-based screening tools therefore require external validation and careful assessment of their clinical consequences.

**5.3 AI in Digital Pathology**

Histopathological examination remains central to cancer diagnosis and classification. Digital pathology enables tissue slides to be converted into high-resolution images that can be analyzed computationally. Ehteshami Bejnordi and colleagues evaluated deep learning algorithms for identifying breast cancer lymph node metastases, demonstrating strong performance by selected systems under controlled conditions [9].

AI may also assist with identifying tissue characteristics associated with molecular alterations. For example, Kather and colleagues demonstrated that deep learning could predict microsatellite instability directly from histological images in gastrointestinal cancer datasets [10]. Such approaches may eventually support prioritization of confirmatory testing and improve the efficiency of molecular evaluation. However, image-derived predictions should not replace validated molecular tests when those tests are required for treatment decisions.

**5.4 AI in Prostate Cancer Assessment**

Prostate cancer management requires interpretation of prostate-specific antigen measurements, clinical risk factors, magnetic resonance imaging, histopathology, and disease stage. AI is being investigated for prostate imaging analysis, lesion identification, pathological grading, and risk stratification.These approaches may eventually support more individualized clinical assessment and treatment discussions.

For oncology and primary care advanced practice providers, AI-generated information may become an additional resource during shared decision-making. Nevertheless, established screening recommendations, validated diagnostic methods, and patient preferences must remain central to clinical decisions.

## VI. ARTIFICIAL INTELLIGENCE IN CANCER TREATMENT PLANNING

### 6.1 Precision Oncology

Precision oncology seeks to tailor treatment according to the biological and molecular characteristics of a patient's cancer. Treatment selection may involve interpretation of genomic alterations, molecular biomarkers, tumor histology, clinical staging, and previous treatment response.

AI may assist clinicians by organizing complex datasets and identifying relationships between tumor characteristics and potential treatment strategies. Elemento and colleagues discussed the potential role of AI in cancer therapeutic decision-making, emphasizing both opportunities for personalized treatment and the need for clinical validation [3]. Recent reviews have also highlighted opportunities to integrate imaging, molecular information, electronic health records, and clinical research findings across the cancer care continuum [4]. However, an algorithm-generated treatment recommendation must be evaluated against established clinical evidence, regulatory indications, and individual patient circumstances.

### 6.2 AI in Chemotherapy and Systemic Treatment

Systemic cancer treatment can cause substantial adverse effects, including myelosuppression, nausea, vomiting, neuropathy, fatigue, infections, and organ toxicity. AI-based predictive models may be developed to estimate the likelihood of complications using patient characteristics, laboratory results, comorbidities, and treatment-related information. Such models could potentially support the identification of patients who require closer monitoring or additional supportive care. For example, a validated predictive system might flag a patient with multiple risk factors for severe treatment toxicity and prompt a clinician to review the treatment plan and monitoring strategy. However, treatment dosing, dose modifications, and interruption decisions require qualified clinical judgment and adherence to established oncology protocols. AI-generated predictions should not independently determine these decisions.

### 6.3 AI in Immunotherapy

Immunotherapy has become an important treatment option for several malignancies. Although immune checkpoint inhibitors have improved outcomes for selected patients, treatment responses vary, and immune-related adverse events can affect multiple organ systems.

Researchers are investigating whether AI can assist with predicting immunotherapy response by integrating molecular biomarkers, tumor characteristics, and radiological findings [3,4]. AI-supported risk prediction may also eventually contribute to the monitoring of treatment-related complications. Nevertheless, immune-related adverse events may develop unpredictably. Patients experiencing concerning symptoms require timely assessment regardless of algorithm-generated risk estimates.

### 6.4 AI in Radiation Oncology

Radiation therapy requires accurate identification of treatment targets and surrounding organs at risk. AI-assisted technologies may support image segmentation, anatomical contouring, treatment planning, and quality assurance. Automated contouring can potentially reduce time spent on repetitive planning tasks and improve workflow consistency. However, anatomical variations, imaging artifacts, and changes in tumor characteristics can introduce errors. AI-generated treatment plans must therefore be reviewed and approved by qualified radiation oncology professionals before clinical use.

## VII. ARTIFICIAL INTELLIGENCE IN CANCER SYMPTOM MANAGEMENT

### 7.1 Importance of Symptom Monitoring

Patients receiving cancer treatment frequently experience physical and psychological symptoms that affect quality of life, treatment adherence, and healthcare utilization. Common symptoms include pain, fatigue, nausea, vomiting, diarrhea, constipation, mucositis, appetite changes, sleep disturbance, anxiety, and depression. Some complications, including febrile neutropenia, sepsis, bleeding, and severe treatment-related toxicity, require urgent evaluation. Early identification of clinical deterioration is therefore a major responsibility of oncology healthcare teams.

### 7.2 Electronic Patient-Reported Outcomes

Electronic patient-reported outcome systems allow patients to communicate symptoms between scheduled visits. In a randomized trial, Basch and colleagues demonstrated that structured electronic symptom monitoring during routine cancer treatment was associated with improved health-related quality of life and reduced emergency

department utilization [11]. A subsequent analysis reported improved overall survival among patients assigned to electronic symptom monitoring [12]. A later randomized clinical trial also examined electronic symptom monitoring among patients with metastatic cancer [13]. These studies support the importance of structured symptom reporting and timely clinical responses.

However, the interventions studied were not necessarily AI systems. Many electronic symptom monitoring platforms rely on predefined alert thresholds rather than machine learning. AI could potentially extend these approaches by analyzing symptom trajectories, integrating laboratory results, and estimating future deterioration risk. The additional benefit of AI over established symptom monitoring systems must be demonstrated through comparative clinical research.

### 7.3 Predicting Treatment-Related Complications

AI-assisted monitoring may incorporate clinical variables such as vital signs, laboratory trends, treatment characteristics, and patient-reported symptoms. Potential applications include identifying patients at increased risk of hospitalization, severe treatment toxicity, or urgent clinical deterioration. For example, an oncology clinic could evaluate a validated predictive model that identifies concerning combinations of symptoms and laboratory abnormalities. The model could prompt a nurse practitioner to review the patient's condition and determine whether further evaluation is necessary. However, AI systems must not delay urgent assessment when clinical findings suggest a potentially life-threatening complication.

### 7.4 AI and Quality of Life

Quality of life is a multidimensional concept involving physical functioning, emotional well-being, social relationships, independence, and personal satisfaction. AI-enabled supportive care systems may help identify persistent symptom patterns and patients who could benefit from additional services. Potential applications include individualized education, symptom tracking, rehabilitation support, and coordination of supportive care referrals. However, quality-of-life improvement cannot be assumed solely because an AI system identifies symptoms accurately. Meaningful benefit requires timely clinical interventions, patient engagement, and ongoing evaluation.

## VIII. ROLE OF ONCOLOGY NURSES AND ADVANCED PRACTICE PROVIDERS

### 8.1 AI-Assisted Clinical Assessment

Oncology nurses and advanced practice providers frequently assess patients with complex treatment-related concerns. AI-supported systems may help organize laboratory results, identify changes in symptom patterns, and summarize relevant clinical information. These capabilities may support more efficient assessment, particularly in busy oncology practices. Nevertheless, AI-generated recommendations should be considered supplementary information rather than independent clinical conclusions. The clinician remains responsible for interpreting findings, conducting appropriate assessments, and developing individualized management plans.

### 8.2 Early Recognition of Clinical Deterioration

Patients receiving chemotherapy, immunotherapy, or other systemic treatments may develop complications requiring immediate attention. These include infection, cytopenias, dehydration, electrolyte disturbances, bleeding, and treatment-related organ dysfunction. AI-based predictive models may eventually support early identification of concerning clinical patterns. However, direct clinical assessment and established emergency protocols must remain the foundation of safe care. Nurses and advanced practice providers should be trained to recognize situations in which algorithm-generated information conflicts with clinical findings.

### 8.3 Patient Education

Patient education is an essential component of oncology nursing practice. Patients require accurate information about treatment plans, medication administration, adverse effects, infection precautions, symptom reporting, and follow-up appointments. AI-assisted tools may help develop educational materials using language appropriate to different health literacy levels. They may also support translation and organization of complex information. However, generative AI can produce incorrect or misleading explanations. Healthcare professionals must review educational content before providing it to patients.

### 8.4 Clinical Documentation

Oncology documentation frequently involves extensive review of treatment histories, laboratory results, imaging findings, and symptom assessments. AI-assisted documentation systems may help summarize encounters and reduce repetitive administrative work. Potential benefits include improved efficiency and greater time available for patient interaction. However, automatically generated notes may contain inaccuracies, omissions, or

unsupported statements. Clinical documentation must therefore be verified and approved by the responsible healthcare professional.

### 8.5 Multidisciplinary Collaboration

Cancer treatment involves collaboration among medical oncologists, hematologists, advanced practice providers, nurses, pharmacists, radiologists, pathologists, radiation oncology professionals, and supportive care specialists. AI may assist by organizing relevant information and identifying potential gaps in care coordination. However, effective teamwork requires direct communication, shared accountability, and timely clinical decision-making. Technology should strengthen these processes rather than replace professional interaction.

### 8.6 Nursing Leadership in AI Implementation

Nursing leadership is essential when introducing AI into clinical practice. Nurses can contribute to identifying workflow needs, evaluating usability, developing staff education, and monitoring safety outcomes. Topol emphasized the importance of combining human clinical expertise with AI capabilities rather than treating technological systems as substitutes for healthcare professionals [14]. Advanced practice nurses can participate in quality improvement projects evaluating AI-assisted documentation, symptom monitoring, patient education, and clinical decision support. Their involvement can help ensure that technology addresses practical patient care needs.

## IX. POTENTIAL BENEFITS OF ARTIFICIAL INTELLIGENCE IN ONCOLOGY

AI may offer several benefits when appropriately validated and implemented.

**Improved diagnostic efficiency:** AI-supported imaging and pathology systems may help clinicians identify abnormalities and prioritize cases requiring further assessment.

**Enhanced risk stratification:** Predictive models may integrate multiple clinical variables to identify patients requiring additional monitoring.

**Support for individualized treatment:** AI may assist in interpreting molecular and clinical information relevant to precision oncology.

**Reduced administrative workload:** Automated documentation and data organization may improve workflow efficiency.

**Improved symptom surveillance:** AI may extend electronic symptom monitoring by identifying complex longitudinal patterns.

**Research support:** AI may assist with data analysis, clinical trial screening, and the organization of scientific information.

However, these benefits vary across technologies and clinical environments. Improvements in algorithm accuracy or workflow efficiency do not necessarily establish improvements in patient survival, safety, or quality of life.

## X. ETHICAL AND CLINICAL CHALLENGES

### 10.1 Patient Privacy and Confidentiality

Cancer care involves highly sensitive medical information, including diagnoses, treatment histories, genomic data, and personal health records. AI systems may require access to substantial quantities of patient information. Healthcare organizations must establish appropriate data governance, cybersecurity safeguards, and access controls. Patient-identifiable information should not be entered into unapproved external AI platforms.

### 10.2 Algorithmic Bias

AI models may perform differently across patient populations. Differences in training data, demographic representation, healthcare access, and diagnostic practices may contribute to unequal performance. Seyyed-Kalantari and colleagues demonstrated underdiagnosis bias in AI algorithms applied to chest radiographs among underserved patient populations [15]. Although this investigation was not limited to oncology, its findings are relevant to cancer-related diagnostic AI because similar disparities could affect the interpretation of clinical images. Healthcare organizations should evaluate algorithm performance across relevant patient groups and monitor for unintended disparities.

### 10.3 Clinical Validation and Generalizability

AI systems may perform well in development datasets but less effectively in real-world practice. Kelly and colleagues identified important challenges in translating AI research into clinically meaningful healthcare applications [16]. These challenges include data quality, external validation, workflow integration, and demonstration of patient benefit. Prospective evaluation is especially important when AI-generated outputs may influence clinical decisions.

### 10.4 Automation Bias

Automation bias occurs when users place excessive confidence in computer-generated recommendations. In oncology, this could result in delayed recognition of complications or inappropriate reliance on an automated risk estimate. Clinical training should emphasize the need to evaluate AI-generated information critically.

### 10.5 Transparency and Explainability

Some AI systems produce predictions without providing a clear explanation of the factors influencing their conclusions. Limited transparency can make it difficult for clinicians to assess whether a recommendation is appropriate. Healthcare professionals should understand the intended use, performance limitations, and uncertainty associated with each AI system.

### 10.6 Ethical Governance

The World Health Organization has emphasized the importance of transparency, accountability, patient safety, equity, and human oversight in the development and use of AI for healthcare [17]. These principles are particularly important in oncology because clinical decisions may have substantial consequences for patient outcomes. AI implementation should therefore include governance policies, staff education, quality monitoring, and clearly defined professional responsibilities.

## XI. SUMMARY OF SELECTED EVIDENCE

| Author and year | Area of application | Key contribution |
|---|---|---|
| Lång et al., 2023 [5] | Breast cancer screening | Evaluated the safety of AI-supported mammography screening |
| Hernström et al., 2025 [6] | Breast cancer detection | Reported improved cancer detection and reduced reading workload |
| Gommers et al., 2026 [7] | Mammography | Evaluated interval cancers and screening performance |
| Ardila et al., 2019 [8] | Lung cancer screening | Demonstrated deep learning applications in low-dose chest CT |
| Ehteshami Bejnordi et al., 2017 [9] | Digital pathology | Evaluated AI identification of lymph node metastases |
| Kather et al., 2019 [10] | Molecular pathology | Demonstrated prediction of microsatellite instability from histology |
| Basch et al., 2016 [11] | Symptom monitoring | Demonstrated benefits of electronic patient-reported symptom monitoring |
| Basch et al., 2017 [12] | Symptom monitoring | Reported overall survival findings from electronic symptom monitoring |
| Elemento et al., 2025 [3] | Treatment decision support | Reviewed AI applications in therapeutic decision-making |
| Seyyed-Kalantari et al., 2021 [15] | Algorithmic bias | Identified disparities in diagnostic AI performance |

## XII. DISCUSSION

Artificial intelligence is becoming an increasingly influential technology in oncology. Its potential applications extend from early cancer detection to treatment planning, clinical documentation, and supportive care. The strength of available evidence, however, differs considerably across these areas.

AI-assisted diagnostic imaging has demonstrated promising results in selected clinical trials. The MASAI trial and subsequent analyses provide evidence that AI-supported mammography can improve aspects of screening performance and reduce reading workload [5–7]. Similarly, research in lung cancer imaging and digital pathology has demonstrated the ability of deep learning systems to identify clinically relevant patterns [8–10]. However, strong diagnostic performance does not automatically establish improved long-term outcomes.

The evidence supporting AI-assisted treatment selection remains more limited. Precision oncology applications may help clinicians organize complex molecular and clinical information, but recommendations require careful validation and multidisciplinary interpretation [3,4]. In symptom management, electronic patient-reported outcome studies provide important evidence that structured monitoring and timely clinical responses can improve patient outcomes [11–13]. These findings establish a foundation for further investigation of AI-enhanced monitoring systems, but they should not be interpreted as proof that AI itself improves survival or quality of life.

For oncology nurses and advanced practice providers, AI may be most useful when it improves the availability and organization of relevant clinical information. Nurses frequently serve as the first point of contact for patients reporting treatment-related symptoms. AI-assisted monitoring could potentially support prioritization of follow-up, while automated documentation may reduce administrative workload. Nevertheless, clinical assessment, empathy, communication, and professional accountability remain essential.

Cancer care involves substantial uncertainty and emotional distress. Patients require individualized explanations, compassionate support, and shared decision-making. AI systems cannot independently provide the human understanding and therapeutic relationships required for comprehensive oncology care. The most appropriate approach is therefore a collaborative model in which AI supports healthcare professionals while preserving human clinical judgment.

## XIII. IMPLICATIONS FOR ONCOLOGY NURSING PRACTICE

The increasing use of AI has important implications for nursing education, clinical practice, leadership, and research. Nursing education programs should introduce foundational concepts related to machine learning, predictive analytics, data privacy, and algorithmic bias. Continuing education should help practicing nurses understand the intended use and limitations of AI technologies encountered in clinical settings.

Healthcare organizations should involve oncology nurses in selecting and evaluating AI systems, particularly those affecting patient monitoring, documentation, education, and clinical triage. Implementation should include staff training, clearly defined escalation procedures, mechanisms for reporting errors, and ongoing evaluation of clinical outcomes.

Advanced practice nurses may also contribute to research examining whether AI-assisted interventions improve patient safety, clinical efficiency, and patient experience.

Potential outcome measures include:

- Time from symptom reporting to clinical assessment.
- Frequency of unplanned emergency department visits.
- Treatment-related hospitalizations.
- Patient-reported symptom burden.
- Documentation accuracy and completeness.
- Clinician workload and satisfaction.
- Patient understanding of treatment-related precautions.

These outcomes would provide meaningful evidence of clinical benefit beyond technical measures of algorithm performance.

## XIV. FUTURE DIRECTIONS

Future research should prioritize prospective evaluation of AI systems in real-world oncology settings. Multicenter studies are needed to determine whether algorithms perform consistently across different institutions and patient populations. Additional research should examine whether AI-assisted symptom monitoring improves early intervention, reduces avoidable healthcare utilization, and enhances quality of life. Studies should also compare AI-enhanced systems with established electronic patient-reported outcome programs to determine whether AI provides additional benefit.

Generative AI applications require further evaluation regarding factual accuracy, readability, patient understanding, and clinical documentation quality. Nursing-led research could investigate the effects of AI on clinical workflow, communication, professional decision-making, and patient safety. Future implementation studies should also assess cost-effectiveness, cybersecurity requirements, staff training, and long-term maintenance. Greater attention should be directed toward ensuring equitable access to AI technologies and preventing the expansion of existing healthcare disparities.

## XV. LIMITATIONS

This narrative review has several limitations. First, it does not include an exhaustive systematic search, and relevant publications may have been omitted. Second, the included evidence represents heterogeneous technologies, research designs, clinical populations, and outcomes. Third, some AI applications discussed remain investigational, and their potential benefits should not be interpreted as established clinical effectiveness. Fourth, the rapid development of AI technologies may result in changes to regulatory status, clinical capabilities, and available evidence. Finally, no formal meta-analysis or standardized risk-of-bias assessment was performed. Consequently, the conclusions should be interpreted as a clinically oriented synthesis rather than definitive estimates of AI effectiveness.

## XVI. CONCLUSION

Artificial intelligence represents an important emerging technology in cancer care, with applications in early detection, diagnostic imaging, digital pathology, treatment planning, predictive analytics, and clinical information management. Selected diagnostic applications have demonstrated improvements in screening performance and workflow efficiency. However, many emerging applications involving treatment selection, toxicity prediction, and AI-assisted symptom monitoring require further prospective clinical evaluation.

Oncology nurses and advanced practice providers have important responsibilities in the safe and effective integration of AI technologies. Their expertise in patient assessment, symptom management, education, clinical decision-making, and multidisciplinary coordination is essential for translating technological innovation into meaningful improvements in patient care. AI should be viewed as a supportive clinical resource rather than a replacement for healthcare professionals.

Future progress should emphasize rigorous validation, patient safety, ethical governance, equitable implementation, and collaboration between technological systems and human clinical expertise.

**DECLARATIONS**

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**Ethical Approval:** Not applicable to a narrative literature review without human participant recruitment or identifiable patient-level data.

**Patient Consent:** Not applicable.

**Data Availability:** No original patient-level dataset was generated for this manuscript.

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