ORIGINAL ARTICLE

Artificial Intelligence in Oncology for Early Detection and Intervention: Clinical and Operational Insights from Malaysia

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ABSTRACT

Background: Cancer is a significant public health challenge in Malaysia and become a major contributor to morbidity and mortality. Early detection and timely intervention are essential to improving survival rates, yet conventional oncology services often face delays and resource constraints. Artificial Intelligence (AI) has emerged as a transformative tool capable of enhancing diagnostic accuracy, treatment planning, and patient monitoring. **Methods:** A scoping review was conducted using the PRISMA-ScR framework. Articles published between 2015 and 2025 were retrieved from PubMed, Google Scholar, and IEEE Xplore. Studies were screened and selected based on predefined inclusion and exclusion criteria, before being analysed into three clinical domains: diagnosis and screening, treatment planning, and monitoring and prognosis. **Results:** Fifteen studies were included. AI applications demonstrated improved diagnostic sensitivity and specificity, radiotherapy planning, and accurate survival prediction models. Operationally, AI contributed to enhanced workflow efficiency, cost reductions, and better decision-making support, particularly in resource-limited settings. **Conclusion:** AI shows significant promise for advancing early detection and intervention in Malaysian oncology, delivering both clinical and operational benefits.

INTRODUCTION

Cancer continues to be one of the leading causes of morbidity and mortality in Malaysia. According to the Malaysian National Cancer Registry, breast, colorectal, and lung cancers consistently rank among the most prevalent malignancies in the country (Haron et al., 2022; Sharma et al., 2024). The increasing cancer burden, driven by population aging, urbanization, and changing dietary and lifestyle habits, has placed immense strain on the nation's healthcare system. Delivering timely and accurate cancer diagnosis, personalized treatment, and long-term monitoring remains a challenge, particularly in rural or resource-limited settings where access to specialized oncology care is restricted (Lim et al., 2021; Kadir et al., 2022; Hassan et al., 2024).

To address these challenges, AI has emerged globally as a transformative force in oncology. AI refers to computational algorithms and systems designed to mimic human cognitive functions such as learning, pattern recognition, and decision-making (Mahusin et al., 2024). In the context of cancer care, AI technologies, especially those based on machine learning (ML) and deep learning (DL) are being deployed to support clinical decision-making, automate repetitive tasks, and improve data interpretation (Phang et al., 2024). By processing large and complex datasets with high precision, AI can facilitate early detection, personalise treatment strategies, and support continuous monitoring, ultimately strengthening allied health contributions to cancer care.

In Malaysia, AI integration into oncology is still in its early stages. A limited number of academic and clinical studies have begun to explore the feasibility of using AI for cancer care, often through pilot projects and prototype models (Sachithanandan et. al, 2024). Most of these efforts focus on breast and colorectal cancers, reflecting national cancer trends. Institutions such as University Malaya Medical Centre (UMMC), University Tunku Abdul Rahman Malaysia (UTAR) and University Tun Hussein Onn Malaysia have been instrumental in developing AI-based models using local datasets (Ganggayah et. al, 2021; Lim et al., 2021; Moksem & Newaz, 2024). However, these projects often remain within the scope of research and have not yet translated into widespread clinical practice.

Despite these limitations, the Malaysian government's push toward digital transformation under the National Artificial Intelligence Roadmap 2021–2025 provides a supportive backdrop for future AI implementation in healthcare (Phang et al., 2024). There is also growing interest among researchers and policymakers in harnessing AI to improve healthcare equity, particularly in

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underserved areas. Given the growing cases of cancer in Malaysia, AI offers a powerful means to enhance diagnostic accuracy, personalize treatment strategies, and streamline patient monitoring.

This scoping review aims to synthesise existing literatures on the clinical and operational impact of AI applications in oncology within Malaysian healthcare context, with a focus on early detection and intervention. It is hoped that the insights will guide researchers, clinicians, and policymakers in understanding the readiness, addressing the challenges, and leveraging the opportunities for responsible AI integration in Malaysia's cancer care ecosystem.

MATERIAL AND METHOD

Study Design

A scoping review was conducted following to the five-stage framework by Arksey & O'Malley (2005), incorporating the checklist from the Preferred Reporting Items for Systematic Reviews and Meta- Analyses extension for scoping reviews (PRISMA-Scr) (Tricco et al., 2018).

Search Strategy

Relevant research articles were selected and retrieved from credible online databases such as Google Scholar, PubMed, and IEEE Xplore. The search was guided by specific keywords, including 'Artificial Intelligence', 'Malaysia', 'Oncology', 'Applications', 'Outcomes', 'Clinical Outcomes', and 'Operational Outcomes'. Boolean operators (AND, OR) were used to combine these keywords appropriately. The 'AND' operator was used to link distinct keywords into comprehensive search strings, while the 'OR' operator was used to group the synonyms of each keyword. Examples of keywords combined using 'OR' include: "Artificial Intelligence, Machine Learning, Neural Networks, Deep Learning"; "Oncology, Cancer Study"; "Healthcare, Hospital, Institute, Clinic"; "Application, Utilisation, Usage, Integration"; and "Outcomes, Results, Impacts".

Inclusion and Exclusion Criteria

The review included study articles of any research designs which is quantitative (e.g., experimental, cross-sectional), qualitative (e.g., interviews, case studies), mixed-methods, and secondary research such as literature and systematic reviews. This broad criterion allowed diverse evidence, including technical validation studies and retrospective analyses relevant to AI applications in oncology. Eligble studies were published between 2015 and 2025, written in English, matched to the research keywords that available in full-text. Exclusions included non-English articles published before 2015 and incomplete works such as abstracts, conference papers, or posters.

Screening and Selection

Titles and abstract were screened before full-text assessment were conducted to map the findings on AI applications and outcomes in oncology. Discrepancies were resolved through discussion among the reviewers.

Data Extraction and Synthesis

The data for AI usages and outcomes were classified based on key areas of diagnostic and screening, treatment planning, and monitoring and prognosis. The findings were further synthesised, which the clinical and operational outcomes that have been reported from the application of AI in oncology in Malaysia across these clinical domains were determined.

RESULTS

A total of 1586 articles were identified for this review via three electronic databases. Following the removal of 95 duplicates, 1491 articles were selected for the screening process. The screening phase resulting in the exclusion of 1412 articles were excluded as it is not related with research keywords in the title, abstract, and publication year. Next, the articles were assessed for eligibility based on inclusion criteria and exclusion criteria which 159 articles were excluded as it does not have full text access, also excluded articles that only have abstract, conference, or incomplete papers. Overall, 15 studies were identified as being eligible for full text evaluation (Figure 1).

Study characteristics

These articles highlighted that AI applications in Malaysian oncology primarily focus on three clinical domains: diagnosis and screening, treatment planning, and m onitoring and prognosis. Across domains, reported advantages included faster diagnosis, reduced costs, and improved workflow efficiency, although challenges such as small datasets, limited local validation, and integration barriers persisted. Together, these findings provide a comprehensive view of how AI is shaping cancer care in Malaysia.

Study type

Of the 15 studies included, 6 were retrospective in design. Only two study employed a prospective study design. For three studies, the study design could not be clearly determined as either retrospective or prospective. Among the included studies, five were conducted within hospital and cancer centre settings, four were undertaken in university-based research environments, and one study was carried out in a Positron Emission Tomography–Computed Tomography scan (PET-CT) scan facility. Additionally, seven studies drew upon global datasets, with several explicitly incorporating data contributions from Malaysia, thereby enhancing the relevance of findings to the local context. This distribution of study settings and data sources highlights both the diversity and representativeness of the available evidence, while also underscoring potential variations in generalisability and applicability across different healthcare contexts (Supplement Table 1).

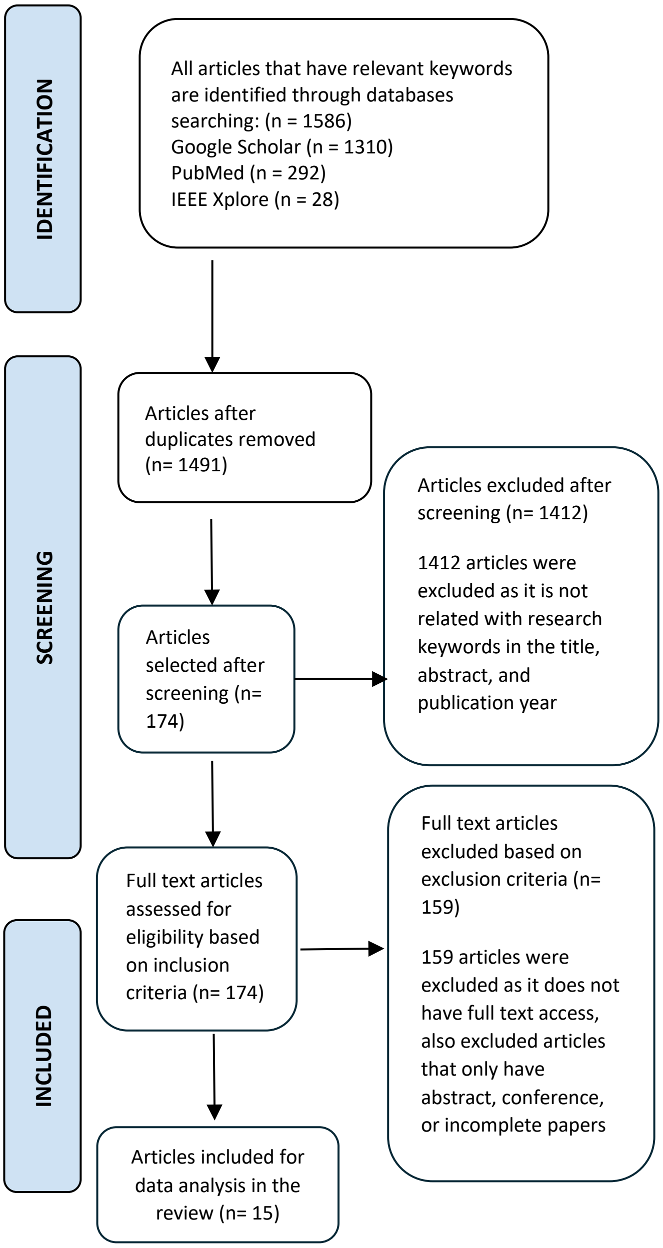

Figure 1. PRISMA-ScR flowchart

Diagnosing and Screening

AI applications in oncology have demonstrated remarkable improvements in diagnostic accuracy across multiple cancer types in Malaysia. For breast cancer, Lim et al. (2021) reported that a hybrid Support Vector Machine-Articial Neural Network (SVM-ANN) model achieved 99.4% diagnostic accuracy, with sensitivity of 100% and specificity of 97.7%. Similarly, Ling et al. (2022) showed that integrating circulating micro RNA (miRNA) profiles with machine learning achieved over 90% accuracy in breast cancer detection, while Zhang et al. (2024) demonstrated that big-data AI models incorporating multi-omics datasets could detect breast tumors with 99% accuracy. In lung cancer, AI-assisted chest X-rays improved sensitivity from 66.4% to 74.7% and reduced false-positive rates from 0.25 to 0.18 (Sachithanandan et al., 2024). For gastric cancer, hybrid deep learning models reached 99.49% classification accuracy (Mirza et al., 2023). Collectively, these findings highlight that AI enhances early detection and diagnostic precision, which is critical for timely intervention.

Beyond clinical performance, AI has also significantly improved operational efficiency in diagnostic workflows. Lim et al. (2021) found that hybrid SVM-ANN models reduced the manual burden on radiologists and accelerated diagnostic turnaround times. Ling et al. (2022) reported that combining circulating miRNA with AI reduced reliance on invasive tissue biopsies and shortened the diagnostic process. In lung cancer, AI-assisted chest X-rays facilitated more efficient referrals for low-dose CT scans and lowered unnecessary follow-ups (Sachithanandan et al., 2024). Similarly, for gastric cancer, Mirza et al. (2023) suggested that AI could potentially reduce unnecessary endoscopies, optimizing resource utilization. These operational benefits demonstrate that AI not only improves accuracy but also enhances workflow efficiency, supporting timely patient management and intervention.

Treatment Planning

AI has significantly improved the precision and effectiveness of oncology treatment planning in Malaysia. In radiotherapy, Moksem and Newaz (2024) reported that AI-based planning reduced tumor contouring errors by 60%, while Aggarwal et al. (2023) found that 95% of AI-generated radiotherapy plans met international clinical standards. For chemotherapy, AI-optimized regimens led to a 20% reduction in treatment-related toxicity (Abdul Rasool Hassan et al., 2025). AI has also enhanced targeted therapies, with Poh et al. (2023) demonstrating that AI-supported selection of Anaplastic Lymphoma Kinase (ALK) -targeted therapy increased patient survival to 62 months with first-generation ALK inhibitors. Furthermore, Faiz et al. (2024) showed that AI-assisted genetic profiling enabled more precise targeted therapies for gastric cancer patients. Collectively, these findings indicate that AI not only improves treatment accuracy but also optimizes clinical outcomes across radiotherapy, chemotherapy, and targeted therapy.

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Monitoring and Prognosis

AI applications have markedly enhanced monitoring and prognostic accuracy in oncology. For breast cancer, Kadir et al. (2022) demonstrated that an ANN model achieved 84.5% accuracy in predicting 5-year survival, while Ganggayah et al. (2021) reported that a Random Forest model reached 92.5% survival prediction accuracy. AI-based volumetric tumor monitoring also improved therapy response assessment, as shown by Mahdi et al. (2024), providing more precise and timely evaluations of tumor progression. In gastric cancer, AI models outperformed conventional Model for End-Stage Liver Disease (MELD) scores in predicting mortality (Faiz et al., 2024), and in lung cancer, AI-assisted follow-up enabled earlier detection of malignant nodules (Sachithanandan et al., 2024). Collectively, these studies indicate that AI supports more accurate prognostic assessments, facilitating earlier interventions and tailored patient management.

AI has also improved operational efficiency in patient monitoring and prognosis. Personalized follow-up plans for breast cancer patients were facilitated by AI predictions, optimizing resource allocation (Kadir et al., 2022), while longitudinal follow-up of over 1,000 patients was streamlined using Random Forest (RF) survival models (Ganggayah et al., 2021). Volumetric tumor monitoring reduced manual measurement bias, enhancing workflow efficiency in therapy assessments (Mahdi et al., 2024). AI-assisted prognostic models also enabled better ICU triaging for gastric cancer patients (Faiz et al., 2024) and decreased missed diagnoses during lung nodule follow-up (Sachithanandan et al., 2024). These operational improvements highlight AI's capacity to optimize patient monitoring, support timely clinical decisions, and enhance overall healthcare efficiency.

DISCUSSION

To our knowledge, this is the most recent scoping review examining the applications of artificial intelligence in oncology within the Malaysian context. A total of 15 studies were identified, covering diverse domains including diagnosis and screening, treatment planning, and monitoring and prognosis. Among these, diagnostic applications were the most frequently reported, reflecting the growing use of AI to support cancer detection and early intervention.

Majority of the studies relied on retrospective data sources. Only one prospective case-control design was reported, and no prospective cohort studies or randomized controlled trials were identified. This highlights the methodological gap in robust validation of AI models in real-world clinical practice. The findings underscore the need for future research to move beyond retrospective analyses and adopt prospective, multi-center, or randomized designs. Such approaches are essential to strengthen evidence on the reliability, generalizability, and clinical utility of AI applications for cancer care in Malaysia.

Nevertheless, AI has played a transformative role across all domains of oncology care, including diagnosis and screening, treatment planning, and monitoring and prognosis; enabling more precise, personalised, and efficient patient management. In Malaysia, AI applications have demonstrated substantial improvements in early detection, optimising therapy selection and radiation dosing, personalising chemotherapy regimens, and predicting patient outcomes, with benefits reported for both clinical and operational performance.

The majority of the studies concentrated on the clinical domain of diagnosis and screening, with fewer studies addressing treatment planning and monitoring and prognosis. Most studies relied on retrospective datasets, and only a few used locally sourced Malaysian clinical data, constraining the generalizability of findings to the national healthcare landscape (Mirza et al., 2024).

Some articles explored AI-driven optimization of chemotherapy regimens; however, these applications remain largely in academic or pilot stages, without large-scale deployment in clinical environments. Whereas, in the monitoring and prognosis domain, AI models were developed to predict patient survival rates, disease progression, and recurrence risks, often with high sensitivity and specificity. Nevertheless, the lack of prospective studies limits confidence in their real-world reliability (Kadir et al., 2022; Aggarwal et al., 2023).

Most AI applications were implemented in academic or simulation-based evaluations rather than routine clinical practice. For instance, Moksem and Newaz (2024) carried out a clinical system evaluation study which applying AI-driven radiotherapy planning into radiation oncology departments in UNIRAZAK and UMMC. Similarly, a study conducted by Abdul Rasool Hassan et al. (2025) shown a predictive AI model that has capability in predicting the chemotherapy toxicity by relying on the patient records.

In lung cancer, AI research has focused on improving screening accuracy, radiotherapy precision, and treatment decision support. AI-enhanced imaging systems have demonstrated significant promise in early detection. For example, Sachithanandan et al. (2024) showed that AI-assisted interpretation of chest X-rays combined with low-dose computed tomography (LDCT) increased the sensitivity for detecting early-stage non–small cell lung cancer (NSCLC) and reduced false positives, thereby improving population-based screening efficiency.

Whereas for treatment planning, AI has revolutionized radiotherapy by improving dose precision and minimizing radiation exposure to surrounding tissues. Mahdi et al. (2024) introduced an AI-enabled fusion transformer model for PET/CT-based segmentation in head and neck and lung tumors, achieving superior performance compared to manual delineation. Similarly, Abdul Rasool Hassan et al. (2025) reported that AI-assisted chemotherapy development and selection tools enhanced therapeutic effectiveness while reducing toxicity profiles.

Furthermore, a retrospective study conducted by Poh et al. (2023) in 18 hospitals in Malaysia which a decision support system for ALK positive non-small cell lung cancer (NSCLC) using a molecular diagnostic was combined with AI algorithms for drug matching. The model was tested within clinical oncology services and it has presented evidence that AI-supported decision-making in ALK-targeted therapy selection extended median survival to 62 months in patients receiving first-generation ALK inhibitors. This underscores the potential of AI to directly influence long-term patient outcomes when integrated into precision oncology workflows.

Various AI model have also been applied to assist in early detection, treatment optimization, and outcome prediction of breast cancer. Diagnostic models using hybrid SVM–ANN model (Lim et al., 2021) and multi-omics big data approaches (Zhang et al., 2024) have achieved diagnostic accuracies exceeding 95%, demonstrating AI's capability to identify malignant lesions from mammography and histopathology images with minimal human bias. These innovations support radiologists in large-scale screening programs by reducing false negatives and enhancing the detection of early-stage breast lesions.

AI also contributes significantly to treatment planning and prognostic modeling by developing machine learning models that predict survival probabilities and guide treatment selection based on clinical and pathological parameters (Kadir et al., 2022). Such model enable oncologists to tailor therapeutic intensity to patient-specific profiles and to identify high-risk individuals who may benefit from more intensive follow-up.

Meanwhile, in colorectal cancer, AI adoption in colorectal cancer has been applied in endoscopic diagnostics and prognostic prediction. AI-enabled colonoscopy systems using deep convolutional neural networks have shown remarkable efficacy in real-time polyp and adenoma detection, achieving sensitivities exceeding 96% (Faiz et al., 2024). These systems improve lesion recognition and procedural safety, contributing to earlier diagnosis and reduced colorectal cancer mortality.

Several systemic barriers limit the broader implementation of AI in Malaysian healthcare. Among the most significant are the lack of standardized and high-quality local datasets required for training AI models, as well as inadequate digital infrastructure and high-performance computing capabilities in public hospitals (Poh et al., 2023; Moksem & Newaz, 2024). Additionally, many clinicians remain unfamiliar with AI technology and lack the training to effectively interpret or validate AI-generated recommendations (Aggarwal et al., 2023). On a regulatory level, Malaysia does not yet have dedicated policies or legal frameworks that govern the clinical use of AI, raising ethical concerns about patient data privacy, algorithmic transparency, and liability in the event of clinical error (Putera et al., 2021; Phang et al., 2024).

In another study which Aggarwal et al. (2023) reported that 95% of AI-generated radiotherapy plans met international clinical standards, achieving reductions in planning time from weeks to minutes, which is crucial for timely cancer treatment initiation. Though it has shown a good result in the radiotherapy, this system however was limited to facilities with advanced infrastructure and personnel trained in AI systems.

In contrast with other country, for example, Shi et al. (2025) provided a comprehensive review of AI applications in high-dose-rate (HDR) brachytherapy for cervical cancer, highlighted several pilot and retrospective studies showing promising results in reducing planning time, increasing plan conformity, and improving dosimetric outcomes, but also emphasized the lack of standardization, limited datasets, and high technical barriers for clinical integration. So, while Aggarwal et al. (2023) presented real-world evidence of AI integration in external beam radiotherapy (RT) planning at scale, demonstrating operational success and feasibility, Shi et al. (2025) offered a technical roadmap for AI applications in High-Dose-Rate (HDR) brachytherapy, underlining theoretical advantages but with limited clinical adoption. Both has affirmed AI's potential to revolutionise radiotherapy planning, but differ in maturity as Aggarwal's model is validated in clinical settings, while Shi's represents a still-developing frontier.

AI is transforming cancer care by improving survival prediction, follow-up efficiency, and clinical decision-making**,** offering new avenues for personalized treatment and patient management. Comparing Malaysia and China provides valuable insight into how different healthcare settings, population needs, and clinical priorities shape the design and application of AI-based prognostic models**.**

In Malaysia, the iSurvive model developed by Ganggayah et al. (2021) represents a holistic, long-term care approach for survivors**,** integrating demographic, lifestyle, and clinical variables to predict survival outcomes and support ongoing patient engagement. This aligns with Malaysia's growing emphasis on survivorship programs and long-term quality-of-life monitoring for breast cancer patients. In contrast, the model introduced by Zhen et al. (2024) in China adopts a focused, short-term mortality risk strategy for targeted intervention, emphasizing modifiable lifestyle factors to identify high-risk patients for early management. This reflects China's healthcare priority of early mortality reduction in a population with diverse lifestyle-related risk factors.

The comparative analysis highlights how AI's flexibility allows adaptation to different national priorities, from survivorship monitoring in Malaysia to mortality prediction in China. Despite their strong predictive performance, iSurvive achieving over 90% survival prediction accuracy and Zhen's model demonstrating high AUC values for 1- and 3-year mortality. Although both models demonstrate strong predictive performance, further external validation, improved data completeness, and seamless software integration are essential before widespread adoption. These findings highlight AI's potential as a flexible and powerful tool in oncology, capable of supporting diverse clinical goals across different healthcare systems.

CONCLUSION

This scoping review explored the applications of Artificial Intelligence (AI) in oncology within the Malaysian context, categorising evidence into three clinical domains—diagnosis and screening, treatment planning, and monitoring and prognosis—and assessing their clinical and operational outcomes.

The findings demonstrate that AI has delivered measurable benefits in enhancing diagnostic accuracy, optimising treatment workflows, and enabling personalised patient monitoring. In diagnosis and screening, AI models such as convolutional neural networks (CNNs) and support vector machines (SVMs) have improved sensitivity, specificity, and early cancer detection rates, particularly for breast, colorectal, and lung cancers. In treatment planning, AI has reduced radiotherapy planning times, enhanced dose prediction accuracy, and supported personalised chemotherapy selection. In monitoring and prognosis, AI-driven survival prediction models, recurrence risk tools, and mobile health platforms have facilitated continuous follow-up and proactive patient management.

From an operational perspective, AI has contributed to improved workflow efficiency, reduced specialist workloads, prioritised urgent cases, and lowered healthcare costs in resource-constrained settings. These benefits are especially relevant for Malaysia, where oncology services often face constraints in manpower, infrastructure, and access to specialised care.

However, the review also identified several barriers limiting widespread AI adoption. Infrastructure gaps, particularly in high-performance computing and digital health integration, remain significant. The scarcity of large, standardised, and representative Malaysian datasets restricts the robustness and generalisability of AI models. Clinician readiness and training in AI use are limited, while ethical concerns, such as patient data privacy, algorithm transparency, and liability in medical decision-making require urgent attention.

The limitations of this review include its restriction to studies published between 2015 and 2025, which may have excluded earlier relevant works. Only English-language publications with full-text access were included, potentially omitting valuable data from non-English sources or conference proceedings. Additionally, the review focused solely on Malaysian oncology, meaning that broader global trends and innovations were not assessed in depth. Finally, as a scoping review, the study did not conduct formal quality appraisal of included articles, which may limit the interpretability of the findings.

Nevertheless, AI holds substantial promise in transforming cancer care delivery in Malaysia by enhancing accuracy, efficiency, and personalisation across the cancer care continuum. Realising this potential will require strategic investments in infrastructure, capacity building, data governance, and regulatory frameworks. Collaborative efforts between healthcare providers, researchers, policymakers, and technology developers will be critical to ensuring that AI adoption is ethical, equitable, and sustainable, ultimately improving outcomes for cancer patients nationwide.

AI has demonstrated substantial potential to enhance oncology care in Malaysia across diagnosis and screening, treatment planning, and monitoring/prognosis. By improving early detection, optimizing therapy selection, and enabling precise prognostic assessment, AI supports timely interventions and personalized patient management. Operationally, these applications streamline workflows, reduce clinician burden, and improve resource allocation.

Despite promising results, most studies remain retrospective, pilot-based, or simulation-focused, with limited use of locally sourced Malaysian data. Future research should prioritize prospective trials, local dataset development, and real-world implementation to ensure clinical reliability and scalability.

Integrating AI into oncology care aligns with the allied health mandate to promote prevention, early detection, and efficient intervention, ultimately improving patient outcomes and supporting evidence-based practice in Malaysia's healthcare system.

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Supplementary Table 1

Table 1: Characteristics of articles reviewed: Types of study designs and study findings

Authors	Data Collection Method	Study Setting	AI Outcome in Diagnosis & Screening	AI Outcome in Treatment Planning	AI Outcome in Monitoring & Prognosis	Advantages (Clinical/Operational)	Limitations
Mohd Nor et al. (2019)	Retrospective	University Malaya Medical Centre (UMMC), Malaysia	Standardized data improved diagnosis; time to diagnosis reduced to 16.8 days	Enhanced multidisciplinary treatment planning with data sharing and e-prescription	6,974 follow-ups tracked; survival analysis supported	Faster diagnosis, fewer errors, better data quality	Resistance by clinicians; partial interoperability; limited AI integration
Sachithanandan et al. (2024)	Neither retrospective not prospective	Klang Valley, Malaysia	AI-assisted X-rays improved sensitivity (66.4%→74.7%)	Prioritized high-risk cases for LDCT; reduced unnecessary scans	Tracked nodules for early intervention	Cost-effective, scalable, faster diagnosis	Poor follow-up adherence; technical barriers; clinician skepticism
Ganggayah et. al, 2021	Prospective	UMMC, Malaysia	ML identified survival predictors (BMI, stage, etc.)	AI-guided personalized treatment strategies	Longitudinal QoL and survival prediction	92.5% survival prediction accuracy; streamlined data	Missing data issues; software integration problems; external validation needed

Faiz et. al, 2024	Neither retrospective not prospective	Global (including Malaysia's hospital and research settings)	AI in endoscopy improved colorectal polyp detection (96.4% sensitivity)	AI-guided genetic therapy personalization	AI predicted cirrhosis mortality better than MELD score	Faster endoscopy, reduced costs, optimized ICU resources	Data heterogeneity; black-box AI issues; regulation challenges
Hassan et al. (2024)	retrospective	Global (including Malaysia)	ML predicted oral cancer at 78.95% accuracy	AI-guided drug delivery models	ML improved telemedicine for rural patients	Faster, cheaper drug discovery; high telemedicine satisfaction	Small datasets; generalizability concerns; limited direct clinical trials
Poh et al. (2023)	Retrospective study (MNCR data)	18 Hospitals in Malaysia	Potential AI use suggested for faster ALK detection (not implemented yet)	AI could optimize ALK inhibitor selection	AI could predict survival based on big data	ALK inhibitors extended survival vs. chemotherapy	Limited sample; cost barriers; delayed genetic testing
Kadir et al. (2022)	Retrospective cancer registry review	7 breast cancer centers, Malaysia	ANN achieved 84.5% survival prediction accuracy	Supported personalized treatment stratification	Predicted 5-year survival probability	High accuracy prediction; aided decision-making	Missing data; socioeconomic factors not included; model comparison complexity

Moksem & Newaz (2024)	Prospective (Survey)	Malaysia (UNIRAZAK and UMMC)	AI automated tumor contouring, reducing manual errors	AI improved dosimetry and beam optimization	Dynamic plan adjustments during treatment	30-60% improved efficiency; high clinical acceptability	Survey bias; unexplained variance; technical limits
Zhang et al. (2024)	Retrospective (Secondary big data analysis :TCGA, SEER)	Global (with Malaysia collaboration)	99% diagnosis accuracy (multi-omics ML models)	AI stratified tumor types for therapy	Survival and recurrence predictions from multi-omics data	Highly accurate predictions; efficient data processing	Data privacy, standardization, generalizability issues
Abdul Rasool Hassan et al. (2025)	Neither retrospective not prospective	Global (Monash University Malaysia included)	AI imaging improved early cancer detection (87% sensitivity)	ML predicted chemotherapy responses	ML predicted toxicity and progression risks	20–30% improved treatment outcomes; workflow automation	Bias, clinical validation needed, ethical concerns
Aggarwal et al. (2023)	Prospective observational study	Malaysia, India, Jordan, South Africa	AI automated contouring (target/OARs)	Reduced RT planning time from weeks to minutes	Quality assurance for plan compliance	95% plan acceptability; significant cost savings	No patient outcome tracking; infrastructure variation
Lim et al. (2021)	Retrospective(Digital mammogram	UTHM	Hybrid SVM-ANN achieved 100% benign vs.	-	-	99.4% overall diagnostic accuracy; reduced	Small , dataset only mammography used

	analysis :Mini MIAS dataset)		malignant classification			radiologist workload	
Ling et al. (2022)	Retrospective (Secondary data + Literature review)	Malaysia (UTAR, Xiamen Univ. Malaysia)	AI + miRNA biomarker profiling >90% accuracy	AI predicted personalized therapy responses	Predicted recurrence, monitored progression	Less invasive; early detection; reduced cost	miRNA variability; clinical integration challenges
Mahdi et al. (2024)	Retrospective (PET/CT imaging dataset: HECKTOR Challenge)	Multinational (including Malaysia PET/CT centers)	Improved tumor segmentation using Weighted Fusion Transformer	Accurate RT planning from better tumor maps	Tumor volumetry tracked treatment response	Faster, more accurate segmentation; reduced radiologist burden	PET/CT fusion computational complexity; lymph node segmentation
Mirza et al. (2023)	Retrospective (GC image datasets :Kvasir)	Global (incl. Malaysia, USM)	Deep learning + Hybrid optimization for GC improved classification	-	Timely relapse detection of GC lesion	Higher early GC detection rates; reduced endoscopy need	Focused only on GC cancers; the model needs further testing

*Note. The table is summary of data extraction of the selected studies. Symbols like “+” indicate and, “-” indicate no result found, “>” indicate is more than, “→” indicate to and “%“is percentages. Abbreviation is also used and explained in the list of abbreviations.