

Artificial Intelligence in cancer diagnosis and prediction: a review study

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Abstract— Artificial intelligence (AI) has emerged as a transformative technology in field of veterinary medicine and comparative oncology, permitting rapid and accurate analysis of complex clinical, histopathological, imaging, and genomic datasets. The Traditional diagnostic and prognostic procedures, although effective, are often limited by time constraints, subjective interpretation, and difficulties in processing large-scale data. Recent advances in machine learning (ML), deep learning (DL), computational pathology, and radiomics have enhanced the ability to predict, diagnose, and manage animal diseases with improved precision. The purpose of this review is to summarize and assess current applications of AI in animal disease diagnosis and prognosis, with particular emphasis on veterinary oncology and One Health perspectives. This review focuses on animal health data and veterinary clinical applications while also discussing the wider implications for human and environmental health. The reviewed studies reveal that AI-based analytical models can successfully integrate histological, clinical, imaging, and genomic information for improving disease detection, prognostication, treatment planning, and outcome prediction in animals. The deep learning and radiomics methods showed promising diagnostic performance across several veterinary modalities, principally in cancer detection and pathological assessment. Besides, AI technologies contribute to reducing the diagnostic time, lowering healthcare costs, increasing the accuracy, and supporting precision veterinary medicine. However, important challenges remain, including data heterogeneity, limited dataset availability, algorithmic bias, lack of interpretability, controlling concerns, and insufficient real-world clinical validation. In conclusion, AI has significant potential to revolutionize veterinary diagnostics and disease management by enabling more accurate and personalized approaches to animal healthcare. Collaboration among veterinarians, veterinary researchers, and commercial AI developers will be essential to achieve reliable clinical integration and maximize the benefits of AI technologies. Through the One Health framework, advancements in veterinary AI may also contribute to improving human health and environmental sustainability.

Keywords — AI, Cancer, Diagnosis

INTRODUCTION

The term cancer originates from the ancient Greek word *karkinos*, meaning “crab” or “tumor.” It was introduced into medical terminology in the 1600s and refers to the uncontrolled growth of abnormal cells with the potential to invade surrounding tissues and metastasize to distant sites (1). Cancer is a genetic disorder driven by mutations that disrupt the cellular growth and division, with tumor cells accumulating and progressive DNA alterations (2). Therefore, cancer remains a major global health concern, which requires the development of novel techniques for earlier detection, accurate diagnosis, and precise treatments (3). In 2022, there were over 20 million new cases of cancer and 10 million cancer-associated mortality cases and the most prevalent occurrence cancer kinds include lung (12.4%), breast (11.6%), and colorectal (9.6%) (4). Early cancer detection greatly improves treatment outcomes, Screening at-risk patients and promptly investigating symptoms are key strategies. Machine learning can enhance diagnosis by analyzing health records, images, biopsies, and blood examinations to support specialists in risk assessment and early detection (5). Cancer diagnosis includes three analytical components: risk assessment, recurrence prediction, and survivability assessment. The process begins with evaluating the probability of cancer development, followed by assessing the risk of cancer recurrence. Finally, predictions are made regarding disease progression, life expectancy, cancer–drug responsiveness, and overall survival outcomes (6). Artificial intelligence (AI) is a recent field focused on creating systems that simulate and enhance human intelligence (7). Artificial intelligence (AI) marks transforming in the medical examination towards healthcare facilities, providing an accepted option for interpreting histopathological image data (8). AI has shown its importance in the field of advanced medical diagnostics by offering distinctive opportunities to integrate the instruments into the healthcare sector (9,10). Computer professionals and health researchers can now work together closely to improve prognoses through the use of Logistic analyses, multi-factor assessments and traditional logistic regression because of recent technological developments in statistical and computer applications. Compared to experimental projections, these predictions have been shown to be substantially more accurate. Researchers

have recently focused on developing models that use AI algorithms to diagnose and forecast cancer as a result of the use of AI (11). This review aims to critically evaluate the current and emerging applications of artificial intelligence (AI) in veterinary medicine, particularly in the prediction, diagnosis, and management of animal diseases via the integration of histopathological, clinical, and imaging data. The review additionally highlights the roles of machine learning, deep learning and computational pathology in improving the diagnostic accuracy. In addition, discuss the main challenges associated with AI applications while emphasizing the future potential of AI within the One Health framework to enhance the animal, human, and environmental health.

DATA COLLECTION

A narrative review design was employed to synthesize current evidence on artificial intelligence applications in pathology, genomics, and oncology diagnostics published between 2017 and 2026. A structured and reproducible literature search was conducted across multiple electronic databases, including PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar, to ensure comprehensive coverage of the relevant literature.

Table 1. the studies that investigated the application of artificial intelligence in cancer diagnosis and treatment:

No.	Study Type	Source (Author, Year)	Modality	AI Method	Animal Species	Key Findings
1	Experimental	Zhang et al., 2017 (12)	Histopathology images	CNN (ResNet)	Mouse	High accuracy in early tumor detection in liver tissue
2	Experimental	Coudray, N. et al. (2018) (13)	Histopathology	CNN (Inception/ResNet)	Human	AI predicted lung cancer subtypes and key mutations with high accuracy
3	Observational	Hsu et al., 2020 (14)	MRI imaging	Deep Learning (U-Net)	Rat	Improved tumor segmentation in brain cancer models
4	Experimental	Banzato, T. et al. (2021) (15)	X-ray radiography	CNN	Dog	AI detected thoracic abnormalities in canine patients
5	Experimental	Kolisnik et al., 2023. (16)	Genomic microbiome sequencing (multi-omics data)	Random Forest	human	identified gene and microbial biomarkers distinguishing right- vs left-sided colorectal cancer with high classification accuracy.
6	Experimental	Hubbard-Perez., 2024 (17)	Histopathology whole-slide images (WSIs)	Convolutional Neural Network (CNN) / Deep Learning.	dog	The deep learning model successfully differentiated hyperplastic lymph nodes from common canine lymphoma subtypes
7	Comparative	Chen et al., 2019. (18)	Dual-energy CT	Imaging analysis	Rabbit	Differentiates tumor infiltration vs edema
8	Experimental	Vishnudas & Gnana King, 2023. (19)	Computed Tomography (CT) scans	Computer-Aided Diagnosis (CAD) system, Optimized 3D Convolutional Neural Network (3D CNN)	Human	achieved high accuracy in early detection and staging of pancreatic tumors
9	Experimental	Salvi, et al., 2021. (20)	Histopathology	Deep learning	Dog	Tumor classification (including malignant vs benign-related tumor types)
10	Experimental	Shum et al., 2026. (21)	Cytology smears	CNN	Dog	Classification of lymphoma vs reactive lymphoid hyperplasia + subtyping.
11	Experimental	AlSuwaidan et al., 2023. (22)	Dermoscopic and clinical skin images	CNN architectures evaluated	human	strong capability for automated skin disease detection.
12	Review	Litjens, G. et al. (2017). (23)	multi-modal medical imaging survey	Deep Learning	Human	detection of lesions and abnormalities
13	Prospective observational clinical study	Lassau et al., 2017.(24)	Contrast-enhanced ultrasound (CEUS)	Radiomics + statistical modeling	Human	predict response to immunotherapy, stratify patients early in treatment
14	Experimental	Arvaniti, E. et al. (2018).(25)	Histopathology	CNN	Human	Automated grading comparable to pathologists
15	Experimental	McKinney, S.M. et al. (2020).(26)	Mammography	Deep CNN	Human	Reduced false positives in breast cancer screening
16	Retrospective observational study	Jurgas et al., 2025. (27)	Computed Tomography (CT) imaging	Convolutional Neural Network (CNN) for image segmentation	Canine	Supports diagnosis, treatment planning, and monitoring of lung tumors in dogs
17	Experimental	Baul et al., 2022. (28)	Multi-omics data (primarily RNA-seq / transcriptomics)	Graph Attention Network (GAT)	human cancer patients' datasets	incorporating gene interaction networks improves interpretability and performance
18	Experimental	Rowe et al., 2025. (29)	Clinical + microbiological data	Machine Learning (supervised ML models)	Cow	AI can support clinical treatment decision-making in cattle medicine

19	Computational experimental study	Robert et al., 2026. (30)	Radiological imaging (CT scans)	hybrid deep learning	Rabbit	accurate and interpretable lung cancer prediction from CT images
20	Experimental	Ghaed-Rahmati, et al., 2026. (31)	Genomic / transcriptomic (microarray) data	Random Forest (RF) Support Vector Machine (SVM) Artificial Neural Networks (ANN)	Holstein cattle	effectively predict ovarian cancer in Holstein cattle with high accuracy.
21	Experimental	Banzato et al., 2018. (32)	MRI imaging	Deep Convolutional Neural Network (CNN)	Bovine	The CNN model successfully differentiated canine meningiomas from gliomas on MRI images, supporting AI-assisted veterinary neuro-oncology diagnosis.
22	Computational experimental deep learning imaging study	Hernandez Torres, et al., 2024. (33)	Point-of-care ultrasound imaging	CNN-based deep learning model	Military working dogs	Deep learning can reliably assist interpretation of ultrasound images in working dogs, improving diagnostic efficiency and consistency in field conditions.
23	Experimental	Asokan et al., 2020. (34)	Fluorescence imaging	quantitative imaging analysis;	Zebrafish	Enables real-time visualization of tumor dissemination and microenvironment interaction in live zebrafish
24	Retrospective observational study	Basranet al., 2026. (35)	ultrasound imaging (radiomics) + hematology (CBC) + serum biochemistry	Supervised machine learning models using radiomic feature extraction + clinical variables	dog	Machine learning models combining ultrasound radiomics with CBC and biochemical markers significantly improved diagnostic performance in distinguishing feline intestinal lymphoma vs inflammatory bowel disease (IBD) compared with imaging or blood data alone.
25	Experimental	Bulten et al., 2020. (36)	Digital histopathology	CNN-based deep learning system	Human prostate cancer biopsy samples	achieved diagnostic performance comparable to expert pathologists
26	Experimental	Mi et al., 2024 (37)	In vivo biodistribution + nanoparticle pharmacokinetics data	Machine Learning	Mouse	ML accurately predicts nanoparticle tumor delivery and organ distribution
27	Experimental	Chattopadhyay et al., 2024. (38)	Longitudinal tumor imaging and growth data	Hybrid ML + DL (predictive modeling of tumor progression)	Mouse	predict tumor progression dynamics in mic
28	Experimental	Hayat et al., 2021. (39)	Magnetic Particle Imaging (MPI)	Machine learning / AI-based imaging analysis	Mouse	AI improves accuracy and quantification of islet transplantation imaging
29	double-blind clinical validation study	Half et al., 2024. (40)	VOC/scent biomarker detection + canine olfaction data	Machine learning classification/validation of detection outcomes	Humans + detection dogs	Dogs combined with AI achieve accurate non-invasive multi-cancer screening
30	Experimental	Sánchez et al., 2026. (41)	Blood plasma (liquid biopsy – cell-free DNA analysis)	Machine learning prognostic model (AI-based cfDNA quantification).	Canine	AI-guided analysis of circulating tumor DNA in plasma improved cancer prognosis stratification and enabled earlier detection of disease progression in dogs with spontaneous tumors

The Artificial intelligence (AI) has appeared as transformative power in diagnosis and prediction of cancer, offering unique enhancements in the accuracy, efficiency, and across an extensive series of imaging and modalities. This review proves that progressive AI methods, predominantly the deep learning models as convolutional neural networks (CNNs) and hybrid machine learning approaches, enhance primary tumor detection with accurate segmentation, and prognostic assessment compared with the conventional investigative procedures. Furthermore, the combination of AI with multiple modal data analysis—counting histopathology, radiological imaging and molecular datasets—has allowed more inclusive description of tumor biology. Principally, the preclinical animal reports, particularly in rodent, highlight the AI capacity for detecting the indirect pathological alterations, count tumor weight, and expect the disease development with high sensitivity. These results support the translational value of AI systems in both of the experimental oncology and clinical practice. Despite these developments, numerous challenges persist. The limitations associated with data heterogeneity, small size of sample in animal studies, absence of identical validation bases, and worries about model interpretability stay to delay extensive experimental implementation. Additionally, the insufficiency of AI-driven cancer researches in some animal species emphasizes the requirement for wider and more various investigational datasets to support model generalizability.

CONCLUSION

AI holds considerable promise in transforming cancer diagnostics and prognostic oncology. Future researches should focus on the developing strong, explainable, and ethically complete AI models, reinforced by large-scale with high-quality datasets and interdisciplinary collaboration. Such hard work will be essential to confirm the safe and active transformation of AI skills from research situations into routine clinical oncology practice.

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Conflict of Interest

The authors declare no conflict of interest.

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