# AI in Oncology - Precision Therapy & Prognosis

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**ABSTRACT**
*Artificial intelligence (AI) has strong logical reasoning abilities and the ability to learn on its own, and it can mimic the human brain's thought process. Machine learning and other AI technologies have the potential to greatly enhance the existing method of anticancer medicine development. However, AI currently has several limits. This study investigates the evolution of artificial intelligence technologies in anti-cancer therapeutic research, such as deep learning and machine learning. At the same time, we are optimistic about AI's future.*

**KEYWORDS:** *Machine Learning, Deep Learning, Artificial Intelligence, Cancer, Drugs.*

## 1. INTRODUCTION

The intelligence demonstrated by computers produced by humans is referred to as "artificial intelligence" (AI). Computer science, cybernetics, neurophysiology, psychology, and linguistics are all included in this large field. At the Dartmouth meeting in 1956, AI was considered to have been born. After decades of fast advancement [1–3], artificial neural networks, machine learning, deep learning, and other technologies have all been added to the notion of AI [1–3]. Deep learning, a subclass of AI, can extract characteristics from massive amounts of data automatically [3]. Deep learning can also identify information in photos that the human eye cannot [4–6]. This is critical for the early diagnosis of tumours using imaging data. AI may also help with cancer detection and therapy. AI is typically built on a multi-layer neural network structure with excellent logical reasoning and learning ability that may closely resemble human thought patterns [7,8]. AI, like the human brain, can solve issues by making the quickest and most intuitive decisions. It is not difficult to infer that AI may significantly improve present cancer research models.

## 2. Objectives

The following are the goals of this study:

- Cancer Diagnosis
- Cancer Prognosis
- Development of Cancer Drugs
- Cancer treatment with pinpoint accuracy
- Cancer Treatment
- AI-assisted chemotherapy
- AI-assisted radiotherapy
- AI and the discovery of anticancer drugs

## 3. USAGE OF AI IN ANTI CANCER DRUGS CREATION

AI may be used to forecast anticancer medication action or to aid in the discovery of anticancer drugs. Distinct malignancies and medications may have different response modes, and results from high-throughput screening processes often demonstrate a link between cancer cell genetic diversity and drug activity. Lind et al. [9] used screening data with machine learning to create a random forest model. According to the mutation status of the cancer cell genome, the model may predict the action of anticancer medications. Wang et al. [10] created a drug sensitivity prediction model based on an elastic net regression machine learning algorithm. Machine learning algorithms have been shown to accurately predict medication sensitivity in patients with ovarian cancer [11–13], gastric cancer [14–16], and endometrial cancer [11–13].

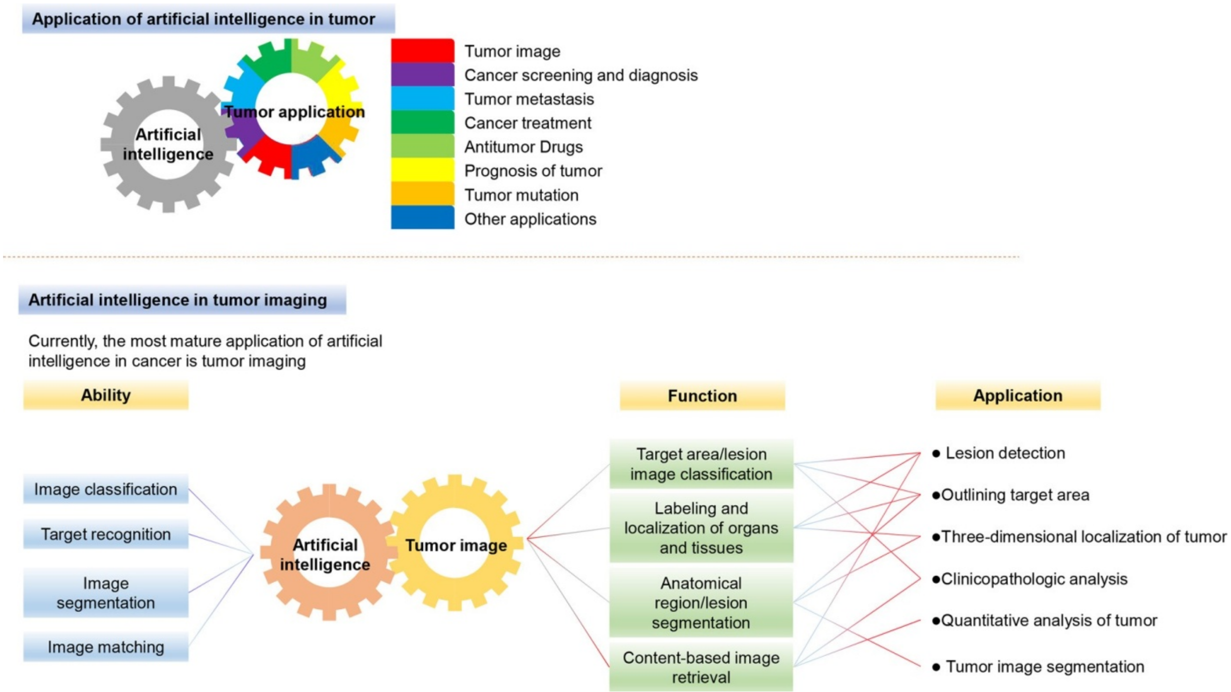


**Fig 1 The applications of AI in tumors**

Cancer imaging, screening, and diagnosis, cancer therapy, cancer medicine, and other domains have the potential to be enhanced by AI. Cancer research and therapeutic treatment have the potential to be advanced by AI. Cancer imaging should be the most developed use of AI in the area of cancer at the moment. Some outstanding AI performance fits the demands of medical imaging, and the combination of the two may advance cancer research[17,18]. The model predicts resistance in patients with ovarian cancer treated with tamoxifen, gastric cancer treated with 5-FU, and endometrial cancer treated with paclitaxel. These individuals were all found to have a dismal prognosis. This research demonstrates that artificial intelligence has a high potential for forecasting the sensitivity of anticancer treatments. AI is also being used to combat medication resistance in cancer [19–21]. By learning and analysing data on big drug-resistant cancers, AI can swiftly comprehend how cancer cells grow resistant to cancer treatments, which may assist in improving medication development and drug usage (Fig. 1).

## 4. Chemotherapy and AI

In the realm of cancer treatment, AI is mainly concerned with the interaction between medications and patients. The key application successes of AI are chemotherapy drug usage management, prediction of chemotherapy drug tolerance, and chemotherapy programme optimization [22–25]. Combination chemotherapy has the potential to improve and speed up the process of optimising. In one study, the researchers successfully determined the optimal dose of zen-3694 and enzalutamide using "CURATE.AI" (an artificial intelligence platform developed by the National University of Singapore that uses deep learning and other technologies), thereby improving the efficacy and tolerance of the combined treatment [26]. Inhibitors of poly ADP-ribose polymerase (PARP) may be used to treat breast cancer cells that lack homologous recombination (HR). Gulhan et al. [27] created a deep learning-based screening method that can identify cancer cells with HR defects with 74%

accuracy and predict which patients would benefit from PARP medicines. Dorman et al. [28] created a machine learning model that predicts breast cancer tolerance to treatment. The research, which looked at the interaction between chemotherapy medications and patients' genes, was able to tell the difference between the effects of two chemotherapy treatments, taxol and gemcitabine. Furthermore, research has demonstrated that the deep learning technique outperforms the Epstein-Barr Virus-DNA-based model in risk classification and induction chemotherapy guidance for nasopharyngeal cancer [29]. This suggests that the deep learning method's directing function may be employed as a possible signal for predicting single induction chemotherapy for advanced nasopharyngeal cancer [30].

## 5. Radiotherapy and artificial intelligence

The use of AI technology in cancer radiation is more particular. AI can assist radiologists in mapping out target regions and automatically planning radiation therapy regimens [31–33]. Lin et al. [34] used a three-dimensional convolutional neural network (3D CNN) to identify nasopharyngeal cancer with 79 percent accuracy, which is comparable to radiation professionals.Cha et al. [35] integrated deep learning technology with radiomics (the extraction of picture attributes from radiographic images) to create a prediction model that can assess the response to bladder cancer therapy. Babier et al. [36] created deep learning-based automation software that decreased the time it needed to schedule radiation treatment to only a few hours. The AI software's treatment plan is equivalent to patients' traditional treatment plans, and the time is considerably reduced (Fig. 2).

## 6. Immunotherapy and artificial intelligence

In the context of cancer immunotherapy, AI primarily focuses on assessing treatment efficacy and assisting clinicians in making treatment plan adjustments [37–40]. Sun et al. [41] created a machine learning-based AI platform to effectively anticipate the therapeutic impact of programmed cell death protein 1 (PD-1) inhibitors. This platform is capable of assessing the efficacy of immunotherapy in patients with advanced solid malignancies who are responsive to PD-1 inhibitors. Bulik-Sullivan et al. [42] created a machine learning system based on a human leukocyte antigen (HLA) mass spectrometry database that may enhance cancer neoantigen detection and the effectiveness of cancer immunotherapy. The use of AI in cancer radiation primarily comprises the identification of cancer target areas, the identification of organs at risk, and the automated creation of treatment plans. The AI system can perform intelligent delineation of radiative pictures without the need for human registration, interpolation, or other processes. Furthermore, AI can forecast three-dimensional dosage distributions based on mapped organs and target locations, allowing for more tailored treatments to be automated.

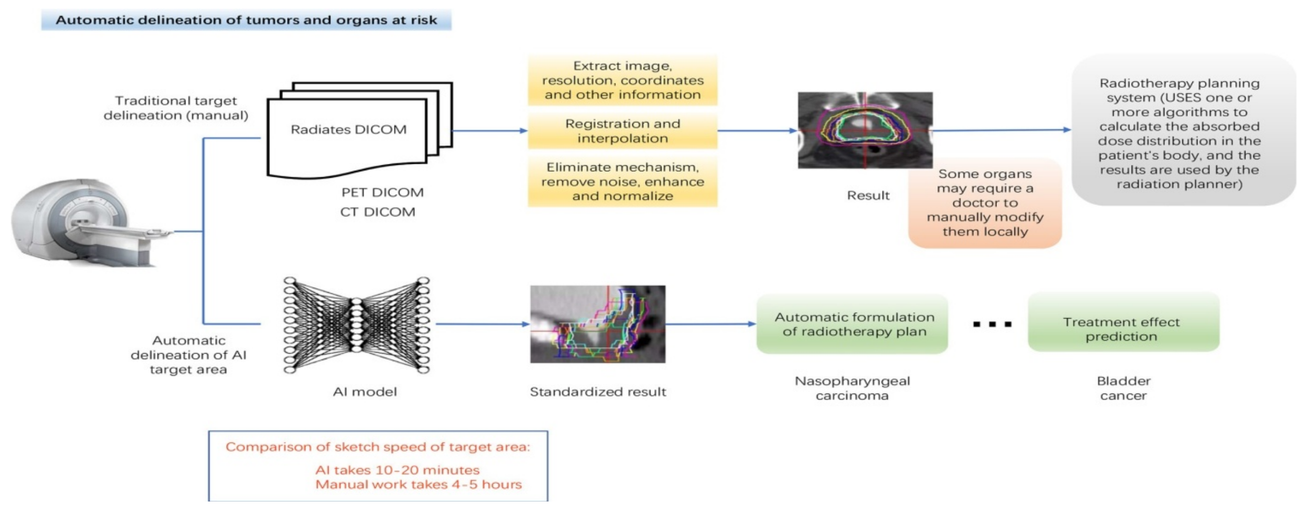


**Fig 2 Automatic delineation of tumors and organs at risk**

## 7. AI helps to decrease cancer overtreatment.

Hu et al. [43] created an algorithm that can evaluate digital pictures of a woman's cervix and properly identify precancerous lesions that need to be treated, reducing patient overtreatment. Bahl et al. [44] created a machine learning technique that helps prevent overtreatment of breast cancer lesions. The technology can predict which high-risk breast lesions are likely to develop into cancer, allowing clinicians to make better treatment choices and avoid needless surgery.

## 8. Artificial intelligence and clinical decision support systems

Deep learning technology improves the intelligence of cancer treatment decisions. AI can determine the best treatment plan for clinicians by learning from large clinical datasets of cancer patients [33,45–49].Printz et al. [50] created a deep learning-based Clinical Decision Support System (CDSS) that can extract and analyse a huge quantity of clinical data from medical records and produce cancer therapy alternatives. The study illustrates the significance of AI technology in assisting doctors in improving cancer treatment strategies for patients.

## 9. Machine learning and deep learning in the creation of anticancer drugs

Machine learning algorithms may be trained on high-throughput screening data to create models that predict how cancer cell lines and patients will respond to novel medications or treatment combinations [51–53]. Machine learning is being used by scientists to design and build reverse synthesis routes for compounds, which is speeding up drug discovery. The whole process of developing a new medicine generates a large amount of data. Machine learning provides an excellent chance to analyse chemical data and provide insights that can aid in drug development [54–56]. Machine learning may assist us in processing data accumulated over years, or even decades, in a relatively short period of time [57]. Furthermore, technology will allow us to make better-informed judgments that would previously have needed prediction and testing [58–60]. Deep learning is a one-of-a-kind machine learning technique that has excelled in a variety of fields, including drug discovery [61–63]. These models have distinct properties that may make them more appropriate for complicated tasks such as predicting drug responses based on biological and chemical data. However, the use of deep learning in drug response prediction has just recently been investigated. Deep learning has lately been used to produce ground-breaking advancements in how computers extract information from photos. Deep learning techniques based on large-scale data sets have resulted in intriguing new medication reuse potential. One such piece of research is that of Kadurin et al. [64]. To construct a deep learning model, they applied the antagonistic autoencoder to the entire dose-response data recorded in the NCI-60 cell line.

## 10. Conclusion

AI has made significant advances in the creation and therapy of anticancer drugs [65–67]. Humans are constrained by their own degrees of knowledge, making it difficult to devise the best therapy. According to this viewpoint, if physicians choose the wrong therapy, patients may lose out on critical treatment chances and may even have their condition worsen. It has the potential to provide critical insights and information that human identification cannot, as well as to personalise therapy for each cancer patient [68–70].AI might hasten the identification of novel materials, perhaps hastening the creation of anticancer treatments. AI is expected to be a significant driving factor in human cancer research and therapy in the future. We think that artificial intelligence will have a significant impact on medical technologies in the future.

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