

# Role of AI and Information Technology in Treating Cancer Patients and Delivering Medicines

**MS. Priya P. Mahajan**

Department of Information Technology  
Mahatma Phule Arts, Science and Commerce, Panvel  
Email: priyampasc2023@gmail.com

**Abstract:** *Cancer remains one of the leading causes of morbidity and mortality worldwide. Advances in Artificial Intelligence (AI) and Information Technology (IT) have significantly transformed oncology, enhancing early detection, diagnosis accuracy, personalized treatment, drug discovery, and medicine delivery systems. AI-driven algorithms assist clinicians in interpreting complex imaging data, genomic information, and electronic health records. Meanwhile, IT infrastructures such as telemedicine, electronic medical records, cloud computing, and IoT-enabled smart drug delivery systems have improved patient monitoring and pharmaceutical logistics. This paper explores the multifaceted role of AI and IT in cancer diagnosis, treatment planning, precision medicine, robotic surgery, predictive analytics, medicine delivery optimization, and future challenges. Ethical, regulatory, and implementation barriers are also discussed*

**Keywords:** *Cancer*

## I. INTRODUCTION

Cancer is a global health burden responsible for millions of deaths annually. Traditional treatment methods—chemotherapy, radiotherapy, and surgery—are often associated with delayed diagnosis, generalized treatment approaches, and systemic toxicity.

Artificial Intelligence (AI) and Information Technology (IT) are revolutionizing oncology by:

### **Enhancing early detection**

AI analyzes medical images, genetic data, and patient records to identify cancer at very early stages. Advanced algorithms can detect subtle abnormalities that may be missed by the human eye. IT systems enable faster data processing and real-time reporting. Early detection increases treatment success rates and survival outcomes. This approach also reduces the need for aggressive late-stage treatments.

### **Supporting Personalized Medicine**

AI helps tailor treatment plans based on a patient's genetic profile, tumor characteristics, and medical history. It analyzes large datasets to predict how individuals will respond to specific therapies. IT systems store and manage genomic and clinical data efficiently. This enables targeted therapies rather than a one-size-fits-all approach. Personalized medicine improves treatment effectiveness and reduces side effects.

### **Improving Treatment Planning**

AI assists oncologists in selecting the most appropriate treatment strategies. It evaluates clinical guidelines, imaging results, and patient-specific factors. IT platforms integrate data from multiple sources for comprehensive decision-making. This leads to more accurate radiation targeting and chemotherapy planning. Improved planning enhances patient outcomes and reduces complications.



### **Optimizing Drug Delivery**

AI models help design smarter drug delivery systems that target cancer cells precisely. They predict optimal dosage levels and timing for maximum effectiveness. IT tools monitor patient responses and adjust treatment accordingly. This reduces damage to healthy tissues and minimizes adverse effects. Optimized drug delivery improves overall treatment efficiency.

### **Reducing Healthcare Costs**

AI automates routine tasks, reducing administrative and diagnostic workload. Early detection and accurate treatment planning lower hospitalization rates. IT systems streamline data management and reduce redundant testing. Efficient resource allocation minimizes unnecessary procedures. Overall, AI and IT contribute to more cost-effective oncology care.

The integration of machine learning (ML), deep learning, big data analytics, robotics, and digital health systems has created a paradigm shift toward precision oncology.

## **II. OVERVIEW OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE**

Artificial Intelligence refers to computer systems capable of performing tasks that typically require human intelligence.

### **2.1 Types of AI Used in Oncology**

#### **Machine Learning (ML) – Pattern Recognition in Patient Data**

Machine Learning uses algorithms to analyze large volumes of structured healthcare data such as lab results, vital signs, medical history, and demographics. It identifies hidden patterns and correlations that may not be obvious to clinicians. ML models can assist in disease diagnosis, treatment recommendations, and early detection of complications. It improves personalized medicine by tailoring care based on patient-specific data patterns. Over time, models improve their accuracy as they are exposed to more data.

#### **Deep Learning (DL) – Image-Based Cancer Detection**

Deep Learning is a subset of ML that uses artificial neural networks with multiple layers to process complex data. In healthcare, it is widely used to analyze medical images such as X-rays, CT scans, MRIs, and mammograms. DL models can automatically detect tumors, classify cancer types, and identify abnormal tissue patterns. These systems often achieve high accuracy comparable to radiologists in specific tasks. They also help in early cancer detection, improving treatment outcomes and survival rates.

#### **Natural Language Processing (NLP) – Extracting Insights from Clinical Notes**

NLP enables computers to understand and interpret unstructured text in electronic health records (EHRs). It processes clinical notes, discharge summaries, pathology reports, and prescriptions. NLP can extract key information such as symptoms, diagnoses, medications, and treatment plans. This reduces manual documentation workload and improves data accessibility. It also supports clinical decision-making and research by converting text into structured data.

#### **Predictive Analytics – Risk Prediction and Survival Modelling**

Predictive analytics uses statistical models and ML techniques to forecast future health outcomes. It analyzes historical patient data to estimate risks such as disease progression, readmission, or mortality. Survival modelling helps predict the likelihood of patient survival over a specific time period. Healthcare providers use these predictions to design early intervention strategies. This approach enhances preventive care and improves overall patient management.



### **III. ROLE OF AI IN EARLY CANCER DETECTION**

#### **3.1 Medical Imaging and Radiology**

AI-powered imaging tools analyze radiological images with high precision. They can detect subtle abnormalities that may be missed during manual review. These systems support radiologists in faster and more accurate diagnosis. AI improves workflow efficiency and enables early-stage cancer detection.

##### **Breast Cancer Detection via Mammograms**

AI algorithms examine mammogram images to identify early signs of breast tumors. They detect microcalcifications and abnormal tissue patterns with high sensitivity. This reduces false negatives and improves screening accuracy. Early detection through AI-assisted mammography increases survival rates.

##### **Lung Cancer Detection from CT Scans**

AI analyzes chest CT scans to identify small lung nodules at early stages. It differentiates between benign and potentially malignant nodules. Automated detection speeds up diagnosis and reduces oversight. Early lung cancer identification significantly improves treatment outcomes.

##### **Brain Tumor Segmentation in MRI**

AI models process MRI scans to accurately locate and segment brain tumors. They outline tumor boundaries for precise diagnosis and treatment planning. This assists in surgical planning and radiation therapy targeting. Accurate segmentation improves patient management and prognosis. Deep learning models often outperform human radiologists in detecting subtle abnormalities.

#### **3.2 Digital Pathology**

AI analyzes histopathological slides to

##### **Identify Malignant Cells**

AI algorithms examine tissue samples to detect abnormal cell structures. They differentiate between normal and cancerous cells based on shape, size, and texture. Automated detection reduces human error and oversight. This helps in confirming cancer presence quickly and accurately.

##### **Classify Tumor Types**

AI systems categorize tumors by analyzing cellular patterns and tissue architecture. They distinguish between different cancer subtypes for accurate diagnosis. Proper classification guides appropriate treatment selection. This ensures patients receive targeted and effective therapy.

##### **Predict Aggressiveness**

AI evaluates tumor features such as cell proliferation and structural abnormalities. It estimates how fast the cancer is likely to grow or spread. Predicting aggressiveness helps determine treatment intensity. This supports better prognosis assessment and personalized care planning.

This reduces diagnostic errors and speeds up reporting.

### **IV. AI IN PRECISION AND PERSONALIZED MEDICINE**

Precision oncology aims to tailor treatments based on:

#### **Genetic Mutations**

AI analyzes genomic sequencing data to identify cancer-causing genetic mutations. It helps detect specific alterations in DNA that drive tumor growth. These insights allow clinicians to select targeted therapies designed for those mutations. Targeting genetic changes improves treatment response and reduces unnecessary side effects.

#### **Tumor Biomarkers**

AI evaluates biomarkers such as proteins, gene expressions, or molecular signatures present in tumors. These biomarkers help determine cancer type, stage, and likely treatment response. AI models can predict how a tumor will react to chemotherapy or immunotherapy. This enables more precise and effective treatment planning.



### **Patient Health Profiles**

AI considers factors like age, medical history, lifestyle, and existing conditions. It analyzes how these variables influence treatment tolerance and outcomes. Personalized recommendations reduce the risk of complications.

This holistic approach ensures treatment strategies are tailored to each patient's overall health condition.

### **AI Analyzes Genomic Data**

AI processes large-scale genomic sequencing data to understand the genetic makeup of a patient's tumor. It identifies patterns and variations within DNA that may contribute to cancer development. Advanced algorithms compare patient data with vast genomic databases. This enables precise and data-driven treatment decision-making.

### **Identify Actionable Mutations**

AI detects specific genetic alterations that can be targeted with available therapies. These "actionable" mutations are linked to drugs designed to block cancer growth. Early identification helps clinicians choose the most effective targeted treatments. This increases treatment success while avoiding ineffective options.

### **Recommend Targeted Therapies**

Based on detected mutations, AI suggests therapies tailored to the tumor's molecular profile. It matches genetic findings with approved drugs or clinical trial options.

This personalized selection improves treatment accuracy. Targeted therapies often cause fewer side effects than traditional chemotherapy.

### **Predict Drug Responses**

AI models analyze genetic and clinical data to estimate how a patient will respond to certain drugs. They predict treatment effectiveness and possible resistance patterns.

This helps avoid trial-and-error approaches in therapy selection. Predicting drug response improves outcomes and reduces unnecessary toxicity.

Machine learning models assist oncologists in selecting optimal therapy combinations.

## **V. AI IN CANCER TREATMENT PLANNING**

### **5.1 Radiation Therapy Optimization**

AI helps design radiation plans by:

#### **Minimizing Exposure to Healthy Tissues**

AI accurately maps tumor boundaries using imaging data. It distinguishes between cancerous and surrounding healthy tissues. This allows radiation beams to focus mainly on the tumor area. As a result, side effects and tissue damage are significantly reduced.

#### **Optimizing Dosage Distribution**

AI calculates the ideal radiation dose required to destroy cancer cells. It ensures uniform dose coverage across the tumor. At the same time, it limits excessive radiation to nearby organs. Optimized dosage improves treatment effectiveness and safety.

#### **Reducing Planning Time**

Traditional radiation planning can take many hours of manual adjustments. AI automates contouring, dose calculation, and treatment simulations. This significantly speeds up the planning process. Faster planning allows timely treatment and better clinical workflow efficiency.



## **5.2 Surgical Robotics**

Robotic-assisted surgeries:

### **Increase Precision**

Robotic-assisted systems use AI-guided tools for highly precise movements. They enable surgeons to operate with enhanced accuracy and control. Small, delicate structures can be handled with minimal error. This precision improves surgical outcomes in cancer procedures.

### **Reduce Complications**

AI-assisted robotics reduce human hand tremors and variability. More controlled movements lower the risk of accidental damage. This decreases bleeding, infection, and surgical errors. Fewer complications improve overall patient safety.

### **Shorten Recovery Time**

Robotic surgeries are often minimally invasive. Smaller incisions result in less pain and reduced blood loss. Patients typically experience faster healing and shorter hospital stays. This improves overall quality of life after surgery. AI enhances real-time decision-making during operations.

## **VI. DRUG DISCOVERY AND DEVELOPMENT**

Traditional drug development takes 10–15 years. AI accelerates:

### **Molecule Screening**

AI rapidly screens millions of chemical compounds to identify potential drug candidates. It evaluates molecular structures and predicts how they may interact with cancer targets. This replaces time-consuming laboratory-based high-throughput screening methods. Promising compounds can be shortlisted within days instead of years. Faster screening accelerates the early stages of oncology drug discovery.

### **Target Identification**

AI analyzes genomic and proteomic data to discover biological targets linked to cancer. It identifies genes, proteins, or pathways responsible for tumor growth. This improves understanding of disease mechanisms at a molecular level. Accurate target identification increases the likelihood of effective drug design. It ensures therapies focus on the root cause of cancer progression.

### **Drug Repurposing**

AI examines existing approved drugs to determine if they can treat different types of cancer. It compares molecular pathways and drug mechanisms with cancer biology.

Repurposing reduces the need for early-stage safety testing. This approach shortens development timelines and lowers costs. It offers faster access to new treatment options for patients.

### **Clinical Trial Design**

AI optimizes patient selection by analyzing genetic and clinical data. It identifies suitable candidates who are more likely to respond to treatment. AI also predicts potential risks and improves trial protocols. This increases trial efficiency and reduces dropout rates. Smarter trial design accelerates regulatory approval processes.

AI models predict:



### **Drug Toxicity**

AI predicts potential toxic effects of drug candidates before human testing. It analyzes chemical structure and biological interaction patterns. Early toxicity prediction reduces failure rates in later trial stages. This improves patient safety and saves development costs. Safer compounds move forward with greater confidence.

### **Treatment Outcomes**

AI models estimate how patients are likely to respond to specific treatments. They use historical clinical data and genetic profiles for prediction. This helps in selecting the most effective therapy for trials. Improved outcome prediction increases trial success rates. It also supports personalized oncology approaches.

### **Success Probability of Compounds**

AI evaluates the likelihood that a drug candidate will succeed in clinical trials. It considers biological relevance, toxicity risk, and past trial data. This helps pharmaceutical companies prioritize high-potential compounds. Resources are allocated more efficiently to promising candidates. Higher prediction accuracy reduces financial risk in oncology drug development.

This reduces cost and time in oncology drug development.

## **VII. INFORMATION TECHNOLOGY IN CANCER CARE**

### **7.1 Electronic Health Records (EHR)**

#### **EHR systems:**

#### **Store Patient History**

EHR systems digitally store a patient's medical history, including diagnoses, lab results, imaging, and medications. This centralized record ensures that clinicians have quick access to critical information. Historical data helps track disease progression and informs treatment planning. Digital storage also reduces errors associated with paper records and lost files.

#### **Track Treatment Progress**

EHRs monitor ongoing treatment, documenting chemotherapy cycles, radiation therapy sessions, and surgical outcomes. They allow clinicians to evaluate effectiveness and adjust therapies in real-time. Automated alerts and reminders ensure adherence to treatment protocols. Tracking progress improves patient outcomes and ensures continuity of care.

#### **Enable Data Sharing**

EHR systems facilitate secure sharing of patient information among multiple providers and specialists. This is essential for multidisciplinary cancer care involving oncologists, radiologists, and surgeons. Data sharing enables coordinated care and reduces duplicate testing. It also supports collaborative research and large-scale population studies. Big data analytics identifies trends across populations.

### **7.2 Telemedicine**

#### **Tele-oncology:**

#### **Enables Remote Consultations**

Tele-oncology allows patients to consult with oncologists via video or online platforms. It provides access to specialist care without requiring travel to major hospitals. Patients can discuss test results, treatment options, and follow-up care remotely. This ensures continuous monitoring and guidance for patients, even from a distance.



### **Improves Rural Access**

Telemedicine bridges gaps in regions with limited oncology services. Patients in rural or underserved areas gain access to expert advice and second opinions. It reduces disparities in cancer care and improves overall health equity. Remote access ensures timely diagnosis and intervention.

### **Reduces Hospital Visits**

Tele-oncology reduces the need for frequent in-person appointments for routine monitoring. This minimizes exposure to hospital-acquired infections and decreases travel burden. Patients save time and resources while maintaining consistent care.

It also frees hospital resources for critical in-person interventions.

## **VIII. DISCUSSION**

The convergence of AI and IT represents a transformative approach in oncology. While technological advancements offer unprecedented opportunities, ethical considerations and equitable access remain critical.

A balanced approach combining human expertise with AI-driven tools ensures optimal patient outcomes.

## **IX. CONCLUSION**

The integration of Artificial Intelligence (AI) and Information Technology (IT) in oncology is reshaping how cancer is diagnosed, treated, and managed. AI algorithms can process vast amounts of complex data—such as genomic sequences, imaging scans, and electronic health records—far faster and more accurately than humans alone. This enables early detection of cancers, personalized treatment plans, optimized drug delivery, and precise monitoring of treatment progress. Similarly, IT systems such as Electronic Health Records (EHRs) and telemedicine platforms improve data organization, accessibility, and patient engagement, facilitating coordinated and efficient care across multiple healthcare providers.

However, the rapid adoption of AI and IT also raises significant ethical and practical challenges. Ensuring **equitable access** is a major concern, as advanced technologies may be unavailable in low-resource settings, creating disparities in cancer care. **Data privacy and security** are critical, given the sensitive nature of patient information used in AI models. Additionally, reliance on AI without sufficient human oversight could lead to misinterpretations or overconfidence in automated decisions, potentially compromising patient safety.

A **balanced approach** is therefore essential. AI and IT should serve as powerful tools that augment—not replace—the clinical expertise of oncologists, radiologists, and pathologists. Human judgment remains vital in interpreting complex results, making nuanced treatment decisions, and addressing patients' emotional and ethical needs. By combining advanced computational tools with professional experience, healthcare providers can maximize accuracy, efficiency, and personalization in cancer care.

## **REFERENCES**

- [1]. Esteva, A., et al. (2019). A guide to deep learning in healthcare. *Nature Medicine*.
- [2]. Topol, E. (2019). High-performance medicine: the convergence of human and artificial intelligence. *Nature Medicine*.
- [3]. Litjens, G., et al. (2017). A survey on deep learning in medical image analysis. *Medical Image Analysis*.
- [4]. Kourou, K., et al. (2015). Machine learning applications in cancer prognosis and prediction. *Computational and Structural Biotechnology Journal*.
- [5]. Jiang, F., et al. (2017). Artificial intelligence in healthcare: past, present and future. *Stroke and Vascular Neurology*.

