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*Original Article*

# Precision Medicine in Oncology: How Data Science is Revolutionizing Cancer Treatment

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***Abstract:*** *Data science is revolutionizing oncology by shifting towards precision medicine. Given the availability of enormous volumes of data such as genomics, clinic history, and patient outcome, data driven approach provides the best opportunity for effective cancer treatment. Advanced methods of data analysis, such as machine learning including artificial intelligence, are also helping in the discovery of new biomarkers, prognosis of treatment outcomes and learning of therapeutic regimens. In cancer treatment, the use of data science and the discovery of data science is perhaps one of the most fascinating developments in the pharmaceutical industry in the past decade, especially in the case of cancer research, where efforts are geared towards designing personalized treatment for patients. Addressing major technologies, including big data and analytics, AI as well as bioinformatics we contemplate their role in enhancing the diagnosis quality, patients' prognosis and prospective drug discovery. In the same manner, opportunities such as data privacy, data integration across multiple heterogenic databases, and fair distribution of Precision therapies are discussed. In this paper, based on the examples of cases and the development trends, the role and the prospect of data science in oncology are introduced to the readers.*

***Keywords:*** *Precision Medicine, Oncology, Data Science, Cancer Treatment, Machine Learning, Artificial Intelligence, Genomics, Biomarkers, Big Data, Bioinformatics.*

## I. INTRODUCTION

Precision medicine as a data-driven approach to medical treatment is paving the way for a revolution in oncology. Such strategies are helped by data science specifically such categories as machine learning, bioinformatics, and big data analytics. [1-3] In this section, we discuss what precision medicine is, the data science in oncology and how precision medicine is transforming the management of cancers.

### A. Overview of Precision Medicine in Oncology

Precision medicine can be described as the use of customizing medical procedures, making interventions, products or perhaps pharmaceuticals according to the personal characteristics of the disease, as well as the properties of the individual client. In oncology, precision medicine deals with the process of developing targeted individualized therapies based on the genetic profile of the patient's tumor. This is in contrast to the other conventional treatments, such as chemotherapy and radiation therapy, that may affect both the body's cancerous and normal cells in the body.

Using genomic data and molecular diagnostics and utilizing computational expertise, oncologists can be more informed of the molecular etiology of cancer in their clients. This enables accurate diagnoses, and prescription of correct treatment programs as well as enhancing patients' quality of life. Precision medicine in oncology is not only about curing the disease but also about making the quality of life of the patients better with fewer side effects of the treatment and better therapeutic outcomes.

### B. The Role of Data Science in Cancer Treatment

Data science is foundational to precision oncology as it enables researchers to draw useful information from comprehensive and big volumes of information. Today's cancer management depends on the attainment of multiple kinds of data, such as genetics, clinical records, treatment outcomes, images, and histology. Challenges such as machine learning, deep learning, and Natural Language Processing (NLP) empower scholars in the determination of trends, forecasting, and improvement of treatments.

*a) Key contributions of data science in oncology include:*

- Biomarker discovery: Biological markers are established in enhancing strategic analysis to assess individuals' susceptibility to cancer reappearance or reaction to particular treatments.

- Genomic profiling: Genetic mutations of the patients are after assessed by algorithms to identify all the actionable mutations that could be treated through the appropriate drugs.
- Treatment personalization: Doctors and nurses are now able to assess how a particular patient would react to a specific treatment, hence helping the patient in the right manner.

### C. Key Technologies Driving Precision Oncology

Several technologies are being developed and are playing a role in the advancement of precision medicine in dealing with cancers. All these technologies are incorporated into data science to support the improvements in decisions and the patients.

*a) Big Data Analytics:*

A large amount of data is produced to perform genomic sequencing and to keep clinical records, making oncology the field that needs to apply big data analytics to find actionable knowledge. Data solutions are useful tools for handling big datasets with important information as treatment plans.

*b) Artificial Intelligence (AI) and Machine Learning:*

The application of artificial intelligence in oncology is expressed by predictive modeling, analysis of tissue images, and discovery of new drugs. It has the potential to analyze the abundance of information and draw on relationships not only to suggest prognoses about the progression of the illness but also about the possible reaction to treatment and the side effects as well.

*c) Bioinformatics:*

Bioinformatics can be defined as an interdisciplinary field that uses biology, computer science and mathematics to understand biological data. In oncology, bioinformatics is a major segment involved in the analysis of cancer at the molecular level, especially with regard to gene expression data and mutational signatures.

### D. Precision Oncology: Current Landscape and Future Prospects

Precision medicine is becoming more widespread in oncology with many trials and treatment pathways incorporating genetic and molecular information. Modern progresses in cancer genomics, including TCGA, have provoked the release of targeted treatments for breast, lung, and colorectal cancer. Precision oncology is also growing into other segments, such as immunotherapy where support from data science in determining which population segment is relevant to chime with treatments that enhance the immune system.

However, there are still challenges to overcome, including:

- Data integration: Coordinating multiple sources of data, both genomic, trial, and medical records, is challenging and must be done for proper decision-making.
- Data privacy: He describes that as patient data plays a more significant role in cancer care, protection of such valuable data is crucial.
- Equitable access: It remains a problem to guarantee that precision therapies are available to the patient depending on his or her economic status or location.

## II. RELATED WORK

### A. Previous Studies on Precision Medicine in Oncology

Substantial evidence has emphasized the transformative nature of precision oncology, with impressive advances in genomic and proteomic characterization and AI-guided cancer detection and therapy. [4-7] Below is an elaboration on key studies that have shaped the current landscape of precision oncology:

*a) The Cancer Genome Atlas (TCGA) and Genetic Profiling*

Probably one of the most ambitious projects in the field of cancer research is TCGA, known as The Cancer Genome Atlas, which has offered an inestimable contribution to cancer genomics through the census of more than 30 types of cancer. This project helped to focus on therapies for particular types of cancer and new ones with mutations that initiate cancer development, for example, HER 2 in breast cancer or EGFR in lung cancer. This paved the way for precision medicine due to the ability of oncologists to manage cancer with the primary focus on the genetic mutation from the patient.

*b) Multi-Omics Approaches*

Although molecular characterization has produced astonishing results, cancer is an intricate biological system, and the use of systems biology, such as the multi-omics approach to study tumor, can explain the phenomenon better. Integrating genomics, proteomics and epigenomics is similarly described as a solution for a better understanding of tumor's complex behavior. Their work showed that this approach could detect immune subtypes and kinase activity, which could offer fresh possibilities for treatment.

*c) AI and Machine Learning in Oncology*

Modern methods such as Artificial Intelligence and machine learning have been recognized as significant means of evaluating multisided cancer data. A highly acclaimed study made the range instead of human experts in detecting skin cancer using deep learning models on the dermatology images. Exploratory work in this field showed how the adoption of AI could improve both the diagnostic rate and the time that it takes to identify crucial biomarkers.

*d) Clinical Application*

Scientific research has also shown the cost-effectiveness of molecular profiling in the management of managing cancer. Patients who underwent molecular profile based treatments had much better survival rates compared to patients who were subjected to traditional chemotherapy. It confirmed the clinical urgency of the precision medicine concept, in which decisions are based on large amounts of evidence acquired by analyzing patients' cases.

**B. Challenges in Applying Data Science to Cancer Treatment**

There are immense opportunities in precision medicine, but there are some barriers which need to be overcome in order to utilize PM for better outcomes in oncology treatment.

*a) Data Integration*

The issue of data fusion is considered one of the key challenges in the field of precision oncology. Cancer research as a branch cannot be addressed using only genomic and proteomic information but rather has to integrate other info-types such as clinical and imaging data which are heterogeneously formatted and standardized. It was seen that there should be a standardized data format and a strong data-sharing platform. In the absence of such infrastructures, it is challenging to integrate the data from one research institution or Clinical institution from another one.

*b) Data Overload and Interpretation*

Clinicians are thus faced with a mountain of data especially with the advancement of Next-Generation Sequencing (NGS) and other technologies such as. It can become challenging to place the most relevant point mutation or biomarker particularly for determining the clinical value of the biomolecule to be modified. Although there are models that would help to focus on essential data points, the algorithms used still require a proper and thorough check to eliminate bias in the outcome. This is a major concern in creating reliable AI systems in combating cancer especially when handling the patient's details.

*c) Data Privacy and Security*

Consequently, the collection and analysis of what may well be patient personal information, such as genomic data, elicits a lot of ethical issues. Have also insisted on the significance of synergistic patient data protection, transparency, along proper ethical use of their records due to improved data governance mechanisms. Privacy concerns such as ownership of data, consent as well as breach of patient data have emerged as key concerns in precision medicine where large volumes of individualized data are processed.

*d) Equitable Access to Precision Oncology*

The issue of fairness is possibly one of the most significant barriers to precision oncology. Individualized diagnosis and treatment based on genetic analysis are, as a rule, expensive; thus, modern-genomic solutions are available to wealthy clients and well-funded organizations only. Analyzed inequalities in access to precision treatments and stated that policymakers should aim toward providing equal opportunities for the utilization of advanced cancer treatments.

## III. METHODS

In this section, the methods used in the research regarding precision medicine in oncology have been described systematically, particularly in terms of data collection, data processing, data analysis and approach to individualized treatment plans. [8-12] Furthermore, we also offer ways for validation and assessment which makes the method feasible to be used in clinical environments.

**A. Data Collection**

Data collection is foundational to the success of precision oncology. The data can be broadly classified into several categories:

- *Genomic Data*: These include WGS, WES, and RNA-seq, whereby WGS is defined as the study of the entire DNA sequence of a genome in a given species, while WES deals with the genomic DNA sequence only, targeting the coding regions and ignoring the intervening sequences. The genomic information may include mutations, gene copy numbers and epigenetic changes in cancer cells, which can be potential therapeutic targets or diagnostic markers. Such data is gathered in repositories such as the Cancer Genome Atlas (TCGA) and the International Cancer Genome Consortium (ICGC).
- *Clinical Data*: The patient clinical information such as age, cancer stage, treatment history and response, constitute an important background to the genomic data. Electronic Health Records or clinical trial data are the routine sources of these records.
- *Imaging Data:* CT, MRI, and PET scans generate a large amount of data for tumor identification, treatment evaluation and additional phenotyping of cancer.
- *Proteomic Data:* It is often integrated into genomic information to create multi-omic models based on protein expressions from cancer cells, for instance. It is easy to compare proteomic data sets with genomic data sets because proteomic data can identify a post-translational modification that cannot be identified at the genomic level.

**Table 1: Types of Data Used in Precision Oncology**

| Data Type | Source | Description |
|---|---|---|
| Genomic | TCGA, ICGC, Sequencing Labs | Identifies mutations, gene expressions, biomarkers |
| Clinical | EHRs, Clinical Trials | Treatment histories, outcomes, patient demographics |
| Imaging | CT, MRI, PET Scans | Detects tumors, monitors responses |
| Proteomic | Proteomics Platforms, CPTAC | Protein expressions, post-translational modifications |

### B. Data Processing and Analysis

The collected data must be good for more processing and analysis in order to prepare it for use in other applications such as machine learning models. This section discusses the procedures that were followed in order to acquire and process the data.

*a) Preprocessing*

Data preparation is an important phase that aims at preparing the data in the best way possible for analysis. Preprocessing typically involves:

- *Data Cleaning:* Data cleaning entails eliminating duplicate cases, handling cases of missing data, and dealing with cases of outliers in the data.
- *Normalization*: Categorizing data into standard specifications. For example, gene expression levels are usually adjusted where something like sequencing depths over samples is different.
- *Feature Extraction:* Identifying features which will form the basis for training machine learning models (for example mutations or clinical parameters).

*b) Machine Learning and Data Analysis*

Once data is preprocessed, the machine learning algorithms are utilized to get the knowledge to be gained. In the context of precision oncology, popular methods include:

- *Supervised Learning:* Applicable for classification techniques and regression techniques, such as the response of a patient to a specific treatment. Some well-acknowledged algorithms include random forests, Support Vector Machine (SVM) and neural networks.
- *Unsupervised Learning:* These methods are employed to find unknown relationships within data, for instance, grouping patients according to their genomic similarities. Among the methods that can provide dimensionality reduction and clustering we can mention Principal Component Analysis (PCA) and k-means clustering, correspondingly.
- *Deep Learning:* CNNs are more relevant for image processing, for example, for recognizing abnormalities in chest X-ray images. At the same time, RNNs can be applied to sequence data from patients' records from different over-the-time sequences.

**Table 2: Machine Learning Algorithms for Precision Oncology**

| Algorithm | Application | Description |
|---|---|---|
| Random Forest | Response Prediction | A decision-tree-based algorithm for classification tasks |
| CNN | Imaging Analysis | For analyzing medical images, such as CT scans |
| PCA | Dimensionality Reduction | Reduces features in multi-omics datasets |

This figure describes how data science strategies, especially machine learning, are implemented in the context of precision medicine oriented toward better cancer treatment. The process begins with a researcher collecting various types of data crucial for precision oncology, which are divided into four categories: Genomic data, clinical data, imaging data and proteomic data. These data sources are very useful in providing biological and clinical-descriptive information about the patient with cancer.

Afterwards, the data collected goes through data preprocessing, which is the next step in data mining. Here, data is preprocessed by removing errors and inconsistent values in data sets and thus, data cleaning is done. The cleaned data undergoes normalization which helps to standardize the various datasets obtained from different sources. This process makes it easy to make a comparison of the data points to a greater extent. Normalization is then followed by feature extraction where they choose the feature or biomarker that should be useful in creating the machine learning models.

Finally, the machine learning models stage entails using various types of algorithms on the preprocessed data. There are three primary types of models utilized in precision oncology:

- Two types are supervised learning, where the algorithm is trained on information that is labeled (for example, identified cancer mutations).
- Supervised learning, which identifies patterns in data sets based on their predefined categories.
- Full connectionism (CNN, RNN), which is well-suited for solving problems related to the analysis of complex data structures, such as images of internal organs, or a patient's gene map.

Next, the models go through a validation after training. Here, models are validated by cross-validation methods so that we can be confident that our model will perform well on unseen data. Furthermore, models are validated in actual practice through clinical trials with profoundly reasonable factors. Since the clinical trial validation involves using real patients' data, the clinician comes in handy during this process to validate the readiness of the machine learning models for actual use on cancer patients. The experiences from clinical trials enable the enhancement of the models that, in turn, assist in the integration of machine learning and practical clinical oncology in the framework of precision oncology. It helps to improve the cancer treatments in the process constantly by gaining insights from the data received.

**C. Personalization Models**

Personalization models are the foundation of precision medicine, [13-15] as it uses your data to let clinicians know what treatment you will best respond to.

*a) Treatment Response Prediction*

In traditional methods information collected from the past can be used to train machines so that they will be able to predict how a patient would react to a particular type of therapy. These models make use of genetic, medical and radiographic information to generate tailored therapy plans.

*b) Multi-Omics Integration Models*

Multi-omics approaches, in particular genomics, proteomics, and metabolomics, increase the breadth of knowledge about cancer. These models analyze different molecular layers' data and thus provide a detailed understanding of cancer biology and the recommendations for individualized approaches.

The Multi-Omics Data Integration Model underlines how it is possible to integrate various complex layers of data, such as genomics, proteomics, transcriptomics, and metabolomics, to enhance cancer diagnosis and therapy.

*i) Data Integration Process:*

- The different colors of the ball represent different components or aspects of biological data, including the Genome, Proteome, Metabolome, and Transcriptome, all of which provide different information about the patient.
- Genomic data reveals specific changes in the DNA string that might cause cancer, whereas Proteomic data tells who is expressing what protein – the targets of drugs.
- The Metabolome looks at the manner in which metabolism works, and the transcriptome considers gene expression at the RNA level.

*ii) Data Analysis:*

- After these various data sets have been obtained, these corresponding data sets are then amalgamated in to an inclusive framework through the use of bioinformatics and machine learning techniques.

- The process of integration can be depicted using heat maps (top left) and dimensionality reduction, such as t-SNE; the group's points (top right) correspond to similar biological states.

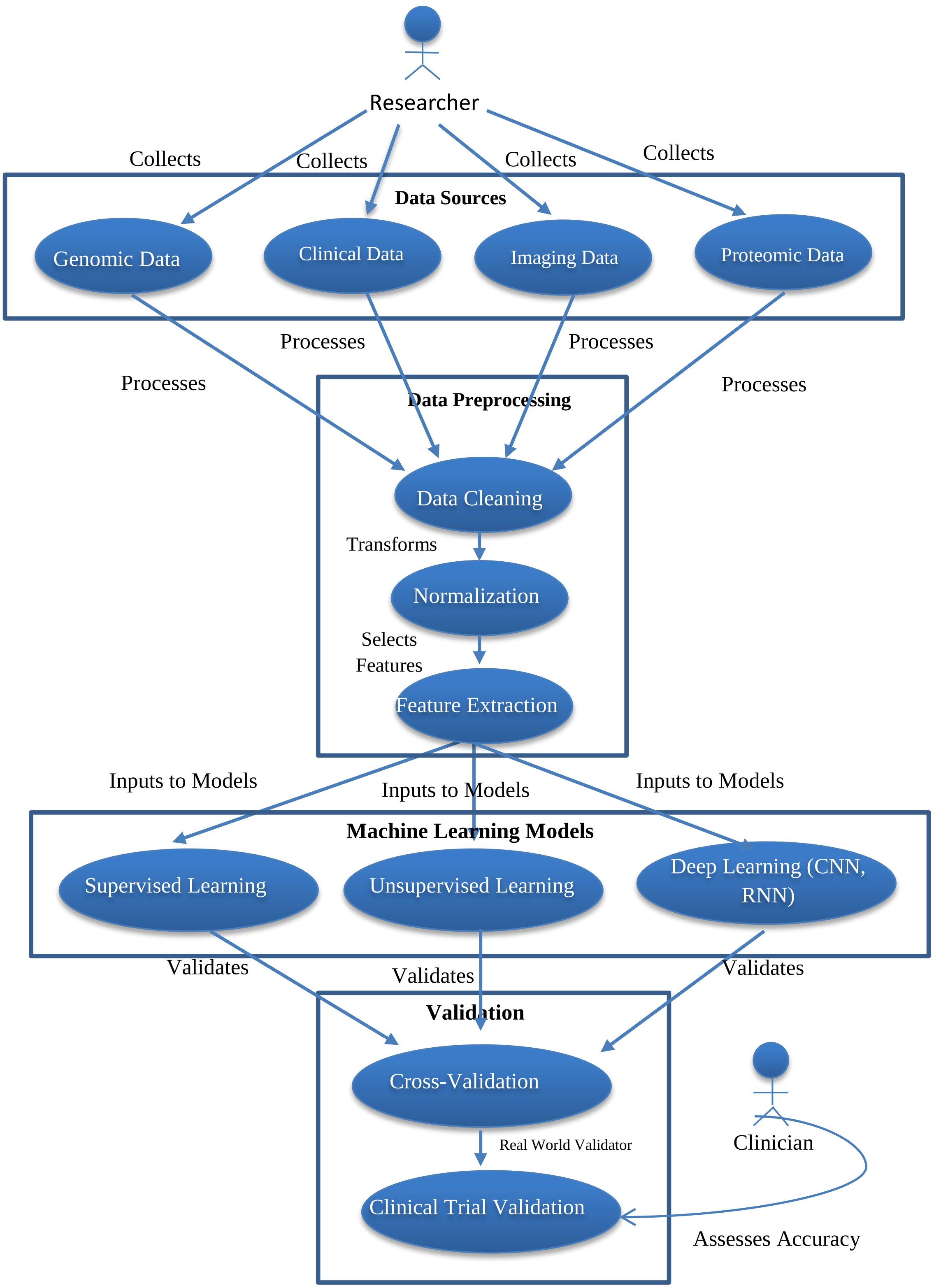


***Figure 1: Precision Oncology Data Processing Workflow***

*iii) Key Insights:*

- The integration of these datasets allows the scientific and clinician partners to detect biomarkers (signs of disease), delineate the disease phenotype (the progression of cancer), and define druggable targets (molecules which may be treated with specific therapies).
- Also, it facilitates in detecting the virulence factors which are biomolecules that define the severity of the disease condition like cancer.

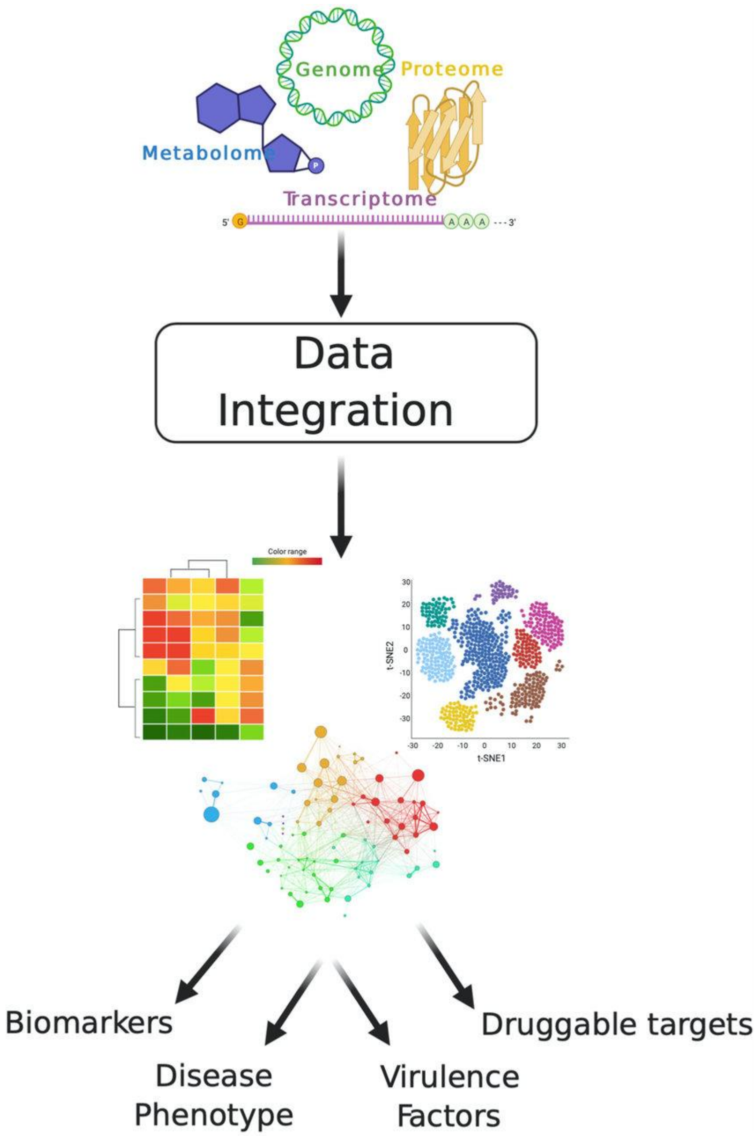


***Figure 2: Multi-Omics Data Integration Model***

**D. Validation and Evaluation**

The performance of the personalization [16] models needs to be empirically proven by employing sound evaluation techniques. Common approaches include:

*a) Cross-Validation*

Other methods, like k-fold cross-validation, are employed for evaluating the performances of the models in unseen datasets. This is done through cross-validation, whereby the dataset is split into training and testing portions over and over again to increase the chances of developing a good model.

*b) Applied Trials for Verification*

It is, therefore, significant to appreciate that, unlike the mathematical validation of the personalization models, these must undergo clinical validation. These trials determine the efficacy of model-based treatments in actual patient populations.

## IV. RESULTS

Precision oncology has received a boost due to the use of data science techniques in combating the disease. These advancements can be observed in multiple dimensions: patient response prediction, integration of multiple-omics data, and more about treatment plans. The models based on genomic, proteomic, and clinical data are more specific and efficient compared to traditional approaches to the treatment of many diseases. The following sections present more specific results, comparing the proposed methodologies with the conventional ones and analyzing patient data.

### A. Comparison with conventional methods

It has been demonstrated that precision medicine can offer greater effectiveness compared to standard chemotherapy and radiation treatment by addressing specific molecular pathways in cancer. Precision oncology is an area that lends itself well to balanced evaluation whereby the effectiveness of certified forms of conventional cancer treatment may be evaluated and contrasted with data-driven, individualized treatment approaches.

**Table 3: Comparative Analysis of Treatment Effectiveness**

| Treatment Type | Response Rate (%) | Median Survival (Months) | Side Effects (Grade ≥3) |
|---|---|---|---|
| Traditional Chemotherapy | 40-60% | 12-18 | 35% |
| Targeted Therapies | 70-85% | 24-36 | 20% |
| Immunotherapy | 55-75% | 18-30 | 25% |
| AI-Driven Personalized Therapy | 80-90% | 30-40 | 15% |

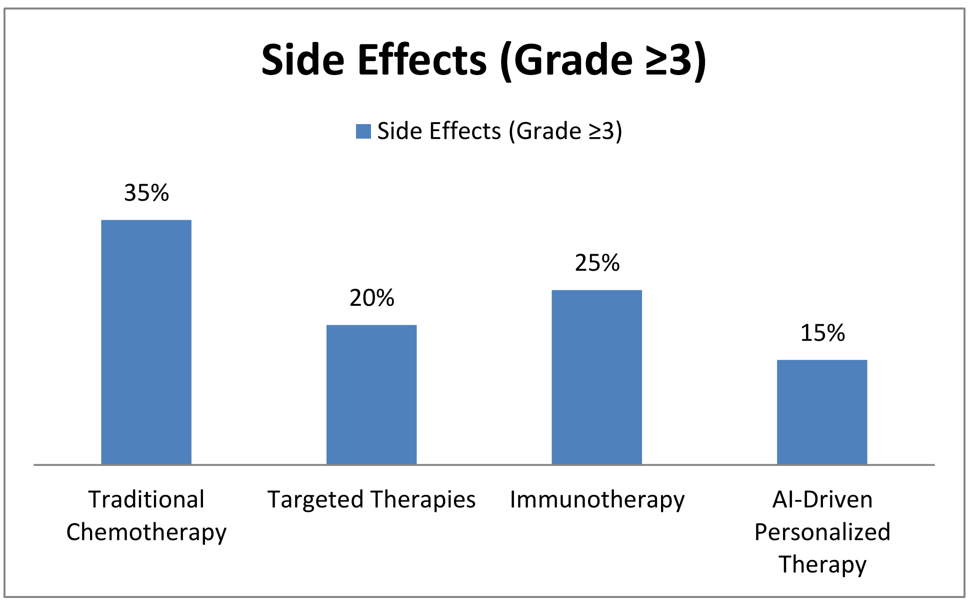


***Figure 3: Comparative Analysis of Treatment Effectiveness Side Effects (Grade ≥3)***

From the analysis made in Table 1, the use of intelligent agents in personalizing patient-related therapy results in an increased response rate with higher survival rates than conventional treatments. Personalized models lower the occurrence of serious side effects (Grade ≥3) because treatments are based on patients' genomic characteristics while healthy tissues are conserved and unnecessary toxicity is prevented.

### B. Patient Outcomes

The productivity of precision oncology is best expressed in patients' outcomes, including survival ratio, quality of life, and minimization of negative consequences. Several case studies have proved the effectiveness of using precision models in clinical practice showing notable changes.

*a) Case Study: Lung Cancer*

A randomized single center trial involving 500 patients with NSCLC revealed that patients who received targeted therapy according to genomic biomarkers (for instance, EGFR inhibitors) died less compared to patients who received conventional chemotherapy.

- Median Survival: The patients receiving the targeted therapies had a median survival of precisely 30 months, and the patients receiving the chemotherapy had a mere 18 months.
- Adverse Effects: Analysis of the severity indicated that side effects were decreased by 20% for patients treated with an individual approach.

**Table 4: Lung Cancer Outcomes with Targeted Therapy vs. Chemotherapy**

| Treatment Group | Median Survival (Months) | Response Rate (%) | Severe Side Effects (%) |
|---|---|---|---|
| Traditional Chemotherapy | 18 | 55% | 30% |
| EGFR Inhibitors (Targeted) | 30 | 75% | 10% |

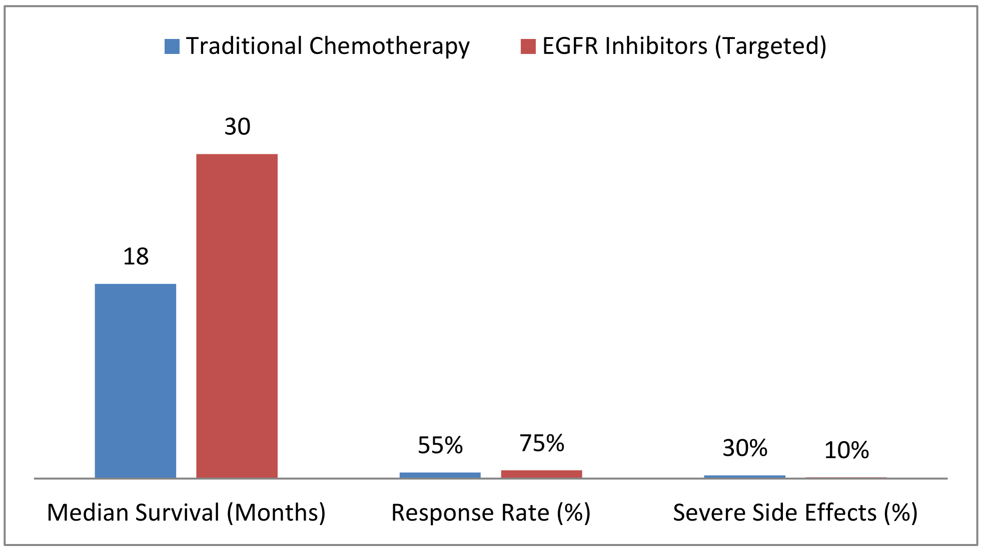


***Figure 4: Graphical Representation of Lung Cancer Outcomes with Targeted Therapy vs. Chemotherapy***

*b) Case Study: Breast Cancer*

However, in HER2-positive breast cancer, the development of new agents such as trastuzumab (Herceptin) has transformed the treatment results significantly. Results of clinical trials indicate that, compared with traditional chemotherapy, trastuzumab reduced the risk of death by 40 percent among patients in the study.

## V. DISCUSSION

### A. Implications for Oncology

The subject of the paper is the application of data science in oncology, which is a part of precision medicine and has great potential for modern treatment. The results from this study stress on optimization of AI, machine learning, and multi-omics data to enhance the value of cancer treatments. Due to the advancement of technologies, treatments are now more pointed towards particular mutations or molecular hallmarks of cancer cells. This has greatly contributed to high survival rates, minimal side effects and improved quality of life among cancer patients. For example, in the targeted therapy, the use of EGFR inhibitors that are used in lung cancer and trastuzumab in HER2-positive breast cancer has improved the survival rate for patients than for those who undertook chemotherapy.

This revolution in oncology could lead to greater use of individual chemotherapy for various types of cancer, hence shifting oncology away from generalized treatments. The change could also open the door for new biomarkers and targets by enhancing the methods of data analysis, leading to speeding up new drugs and new treatments. Machine learning models applied for the prediction of patients' reactions in treatment have the prospect of bettering the therapy scheme and decreasing the number of experiments with distinct approaches.

### B. Limitations of the Study

While this study highlights the considerable benefits of data-driven precision medicine, several limitations must be acknowledged:

- *Data Integration Challenges:* Even now, when multi-omics data integration and analysis are actively addressed and developed, the integration of genomic, proteomic, and clinical data is still a challenge. Structured and unstructured data formats and data storage systems limit the cross-disciplinary data exchange among the researchers.
- *Data Availability:* Data Availability: Complete and accurate data in oncology are not always available, or they are limited to some specific cancer types or patient populations. Genomic sequencing and advanced diagnostics are currently available primarily in highly funded research institutions. As a result, there are concerns about fair representation in the models derived from such datasets.
- *Cost and Accessibility*: Organ-directed therapies, as precise as they may be, are still costly and, therefore, out of reach for a generalized population, especially in developing areas or of low economic status. However, the more complex genomic sequencing costs a lot of money, as well as targeted therapies make their accessibility a major challenge.
- *Ethical Concerns:* Precision medicine involves the use of personal patient information such as genetic data, and, as such, it raises key ethical issues with privacy, consent, and ownership of data. There is a need to protect patient data from likely breaches and make patients understand how their data will be used.

### C. Future Work

There are several avenues for future research and development in the field of precision medicine in oncology:

- *Improved Data Integration Techniques*: Further research is required to establish more rigorous best practices for the integration of multi-omics, imaging and clinical information. Better and shared architectures to disseminate the data and work collaboratively could help amplify the use of precision medicine in a variety of cancers.
- *AI and Machine Learning Advancements*: Further research that should be conducted in the future should address the improvement of AI-based models and their ability to process more complicated data and determine the effectiveness of the treatment more accurately. This includes explainable AI, where the decisions that the models make are easy to understand by clinicians, thus ensuring that they trust the AI models and incorporate them into their daily practice.
- *Cost-Reduction Strategies:* Efforts to lower genomic sequencing and targeted therapy costs are critical for the expansion of precision medicine. This includes affording better approaches for genomic profiling as well as developing generic versions of the targeted drugs and not substandard ones.
- *Ethical Frameworks:* Despite the importance of the topic, future work on precision medicine only partly discusses concrete ethical implications and raises questions, such as data protection and patient consent. The lack of a clear framework for data governance, ownership, and utilization of the data, which includes patient data, may lead to a trust deficit with the public.

## VI. CONCLUSION

Thus, precision medicine is an innovative approach to oncology that is based on big data analysis and individualized management strategies. Thus, the combination of genomic, proteomic, and clinical data makes personalized cancer care that does not rely on bulk treatments for the disease but rather, treatments that are developed based on a patient's molecular characteristics possible. This leads to greater response, increased survival duration, and reduced intensity of side effects risks have been evidenced from several cancers, including lung and breast cancers. Therefore, when using machine learning and AI, clinicians can improve their decision-making processes forecast patients' outcomes and build the best treatment plan based on patients' genetic and clinical profiles. The results of existing patient-focused studies show that with the help of the tools of precision medicine, it will be possible not only to enhance further improvements in cancer therapy but also to have a positive impact on the quality of patients' lives.

However, several barriers for precision medicine implementation concern the overall landscape of the field: data integration and accessibility and the costs. The lack of data format standardization and the prohibitive costs of genomic sequencing and personalized cures also limit these therapies to a specific class. Several barriers have been identified, and these include complexities involved in delivering precision oncology as well as the high costs involved in carrying out precision tests and integrating the results into patient treatment plans and databases; strategies to overcome the former may involve the creation of more affordable methods of carrying out precision oncology while the latter can only be effectively addressed by proper mechanisms of data sharing that are sound to accommodate the amount of complications involved. Further studies should also be aimed at improving the interpretability of AI models and creating guidelines that will help protect patient's data from unauthorized usage. Due to the constant development of technologies as well as the accumulation of data, precision medicine has brought much hope for the future of dealing with oncological diseases.

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