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AI-based personalized treatment recommendation for cancer patients

Joseph DeFrank[1*], Aline Luiz[2]

Abstract

The combination of artificial intelligence (AI) with personalized cancer treatment has revolutionized oncology by changing how we tackle the complexities of this complex disease. The research describes the AL-based personalized treatment recommendation for cancer patients. This research study explores the potential uses, ramifications, and bright future of artificial intelligence in personalized cancer care. Personalized cancer therapy is at the forefront because of AI's ability to analyze large datasets, including genetic profiles, medical pictures, and treatment outcomes. Artificial Intelligence (AI) provides physicians with a comprehensive grasp of each patient's health, from early diagnosis through image analysis to interpreting the distinct genetic markers of tumors. It's used in precision medicine to expedite diagnosis, help choose treatments, and predict possible reactions. In this research, genomic profiling becomes crucial as AI interprets the genetic complexities of tumors to help choose tailored treatments. Privacy and ethical issues take front stage, highlighting the necessity of responsible data processing and a careful balancing act between innovation and patient information protection. The research determined results with smart PLS software and run smart PLS Algorithm model between them. A pillar that emphasizes the indispensable role of healthcare professionals in the decision-making process is the cooperation between AI and human knowledge. The end objective is still quite apparent as we negotiate this revolutionary terrain: to raise the bar for treatment, enhance patient outcomes, and foster a sense of empowerment among the challenges posed by cancer. AI and personalized cancer care create a picture-perfect future in which customized solutions are provided for every patient's journey, ushering in a new era of resiliency, healing, and hope. AI emerges as a strong friend in this symbiotic dance between compassion and technology, advancing us toward a day when accuracy and empathy will unite to rewrite the history of cancer care.

Keywords:

Artificial Intelligence (AI), Personalized Treatment (PT), Recommendations, Cancer Patients (CP), Smart PLS Algorithm.

Introduction

The word "artificial intelligence" can be explained in these words: "the modern theory related to use of computer systems that will make computer capable of performing normal tasks which require human intelligence.

For example, recognition of speech, perception related to visual stimuli, power of decision making, translation of different languages and others ". This study covers how artificial can be used for personalized cancer treatment.

The number of cancer cases has been tremendously unceasing and increasing day by day. There are versatile and different reasons that can cause cancer in the human body[1]. The healthcare field has seen a revolution in the use of artificial intelligence (AI), which has completely changed how complicated disease diagnosis and treatment are done. Making individualized therapy suggestions for cancer patients is one of the most exciting uses of AI in medicine. This innovative method customizes treatment regimens based on the unique traits of each patient, their genetic profiles, and their past medical.

[1]Institute of Molecular Biology and Biotechnology, Foundation for Research and Technology, Hellas, Crete, Greece,
[2]BSC in Biotechnology. University of Nottingham, United Kingdom

Address for correspondence:
Joseph De Frank
Institute of Molecular Biology and Biotechnology, Foundation for Research and Technology, Hellas, Crete, Greece

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experiences by utilizing the capabilities of machine learning and data analytics. Traditional one-size-fits-all treatment options confront considerable hurdles from the diverse and heterogeneous group of infections known as cancer. Every patient's cancer is distinct, caused by certain genetic alterations and impacted by a wide range of variables, such as way of life, exposure to the environment, and general health. The use of AI to oncology signifies a paradigm change in the direction of precision medicine since it acknowledges the intrinsic complexity of cancer. There are various internal and external factors which are termed carcinogens that can cause cancer in human body. There are different types of carcinogens, such as occupational and environmental. When these carcinogens enter the body, they cause changes in genetic material, which is termed mutation. As a result of mutation in genetic material, the process of cell division becomes uncontrolled[2]. This process produces an abnormal number of cells in the body, which produces tumors in the body. There are different treatments which are suggested for early diagnosis and treatment of cancer. Artificial intelligence is the leading way for the treatment of different types of cancer. The treatment of cancer is totally dependent upon early diagnosis of cancer. The screening tests, which are conducted with the help of artificial intelligence, are quite better for early diagnosis of cancer. One of the important technologies of artificial intelligence is electronic medical health records, which are quite reliable as compared to paper work[3]. The capacity to evaluate large and varied datasets is the fundamental component of AI-based personalized therapy suggestions. This comprises demographic and lifestyle data, healthcare records describing previous treatments and results, and genetic data acquired using cutting-edge sequencing technology. The combination of various data sources enables AI systems to identify complex relationships and patterns that may be difficult for humans to analyze, opening the door to more customized and knowledgeable treatment choices. In this approach, genomic profiling is essential. AI systems are able to determine the precise mutations or changes that propel the growth of cancer by deciphering the genetic composition of a patient's tumor. With some drugs and therapies intended to target particular genetic defects, this knowledge becomes essential for customizing therapy recommendations. This focused strategy increases the treatment's overall efficacy while reducing the possibility of side effects. It is basically a structured data base which uses different recognition patterns to identify different characteristics related to diagnosis of cancer. The other benefits of medical health records are that it can be used in multiple hospitals at single time. Most importantly by using artificial intelligence, much of the cost and time can be saved because it is totally computer-based programs. The other technology related to artificial intelligence is machine Learning and deep learning[4]. The word machine Learning means that these are computer-based programs which are able to adapt without using any kind of spontaneous instruction. It works on algorithms and different statistical models, which help to draw inferences from data. The deep learning technique is also based on artificial intelligence and has a major role in the detection and treatment of different types of cancer in the human body. The other technology related to artificial intelligence is medical images-based data use in healthcare centers. These images are taken by using high-resolution cameras then these images are thoroughly studied by medical experts. These images also help to distinguish between cancerous and non-cancerous cells because there are major structural and functional differences between cancerous and non-cancerous cells[5]. The cancerous cells are abnormal in size and function, these have high metabolism and less functionality. These cancerous cells have greater size as compared to normal cells. All of these characters of cancerous cells help to identify them by using medical images technique. There are many benefits of artificial intelligence in treating cancer, such as can analyze data with high accuracy and less error. It has the ability to provide better care to patients because of using computer-based systems. The cost of care is also lessened by the help of artificial intelligence. It provides real-time and totally accurate data, it helps to reduce staff stress, it makes administration quite easy and accessible[6]. AI-generated insights are seamlessly integrated into the clinical decision-making process due to a simple and user-friendly interface between healthcare practitioners and AI. Through this partnership, a synergistic connection is fostered wherein the capabilities of AI and human knowledge are combined to provide the best possible level of individualized care. AI takes into account patient preferences and values in addition to customizing therapies based on clinical and genetic data. Understanding the value of patient-centered care, the system makes an effort to match treatment suggestions with the priorities and goals of each individual. This patient-centered approach promotes patient empowerment and involvement and improves treatment compliance. The other benefit is that it works at a greater speed than human resources, which makes cancer diagnosis easy. It can detect the reason for cancer at the genetic level, along with its causes and effects. Nowadays, artificial intelligence-based tests are developed to detect the type of cancer before showing any symptoms in them. One of the great achievements of artificial intelligence is cancer Genomics, which is the study of DNA sequence responsible for causing cancer in the body. This technology helps to differentiate between cancerous and non-cancerous cells based on the changes in chromosome and DNA[7]. This technique also helps to identify which type of carcinogen acts on which part of the body to cause cancer in the human body. For example, air pollution has some carcinogens which directly act on lungs to cause lung cancer in body. The

other benefit of artificial intelligence is machine Learning and personalized machine use. By using technology of machine learning, every person is somehow able to conduct some treatment by using computer-based systems. AI-assisted personalized cancer therapy requires ongoing learning and adaptation. The system continuously improves its algorithms to reflect the most recent developments in cancer research as it processes fresh patient data and treatment outcomes. This iterative learning process guarantees that the AI stays at the forefront of knowledge by constantly adapting to the growing body of information regarding cancer biology and treatment approaches. AI's prediction powers in cancer are revolutionary. Based on similarities with prior instances, the system analyses past data to predict a patient's possible response to various treatment choices. This kind of foresight enables medical practitioners to choose therapies with better chances of success and maximize their patients' overall health. Although artificial intelligence has been proved a better way to treat different diseases such as cancer, there are also some challenges related to artificial intelligence. The first problem is that it is decreasing the value of human resources and more reliance on computers and technology; thus, few computer systems are controlling the whole healthcare aspect of life[8]. Although one-fifth of world healthcare centers are using artificial intelligence-based systems thi,s use is resulting in a scarcity of jobs for human beings. There are also some ethical concerns related to using artificial intelligence. There are also some privacy and security issues which can result in data loss. Another challenge related to artificial intelligence is that it is making human creativity of less use in society in almost all aspects of the human life. All these factors show that there are some hurdles in the adoption of artificial intelligence in treating cancer. If all of these challenges are coped up effectively, artificial intelligence could be proved very effective for treating different diseases such as cancer. These techniques and technologies speak truly about the importance of artificial intelligence in our daily live[9, 10]. As the field of personalized cancer therapy advances, the privacy of data and ethical issues become increasingly important. Following legal and ethical guidelines to the letter is essential when managing sensitive patient data. The appropriate use of AI in healthcare requires balancing protecting patient privacy and drawing insightful conclusions from patient data. There are a lot of promising opportunities and continuous obstacles on the horizon for AI-based personalized therapy recommendations in cancer care. Improvements in technology and joint efforts by engineers, physicians, and researchers will propel the growth and improvement of AI applications in cancer. As we traverse this revolutionary terrain, the end objective is unambiguous: to elevate the standard of treatment and optimize the results for each person confronting the overwhelming obstacle of cancer.

Research Objective

The main objective of this study is to understand the use of artificial intelligence in the modern world to treat different diseases such as cancer and others. This study has overviewed the different technologies based on artificial intelligence that are being used effectively for diagnosis and treatment of cancer.

The research study determined that AI-based personalized treatment recommendations for cancer patients. The research is divided into five specific chapters: the first section represents the introduction related to the variables, including dependent and independent. The second portion describes the literature review the third section describes the methodology, including data collection, methods tools, and techniques. The fourth section results also describe the applications of the overall research, summarize the overall research study, and present recommendations about topics.

Literature Review

AI-Based Personalized Treatment Recommendations for Cancer Patients

Artificial Intelligence (AI) is a kind of human simulations programmed to convert the raw form of data into the meaningful form which is used in the decision-making process. Usage of the deep learning computer aided programs are designed to analyze the raw data into clinical decision making. New techniques have been developed for predicting the cancer. Artificial Intelligence (AI) use the smart and intelligent computer system for the prediction and diagnosis of the cancer. With time, art and artificial intelligence have changed and revolutionized the cancer-related matters of the medical field. Artificial Intelligence (AI) is able to detect the cancer with precision and accuracy at the early stages. It is innovative technology of the future which enables the timely diagnosis and prediction of the cancerous cells[11]. Cancer is considered as the major heath issue and a leading cause of death worldwide. In any form, the cancer is dangerous and life taking if not detected at early age. Early detection of the cancer increases the chances of the survival of the patients[12]. For the detection of the cancer, the artificial intelligence (AI) emerged as the revolutionized technology for the treatment of the cancer patients. The artificial intelligence-based computer aided techniques have been emerged as the tools for the surveillance management of patients[13]. Beyond simple forecasts, AI is being used in customized cancer therapy, though. Additionally, the system carries out thorough risk evaluations, taking into account any potential drawbacks and consequences related to every available treatment choice. This comprehensive assessment considers the patient's general health, co-occurring conditions, and additional variables that may impact the acceptability and

practicality of particular therapies. In an AI-driven world, the work of healthcare professionals is still crucial. Although artificial intelligence (AI) offers insightful analysis and helpful suggestions, it functions as a cooperative tool rather than a replacement for human knowledge. Together with AI, oncologists use their clinical expertise and patient-centered approach to make sure that the suggestions are in line with the patient's values, preferences, and general well-being. The oncologist, in conventional methods, has to administer the drugs which are provided to the patients. It may lead to less efficacy. In advance form using the AI, CURATE is the efficacy driven and independent of the traditional form of the mechanism helps in administrating the drugs for chemotherapy[7]. Treatments for the cancer patients are somewhat personalized and are specific with the demand of the patient's health. It may lead to the personalized dosing of the patients by the clinicians. The phase -1 patients are provided with the tradeoff between the toxicity and efficacy of the drugs[14]. Artificial intelligence (AI), along with precision-based medicine for patients, has changed the medical field. The digitalization of the medical data increases the pace of the Artificial Intelligence in the medical field. Artificial Intelligence (AI) has provided the more security and privacy leading to the transparency in the medical history of the patients[15]. Precision or personalized medicines is the form to provide the patients with the special health care problems. This can be achieved not with the presence of medical history of the patients but with the genetic information and physiological data of the individuals. This helps in maintaining the custom-based plan for each patient, which further be treated properly[16]. The clinicians, when treating patients, are faced with two major questions: first is what kind of treatment is required, and the other is how it does. The decision to treat the patient is complex with time because the response of the individual to the trials are variable. The complexity increases with the combination of the medicines over time. Same the individual patient's response to the treatment has been changed over time with each stage of medicine provisions to the patients[8].The huge amount of data produced from the intensive techniques has increased the needs of the researchers to analyze and interpret the data they have generated over time. There are many methods in statistics to overcome the synthesis of the big data, with the use of Artificial Intelligence (AI) generating the tailored based medicine for each patient[17]. Oncology applications have widely been changed with the time for the flow of the medicine. Artificial Intelligence is providing the precision medical treatment for the patients. Artificial Intelligence based medical devices have provided a new role in providing the health care solutions to the patients[18].The chronic disease of the cancer has improved the needs of the care of patients. The toxicity of the treatment majorly supports the quality of life of patients. Not only the people are left at the discretion of the clinicians' traditional ways of the providing the medication. The state-of-the-art techniques of the Artificial intelligence and data science to benefits the status of the health and support and managed the cancer patients[19]. Breast cancer has resulted in the poor quality of the life in various domains of life. ASCAPE is designed to provide the Artificial Intelligence (AI) techniques in the medication of the breast cancer. The potential interventions have been provided by the physician to provide the modern medical treatments to the patients[20]. Artificial Intelligence (AI) is a computer-based technology that requires human intelligence to perform a particular task. It is a broader based technology which enabled the applications and its impacts on the communities and business framework. For generating the medical imaging for the cancer detection and treatment helps in precision-based medicine for each patient[21]. The computer aided diagnosis and computer aided detection are accelerated due to the Artificial Intelligence (AI) with the inculcation of the personnel at the early stage of the treatment and it is available nationwide regular basis. The peripheral intelligence and the big data technologies have been the basic part of the artificial Intelligence (AI)[22]. With the changing nature of the treatments, the oncologists preferred to personalize care of the patients. The drugs and treatments of the patients must be specified with the need of each patient[23]. The success in the personalized health care department has increased due to the invasion of the Artificial Intelligence. The computational based modeling of the Artificial Intelligence designed the models for managing the patients with special health care. The integrated modeling helps in enabling the clinicians for supporting the patients[1]. In the Russian Health care programs, the treatment of the cancer patients has changed the treatment processes. The previous techniques of fit for all has been widely changed due to the Artificial Intelligence. The genetic codes and lifestyles of the individual patients have been judged and made them capable of analyzing the solutions of the diseases[5]. The manual assessment of the patients has become difficult for t clinicians' overtime, so there is a need to develop a new technique of Artificial Intelligence to overcome the problems. In 2022, around 600000 deaths in the United Stated have been due to the cancer problems. The major issue is the detection of the cancer at the early stages[24].

Data collection

This research study present the AI based personalized treatment recommendation related to the cancer patients. For measuring the research, Compile detailed medical history, genetic information, tumor features, past medical history, and general health. To find patterns or correlations that could affect treatment outcomes, analyze the gathered data using machine

learning methods. After that, to identify the precise genetic mutations or variations present in the tumor, do genomic profiling. This makes potentially more effective tailored medicines easier to find.

Methods

Using data from comparable instances in the database, AI can forecast how certain therapies will work. It takes into account variables such as genetic makeup, past medical records, and comparable patient outcomes. As new information and treatment results are included into the system, it continually learns and adjusts its recommendations to reflect the changing landscape of cancer biology and treatment efficacy. This research study based on the primary data analysis for determine the result used Smart PLS software and generate informative results. The descriptive statistic, the correlation coefficient analysis, the smart PLS Algorithm model between them. Taking into account the patient's medical history and general health, evaluate the possible risks and side effects of each treatment choice. To ensure a patient-centered approach, consider the values and preferences of the patient while making treatment recommendations.

Assist oncologists in making decisions by giving them access to AI-generated advice through an intuitive interface. While AI may greatly improve personalized cancer treatment recommendations, it should be utilized as an aid to healthcare practitioners rather than as a substitute for them. AI and human knowledge working together provide a patient-centered, comprehensive approach.

Descriptive statistic

Table: 1

Name	No.	Mean	Median	Scale min	Scale max	Standard deviation	Excess kurtosis	Skewness	Cramér-von Mises p value
AI	0	1.571	1.000	1.000	4.000	0.670	2.028	1.200	0.000
PTR	1	1.653	2.000	1.000	4.000	0.771	1.633	1.258	0.000
CP	2	1.551	1.000	1.000	3.000	0.641	-0.403	0.763	0.000

The above result describes that the descriptive statistical analysis result presents the mean values, the median rates, the standard deviation rates, also that excess kurtosis rates, the skewness values, and the probability values of each indicator, including dependent also independent. The mean values are 1.571, 1.653, 1.551 result shows that average values of each indicator. The overall median rate is 1.00, the maximum value is 4.000 and 3.00 respectively. The standard deviation rate is 67%, 77%, and 64% of each variable. the overall probability rate is 0.000 shows that 100% significantly level between them. the skewness rate is 1.200, 1.258, and 0.763, showing the positive skewness rates of each indicator. AI's iterative learning process guarantees that it can adapt to the changing field of cancer research, providing medical practitioners with a dynamic and knowledgeable tool for decision-making. AI extends its powers to patient monitoring beyond diagnosis and therapy planning. AI supports continuous patient care by monitoring alterations in tumor features and providing real-time clinical decision assistance. The smooth incorporation of AI in clinical trials advances the field of experimental medicines by accurately and quickly matching eligible patients.

Applications

AI is being used in personalized cancer care at several phases of patient care, from diagnosis to therapy selection and follow-up monitoring. The following are important domains where AI is having a big influence:

Evaluation and Prompt Identification

• **Image Analysis:** To find early indications of cancer, AI algorithms examine medical pictures, including CT, MRI, and mammograms. This raises the probability of a good outcome and facilitates early detection.

• **Pathology:** AI speeds up the identification of malignant cells and produces more precise diagnoses by helping pathologists' analyses tissue samples.

Genomic Examination

• **Genomic Profiling:** To pinpoint certain genetic mutations or changes in a patient's tumor, AI analyses genomic data. This data is essential for developing tailored treatments that target the distinct genetic features of the malignancy.

Selection of Treatment

• **Personalized Treatment Plans:** AI examines a variety of information, including as patient histories and treatment results, to suggest tailored regimens that take into account a person's genetic makeup, past treatment experiences, and other pertinent variables.

• **Drug Discovery:** By forecasting the efficacy of possible cancer medications based on molecular and genetic data, AI expedites the drug discovery process.

Supporting Clinical Decisions

• **Aiding in Decision-Making:** AI gives oncologists evidence-based, real-time advice to help them choose the best course of action for their patients.

• **Risk assessment:** AI evaluates the possible risks and adverse effects of every treatment, assisting medical personnel in balancing the advantages and disadvantages for each patient.

Observation and Succession

• **Disease Progression Monitoring:** AI tracks alterations in tumor properties over time, allowing timely treatment plan modifications and early identification of resistance or recurrence.

• **Patient Management:** By monitoring side effects, tracking treatment responses, and offering ongoing assistance during the course of therapy, AI helps with ongoing patient management.

Therapeutic Trials

• **Patient Matching:** AI connects suitable clinical trials with qualified patients according to their unique attributes, boosting the effectiveness of recruiting and raising the chance that experimental therapies will be successful.

Patient Involvement and Assistance

• **Educational Tools:** By giving patients individualized information about their disease, available treatments, and possible side effects, AI-powered educational tools enable patients to take an active role in their care.

• **Psychosocial Support:** Artificial intelligence (AI)-powered chat bots and virtual assistants provide emotional support and respond to inquiries, enhancing the general experience and well-being of cancer patients.

Investigating and Analyzing Data

• **Population Health Studies:** In the larger framework of cancer research, AI enables large-scale analysis of population health data, revealing patterns, risk factors, and possible areas for intervention.

• **Data Integration:** Artificial Intelligence contributes to a better knowledge of cancer biology and treatment efficacy by integrating and analyzing a variety of datasets, such as genetic data, electronic health records, and treatment outcomes. A paradigm change in cancer care has been brought about by the incorporation of AI in these many applications, which promote a more accurate, patient-centered, individualized approach to treatment and therapy. The potential for artificial intelligence (AI) to improve the quality of life for cancer patients is increasing as technology develops, opening up new possibilities for oncology research and innovation.

Correlations coefficient analysis

Table: 2

	AI	PTR	CP
AI	1.000	0.000	0.000
CP	0.027	-0.067	1.000
PTR	-0.011	1.000	0.000

The above result describes that the correlation coefficient values of each indicator of the AI show that 100% significant relation with PTR. The CP present that 0.027 shows that 2% significantly level the PTR present -0.067 shows that negative rates between negative rate between them. the PTR present that negative rate AI rate is -0.011 shows that 11% significantly correlation between them.

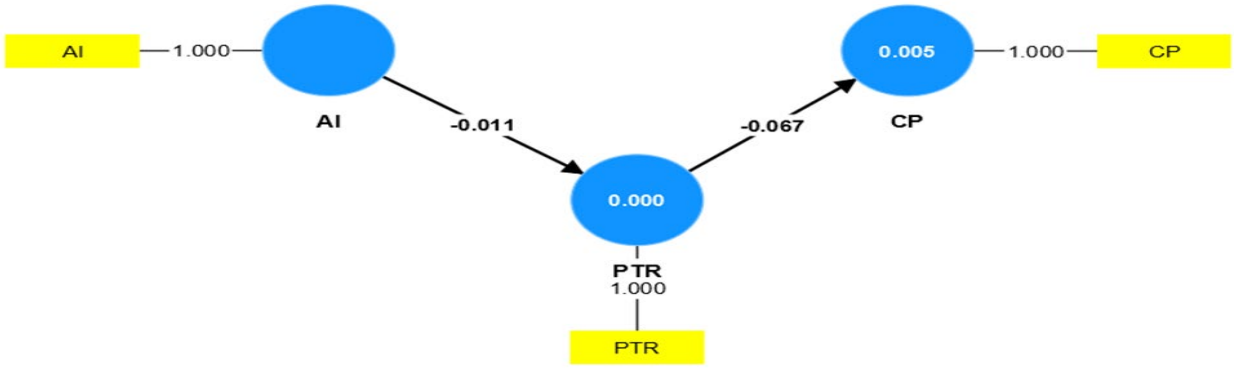

Figure 1

The above graph present that smart PLS Algorithm model the AI shows that -0.011 present that negative link with PTR. The CP shows that -0.067 rate and relation with PTR. The AI, PTR, CP these are shows 1.000 rates with each other.

Conclusion

In summary, the combination of AI with customized cancer care represents a revolutionary moment in medical history. The complicated dance of human knowledge and state-of-the-art technology has the ability to completely change the oncology scene by providing a customized strategy that takes into account the particular difficulties of every patient's cancer experience. Advances in data analytics, machine learning, and genetic profiling have paved the way for a new standard of care that values and acknowledges the uniqueness of each cancer case. Due to large datasets and ongoing learning, AI's predictive power allows for the development of treatment plans that are not only efficient but also sensitive to patient preferences and possible hazards. In light of this revolutionary path, it is critical to emphasize the mutually beneficial partnership between AI and healthcare providers. Because of their intricate knowledge of the values and context of their patients, physicians continue to play an essential role.

Artificial Intelligence functions as a technology that improves healthcare practitioners' abilities and enhances the decision-making process. In conclusion, a paradigm changes in our understanding of this intricate and varied disease is represented by the use of AI into tailored cancer treatment. Through the utilization of data analytics, genetic profiling, and ongoing learning, artificial intelligence (AI) enables medical practitioners to customize therapy recommendations according to unique patient attributes. AI-assisted collaborative approach, which enhances human knowledge, has the potential to transform cancer care by providing patients with new opportunities and hope as they pursue recovery.

Ethical issues are a major concern going forward, highlighting the necessity of handling data responsibly and protecting privacy. As we navigate this new region, maintaining a careful balance between innovation and patient information security is not only technologically necessary, but also morally required. Looking ahead, the road ahead is full of opportunities and difficulties. To further refine and develop AI applications in personalized cancer therapy, researchers, physicians, and technologists must work together. With every step ahead, we get closer to a day when compassionate and cutting-edge cancer treatment coexist, and when artificial intelligence and human touch combine to create a story of hope and fortitude for every person facing the challenges of cancer. The ultimate objective in this era of AI-driven personalized therapy is still quite clear: to raise the bar for patient care, enhance patient outcomes, and give patients a sense of empowerment in the face of hardship. The nexus of AI and personalized cancer therapy presents a compelling image of a future where each patient's journey is met with customized solutions, encouraging a new era of resilience, recovery, and fresh hope, as we stand at the intersection of innovation and compassion.

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