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The Evolving Role of Artificial Intelligence in Radiation Therapy: From Clinical Applications to Future Perspectives

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ABSTRACT- Artificial intelligence (AI) is rapidly changing many medical specialties, and Radiation Therapy is one of them. This paper deals with the adoption of AI in Radiation Therapy, its benefits and its challenges. Artificial intelligence can improve the accuracy, speed, and results of radiation therapy and may also aid in adaptive radiation therapy, predictive analytics, optimized treatment planning, and improved image analysis. Artificial intelligence can help cut planning times and boost accuracy by analyzing large data sets to determine the best treatment settings and automate difficult tasks. AI-driven methods are increasingly improving tumor detection and segmentation in image analysis by analyzing data from CT, MRI, and PET imaging, leading to precise delineation of the tumor. Adaptive radiation therapy uses AI to improve the accuracy and efficacy of treatment by adjusting treatment regimens in real time as a patient's anatomy and tumor growth change. Using previous patient data for predictive analytics in order to predict treatment outcomes and potential complications make clinical decision making and more personalized treatment strategies possible. Barriers to AI implementation in radiotherapy include: - Data quality and quantity - Interoperability and standardization - Ethical and regulatory issues - Resistance to clinical implementation to meet these challenges, researchers, clinicians, data scientists, and business stakeholders must collaborate. AI could help overcome these barriers to advance radiation treatment, better patient care and streamline operations. This study provides an overview of the state of the art of the integration of AI in radiation therapy and recommendations for future lines of research and clinical application.

KEYWORDS: Radiation Therapy, Artificial Intelligence (AI), Radiation Oncology, Adaptive Radiation Therapy (ART)

I. INTRODUCTION

Artificial Intelligence (AI) is the term used to describe computer systems that carry out tasks requiring human intelligence. It is the process of simulating human cognitive functions, including learning, reasoning, and problem-solving, using machines [1]. The process of radiation treatment is long, complicated, and requires a lot of work. It needs to be carefully planned and carried out. Radiation therapy or Radiotherapy or simply Radiation Oncology has many steps, such as choosing the first treatment, simulating it, planning and getting ready for it, quality assurance (QA), giving radiation, and following up with care afterward [2]. AI is being employed to automate a variety of components of this workflow. These consist of image reconstruction, target and tissue segmentation, treatment planning, radiotherapy delivery, and treatment response assessment [3]. Because the whole procedure is largely dependent on technology infrastructure, including CT scans, MRIs, image reconstruction software, and linear accelerators, the use of AI in radiation therapy practice is more seamless and, as a result, quicker than in other medical disciplines [4]. Furthermore, a team of medical physicists, radiation oncologists, and radiation therapists must analyze the extensive datasets produced by this technology equipment, which reduces workflow efficiency. In addition to reducing burden, automation in radiotherapy may cut down on lengthy delays that might have otherwise prevented the prompt beginning of appropriate care in a patient who was already experiencing anxiety.

AI's capacity to process massive volumes of data with improved accuracy and speed. Applications including radiation treatment delivery, image processing, 3D structural contouring, and response evaluation are already being developed. At almost every step of this process, AI is being evaluated and employed in a variety of applications. By doing this, we can identify and provide patients with a treatment plan that is quicker, more accurate, and less expensive, which will shorten wait times, increase effectiveness, and lessen side effects [5].

AI can be incorporated into the entire radiotherapy workflow, from image processing (such as image registration and segmentation) to treatment planning. It can also be used to predict radiation-related side effects (such as radiation pneumonitis and radiation-induced temporal lobe injury) after radiation therapy has been administered, creating an overall effective and customized workflow [6],[7].

AI in radiation therapy is a revolutionary change in the way cancer is identified, treated, and controlled. This article examines the many facets of AI in radiation therapy, emphasizing how it might improve accuracy, efficiency, benefits, drawbacks, clinical applications, and patient outcomes in the battle against cancer.

II. THEORETICAL BACKGROUND

A. Forces behind increased use of AI automation in Radiation Therapy

Artificial intelligence automation in treatment planning might hold the potential to improve patient outcomes in radiation oncology significantly. AI-automation is a prerequisite for wide-spread implementation of adaptive radiotherapy including MR-guided adaptive radiotherapy to maintain on-table time to a reasonable length [8],[9]. AI automation allows technically feasible same-day treatment with a short interval between planning imaging and treatment delivery, and has the potential to improve patient experience and outcomes in radiation oncology. Moreover, tumors grow and the prognosis is worsened from the time of diagnosis to the time treatment begins [10]. AI automation can shorten this critical time window considerably. There is also a shortage of radiotherapy specialists in emerging and third-world countries, a problem that affects millions of patients. AI automated planning is already being used in efforts such as the Radiation Planning Assistant (RPA) that seek to increase global access to radiation therapy [11]. Lastly, AI automation can make possible more complicated treatments which are too time-consuming today. Examples are the more refined definition of the target volume, the sparing of a large set of risk structures and the local treatment of a large number of targets in patients with metastatic disease.

The demographic crisis will be an important megatrend in the western world and probably an important driving force for increased use of AI automation in radiation oncology as well. The number of older people in western populations is growing and so is the number of required radiation therapy treatments. At the same time, the share of younger people for the radiation therapy workforce will decline, creating an enormous supply gap when considering a pre-existing workforce crisis. Artificial intelligence automation is an obvious answer to the required increase in productivity and, given the scope of the challenge, resistance to an increasing role of AI in radiation oncology seems to have little promise of success.

It is important, however, to maintain medical supervision and control. Therefore, the future of radiotherapy treatment planning will be how to best interact between AI and radiotherapy experts, e.g., interactive AI models and workflows [12].

B. Integrating AI Expertise in Radiation Oncology

If AI in radiation oncology is left to external entities (i.e., MedTech companies or the fields of computer sciences and engineering) then the role of radiation oncologists, medical physicists and the entire field bear the risk of being diminished as much as the role of AI will grow. Radiation oncology could lose its defining core competency. If thought through to their end, radiation treatments could become completely autonomous, supervised and applied by any oncology discipline.

To avoid such a fate and to get the most out of the combination of AI and radiation oncology, AI expertise should be an integral competency of our field. This is how the field of radiation oncology will change with the increasing role of AI in medicine. One piece of the solution might be to bring computer scientists and AI experts into radiation oncology. However, this will be limited by the availability of computer science experts and the fact that expertise in AI and radiation oncology is still separated across different professions here. Therefore, we should raise the technical competency of medical physicists and radiation oncologists as functional units of our field to be experts for AI in radiation oncology. If AI is to become an integral part of radiation oncology, then AI expertise has to become an integral part of our competence as well. Furthermore, enhanced AI and computer science skills would allow for a more differentiated deployment of AI methods in radiation oncology, specific to the individual patient and center. However, the integration of radiation oncology and AI expertise among medical physicists and radiation oncologists is particularly important to identify the future directions of our field and to spark ideas on the optimal implementation of artificial intelligence (AI) tools in radiation oncology. Increasing the AI competency within radiation oncology will also ensure that the driving intellectual forces that will shape the future of radiotherapy will emerge from within our field and not from outside.

III. METHODOLOGY

A. Search Strategy and Database Selection

The authors reviewed the literature relevant to this work between year 2019 to 2025 on PubMed and Google Scholar for articles using AI in Radiation Therapy as summarized in Table 1. Specifically, we searched PubMed and Google Scholar using the following list of queries: [“Artificial Intelligence” AND “automatic segmentation”], [“Artificial Intelligence” AND “automated treatment planning” AND “radiotherapy”], [“Artificial Intelligence” AND “dose prediction”], [“Artificial Intelligence” AND “automated optimization”], [“Artificial Intelligence” AND “challenges”], [“Artificial Intelligence” AND “future scopes”], [“Artificial Intelligence” AND “contouring ”], [“Artificial Intelligence” AND “Image synthesis”], [“Artificial Intelligence” AND “adaptive radiation therapy”] and [“Artificial Intelligence” AND “Image acquisition”]. “Artificial Intelligence” was substituted with the terms “Machine Learning”, “Deep Learning” and “Neural Network”. The authors checked the relevance of these searched articles to the topic. Articles unrelated to radiotherapy were excluded from this review. The reference lists of selected articles were also hand searched for other relevant articles.

B. Inclusion and Exclusion Criteria

Table 1 summarizes the inclusion and exclusion criteria used during screening. Articles were included if they were published in peer-reviewed journal with extensively search relevant topic based on Artificial Intelligence in Radiation therapy. The literature search was restricted to original researches published in a journal in the English language.

Table 1: The search strategy summary of the literature and Inclusion and Exclusion criteria.

Items	Specifications
Time Period	year 2019 to 2025
Databases and other sources searched	PubMed and Google Scholar

Search terms used	Artificial Intelligence, automatic segmentation, automated treatment planning, radiotherapy, dose prediction, automated optimization, workflow, Image Acquisition, Image Contouring, Image Synthesis, adaptive radiation therapy, Challenges of AI, Future Scopes
Inclusion and exclusion criteria	Articles published in the English Language were included in the review and non-English language publications were excluded. Articles which were relevant to use of AI in Radiation therapy were included. And excluded based on topics related to treatment planning, techniques like IMRT, IGRT & 3DCRT used in radiation therapy.
Selection process	The search was conducted independently by all authors

Finally, we categorized these selected articles into seven categories: (A) Workflow using AI in Radiation Therapy, (B) Image Acquisition, (C) Image Contouring, (D) Image Synthesis, (E) adaptive radiation therapy (art) in treatment planning, (F) Challenges of AI and (G) its Future Scopes.

IV. RESULTS AND DISCUSSION

A. Improving Radiation Therapy Workflow Using Ai

Each of the many rigorous processes in the radiotherapy workflow is essential for creating a customized treatment plan. This multi-step procedure typically involves a radiation oncologist manually defining the tumor and organs at risk (OARs) on CT images, which can be very time-consuming. For example, contouring six OARs in head and neck cases can take up to several minutes [13]. This multi-step procedure is changed by the inclusion of AI, resulting in a more efficient workflow with AI assistance and potential future uses with more advancements as shown in Figure 1.

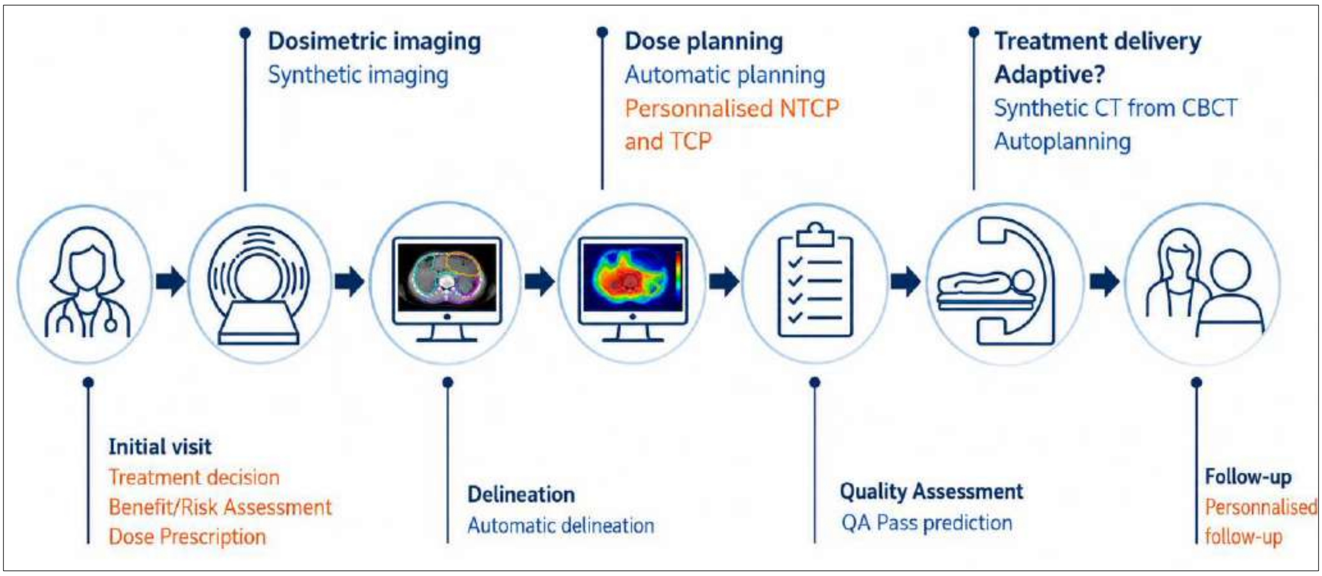

Figure 1: Workflow comparison using AI assisted (Highlighted in Blue) and Traditional way. CBCT indicates cone beam computed tomography; CT indicates computed tomography; NTCP indicates non tumoral complication probability; TCP indicates tumor control probability.

Radiotherapy departments often deal with complicated treatment plans and large patient numbers. By automating administrative duties, scheduling appointments, and allocating resources, AI may simplify workflow management. This improves overall efficiency by allowing healthcare personnel to concentrate more on patient care and less on administrative tasks.AI has the potential to improve healthcare operations, reduce treatment times, and provide more individualized and efficient care.

B. Image Acquisition

From the very beginning, imaging is crucial for treatment planning and for keeping track of how things are going, even long after treatment is over. Computed Tomography (CT) is the primary imaging modality, because it is compliant with dose calculations. It is used at the start of the planning process to define the region of interest, which includes the tumor and the surrounding critical structures. Under-sampled and noisy sensor data may lead to more artifacts and noise during computerized image reconstruction. AI uses convolutional neural networks (CNNs) to identify items in a scan and recurrent neural networks to remember them, which helps to suppress noise and artifacts [14].

C. Image Contouring

Delineating and contouring targets and Organs at risk (OARs) manually has long been tedious, sensitive to human mistake, and prone to human variability owing to the subjective nature of the procedure [15]. The operation of AI segmentation has been evaluated on numerous treatment locations, including head and neck, prostate, esophagus, and breast tissue malignancies. Although stronger at contouring of OARs, AI has hurdles when it comes to target contouring owing to the multimodal imaging needs for target segmentation and variability in the target itself when prioritizing tumor control over toxicity. The aim of the AI-based image analysis is to increase the accuracy and efficiency of tumor identification and segmentation [16],[17]. Imaging data from CT, Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET)

Deep learning models, especially convolutional neural networks (CNNs), are widely used for the analysis of PET images. In many cases, they are more accurate and consistent than human specialists in differentiating cancers from nearby healthy tissues [18]. Research in multimodal image analysis also suggests that artificial intelligence can integrate data from multiple imaging modalities to improve diagnostic accuracy and guide treatment planning.

D. Image Synthesis

CT offers a trustworthy evaluation of the tissue density and geometric data required to calculate the administered dosage. Planning CT is therefore necessary for external beam radiation therapy. But some organs are not clearly defined on CT images [19]. In order to improve precision in delineation, magnetic resonance imaging (MRI) is typically performed and registered with the planning CT. However, this registration may be inaccurate because the patient may have been in a different position between the planning CT and MRI [20]. Additionally, high-field MRIs may be subjected to distortions that could affect accuracy. As a result, AI-generated planning CT based on MRIs has been developed, using either generators (like convolutional neural networks) or generative adversarial networks (GAN) to generate synthetic CT images from MRI examinations performed in radiation treatment position [21].
As a result, when MRI examination is required in treatment position to be registered with the planning CT, MRI examination could be used for planning, thereby avoiding a planning CT. This offers an opportunity to streamline the planning workflow while improving delineation, particularly for pelvic and brain tumors for which MRI is typically required as shown in Figure 2. GAN provides more detailed and less blurred images and tends to be the preferred technique to generate synthetic images [22].

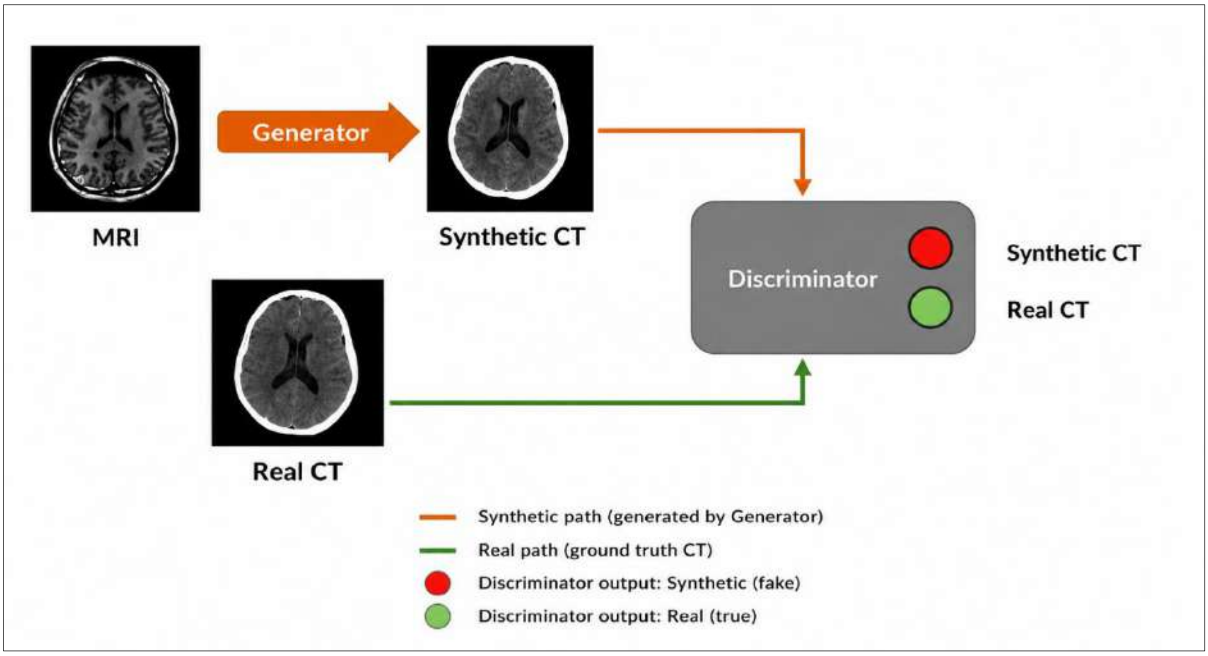

Figure 2: Process of Generative Adversarial Networks (GAN)

E. Adaptive Radiation Therapy (Art) In Treatment Planning

The treatment regimens are adapted to the patient's anatomy and tumor size changes during the adaptive radiation therapy (ART). AI has the potential to enhance ART through speedily analyzing images and providing real-time modifications to the treatment plan, resulting in more accurate and successful treatment. The idea of ART has changed significantly over the last few decades. Radiation therapy plans were initially static and did not consider anatomical changes that occurred throughout the course of treatment. With the development of technology, there was an increasing need for more flexible methods, which led to the creation of ART [23]. Early ART systems required manual changes and repeated imaging, which took time and could not be performed in real time. Current ART research and development is primarily focused on the use of AI to automate and improve treatment plan flexibility [24]. AI-based ART systems utilize such advanced imaging technologies as daily cone-beam CT scans to follow patients' anatomical changes and tumor growth. Machine learning algorithms process this imaging data to predict anatomical changes and adapt the distribution of radiation dose accordingly. This real-time adaptation capability ensures that radiation doses are accurately targeted to the tumor, thus decreasing exposure to nearby healthy tissues and improving overall treatment outcomes [25],[26].

F. Challenges In Ai Integration In Radiation Therapy

There are many challenges to integrating AI into radiation therapy that must be overcome to fully realize the potential of AI. These issues have technological, clinical and ethical components (Figure 3) and must be addressed by researchers, physicians and legislators.

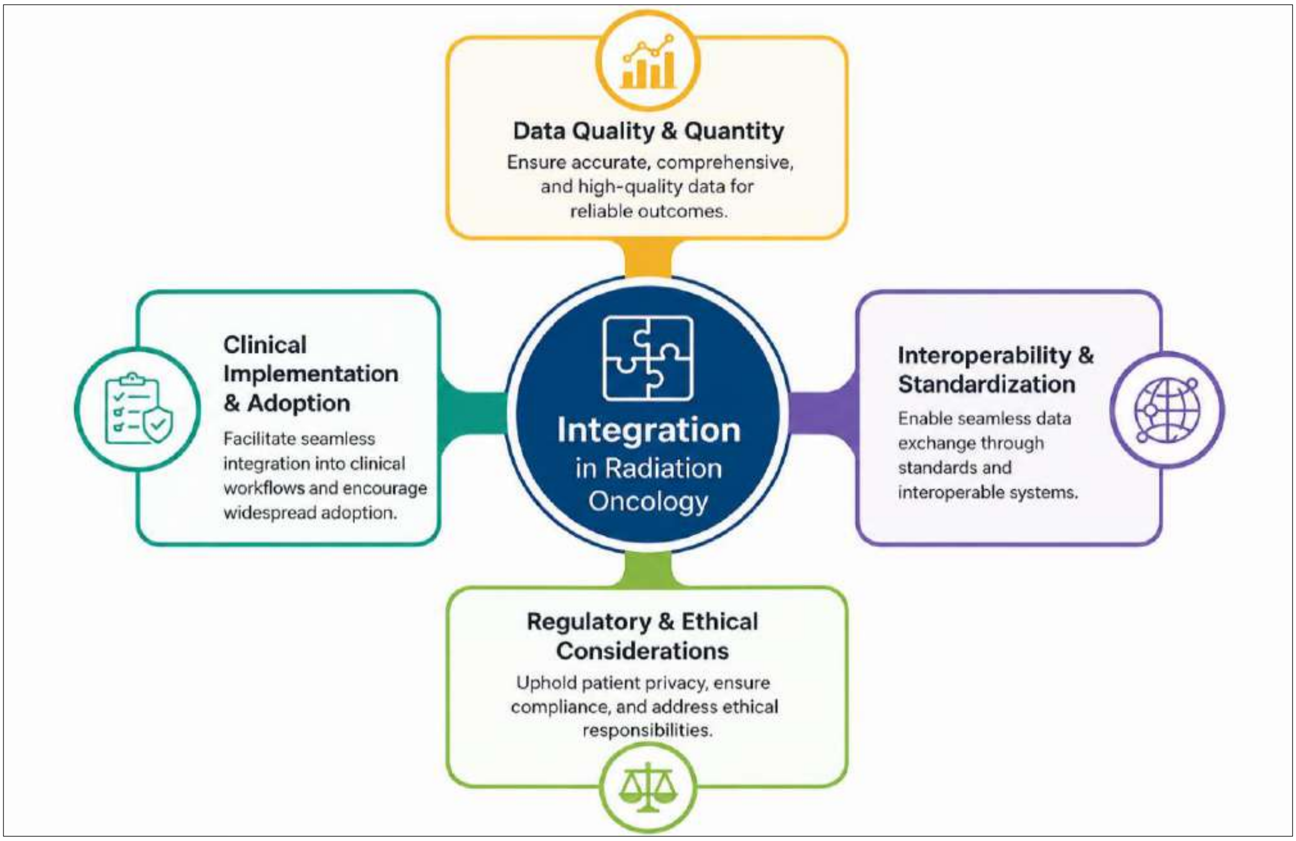

Figure 3: Challenges in AI integration in radiation therapy/radiation oncology.

- **Data quality and quantity:** The usefulness of AI models depends heavily on the quality and quantity of data used to train them. Major barriers and challenges are uneven data quality, missing data and limited access to big labelled datasets. Artificial intelligence systems require good datasets that properly represent different patient groups and treatment situations [27].
- **Training and Integration Costs:** Substantial financial investments in hardware, software, and training are required for the implementation of AI in radiation therapy, which could be a challenge for smaller medical institutions.
- **Regulatory and ethical issues:** The use of AI in radiation therapy raises several regulatory and ethical issues, such as patient privacy, data security, and the need for thorough testing of AI models. These issues will need to be addressed and regulations will need to evolve to ensure the safe and effective use of AI in therapeutics. The specifics of artificial intelligence (AI) technology may not be captured by existing rules and therefore require modifications of existing rules and/or the creation of new rules. The incorporation of AI also raises ethical issues. It is important to obtain patient consent and to keep data confidential especially when handling sensitive health information [28]. Also, the possibility that AI could reinforce existing biases in healthcare should be addressed because biased algorithms could exacerbate health inequities. Building visible and explainable AI models will create trust among physicians and patients, making them understand and accept AI-based decision.
- **Clinical Implementation and Adoption:** Many of the accepted artificial intelligence (AI) technologies do not have rigorous clinical validation and are still experimental. This could impede their broad application.
- **Interoperability and standardization:** The systems used in radiation therapy may employ different software and data formats, which can lead to interoperability issues. Data formats and protocols need to be standardized to ensure smooth integration of artificial intelligence technologies across different platforms and organizations. The lack of interoperability may hinder the effective use of standard artificial intelligence (AI) technology. Standardized data standards like Digital Imaging and Communications in Medicine (DICOM) need to be formulated for data integration and interchange [29].

G. Future Scope Of Ai In Radiation Therapy

AI in radiation therapy has the potential to significantly improve patient treatment. In a few coming years AI based technologies will develop a number of crucial areas to enhance this discipline. Future AI research will focus on developing more complex models capable of handling complicated, high-dimensional data. Developments in deep learning and reinforcement learning will make it possible to build models that can more accurately anticipate treatment results and instantly adjust to new data as shown in Figure 4.

Figure 4: Future Scope of AI in radiation therapy/radiotherapy.

Radiation therapy is predicted to undergo a revolution as AI is integrated with other cutting-edge technologies like radiomics, genomics, and wearable health devices. AI employs the many elements that radiomics derives from medical pictures to forecast how a disease will develop and how a therapy will work. Understanding the genetic composition of cancers via genomics enables more focused and efficient therapies. Patients' health indicators are continually monitored by wearable health devices, which provide data that allows AI to dynamically modify treatment regimens in real-time.

Large datasets may be processed by AI algorithms to create treatment regimens that are optimized for each patient's particular anatomy. This lowers the possibility of harming healthy tissues and organs by increasing the precision of radiation delivery.AI can carry out automatic quality assurance tests, lowering the possibility of human mistake and guaranteeing that treatment plans follow safety regulations [30] .

AI may shorten the time required for treatment planning and image analysis, freeing up physicians to focus more on patient care, according to research. Proactive therapies that enhance outcomes are made possible by AI-based predictive analytics, which may identify patients who are at high risk of problems.

There are many promising opportunities for artificial intelligence (AI) technologies to enable important advances in radiation therapy in the clinic. These developments, which enhance both patient outcomes and operational efficiency, include improving diagnostic accuracy, allowing for real-time adaptive therapy, enhancing patient monitoring, and developing customized treatment regimens.

- **Improving diagnostic accuracy:** AI-based image analysis improves radiation targeting accuracy by improving tumor diagnosis and segmentation. The increase in accuracy limits damage to surrounding healthy tissue and increases the effectiveness of the therapy.
- **Enabling real-time adaptive therapy:** AI improves the efficacy of ART by quickly processing daily imaging data and modifying the treatment regimens in real-time. This capability ensures that, during the course of therapy, radiation doses are accurately targeted to the tumor, compensating for anatomical changes or fluctuations in tumor size.
- **Better patient monitoring:** Wearable medical technology and AI analytics can continuously monitor the health signs of the patients. That means they can intervene early when they see things going wrong. Such a predictive strategy improves the overall treatment results and helps to manage the adverse effects.
- **Developing personalized treatment regimens:** AI examines extensive datasets to find patterns and predict individual reactions to various treatment strategies. This allows clinicians to create treatment regimens that are

specific to a particular patient's genetic and clinical profile, maximizing efficacy and minimizing adverse events.

The future of radiation therapy lies in collaborative multidisciplinary teams, solid standards and the continuous evolution of artificial intelligence (AI) technology that will revolutionize patient treatment.

V. CONCLUSION

AI has many opportunities to improve outcomes, precision and efficiency in radiation therapy. The promise of artificial intelligence (AI) technologies to transform radiation treatment is becoming ever more apparent as they evolve.

This assessment has identified many domains where artificial intelligence can have a significant impact including treatment planning, image analysis, ART and predictive analytics. In every field, we see the ways artificial intelligence can improve healthcare processes, shorten the treatment times, and offer more personalized and effective care. The future of AI in radiation therapy is promising, and more research and development are poised to surmount current challenges and create new opportunities. The rise of AI-powered innovations in patient monitoring, real-time adaptive therapy, personalized treatment strategies, and diagnostic precision have the ability to revolutionize the industry, while also improving operational efficiency and patient care.

CONFLICTS OF INTEREST

The Authors declare that they have no Conflicts of Interest.

REFERENCES

[1] T. M. Ahmed, S. Kawamoto, R. H. Hruban, E. K. Fishman, P. Soyer, and L. C. Chu, "A primer on artificial intelligence in pancreatic imaging," *Diagn. Interv. Imaging*, vol. 104, no. 9, pp. 435–447, Sep. 2023. Available from: https://doi.org/10.1016/j.diii.2023.03.002

[2] E. Huynh et al., "Artificial intelligence in radiation oncology," *Nat. Rev. Clin. Oncol.*, vol. 17, no. 12, pp. 771–781, Dec. 2020. Available from: https://doi.org/10.1038/s41571-020-0417-8

[3] Wang, X. Zhu, J. C. Hong, and D. Zheng, "Artificial intelligence in radiotherapy treatment planning: Present and future," *Technol. Cancer Res. Treat.*, vol. 18, p. 1533033819873922, Jan. 2019. Available from: https://doi.org/10.1177/1533033819873922

[4] Y. Fu et al., "Artificial intelligence in radiation therapy," *IEEE Trans. Radiat. Plasma Med. Sci.*, vol. 6, no. 2, pp. 158–181, Feb. 2022. Available from: https://doi.org/10.1109/TRPMS.2021.3107454

[5] R. Rattan et al., "Artificial intelligence in oncology, its scope and future prospects with specific reference to radiation oncology," *BJR Open*, vol. 1, no. 1, p. 20180031, 2019. Available from: https://doi.org/10.1259/bjro.20180031

[6] L. Ma et al., "Correlation between AI-based CT organ features and normal lung dose in adjuvant radiotherapy following breast-conserving surgery: A multicenter prospective study," *BMC Cancer*, vol. 23, no. 1, p. 1085, Nov. 2023. Available from: https://doi.org/10.1186/s12885-023-11554-2

[7] L. Huang et al., "MRI-based radiomics models for the early prediction of radiation-induced temporal lobe injury in nasopharyngeal carcinoma," *Front. Neurol.*, vol. 14, p. 1135978, 2023. Available from: https://doi.org/10.3389/fneur.2023.1135978

[8] M. Rabe, C. Kurz, A. Thummerer, and G. Landry, "Artificial intelligence for treatment delivery: Image-guided radiotherapy," *Strahlenther. Onkol.*, vol. 201, no. 3, pp. 283–297, Mar. 2025. Available from: https://doi.org/10.1007/s00066-024-02277-9

[9] S. Psoroulas, A. Paunoiu, S. Corradini, J. Hörner-Rieber, and S. Tanadini-Lang, "MR-linac: Role of artificial intelligence and automation," *Strahlenther. Onkol.*, vol. 201, no. 3, pp. 298–305, Mar. 2025. Available from: https://doi.org/10.1007/s00066-024-02358-9

[10] R. Jensen, H. M. Nellemann, and J. Overgaard, "Tumor progression in waiting time for radiotherapy in head and neck cancer," *Radiother. Oncol.*, vol. 84, no. 1, pp. 5–10, Jul. 2007. Available from: https://doi.org/10.1016/j.radonc.2007.04.001

[11] L. E. Court, "The Radiation Planning Assistant: Addressing the global gap in radiotherapy services," *Lancet Oncol.*, vol. 25, no. 3, pp. 277–278, Mar. 2024. Available from: https://doi.org/10.1016/S1470-2045(24)00084-6

[12] F. Putz et al., "The Segment Anything foundation model achieves favorable brain tumor auto-segmentation accuracy in MRI to support radiotherapy treatment planning," *Strahlenther. Onkol.*, vol. 201, no. 3, pp. 255–265, Mar. 2025. Available from: https://doi.org/10.1007/s00066-024-02313-8

[13] N. T. C. Fung, W. M. Hung, C. K. Sze, M. C. H. Lee, and W. T. Ng, "Automatic segmentation for adaptive planning in nasopharyngeal carcinoma IMRT: Time, geometrical, and dosimetric analysis," *Med. Dosim.*, vol. 45, no. 1, pp. 60–65. Available from: https://doi.org/10.1016/j.meddos.2019.06.002

[14] Y. Rong et al., "NRG Oncology assessment of artificial intelligence deep learning-based auto-segmentation for radiation therapy: Current developments, clinical considerations, and future directions," *Int. J. Radiat. Oncol. Biol. Phys.*, vol. 119, no. 1, pp. 261–280, May 2024. Available from: https://doi.org/10.1016/j.ijrobp.2023.10.033

[15] X. Liu, L. Qu, Z. Xie, J. Zhao, Y. Shi, and Z. Song, "Towards more precise automatic analysis: A systematic review of deep learning-based multi-organ segmentation," *Biomed. Eng. Online*, vol. 23, no. 1, p. 52, Jun. 2024. Available from: https://doi.org/10.1186/s12938-024-01238-8

[16] Y. Zi, Q. Wang, Z. Gao, X. Cheng, and T. Mei, "Research on the application of deep learning in medical image segmentation and 3D reconstruction," *Acad. J. Sci. Technol.*, vol. 10, no. 2, pp. 8–12, Apr. 2024. Available from: https://doi.org/10.54097/0h77ge77

[17] Santhakumar, D. G. Takale, S. Tyagi, R. Anitha, M. Tiwari, and J. A. Dhanraj, "Analysis of multimodality fusion of medical image segmentation employing deep learning," in *Human Cancer Diagnosis and Detection Using Exascale Computing*, Wiley, 2024, pp. 171–183. Available from: https://doi.org/10.1002/9781394197705.ch11

[18] Lim Joon et al., "Prostate cancer post-prostatectomy radiotherapy: CT vs MRI for vesico-urethral anastomosis target delineation," *Radiother. Oncol.*, vol. 125, no. 1, pp. 113–117, Oct. 2017. Available from: https://doi.org/10.1016/j.radonc.2017.08.031

[19] G. Aldosary et al., "Geometric inaccuracy and co-registration errors for CT, DynaCT and MRI images used in robotic stereotactic radiosurgery treatment planning," *Phys. Medica*, vol. 69, pp. 212–222, Jan. 2020. Available from: https://doi.org/10.1016/j.ejmp.2019.12.002

[20] M. Boulanger et al., "Deep learning methods to generate synthetic CT from MRI in radiotherapy: A literature review," *Phys. Med.*, vol. 89, pp. 265–281, Sep. 2021. Available from: https://doi.org/10.1016/j.ejmp.2021.07.027

[21] Y. Peng et al., "Magnetic resonance-based synthetic computed tomography images generated using generative adversarial networks for nasopharyngeal carcinoma radiotherapy treatment planning," *Radiother. Oncol.*, vol. 150, pp. 217–224, Sep. 2020. Available from: https://doi.org/10.1016/j.radonc.2020.06.049

[22] L. Schwartz and L. Dong, "Adaptive radiation therapy for head and neck cancer—Can an old goal evolve into a new

standard?" *J. Oncol.*, vol. 2011, 2011. Available from: https://doi.org/10.1155/2011/690595

[23] K. Glide-Hurst et al., "Adaptive radiation therapy (ART) strategies and technical considerations: A state of the ART review from NRG Oncology," *Int. J. Radiat. Oncol. Biol. Phys.*, vol. 109, no. 4, pp. 1054–1075, Mar. 2021. Available from: https://doi.org/10.1016/j.ijrobp.2020.10.021

[24] Liu et al., "Review of cone beam computed tomography based online adaptive radiotherapy: Current trend and future direction," *Radiat. Oncol.*, vol. 18, no. 1, p. 144, Sep. 2023. Available from: https://doi.org/10.1186/s13014-023-02340-2

[25] Y.-F. Wang et al., "Enhancing safety in AI-driven cone beam CT-based online adaptive radiation therapy: Development and implementation of an interdisciplinary workflow," *Adv. Radiat. Oncol.*, vol. 9, no. 3, p. 101399, Mar. 2024. Available from: https://doi.org/10.1016/j.adro.2023.101399

[26] S. E. Whang, Y. Roh, H. Song, and J.-G. Lee, "Data collection and quality challenges in deep learning: A data-centric AI perspective," *VLDB J.*, vol. 32, no. 4, pp. 791–813, Jul. 2023. Available from: https://doi.org/10.1007/s00778-022-00775-9

[27] B. Murdoch, "Privacy and artificial intelligence: Challenges for protecting health information in a new era," *BMC Med. Ethics*, vol. 22, no. 1, p. 122, Dec. 2021. Available from: https://doi.org/10.1186/s12910-021-00687-3

[28] M. Bukowski et al., "Implementation of eHealth and AI integrated diagnostics with multidisciplinary digitized data: Are we ready from an international perspective?" *Eur. Radiol.*, vol. 30, no. 10, pp. 5510–5524, Oct. 2020. Available from: https://doi.org/10.1007/s00330-020-06874-x

[29] M. Kawamura et al., "Revolutionizing radiation therapy: The role of AI in clinical practice," *J. Radiat. Res.*, vol. 65, no. 1, pp. 1–9, Jan. 2024. Available from: https://doi.org/10.1093/jrr/rrad090

[30] A. Wahid et al., "Artificial intelligence for radiation oncology applications using public datasets," *Semin. Radiat. Oncol.*, vol. 32, no. 4, pp. 400–414, Oct. 2022. Available from: https://doi.org/10.1016/j.semradonc.2022.06.009