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Remote radiotherapy treatment planning system: An efficiency tool for increasing patient flow in cancer treatment in South Africa

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Dear Editor,

The radiotherapy field has made significant progress in identifying patients for radiotherapy and administering treatment to maximize clinical benefits while minimizing toxicity and burden[1,2]. However, discrepancies in treatment supply and demand, particularly in low-and middle-income countries (LIMCs), have highlighted the need for improved access[2]. Global cancer incidence is increasing, with over half requiring radiotherapy treatment, and some studies suggest higher rates in areas with limited access to radiotherapy[1,3]. LMICs are grap pling with significant challenges in deploying radiotherapy.

Advancements in radiotherapy delivery systems and global supply chains have made radiotherapy technologies more accessible to more hospitals and health systems, addressing the issue of access to technology[4]. Staffing remains a significant barrier to radio therapy access in both developed and developing countries, with a growing shortage of medical physicists and radiation oncologists predicted for the next decade[2]. A study conducted by Romani *et al.*[5] in Canada reported that radiotherapy clinics located in rural Canada have been utilizing remote treatment planning models, with on-site teams of radiation therapists and physicists working from a central hub, delivering successful care since 2010.

Remote treatment planning is predicted to significantly expand in the next decade in both high-income countries (HICs) and LMICs[6–10], utilizing AI-driven auto contouring algorithms for improved accuracy and workflow efficiency[11]. New-generation technologies such as Precision software will automate treatment planning workflows, enabling clinical team members to utilize unique knowledge[12], explore alternative treatments, fine-tune plans, and drive patient volume[13–15]. However, remote radiotherapy in radiation oncology is still nascent across the globe in LMICs.

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A study by Vanderpuye *et al.*[16] highlighted the significant challenge of oncology care in the sub-Saharan region during the COVID-19 pandemic, leading to suspension of patient follow-up and rescheduling of new patients. Consequently, significant delays in radiotherapy waiting times, workloads, and patient treatment occurred[16]. When remote radiotherapy or an artificial intelligence-driven planning system is implemented, a fraction of waiting times can be reduced[10]. Previous studies have consistently demonstrated a significant reduction in delays and improvement in efficiency when using a remote radiotherapy system[10,11,14]. The contribution of remote radiotherapy planning in cancer care is still not fully understood, and there is no data on remote radiotherapy planning in SSA, especially in South Africa.

Sub-Saharan Africa still suffers from a higher prevalence of cancer, and the cancer mortality rate remains very high[17–19]. Accurate and efficient treatment planning and access to care are crucial for effective cancer treatment[20–22]. Novel systems such as remote radiotherapy systems might be a potential solution, enabling patients to receive timely radiotherapy[23,24]. This study successfully demonstrated the feasibility of remote treatment planning in South Africa to significantly streamline the planning work, potentially alleviating treatment backlogs and improving radiation therapy delivery.

The Varian Eclipse treatment planning system will be integrated with Elekta Versa HD linear accelerators, aiming to improve treatment planning efficiency and expand care access. Researchers in oncology have consistently proposed remote treatment planning as a powerful strategy to enhance accessibility, optimize clinical workflow, and resolve human resource misalignment issues[25–28]. Empirical case studies and published research demonstrate the feasibility of this paradigm in radiation therapy while preserving key clinical outcomes[29,30].

This study will assess the feasibility of remote radiotherapy planning aimed at enhancing the efficiency of treatment planning and expanding access to care. The remote planning via Varian Eclipse TPS for Elekta Linear Accelerators system includes the collection of accurate commissioning data and the adoption of artificial intelligence contouring software to enhance treatment planning efficiency.

Patients >18 years old with a diagnosis of cervical, breast, prostate, head and neck, and rectal cancers who are candidates for radiotherapy at the time of their initial consultation and staging visit by the study will be eligible. Baseline information, including age, sex, staging, Plan name, Plan ID, Plan intent, tumor grade, Date of 1st visit, Date of consent approval by patient, Date scanned and exported, contours checked, Ptv and prescription, plan created, Physics 1st checked, Doctors approval, Physics 2nd checked and mosaic export, Quality assurance (Physics), Quality

assurance (radiation therapist), planning approved, treatment approved, and Date to start treatment.

The Charlotte Maxeke Johannesburg Academic (CMJAH) Radiation Oncology Department has implemented a remote planning workflow for Elekta LINACs using the Varian Eclipse TPS, which was piloted in November 2023. This approach employs the sweeping gap technique, utilizing Varian's Digital Imaging and Communications in Medicine (DICOM) plan files, which are imported into Monaco, the TPS used clinically at CMJAH, and subsequently exported to Mosaiq. The choice of Monaco and Mosaiq was dictated by their current use within the hospital's clinical workflow. The use of Monaco and Mosaiq streamlined the process of running the plan and collecting the required data.

Remote treatment planning workflows could expand adaptive radiotherapy (ART) access, reducing the time and labor-intensive replanning and reapproval components[10]. AI can potentially enhance treatment planning efficiency and outcomes but necessi tates extensive validation to ensure reliability and clinical safety[31]. The final workflow will be specifically designed to clarify the roles and responsibilities of all parties: medical physi cists, radiotherapists, radiation oncologists, and external treat ment planners.

The incorporation of external treatment planning services by Varian at CMJAH represents a notable progression in the radiotherapy workflow. The service leverages cutting-edge technologies and implements strong security protocols to guarantee smooth, effective, and protected treatment planning procedures. The CT dataset and AI-generated contoured structure set are imported by the remote planners into the Eclipse TPS, ensuring the completeness and accuracy of the data. The contours are reviewed and validated by the radiation oncologist at CMJAH, who also defines treatment volumes. Once the radiation oncologist has granted clearance, Varian's remote planners proceed to develop the treatment plan, ensuring strict adherence to clinical protocols.

Patient-specific quality assurance (PSQA) was done for the head cervical, breast, rectal cancers plans. The local radiotherapy team plays a crucial role in this workflow by conducting parallel checks to those performed for an in-house Monaco plan. This level of engagement guarantees the provision of optimal patient care and ensures that each stage of the workflow is given the required level of attention.

The practical application and technical feasibility of the commissioned TPS system are demonstrated through the results obtained from five mock patients. The successful commissioning of remote radiation therapy services is supported by dosimetric validation and quality assurance standards, establishing a strong foundation. The integration of the Varian Eclipse TPS with Elekta Versa HD linear accelerators to enhance remote treatment planning services improves treatment planning efficiency and ultimately enhances patient care. The system's clinical validation shows high gamma pass rates, indicating its potential as a solution to optimize workflows and potentially alleviate treatment backlogs.

Remote treatment planning may serve as a model for radiation therapy, allowing patients in developing, rural, and underserved areas more access to high-quality radiotherapy care[32,33]. This approach increases clinical efficiency, reduces complicated workflows[34–37], and promotes job satisfaction and retention. Additionally, remote treatment planning can make advanced treatment modalities more practical for clinics, making them more economically viable[38].

However, the implementation of a remote system workflow encountered several challenges, including ensuring effective communication among multidisciplinary teams, integrating CT scanners, AI contouring systems, Eclipse, and Monaco TPS systems, and coordinating with local IT services. The extended setup time for the remote access/VPN system posed a significant obstacle, resulting in the expiration of trial licenses. The Eclipse system will be assessed for its efficacy in remote treatment planning, gathering data such as patients' demographic profiles, type of cancer, and treatment to ensure precise treatment planning.

Remote radiotherapy planning systems have potential for LMICs to address radiotherapy planning deficiencies in health systems. Other than the conventional radiation therapy planning, there has been no systematic assessment of remote planning in from hospital in SSA.

Ethical approval

Ethics has been given by the University of the Witwatersrand Human Research Ethics Committee (Medical): M231076.

Consent

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Author contribution

D.M.M.: conceptualization and design; D.M.M. and D.R.: data collection and analysis or interpretation. All authors contributed in collection and assembly of data, manuscript writing, final approval of manuscript, and accountable for all aspects of the work.

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The authors declare no conflicts of interest.

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