Asian Pacific Journal of Cancer Care
Vol 10 No 2 (2025), 589-592
Short Communication

From Mountain to Medicine: Overcoming Radiotherapy Setup Challenges in the Sub-Himalayan Region

Kapil Kumar Soni	Senior Resident, Department of Radiation Oncology, AIIMS Bilaspur, India.
Hardik Sharma	Senior Resident, Department of Radiation Oncology, AIIMS Bilaspur, India.
Muninder Kumar	HOD and Additional Professor, Department of Radiation Oncology, AIIMS Bilaspur, India.
Priyanka Thakur	Associate Professor, Department of Radiation Oncology, AIIMS Bilaspur, India.
Niketa Thakur	Assistant Professor, Department of Radiation Oncology, AIIMS Bilaspur, India.
Sucehta Das	Junior Resident, Department of Radiation Oncology, AIIMS Bilaspur, India.

Cancer is a major public health challenge, particularly in low and middle-income countries (LMICs), where access to essential treatment modalities such as radiotherapy remains inadequate. India, with an increasing cancer burden, faces significant disparities in cancer care due to financial, geographic, and infrastructural limitations. The situation is especially dire in rural regions, including Himachal Pradesh, where a predominantly rural population struggles with limited healthcare resources. Despite an increasing incidence of cancers such as cervical, breast, and head and neck cancers many of which require radiotherapy patients in this region often lack access to timely treatment, leading to poorer outcomes. The primary challenges to establishing effective radiotherapy facilities in the Sub-Himalayan region include economic and financial barriers, regulatory and administrative delays, geographic constraints, and a shortage of trained professionals. The high cost of modern radiotherapy equipment, along with the rugged terrain and fragmented healthcare infrastructure, further complicates the development of treatment centers. Additionally, a lack of trained oncologists, physicists, and radiotherapy technicians limits the availability of high-quality cancer care. To overcome these challenges, a multi-pronged approach is necessary. Infrastructure development, increased funding, and expedited regulatory approvals can facilitate the establishment of radiotherapy centers. Public-private partnerships can help mitigate financial constraints, while training programs, in collaboration with national regulatory bodies, can address workforce shortages. Community outreach initiatives aimed at raising awareness about early cancer detection are also crucial for improving treatment outcomes. Ensuring equitable access to radiotherapy services in the Sub-Himalayan region requires coordinated efforts from policymakers, healthcare providers, and stakeholders. By addressing these barriers, healthcare accessibility can be improved, ultimately enhancing cancer treatment and survival rates in underserved populations.

Introduction

Cancer represents a significant public health challenge and is a leading cause of morbidity and mortality worldwide, particularly in low and middle-income countries (LMICs). According to the World Health Organization (WHO), the global incidence of cancer is escalating, with recent data indicating approximately 23.6 million new cancer cases reported globally [1]. The GLOBOCAN 2022 report projects that India alone will experience around 1.4 million new cancer cases and 0.91

million cancer-related deaths annually. Furthermore, it is anticipated that by 2040, the number of cancer cases in India could rise to 2.08 million, reflecting an alarming increase of 57.5% since 2020 [2]. This burgeoning cancer burden is attributable, in part, to advancements in diagnostic capabilities and a shift in the treatment- seeking behaviors of patients. According to the Medical Certification of Cause of Death 2018, cancer is currently ranked as the fifth most prevalent cause of mortality in India [3]. There exists a significant disparity between the incidence and prevalence of cancer and the availability of, as well as the need for, essential cancer care across different global populations. These disparities have profound negative implications for cancer management and contribute to unnecessary loss of life. Surgery, radiation therapy and systemic therapy constitute the three primary modalities employed in the treatment of cancer. Among these, radiation therapy necessitates the most considerable investment in both financial resources and specialized infrastructure [4]. The limited access to radiation therapy in India is predominantly attributed to inadequate infrastructure, alongside financial constraints and geographic barriers, resulting in significant disparities in cancer care delivery. The International Atomic Energy Agency's (IAEA) Directory of Radiotherapy Centre (DIRAC) serves as the most authoritative source of information concerning radiotherapy facilities globally [5, 6]. The accessibility of life-saving radiation therapy for cancer patients exhibits substantial variability across different nations and geographical regions. According to a global assessment conducted by DIRAC, there exists one operational radiation device for every 120,000 individuals in high-income countries (HICs), while in middle-income countries, a single machine caters to over one million persons. In low-income nations, this statistic becomes even more pronounced with approximately five million individuals relying on a single radiation machine. This disparity becomes acutely evident when considering that HICs accommodate only one-fifth of the global population [7].

In India, the majority of treatment facilities operate with megavoltage equipment, resulting in a ratio of less than one radiation machine per million people. India currently has 779 teletherapy machines, representing a shortfall of 62% compared to the recommended 2,040 units 175 simulators (66% below the required 520), and 413 brachytherapy machines (36% below the suggested 650) [8]. The India Radiotherapy Market Report (2022- 2030) indicates that the country adds approximately 40 new units annually while decommissioning 15, culminating in a net increase of 25 units. This 25 net increase in number of machines is insufficient for rising population of india as annual population growth rate is 25 million per year, in which approximately 800,000 population require treatment by radiation therapy [9]. Furthermore, a significant concentration of these centers is located in urban regions, posing accessibility challenges for the majority of the rural population. Current statistics reveal that despite over 50% of the population residing in central and eastern India, greater than 60% of radiation therapy facilities are situated in the western and southern regions [10]. Alarmingly, only 26% of the population in eastern India has direct access to the 11% of radiation facilities available there. Additionally, while the incidence of cancer in rural India is approximately half that of urban areas, the cancer mortality rate is doubled in rural regions, highlighting the critical need for improved access to effective cancer treatment in these underserved communities [11].

In India, the most prevalent malignancies include cervical, breast, and head and neck cancers [12, 13]. A significant proportion of patients diagnosed with these cancer types present with locally advanced disease, necessitating radiation therapy as a pivotal component of their treatment regimen. The radiotherapy utilization rate defined as the percentage of cancer patients who require at least one radiation treatment during the course of their illness remains notably high for these cancers, with reported rates of 71% for cervical cancer, 74% for breast cancer, and 87% for head and neck cancer [14].

Himachal Pradesh has witnessed a notable increase in cancer diagnoses. A comprehensive national survey, known as the Longitudinal Ageing Study in India (LASI), focused on the scientific investigation of health, as well as the economic and social determinants and consequences of population ageing in India. The findings revealed that the self-reported prevalence of diagnosed cancer is highest in Himachal Pradesh, at 2.2%, compared to the national average of 0.6% for the

older population [15]. With a population of around 8 million, a staggering 89.97% of residents reside in rural areas, indicating a predominantly rural demographic. Annually, approximately 8,500 cases are reported, although it is important to note that many cases in rural regions remain undetected. The state's unique geographical and cultural landscape provides a compelling context for investigating the incidence of cancer. Health indices for Himachal Pradesh reflect positive outcomes, with a crude birth rate of 15.4, a crude death rate of 6.9, an infant mortality rate of 19, and a total fertility rate of 1.6 [16], suggesting that the state performs comparatively well in various health metrics. However, despite these favorable indicators, serious public health concerns arise from the escalating cancer rates. The increase in cancer incidence has been associated with multiple factors, including lifestyle choices, genetic predispositions, environmental hazards, and tobacco consumption. Addressing these issues is critical for improving public health outcomes in the region.

External beam radiation therapy is predominantly delivered through Telecobalt machines and linear accelerators. Recent advancements in radiation treatment modalities, such as intensity-modulated radiation therapy (IMRT), image-guided radiation therapy (IGRT), volumetric arc therapy, stereotactic body radiation therapy (SBRT), stereotactic radiosurgery (SRS), and proton therapy, reflect the rapid evolution of radiation oncology [17]. These advanced techniques are associated with improved clinical outcomes and reduced toxicity profiles; consequently, they have become the standard of care in developed nations. Notwithstanding these advancements, the accessibility of such cutting-edge radiation therapies remains limited in India, highlighting a crucial gap in the availability of state-of-the-art oncological care.

Until last year, Himachal Pradesh had only two megavoltage therapy facilities, one cobalt-60 center and one LINAC center, as well as a single brachytherapy center to serve a population of approximately 8 million. Consequently, patients requiring treatment for common cancers such as head and neck, breast, and cervical cancers often had to travel significant distances to receive care at hospitals located far away. This situation underscores a serious deficiency in healthcare services in the region. The urgent demand for improved radiotherapy facilities in the Sub-Himalayan region is stymied by a multitude of significant challenges.

Challenges

Economic and Financial Barriers

The foremost important reason for the lack of infrastructure in healthcare facilities for cancer care in Himachal Pradesh is the substantial financial investment required to establish radiotherapy facilities. The cost of acquiring advanced LINAC machines is significantly higher than that of older cobalt machines, creating a considerable economic barrier for the state government. Additionally, established Cancer Center faces limitations due to a lack of advanced equipment, which hampers the range of treatments available. The facility is often overwhelmed by a heavy patient load, leading to long wait times for treatment and follow-ups. Patients who are required to seek treatment at alternative healthcare facilities often incur additional expenses related to travel and accommodation. These supplementary costs can significantly contribute to the overall financial burden of medical treatment. This geographical disparity not only discourages patients from adhering to treatment protocols but also results in poorer health outcomes. Addressing these financial and accessibility challenges, along with improving the capacity and resources of already established Cancer Center, is crucial for the Himachal Pradesh government to develop adequate infrastructure for cancer care within the state.

The Sub-Himalayan region is characterized by a deficiency of private and corporate hospitals specializing in cancer care and superspeciality services. This shortfall can be attributed to several interrelated factors, including a low population density that contributes to insufficient patient volume, thereby complicating the financial viability of such healthcare establishments. Furthermore, the region faces significant challenges related to land acquisition, which are

compounded by the need for increased investment in healthcare infrastructure. These factors collectively hinder the establishment and growth of medical facilities capable of providing advanced cancer treatment and specialized care.

Regulatory and Administrative Challenges

The intricate and often time-consuming regulatory frameworks that govern healthcare facility establishment present another formidable hurdle. Stakeholders encounter delays in approval processes due to complex compliance requirements, which can prolong the timeline for bringing new facilities into operation. Additionally, the fragmentation of systems wherein government bodies, private entities, and non-governmental organizations operate in silos impedes effective collaboration and further complicates the establishment of comprehensive cancer care services.

Geographic and Infrastructural Challenges

The rugged mountainous terrain of the Sub-Himalayan region presents considerable logistical challenges for the establishment and sustainability of healthcare infrastructure. Issues related to land stability and load- bearing capacity are particularly significant when planning the construction of radiotherapy facilities. Furthermore, the transport and installation of essential radiotherapy equipment, such as linear accelerators (LINACs), necessitate careful planning and substantial financial investment. Additionally, obtaining necessary permissions from the forest department adds another layer of complexity to the process. These infrastructural challenges are particularly pronounced in the context of the Sub-Himalayan region, highlighting the unique difficulties faced in healthcare delivery within this geographic setting.

Human Resource Constraints

A critical component of effective cancer care is the availability of qualified healthcare professionals. Unfortunately, the Sub-Himalayan region grapples with a severe shortage of trained radiation oncologists, medical physicists, and radiotherapy technicians. This shortage reflects a broader issue found in many LMICs and is exacerbated by limited opportunities for ongoing professional development and specialized training programs. Consequently, the existing workforce struggles to meet the growing demand for cancer care.

Proposed Solutions

1. Infrastructure Development: Strategic investments are essential for the enhancement of transportation networks, which are critical for the effective operation and sustainability of radiotherapy facilities within the Sub-Himalayan region. There is a pressing need for increased funding dedicated to healthcare infrastructure development, which should be complemented by streamlined processes for the clearance of such funds. Easing and expediting the approval and allocation of financial resources will ensure timely progress in establishing and upgrading necessary facilities.

2. Subsidies and Partnerships: The formation of collaborative partnerships between the public and private sectors is imperative to alleviate financial constraints. Such partnerships will facilitate the establishment and expansion of cancer care facilities, thereby increasing accessibility to radiotherapy services.

3. Training and Retention Programs: Collaboration with national organizations, including the atomic energy regulatory board (AERB) is vital. AERB not only sets regulations but also establishes training facilities specifically designed for the education of medical physicists and specialized

radiation therapy technicians.

These training programs are essential for equipping professionals with the knowledge and skills necessary to safely operate radiation equipment and administer treatments. By providing a structured and comprehensive training environment, AERB plays a vital role in addressing the existing skills gap within the healthcare system. This ensures that medical physicists and radiation therapy technicians are well-prepared to support the growing demand for radiation therapy services. Moreover, the establishment of these training facilities enhances the overall quality of care, thereby improving patient outcomes and increasing the availability of essential radiation therapy treatment facilities.

4. Community Outreach: Engaging with local communities to increase awareness about cancer symptoms and the importance of early diagnosis can significantly improve treatment outcomes. Such outreach efforts may contribute to a decrease in the incidence of late-stage cancer presentations.

In conclusion, ensuring equitable access to radiotherapy services in the Sub-Himalayan region is paramount for addressing the burgeoning cancer burden and improving health outcomes for affected populations. A comprehensive and multifaceted strategy is required, emphasizing infrastructure enhancement, financial support, workforce education, and regulatory reform. By leveraging best practices from both global and regional contexts, stakeholders can work collaboratively to bridge the existing gaps in cancer care, ultimately fostering a healthier future for underserved community.

Acknowledgements

Medical physicist

Conflict of interest

None

Funding

None

References

References

1. Prinja S, Dixit J, Gupta N, Dhankhar A, Kataki AC, Roy PS, Mehra N, et al. Financial toxicity of cancer treatment in India: towards closing the cancer care gap. *Frontiers in Public Health*. 2023; 11DOI
2. Sathishkumar K, Chaturvedi M, Das P, Stephen S, Mathur P. Cancer incidence estimates for 2022 & projection for 2025: Result from National Cancer Registry Programme, India. *The Indian Journal of Medical Research*. 2022; 156(4&5)DOI
3. Office of the Registrar General, India. Report on medical certification of cause of death 2020. Government of India [Internet]. Available from: https://censusindia.gov.in/nada/index.php/catalog/42681.

4. Laskar sg, Sinha S, Krishnatry R, Grau C, Mehta M, Agarwal jp. Access to Radiation Therapy: From Local to Global and Equality to Equity. *JCO global oncology.* 2022; 8DOI
5. International Atomic Energy Agency. DIRAC (Directory of Radiotherapy Centres) [Internet]. Available from: https://dirac.iaea.org.
6. International Atomic Energy Agency. Availability of Radiotherapy: Number of Radiotherapy Machines per Million Persons. Vienna: IAEA; 2021 [Internet]. Available from: https://dirac.iaea.org/Query/Map2?mapId=0.
7. Directory of Radiotherapy Centres. Number of Radiotherapy Machines Per Million Population. IAEA [Internet]. Available from: https://dirac.iaea.org/Query/Map..
8. World Health Organization. Total density per million population: Radiotherapy units [Internet]. Available from: https://www.who.int/data/gho/data/indicators/indicator-details/GHO/total-density-per-million-population-radiotherapyunits..
9. Insights10. India radiotherapy market report 2022 to 2030. Available from: https://www.insights10.com/report/india-radiotherapy-market-analysis/..
10. Pramesh C. S., Badwe ra, Borthakur bb, Chandra M, Raj EH, Kannan T., Kalwar A, et al. Delivery of affordable and equitable cancer care in India. *The Lancet. Oncology.* 2014; 15(6)DOI
11. Mehrotra R, Yadav K. Breast cancer in India: Present scenario and the challenges ahead. *World Journal of Clinical Oncology.* 2022; 13(3)DOI
12. Mathur P, Sathishkumar K, Chaturvedi M, Das P, Sudarshan KL, Santhappan S, Nallasamy V, et al. Cancer Statistics, 2020: Report From National Cancer Registry Programme, India. *JCO global oncology.* 2020; 6DOI
13. Shetty R, Mathew RT, Vijayakumar M. Incidence and pattern of distribution of cancer in India: A secondary data analysis from six population-.based cancer registries. *Cancer Res Stat Treat.* 2020; 3:678. DOI
14. Atun R, Jaffray DA, Barton MB, Bray F, Baumann M, Vikram B, Hanna TP, et al. Expanding global access to radiotherapy. *The Lancet. Oncology.* 2015; 16(10)DOI
15. Times of India. [Internet]. Available from: http://timesofindia.indiatimes.com/articleshow/80192473.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.
16. International Institute for Population Sciences (IIPS) and ICF. National Family Health Survey (NFHS-5), 2019-21 [Internet]. Available from: http://www.iipsindia.ac.in. Accessed August 18, 2024..
17. Koka K, Verma A, Dwarakanath BS, Papineni RVL. Technological Advancements in External Beam Radiation Therapy (EBRT): An Indispensable Tool for Cancer Treatment. *Cancer Management and Research.* 2022; 14DOI