



Telemedicine for Cancer Care in Resource-Constrained Settings: Benefits, Barriers, and Implementation Priorities

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Abstract

Cancer care delivery in low- and middle-income countries (LMICs) remains hindered by late diagnosis, geographic disparities, and limited specialist availability. Tele-oncology has gained momentum as a strategy to bridge these gaps, with adoption accelerated during the COVID-19 pandemic. This narrative review synthesizes evidence from peer-reviewed and grey literature to examine the benefits, barriers, and implementation priorities for telemedicine in oncology within resource-constrained settings, with India as the primary context and comparative insights from other LMICs. Findings indicate that tele-oncology improves access to specialist care, reduces patient travel and cost burdens, supports multidisciplinary decision-making through virtual tumor boards, and maintains continuity of care during service disruptions. Patient satisfaction is consistently high, and emerging models such as tele-genetic counselling, telepathology, and e-palliative care show promise. However, persistent challenges include inadequate digital infrastructure, variable digital literacy, data security concerns, regulatory ambiguities, and limitations of remote assessment for certain cancer cases. Drawing on cross-country examples, the review identifies eight implementation priorities: strengthening infrastructure, establishing oncology-specific policies, expanding workforce training, promoting LMIC research collaboration, fostering service innovation, integrating tele-oncology with national digital health platforms, generating evidence on survival outcomes, and developing clear reimbursement mechanisms. The current evidence base is limited by the predominance of small-scale or observational studies and uneven methodological quality, underscoring the need for

Keywords

- tele-oncology
- cancer care
- low- and middle-income countries
- telemedicine
- implementation priorities

robust evaluation of tele-oncology's impact on treatment timeliness and survival in LMIC contexts. Tele-oncology offers a scalable, adaptable adjunct to conventional cancer care, but its long-term sustainability will depend on coordinated policy action, equitable access to technology, and systematic outcome measurement.

Introduction

Cancer remains a major global health challenge, with nearly 20 million new cancer cases and 9.7 million cancer-related deaths reported worldwide in 2022. The global burden is expected to rise substantially, with annual new cancer cases projected to reach approximately 35 million by 2050, representing a 77% increase compared with 2022 estimates.¹ Low- and middle-income countries (LMICs) account for more than 65% of cancer deaths, reflecting the combined effects of late diagnosis, limited treatment access, and constrained health system capacity.² India contributes substantially to this burden, representing one of the largest single-country cancer caseloads among LMICs—accounting for nearly a tenth of all new cancer cases in these settings.³ In 2022, India recorded an estimated 1.46 million new cancer cases, with projections exceeding 1.57 million by 2025—an increase of nearly 8% in 3 years.⁴ Rural–urban disparities are stark: while rural areas are home to approximately 70% of the population, over 95% of oncology facilities are concentrated in urban centers, resulting in later-stage presentations and poorer survival among rural patients.⁵ These inequities highlight the urgent need for scalable, adaptable models of cancer care delivery in resource-constrained settings.

Telemedicine—defined by the World Health Organization as the delivery of healthcare services using information and communication technologies for diagnosis, treatment, prevention, and education—offers a potential solution to bridge these gaps.⁶ When applied specifically to cancer care, this is referred to as tele-oncology, encompassing the use of digital platforms to support prevention, diagnosis, treatment, follow-up, and palliative services for oncology patients.⁷ In oncology, such models are particularly relevant given the specialty's reliance on multidisciplinary tumor boards, longitudinal follow-up, survivorship care, and remote symptom monitoring in palliative settings. Modalities such as synchronous (real-time consultations), asynchronous (store-and-forward diagnostics), and remote patient monitoring via wearables have been identified as key operational models in telemedicine globally, and these approaches are increasingly being adapted for oncology care in LMIC contexts.⁸ Evidence from high-income countries demonstrates benefits such as reduced time-to-treatment, improved multidisciplinary coordination, and high patient satisfaction.⁹ In LMICs, however, large-scale implementation remains limited. Barriers include inadequate broadband coverage, fragmented health information systems, limited digital literacy, and evolving regulatory environments.¹⁰ In India, the 2020 Ministry of Health and Family Welfare (MoHFW) Telemedicine Practice Guidelines provided legal

clarity for remote consultations, outlined the scope of practice for registered medical practitioners, and enabled integration into national initiatives such as Ayushman Bharat. Nonetheless, operational challenges—such as those highlighted by the COVID-19 pandemic's impact on cancer services in India—persist in embedding tele-oncology into routine service delivery.¹¹

Early experiences from LMICs demonstrate both potential and constraints. In Pakistan, weekly video-conferenced tumor board meetings have been implemented between the surgery department at Holy Family Hospital and oncologists at the National Oncology Research Institute, enhancing multidisciplinary collaboration despite infrastructural limitations.¹² India's eSanjeevani platform—delivering over 276 million teleconsultations across disciplines—has begun piloting oncology modules, but robust evaluations of clinical outcomes, cost-effectiveness, and sustainability are lacking.¹³ These examples underscore the feasibility of tele-oncology in resource-constrained settings while reinforcing the need for evidence-driven implementation strategies.

This narrative review is one of the first to integrate policy developments, service delivery models, and emerging outcome data on tele-oncology in India within a broader LMIC framework. It addresses the research question: What is the current evidence on the benefits, barriers, and implementation priorities for telemedicine in oncology within resource-constrained settings? Using India as the primary case study while drawing comparisons from other LMICs, the review synthesizes literature across two domains: benefits—including improved geographical access, cost savings, and enhanced multidisciplinary coordination; and barriers—spanning infrastructural, regulatory, and capacity-building challenges. By integrating lessons from national platforms and state-level pilots, this review aims to inform the development of scalable, context-sensitive telemedicine strategies to strengthen oncology care delivery in resource-limited environments.

Methods

This paper adopts a narrative review approach to synthesize published and grey literature on the use of telemedicine in oncology, with a primary focus on India and relevant examples from other LMICs. The narrative review format was chosen to allow integration of diverse evidence types—such as peer-reviewed studies, policy documents, program reports, and case studies—that are often excluded from systematic reviews but are essential for understanding service delivery in resource-constrained settings.

Search Approach

Literature was identified through searches of PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar, complemented by targeted searches of grey literature from the World Health Organization (WHO), the MoHFW in India, and official program websites such as eSanjeevani. Gray literature searches also included relevant conference abstracts, non-governmental organization (NGO) reports, and health technology assessment documents, retrieved through targeted Google searches and manual review of organizational websites identified as national or international stakeholders in telemedicine and oncology. The search combined terms related to telemedicine (e.g., “telemedicine,” “telehealth,” “tele-oncology,” “virtual care”), oncology (e.g., “cancer,” “oncology care”), and setting descriptors (e.g., “India,” “low- and middle-income countries,” “resource-constrained settings”).

Selection of Sources

Sources were included if they addressed telemedicine or tele-oncology in the context of oncology care delivery in India or comparable LMICs, and reported on at least one of the following: benefits, barriers, policy context, or implementation approaches.

Editorials and commentaries without empirical, policy, or programmatic detail were excluded. No restrictions were placed on study design, and both quantitative and qualitative evidence were considered. Only sources published in English were included. Screening was conducted, followed by full-text review of those meeting the scope criteria. Key characteristics of the studies included in this review are summarized in ►Table 1, outlining reference details, study context, design, and relevance to LMICs.

Synthesis

Both “telemedicine” and “tele-oncology” search terms were intentionally included to capture literature ranging from general digital health interventions to cancer-specific applications. Relevant information from eligible sources was extracted and synthesized thematically under two domains: benefits and barriers. A thematic synthesis approach was chosen to integrate diverse evidence types into coherent categories aligned with the review objectives. India was used as the primary case study, with selected LMIC examples included to provide comparative insight.

Findings and Discussion

Benefits of Tele-oncology

Improved Access to Care

Geographic disparities remain a core barrier in oncology service delivery: in India, 70% of the population lives rurally, yet over 95% of tertiary cancer centers are urban, prolonging diagnosis-to-treatment intervals and reducing survival.⁵ Tele-oncology initiatives—such as asynchronous pathology consultations via Project ECHO Cancer programs in India, using a “Hub and Spoke” tele-mentoring model, have enhanced provider knowledge and referral coordination across

multiple states, though quantitative outcomes on diagnostic delay reduction remain under-evaluated.¹⁴ Pilot tele-oncology programs in select Indian states have also begun to demonstrate reductions in time to treatment initiation, suggesting improved referral efficiency, although more rigorous outcome studies are needed. In Pakistan, telemedicine initiatives have improved care coordination and continuity in rural areas, with some programs incorporating oncology services and reporting positive trends in patient follow-up, though large-scale outcome data remain limited.¹⁵ A proof-of-concept study in rural Tanzania demonstrated that integrating virtual case discussions into an ultrasound training program improved the clinical competence of health workers and showed promise for earlier cancer detection, though formal evaluations of patient outcomes are still needed.¹⁶

While the direction of evidence is consistent, most studies to date are small-scale pilots or observational designs, limiting the ability to generalize outcomes across diverse LMICs.

Cost Savings

Tele-oncology reduces travel, lodging, and income loss for patients, while optimizing system-wide resource use. At an Indian tertiary center (2021), 84% of patients or caregivers reported savings in time and money through teleconsultation, with increased access and follow-up noted.¹⁷ A satellite tele-chemotherapy module implemented in the Peruvian Amazon (San Martín region) reduced out-of-pocket travel and accommodation costs by PEN 870 (approx. USD 265) per treatment cycle, aligning with broader national efforts to decentralize oncology care.¹⁸

Enhanced Quality of Care

In India, virtual tumor boards have demonstrated feasibility for multidisciplinary cancer care. For instance, the National Cancer Grid’s head-and-neck virtual tumor board (208 patients across 54 sessions) reported that 96% of participating centers agreed with the recommendations, with most recommendations being implementable despite gaps in standardized guidelines.¹⁹ In Botswana, telepathology initiatives—such as remote robotic pathology services at the National Health Laboratory—have improved access to pathology expertise and educational collaboration, although comprehensive outcome evaluations remain limited.²⁰ As with access, most LMIC evidence is derived from pilot or early-stage implementations, with few large-scale controlled evaluations.

Patient Satisfaction

Patient and caregiver satisfaction with telehealth—including tele-oncology modalities—has been consistently high across diverse contexts globally. A systematic review found strong overall satisfaction, especially among individuals in rural and remote areas, driven by convenience, improved access, and reduced travel-related burden.²¹ In oncology specifically, several studies report good patient acceptance and perceived quality with virtual care, though detailed satisfaction metrics in LMICs like India, Kenya, and the Philippines remain under-reported.²² In Kerala, tele-oncology initiatives like

Table 1 Characteristics of included studies

Ref. no.	Authors	Year	Country/ Setting	Study design	Relevance to LMICs
5	Mallath et al	2014	India	Narrative review/ epidemiological overview	Highlights India's growing cancer burden and systemic challenges in LMIC contexts
9	Sirintrapun and Lopez	2018	Global	Review	Discusses tele-oncology models, including applicability to LMICs
14	Bhuyan et al	2025	India	Systematic review	Directly relevant to capacity building for oncology in LMICs
15	Mahdi et al	2022	Pakistan	Systematic review	LMIC-specific telemedicine opportunities and challenges
16	Weimer et al	2024	Tanzania	Proof-of-concept study	Capacity-building in rural LMIC healthcare settings
17	Ganguly et al	2024	India	Cross-sectional study	Evaluates service quality in LMIC cancer care
18	Vidaurre et al	2019	Peru	Implementation study	Addresses access barriers in remote LMIC settings
19	Thiagarajan et al	2023	India	Observational report	Demonstrates multidisciplinary cancer care via tele-oncology in LMIC
20	Fischer et al	2011	Botswana	Implementation study	Improves pathology capacity in resource-limited settings
21	Orlando et al	2019	Global	Systematic review	Includes LMIC-relevant implications for oncology services
22	Joseph et al	2023	Nigeria	Cross-sectional study	LMIC-specific patient perspectives during pandemic
23	Sudhamony et al	2008	India	Review	Early LMIC-focused telemedicine development
24	Rashid M	2022	Bangladesh	Cross-sectional study	Highlights digital literacy challenges in LMIC telemedicine users
25	Shruthi et al	2021	India	Survey	Infrastructure limitations in LMIC healthcare delivery
26	Shiferaw and Zolfo	2012	Ethiopia	Case study	Telemedicine integration in LMIC health systems
27	DLA Piper	2025	India	Policy overview	Legal frameworks impacting LMIC telehealth
28	Kaitan A	2023	Bangladesh	News/report	Highlights data security vulnerabilities in LMIC health IT
29	Republic of Kenya	2025	Kenya	Policy document	National telehealth governance in LMIC context
30	Datta et al	2023	India	Survey	LMIC workforce readiness assessment
31	Rasekaba et al	2022	India	Cross-sectional study	Identifies barriers to telehealth adoption in LMIC elderly
32	Ezeonwumelu et al	2022	Nigeria	Cross-sectional study	LMIC-specific healthcare provider and patient perspectives

Abbreviation: LMIC, low- and middle-income countries.

OncoNET have enabled structured virtual follow-up and cancer-care information delivery across peripheral centers, suggesting improved communication channels between patients and providers.²³ Conversely, findings from Bangladesh indicate that lower eHealth literacy is linked to reduced patient engagement and satisfaction with telemedicine services, a factor likely to affect tele-oncology uptake.²⁴

While these benefits demonstrate tele-oncology's potential, they are moderated by a set of persistent challenges that have constrained its wider adoption in resource-limited settings.

Barriers to Tele-oncology

Technical Barriers

Surveys on rural internet connectivity in India suggest broadband penetration remains limited—estimated at around 37%—with frequent power outages posing additional challenges to sustained tele-oncology consultations.²⁵ Tele-oncology and telemedicine implementations in Ethiopia have encountered significant technological and resource-related challenges, including limited internet access and infrastructure reliability, which have complicated consistent service delivery.²⁶

Data Privacy and Security

Oncology data are highly sensitive. Although India has enacted the Digital Personal Data Protection Act of 2023 (DPDP Act) to bolster privacy protections, the law currently applies only to digital personal data and lacks telemedicine- or tele-oncology-specific encryption requirements—indicating significant governance and regulatory gaps.²⁷ In Bangladesh, telehealth systems—including teleradiology—have faced cybersecurity threats such as ransomware attacks, raising concerns about data protection in tele-oncology networks.²⁸ Kenya's national telehealth framework offers an LMIC model for embedding security protocols and audit trails into clinical workflows.²⁹

Training and Digital Literacy

A 2021 cross-sectional survey of 602 Indian healthcare professionals found that while awareness of and attitudes toward telemedicine were high, only 39.5% demonstrated strong telemedicine-related skills, suggesting gaps in formal training and proficiency.³⁰ Elderly individuals—particularly in rural India—face significant barriers to navigating telehealth platforms due to limited digital health literacy, low smartphone ownership, and physical challenges such as poor vision, often resulting in difficulty using apps or uploading scans.³¹ In Nigeria and Indonesia, pilots have shown that structured training programs for healthcare providers and patients can enhance telemedicine uptake and familiarity, particularly in areas where digital health infrastructure is emerging.³²

Limitations in Clinical Assessments

Tele-oncology is well-suited to supportive care but has clear limitations: it typically cannot replace in-person consultations for critical elements such as physical examinations, diagnostic imaging, or interventional procedures. Consequently, its use is best confined to activities such as triage, routine follow-up, survivorship monitoring, and palliative symptom management.⁹

These barriers limit the realization of the benefits outlined earlier. Targeted policy reform, infrastructure investment, and training initiatives are essential to scaling tele-oncology in resource-constrained settings.

Implementation Priorities and Future Directions

Although the primary focus is on India, the priorities outlined here reflect broader international recommendations for scaling tele-oncology in resource-limited environments.

Infrastructure and Technology

Robust digital infrastructure—high-speed broadband, uninterrupted power, interoperable tele-oncology platforms—is foundational. In India, public-private partnerships could draw lessons from national telehealth expansion efforts in Brazil, which have significantly extended virtual care reach in rural and underserved regions.³³ Tele-oncology deployments in Ethiopia have encountered significant infrastructure-related disruptions, such as unstable internet

connectivity and limited technical maintenance support, underscoring the importance of procuring durable, easy-to-maintain hardware to minimize service downtime.³⁴

Policy and Regulation

India's 2020 MoHFW Telemedicine Practice Guidelines provided essential legal clarity for remote consultations but did not address oncology-specific issues such as cross-state licensing, telehealth reimbursement mechanisms, or integration into national cancer control frameworks.³⁵ Policies in Australia and Canada demonstrate that reimbursement parity and licensure reciprocity can accelerate telehealth adoption without compromising care quality.³⁶

Training and Education

Capacity-building for oncology providers should include training in digital platform navigation, virtual communication, and remote assessment tools. In Kenya, Project ECHO-style tele-mentoring programs in pediatric oncology were associated with a 33% increase in cancer diagnoses—suggesting meaningful gains in provider engagement and system responsiveness.³⁷ Integration of tele-oncology modules into oncology fellowship curricula could normalize virtual care delivery as a core competency.

Research and Collaboration

There is an urgent need for multicenter LMIC studies on tele-oncology's impact on survival, cost-effectiveness, and health equity. Regional research networks could facilitate standard-setting and adaptation of evidence-based models.

Service Innovation

Beyond foundational measures, innovative applications hold considerable promise for expanding tele-oncology's role in resource-constrained settings. Remote monitoring and symptom management, for instance, have shown measurable benefits. India's National Cancer Grid has implemented virtual tumor board sessions—facilitating multidisciplinary decision-making across its network of centers—which has enhanced guideline-based treatment planning and coordination in complex oncology cases.³⁸ In urban India, tele-genetic counselling has demonstrated high patient satisfaction and efficiency. For example, one study involving 539 families with inherited disorders found that approximately 87% reported satisfaction with the audio-visual quality and time savings of virtual sessions, even though 74% still preferred face-to-face appointments.³⁹ Similarly, a prospective study of e-palliative homecare in Kerala, conducted at a tertiary cancer center, reported high levels of satisfaction across key domains—including communication, convenience, and time spent with doctors—with an overall mean satisfaction score of 4.39 out of 5 among 120 patients and caregivers.⁴⁰

National Platform Integration

India's eSanjeevani platform—over 276 million consultations to date—demonstrates large-scale telehealth capacity.¹³ Integrating tumor board functions, remote monitoring, and

cancer registry linkages could position eSanjeevani as the backbone of equitable national cancer care delivery.

Evidence on Survival Outcomes and System Resilience

While direct data on mortality reduction from tele-oncology interventions in LMICs remain limited, broader evidence suggests that telemedicine helped preserve continuity of care during COVID-19. Teleconsultations were associated with reduced delays in diagnosis and treatment, both essential determinants of survival in cancer care.⁴¹

Clear and Equitable Reimbursement Models

Sustainability of tele-oncology hinges on structured reimbursement mechanisms that recognize both clinician effort and institutional costs. Although formal teleconsultation fee frameworks in LMICs are largely underdeveloped, authoritative guidance—such as India's Telemedicine Practice Guidelines treating teleconsultations equivalently to in-person visits—offers a foundational model.

Limitations

Much of the available evidence is derived from small-scale, observational studies or pilot implementations, which restricts the strength of causal inferences. Quantitative outcomes—such as measurable reductions in time-to-treatment, survival improvements, or cost-benefit ratios—are seldom reported, with findings often presented in qualitative terms. The evidence base is uneven across benefit domains, with access and patient satisfaction more comprehensively studied than cost savings or quality-of-care outcomes. While international examples from Tanzania, Peru, Botswana, Nigeria, and Brazil provide useful comparative perspectives, differences in health system capacity and resources may limit their direct transferability to the Indian context. Evidence for innovative models, including tele-palliative care and tele-genetic counselling, remains limited with respect to long-term sustainability, scalability, and cost-effectiveness. In addition, the inclusion of gray literature—essential to capture recent policy and programmatic developments—introduces potential variability in methodological rigor, despite efforts to verify accuracy and relevance.

Conclusion

Tele-oncology holds significant potential to reduce cancer care inequities in resource-constrained settings. Evidence from India and comparable LMICs shows consistent benefits, including improved geographical access, faster treatment initiation, enhanced multidisciplinary coordination, high patient satisfaction, and cost savings. Yet, these gains are constrained by persistent infrastructure gaps, variable digital literacy, data governance challenges, and the inherent limits of remote clinical assessment.

Scaling tele-oncology from pilot initiatives to routine practice requires integrated strategies: robust digital infrastructure, oncology-specific regulatory frameworks,

provider and patient training, and adoption of innovative service models such as virtual tumor boards, tele-palliative care, and remote monitoring. India's rapid expansion of eSanjeevani, coupled with targeted oncology pilots, offers a replicable model for other LMICs seeking to embed tele-oncology into national cancer control plans.

With sustained policy commitment, strategic investment, and rigorous evaluation, tele-oncology can transition from an adjunct to a core component of equitable, high-quality cancer care—ensuring that timely treatment is determined by need, not geography.

Authors' Contributions

A.K. and A.R.K. conceived the study. G.R. and A.R. performed the literature review. G.R., A.R., and A.K. drafted the main manuscript. B.S., A.G., and Am.K. assisted in interpretation of findings and B.K.M. and S.P. critically reviewed the manuscript. All authors reviewed, edited, and approved the final version of the article.

Data Availability Statement

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Informed Consent

Written informed consent for publication of anonymized clinical data was obtained from the participants.

Conflict of Interest

None declared.

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