

## Review Article

# The Role of Robotic Surgery in Tier-II Cities and Overcoming Financial Hurdles to Provide Optimal Surgical Care

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## ABSTRACT

Robotic surgery has revolutionized minimally invasive surgical techniques, offering enhanced precision, dexterity, and visualization. However, its adoption in tier-II cities—urban areas experiencing growth but not yet at the level of major metropolitan centres—has been slower compared to tier-I cities, primarily due to financial, infrastructural, and logistical challenges. This review explores the current role of robotic surgery in tier-II cities, identifying key barriers such as high acquisition costs, lack of trained personnel, and limited patient awareness. It also examines strategies to overcome these challenges, including collaborative purchasing, public-private partnerships, government subsidies, workforce development, and the adoption of flexible payment models. Through case studies from cities like Coimbatore in India and Campinas in Brazil, this review highlights successful approaches to implementing robotic surgery in resource-constrained settings. Ultimately, the widespread adoption of robotic surgery in tier-II cities requires coordinated efforts from healthcare providers, government agencies, and the private sector to ensure optimal surgical care for all patients, regardless of their location.

**Keywords:** Robotic Surgery, Optimal Care, Tier2 Cities, Surgical Outcomes, Standard of Care

## INTRODUCTION

Robotic surgery represents a significant advancement in minimally invasive surgical techniques, offering precise control, enhanced dexterity, and improved visualization. While the benefits of robotic surgery are well-documented, its adoption in tier-II cities—urban areas that are growing but not yet at the level of major metropolitan centres—has been relatively slow compared to tier-I cities. This lag is often due to several factors, including financial, infrastructural, and logistical challenges. This review explores the current role of robotic surgery in tier-II cities, the barriers to its implementation, and strategies to overcome these challenges, ensuring the best possible surgical outcomes for patients in these regions.

## OVERVIEW OF ROBOTIC SURGERY

Robotic surgery, particularly with systems like the da Vinci Surgical System, allows surgeons to perform complex procedures with more precision, flexibility, and control than is possible with conventional techniques. The system translates the surgeon's hand movements into smaller, more precise movements of tiny instruments inside the patient's body. Robotic surgery is used in various specialties, including urology, gynaecology, general surgery, and oncology, offering benefits such as reduced blood loss, fewer complications, shorter hospital stays, and faster recovery times.<sup>[1]</sup>

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## THE ADOPTION OF ROBOTIC SURGERY IN TIER-II CITIES

Tier-II cities in countries like India, Brazil, and China are characterized by rapid economic growth, increasing population, and expanding healthcare infrastructure. However, the adoption of advanced medical technologies like robotic surgery in these cities has been relatively slow. This is largely due to several factors:

**Cost of Acquisition and Maintenance:** Robotic surgical systems are expensive, with costs ranging from \$1.5 million to \$2.5 million per unit, excluding the costs of maintenance, training, and consumables.<sup>[2]</sup> For hospitals in tier-II cities, which often operate on tighter budgets, this cost is prohibitive.

**Lack of Trained Personnel:** The availability of surgeons and support staff trained in robotic surgery is limited in tier-II cities. Training programs are often concentrated in tier-I cities, creating a gap in expertise.<sup>[3]</sup>

**Patient Awareness and Acceptance:** Patients in tier-II cities may be less aware of the benefits of robotic surgery and may hesitate to opt for it due to perceived risks or costs.<sup>[4]</sup>

**Healthcare Infrastructure:** The infrastructure required to support robotic surgery, including specialized operating rooms, backup systems, and sterile environments, may be lacking or underdeveloped in tier-II cities.<sup>[5]</sup>

## ECONOMIC AND FINANCIAL BARRIERS

One of the primary barriers to the widespread adoption of robotic surgery in tier-II cities is financial. The high cost of robotic systems, combined with the additional expenses of training, maintenance, and consumables, poses a significant challenge. Additionally, the return on investment for hospitals in tier-II cities is slower due to lower patient volumes and reduced ability to charge premium fees for robotic procedures.<sup>[6]</sup>

Several economic and financial hurdles include:

**High Initial Investment:** The cost of acquiring robotic surgical systems is a significant barrier. Hospitals in tier-II cities may struggle to justify such a large investment, especially if patient demand is uncertain.<sup>[7]</sup>

**Operational Costs:** The ongoing costs of maintenance, repairs, and purchasing consumables can be substantial. These costs can erode the profitability of robotic surgery programs in tier-II cities.<sup>[8]</sup>

**Insurance Coverage:** In many countries, insurance coverage for robotic surgery is limited or non-existent, making it difficult for patients to afford these procedures. This limits the patient base and, consequently, the financial viability of robotic surgery in these areas.<sup>[9]</sup>

## STRATEGIES TO OVERCOME FINANCIAL AND OPERATIONAL HURDLES

To overcome the financial and operational barriers to robotic surgery in tier-II cities, several strategies can be employed:

**Collaborative Purchasing and Shared Services:** Hospitals in tier-II cities can collaborate to share the costs of robotic surgical systems. This could involve joint purchasing agreements, where multiple hospitals contribute to the cost of a single robotic system, which is then shared among them.<sup>[10]</sup>

**Public-Private Partnerships (PPPs):** Governments can play a crucial role by partnering with private healthcare providers to subsidize the costs of acquiring and maintaining robotic systems. PPPs can help reduce the financial burden on individual hospitals and promote wider access to advanced surgical technologies.<sup>[11]</sup>

**Government Subsidies and Grants:** Governments can provide financial incentives, subsidies, or grants to hospitals in tier-II cities to promote the adoption of robotic surgery. These could include tax breaks, low-interest loans, or direct financial assistance.<sup>[12]</sup>

**Training Programs and Workforce Development:** Establishing local training centres in tier-II cities can help build a workforce skilled in robotic surgery. This can reduce the costs associated with sending staff to distant training centres and ensure that expertise is available locally.<sup>[13]</sup>

**Flexible Payment Models:** Hospitals can offer flexible payment options for patients, such as instalment plans or bundled payment packages, to make robotic surgery more affordable. Additionally, engaging with insurance providers to expand coverage for robotic procedures can help reduce the financial burden on patients.<sup>[14]</sup>

**Leasing Models:** Hospitals can explore leasing options for robotic systems rather than purchasing them outright. Leasing can spread out the costs over time, making it more manageable for hospitals with limited budgets.<sup>[15]</sup>

**Utilization of Low-Cost Robotic Systems:** The development of more affordable robotic systems designed specifically for low-resource settings can help expand access to robotic surgery in tier-II cities. Companies are increasingly exploring ways to reduce the cost of robotic surgery systems without compromising on quality.<sup>[16]</sup>

## OPTIMIZING SURGICAL CARE IN TIER-II CITIES

Providing optimal surgical care in tier-II cities requires a multifaceted approach:

**Multidisciplinary Teams:** Establishing multidisciplinary teams that include surgeons, anaesthetists, radiologists, and support staff trained in robotic surgery can enhance

patient outcomes. Collaborative care models are essential for managing complex cases.<sup>[17]</sup>

**Integration with Telemedicine:** Telemedicine can be integrated with robotic surgery to provide real-time guidance and support from experts in tier-I cities or specialized centres. This can enhance the capabilities of local surgeons and improve patient outcomes.<sup>[18]</sup>

**Education and Awareness Campaigns:** Conducting education and awareness campaigns to inform patients and healthcare providers about the benefits and safety of robotic surgery can increase acceptance and demand in tier-II cities.<sup>[19]</sup>

**Continuous Quality Improvement:** Establishing protocols for continuous quality improvement, including monitoring outcomes, patient satisfaction, and cost-effectiveness, can help ensure that robotic surgery programs in tier-II cities meet high standards of care.<sup>[20]</sup>

## CASE STUDIES AND EVIDENCE FROM TIER-II CITIES

Several tier-II cities have successfully implemented robotic surgery programs, providing valuable insights:

**Case Study 1: Robotic Surgery in Coimbatore, India**  
Coimbatore, a tier-II city in India, has seen the successful implementation of robotic surgery in several hospitals. This success is attributed to collaborative efforts between hospitals, government support, and the presence of skilled surgeons who have received training in tier-I cities.<sup>[21]</sup>

**Case Study 2: Robotic Surgery in Campinas, Brazil**  
Campinas, a tier-II city in Brazil, has developed a robust robotic surgery program by leveraging public-private partnerships. The city has also focused on training local surgeons and promoting public awareness, leading to increased patient acceptance and demand.<sup>[22]</sup>

## CONCLUSION

Robotic surgery holds great promise for enhancing surgical care in tier-II cities, offering patients access to advanced, minimally invasive procedures. However, the financial and operational challenges associated with adopting this technology are significant. By implementing strategies such as collaborative purchasing, government support, workforce development, and flexible payment models, tier-II cities can overcome these barriers and provide the best possible surgical care to their populations. The successful implementation of robotic surgery in tier-II cities requires a coordinated effort involving healthcare providers, government agencies, and the private sector to ensure that the benefits of this technology are accessible to all patients, regardless of their location.

## Author Contributions

Dr. Naveen Gowda was responsible for the preparation and organization of the review of the literature. Dr. Raxith Sringeri contributed to the analysis, interpretation of the literature, and critical revision of the manuscript. Dr. Vijay, as Head of the Department, provided oversight and contributed to the conceptual framework of the review, ensuring comprehensive coverage of relevant topics.

## Ethical approval

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Raxith S R is on the editorial board of the Journal.

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The author(s) confirms that there was no use of Artificial Intelligence (AI)-Assisted. Technology for assisting in the writing or editing of the manuscript and no images were manipulated using the AI.

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