

Scalpel in the cloud: Navigating the future of remote robotic surgery in Pakistan

Moiz Ahmad¹, Hassan Mehmood², Bakhtawar Haseeb³

Dear Editor, The healthcare sector is rapidly evolving towards remote robotic surgery, enabled by advances in robotics, artificial intelligence, and 5G/6G connectivity. This innovation holds the promise of delivering precise surgical care to rural and underserved areas, thereby reducing geographical disparities.¹ Also known as telesurgery or cyber surgery, this approach allows surgeons to operate remotely via robotic systems and real-time data transmission.¹ However, despite its potential, significant challenges must be addressed before its widespread adoption, particularly in countries like Pakistan. Network latency remains a critical issue; delays beyond 200 milliseconds can impair a surgeon's precision and compromise patient safety.² While 5G technology shows promise in reducing lag, ultra-low latency networks is not yet universally available or reliable.³ Technical resilience is another pressing concern. Although trials, including transcontinental procedures, have demonstrated feasibility in controlled settings, real-world application demands robust, standardised safety protocols, reliable emergency backup systems, and system redundancy.⁴

The substantial cost of procuring and maintaining robotic systems and their maintenance are expensive, limiting use to well-funded institutions in high-income countries.⁵ Without inclusive funding and international collaboration, these advances risk widening global health inequalities.⁵ Additionally, ethical and legal frameworks, including cross-border liability, the process of informed consent for a remote procedure, and data protection, are underdeveloped.⁶ Finally, cybersecurity must be treated as a non-negotiable priority. These complex systems are vulnerable to cyber threats, making end-to-end encryption, real-time intrusion monitoring, and security protocols essential.⁷

¹4th Year MBBS Student, Allama Iqbal Medical College, Lahore, Pakistan;

^{2,3}Department of Medicine, Allama Iqbal Medical College, Jinnah Hospital, Lahore, Pakistan.

Correspondence: Moiz Ahmad. e-mail: moizmoiz33344@gmail.com

ORCID ID: 0009-0001-4473-4685

Submission completed: 16-08-2025 **1st Revision received:** 11-09-2025

Acceptance: 29-11-2025 **2nd Revision received:** 28-11-2025

To ensure the safe and equitable adoption of remote robotic surgery in Pakistan and similar contexts, several critical actions are necessary. First, strategic investment in low-latency, high-bandwidth network infrastructure, especially in underserved areas, is essential to maintain sub-200ms response times. Second, universal training and credentialing systems must be developed specifically for robotic and telesurgery proficiencies. Third, international regulatory frameworks should be established to address licensing, liability, and ethical issues in cross-border care. Cybersecurity must be integrated into system design from the outset, incorporating multi-level authentication, strong encryption, and manual emergency override mechanisms. Additionally, fostering public-private partnerships is key to expanding access and lowering financial barriers. Remote robotic surgery has the potential to transform surgical practice by improving precision, expanding access, and enabling global collaboration. Yet without immediate, coordinated solutions to the technological, legal, ethical, and economic challenges, these benefits may be lost. A globally unified, multidisciplinary approach is essential to ensure robotic innovation enhances rather than hinders healthcare equity.

Disclaimer: None.

Conflict of interest: None.

Source of funding: None.

DOI: <https://doi.org/10.47391/JPMA.32302>

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Author Contribution:

MA: Concept, literature review and drafting.

HM: Literature search, critical revision and formatting.

BH: Expert insights, review, clinical relevance and supervision.