Journal of Surgical Sciences 2024;28(1): 1-2

DOI: https://doi.org/10.3329/jss.v28i1.91048

JOURNAL OF SURGICAL SCIENCES

Editorial

Robotic Surgery: Precision, Equity and Evidence in A Pivotal Decade

Robotic surgery has entered a transformative era, marked by rapid technological innovation, expanding clinical applications, and a growing evidence base supporting its efficacy and safety. Over the past decade, the integration of robotics and artificial intelligence (AI) has redefined surgical precision, workflow efficiency, and patient outcomes across multiple specialties including general surgery, urology, gynecology, colorectal, thoracic, orthopedic and hepato-pancreatobiliary specialties. The current inflection point is defined less by “can we do it robotically?” and more by whether robotic approaches improve outcomes that matter to patients and health systems: complications, functional recovery, cancer control, cost, and equitable access.

Clinical Impacts

- Precision and dexterity: Robotic arms eliminate tremors and allow micro-movements beyond human capability.
- Reduced complications: Evidence shows lower blood loss, fewer infections, and shorter hospital stays compared to traditional open surgery.
- Patient outcomes: Enhanced recovery times and cosmetic benefits are increasingly documented, though long-term comparative data are still being collected.

Challenges and Limitations

- Cost barriers: Robotic systems remain prohibitively expensive, limiting access in resource-constrained settings like Bangladesh.
- Training demands: Surgeons require extensive training to master robotic platforms, raising questions about standardization and credentialing.
- Ethical considerations: As AI becomes more integrated, issues of accountability and patient consent must be addressed.

Future Directions

- Next-generation platforms: Emerging systems promise smaller footprints, modular designs, and improved ergonomics.
- AI-assisted autonomy: Partial automation of routine tasks could free surgeons to focus on critical decision-making.
- Global equity: Wider adoption will depend on cost reduction and scalable training programs to ensure access beyond elite centers.

The da Vinci Surgical System remains the most widely adopted platform, but the expiration of key patents and the emergence of new competitors - such as Medtronic’s Hugo, CMR Surgical’s Versius, and others-are reshaping the market and driving down costs. The evidence base, while robust in some areas, still lacks long-term, high-quality randomized controlled trials (RCTs) for many indications, and cost-effectiveness remains a subject of debate.

Equity of access, regulatory oversight, and ethical considerations, especially as AI and semi-autonomous systems become more prevalent, are critical issues for the coming decade. The next decade will be decisive - converging advances in systems engineering, human–machine collaboration, and rigorous trial methodology will determine whether

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robotics becomes the default for complex minimally invasive procedures or remains a premium alternative.

In summary, robotic surgery stands at a pivotal crossroads. Its future will be shaped by ongoing technological innovation, rigorous evidence generation, sustainable implementation models, and a commitment to equitable access and ethical governance.

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