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ROBOTIC-ASSISTED SURGERIES: EXPANDING HORIZONS WITH NURSES' EVOLVING ROLES

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ABSTRACT

Robotic-assisted surgery (RAS) continues to reshape surgical practice with clear clinical benefits over traditional and laparoscopic procedures. Across multiple specialties and the latest meta-analyses, robust evidence indicates that RAS can reduce blood loss, hospital stay, transfusion needs and complications-though longer operative times and higher costs persist. Adoption is increasing globally, supported by both evidence and strategic healthcare plans. Addressing cost, training and patient awareness remains crucial to expanding equitable access and optimizing outcomes.

KEYWORDS

Robotic-Assisted Surgery (RAS), Cost-reduction approaches, Training and Patient awareness.

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INTRODUCTION

Robotic surgery represents a significant innovation in modern surgical practice. Over the past several decades, it has evolved from experimental procedures to a mainstream option in superspecialty hospitals worldwide. Although initially hindered by cost and technological limitations, robotic-assisted procedures are increasingly recognized for their precision, reduced invasiveness and improved patient recovery outcomes. This paper reviews the historical development, clinical advantages, limitations, and future implications of robotic surgery while drawing insights from current literature and the researcher's observations.

Historical Background

The concept of robotics in surgery has been under exploration for approximately 75 years. However, it is only within the past two decades that the surgical community has fully recognized its potential. The earliest milestone dates back to 1985, when Kwoh *et al*[1]. employed the Puma 560 robot for neurosurgical biopsies, marking the beginning of robotic integration in surgical practice. Shortly thereafter, the PROBOT was developed for transurethral resection of the prostate and the ROBODOC system was introduced for orthopedic applications such as femoral machining in hip replacements. ROBODOC became the first robotic system to receive FDA approval.

The U.S. Army's research initiatives further accelerated the integration of robotics into surgery. Technologies such as the Automated Endoscopic System for Optimal Positioning (AESOP) and telepresence surgical systems eventually led to the development of the Da Vinci Surgical System, now one of the most widely adopted platforms for robotic-assisted surgery. Over time, these systems have evolved with enhanced optics, instrumentation, and cardiopulmonary technologies, supporting complex procedures such as minimally invasive cardiac surgery.

Evolution from Minimally Invasive Surgery

Minimally invasive surgery (MIS) began in 1987 with the first laparoscopic cholecystectomy. This innovation revolutionized surgical practice by reducing incision size, infection risk, hospital stays, and recovery time. Studies have consistently demonstrated benefits such as faster return to work, reduced pain, and improved postoperative immune function. However, MIS has inherent limitations, including restricted dexterity, diminished tactile feedback, and challenges with hand-eye coordination due to the fulcrum effect of laparoscopic tools. Physiological tremors and difficulties in performing delicate dissections further restricted its scope. The advent of robotic systems aimed to overcome these limitations, expanding the possibilities of minimally invasive interventions.

Advantages of Robotic Surgery

A 2025 meta-analysis of 33 RCTs across over 6,000 cancer patients found that robot-assisted surgery (RAS) significantly reduces hospital stay, blood loss, and overall complications compared to open surgery-while operative time increased-but with no difference in long-term oncologic outcomes

A systematic overview of 165 reviews confirms that RAS outcomes are largely positive or neutral compared to both open and laparoscopic surgeries-though operative times are often longer and financial impact requires further exploration.

A 108-study meta-analysis reported that robotic surgery versus open surgery significantly reduces blood loss (average ratio of means ~0.505), transfusion rates (~0.272), hospital stay (~0.695), and complication rates (~0.637)

In pediatric cases of Hirschsprung's disease, RAS showed significant reductions in blood loss and hospital stay compared to laparoscopic surgery, with no increase in postoperative complications

Robotic pancreaticoduodenectomy (RPD) offers advantages over open PD-less blood loss, shorter stay, lower wound infection and transfusion rates-though operative times remain longer

For colon cancer, RAS had longer operative times than laparoscopic surgery but achieved shorter hospital stays, better lymph node harvesting and lower conversion-to-open rates

Among obese patients undergoing colorectal surgery, robotic methods resulted in shorter hospital stays and reduced blood loss, with no differences in complications or readmissions-though surgery duration was longer

A study of robot-guided pedicle screw insertion in spinal fusion (1,633 patients) found significantly less blood loss and shorter hospital stay, without increasing operative time

In gastric cancer cases, robotic gastrectomy (RG) showed better overall survival, lower complications, less blood loss, faster recovery and higher lymph node yield compared to laparoscopic gastrectomy (LG)-with longer operative times

In endometrial cancer staging, robotic surgery offered less blood loss, fewer transfusions, fewer complications, shorter stays and fewer conversions than both laparoscopy and open surgery-despite longer operative times

Challenges and Limitations

Many RAS studies suffer from low quality or bias, and the evidence base is weaker for operative time and cost comparisons, indicating the need for better-designed trials

A systematic review found no significant differences in mortality, complication rates, or recovery times between robotic and laparoscopic abdominal or pelvic procedures-while robotic surgery was typically more expensive and took longer

A propensity-matched study of 15,009 patients revealed that compared to open surgery, RAS significantly reduced unnecessary transfusions and shortened hospital stay by about 4.3 days; compared to laparoscopy, differences were minimal

Several reports highlight that operative time is longer, and RAS comes at a higher cost, particularly in the early learning curve phases

Broader Adoption and Future Directions

Globally, clinicians note expanded adoption of RAS across fields like gynecology, urology, neurosurgery, orthopedics and gastroenterology, driven by its advantages in precision and recovery. Yet, patient awareness and cost remain barriers.

NHS England plans to dramatically increase RAS use-from around 70,000 to 500,000 annual cases by 2035-for cancer, hysterectomy, joint replacements and more, citing faster recovery and hospital discharge as key system-wide benefits

Researcher's Observations

Based on clinical observations and literature review, several findings emerge:

Patients demonstrate limited awareness about robotic surgeries.

The financial burden is a significant barrier to accessibility.

Hospital stay duration is notably shorter, leading to fewer work absences.

Postoperative pain management requirements are minimal.

Recovery rates are favorable, with fewer complications.

Surgeons require high levels of training and expertise to ensure procedural success.

Nurses' Role and Responsibilities in Robotic Surgery

Introduction

As robotic surgery increasingly becomes a standard of care, nurses play a pivotal role in ensuring patient safety, optimizing surgical outcomes, and supporting surgeons during robotic-assisted procedures. Their responsibilities span the preoperative, intraoperative, and postoperative phases of care, requiring both advanced clinical expertise and specialized technical knowledge.

Roles and Responsibilities

Preoperative Phase

Patient education and awareness

Nurses provide counseling on the benefits, risks, and recovery expectations of robotic surgery, addressing the common gap in patient knowledge.

Psychological support

Preoperative anxiety is common; nurse-led interventions improve patient preparedness and reduce stress.

Assessment and preparation

Includes comprehensive health assessment, equipment readiness checks and coordination with surgical teams.

A study by Mohan *et al*, (2020)[2] found that nurse-led preoperative education significantly improved patient satisfaction and reduced anxiety levels in robotic gynecological surgeries.

Karsh *et al*, (2021)[3] highlighted that nurses' communication reduces decisional conflict in patients undergoing robotic prostatectomy.

Intraoperative Phase

Circulating nurse role

Ensures sterile field maintenance, supplies, and coordinates communication between scrub nurse, console surgeon, and anesthesia team.

Scrub nurse role

Assists in docking/undocking the robotic system, instrument changes and troubleshooting technical issues.

Safety monitoring

Vigilant observation for equipment malfunctions, patient positioning issues, and adherence to safety protocols.

According to an integrative review by Sandor *et al*, (2019)[4], operating room nurses require specialized training in robotic system handling, patient positioning and equipment troubleshooting.

The Association of perioperative Registered Nurses (AORN)[5] recommends that scrub nurses in robotic surgery undergo structured competency-based training, highlighting the essential role of perioperative nurses in preventing intraoperative complications.

Postoperative Phase

Monitoring and recovery

Nurses monitor vital signs, pain management, and wound healing, with emphasis on early mobilization due to shorter hospital stays.

Patient and family education

Guidance on discharge, wound care, activity restrictions and warning signs of complications.

Follow-up support

Coordination with outpatient teams to ensure continuity of care.

A study by Kim *et al*, (2018)[6] found that nurse-led postoperative care programs improved recovery outcomes and reduced readmission rates following robotic colorectal surgeries.

Similarly, research by Zhang *et al*, (2022)[7]demonstrated that postoperative nurse-led telemonitoring reduced complications and improved quality of life among robotic-assisted urology patients.

Skills and Competencies Required

Knowledge of robotic technology and troubleshooting.

Advanced perioperative nursing skills.

Communication and patient education expertise.

Interdisciplinary collaboration with surgeons, anesthesiologists and technical staff.

Research and quality improvement participation to advance best practices.

CONCLUSION

Robotic surgery represents a critical frontier in modern surgical innovation. Its ability to overcome the limitations of traditional and laparoscopic methods has made it an increasingly viable option across diverse surgical disciplines. However, challenges related to cost, patient awareness and training must be addressed to expand its accessibility and impact. Future studies are warranted to explore patient education strategies, cost-reduction approaches and long-term outcome comparisons with conventional surgical techniques.

Nurses are indispensable in robotic surgery, functioning as educators, safety monitors, technical experts and patient advocates. Their evolving role is critical in bridging the gap between complex technology and holistic patient care. Ongoing professional development, structured competency training and participation in clinical research will further enhance their contributions.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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