

Economics of Robotic Surgery

Does It Make Sense and for Whom?



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KEYWORDS

• Treatments • Utilization • Costs • Robotic • Surgery

KEY POINTS

- There has been a rapid adoption of robotic-assisted laparoscopic surgery (RALS) in the absence of high-level evidence showing its superiority to conventional approaches.
- The authors' systematic literature research revealed that only a few studies compared direct costs of different approaches.
- Despite the heterogeneous nature of cost comparison studies, they demonstrate that RALS is associated with greater direct costs.
- To date, RALS, and in particular robotic-assisted laparoscopic prostatectomy (RALP), has not been found to be cost-effective from a health economic standpoint.
- Although the demand for RALS by surgeons and patients is high, spiraling health care costs and strained health care systems will demand more comprehensive study designs for the inevitable adoption of costly new technologies such as RALS.

INTRODUCTION

Robotic-assisted laparoscopic surgery (RALS) has evolved since its inception in 1985 to its current state in the form of the da Vinci surgical system (Intuitive Surgical, Sunnyvale, California). Following receipt of US Food and Drug Administration approval in 2000 for adult and pediatric surgeries, utilization has increased ahead of empirical evidence demonstrating superiority over conventional surgical approaches. The technology offers advantages of a 3-dimensional view of the operative field, absence of a fulcrum effect, 7° versus 4° of freedom of movement compared with conventional laparoscopy with 'wristed' instruments that facilitate intracorporeal suturing, elimination of surgeon tremor, and ergonomic benefits,¹

hastening the learning curve for open surgeons transitioning to minimally invasive surgery.²⁻⁴ Additional advantages over open surgery include smaller incisions, reduced intraoperative blood loss due to carbon dioxide insufflation, decreased postoperative pain, and shorter hospital lengths of stay (LOS) and convalescence.⁴⁻⁶ Disadvantages of RALS include relatively longer operative times, absence of tactile feedback, and instrument collisions when traversing broader operative fields.^{3,7,8}

Since the introduction of the da Vinci system, most cases are now dedicated toward urology and urologic oncology procedures. With more than 1400 robotic surgical systems installed in US hospitals, with some having up to 5 systems, and the number of robotic systems in other countries doubling from 200 to 400 between 2007 and 2009,⁹ RALS

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has been rapidly adopted in the absence of overwhelming evidence demonstrating superior outcomes compared with laparoscopic and open surgery.^{1,10} Further, direct-to-consumer advertising has resulted in heightened patient demand for RALS,¹¹ particularly for radical prostatectomy. However, men who underwent radical prostatectomy with RALS versus open surgery were more likely to be diagnosed with incontinence and erectile dysfunction, and more likely to experience treatment regret.^{10,12} Regarding utilization of pharmacotherapy for erectile dysfunction following treatment for localized prostate cancer, men undergoing minimally invasive surgery including RALS were more likely to use pharmacotherapy after treatment.¹³ Moreover, patients were more likely to be regretful and dissatisfied, possibly because of greater expectation of an innovative procedure with less counseling on adverse effects.¹² It has been suggested that urologists carefully portray the risks and benefits of new technologies during preoperative counseling to minimize regret and maximize satisfaction.¹² However, more recent analysis demonstrates that robotic-assisted versus open radical prostatectomy is associated with fewer positive surgical margins and less use of radiation or androgen deprivation therapy within 2 years of surgery, suggesting better cancer control outcomes.¹⁴ As such, further comparative effectiveness research is needed to identify determinants of appropriate dissemination of robotic surgery.

CONSEQUENCES OF RAPID ADOPTION OF ROBOTIC SURGERY

Many patients intuitively perceived minimally invasive approaches as reducing complications compared with conventional surgery. Patients prefer these approaches, especially RALS, because of smaller incisions requiring fewer analgesics and shorter hospital stays, even at a greater cost to the health system.¹⁵ The cosmetic appeal of multiple small incisions versus a single incision is one of personal preference. With rapid adoption, prolonged learning curves, and varying hospital accreditation practices for attaining RALS privileges, there may come unforeseen risks. For example, the rapid adoption of laparoscopic cholecystectomy in the 1990s resulted in a spike in biliary tract injuries from 1500 to 4000 per year.¹⁶ Well-designed studies comparing surgical approaches are sparse, and most studies are comprised of single-surgeon series that may not be generalizable to other practice settings.

RALS was rapidly adopted for radical prostatectomy, and hospital acquisition led to the expansion of RALS for other procedures.¹⁷ A consequence of

the rapid adoption of RALS resulted in certain professional organizations recommending against RALS as a preferred treatment option.¹⁸ For instance, robotic hysterectomy has become increasingly utilized with increased complications and costs over open surgery, so much that the American Society of Obstetrics and Gynecology no longer recommends RALS as a first-line surgical option.¹⁸

A recent population-based comparative effectiveness study of RALS utilization, patterns of care, and costs resulted in several important findings that may provide some insight into lessons learned from the rapid adoption of RALS.¹ First, racial, geographic, and hospital-based variations exist in patients undergoing RALS, with limited access to care for nonwhite patients. Several other studies have demonstrated similar heterogeneity in access to newer technology and therefore limit generalizability of outcomes.^{19–21} Second, higher-volume hospitals are more likely to offer RALS for procedures such as radical prostatectomy; however, they are less likely to offer it for other procedures such as cystectomy, owing to likely increased complexity of the latter procedure. Outcomes of robotic cystectomy are comparable to the open approach; however, prior comparative analyses are derived from high-volume open and robotic surgeons.²² Interestingly, robotic partial nephrectomy has become increasingly adopted over conventional laparoscopy, which had a prolonged learning curve and technical complexity that precluded universal adoption.^{1,23,24} A recent population-based study found robotic partial nephrectomy to result in fewer complications and shorter length of stay than either the laparoscopic or open approach.¹ As newer technologies such as RALS become further adapted to more complex procedures, it is critical to understand the consequences of rapid adoption of RALS in order to avoid potential future pitfalls. Some have suggested that state-based certificates of need should be implemented to control RALS utilization and limit costs as they pertain to prostate cancer.²⁵ However, state-based regulations were ineffective in constraining robotic surgery adoption and intensity-modulated radiation therapy, another controversial, high-cost prostate cancer treatment modality.²⁶ As health care reform gets underway, one may expect similar constructs to be implemented in order to control RALS and health care costs while striving to improve patient outcomes.

THE COSTS OF ROBOTIC SURGERY

RALS has been consistently shown to be more costly than conventional laparoscopic or open

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