



Technology

The da Vinci Surgical System is a telemanipulation system with three or four robotic arms that are controlled by a surgeon seated at a computer console. Surgical robots were developed to facilitate minimally invasive surgeries and to assist with surgeries that would otherwise be very difficult, if not impossible, to perform using more traditional methods (open or laparoscopic approaches).

Conditions

The robot-assisted surgeries examined in this report are prostatectomies (removal of the prostate), hysterectomies (removal of the uterus), nephrectomies (removal of all or part of a kidney), and some cardiac surgeries, such as coronary bypass surgery or surgery to replace one or more valves in the heart.

Issues

Robot-assisted surgery with the da Vinci System may offer benefits to patients and surgeons, but the costs to acquire, maintain, and operate the system are significant. An understanding of the cost- and clinical effectiveness of robot-assisted surgery compared with open and laparoscopic procedures will help with decisions about purchasing and using surgical robots in Canada.

Key Messages

- Robot-assisted surgeries do improve a number of short-term patient outcomes, depending on the type of surgery performed (prostatectomy, hysterectomy, or nephrectomy).
- Robot-assisted surgery is costly and requires a significant investment.
- There are strategies that can help to decrease costs and maximize cost-effective use, including:
 - maximizing caseloads
 - operating the surgical robot for longer periods
 - using the surgical robot for several different types of surgery.

Methods

A systematic review with meta-analyses was conducted to compare clinical efficacy between robot-assisted, open, and laparoscopic surgeries.

A systematic review of the economic literature was conducted with the aim of assessing the economic evidence for robotic surgery (a mainly descriptive approach was used).

Based on the results of the clinical analysis – which found differences in short-term outcomes, but not in long-term outcomes – a cost-minimization analysis was carried

out that compared the relative costs of robot-assisted surgery with open and laparoscopic surgeries. This primary economic evaluation compared robotic surgery with open and laparoscopic surgery in the most frequently performed robotic procedure in Canada: radical prostatectomy.

Results

Robot-assisted surgery was associated with a statistically significant benefit for several short-term clinical outcomes (length of hospital stay, blood loss and transfusion rates, positive margin rates, complications, and operative time). Due to a scarcity of evidence, comparisons between the methods of surgery on longer-term outcomes, such as survival rates and time to return to work, were inconclusive. There were no data from randomized controlled trials, and the availability of data on nephrectomy and cardiac surgery was very limited.

The conclusions of the studies included in the economic review varied with respect to the costs and cost-effectiveness of robotic surgery.

In the cost-minimization analysis, shorter lengths of stay with robot-assisted prostatectomy reduced hospitalization costs compared with open and laparoscopic surgery. However, because of the high cost of acquiring, operating, and maintaining the surgical robot, the estimated costs of the robotic technology per patient were higher overall.

Other Considerations for Decision-Makers

The most commonly performed robot-assisted surgery in Canada, prostatectomy, was estimated to be the least cost effective. The robot-assisted surgery performed the least in Canada (and with the least clinical evidence), cardiac surgery, was estimated to be the most cost effective. This may help to guide the design and implementation of surgical robotics programs in Canada.

Patients with stage II prostate cancer who had their prostate removed with the assistance of the surgical robot were less likely to have positive margin rates (prostate cancer left behind after the surgery) than those patients who had their prostates removed by other surgical techniques. This was not the case for patients with stage III prostate cancer. These results could help guide decisions on which patients are most likely to benefit from robot-assisted prostatectomy. This could contribute to the effective use of this new technology; however, more research is needed on long-term outcomes.

Although beyond the scope of this research project, availability of surgical robots may play a role in surgeon recruitment and retention.

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