The use of robotic-assisted surgery is rapidly expanding into the field of gynecological oncology.

Robotic-Assisted Surgery in Gynecological Oncology

Stephen H. Bush, MD, and Sachin M. Apte, MD

Background: Robotic-assisted surgery is a technological advancement, and its use is rapidly expanding into the field of gynecological oncology. However, a paucity of evidence exists to prove its superiority over standard laparoscopy. Its cost is also high and it lacks haptic feedback.

Methods: A systematic review of the relevant literature was undertaken to understand the use of robotic-assisted surgery in gynecological oncology.

Results: Robotic-assisted surgery is being used for select cases of endometrial cancer and has resulted in the increased utilization of minimally invasive surgery for such patients. Use of robotic-assisted surgery among patients who are obese has led to decreased complication rates. Robotic-assisted surgery appears to be more expensive than traditional laparoscopy; however, there are potential cost savings to robotic-assisted surgery, including shorter hospital stays and fewer complications, compared with laparotomy.

Conclusions: The gynecological oncology community is rapidly accepting the use of robotic-assisted surgery. Although randomized controlled trials are lacking, the technology appears to be safe and effective, and it has equivalent oncological outcomes in this patient population.

Introduction

Robotic-assisted surgery is a relatively recent advancement in surgical technique. The US military planned to use a robotic system to perform surgery on injured soldiers located far from a medical center. The Automated Endoscopic System for Optimal Positioning Robotic System (Computer Motion, Goleta, California) was one of the first robotic devices to operate a camera during laparoscopic surgery. The next advancement introduced was the ZEUS Robotic Surgical System (Computer Motion), which had robotic arms attached to an operating table. This device introduced the concept of removing the surgeon from the sterile operative field. Subsequently, the da Vinci Surgical System (Intuitive Surgical, Sunnyvale, California) was developed and approved in 2000 by the US Food and Drug Administration for general laparoscopic surgery.

Since then, the da Vinci Surgical System was rapidly adopted by surgeons across many fields and received initial clearance from the US Food and Drug Administration in 2005 for gynecological conditions. The adoption of this technology led to major changes in the surgical care of women with gynecological malignancies. Prior to the inception of this technology, many women with endometrial carcinoma underwent laparotomy, with relatively few receiving the traditional laparoscopic approach. However, most of these cases are now performed with robotic assistance, representing a rapid transformation in surgical practice. Robotic-assisted surgery has many other benefits over traditional laparoscopy, including enhanced visualization with 3-dimensional stereoscopic vision, improved dexterity, and improved surgeon comfort. These ben-
Benefits have allowed more surgeons to offer minimally invasive surgery to patients, as evidenced by the rapid change in practice patterns for the care of patients with endometrial cancer. Despite these advantages, some traditional, “straight stick” expert laparoscopists believe that robotic-assisted surgery offers few, if any, benefits when compared with standard laparoscopy, citing lack of haptic feedback, lack of prospective randomized trials showing benefit, increased cost, and the impact of robotic-assisted surgery on the surgical education of medical residents and fellows.

**Endometrial Cancer**

In 2015, an estimated 54,870 new US cases of endometrial cancer will be diagnosed and 10,170 women are expected to die from the disease. Most cases of endometrial cancers are classified as type 1, meaning that they are hormonally responsive tumors. The most common risk factor present for this disease in the United States is obesity due to the production of peripheral estrogen following steroid conversion in adipose tissue. A large, open incision in a patient who is obese increases the risk of postoperative complications, such as wound infection and dehiscence, and makes the procedure more difficult. This fact made minimally invasive surgery an attractive alternative to traditional open surgery.

The Gynecologic Oncology Group conducted a large, multicenter, prospective study comparing laparoscopy with laparotomy for the surgical staging of endometrial cancers and confirmed the short-term surgical safety and the feasibility of laparoscopically conducting the procedure. The trial was designed as a noninferiority study and the predetermined hazard ratio of 1.4 was not reached; however, the study was underpowered due to recurrence rates in both arms that were less than the pretrial assumptions. The 5-year overall survival rates were equivalent in both arms at 89.9%. These results could be confounded due to the relatively high (25%) conversion rate to laparotomy in the laparoscopic cohort. Although the trial did not meet its assigned end point to confirm noninferiority, the laparoscopic staging may not have adversely affected survival rates in women with endometrial cancer.

Traditional laparoscopic surgery has not been widely utilized in women with endometrial cancer due to the complexity of the procedure and the extended learning curve. Robotic-assisted surgery for endometrial cancer has become the standard in most centers across the United States. Numerous studies have evaluated robotic-assisted staging for endometrial cancer to laparotomy, the majority of which show that, when compared with open surgery, robotic-assisted surgery is associated with longer operative times, decreased rates of blood loss, decreased transfusion rates, decreased postoperative complications, and decreased length of stay; in addition, when compared with traditional laparoscopy, robotic-assisted surgery appears to decrease rates of blood loss and maintain similar lymph node (LN) counts.

Obesity is a risk factor for endometrial cancer, and defining the optimal surgical intervention for patients at high risk is of the upmost importance. Gehrig et al examined 49 women (36 were obese and 13 were morbidly obese) who underwent robotic-assisted surgical staging and compared their outcomes with 32 women (25 were obese and 7 were morbidly obese) surgically staged with traditional laparoscopy. Among the women who were obese and morbidly obese, the authors found that robotic-assisted surgery was associated with shorter operative time (P = .0004), decreased blood loss (P < .0001), increased LN count (P = .004), and decreased length of stay (P = .0119).

Bernardini et al compared outcomes of women with stage 1 or 2 endometrial cancer and a body mass index greater than 35 kg/m² who were treated at a single institution with either robotic-assisted surgical staging or open surgical staging. The results from 86 women were analyzed; 45 women were assigned to the robotic-assisted cohort and 41 were assigned to the laparotomy cohort. Postoperative complications were significantly higher in the patients who underwent laparotomy compared with robotic-assisted staging (44% vs 17.7%; P = .007). Hospital stay was significantly longer in the laparotomy group compared with the robotic-assisted group (4 vs 2 days; P < .001). No difference was seen in the rate of pelvic LN dissection, but para-aortic nodal dissection was more common in the robotic-assisted cohort.

In a large study by Paley et al, 377 robotic-assisted staging procedures were compared with 131 open staging procedures. No differences were seen between the groups with regard to age, body mass index, medical comorbidities, or number of prior surgeries. Operative times alone favored the open-staging group, whereas length of stay, nodal counts, and rate of blood loss were all improved in the robotic-assisted cohort; in addition, a significant decrease was seen in complications for the robotic-assisted cohort (26% vs 6.4%; P < .001). The most significant reductions were observed in the incidence of wound separation, infectious complications, and ureteral injury or acute renal failure in the robotic-assisted cohort.

Even lacking prospective randomized data to support the use of robotic-assisted staging in endometrial cancer, most of the medical literature supports the method as safe and effective. Robotic-assisted surgery for endometrial cancer staging has been rapidly incorporated into the field of gynecological oncology in both academic and community settings, and the learning curve has been described by many as being faster...
for robotic-assisted staging than laparoscopic staging.\textsuperscript{14} Compared with both laparotomy and laparoscopy, robotic-assisted surgery is advantageous in patients who are obese when examining rates of blood loss, transfusions, length of stay, wound complications, and conversions to laparotomy.\textsuperscript{11,15}

Robotic-assisted staging for endometrial cancer is an accepted surgical practice, appears to be safe and effective, and offers many advantages over laparotomy. Although its advantages over traditional laparoscopy are debatable, robotic-assisted surgery has allowed more women to have access to minimally invasive surgery for endometrial cancer.\textsuperscript{16}

**Cervical Cancer**

Although safe and effective screening for cervical cancer has been available in the United States for decades, a significant number of new cases are diagnosed each year; for example, in 2015, an estimated 12,900 women will be diagnosed with cervical cancer and 4,100 will die of the disease in the United States.\textsuperscript{5} Cervical cancer is the second leading cause of cancer death in women 20 to 39 years of age.\textsuperscript{17} Early-stage disease is typically treated with radical hysterectomy, which has significant morbidity (eg, significant blood loss, bladder atony, lymphedema, pain, sexual dysfunction). As such, attempting to limit morbidity with a minimally invasive approach was a logical progression. Traditional laparoscopy has not been widely accepted for this procedure due to its complexity and extended learning curve.

Robotic-assisted radical hysterectomy was first reported in 2006 by Sert et al.\textsuperscript{18} Since their initial report, subsequent publications have sought to refine the procedure and describe the safety and effectiveness associated with this approach. One case-control series compared robotic-assisted surgery with laparoscopic radical hysterectomy and bilateral pelvic lymphadenectomy and reported decreased rates of blood loss (71 vs 160 mL) and length of stay (4 vs 8 days) in the robotic-assisted group ($P < .05$), although they did not observe any differences in LN count, parametrial tissue size, or operative times.\textsuperscript{19} Kim et al\textsuperscript{20} confirmed the safety and feasibility of a robotic approach in a series of 10 patients with early-stage cervical cancer who had no conversions, ureteral injuries, or fistulas. They reported a mean rate of blood loss of 355 mL, an average of 28 LNs, and a median operative time of 207 minutes.\textsuperscript{20}

Many publications have investigated the outcomes of robotic-assisted radical hysterectomy compared with traditional laparotomy. Boggess et al\textsuperscript{17} compared 51 robotic-assisted radical hysterectomy cases with 49 open radical hysterectomy cases and reported significant improvements in rates of blood loss, operative time, and nodal counts in favor of the robotic-assisted cohort. In 2008, Magrina et al\textsuperscript{21} compared all 3 modalities. Their mean operative times for women in the robotic-assisted, laparoscopic, and open cohorts were 190, 220, and 167 minutes, respectively; the mean rates of blood loss were 133, 208, and 443 mL, respectively; and the mean rates of length of stay were 1.7, 2.4, and 3.6 days, respectively.\textsuperscript{21} In 2011, Soliman et al\textsuperscript{22} also reviewed all 3 modalities. They reviewed the findings from 95 radical hysterectomies and found that minimally invasive methods offered significant benefits over the open approach, including decreased rates of blood loss and shorter hospital stays.\textsuperscript{22} Open radical hysterectomy had shorter operative times, and the robotic approach had a shorter length of stay than traditional laparoscopy.\textsuperscript{22}

However, all of these studies are retrospective in nature and do not describe oncological outcomes. No prospective randomized trials have addressed this issue. However, Cantrell et al\textsuperscript{23} published a single institution, 3-year outcome report of 71 study patients undergoing robotic-assisted radical hysterectomy. They reported a progression-free survival rate of 94\% and overall survival at 36 months with a median follow-up period of 12.2 months.\textsuperscript{23} Compared with historical controls, no significant difference was seen in either of these survival rates.\textsuperscript{23} Based on the information available in the literature, no evidence suggests that minimally invasive radical hysterectomy in general or robotic-assisted radical hysterectomy specifically is oncologically inferior to traditional open radical hysterectomy; however, no level 1 evidence suggests that the approaches are equivalent.

Given that cervical cancer is often diagnosed in women in their reproductive years,\textsuperscript{5} fertility-sparing surgery is of great importance to these patients. This is another area in which robotic-assisted surgery is gaining traction. Radical tracheectomy, in which the cervix and parametrial tissues are removed and the uterus is left intact, is an accepted procedure for carefully selected, early stage 1 cervical cancer in women desiring to preserve their fertility. Traditional laparoscopic radical tracheectomies are rarely performed, and only select, high-volume laparoscopic centers offer them due to the complexity of the procedure and the limitations of rigid instrumentation. Nick et al\textsuperscript{24} reported on a large series of 37 study patients undergoing radical tracheectomy. Of those, 25 underwent radical tracheectomy and 12 patients underwent robotic-assisted radical tracheectomy; 1 study patient assigned to the open approach and 4 assigned to the robotic approach were converted to radical hysterectomy due to close margins.\textsuperscript{24} The robotic-assisted cohort had a decreased rate of blood loss (62 vs 300 mL) and a shorter hospital stay (1 vs 4 days) than the open cohort, although no differences were seen in operative time or histopathological outcomes between the groups.\textsuperscript{24}

Patients with locally advanced cervical cancer (stages 2A–4A) are at high risk for LN metastasis,
and some concern exists regarding the accuracy of positron emission tomography/computed tomography for detecting para-aortic LNs in this setting. In some centers, surgically staging the para-aortic nodes is common practice in these patients, who are typically treated with concurrent chemotherapy and radiation rather than radical hysterectomy. An accurate assessment of LN status is necessary to provide optimum care for these patients. Transperitoneal lymphadenectomy is technically challenging and, when it is followed by radiation, can be associated with adverse events (eg, intestinal obstruction). Performing para-aortic lymphadenectomy using an extraperitoneal approach can avoid many of the complications associated with the transperitoneal approach, and this technique has been described using both the traditional laparoscopic and robotic approaches. The robotic approach was first described by Vergote et al, who concluded that the robotic approach was easier than traditional laparoscopy. Lambaudie et al reported on a series of 39 study patients with locally advanced cervical cancer who underwent robotic-assisted para-aortic lymphadenectomy (15 underwent the extraperitoneal approach and 24 underwent the transperitoneal approach). They noted similar operative times, rates of blood loss, nodal counts, and lengths of hospital stay, but they did comment on the challenges from the limited space available that resulted in instrument collisions.

For central pelvic recurrences of cervical cancer following radiation therapy, the traditional treatment offered has been pelvic exenteration in which the pelvic organs (uterus, cervix, parametria, bladder, vagina, and rectum) are removed in a highly morbid procedure. There have been reports of robotic assistance during this surgical procedure whose results suggest that the incisions used are smaller and most have also incorporated mini-laparotomy. However, these are early reports and more information is needed regarding the oncological and perioperative outcomes before the robotic approach to pelvic exenteration can be recommended.

Ovarian Cancer
Approximately 5% of cancer-related deaths among US women are due to ovarian cancer, and an estimated 21,290 new cases of ovarian cancer and 14,180 related deaths will occur in the United States this year. The current standard of care for ovarian cancer in the United States is cytoreductive surgery. When ovarian cancer is debulked to microscopic residual disease, survival rates improve. Chemotherapy can either be preoperatively (neoadjuvant) or postoperatively (adjuvant) given. With the rapid growth of minimally invasive surgery — in particular, robotic-assisted surgery — interest has been growing about using the technology to benefit women with ovarian cancer. Comprehensive surgical staging in ovarian cancer requires exploration of the entire peritoneal cavity, from the diaphragm to the pelvic floor. For it to be useful, a robotic surgical system must address its limited range of motion, which requires undocking and rotation of the patient; however, such a limitation may be overcome by the fourth-generation da Vinci Xi Surgical System (Intuitive Surgical) because it eliminates the need to undock and rotate patients, thus making multiquadrant surgery easier to perform. This robotic platform also allows the camera to be attached to any arm, has a lower profile, and increases docking flexibility. However, at the time of publication, the use of robotic-assisted surgery for upfront debulking surgery in women with advanced ovarian cancer is not yet recommended.

Borderline ovarian tumors are a subset of epithelial ovarian cancer with a good prognosis, although surgical staging of these tumors is still recommended due to the risk of underdiagnosis on frozen section. Fauvet et al compared traditional laparoscopy with surgical staging in conjunction with laparotomy for women with ovarian borderline tumors. Women in the laparoscopy group had lower rates of complete surgical staging; however, no significant difference in the recurrence rates between the laparoscopy and laparotomy groups were identified (12.1% vs 9.1%). Their reported conversion rate of 28% in the laparoscopy group confirms the importance of appropriate patient selection when considering a minimally invasive approach.

Early-stage ovarian cancer represents another group of patients who might benefit from robotic-assisted surgery. Tozzi and Schneider reported on 24 study patients with stage 1A or 1B ovarian cancer who underwent laparoscopic staging. They showed excellent progression-free and overall survival rates of 92% and 100%, respectively. The Gynecologic Oncology Group explored completion staging with laparoscopy for women with incompletely staged ovarian, fallopian tube, or primary peritoneal carcinoma. Women who underwent laparoscopy had lower rates of blood loss and shorter length of hospital stay than women who underwent laparotomy, whereas operative times and number of LNs removed were equivalent. A 23% conversion rate was reported, thus further stressing the importance of appropriate patient selection. No follow-up survival data were provided.

Magrina et al reported a case-control study of 25 study patients with epithelial ovarian cancer who either underwent robotic-assisted surgical treatment or were treated by traditional laparoscopy or laparotomy. Eligibility was not limited to early disease. Patients in the robotic-assisted cohort had increased operative time, but decreased blood loss and shortened length of stay. The authors concluded that laparoscopy or robotic-assisted surgery is preferred for
patients with ovarian cancer who require tumor excision alone and 1 additional major procedure; those needing more than 1 additional major procedure would fare better with laparotomy.39

Occasionally, recurrent ovarian cancer is amenable to surgical resection, representing another area for robotic-assisted surgery to potentially benefit patient care. Magrina et al40 reviewed 52 study patients with recurrent ovarian cancer undergoing secondary cytoreduction by laparoscopy (n = 9), laparotomy (n = 35), or robotic assistance (n = 10) between 2006 and 2010.40 They found decreased blood loss and decreased length of hospital stay with those assigned to the robotic-assisted procedure and laparoscopy compared with laparotomy.40 All 3 groups were similar in regard to operating time, complications, complete debulking, and survival rates.40

It is important to note that robotic-assisted surgery is unlikely to replace laparotomy for primary debulking surgery in patients with ovarian cancer. For select patients with isolated recurrent disease, robotic-assisted surgery may offer benefit over laparotomy.

**Cost**

The increasing rate of health care expenditures in the United States is unsustainable and has resulted in significant disruption to the health care industry. As a result of the Affordable Care Act, reimbursement models, such as accountable care organizations, are evolving. Becoming cost conscious about the way in which we deliver care is increasingly important, and a major criticism of robotic-assisted surgery is its increased cost over traditional laparoscopy.41-44 Many costs unique to robotic-assisted surgery must be taken into account, including the acquisition of the robotic system, specific robotic instruments, special drapes for the robotic arms, and increased training requirements for the entire operating room team. The robot also adds complexity and inefficiency to operating room scheduling. In 2010, Barnett et al41 compared costs between robotic, laparoscopic, and laparotomy approaches in endometrial cancer. They calculated costs in 2 separate methods, including societal and hospital perspective models. In the societal perspective model, the least costly approach was laparoscopy ($10,128/case), followed by robotic-assisted surgery ($11,467/case) and laparotomy ($12,847/case).41 Utilizing a hospital perspective model, the least costly approach was laparoscopy ($6,581/case), followed by laparotomy ($7,009/case) and robotic-assisted surgery ($8,770/case).41 Venkat et al42 and Bell et al43 both showed that hospital charges were increased when using robotic assistance compared with traditional laparoscopy; however, hospital costs were not equitable across all of the institutions.

In a cost analysis from Memorial Sloan Kettering Cancer Center (New York), Leitao et al44 examined direct costs for 436 patients, including 132 planned laparoscopic, 262 planned robotic-assisted, and 42 planned laparotomy cases for patients with newly diagnosed uterine cancer to assess the direct costs of the 3 surgical modalities. When accounting for the capital purchase and maintenance fees, the mean amortized cost was $3,157 more for robotic-assisted procedures than laparoscopic cases ($p < .05) and $996 less for robotic-assisted procedures than laparotomy cases ($P = .6).44 When the capital costs were excluded, the robotic-assisted procedures were $178 more than laparoscopy, but they were $3,966 less for the robotic-assisted procedures than laparotomy ($P = .03).44 During the 3-year period of the study, the researchers found a 63% reduction in laparotomy rates, an eightfold increase in the use of robotic-assisted procedures, and a 62% decrease in traditional laparoscopy cases.44 This shift in case selection resulted in an increased cost of $940 per patient presenting with endometrial cancer.44 The modeling performed assumed no change in the traditional laparoscopy rates, which would have resulted in a decreased cost of $418 per patient with endometrial cancer.44 Thus, the authors concluded that the cost of robotics simply comparing successfully completed robotic-assisted procedures with laparoscopy.44

Lau et al45 reported on the effect of incorporating a robotic-assisted surgical program for women with uterine cancer on patient outcomes and cost. After introducing a robotic-assisted surgical approach, 143 patients who underwent robotic-assisted procedures were compared with 160 patients (133 laparotomy cases, 27 traditional laparoscopy cases) who received treatment prior to the robotic-assisted era.45 The rate of minimally invasive surgery improved to 98% (from 17%) in 2 years by introducing the robot, complications decreased from 42% to 13%, and mean cost decreased (and included the amortization of the robot).45 Both a lower complication rate and a shorter length of hospital stay were thought to contribute to this cost savings, even after the authors accounted for the acquisition and maintenance costs of the robot.45

Reynisson and Persson46 analyzed total hospital costs, including initial capital investment, with a depreciation time of 7 years, in a cohort of 180 consecutive cases of robotic-assisted radical hysterectomies with pelvic lymphadenectomy and compared these with a control group of 51 cases of open radical hysterectomies with pelvic lymphadenectomy. The robotic-assisted cohort was chronologically divided into smaller groups of 30 to investigate changes over time as experience was gained.46 A break-even point was identified after 90 robotic-assisted cases.46 Over time, the savings was mostly due to improved opera-
itive time (406 minutes for the first 30 robotic-assisted cases vs 288 minutes for the last 30 robotic-assisted cases), decreased length of stay (5.5 days for the first 30 robotic-assisted cases vs 3.5 days for the last 30 robotic-assisted cases), and decreased numbers of robotic instruments used (5 for the first 30 robotic-assisted cases vs 4 for the last 30 robotic-assisted cases). Robotic-assisted radical hysterectomy and pelvic lymphadenectomy can be performed without increasing hospital costs compared with traditional open technique after an initial learning curve.

Comparing robotic-assisted surgery with laparoscopic surgery is likely to show an increased cost associated with the use of robotics, but such an analysis does not capture the entire clinical situation. The robotic-assisted surgery platform increases the use of minimally invasive surgery, and it is likely that many patients undergoing robotic-assisted surgery today would not be offered traditional laparoscopic surgery. As evidenced by the Lau et al study, the robotic surgical system has made a dramatic impact on minimally invasive surgery in a relatively short period of time. The intent of robotic-assisted surgery should not be to replace traditional laparoscopic surgery but rather to allow more surgeons to offer minimally invasive surgery to more patients.

Impact on Training Residents and Fellows
Another criticism of the robotic-assisted surgery platform is that it takes a 2-trainee case (laparoscopic hysterectomy) and turns it into a 1-trainee procedure (robotic-assisted). Other critics suggest that robotic-assisted surgery has been a root cause of the rapid decline in vaginal hysterectomies in training programs. No consensus exists on how many robotic-assisted procedures during a fellowship or residency a trainee must complete to be deemed competent upon graduation. However, some institutions have incorporated skill exercises and protocols for robotic-assisted training.

Sandadi et al showed that the learning curve associated with robotic-assisted hysterectomy required a completion of 33 cases by a fellow after an initial experience of 16 cases. They suggest that 50 cases are required during a fellowship to competently perform robotic-assisted hysterectomy. Soliman et al showed that fellows can achieve comparable outcomes to faculty, including time and LN counts, after robotic-assisted surgery is incorporated into a fellowship program. In 2009, Brenot and Goyert showed that, after the introduction of robotic-assisted surgery into a residency program, an immediate and statistically significant decrease was seen in both laparoscopic-assisted vaginal hysterectomies and total abdominal hysterectomies.

Robotic-assisted surgery has had many positive impacts in both benign gynecology and gynecological oncology. The impact on surgical training in residency programs is difficult to measure, but it is likely that residents will finish training with less experience with open and traditional laparoscopy, and the impact of this changing tide is unknown.

Conclusions
Traditional laparoscopic hysterectomies make up a small percentage of all hysterectomies performed in the United States and the rest of the world, even though the technology has been available for nearly 40 years. Robotic-assisted surgery has overcome many of the limitations of traditional laparoscopy and has had a direct and measurable impact on the utilization of minimally invasive approaches. Patients with endometrial cancer have seen the largest benefit from the introduction of robotic-assisted surgery, because these patients are typically obese and have a high complication rate from laparotomy; in addition, they are not appropriate candidates for traditional laparoscopy due to the limited range of motion and poor visualization related to their body habitus. Thus, robotic technology allows these high-risk patients the ability to have minimally invasive surgery, resulting in quicker recovery times and less morbidity than other traditional methods.

Although concerns about the cost of robotics remain and may potentially deter some hospitals, institutions, or health care professionals from offering this modality, potential exists for cost savings over laparotomy if the robotic surgical system is adequately utilized to make up for its initial cost and maintenance. The robotic surgical systems used in gynecological oncology are not meant to replace laparoscopy but rather to give patients who would otherwise undergo laparotomy the option of a minimally invasive approach. The financial analysis of the impact of robotics in gynecological oncology will vary between hospitals and, thus, needs must be individualized. Many factors must be considered, including all the various services using the robot (eg, urology, thoracic, gastrointestinal, head and neck). A financial analysis must include all the different types of cases that will be performed using robotic assistance, the relative impact on length of hospital stay, payer mix, and volumes. Perhaps avoiding robotic-assisted surgery for simple procedures in thin and healthy patients with no prior history of surgery may help control costs. It may also be possible to optimally develop a robotics program in gynecological oncology that is fiscally responsible, thus offering significant benefit to patients with gynecological malignancy.

References