

Clinical Benefits Promote Positive Economic Value of *da Vinci*® Surgery in Gynecology

INTRODUCTION

Eleven years after the introduction of *da Vinci* Surgery for gynecology there are still reservations regarding the cost effectiveness of the technology, despite reports of positive clinical benefits. A number of publications have concluded that *da Vinci* Surgery is expensive for gynecologic procedures. Most recently an editorial summarized many of these cost publications.¹ The editorial indicated that using the *da Vinci* System for benign hysterectomy is “costly” and provided no advantage over standard laparoscopic technique.

The rate of minimally invasive surgery (MIS) has increased and the rate of open surgery has decreased since the introduction of *da Vinci* Surgery for gynecological procedures in 2005.^{2,3} A 2013 study found that gynecology programs that included robotic surgery had a lower open rate (35.1%) for benign hysterectomy compared to programs that did not include robotic surgery (44.3%).² The authors attributed this result to observations that robotic surgery may allow for the completion of more technically demanding cases that would otherwise have required laparotomy. In addition, robotic surgery has demonstrated fewer complications in a patient population that has more comorbidities; there is a lower conversion rate compared to laparoscopy.^{3,4,5} In a more recent study of high-volume surgeons, robotic-assisted hysterectomy patients generally represented more complex cases; the patients were older, had higher rates of adhesive disease, and had higher rates of large uteri than

patients in other cohorts. Despite increased case complexity, there was no difference in conversion rate between robotic and laparoscopic approaches when performed by highly experienced surgeons.⁶

The clinical benefits with the use of *da Vinci* Surgery for gynecologic procedures may subsequently give rise to cost savings benefits. In a study by Martino et al (2014), it was demonstrated that women undergoing robotic-assisted benign hysterectomy had a significantly lower chance of readmission at <30 days compared to those undergoing laparoscopic, vaginal, and open hysterectomies; a significant cost savings related to readmissions was identified in the robotic group when compared to non-robotic approaches.⁷ Similarly, two other studies found significantly lower rates of readmission at <30 days for the robotic cohort compared to the open hysterectomy cohort; the rates were comparable with the rates from other minimally invasive approaches.^{6,8} Other reports have shown how robotic-assisted surgery for endometrial cancer improved surgical outcomes and contributed to the cost-effectiveness of robotically assisted procedures for endometrial cancer by decreasing the rate of laparotomy.^{9,10} In summary, the cost of robotics must take into account the total cost of care and how robotic-assisted surgery affects the rate of laparotomy to provide the benefits of minimally invasive surgery without increasing costs.^{9,10}

INTRODUCTION CONT.

Other benefits should also be taken into account. For example, in a survey of 6,262 women who underwent a robotic-assisted hysterectomy, the majority (53%) returned to work within four weeks.¹¹ Early return to work may lead to fewer days of lost work productivity and an overall societal benefit.

It becomes clear that in a discussion of the cost-effectiveness of *da Vinci* Surgery, a comprehensive cost assessment should include an evaluation of

how clinical and societal outcomes contribute to the health economics for robotic surgery. Total cost of a patient's care includes not only instrumentation costs, but also the costs based on factors such as length of hospital stay, operating room (OR) time, conversions, complications, discharge facility/status, readmissions, and reoperation. There are also societal cost savings to consider based on the patient's quicker return to normal activities.

The following data presented for Dr. Shultz and Dr. Jain reflect individual surgeon experiences; the data were not collected under formalized study, were not peer reviewed, and were not published. Data based on individual surgeon experiences may or may not be reproducible and are not generalizable. The data are not case-matched for patient complexity and/or disease status and may not be comparable across surgical modalities. As such, these data should be considered as informational only and are not conclusive.



Dr. Thomas Shultz
Cox Health Systems
Springfield, MO



Dr. Meena Jain
HCA West Florida
St. Petersburg, FL

EVALUATING CLINICAL OUTCOMES

Two gynecologic surgeons assessed the value they bring to their patients and their hospitals by choosing minimally invasive benign hysterectomy performed with the *da Vinci* System. In the hands of these two surgeons, *da Vinci* Surgery for benign hysterectomy has superior clinical benefits to traditional laparoscopic and open approaches.

The first surgeon, Dr. Thomas Shultz, is located in Springfield, MO and is part of Cox Health Systems. He evaluated his own data for length of stay (LOS), readmission, and uterine size. "We knew we had to measure our outcomes. Importantly, we had to look at those cases that would have been done open [but

instead were] completed minimally invasive with robotic surgery," he said. Dr. Shultz then compared his data with data from the gynecologic surgery service line within Cox Health Systems.

In Dr. Shultz's experience, his LOS outcome is almost a full day less than LOS achieved with laparoscopic and vaginal approaches; furthermore, his LOS is 1/6 the duration of LOS achieved by his colleagues who choose an open approach (**Table 1**, page 3). Dr. Shultz combines robotic surgery with a multi-modal analgesia approach (MMA), which enables him to discharge his patients from the hospital within three hours after discharge from the post-anesthesia care

EVALUATING CLINICAL OUTCOMES CONT.

OUTCOME	ROBOTIC WITH MMA (DR. SHULTZ) N=283	ROBOTIC WITH MMA (TOTAL) N=561	ROBOTIC N=866	LAPAROSCOPIC N=223	VAGINAL N=224	OPEN N=334
LOS (days)	0.49	0.52	0.95	1.3	1.5	3.1
Readmission <30 days (%)	1.06	2.32	3.58	7.62	7.59	8.98
Uterine weight >250 g (%)	15.19	12.30	12.82	11.21	2.68	26.95
Average uterine weight >250 g (g)	477	436	414	362	326	748

TABLE 1. DR. SHULTZ & COX HEALTH SYSTEMS - CLINICAL BENEFITS OF ROBOTIC SURGERY FOR BENIGN HYSTERECTOMY.
Comparison of Dr. Shultz's data with peers' data at Cox Health Systems (2013–2015).

unit. (MMA is the use of more than one pain-control modality to obtain additive, or even synergistic, beneficial analgesic effects while reducing opioid-related side effects.) This approach decreases his overall LOS compared to the LOS of his colleagues who don't use MMA and/or a robotic approach. In addition, the use of a robotic approach with MMA for benign hysterectomy allowed Dr. Shultz and his robotic colleagues to have far fewer readmissions than their laparoscopic, vaginal, and open counterparts.

As would be expected, the highest proportion of uteri >250 grams (26.95%) were addressed by an open approach. However, Dr. Shultz was able to provide a minimally invasive robotic approach to a higher percentage of patients with large uteri (15.19%) than what could be achieved by other minimally invasive approaches at his institution. The higher proportion of large uteri removed robotically could potentially reduce LOS duration and readmissions.

The second surgeon, Dr. Meena Jain, is located in St. Petersburg, FL and operates out of St. Petersburg General Hospital, a Hospital Corporation of America (HCA) facility. Like Dr. Shultz, Dr. Jain uses MMA, but does so in conjunction with her own "Jain technique" for docking, port placement, and instrument selection.* She has done approximately 1,500 cases with this technique.

Dr. Jain evaluated her robotic data for OR time, conversions, complications, and length of stay. She then benchmarked her results to the published results of two studies. For OR time, conversions, and complications, Dr. Jain consulted a published review of 289,875 abdominal, vaginal, laparoscopic, or robotic benign hysterectomy cases from 156 US hospitals found in the Premier Research Database.³ As this database only accounts for inpatient LOS, Dr. Jain compared her LOS result to LOS data published in a retrospective review of 1,474 consecutive benign hysterectomy cases from 2003 to 2008; this review included both inpatient and outpatient LOS.⁴

Long OR times are often associated with the use of robotic surgery; this phenomenon was seen in the robotic cohort data (3.39 hours) in the published review.³ The same publication did note, however, that surgery time decreased with progressive experience. Dr. Jain, a highly experienced robotic surgeon, has a shorter OR time using a robotic approach than the OR times of both laparoscopic and open approaches reported in the published review (Table 2, page 4). "There is a misconception that robotic cases are longer in duration and require a longer setup compared to laparoscopic cases. In my experience, robotic cases are faster than laparoscopy. It takes us 2 minutes to do docking and the turnover between cases is less than 25 minutes," Dr. Jain said.

*Jain M. Making Robotic Surgery Easier and Safer: A Clinical Review. World Journal of Laparoscopic Surgery with DVD. 2012;5:67-71. doi:10.5005/jp-journals-10007-1152. Dr. Jain's technique reflects her individual surgeon experience that may or may not be reproducible. Dr. Jain's technique is not validated by Intuitive Surgical.

OUTCOME	OPEN (LUCIANO ET AL) ³ N=138,311	LAPAROSCOPIC (LUCIANO ET AL) ³ N=78,148	ROBOTIC (DR. JAIN) N=1,094
OR time (min)	148	164	90
Conversions (%)	NA	7.2	0.3
Complications (%)	28.9	18.6	5.0

TABLE 2. DR. JAIN - CLINICAL BENEFITS OF ROBOTIC SURGERY FOR BENIGN HYSTERECTOMY.
Comparison of Dr. Jain's data with peer-reviewed, published data.³

"There is a misconception that robotic cases are longer... In my experience, robotic cases are faster than laparoscopy."

Dr. Meena Jain

Conversion rate is another important clinical indicator for MIS. Using *da Vinci* Surgery, Dr. Jain has seen a low conversion rate for her patients (0.3%) when benchmarked to the national conversion rate for laparoscopy (7.2%)—the difference between rates is almost 7%.³ Out of every 100 patients undergoing a laparoscopic procedure, 7 patients will be opened. In contrast, 0-1 of patients undergoing robotic surgery by an experienced robotic surgeon like Dr. Jain will end up with an open incision.

Finally, Dr. Jain observed a low complication rate (5%; **Table 2**) and a short LOS (0.5 days; **Table 3**) in her cases; these benefits could allow hospitals to turn over their beds quickly because patients could potentially return home sooner than the open and laparoscopic cohorts.⁴

"I do believe that my technique utilizing the da Vinci Surgical System is the reason why my OR time, conversion rate, and complication rate are as low as they are."

Dr. Meena Jain

OUTCOME	OPEN (LANDEEN ET AL) ⁴ N=274	LAPAROSCOPIC (LANDEEN ET AL) ⁴ N=230	ROBOTIC (DR. JAIN) N=1,094
LOS (days)	2.7	1.8	0.5

TABLE 3. DR. JAIN - LOS OUTCOME OF ROBOTIC SURGERY FOR BENIGN HYSTERECTOMY.
Comparison of Dr. Jain's data with peer-reviewed, published data.⁷

TRANSLATING IMPROVED BENEFITS TO ECONOMIC VALUE

The clinical benefits with the use of *da Vinci* Surgery for gynecologic procedures can be subsequently translated to tangible cost savings.

For each clinical benefit, there is an associated cost. National cost average data suggests the average bed day costs \$1,553¹², a conversion costs \$3,162¹³, complications cost \$3,632¹⁴, OR room time costs \$11 per minute¹⁵, and readmissions cost \$11,087¹⁶. These national cost averages were reviewed and validated by an independent third-party consulting firm.¹⁷ Individual hospital figures undoubtedly vary from these national averages, but these data are as accurate as possible for a nationwide sample.

Dr. Shultz used these cost averages to evaluate the economics of *da Vinci* Surgery within Cox Health Systems. By employing a robotic surgical approach with the *da Vinci* Surgical System, in conjunction with MMA, Dr. Shultz recognized a potential cost avoidance of \$1,258 to \$4,053 due to reduced LOS, and a potential cost savings of \$724 to \$878 due to fewer readmissions (Table 4). Even with the higher instrumentation costs for robotic surgery, Dr. Shultz estimates there is a combined cost savings of \$1,430 to \$4,138 per procedure. He remarked, “My *da Vinci* approach coupled with a MMA protocol may not

reflect line-item savings in the OR or pharmacy,[†] but that doesn’t mean that the health system didn’t save money. It’s much harder to measure those savings when they are reflected in [benefits such as]... earlier return-to-normal activity for the patient. The savings may show up outside of the areas where typical surgery costs are measured.”

“My da Vinci approach ... may not reflect line-item savings in the OR or pharmacy, but that doesn’t mean that the health system didn’t save money. The savings may show up outside of the areas where typical surgery costs are measured.”

Dr. Thomas Shultz

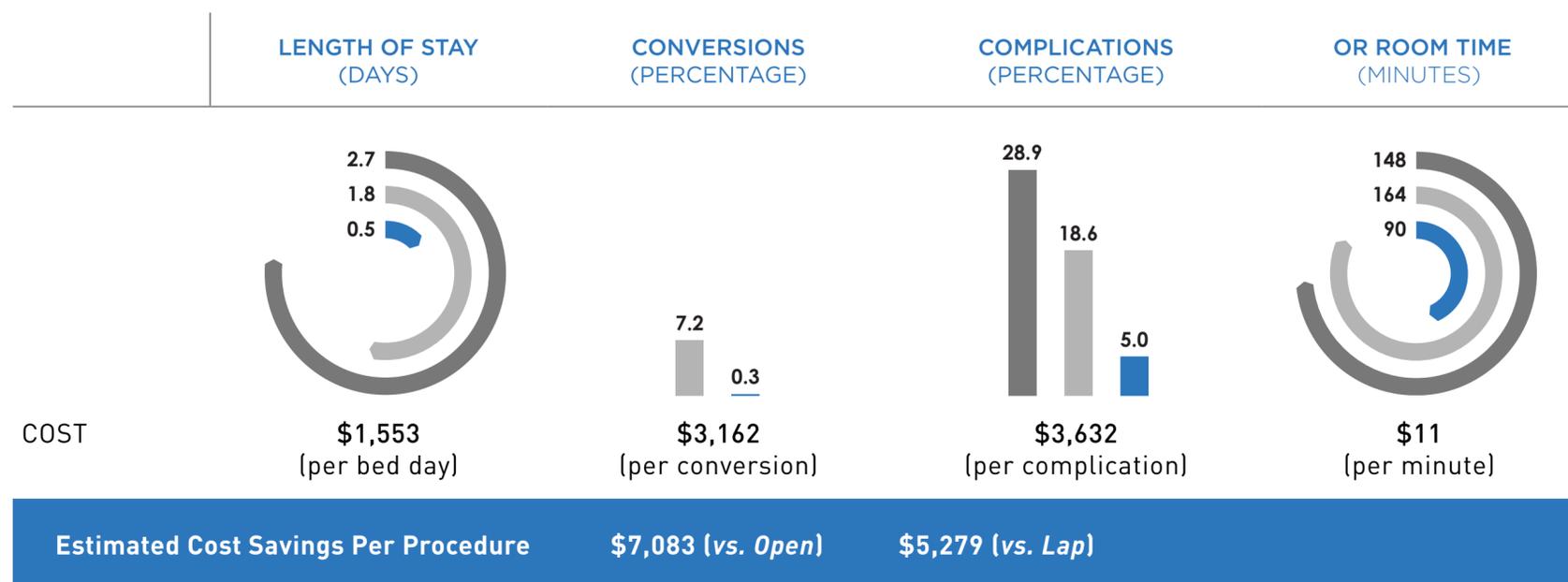
Similarly, Dr. Jain translated her clinical benefits to associated costs and also found potential cost savings per robotic procedure when compared to the translated costs based on published data for OR time, conversions, and complications;³ she also discovered a potential cost avoidance due to reduced LOS when compared to published data.⁴ The estimated cost savings per procedure were \$5,279 compared to a laparoscopic approach and \$7,083 compared to an open approach (Fig. 5, page 6).

	VS. LAP	VS. VAGINAL	VS. OPEN
Instrument cost savings	(\$488)	(\$863)	(\$793)
Readmission cost savings	\$727	\$724	\$878
LOS cost savings	\$1,258	\$1,569	\$4,053
Combined cost savings per procedure	\$1,497	\$1,430	\$4,138

TABLE 4. DR. SHULTZ & COX HEALTH SYSTEMS - COMBINED POTENTIAL COST SAVINGS OF ROBOTIC BENIGN HYSTERECTOMY.
Comparison of Dr. Shultz’s data with other surgical approaches at Cox Health Systems (2013 – 2015), using national cost average data.¹²⁻¹⁶

[†] The MMA drugs add approximately \$154 to the hospital costs.

TRANSLATING IMPROVED OUTCOMES TO COST SAVINGS CONT.



- OPEN (Luciano et al)³ • N=138,311
- LAP (Luciano et al)³ • N=78,148
- DA VINCI (DR. JAIN) • N=1,094

FIG. 5. DR. JAIN - POTENTIAL COST OFFSETS FROM DA VINCI BENIGN HYSTERECTOMY.
Comparison of Dr. Jain's data with peer-reviewed, published data,³ using national cost average data.¹²⁻¹⁶

INCLUDING LEAVE-OF-ABSENCE SAVINGS

Dr. Shultz was able to take his investigation a step further. Many of the Cox Health Systems patients who underwent a hysterectomy were also Cox Health employees. Dr. Shultz, therefore, had access to and could evaluate leave of absence (LOA) data and translate the results into cost savings to the health system. In addition to the potential cost savings per procedure, he found that patients who had a *da Vinci* hysterectomy with MMA returned to work sooner than patients who underwent all approaches to benign hysterectomy without MMA. Light duty employees returned to work 15.2 days sooner and non-light duty employees returned to work 5.7 days sooner (**Table 6**).[‡] The reduction in LOA time resulted

in a \$92,478 savings for Cox Health Systems. "By using our hospital employee database we were able to take a close look at the return-to-work differences between modality and the use of MMA. The savings that were reflected to the health system showed up in human resources [costs], not surgery costs," Dr. Shultz explained.

"...We were able to take a close look at the return-to-work differences... The savings... showed up in human resources [costs], not surgery costs."

Dr. Thomas Shultz

	RETURN TO WORK			LOA COST SAVINGS (DOLLARS)
	DA VINCI WITH MMA (MEAN, DAYS)	ALL APPROACHES WITHOUT MMA (MEAN, DAYS)	LOA TIME SAVINGS (DAYS)	
Non-light Duty Employees	42.2	48.1	5.7	\$92,748
Light Duty Employees	28.0	43.2	15.2	

TABLE 6. IMPACT OF ROBOTIC SURGERY ON EMPLOYER LOA SAVINGS.
Comparison of LOA data from Cox Health Systems employees who underwent a *da Vinci* hysterectomy with MMA and those who underwent all approaches to benign hysterectomy without MMA.

[‡] Employees classified as light duty do not lift items ≥10 pounds. Employees classified as non-light duty may lift items ≥10 pounds.

REIMBURSEMENT CHANGES AND A SHIFT TO OUTPATIENT SURGERIES

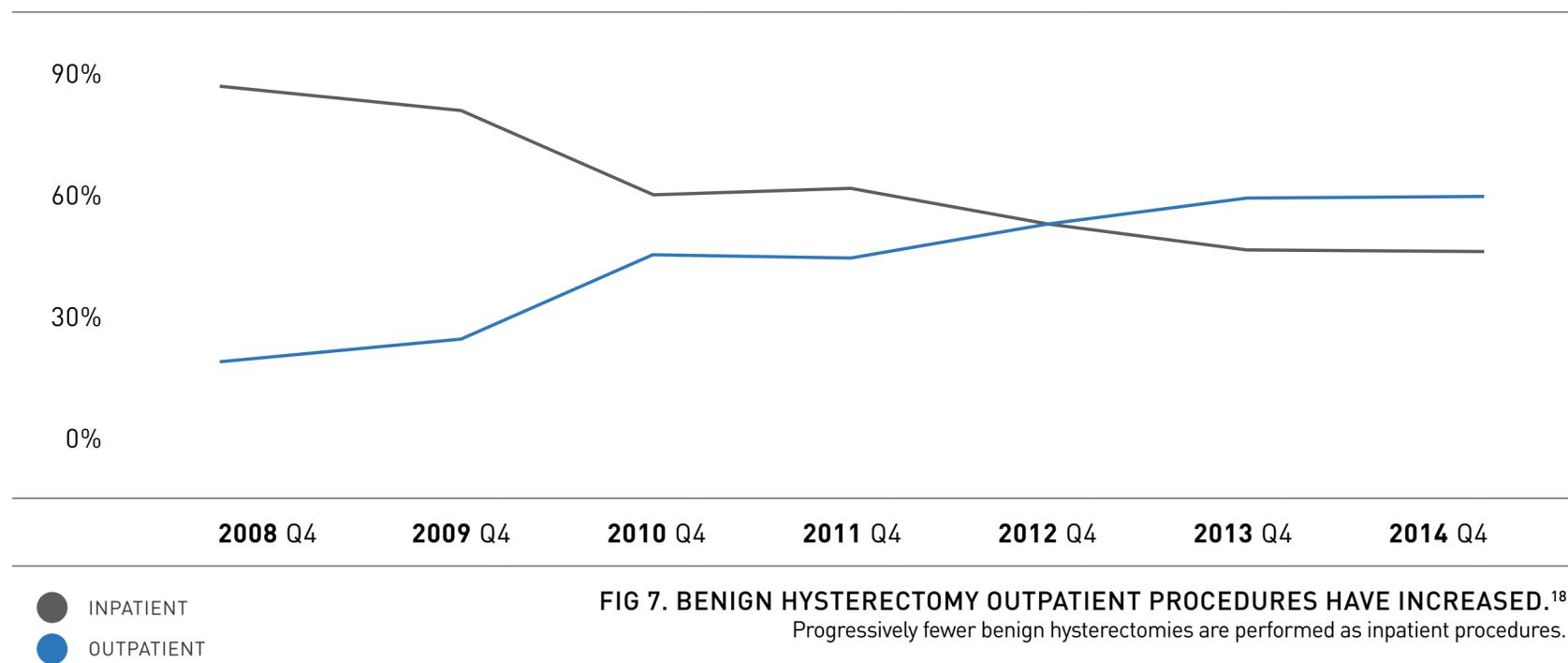
Over the past few years there has been an increasing trend of benign hysterectomy procedures performed as outpatient surgery (Fig. 7).¹⁸ Dr. Jain performs 75% of her benign hysterectomy cases in the outpatient setting and Dr. Shultz routinely discharges his patients after three hours in the post-anesthesia care unit.

Coincidentally, the Center for Medicare & Medicaid Services (CMS) increased 2016 reimbursement rates up to 82% for most minimally invasive gynecology outpatient procedures (Fig. 8).¹⁹ It is anticipated that most private payor payments will adjust accordingly. Similar to the national cost average data mentioned in this paper, individual hospital reimbursement

may vary from the national average CMS outpatient reimbursement.

Given these increases in outpatient reimbursement, the national outpatient payment for minimally invasive gynecologic surgery can exceed the national inpatient payment for open procedures.[§]

The higher reimbursement rates, along with the potential cost savings illustrated in this paper, may further improve the financial health of minimally invasive surgery, including *da Vinci* gynecologic surgery programs that include outpatient surgery.



CPT		2015	2016	
57425	Colpopexy	\$3,779	\$6,861	▲ 82%
58546	Complex Myomectomy			
58553	Complex Vaginal Hysterectomy			
58552/58554	Simple/Complex Vaginal Hysterectomy with Adnexa			
58570/58572	Simple/Complex Total Hysterectomy			
58571/58573	Simple/Complex Total Hysterectomy with Adnexa			
58545	Simple Myomectomy	\$3,017	\$4,001	▲ 33%
58550	Simple Vaginal Hysterectomy	\$5,479	\$4,001	▼ 27%

FIG. 8. INCREASED 2016 CMS REIMBURSEMENT RATES FOR MOST MINIMALLY INVASIVE GYNECOLOGY OUTPATIENT PROCEDURES.¹⁹ These rates may further improve the financial health of minimally invasive surgery, including *da Vinci* gynecologic surgery programs that include outpatient surgery.

§ From an Intuitive Surgical analysis of the Premier database, >70% of inpatient hysterectomies are billed under DRG 743.

SUMMARY

The data presented for Dr. Shultz and Dr. Jain reflect individual surgeon experiences; the data were not collected under formalized study, were not peer reviewed, and were not published. Data based on individual surgeon experiences may or may not be reproducible and are not generalizable. The data are not case-matched for patient complexity and/or disease status and may not be comparable across surgical modalities. As such, these data should be considered as informational only and are not conclusive.

For Dr. Shultz and Dr. Jain, using the *da Vinci* Surgical System for benign hysterectomy has provided clinical benefits for their patients and a cost-effective option in their respective practices. With potential cost savings ranging from \$1,430 to over \$7,000 per procedure and economic benefits seen from a shorter leave of absence, the robotic approach to benign hysterectomy is not only valid, but to be commended. Dr. Shultz's and Dr. Jain's data provide evidence, based on their experiences, that robotic surgery is not too costly and may even show cost savings compared to laparoscopic, vaginal, and open approaches to benign hysterectomy. In addition, the shift of MIS for benign hysterectomy to outpatient surgery coupled with increased CMS reimbursement rates for common outpatient gynecologic procedures further refute the idea that robotic surgery with the *da Vinci* Surgical System is detrimental to the financial health of gynecologic surgery programs.

The immediate assumption that *da Vinci* Surgery for benign hysterectomy costs too much should not be accepted at face value. The overall cost of a procedure depends on identifying cost efficiencies. Cost savings can stem from clinical benefits and improved quality of life. The experiences of Dr. Shultz and Dr. Jain show that robotic surgeons can translate their own clinical benefits to cost savings within their practices and for their hospitals.

"It is up to the physician to play a role in evaluating the metrics and outcomes."

Dr. Thomas Shultz

It is possible for a robotic surgeon to have a discussion on the cost-effectiveness of *da Vinci* Surgery for benign hysterectomy. Start evaluating your own clinical data and realize the clinical and economic benefits you bring to your hospital and patients.

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IMPORTANT SAFETY INFORMATION

Risks for benign hysterectomy include urinary tract injury, vaginal cuff problem (separation, adhesions, granulation tissue, infection, cellulitis, hematoma), bladder injury, bowel injury, vaginal tear or laceration, vaginal shortening, voiding dysfunction, and fistula formation: vesicovaginal, rectovaginal. Uterine tissue may contain unsuspected cancer. The cutting or morcellation of uterine tissue during surgery may spread cancer, and decrease the long-term survival of patients.

Serious complications may occur in any surgery, including *da Vinci*® Surgery, up to and including death. Examples of serious or life-threatening complications, which may require prolonged and/or unexpected hospitalization and/or reoperation, include but are not limited to one or more of the following: injury to tissues/organs, bleeding, infection and internal scarring that can cause long-lasting dysfunction/pain. Individual surgical results may vary.

Risks specific to minimally invasive surgery, including *da Vinci*® Surgery, include but are not limited to, one or more of the following: temporary pain/nerve injury associated with positioning; a longer operative time, the need to convert to an open approach, or the need for additional or larger incision sites. Converting the procedure could result in a longer operative time, a longer time under anesthesia, and could lead to increased complications. Contraindications applicable to the use of conventional endoscopic instruments also apply to the use of all *da Vinci* instruments. You should discuss your surgical experience and review these and all risks with your patients, including the

potential for human error and equipment failure. Physicians should review all available information. Clinical studies are available through the National Library of Medicine at www.ncbi.nlm.nih.gov/pubmed.

Be sure to read and understand all information in the applicable user manuals, including full cautions and warnings, before using *da Vinci* products. Failure to properly follow all instructions may lead to injury and result in improper functioning of the device. Training provided by Intuitive Surgical is limited to the use of its products and does not replace the necessary medical training and experience required to perform surgery. Procedure descriptions are developed with, reviewed and approved by independent surgeons. Other surgical techniques may be documented in publications available at the National Library of Medicine. For Important Safety Information, indications for use, risks, full cautions and warnings, please also refer to www.davincisurgery.com/safety and www.intuitivesurgical.com/safety. Unless otherwise noted, products featured are available for commercial distribution in the U.S. For availability outside the U.S., please check with your local representative or distributor.

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