

# Healthcare and Indirect Cost of the Laparoscopic vs. Vaginal Approach in Benign Hysterectomy

María Ángeles Martínez-Maestre, MD, PhD, Francisco Jódar-Sánchez, PhD,  
Ana María Calderón-Cabrera, PhD, MD, Carmen González-Cejudo, MD, PhD,  
José Manuel Silván-Alfaro, MD, PhD, Lidia María Melero-Cortés, MD, PhD

## ABSTRACT

**Background and Objectives:** The aim of this study was to analyze indirect costs of vaginal and laparoscopic routes for hysterectomy to determine whether this makes a difference in total costs when considering route for surgery.

**Methods:** A five-year observational retrospective cohort study was conducted in an academic tertiary care center. A total of 517 patients scheduled for total laparoscopic hysterectomy (n = 137) and vaginal hysterectomy (n = 380) for benign conditions between January 1, 2008 and December 31, 2012 meeting inclusion criteria were reviewed.

**Results:** Indirect costs were higher in the vaginal hysterectomy group compared to the laparoscopic hysterectomy group (mean cost €3,239.86 vs. €1,371.58; cost increase of €1,868.28;  $p < .001$ ). Indirect costs due to lost-work-productivity were the most important, represented by 97.7% in the vaginal group and 93.6% in the laparoscopic group.

**Conclusion:** Among women undergoing hysterectomy for benign disease, laparoscopic hysterectomy appears to be superior to vaginal hysterectomy when indirect costs are

analyzed in a five-year temporal horizon. Laparoscopic hysterectomy is a good alternative to vaginal hysterectomy when technically feasible as both present comparable advantages. The surgical approach to hysterectomy should be decided in light of the relative benefits and hazards, which will depend on clinical circumstances and surgical expertise.

**Key Words:** Gynecologic Diseases, Health Care Costs, Indirect Expenditures, Laparoscopic Surgery, Vaginal Hysterectomy.

## INTRODUCTION

Currently in gynecological surgery, it is recommended to use vaginal hysterectomy when feasible, for benign pathology.<sup>1-9</sup>

Total laparoscopic hysterectomy (LH) is a technique with a longer learning curve but with minimally invasive surgery advantages including reduced invasiveness, shorter hospital stay, faster postoperative recovery, greater precision of surgical maneuvers, and less blood loss.<sup>10</sup> It also provides a better vision of anatomical spaces, permits the surgeon to perform simultaneous pelvic and abdominal surgeries, and allows the surgeon to operate large and nonprolapsed uteri. This is probably why as experience with LH increased, gynecologists began to indicate preference for LH instead of vaginal hysterectomy (VH) in benign pathology.<sup>11</sup>

Based on numerous studies assessing the effectiveness and safety of different surgical approaches to hysterectomies for benign gynecological conditions, it has been recommended that when feasible VH may be considered the surgical route of choice.<sup>5</sup> Besides the advantage that VH can be performed under regional anesthesia, and no manipulation is performed in the intra-abdominal cavity, vaginal approach had also been supported by the conviction that operation costs are reduced.<sup>12</sup>

In the last decade there has been an increased interest in comparing different surgical approaches of hysterectomies, in regard to efficiency and cost-effectiveness. Most

Department of Gynecology, Virgen del Rocío University Hospital, Seville, Spain. (Drs. Martínez-Maestre, Calderón-Cabrera, González-Cejudo, Silván-Alfaro, Melero-Cortés).

Department of Statistics and Econometrics, University of Málaga, Málaga, Spain. (Dr. Jódar-Sánchez).

Drs. María Ángeles Martínez-Maestre and Francisco Jódar-Sánchez contributed equally to the manuscript.

Conflict of interests: none.

Disclosure: none.

Funding sources: none.

Informed consent: Dr. Ana María Calderón-Cabrera declares that written informed consent was obtained from the patient/s for publication of this study/report and any accompanying images.

Address correspondence to: Dr. Ana María Calderón-Cabrera, Department of Gynecology, Virgen del Rocío University Hospital, Avda. Manuel Siurot S/N. ES-41013, Seville, Spain, Telephone: +34 955012806, Fax: +34 955012704, E-mail: amaria.calderon.sspa@juntadeandalucia.es.

DOI: 10.4293/JSLS.2022.00048

© 2022 by SLS, Society of Laparoscopic & Robotic Surgeons. Published by the Society of Laparoscopic & Robotic Surgeons.

studies confirm the superiority of the vaginal and laparoscopic approaches when compared to the abdominal approach in reducing the average length of hospital stay and postoperative outcomes.<sup>5,6,13,14</sup> However, there is a lack of evidence comparing vaginal and laparoscopic approaches. Furthermore, in the most conclusive studies the recommendations for deciding on what is the best approach are based on health outcomes and healthcare costs without taking into account indirect costs, which should be an important fact for decision making.<sup>2,3,15</sup>

To our knowledge, this study represents the most expansive analysis of costs associated with LH and VH for benign disease. Most comparative studies on hysterectomy are based on hospitalization cost<sup>8,16,17</sup> and the most important contribution of this study is the consideration of the indirect cost mainly represented by transport and lost-work-productivity costs. We aim to determine if the indirect cost impact, added to the traditional healthcare cost analysis, changes the consideration of vaginal approach as the surgical route of choice for benign hysterectomy.

## METHODOLOGY

### Study Design

A five-year observational retrospective cohort study was conducted. The methodology of this study is based on a previous study published by Martínez-Maestre et al.<sup>18</sup> in 2019, adapted for this analysis and detailed in this section.

### Study Population

This study was carried out at Virgen del Rocio University Hospital, Spain between January 1, 2008 and December 31, 2012. All vaginal and laparoscopic total hysterectomies were identified from the medical records. From these, we excluded circumstances that influence the preference toward a particular surgical route, as patients with suspected malignancy, adnexal masses of size  $\geq 7$  cm, or pelvic or abdominal adhesions that contraindicates the vaginal or laparoscopic route. The inclusion criteria were patients with uterine size  $< 16$  cm on transvaginal ultrasound.

### Surgical Procedures

Laparoscopic approach was standardized. We generally prefer to use the Clermont-Ferrand uterine reusable manipulator (Karl Storz Company), except in those patients who have never had intercourse. Pneumoperitoneum was

created using a Veress needle until intraperitoneal pressure reached 15 mm Hg. A reusable bipolar grasper is used instead of a vessel sealer. Colpotomy sutured was performed with intracorporeal knotting.

Vaginal approach was also standardized. Vessel sealers were avoided, so only clamps and suture ligations were used.

All vaginal and laparoscopic procedures were performed by surgeons trained in these techniques.

### Ethics Approval and Consent to Participate

This study respected the ethical standards of the institutional and/or national research committee and the principles established in the 1964 Helsinki Declaration. The protocol was approved by the local ethical committee (ref. 1863-N-21) and informed consent was obtained for each of the study participants.

### Primary Outcome: Indirect Cost

Indirect cost is defined as the expenses incurred from the cessation of work productivity as a result of the morbidity and mortality associated with a given disease. In this study, transport and lost work have been included. Regarding transportation costs, it was assumed that the patient traveled in her own vehicle and the cost was estimated based on the distance from her home to the hospital.<sup>19</sup> Lost-work-productivity was defined by the time they were unable to carry out the patient's work or housework during medical leave, from the time of the intervention until they returned to their usual daily activity. Predetermined time of work allowed was similar for both procedures. This information was obtained from their clinical records and was calculated based upon the labor cost according to the Spanish National Statistics Institute.<sup>20</sup>

### Secondary Outcomes: Health Outcomes and Healthcare Cost

As secondary outcomes we analyzed health outcomes and healthcare costs. Health outcomes included minor and major surgery complications as well as survival rate five years after the primary intervention. Healthcare costs included the consumption of in-patient, out-patient, and pharmaceutical services within the healthcare delivery system. It was estimated in relation to the primary surgery, secondary interventions derived from or associated with the primary one, visits to the emergency department or to

the specialist for gynecological reasons, and the medical material used. Healthcare resources information was obtained from the hospital database. The costs of visits to the emergency department and to the specialist were calculated based on the prices established by the Andalusian Public Health System.<sup>21</sup> Hospitalization costs were calculated using diagnosis-related groups during hospitalization.<sup>22</sup> The cost of the material was calculated based on its market price and in the case of reusable material, the number of uses was taken into account. Disposable materials, sutures, and electric scalpels were used in the vaginal route; trocars, camera sheaths, and monopolar scissors in the laparoscopic route.

### Statistical Analysis

In the descriptive analysis, the mean and standard deviation were calculated for the quantitative variables, and the absolute and relative frequencies were estimated for the qualitative variables. Student t test was used to compare normally distributed quantitative variables and Mann-Whitney test for those variables without normal distribution.  $\chi^2$  test or Fisher's exact test were used to compare qualitative variables.

A per-protocol basis analyses was carried out for both primary and secondary outcomes. Subsequently, to examine the differences between the groups, a bivariate and multivariate analysis were conducted.

## RESULTS

Over the study period, 517 women underwent hysterectomy for benign pathology and fulfilled the inclusion criteria; of these, 380 comprised the vaginal group and 137 the laparoscopic group. **Table 1** shows the baseline characteristics of the study patients in both groups. Patients undergoing VH were older ( $64.05 \pm 9.72$  years vs.  $50.42 \pm 10.41$  years;  $p < .001$ ), had higher body mass index ( $28.88 \pm 5.36$  kg/m<sup>2</sup> vs.  $27.29 \pm 5.32$  kg/m<sup>2</sup>;  $p = .005$ ), and had a higher score on the Charlson Comorbidity Index (CCI) ( $1.08 \pm 1.23$  vs.  $0.49 \pm 0.88$ ;  $p < .001$ ) compared to those with LH.

### Primary Outcome: Indirect Costs

Productivity loss was  $36.34 \pm 17.47$  days and  $14.73 \pm 14.39$  for the VH and LH groups respectively (difference of 21.61 days;  $p < .001$ ). A similar association was observed in productivity loss both following the main

<b>Table 1.</b> Patient Characteristics			
	VH (n = 380)	LH (n = 137)	p-Value
Age (years)	$64.05 \pm 9.72$	$50.42 \pm 10.41$	<.001
CCI	$1.08 \pm 1.23$	$0.49 \pm 0.88$	<.001
BMI (kg/m <sup>2</sup> )*	$28.88 \pm 5.36$	$27.29 \pm 5.32$	.005
Prior abdominal surgery	$0.23 \pm 0.54$	$0.29 \pm 0.61$	.37
Caesarean, n (%)	6 (1.6)	5 (3.6)	.15
Appendectomy, n (%)	35 (9.2)	17 (12.4)	.29
Cholecystectomy, n (%)	28 (7.4)	7 (5.1)	.37
Tubal sterilization, n (%)	5 (1.3)	6 (4.4)	.03
Other, n (%)	14 (3.7)	4 (2.9)	.68

Abbreviations: VH, vaginal hysterectomy; LH, laparoscopic hysterectomy; CCI, Charlson comorbidity index; BMI, Body Mass Index.

\* Missing data.

Data presented as mean  $\pm$  standard deviation or frequencies (%).

surgical intervention:  $33.18 \pm 8.42$  days and  $12.68 \pm 10.07$  days for the VH and LH groups respectively (difference of 20.50 days;  $p < .001$ ), and between secondary surgeries associated with the first one:  $44.44 \pm 12.51$  days and  $20.07 \pm 15.18$  days for the VH and LH groups respectively (difference of 24.37 days;  $p < .001$ ). In the next five years after the main surgery, the mean number of journeys to the hospital was  $6.10 \pm 4.04$  for the VH group and  $8.52 \pm 6.92$  for the LH group ( $p < .001$ ).

Indirect costs were higher in the VH group compared to the LH group (mean cost €3,239.86 vs. €1,371.58; cost increase of €1,868.28;  $p < .001$ ) (**Table 2**). Indirect costs due to lost-work-productivity were the most important, represented by 97.7% in the vaginal group and 93.6% in the laparoscopic group. For both groups, the indirect cost of the first year meant a high percentage of the total (97.5% in the VH group vs. 96.8% in the LH group).

### Secondary Outcomes: Health Outcomes and Healthcare Cost

Higher cumulative incidences were observed for all-type complications in the vaginal surgery group compared to the laparoscopic group: 20.8% vs. 18.2% (relative risk [RR] 1.14; 95% confidence interval [CI], 0.76 – 1.71) for complications associated with their gynecological pathology; 13.2% vs. 11.7% (RR 1.13; 95% CI, 0.66–1.91) for major complications needful of surgery; and 11.6% vs. 8.0% (RR 1.44; 95% CI, 0.77–2.71) for

**Table 2.**  
Indirect Costs

	VH (n = 380)	LH (n = 137)	p-value
Indirect cost (euros)	3,239.86 ± 1,583.11	1,371.58 ± 1,284.63	<.001
Productivity loss (euros)	3,166.12 ± 1,521.62	1,283.27 ± 1,253.59	<.001
Trips to the hospital (euros)	73.74 ± 176.57	88.31 ± 213.75	.48
Distribution by year (euros)			
First year	3,158.41 ± 1,478.01	1,327.76 ± 1,269.93	<.001
Second year	20.79 ± 193.44	8.33 ± 36.36	.23
Third year	5.44 ± 31.61	15.36 ± 114.70	.32
Fourth year	34.64 ± 336.59	5.51 ± 25.33	.10
Fifth year	20.58 ± 261.78	14.62 ± 116.49	.72

Abbreviations: VH, vaginal hysterectomy; LH, laparoscopic hysterectomy.  
Data presented as mean ± standard deviation.

minor complications. Nevertheless, the VH group needed fewer additional surgical interventions (7.1% vs. 10.2% in the LH group;  $p = .25$ ). There were no deaths in either group.

The average length of hospital stay was very similar in both groups:  $3.03 \pm 1.57$  days in the VH group compared to  $2.91 \pm 3.83$  days in the LH;  $p = .73$ ).

In the LH group, we observed a higher mean number of consultations to the emergency department ( $0.18 \pm 0.56$

vs.  $0.53 \pm 0.99$ ;  $p < .001$ ) and to the specialist ( $1.81 \pm 1.62$  vs.  $2.64 \pm 2.97$ ;  $p < .001$ ).

The mean healthcare cost was lower in the VH group compared to the LH group (€5,335.16 vs. €6,660.21; cost increase of €1,325.06;  $p < .001$ ) (**Table 3**). Hospital admissions are the most important component of healthcare cost and represents 90.6% for the VH group and 84.5% for the LH group. For both groups, the healthcare cost of the first year meant a high percentage of the total (97.8% in the VH group vs. 98.3% in the LH group).

**Table 3.**  
Healthcare Costs

	VH (n = 392)	LH (n = 142)	p-value
Healthcare cost (euros)	5,335.16 ± 1,404.78	6,660.21 ± 3,573.60	<.001
Hospital admissions (euros)	4,835.21 ± 641.31	5,630.34 ± 2,019.05	<.001
Emergency Department (euros)	25.43 ± 80.21	75.81 ± 143.26	<.001
Specialized care (euros)	157.84 ± 92.55	203.36 ± 161.98	.002
Hospital readmissions (euros)	277.24 ± 1,121.94	676.17 ± 2,689.25	.09
Material (euros)	39.43 ± 0.00	74.54 ± 0.00	<.001
Distribution by year (euros)			
First year	5,220.38 ± 1,274.85	6,547.36 ± 3,522.88	<.001
Second year	35.59 ± 283.16	24.42 ± 47.69	.46
Third year	10.48 ± 33.24	34.20 ± 170.53	.11
Fourth year	43.86 ± 375.90	22.25 ± 66.53	.28
Fifth year	24.85 ± 262.21	31.99 ± 214.29	.75

Abbreviations: VH, vaginal hysterectomy; LH, laparoscopic hysterectomy.  
Data presented as mean ± standard deviation.

**Table 4.**  
Regression Model for Mean Total Cost

Variable	Coefficients	Standard Error	p-value
Intercept (euros)	7,484.27	151.39	<.001
Major complications (euros)	6,006.44	342.92	<.001
CCI	194.71	97.65	.047

Abbreviations: CCI, Charlson comorbidity index.

Finally, considering indirect and healthcare costs, the mean total cost was higher in the vaginal surgery group compared to the laparoscopic one (€8,575.02 vs. €8,031.79; cost increase of €543.22;  $p = .18$ ). In spite of the difference in mean total cost in both groups and the differences observed in basal features (**Table 1**), predictor variables of the mean total cost are the presence of major surgeries (increase in cost of €6,006.44;  $p < .001$ ), and the CCI (increase in cost of €194.71;  $p < .001$ ) (**Table 4**).

## DISCUSSION

In the last decade there has been an increased interest in comparing different surgical hysterectomy approaches in regard to efficiency and cost-effectiveness,<sup>2,3,15</sup> as the soaring costs of health care will likely play a very important role in decision making. Among the few studies that specifically focus on cost comparisons, most of the authors conclude that surgical approach may be an important factor responsible for final cost.

Although indirect costs are relevant and must be taken into account if we want to know the real cost, most comparative studies are conducted incorporating only hospitalization costs associated with each procedure.<sup>8,16,17</sup> This study carries out a cost analysis of both healthcare costs and indirect costs over five years.

In terms of healthcare outcomes, intraoperative or delayed complications have been considered in most of the studies to determine which method is best for the patient. Most authors assumed that the relevant health outcomes (survival and complications) of both techniques are equal for both procedures.<sup>23</sup> Although minor and major complications in the five years following the original procedure were slightly lower for LH, there were no significant differences. There were no deaths reported in either groups.

The 2015 Cochrane systematic review<sup>5</sup> assessed the effectiveness and safety of different surgical approaches to hysterectomies for women with benign gynecological conditions. These included 47 randomized controlled trials, but only 16 LH versus VH. The authors concluded that there was no evidence of a difference in intraoperative complications, major long-term, and short-term complications. These results align with two systematic reviews and meta-analyses,<sup>15,24</sup> showing the same clinical outcomes but offering some advantages to LH when compared with VH, such as the possibility of abdominal exploration which makes it preferable in patients with suspicion of adhesions, ovarian cysts/mass, and endometriosis.<sup>25</sup>

Although some authors suggest that for hysterectomy in benign conditions VH is still superior to LH regarding the average length of hospital stay,<sup>8,15</sup> most reported no differences.<sup>25–28</sup> In our experience there is a controversial outcome, because although our results show no differences between both groups, predicted hospital discharge is usually shorter for LH (24 h), than for VH (48 h). This result could be explained because in a public hospital such as ours, the average length of hospital stay could be impacted by peculiar circumstances. For example, endoscopic surgeries are performed at the end of the working week, so hospital discharge is generally on weekends where the postsurgical evolution is in charge of the duty team.

We found no studies that considered healthcare costs such as the number of emergency department and specialist consultations. Both were higher among the laparoscopic group, which could be explained because it was a more innovative technique at that time, so it merited closer follow-up on the part of clinicians. On the other hand, VH patients were older which could make more difficult for them to complete the follow-up.

The main limitation of this study could be the difference between both groups, as VH patients were older and consequently with more morbidity associated which may influence the average length of hospital stay. This is because we included every patient who underwent surgery in that period and met the inclusion criteria, which is the best way to simulate the daily real situation. In spite of the differences in both groups, age is not a predictor variable of the mean total cost. This is because major complications, which resulted in being the main factor that justified the increase in cost, had no correlation with age. There was no lineal relation between age and total cost, as major complications did not occur exclusively in older patients.



The major strength of the study is the analysis of indirect cost, especially because both healthcare costs and indirect costs are analyzed in a five-year time horizon. While most comparative studies on hysterectomy are based only on hospitalization costs,<sup>8,16,17</sup> our cost analysis was conducted incorporating indirect costs associated with each procedure.

From a societal perspective, it is possible to account for productivity loss as indirect costs. It considers the time during which the patient is out of work or domestic labor on medical leave, from the date of the procedure until the patient returns to normal activities. Although LH and VH have proved to be superior to abdominal hysterectomy regarding the return to normal activities,<sup>24</sup> there are few studies comparing LH and VH. A meta-analysis, including two studies of 140 patients,<sup>26</sup> showed no advantages of VH over LH regarding the recuperation time. In the current study, the recuperation time was longer for VH than for LH. This fact might be explained due to the higher need for additional surgeries among patients in the VH group because major and minor complications were more frequent in this group. In our experience, there is a positive aspect of LH associated with a reduction in productivity loss, in spite of the number of trips to the hospital, was slightly higher. The most important component of healthcare cost (90.6%), is represented by the cost of the first year which include mostly the expenses related to the surgery.

In general, endoscopic surgery and vaginal surgery achieve the same goal in reducing the need for laparotomy,<sup>6,8,14, 23</sup> but if we try to compare both approaches there are many unknowns to solve. The main reasons why VH is the least costly hysterectomy in most studies, is because the operating time is not prolonged, disposable instruments are not used, and the average length of hospital stay is not long.<sup>3,8</sup> Over the past several decades of endoscopic surgeries, there have been many changes to both techniques. VH has increased the final cost due to the use of disposable supplies, especially for a nonprolapsed uterus. LH has been simplified because of technical developments and surgeon experience, which has reduced both operating time and length of hospital stay.<sup>18,29</sup>

In our experience, LH is advantageous regarding productivity loss with a five-year horizon, which is an important factor for reducing total costs. This may be an important reason why, in the same circumstances, both approaches should be considered equally, especially taking into account that short hospital stay, low complication rate, and minimally invasive approach are attractive features for patients considering hysterectomy.

Most surgeons consider the surgical approach depending on their experience and the presence of clinical conditions that are specific to a certain surgical route as a genital prolapse or the need to perform a concomitant pelvic and abdominal surgery. The cost of the surgical procedure will play an important role only when both routes are equally considered.

## CONCLUSION

To our knowledge, this is the only study that extensively analyzes and compares the costs associated with LH and VH for benign disease.

Among women undergoing hysterectomy for benign condition, LH is associated with a reduction in productivity loss and it appears to have a positive impact compared to VH when indirect costs are analyzed in a five-year temporal horizon.

LH is a good alternative to VH when is technically feasible as both present comparable advantages.

Taking into account these findings, the surgical approach to hysterectomy should be decided in light of the relative benefits and risks, which will depend on clinical circumstances and surgical experience.

## References:

1. Cho HY, Park ST, Kim HB, Kang SW, Park SH. Surgical outcome and cost comparison between total vaginal hysterectomy and laparoscopic hysterectomy for uteri weighing >500 g. *J Minim Invasive Gynecol.* 2014;21(1):115–119.
2. Dayaratna S, Goldberg J, Harrington C, Leiby BE, McNeil JM. Hospital costs of total vaginal hysterectomy compared with other minimally invasive hysterectomy. *Am J Obstet Gynecol.* 2014;210(2):120.e1–120.e1206.
3. Kovac SR. Route of hysterectomy: an evidence-based approach. *Clin Obstet Gynecol.* 2014;57(1):58–71.
4. Lönnerfors C, Reynisson P, Persson J. A randomized trial comparing vaginal and laparoscopic hysterectomy vs robot-assisted hysterectomy. *J Minim Invasive Gynecol.* 2015;22(1):78–86.
5. Aarts JW, Nieboer TE, Johnson N, et al. Surgical approach to hysterectomy for benign gynaecological disease. *Cochrane Database Syst Rev.* 2015;2015(8):CD003677.
6. Committee Opinion No. 701: Choosing the route of hysterectomy for benign disease. *Obstet Gynecol.* 2017;129(6):e155–e159.
7. Schmitt JJ, Carranza Leon DA, Occhino JA, et al. Determining optimal route of hysterectomy for benign

- indications: clinical decision tree algorithm. *Obstet Gynecol*. 2017;129(1):130–138.
8. Kala E, Stojko R, Sadlocha M. Hysterectomy costs depending on operational technique. *Ginekol Pol*. 2018;89(12):672–676.
9. Whiteside JL, Kaeser CT, Ridgeway B. Achieving high value in the surgical approach to hysterectomy. *Am J Obstet Gynecol*. 2019;220(3):242–245.
10. Rademaker D, Einarsson JI, Huirne JAF, Gu X, Cohen SL. Vaginal or laparoscopic hysterectomy: do perioperative outcomes differ? A propensity score-matched analysis. *Acta Obstet Gynecol Scand*. 2019;98(8):1040–1045.
11. Ghezzi F, Uccella S, Cromi A, et al. Postoperative pain after laparoscopic and vaginal hysterectomy for benign gynecologic disease: a randomized trial. *Am J Obstet Gynecol*. 2010;203(2):118.e1–118.e8.
12. Garry R, Fountain J, Mason S, et al. The eVALuate study: two parallel randomised trials, one comparing laparoscopic with abdominal hysterectomy, the other comparing laparoscopic with vaginal hysterectomy [published correction appears in *BMJ*. 2004;328(7432):129]. *BMJ*. 2004;328(7432):129.
13. Fitch K, Huh W, Bochner A. Open vs. minimally invasive hysterectomy: commercially insured costs and readmissions. *Manag Care*. 2016;25(8):40–47.
14. Billfeldt NK, Borgfeldt C, Lindkvist H, Stjern Dahl JH, Ankardal M. A Swedish population-based evaluation of benign hysterectomy, comparing minimally invasive and abdominal surgery. *Eur J Obstet Gynecol Reprod Biol*. 2018;222:113–118.
15. Andres MP, Borrelli GM, Abrão MS. Advances on minimally invasive approach for benign total hysterectomy: a systematic review. *F1000Res*. 2017;6:1295.
16. Sandberg EM, Twijnstra ARH, Driessen SRC, Jansen FW. Total laparoscopic hysterectomy versus vaginal hysterectomy: a systematic review and meta-analysis. *J Minim Invasive Gynecol*. 2017;24(2):206–217.e22.
17. Mohammed WE, Salama F, Tharwat A, Mohamed I, ElMaraghy A. Vaginal hysterectomy versus laparoscopically assisted vaginal hysterectomy for large uteri between 280 and 700 g: a randomized controlled trial. *Arch Gynecol Obstet*. 2017;296(1):77–83.
18. Martínez-Maestre MA, Melero-Cortés LM, Coronado PJ, et al. Long term COST-minimization analysis of robot-assisted hysterectomy versus conventional laparoscopic hysterectomy. *Health Econ Rev*. 2019;9(1):18.
19. Spanish Government. Spanish Official State Gazette 289. Available at: <https://www.boe.es/boe/dias/2005/12/03/pdfs/A39852-39852.pdf>. Accessed November 13, 2021.
20. Spanish Statistical Office. Quarterly Labour Cost Survey. Available at: [http://www.ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica\\_C&cid=125](http://www.ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica_C&cid=125). Accessed November 13, 2021.
21. Government of Andalusia. Order of 14 October 2005, which are priced public health services provided by centers dependent of Andalusian public health system. Official Gazette of the Government of Andalusia 2005:210. Available at: <https://www.juntadeandalucia.es/boja/2005/210/28>. Accessed November 13, 2021.
22. Ministry of Health, Social Services and Societal Wellbeing. Analysis and development of the DRGs in the National Health System. Available at: <https://www.msbs.gob.es/estadEstudios/estadisticas/inforRecopilaciones/anaDesarrolloGDR.htm>. Accessed November 13, 2021.
23. Settnes A, Moeller C, Topsoe MF, et al. Complications after benign hysterectomy, according to procedure: a population-based prospective cohort study from the Danish hysterectomy database, 2004–2015. *BJOG*. 2020;127(10):1269–1279.
24. Lee SH, Oh SR, Cho YJ, et al. Comparison of vaginal hysterectomy and laparoscopic hysterectomy: a systematic review and meta-analysis. *BMC Womens Health*. 2019;19(1):83.
25. Sesti F, Cosi V, Calonzi F, et al. Randomized comparison of total laparoscopic, laparoscopically assisted vaginal and vaginal hysterectomies for myomatous uteri. *Arch Gynecol Obstet*. 2014;290(3):485–491.
26. Ottosen C, Lingman G, Ottosen L. Three methods for hysterectomy: a randomised, prospective study of short term outcome. *BJOG*. 2000;107(11):1380–1385.
27. Garry R, Fountain J, Brown J, et al. EVALUATE hysterectomy trial: a multicentre randomised trial comparing abdominal, vaginal and laparoscopic methods of hysterectomy. *Health Technol Assess*. 2004;8(26):1–154.
28. Allam IS, Makled AK, Gomaa IA, El Bishry GM, Bayoumy HA, Ali DF. Total laparoscopic hysterectomy, vaginal hysterectomy and total abdominal hysterectomy using electrosurgical bipolar vessel sealing technique: a randomized controlled trial. *Arch Gynecol Obstet*. 2015;291(6):1341–1345.
29. Kaaki B, Lewis E, Takallapally S, Cleveland B. Direct cost of hysterectomy: comparison of robotic versus other routes. *J Robot Surg*. 2020;14(2):305–310.