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Implementation of Hysterectomy Pathway: Impact on Complications

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Abstract

Objective: Hysterectomy is one of the most common surgical procedures in the United States. For women who need hysterectomy, it is important to ensure that minimally invasive hysterectomy procedures are used appropriately to reduce surgical complications and improve value of care. Although we previously demonstrated a reduction in total abdominal hysterectomy rates after the implementation of hysterectomy pathway treatment algorithm in 2012, this study focuses on exploring the effect of pathways implementation on surgical outcomes.

Methods: All retrospective medical records for hysterectomy surgeries performed for benign indications at University of Pittsburgh Medical Center hospitals between the fiscal years (FY) 2012 and 2014 were identified. We analyzed the health care outcomes by route of surgery and year using X^2 test for categorical data, and non-parametric approaches for non-normal continuous variables.

Results: A total of 6,569 hysterectomies for benign indications were performed between FY 2012 and 2014. In FY 2012, 1,154 patients (59.15%) had a length of stay of 1 day or less, whereas in FY 2014 this number increased to 1,791 (74.53%; $p < .0001$). Within 3 years of implementing the pathway, surgical site infections had a reduction of 47%, with a considerable trend toward significance ($p = .067$).

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Conclusions: Implementation of hysterectomy pathway has been associated with reduction of surgical complications in benign hysterectomy settings. Implementation of clinical pathways offers an opportunity for improving patient outcomes that should be investigated in various health care settings and across procedures.

Hysterectomy is one of the most common major surgical procedures in the United States (DeFrances, Lucas, Buie, & Golosinskiy, 2008). Between 1994 and 1999, one of every nine women aged 35 to 45 years had a hysterectomy, which made hysterectomy the most common nonobstetric surgical procedure performed on women (Matteson et al., 2006). There were more than 430,000 hysterectomies performed in the United States in 2010 (Centers for Disease Control and Prevention, 2014; Wright et al., 2013). Between 2011 and 2013, the period prevalence of hysterectomy among women 40 to 44 years of age was 10.4% (Centers for Disease Control and Prevention, 2015).

Shared decision making is viewed as fundamental to safe and effective health care, especially in situations where multiple treatment options are available to the patient (Mulley, Trimble, & Elwyn, 2012). But not all physicians are equipped to create environments where shared decisions can be made effectively (Epstein, Alper, & Quill, 2004). Decision making about the route of hysterectomy, like any other medical decision, should be the result of a mutual interaction between physicians and patients. To accomplish this goal, physicians need evidence-based guidelines that are outlined and supported by the specific department or service line (World Health Organization, 2005). Clinical pathways are disease-specific, structured, multidisciplinary care algorithms that are practiced locally (Campbell, Hotchkiss, Bradshaw, & Porteous, 1998), representing a shift from opinion-based practice to evidence-based practice (Rotter et al., 2010).

Of the four routes of hysterectomy, vaginal hysterectomy (VH), laparoscopic hysterectomy (LH), and robotic hysterectomy are collectively called minimally invasive hysterectomy (MIH), and the fourth, total abdominal hysterectomy (TAH), is considered a more invasive route. MIH is usually associated with fewer complications; however, not every patient is a good candidate. In particular, considerations by the surgeon and the patient should include the appropriateness of the patient for MIH regarding underlying comorbidities, the suitability of the condition for MIH, the risks and benefits of TAH procedure versus MIH, and the proficiency of the surgeon and the treatment facility with the respective techniques. However, it is difficult for individual physicians or physician groups to recognize variations in their practices that indicate possible overuse of TAH. Engaging physicians in collaborative dialogue, as well as effectively analyzing data on practice variation, is critically important for improving quality of care and for the practice of evidence based medicine (Tomson & van der Veer, 2013).

In cases where hysterectomy is necessary, it is important that minimally invasive surgical procedures are used, as appropriate, to reduce surgical complications. The gynecologic literature strongly supports the use of VH and LH in the majority of benign cases. This has led to the publication of the American College of Obstetricians and Gynecologists (ACOG) Committee Opinion No. 444, establishing a clear national opinion supporting the use of MIH (ACOG, 2009). Patients undergoing MIH often have a more favorable experience

(including less pain, quicker recovery, and better short-term quality of life) compared with those undergoing TAH (Garry et al., 2004). MIH has proven to be as effective as TAH surgery for many clinical conditions, and benefits the patient with shorter recovery time, less time in the hospital, less pain, a reduced infection rate, fewer complications, and faster return to normal activities (ACOG, 2009; Nieboer et al., 2009; Walsh, Walsh, Tang, & Slack, 2009).

Our goal at Magee-Womens Hospital of the University of Pittsburgh Medical Center (UPMC) Health System was to develop an evidence-based clinical decision pathway based on best practice and literature evidence (Kovac, 2004) with the following objectives: to decrease overuse of TAH where unnecessary and promote the use of MIH, to improve clinical outcomes and quality of patient care, and to reduce unnecessary variations in physician practice. As a follow-up to our previously published paper (Sanei-Moghaddam et al., 2016) showing a significant decline (from 27.8% in FY 2012 to 17.0% in FY 2014; $p < .001$) in the proportion of TAH after implementing the hysterectomy pathway in 2012, this article investigates the effect of implementing the pathway on complication rates (surgical site infections [SSI] and blood transfusions) and health care outcomes (30-day readmission rates, length of stay [LOS], and duration of operation [DO]) within 3 years after pathway development and implementation. The overarching goal of this research is identification of strategies to improve value of care by improving quality and reducing costs.

Materials and Methods

Pathway Development

The process of our hysterectomy pathway development can be broken down into four steps: 1) quality analysis, 2) pathway definition, 3) physician engagement, and 4) electronic medical record pathway integration.

Two Diagnosis Related Groups, a list of procedure codes (*International Classification of Disease, 9th Revision*), and severity levels were used, allowing us to compare similar cases, analyze the quality of care, and exclude any cases that would be affected by elements, such as cancer-related procedures or hysterectomies prompted by acute conditions.

At the beginning of the process, a project team, consisting of physicians, nurses, PhD-level researchers, and health care managers was created and engaged in pathway definition and development. Simultaneously, transparent and integrated communication with a broader group of physicians within the department took place.

The hysterectomy pathway is the first one developed for the Ambulatory eRecord (EpicCare), and consists of a documentation flow sheet and decision support tool to streamline the surgery and preoperative ordering process. The flow sheet gives ACOG recommendations for scheduling imaging, MIH, or TAH. It then cascades as the provider answers questions about hysterectomy indications, uterine size, suspicion of extrauterine disease, ability to perform MIH safely, contraindications to MIH, and several others (Sanei-Moghaddam et al., 2016). After the provider answers all the questions, pathways offer a suggestion about the most optimal procedure route for this particular patient. If a physician

chooses to do a procedure not consistent with pathway, he or she has to document the reason for that choice. As of the end of 2012, the update of pathways was 100% for participating hospitals and approximately 80% for physicians. This study was inclusive of all UPMC facilities practicing hysterectomies. Entities included in this study had no options about participation, because this research was exempt (no human subjects involvement) by the University of Pittsburgh Institutional Review Board. Once completed, the provider is prompted to close the section and a Best Practice Alert will fire that provides ACOG recommendations regarding the type of surgery. Order sets are embedded into the Best Practice Alert so the provider can initiate the scheduling process. If the provider disagrees with the recommendation, he or she can select an acknowledgment reason and proceed with placing an alternative order.

Based on the data provided by the UPMC Health Plan, we investigated whether pathway implementation was associated with changes in complication rates (SSI and blood transfusions) and health care outcomes (30-day readmission rate, LOS, and DO) between 2012, when the pathway was introduced, and 2014. DO was measured as the number of minutes each patient spent in the operating room between the start and the end of procedure. Any preoperative care in a separate unit or recovery time in a postanesthesia care unit was not included in this measure.

Data Analysis

After finalizing the pathway integration into the UPMC system, a retrospective review of medical record data was conducted for complications associated with hysterectomy surgeries performed for benign indications at UPMC-affiliated hospitals between the FY 2012 and FY 2014. All study procedures and data acquisitions were carried out in the UPMC facilities. This project was reviewed by the University of Pittsburgh Institutional Review Board and approved as an exempt protocol (# PRO15030115). Study data were gathered through various sources, including Medipac (HBO Corporation, Atlanta, GA), EpicCare (Epic Systems, Verona, WI), Crimson (The Advisory Board Company, Austin, TX), and Cerner (Cerner Corporation, Kansas City, MO). Hysterectomy routes were classified into four groups (TAH, VH, LH, and robotic hysterectomy) based on appropriate *International Classification of Diseases, 9th Revision* codes.

The collected data included the route of surgery, LOS in days, DO in minutes, presence of SSI, need for blood transfusion, and whether the patient was readmitted to the hospital within 30 days after the surgery.

Data analyses were performed using SAS 9.4 (SAS Institute Inc., Cary, NC). We generated descriptive statistics to characterize the data. Analysis of variance was used to compare the mean ages of the participants in each FY. For categorical data, the X^2 test was used, and generalized Cochran-Mantel-Haenszel statistics were used to adjust for other variables. Nonparametric approaches (rank-based analysis of variance and Kruskal-Wallis) were used for non-normally distributed continuous variables. Data from FY 2014 were compared with FY 2012. All tests were two-sided with a significance level of $\alpha = 0.05$. Because all three minimally invasive approaches were yielding similar results when analyzed individually, we grouped them together for the final analysis.

Results

In 2012, the final version of the hysterectomy clinical pathway (Sanei-Moghaddam et al., 2016) was introduced across UPMC Health System hospitals. A major emphasis of our pathway development was on collaborative, nonjudgmental engagement with physicians in a positive inquiry regarding their practice patterns. The pathway is both an evaluation and treatment algorithm based on best practices.

A total of 6,569 hysterectomies for benign indications were performed at 14 UPMC-affiliated hospitals from FY 2012 to FY 2014. Two patients from FY 2014 were removed from this study's dataset because the route of surgery was not recorded (Table 1). The mean age of all the participants within these 3 years was 48.6 years (standard deviation, 11.69). For FYs 2012, 2013, and 2014, the mean age of participants was 48.9 years, 48.1 years, and 48.8 years, respectively ($p = .60$). The youngest patient was 20 years old, and the oldest was 94.

In FY 2012, 1,154 patients (59.15%) had a LOS of less than 1 day, and in FY 2014 this number increased to 1,791 (74.53%; $p < .0001$; Table 2). The SSI rate decreased by 47%, with a considerable trend toward significance ($p = .067$; Table 2). Thirty-day readmission decreased 20%, but the decrease was not significant.

SSI had a reduction of 47%, with a considerable trend toward significance ($p = .067$; Table 2). Thirty-day readmission decreased 20%, but it was not significant. DO did not change.

Table 3 shows that overall, TAH had the highest blood transfusion rate (17.57%) and robotic hysterectomy had the lowest blood transfusion rate (2.77%; $p < .001$). TAH also had the highest rate of SSI (2.18%) compared with other routes ($p < .001$). For 30-day readmission rate, again TAH had the highest rates ($p < .001$). Among 1,514 patients who underwent TAH surgery, 92 (6.08%) were admitted within 30 days after the surgery. Patients who had LH had the lowest 30-day readmission rate (1.58%). Adjusting for the year, all significant associations persisted. The vaginal route had the shortest DO with a median of 133.00 minutes (range, 95.00–183.00), and the robotic route had the longest DO with a median of 175.00 minutes (range, 147.00–211.00; $p < .001$). In contrast, the robotic route had the shortest LOS with a median of 1 day and the total abdominal route had the longest LOS with a median of 3 days ($p < .001$). Adjusting for the year, there remained a significant association between the type of surgery and both LOS and DO (Table 3).

Discussion

As our previous paper demonstrated (Sanei-Moghaddam et al., 2016), the hysterectomy pathway implementation was associated with reducing the proportion of TAH surgeries performed at UPMC hospitals from 27.8% in FY 2012 to 17% in FY 2014 (p for trend $< .001$). The current study demonstrated that, in conjunction with the reduction of TAH, implementation of the hysterectomy pathway has been associated with shorter LOS, which is consistent with findings in other fields (Pearson, Kleefield, Soukop, Cook, & Lee, 2001; Stephen & Berger, 2003). This finding has important implications for both quality and cost of care. A study by Panella, Marchisio, and Di Stanislao (2003) showed that, by

implementing clinical pathways in inguinal hernia repair procedures, the average LOS decreased from 3.25 to 1.64 days, and the median number of preoperative examinations per patient decreased from 22 to 7, which promoted cost reduction (Panella et al., 2003). In the area of total hip replacement, a significant reduction in preoperative examinations and a significant increase in patient compliance have been observed for those who have been treated using pathways (Panella et al., 2003).

Shorter hospital LOS reflects the effectiveness of symptom management, patient mobilization, and the absence of complications. In contrast, longer hospital stays are associated with increased overall health care costs. Hospital-acquired infection rates for hysterectomy have been shown to add $4,528 to the cost of stay and 2.52 days to the LOS (Gunnarsson, Rizzo, & Hochheiser, 2009). Individuals undergoing MIH are more likely to return to work activities faster than those having a TAH procedure for the same condition (Roumm, Pizzi, Goldfarb, & Cohn, 2005). Time to return to normal activities was 18 days shorter for LH and 3.15 days shorter for VH when compared with a TAH procedure (Roumm et al., 2005). From an employer perspective, there is always the possibility that increased disability duration will demand sick leave, disability payments, or even replacement employees; therefore, shorter disability duration will result in decreased societal costs. The age difference of patients between the years was an important factor to adjust for; however, our analysis demonstrated that mean age was not different among the years of investigation.

Although the difference in SSI between 2012 and 2014 was not significant, there was a considerable trend for decrease in SSI following the implementation of the pathway ($p = .067$). The small number of cases with SSI each year contributes to an inability to demonstrate a significant reduction, although there was a 47% reduction from 2012 to 2014. Of all the health care outcomes, blood transfusion was the only one increasing from 2012 to 2014. This might be partly explained by the fact that in 2014 a higher percentage of TAH patients received blood compared with 2012 (23.11% vs. 13.59%; $p < .001$; Table 1). This can also be a result of changing patient population and comorbidities from year to year. Having access to the data on the amount of blood transfused in each case rather than data on transfusion status (yes/no) would be helpful in future studies to investigate blood transfusion data in more detail.

The strengths of this study include a large sample size and a relatively large catchment area, which makes it easier to generalize our findings to other populations and health care systems. The main limitation of this study is the short duration. Because the pathway has been launched recently, at the time of this submission, we did not have enough data to examine how this pathway would change practices across the UPMC system in the long run. Another key limitation of this study is that we had limited access to information on patient comorbidities and detailed demographics. In addition, our lack of ability to measure the physicians' disagreement or divergence from the proposed pathway is another limitation to this study. Although this paper mainly focuses on the hysterectomy pathway implementation in a single health care system, it is likely that implementing similar pathways in other communities and health care systems would also yield favorable outcomes.

Implications for Practice and/or Policy

Overuse generally occurs for procedures where there are no clear guidelines about the optimal indications or the appropriate level of use of the procedure. This uncertainty leads to variation in care and vulnerability to local influences, such as physician training, payment incentives, medicolegal concerns, and patient expectations. Overuse has a considerable impact on our health care system. In the United States, it is estimated that as much as 30% of health care costs, or approximately $700 billion (as of 2010), could be eliminated without reducing quality (Baker, Whittington, Resar, Griffin, & Nolan, 2010).

Even when physicians identify where changes are needed in terms of procedure choice based on an evaluation of their individual cost and quality metrics, pathways can support sustainable change in practice and allow for meaningful improvements in clinical care and cost savings. The ultimate goals of clinical pathways are error reduction, quality of care improvement, and cost reduction (Carlson, 2009). The success of a pathway in increasing value for patients by improving quality and decreasing cost should occur without using techniques experienced as coercive by physicians. This study demonstrates improved value of care by reducing adverse outcomes while containing costs.

Key elements in our pathway development framework included 1) identifying an opportunity to reduce overuse of a particular procedure, in this case, TAH, 2) the use of variation data to engage physicians in a noncoercive, positive inquiry about their practice patterns (physician dashboard), and 3) the incorporation of the pathway into the electronic medical record to prospectively test the pathway, and to measure physicians' willingness and ability to apply it (including monitoring for pathways participation among physicians).

To promote MIH, Centers of Excellence, an education/mentoring program could be developed for core MIH techniques, allowing those physicians who have the motivation to transition to MIH approaches. This can be accomplished via two tracks: 1) familiarize the head of department with evidence-based supporting data about MIH approaches, and 2) certification via an education/mentoring program, which is maintained by achieving adequate volume and quality metrics at the discretion of the head of department and/or their designee.

In cases where variation in care exists, and is justified, variation data should be presented without prejudgment of high or low use. The main goal is to change practice culture to generate sufficient questions about the current practice to lead to an agreement by the physicians to test the development and application of a standard of care.

Conclusions

The implementation of the clinical hysterectomy pathway was associated with a shorter LOS and fewer SSI in this pilot study. The development of clinical pathways across health care systems may be a helpful tool in improving the value of care.

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References

American College of Obstetricians Gynecologists (ACOG). (2009). ACOG Committee Opinion No. 444: Choosing the route of hysterectomy for benign disease. Obstetrics & Gynecology, 114(5), 1156–1158. [PubMed: 20168127]

Baker N, Whittington JW, Resar RK, Griffin FA, & Nolan KM (2010). Reducing costs through the appropriate use of specialty services. IHI Innovation Series white paper. Available: www.ihi.org/resources/Pages/IHIWhitePapers/ReducingCostsAppropriateUseSpecialtyServicesWhitePaper.aspx. Accessed: February 16, 2015.

Campbell H, Hotchkiss R, Bradshaw N, & Porteous M (1998). Integrated care pathways. BMJ, 316(7125), 133–137. [PubMed: 9462322]

Carlson B (2009). Controlling the cost of care through clinical pathways. Biotechnology Healthcare, 6(1), 23–26.

Centers for Disease Control and Prevention. (2014). Inpatient surgery. Available: www.cdc.gov/nchs/fastats/inpatient-surgery.htm. Accessed: February, 12, 2015.

Centers for Disease Control and Prevention. (2015). Key statistics from the National Survey of Family Growth. Available: www.cdc.gov/nchs/nsfg/key_statistics/h.htm#hysterectomy. Accessed: September 24, 2015.

DeFrances CJ, Lucas CA, Buie VC, & Golosinskiy A (2008). 2006 National Hospital Discharge Survey. National Health Statistics Report, (5), 1–20.

Epstein RM, Alper BS, & Quill TE (2004). Communicating evidence for participatory decision making. JAMA, 291(19), 2359–2366. [PubMed: 15150208]

Garry R, Fountain J, Brown J, Manca A, Mason S, Sculpher M, … Lilford R (2004). EVALUATE hysterectomy trial: A multicentre randomised trial comparing abdominal, vaginal and laparoscopic methods of hysterectomy. Health Technology Assessment, 8(26), 1–154.

Gunnarsson C, Rizzo JA, & Hochheiser L (2009). The effects of laparoscopic surgery and nosocomial infections on the cost of care: Evidence from three common surgical procedures. Value in Health, 12(1), 47–54. [PubMed: 18657101]

Kovac SR (2004). Clinical opinion: Guidelines for hysterectomy. American Journal of Obstetrics & Gynecology, 191(2), 635–640. [PubMed: 15343253]

Matteson KA, Peipert JF, Hirway P, Cotter K, DiLuigi AJ, & Jamshidi RM (2006). Factors associated with increased charges for hysterectomy. Obstetrics & Gynecology, 107(5), 1057–1063. [PubMed: 16648411]

Mulley AG, Trimble C, & Elwyn G (2012). Stop the silent misdiagnosis: Patients' preferences matter. BMJ, 345, e6572. [PubMed: 23137819]

Nieboer TE, Johnson N, Lethaby A, Tavender E, Curr E, Garry R, … Kluivers KB (2009). Surgical approach to hysterectomy for benign gynaecological disease. Cochrane Database of Systematic Reviews, (3), Cd003677.

Panella M, Marchisio S, & Di Stanislao F (2003). Reducing clinical variations with clinical pathways: Do pathways work? International Journal for Quality in Health Care, 15(6), 509–521. [PubMed: 14660534]

Pearson SD, Kleefield SF, Soukop JR, Cook EF, & Lee TH (2001). Critical pathways intervention to reduce length of hospital stay. American Journal of Medicine, 110(3), 175–180.

Rotter T, Kinsman L, James E, Machotta A, Gothe H, Willis J, … Kugler J (2010). Clinical pathways: Effects on professional practice, patient outcomes, length of stay and hospital costs. Cochrane Database of Systematic Reviews, (3), Cd006632.

Roumm AR, Pizzi L, Goldfarb NI, & Cohn H (2005). Minimally invasive: Minimally reimbursed? An examination of six laparoscopic surgical procedures. Surgical Innovation, 12(3), 261–287. [PubMed: 16224649]

Sanei-Moghaddam A, Ma T, Goughnour SL, Edwards RP, Lounder PJ, Ismail N, … Linkov F (2016). Changes in hysterectomy trends after the implementation of a clinical pathway. Obstetrics & Gynecology, 127(1), 139–147. [PubMed: 26646126]

Stephen AE, & Berger DL (2003). Shortened length of stay and hospital cost reduction with implementation of an accelerated clinical care pathway after elective colon resection. Surgery, 133(3), 277–282. [PubMed: 12660639]

Tomson CR, & van der Veer SN (2013). Learning from practice variation to improve the quality of care. Clinical Medicine (London), 13(1), 19–23.

Walsh CA, Walsh SR, Tang TY, & Slack M (2009). Total abdominal hysterectomy versus total laparoscopic hysterectomy for benign disease: A meta-analysis. European Journal of Obstetrics, Gynecology, and Reproductive Biology, 144(1), 3–7.

World Health Organization (WHO). (2005). Evidence-led obstetric care: Report of a WHO meeting. Geneva, Switzerland: 28–30 January 2004.

Wright JD, Herzog TJ, Tsui J, Ananth CV, Lewin SN, Lu YS, … Hershman DL (2013). Nationwide trends in the performance of inpatient hysterectomy in the United States. Obstetrics and Gynecology, 122(201), 233–241. [PubMed: 23969789]

Table 1

Health Care Quality Outcomes by Year and Route of Surgery

Health Care Quality Outcomes	FY 2012				FY 2013				FY 2014			
	TAH (*n* = 559)	VH (*n* = 354)	LH (*n* = 788)	RH (*n* = 250)	TAH (*n* = 518)	VH (*n* = 403)	LH (*n* = 990)	RH (*n* = 302)	TAH (*n* = 437)	VH (*n* = 473)	LH (*n* = 1,141)	RH (*n* = 352)
Blood transfusion, *n* (%)	76 (13.59)	16 (4.51)	21 (2.66)	13 (5.20)	89 (17.18)	10 (2.48)	25 (2.52)	3 (0.99)	101 (23.11)	20 (4.22)	42 (3.68)	9 (2.55)
Surgical site infection, *n* (%)	17 (3.04)	0 (0.00)	0 (0.00)	3 (1.20)	8 (1.54)	3 (0.74)	8 (0.80)	0 (0.00)	8 (1.83)	2 (0.42)	1 (0.08)	2 (0.56)
30-day readmission, *n* (%)	29 (5.18)	15 (4.23)	13 (1.64)	11 (4.40)	38 (7.33)	17 (4.21)	15 (1.51)	4 (1.32)	25 (5.72)	23 (4.86)	18 (1.57)	1 (0.28)
LOS (d), median (25th–75th)	3.00 (2.00–3.00)	1.00 (1.00–2.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)	3.00 (2.00–3.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)	2.00 (2.00–3.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)
Operation time (min), median (25th–75th)	132.00 (108.00–177.00)	143.00 (112.00–199.00)	169.00 (138.00–220.00)	163.00 (133.00–200.00)	141.00 (114.00–180.00)	132.00 (91.00–176.00)	162.00 (133.00–218.00)	181.00 (155.00–217.00)	148.00 (115.00–195.00)	123.00 (90.00–175.00)	163.00 (130.00–215.00)	177.00 (149.00–213.00)

Abbreviations: FY, fiscal year; LH, laparoscopic hysterectomy; RH, robotic hysterectomy; TAH, total abdominal hysterectomy; VH, vaginal hysterectomy.

Table 2

Health Care Quality Outcomes by Year, 2012 Versus 2014

	FY 2012 (*n* = 1,951)	FY 2014 (*n* = 2,403)	*p*-Value
Blood transfusion, *n* (%)	126 (6.45)	172 (7.15)	.363*
Surgical site infection, *n* (%)	20 (1.025)	13 (0.54)	.067*
30-day readmission, *n* (%)	68 (3.48)	67 (2.78)	.187*
LOS (d), median (25th–75th)	1.00 (1.00–2.00)	1.00 (1.00–2.00)	<.0001†
DO (min), median (25th–75th)	154.00 (121.00–202.00)	159.00 (123.00–204.00)	.4106†

Abbreviations: DO, duration of operation; FY, fiscal year; LOS, length of stay.

*χ^2 test.

†Wilcoxon two-sample test.

Table 3

Health Care Quality Outcomes by the Type of Surgery 2012 Through 2014

Complications	TAH (*n* = 1,514)	VH (*n* = 1,230)	LH (*n* = 2,919)	RH (*n* = 904)	*p*-Value
Blood transfusion, *n* (%)	266 (17.57)	46 (3.74)	88 (3.01)	25 (2.77)	<.001 *
SSI, *n* (%)	33 (2.18)	5 (0.41)	9 (0.31)	5 (0.55)	<.00 *
30-day readmission, *n* (%)	92 (6.08)	55 (4.47)	46 (1.58)	16 (1.77)	<.001 *
DO (min), median (25th–75th)	140.00 (112.00–184.00)	133.00 (95.00–183.00)	164.00 (133.00–218.00)	175.00 (147.00–211.00)	<.001 †
LOS (d), median (25th–75th)	3.00 (2.00–3.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)	1.00 (1.00–1.00)	<.001 †

Abbreviations: DO, duration of operation; LH, laparoscopic hysterectomy; LOS, length of stay; RH, robotic hysterectomy; SSI, surgical site infection; TAH, total abdominal hysterectomy; VH, vaginal hysterectomy.

* Cochran-Mantel-Haenszel statistics.

† Kruskal-Wallis test.