

Increasing the Technicity Index to 92% in a Community Hospital: A 5-Year Retrospective Review



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Abstract

Objective: This study describes the observed trends in hysterectomy routes at Langley Memorial Hospital (LMH) in Langley, British Columbia, over 5 consecutive years. Associations between patient characteristics and surgical approach were explored, and approach-based surgical outcomes were evaluated using the institutional technicity index (TI), defined as the ratio of hysterectomies performed by minimally invasive surgery to all hysterectomies.

Methods: A retrospective descriptive study involving 706 women who underwent hysterectomy at LMH between January 1, 2012 and December 31, 2016 by six full-time surgeons was performed. From the patient characteristics and surgical outcomes associated with the route of hysterectomy, the annual institutional and overall rates of hysterectomy by type were calculated according to the Canadian Task Force Classification II-2.

Results: The TI increased from 67% to 92% from 2012 to 2016. Specifically, the proportion of hysterectomies completed by a total laparoscopic approach increased from 37% to 78%, whereas hysterectomies performed by the abdominal or laparoscopic-assisted vaginal approach decreased from 32% to 8% and from 17% to 1%, respectively. Vaginal hysterectomy rates remained constant across the study period. Minimally invasive surgery was associated with significantly reduced surgical blood loss and

decreased length of hospital stay, with no difference in surgical time compared with an open approach.

Conclusions: As far as the study investigators are aware, the TI at LMH is among the highest reported to date in Canada. Potential contributing factors include well-trained and experienced gynaecologic surgeons, readily available peer-to-peer mentorship, certified gynaecologic assistance, dedicated surgical staff, and consistency in the operating room set-up. Hence, achieving a high TI in a community setting is feasible without increasing the risk of surgical complications or length of surgery.

Résumé

Objectif : La présente étude décrit les tendances observées dans le choix d'approche chirurgicale pour l'hystérectomie à l'hôpital Langley Memorial Hospital (LMH) de Langley (Colombie-Britannique) durant cinq années consécutives. De possibles associations entre les caractéristiques des patientes et les approches chirurgicales ont été explorées, et les issues pour chaque approche ont été évaluées selon l'indice de technicité (IT) de l'établissement, qui correspond à la proportion de toutes les hystérectomies qui ont été effectuées par chirurgie à effraction minimale.

Méthodologie : Dans cette étude descriptive rétrospective, nous avons retenu 706 femmes ayant subi une hystérectomie à l'hôpital LMH entre le 1^{er} janvier 2012 et le 31 décembre 2016, pratiquée par l'un de six chirurgiens à plein temps. Pour chaque approche étudiée, les patientes ont été classées selon leurs caractéristiques et les issues chirurgicales; des taux annuels ont été calculés, globalement et pour l'établissement, selon la classification II-2 du Groupe d'étude canadien.

Résultats : L'IT a augmenté de 2012 à 2016, passant de 67 % à 92 %. Plus précisément, la proportion d'hystérectomies totales par laparoscopie est passée de 37 % à 78 %, alors que les pourcentages d'hystérectomie abdominale et d'hystérectomie vaginale assistée par laparoscopie sont passés de 32 % à 8 % et de 17 % à 1 %, respectivement. Le recours à une approche vaginale est resté proportionnellement constant durant la période à l'étude. La chirurgie à effraction minimale a été associée à une réduction significative des pertes sanguines durant l'intervention et de la durée du séjour à l'hôpital; le temps nécessaire pour l'intervention n'était pas différent de celui pour la chirurgie ouverte.

Conclusion : Autant que les sachent les auteurs, l'IT de l'hôpital LMH est parmi les plus élevés jamais enregistrés au Canada. La formation de

Key Words: Technicity index, minimally invasive hysterectomy, laparoscopic hysterectomy, surgical mentorship, surgical approach, surgical training

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qualité et l'expérience des chirurgiens gynécologiques, l'accès facile à du mentorat individuel entre pairs, l'aide de gynécologues agréés, la stabilité du personnel de soutien en chirurgie et l'uniformité de la configuration des salles d'opération ont pu contribuer à cet impressionnant résultat. Bref, il est possible d'atteindre un IT élevé dans un milieu donné sans augmentation du risque de complications chirurgicales ou de la durée de l'intervention.

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INTRODUCTION

Hysterectomy is the definitive therapy for many common gynaecological conditions, including abnormal uterine bleeding, uterine fibroids, adenomyosis, and endometrial cancer, and is a component of surgical treatment for conditions such as endometriosis and pelvic organ prolapse.^{1,2} With over 40 000 cases performed annually, hysterectomy is the sixth most common inpatient surgical intervention and the most common major gynaecological procedure performed in Canada.³ Indeed, one in four Canadian women over age 45 have had a hysterectomy,³ with uterine fibroids accounting for 30% of all hysterectomies.³ However, hysterectomy is occasionally associated with significant morbidity, mortality, and economic burden on health care systems.^{4,5}

The approach to performing a hysterectomy continues to evolve. The once preferred total abdominal hysterectomy has been supplanted by less morbid minimally invasive surgery (MIS) techniques, including vaginal hysterectomy, total laparoscopic hysterectomy, and laparoscopic-assisted vaginal hysterectomy. The drivers of this paradigm shift are numerous and include improved access to surgical training in minimally invasive techniques, rapid technological advancements, and improved patient outcomes.^{6,7} Specifically, advances in surgical instruments and safer energy sources have made minimally invasive approaches more feasible to perform, and quicker recovery times, shorter length of hospital stay, and improved patient satisfaction have broadened acceptance and translated to significant health care savings.^{8–10}

Canadian national guidelines recommend MIS as the preferred route for patients undergoing hysterectomy for benign indications.¹¹ Still, change in surgical practice remains slow: A recent audit of surgical performance reported a minimally invasive hysterectomy rate of 34% in

Winnipeg, Manitoba.¹² By comparison, tertiary centres in Europe in 2005 had rates of laparoscopic hysterectomy surpassing 50%,¹³ with the boundaries of laparoscopic surgery continuing to increase with increasing case complexity.^{14,15} Cited barriers to uptake of laparoscopic hysterectomy include a lack of operating room resources, unfamiliarity with instruments and energy sources, and a reluctance to manage unexpected surgical scenarios.^{16–19} Others suggest that the learning curve inherent to endoscopy remains steep. Challenges include the fulcrum effect, constraints of two-dimensional viewing of three-dimensional objects, the need for superior video-eye-hand coordination, and reduced haptic feedback.^{17,20}

The technicity index (TI) is a quality index first used in France to compare surgical performance among hospitals at a national level.²¹ It serves to quantify the number of hysterectomies performed via an MIS approach compared with the total number of hysterectomies in a single institution (Figure 1). In Canada, the concept of “technicity” was reintroduced by Laberge and Singh¹ to highlight the advantages of less invasive surgical approaches. TI is increasingly used as a performance indicator and to drive improvement at tertiary hospitals. Indeed, institutional technicity increased from 40% to 74% over a 7-year period at the Ottawa Hospital in Ottawa, Ontario,¹⁴ and it increased from 13% to 56% over a 5-year period at a similar tertiary centre in Vancouver, British Columbia.¹⁵ Globally, TI has been reported to be as high as 93% in Newton, Massachusetts.⁶ However, the TI in community hospitals across Canada is understudied and underreported. To address this, we calculated the TI at an acute care community hospital and level IV trauma centre in the township of Langley, British Columbia, over 5 years. Patient characteristics and surgical outcomes that were associated with different routes of hysterectomy and that affected the TI were also determined.

MATERIALS AND METHODS

Study Design

We conducted a single-centre, descriptive study using retrospective data of women who underwent hysterectomy at Langley Memorial Hospital (LMH), a government funded 214-bed community hospital Langley, British Columbia, served mainly by six full-time general obstetrician gynaecologists over the study period in a group practice. Langley is a rapidly growing township of ~125 000 people on the

Figure 1. Technicity Index.

$$\text{Technicity Index} = \frac{\text{No. of Vaginal + Laparoscopic Hysterectomy Cases}}{\text{Total Number of All Hysterectomy Cases}}$$

outskirts of Metro Vancouver. This study is part of a quality improvement initiative and therefore was exempt from institutional review by the Fraser Health Research and Ethics Board.

Patient Database

Using National Surgical Quality Improvement Program reports, we identified all hysterectomies performed at LMH from January 1, 2012 through December 31, 2016. Open and minimally invasive routes of hysterectomy for benign and malignant gynaecological conditions were eligible. Benign indications included abnormal uterine bleeding, fibroids, endometriosis, pelvic organ prolapse, ovarian neoplasm, and endometrial hyperplasia. Malignant conditions were limited to early-stage, low-grade endometrial cancer, early-stage cervical cancer, and two cases of unexpected ovarian malignancy. Pelvic lymphadenectomy was not performed at LMH. MIS cases that were converted to abdominal hysterectomy were included in the MIS cohort for the comparisons. Cases excluded were hysterectomies performed at the time of Caesarean section or immediately after delivery. Patients known to have invasive bladder or bowel endometriosis were referred for a multidisciplinary approach in a tertiary care centre. Every hysterectomy procedure performed was used to calculate the TI. Concomitant apical support procedures that were most commonly used and incorporated into the TI calculation included laparoscopic uterosacral ligament suspension, laparoscopic sacrocolpopexy, and vaginal sacrospinous ligament suspension. In addition, vaginal uterosacral ligament suspension was performed in some cases. Robotic surgery was not used.

Patient demographics and clinical characteristics collected included age, body mass index, parity, and previous abdominal and pelvic surgery. Outcome variables were extracted from patients' charts and surgical reports and included postoperative diagnosis, route of hysterectomy, estimated surgical blood loss, uterine weight, duration of surgery, and length of postoperative stay. Intraoperative complications, postoperative complications, conversion to abdominal surgery, need for blood transfusion, and re-admission within 30 days were also collected. Surgical complications assessed included the following: bowel, bladder, and ureteric injury; vaginal laceration; surgical site infection; urinary tract infection; pneumonia; deep vein thrombosis; and pulmonary embolism.

Surgeons

Of the surgeons at LMH, one had fellowship training in minimally invasive gynaecologic surgery and joined LMH in 2012 at the start of the study. Other subspecialty surgeons such as gynaecologic oncologists or urogynaecologists were

not involved. LMH is also a popular centre for operating room elective placements among residents with an interest in gynaecologic surgery. Senior (postgraduate year 3 to 5) gynaecology residents from the University of British Columbia and University of Saskatchewan were actively involved in the surgical procedures as the principle operator or first assistant over the study period.

Statistical Analysis

Data analysis was performed using SPSS software version 21 (IBM Corp, Armonk, NY). Annual and overall technicity were determined for each surgeon and collectively as a group. However, given the limited number of staff and to maintain anonymity, only the institutional TI is reported. Patient characteristics, surgical outcomes, and postoperative diagnoses were compared between women who underwent MIS and those who had abdominal hysterectomy. Bivariate associations were determined using the chi-square test or independent *t* test, as appropriate. Logistic regression analysis was completed to identify demographic and clinical characteristics associated with hysterectomy approach. Significance was determined to an alpha of 0.05.

RESULTS

Of the study patients, 54% were between 45 and 64 years of age (Table 1). The body mass index was 29 ± 6.5 kg/m². One-fifth of the population (19%) had undergone previous abdominal surgery, and half (53%) had undergone previous pelvic surgery. As shown in Table 1, more participants in the MIS group (36%) were in the youngest age category (20 to 44 years) compared with those in the open hysterectomy group (25%; *P* = 0.011). There were no other significant differences between the two participant groups (Table 1).

With a study population of 706 hysterectomies performed by six practising obstetrician gynaecologists at LMH, we report that the institutional TI increased from 67% to 92% from 2012 to 2016 (Figure 2), with a 5-year average institutional technicity of 85%. Specifically, the proportion of hysterectomies completed by total laparoscopic approach increased from 37% to 78%, whereas hysterectomies performed by total abdominal or laparoscopic-assisted vaginal approach decreased from 33% to 8%, and 17% to 8%, respectively. Rates of vaginal hysterectomy remained relatively constant between 7% and 13% throughout the study.

Abnormal uterine bleeding (39%) was the most common diagnosis, followed by fibroid uterus (23%) (Figure 3). The remaining patients had pelvic organ prolapse (16%), endometriosis (5%), or a pre-malignant or malignant condition (16%). Patients who underwent an open abdominal approach

Table 1. Patient characteristics by surgical approach

Characteristics	MIS n = 600	Open n = 106	All n = 706	P value (MIS vs. open)
Age group, %				0.011
20–44	36.2	24.5	34.4	
45–64	51.2	67.0	53.5	
≥65	12.7	8.5	12.0	
BMI, kg/m ²				0.654
Mean ± SD	28.6 ± 6.44	28.4 ± 6.98	28.6 ± 6.51	
Parity, %				0.060
Nulliparous	14.5	21.7	15.6	
Multiparous	85.5	78.3	84.4	
Previous abdominal surgery, %				0.339
No	81.3	77.4	80.7	
Yes	18.7	22.6	19.3	
Previous pelvic surgery, %				0.604
No	46.3	49.1	46.7	
Yes	53.7	50.9	53.3	

BMI: body mass index; MIS: minimally invasive surgery.

Bold P values were considered statistically significant.

were more likely to have a fibroid uterus (35%) or abnormal uterine bleeding (32%), whereas those who underwent a minimally invasive approach were more likely to have been diagnosed with abnormal uterine bleeding (39%).

Patients who underwent minimally invasive hysterectomy achieved more favourable outcomes compared with patients who underwent an abdominal route hysterectomy (Table 2): Patients in the MIS group had reduced surgical blood loss

Figure 2. Trajectory of hysterectomies and Technicity Indices at Langley Memorial Hospital. Surgical routes include vaginal hysterectomy (VH), laparoscopic-assisted vaginal hysterectomy (LAVH), total laparoscopic hysterectomy (TLH), and total abdominal hysterectomy (TAH).

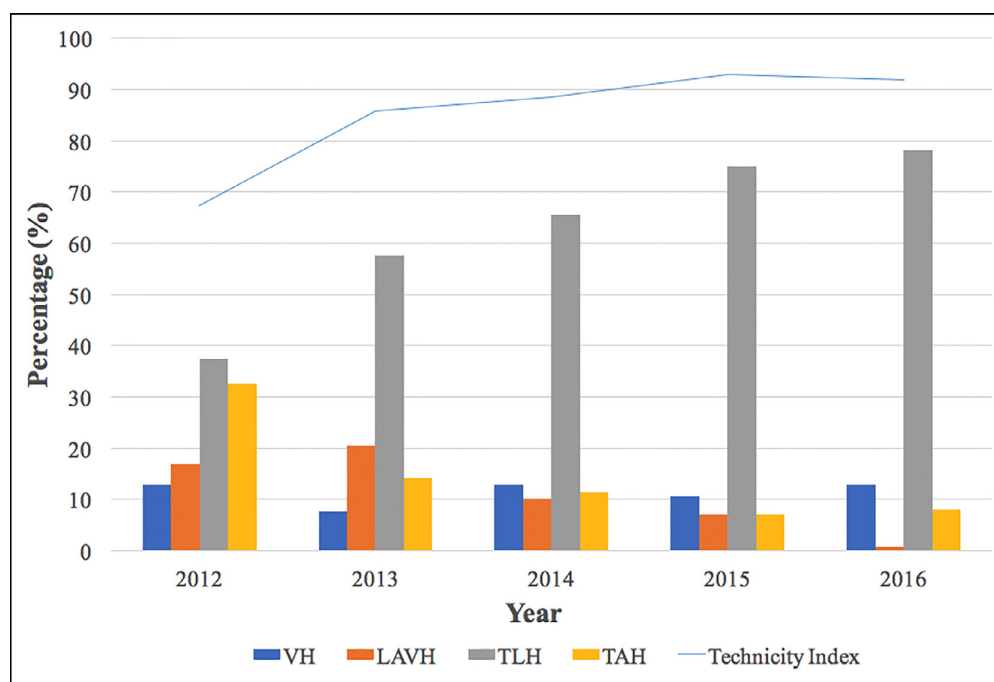


Figure 3. Patients' postoperative diagnosis by surgical approach.

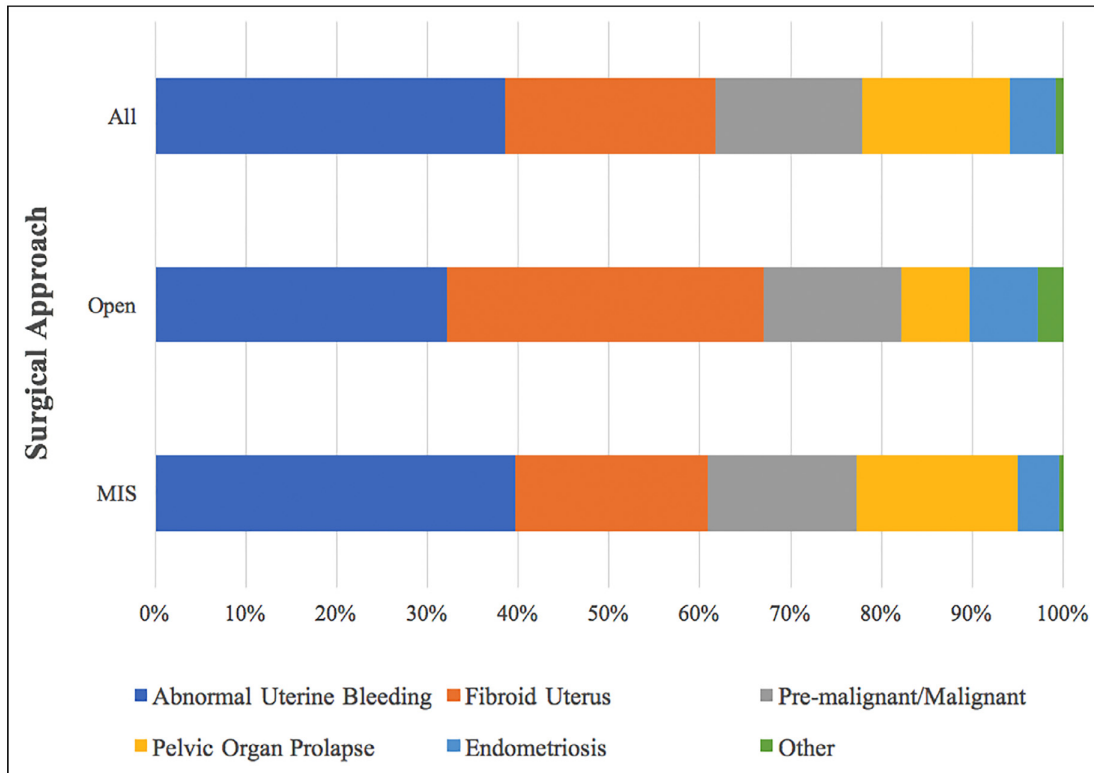


Table 2. Surgical outcomes by hysterectomy approach

Surgical outcomes	MIS; mean ± SD (range) n	Open; mean ± SD (range) n	P value
Estimated blood loss, mL	141 ± 105 (10–1000) n = 535	495 ± 650 (70–4100) n = 92	<0.01
Uterine weight, g	187 ± 173 (28–1202) n = 539	526 ± 14 (38–2512) n = 103	<0.01
Duration of surgery, min	110 ± 39.1 (40–272) n = 600	106 ± 67.7 (47–559) n = 106	0.089
Length of stay, d	1.21 ± 0.68 (0–8) n = 600	2.94 ± 0.86 (1–7) n = 106	<0.01

MIS: minimally invasive surgery.
 Bold P values were considered statistical significant.

(MIS, 141 ± 105 mL vs. open, 495 ± 650 mL; $P < 0.01$) and length of hospital stay (MIS, 1.21 ± 0.68 days vs. open, 2.94 ± 0.86 days; $P < 0.01$). An abdominal route was more often used for larger uteri, with the largest weighing

2512 g. In contrast, MIS-treated patients had smaller uteri (MIS, 187 ± 173 g vs. open, 526 ± 514 g; $P < 0.01$), with the largest at 1202 g. Nonetheless, there was no difference in surgical time between routes of hysterectomy (MIS, 110 ± 39.1 minutes vs. open, 106 ± 67.7 minutes; $P = 0.089$).

The combined, all-cause complication rate was 6% ($n = 706$). An insignificant trend towards a greater complication rate was observed in those who underwent open abdominal hysterectomy (MIS, 5%; open, 9%) with a higher rate of readmission within 30 days of surgery (MIS, 2%; open, 3%). Transfusion rates were also higher for open abdominal procedure (10%) compared with MIS (1%; $P < 0.01$). In 600 MIS cases that began as a total laparoscopic hysterectomy, the operative conversion rate to an open approach was 4% ($n = 24$).

Fibroid uterus was the only factor found to be associated with an open abdominal approach to hysterectomy (odds ratio [OR] 2.0; 95% confidence interval [CI] 1.28–3.12) (Table 3). In contrast, young age (20–44 years) (reference

Table 3. Patient characteristics that predicted use of an open abdominal approach

Patient characteristics	Adjusted odds ratio (95% CI)
Age group	
20–44	0.52 (0.32–0.84)
45–64	Reference
≥65	0.51 (0.25–1.07)
Pelvic organ prolapse	
Yes	0.38 (0.18–0.80)
No	Reference
Fibroid uterus	
Yes	2.0 (1.28–3.12)
No	Reference
Endometriosis	
Yes	1.73 (0.77–3.92)
No	Reference
Abnormal uterine bleeding	
Yes	0.72 (0.46–1.12)
No	Reference
Pre-malignant and malignant conditions	
Yes	0.91 (0.51–1.62)
No	Reference

age 45–64 years; OR 0.52; 95% CI 0.32–0.84) and pelvic organ prolapse (OR 0.38; 95% CI 0.18–0.80) were associated with use of a minimally invasive approach. Advanced age (≥65 years) (reference age 45 to 64 years; OR 0.51; 95% CI 0.25–1.07), endometriosis (OR 1.73; 95% CI 0.77–3.92), abnormal uterine bleeding (OR 0.72; 95% CI 0.46–1.12), and pre-malignant and malignant conditions (OR 0.91; 95% CI 0.58–1.62) were not associated with the choice of one approach over the other.

DISCUSSION

To our knowledge, this is the first Canadian study to report a TI >90% for a department rather than a single surgeon, with a steady increase in TI from 67% in 2012 to 92% in 2016. Furthermore, these data reveal that a change in surgical approach to hysterectomy from an open to a minimally invasive technique can be achieved at scale and pace over a short time in a small community hospital. LMH is an active participant in the National Surgical Quality Improvement Program, a quality improvement initiative offered by the American College of Surgeons, which provides hospitals with outcome-based surgical performance reports that can be used to improve health care delivery. Indeed, access to

this database facilitated our study. The observed increase can be attributed solely to the increased rate of total laparoscopic hysterectomy at the expense of laparoscopic-assisted vaginal hysterectomy and vaginal hysterectomy, which decreased or remained unchanged.

Multiple factors may be responsible for the increase in TI, but we suggest that the main driver was the ready availability of peer-to-peer mentorship as needed. In future studies we would analyze this specifically and add to such studies survey questions completed by each participant at the start and end of the study period to assess other factors qualitatively. The introduction of a fellowship-trained minimally invasive surgeon and of a *surgical preceptor* model was associated with the increase in TI. In this model a surgeon who is proficient in a subset of operative techniques is partnered with a surgeon of lesser experience.¹⁵ Every hysterectomy was performed by two gynaecologists over the study, with the mentor either as the surgical assistant or primary surgeon to facilitate skill transfer among the group. Hours were not logged. Loring et al.⁶ previously spearheaded a similar departmental, voluntary mentorship program for minimally invasive gynaecological surgery, also with marked success. These models provide surgeon learners with an avenue to acquire new motor skills through the benefits of immediate feedback and exchange of tacit knowledge. Benefactors of the voluntary peer-to-peer mentorship at LMH included all surgeons who demonstrated a rise in technicity over the study. Other collaborative models aimed at reducing the learning curve associated with advanced surgical techniques include *Buddy Operating*, whereby consultants pool referrals and operate together.²² These approaches provide surgeon learners with valuable operative time and exposure and can be combined with more traditional avenues of training to help gynaecologists gain new skills and further increase technicity.⁷ For example, the decrease in the rate of laparoscopic-assisted vaginal hysterectomy was likely the result of improved techniques in laparoscopic suturing and cuff closure. Notably, the barbed suture was already in use in 2012 at the start of the study. Finally, the population group in Langley is predominantly well educated and Internet informed, and over the course of the study these patients more often requested MIS for their procedures.

Other factors that contributed to the increase in TI include appropriately trained and consistent surgical support staff for implementation of minimally invasive techniques and consistency in the operating room set-up. At LMH, the surgical support team most often comprised specialized nursing staff who consistently worked in the gynaecology team. Team members received regular in-service training

that helped to equip them with the skills needed to tackle challenges such as operative room set-up, patient positioning in deep Trendelenburg, and specialized equipment including energy sources, insufflation, and laparoscopic instruments unique to gynaecologic MIS. Consistency among surgical support staff and anaesthesiologists helped breed familiarity and thereby improved operative efficiency. Furthermore, surgical staff who are accustomed to their role are more capable of troubleshooting and may take on unconventional roles such as driving the laparoscope or assisting with uterine manipulation when needed.

Tangible patient benefits were observed among those who underwent hysterectomy by MIS compared with an open technique: Both estimated blood loss and length of hospital stay were significantly reduced. Contrary to previous studies,¹⁴ we found that the operative time was not significantly different between the two approaches. Most importantly, patient care was not jeopardized by an increase in surgical technicity. Indeed, there was a significant reduction in blood transfusion rates, and the complication rates trended lower in the MIS group compared with the open hysterectomy group, consistent with findings previously reported.^{14,23,24} This approach also benefits institutions with reduced costs, lower re-admission rates, and shorter hospital stays.^{9,14,25}

The choice of surgical approach is determined on a case-by-case basis. Patient characteristics, including uterine size, the absence of uterine descent, and the need to access adnexa, can obviate a vaginal hysterectomy for some surgeons. Similarly, an extremely large uterus, a frozen pelvis requiring extensive adhesiolysis, or a history of multiple previous abdominal operations may lie outside a surgeon's comfort zone for laparoscopy and warrant consultation with an MIS expert. Nevertheless, a laparoscopic approach would yield a more meticulous dissection with less morbidity in this setting. Therefore, establishing a target TI among hospitals with a goal to improve TI across the nation is realistic and should be a priority.

Because the only contributing factor to open hysterectomy in our study was uterine fibroids, the next step in improving TI should be defining techniques to approach large uteri. Gaining technical skills for ligation of uterine arteries at their origin may further reduce use of an open approach and optimize patient outcomes. This requires a comprehensive understanding of the retroperitoneal anatomy and proficiency in laparoscopic dissection techniques. Formative training in female pelvic anatomy as a fundamental of gynaecologic surgery is therefore a requisite competency that should be acquired during residency training. This training, combined with regular engagement in surgical

workshops, such as cadaveric dissections and in-house use of box trainers, will ensure maintenance of skill for the safety and quality of surgical care delivered to women.

CONCLUSION

Our study demonstrates that a high TI in a comparatively small community hospital setting is attainable. The success in increasing TI underlines the cooperative strength of all members of the surgical team, the transference of surgical skills among interested surgeons, and the importance of a consistent, well-trained surgical support team. These factors can be readily established and implemented at an institutional level to allow for wider adoption of minimally invasive approaches for hysterectomy without compromise to patient care or safety. With hysterectomy being the most commonly performed major gynaecologic surgery worldwide, maximizing use of the MIS route is a sound way to enhance patient outcomes and reduce institutional costs.

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