



Variability between individual surgeons in route of hysterectomy for patients with endometrial cancer in Florida



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ABSTRACT

Objectives: Minimally invasive surgery (MIS) was designated as a quality measure for endometrial cancer in 2014. However, national database analyses demonstrate that laparotomy is still performed for this indication. This study aims to assess the route of hysterectomy performed by gynecologic surgeons who manage endometrial cancer in the state of Florida.

Materials and methods: All patients in Florida who were diagnosed with endometrial cancer (both ICD-9 Code 182.0 and ICD-10 Code C54.10), and who received a related surgical procedure from 2014 to 2016 were included. Eligible patients were identified using the Florida Inpatient Discharge Dataset, the Florida Ambulatory and Emergency Discharge Dataset, the Hospital Compare dataset, and the Healthcare Cost Report Information System. The primary surgeon was identified using their national provider identifier (NPI) number. Each surgeon's overall operative volume, MIS volume, and percentage of MIS procedures were collected.

Results: Hysterectomy for endometrial cancer was performed in 6086 patients; 4959 (81.5%) underwent MIS and 1127 (18.5%) had an abdominal approach. Hysterectomy for endometrial cancer was performed by 368 providers in Florida (range of 2–244 surgeries). The percentage of MIS to total hysterectomies for providers who performed 1–10 cases was 72.1%; 11–25 cases was 40.9%; 26–100 cases was 80.1%; and more than 100 cases was 86.1%. Variation in operative route exists amongst low- and high-volume providers.

Conclusions: Statewide databases can be used to identify surgical trends for policy purposes. These findings support the referral of patients with endometrial cancer to surgeons with high MIS volumes.

1. Introduction

Minimally invasive surgery (MIS) was designated as a quality measure for endometrial cancer in 2014 [1–4]. The advantages of MIS are well-known; they include decreased perioperative complications, shorter hospital stay, less pain, and quicker resumption of daily activities [5,6]. One study demonstrated that a robotic approach to hysterectomy is associated with significant reductions in the rates of post-operative surgical (8.3% vs 20.5%) and medical complications (12.3% vs 23.3%) including death (0.0% vs 0.8%), and higher rates of discharge to home (88.8% vs 71.2%) in patients with endometrial cancer [7]. A recent meta-analysis reviewing 8 randomized controlled trials comparing laparotomy and laparoscopy for endometrial cancer concluded that there were no differences in intra-operative complications among the groups, and there were fewer postoperative complications in

the laparoscopy group (relative risk 0.71; 95% confidence interval 0.63–0.79; p value 0.016) [8]. Another prospective trial involving patient-reported outcomes demonstrated that MIS for endometrial cancer was associated with improved quality of life compared with the laparotomy group, which was sustained up to 12 weeks following surgery [9]. Additionally, there are prospective trials that demonstrate no differences in disease-free survival in patients who underwent laparoscopic resection versus laparotomy [10,11].

Despite a large body of data that supports MIS in women with endometrial cancer, laparotomy is still being performed for this indication. National database analyses demonstrated that 52.4% of women were treated with open surgery in 2012–2013; this study showed that patients who received MIS differed by race, practice type, hospital location, and surgeon preference. [2] Another study utilizing the United States National Inpatient Sample database showed that MIS was less

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likely to be performed in patients with Medicaid compared with private insurance, black and Hispanic compared with white patients, and more likely to be performed in high-compared with low-volume hospitals [10]. An analysis of the SEER-Medicare database showed a marked increase in the use of MIS for uterine cancer between 2006 (9%) and 2011 (62%). The authors commented that this may be attributable to widespread adoption of the robotic platform, as these accounted for two-thirds of MIS cases in the later years of the study [11]. An additional consideration is that historic database studies have primarily included inpatient data only, which excluded cases of same-day surgery. This bias may result in under-reporting of actual rates of MIS by missing patients that are discharged via enhanced recovery protocols. For this reason, it is important to ensure accurate reporting with both inpatient and outpatient databases.

Endometrial cancer incidence and mortality have risen sharply in the United States, with black women being twice as likely to die from the disease than white women [12]. Black women are more likely to receive a diagnosis at distant stage and with more aggressive histologic types than other women [12]. Obesity and adiposity-related conditions are strong, causal endometrial cancer risk factors, suggesting that the obesity epidemic is a major contributor to the rising incidence of endometrial [13,14]. Given the increasing incidence and mortality of endometrial cancer, an understanding of the variation and disparities in healthcare delivery is critically important. As outlined by the Institute of Medicine's 2003 report "Unequal treatment: Confronting Racial and Ethnic Disparities in Health Care," analysis of the individual factors contributing to these disparities should be undertaken [15,16]. The framework for the context of disparities includes patient-level, health care system-level, and practitioner-level factors.

In the current study, we evaluate practitioner-level factors contributing to disparities with the primary objective of assessing variability in route of hysterectomy depending on the volume and training (fellowship status) of the gynecologic surgeons who manage endometrial cancer in the state of Florida. Secondary objectives include to analyze whether disparities in route of hysterectomy for endometrial cancer still exist in a state with high utilization of MIS techniques, as well as assessment of patient characteristics, hospital factors, and complications between abdominal hysterectomy and MIS.

2. Materials and methods

2.1. Data collection

The following datasets were utilized for this analysis: the Florida Inpatient Discharge Dataset, which provides anonymized patient-level data from all acute care hospitals in the state; the Florida Ambulatory and Emergency Discharge Dataset, which includes data from free-standing ambulatory surgical centers and hospitals with outpatient surgery services; the Hospital Compare dataset, which provides information from the Centers for Medicare and Medicaid Services (CMS) regarding healthcare facility characteristics and quality metrics; the National Plan and Provider Enumeration System (NPPES), which provides basic information about providers who have a National Provider Identifier (NPI) number; and the Healthcare Cost Report Information System, which includes annual reports from healthcare facilities to CMS [17–19]. Data was collected from 2014 through 2016. These dates were chosen because each of the aforementioned datasets were able to be utilized for the same overlapping timeframe. Due to the publicly-available nature of the dataset and the anonymous patient information, the Institutional Review Board categorized this research as exempt.

Inclusion criteria was all patients in the state of Florida who were diagnosed with endometrial cancer (both ICD-9 Code 182.0 and ICD-10 Code C54.10), and who received a related surgical procedure from 2014 to 2016. Exclusion criteria were surgeries that were classified as urgent or emergent and patients who had more than one procedure or

procedure type as our ability to match providers and procedures are reduced when more than one procedure is listed.

Procedure codes were assessed to classify patients into MIS and open groups. MIS procedures were vaginal, conventional laparoscopy, and robotic-assisted laparoscopy. ICD-9, ICD-10, and CPT codes were cross-referenced to confirm the route of surgery. During classification of cases, if an MIS indicator was present the surgery was classified as minimally invasive. If no minimally invasive code was present but an abdominal code was present, then it was classified as abdominal.

Surgeon sub-specialty training status was verified by performing a cross-reference search of each provider's NPI number in the NPPES. Surgeons were classified as generalist gynecologist or gynecologic oncologist. Individual surgeons were also classified into groups based upon the number of cases of hysterectomy performed over the 3-year period. Complications were defined by ICD-9 and ICD-10 codes for surgical site infection, wound disruption, sepsis, pulmonary embolism and/or deep venous thrombosis, stroke, myocardial infarction, myocardial arrest, pneumonia, acute post hemorrhagic anemia, and other non-surgical site infections. Due to the de-identified nature of the dataset, all complications were restricted to the initial surgical encounter and could not be tracked during postoperative visits or readmissions. Complications were combined to create a binary variable indicating presence or absence for multivariable models due to the low number occurring in each category.

The following patient characteristics were collected: age, race (white, African American/black, and other), ethnicity, hospital location including region (based on the definitions by the American College of Obstetricians and Gynecologists) and rurality (based on Florida Department of Health), and insurance payer type (Medicare, Medicare Managed Care, Medicaid, commercial, or other) [20,21]. Patient comorbidities were assessed using the Elixhauser Score (categories are 0, 1–2, 3–5, and greater than 5) [21]. Obesity was determined as a BMI of greater than 30. Hospital facility size was determined by the number of staffed beds: small is less than 100, medium is greater than or equal to 100 but less than 200, and large is greater than or equal to 200. Teaching status was calculated by the number of medical residents to licensed beds. If the ratio was greater than 0, the facility was designated as a teaching site [22]. Hospital organizational ownership was categorized as non-federal government, for-profit, and not-for-profit.

2.2. Statistical analysis

Data were described as percentages or means. The Kruskal-Wallis test was utilized for continuous variables and chi-square tests were used to compare categorical variables. In addition, mixed effects multivariable logistic regression models were utilized to compare differences in surgeon type, patient characteristics, facility characteristics, location, comorbidities, year, and physician surgical volume between MIS versus abdominal approaches. Both physician and hospital identification numbers were utilized as random effects within the model. These were utilized to help adjust for differences which might be observed due to groups of patients being seen by specific physicians, as well as practice differences between hospitals. In other words, the models adjust for nesting of patients under physicians and physicians at hospital facilities. In addition, a logistic regression comparing influential variables and the presence of a complication was performed. Due to the limited number of complications in the dataset, we were unable to include all variables assessed in previous models. As such, we chose influential variables to determine whether or not there was a difference in complications based upon physician subspecialty. All tests of significance were two-sided, and both the 95% confidence intervals and p-values are reported. For logistic regression models, odds ratios and beta coefficients were utilized. Analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, North Carolina).

Table 1
Distribution of selected characteristics among women with endometrial cancer in Florida who underwent hysterectomy from 2014 through 2016.

Variable*	Abdominal	Minimally	Total	P-value
	(N = 1127)	Invasive (N = 4959)	(N = 6086)	
Age				0.2199
Mean (SD)	64.1 (11.5)	63.5 (10.7)	63.6 (10.9)	
Range	24.0–97.0	23.0–94.0	21.0–97.0	
Year				0.0008
2014	249 (22.1%)	981 (19.8%)	1230 (20.3%)	
2015	469 (41.6%)	1874 (37.8%)	2343 (38.5%)	
2016	409 (36.3%)	2104 (42.4%)	2513 (41.3%)	
Race/Ethnicity				< 0.0001
Black or African American	249 (24.1%)	422 (9.1%)	671 (11.8%)	
White	596 (57.8%)	3452 (74.0%)	4048 (71.1%)	
Hispanic or Latino	187 (18.1%)	788 (16.9%)	975 (17.1%)	
Patient Insurance Payer				< 0.0001
Commercial	408 (36.2%)	2183 (44.0%)	2591 (42.6%)	
Medicaid	70 (6.2%)	124 (2.5%)	194 (3.2%)	
Medicare	578 (51.3%)	2386 (48.1%)	2964 (48.7%)	
Other	71 (6.3%)	266 (5.4%)	337 (5.5%)	
Region of Florida				< 0.0001
Panhandle	57 (5.1%)	171 (3.4%)	228 (3.7%)	
North	219 (19.4%)	639 (12.9%)	858 (14.1%)	
Central	142 (12.6%)	1177 (23.7%)	1319 (21.7%)	
West	252 (22.4%)	1211 (24.4%)	1463 (24.0%)	
East	317 (28.1%)	810 (16.3%)	1127 (18.5%)	
Peninsula	140 (12.4%)	951 (19.2%)	1091 (17.9%)	
Insurance Payer				< 0.0001
Medicaid/Medicare	686 (56.6%)	2694 (50.7%)	3380 (51.8%)	
Commercial	449 (37.0%)	2319 (43.8%)	2768 (42.5%)	
Other	78 (6.4%)	287 (5.4%)	365 (5.6%)	
Teaching Hospital	935 (83.3%)	3581 (72.3%)	4516 (74.3%)	< 0.0001
Hospital Size				0.083
Small	4 (0.4%)	52 (1.0%)	56 (0.9%)	
Medium	74 (6.6%)	309 (6.2%)	383 (6.3%)	
Large	1049 (93.1%)	4598 (92.7%)	5647 (92.8%)	
Hospital Volume				< 0.0001
Low	158 (14.0%)	446 (9.0%)	604 (9.9%)	
Medium	214 (19.0%)	1174 (23.7%)	1388 (22.8%)	
High	755 (67.0%)	3339 (67.3%)	4094 (67.3%)	
Surgeon Type				< 0.0001
Gynecologic oncology	1026 (91.0%)	4705 (94.9%)	5731 (94.2%)	
General gynecology	101 (9.0%)	254 (5.1%)	355 (5.8%)	
Surgeon Volume				< 0.0001
Mean (SD)	90.4 (57.4)	109.1 (57.0)	105.6 (57.5)	
Range	2–244	2–244	2–244	
Elixhauser Comorbidity Scale				< 0.001
0	196 (17.4%)	1590 (32.1%)	1786 (29.3%)	
1–2	603 (53.5%)	2659 (53.6%)	3262 (53.6%)	
3–5	310 (27.5%)	700 (14.1%)	1010 (16.6%)	
More than 5	18 (1.6%)	10 (0.2%)	28 (0.5%)	
Surgeons with more than one surgery	1127 (100.0%)	4959 (100.0%)	6086 (100.0%)	–

ACOG, American College of Obstetricians and Gynecologists.

*p-values are reported using Kruskal-Wallis test for continuous variables and chi-square for categorical variables.

3. Results

3.1. Overall results

Hysterectomy for endometrial cancer was performed in 6086 patients; 4959 (81.5%) underwent MIS and 1127 (18.5%) had an abdominal approach. Hospitals providing hysterectomies included 74.3% teaching, 92.8% large-sized, and 67.3% high-volume. Gynecologic oncologists performed 94.2% of all hysterectomies for endometrial cancer versus 5.8% performed by general gynecologists (Table 1). All surgeons performed more than one hysterectomy for endometrial cancer in the study period.

Hysterectomy for endometrial cancer was performed by a total of 368 providers in Florida; they performed a range of 2–244 surgeries. The percentage of MIS to total hysterectomies for providers who

performed 1–10 cases was 72.1%; 11–25 cases was 40.9%; 26–100 cases was 80.1%; and more than 100 cases was 86.1% (Fig. 1).

Our data shows that variation in operative route exists amongst low- and high-volume providers, and some providers did not perform any MIS for patients with endometrial cancer. Surgeries for endometrial cancer were performed both by general gynecologists (n = 46) as well as gynecologic oncologists (n = 83). As shown in Fig. 2, gynecologic oncologists performed significantly more hysterectomies for endometrial cancer (median 61 cases, 94.2% of endometrial cancer surgeries, range 2–244) compared to general gynecologists (median 3 cases, 5.8% of endometrial cancer surgeries, range 2–45; p value < 0.001). The rates of MIS to total hysterectomies did not differ between gynecologic oncologists (median 87%, range 0–100%) and general gynecologists (median 84.8%, range 0–100%, p value 0.25).

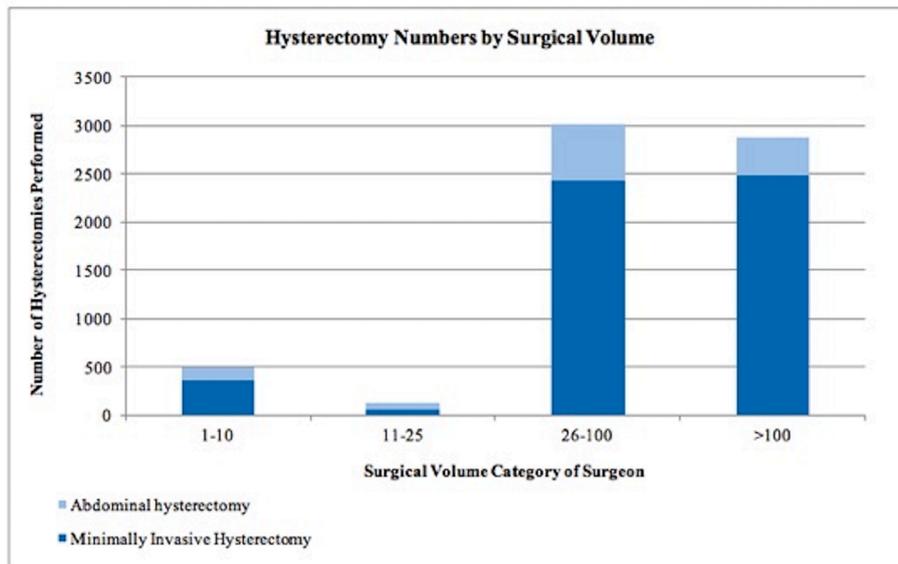


Fig. 1. Hysterectomy numbers by surgical volume.

3.2. Logistic regression

A multivariable logistic regression model predicting the odds of having MIS (Table 2) showed that minimally invasive surgery rates increased in 2016 (OR 1.38, 95% CI 1.09–1.74, p-value 0.0072) when stratified by year. Patient factors associated with lower rates of MIS include Medicaid insurance (OR 0.57, 95% CI 0.37–0.87, p-value 0.0091); higher Elixhauser Comorbidity Scale (score 1–2 OR 0.56, 95% CI 0.44–0.7; score 3–5 OR 0.33, 95% CI 0.25–0.43; score more than 5 OR 0.08, 95% CI 0.03–0.23; all p-values < 0.0001), and black race (OR 0.44, 95% CI 0.35–0.56, p-value < 0.0001). With each 10-case increase in physician volume, there was a higher odds of MIS (OR 1.09, 95% CI 1.03–1.15, p-value 0.0016). There was no difference in the odds of MIS for endometrial cancer between gynecologic oncologists versus generalist gynecologists (OR 0.85, 95% CI 0.43–1.68, p-value 0.6346).

A multivariable logistic regression model predicting the odds of

having a complication (Table 3) showed lower rates with MIS (OR 0.23, 95% CI 0.16–0.34, p-value < 0.0001). There were higher rates of complications in patients with an Elixhauser Comorbidity Score of 3–5 (OR 3.96, 95% CI 2.16–7.27, p-value < 0.0001). There was no statistically significant difference in complication rates between gynecologic oncologists versus generalist gynecologists (OR 1.06, 95% CI 0.5–2.26, 0.8695). None of the other variables were statistically significant.

4. Discussion

4.1. Considerations for surgical route

Previous studies have documented variations in MIS versus abdominal hysterectomy based upon patient race, practice type, hospital location, and surgeon preference. This study sought to assess variability in route of hysterectomy amongst gynecologic surgeons who manage

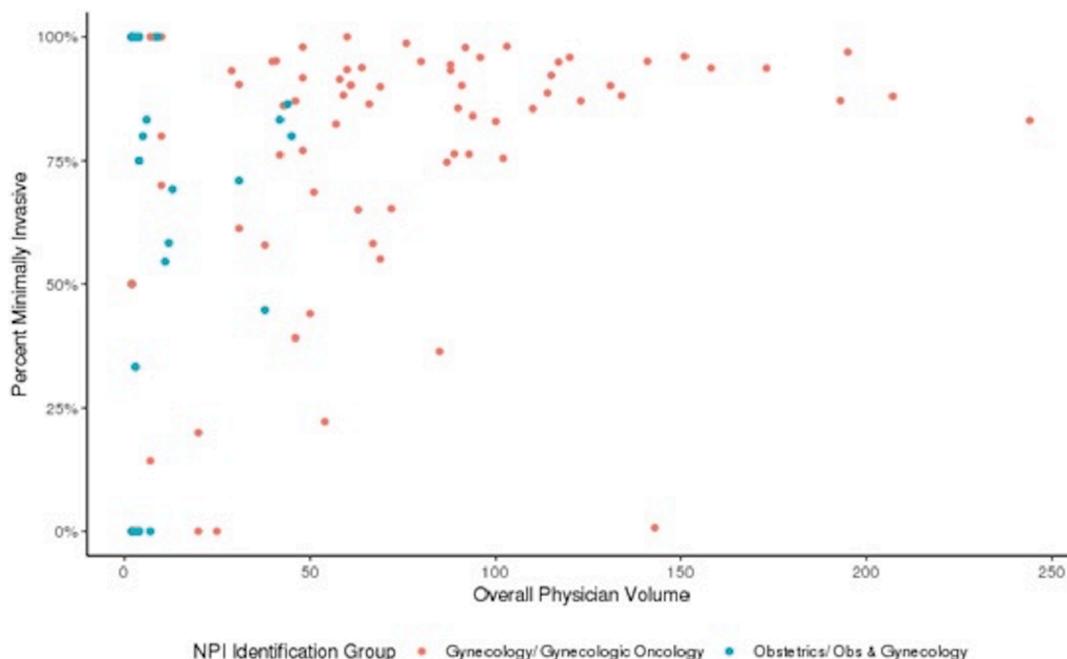


Fig. 2. Percentages of MIS stratified by surgeon volume and sub-specialty.

Table 2
Nested multivariable mixed effects logistic regression model predicting the odds of having MIS.

Effect	Odds Ratio (95% Confidence Interval)	P-value
Surgeon Volume (10-case increase)	1.09 (1.03, 1.15)	0.0016
General Gynecologist	0.85 (0.43, 1.68)	0.6346
Year		
2014	1.00 (Reference)	N/A
2015	1.01 (0.81, 1.26)	0.9569
2016	1.38 (1.09, 1.74)	0.0072
Practice Setting		
Urban	1.00 (Reference)	N/A
Rural	1.07 (0.7, 1.64)	0.7416
Insurance Payer		
Commercial	1.00 (Reference)	N/A
Medicaid	0.57 (0.37, 0.87)	0.0091
Medicare	1.01 (0.78, 1.32)	0.9377
Other	1.22 (0.84, 1.78)	0.2900
Elixhauser Comorbidity Scale		
0	1.00 (Reference)	N/A
1-2	0.56 (0.44, 0.7)	< 0.0001
3-5	0.33 (0.25, 0.43)	< 0.0001
More than 5	0.08 (0.03, 0.23)	< 0.0001
Obese	1.03 (0.85, 1.23)	0.7889
Race/Ethnicity		
White	1.00 (Reference)	N/A
Black or African American	0.44 (0.35, 0.56)	< 0.0001
Hispanic or Latino	0.91 (0.69, 1.19)	0.4736
Age (10-year increase)	1.03 (0.93, 1.14)	0.5704
Region of Florida		
Panhandle	1.00 (Reference)	N/A
North	0.61 (0.14, 2.61)	0.5100
Central	1.6 (0.36, 7.09)	0.5380
West	0.8 (0.19, 3.3)	0.7569
East	0.71 (0.18, 2.87)	0.6334
Peninsula	1.81 (0.45, 7.26)	0.4004
Teaching Hospital	1 (0.53, 1.92)	0.9895
Hospital Size		
Small	1.00 (Reference)	N/A
Medium	0.97 (0.14, 6.78)	0.9789
Large	1.21 (0.15, 9.97)	0.8612

Table 3
Multivariable Logistic Regression Model Predicting the Odds of having a Complication.

Variable	Odds Ratio (95% Confidence Interval)	P-value
Surgeon Volume (10-case increase)	1.01 (0.97, 1.04)	0.7141
General Gynecologist	1.06 (0.5, 2.26)	0.8695
Minimally Invasive Surgery	0.23 (0.16, 0.34)	< 0.0001
Insurance Payer		
Medicaid	1.75 (0.81, 3.77)	0.1555
Medicare	0.9 (0.5, 1.6)	0.7099
Other	1.08 (0.47, 2.46)	0.8636
Elixhauser Comorbidity Scale		
1-2	1.77 (0.99, 3.16)	0.0531
3-5	3.96 (2.16, 7.27)	< 0.0001
More than 5	1.63 (0.2, 13.18)	0.6491
Race/Ethnicity		
Black or African American	1.12 (0.68, 1.84)	0.6632
Hispanic or Latino	1.25 (0.76, 2.04)	0.3777
Age (10-year increase)	1.14 (0.92, 1.42)	0.2390

endometrial cancer in the state of Florida. Our study found that variation in operative route for patients with endometrial cancer exists amongst low- and high-volume providers. Though gynecologic oncologists performed significantly more hysterectomies for endometrial cancer than general gynecologists, there was no difference in MIS use or complication rates based on provider subspecialty training.

While MIS is the standard of care for surgical management for patients with endometrial cancer, there are scenarios that may require laparotomy. Considerations for open incision include multiple prior abdominal incisions, morbid obesity, medical comorbidities, anatomic considerations (uterine fibroids, size, and estimated weight), and concern for upper abdominal disease. Some of the challenges in performing MIS associated with obesity include difficult laparoscopic entry through subcutaneous tissue, inability to adequately ventilate the patient during steep Trendelenburg positioning, and a need for bariatric trocars in order to reach the pelvis. However, laparotomy in this population is associated with increased risk of wound complications (including infection and seroma formation) and development of ventral hernia. Therefore it is especially important for obese patients to be referred to high-volume MIS providers in order to provide them with the best care. In our study, obesity was not an independent risk factor for having open surgery.

Our study found that certain patient populations, including African Americans, those with Medicaid insurance, and individuals with increased comorbidities were more likely to undergo abdominal hysterectomy than MIS. This finding is consistent with previous research that reported racial disparities in the receipt of minimally invasive hysterectomy among women undergoing inpatient treatment for endometrial cancer in the United States [2,23]. Of note, abdominal hysterectomy was associated with increased complication rates. Together, these findings have important implications for clinicians, payers, and policy makers.

Our study suggests that there is a wide range of providers who perform surgery for endometrial malignancies in the state of Florida. Some of the providers performed as few as 2 cases, while others performed more than 100 cases. Multivariable regression showed higher rates of MIS as provider volume increased. Both generalist gynecologists and gynecologic oncologists operated on patients with endometrial cancer. In fact, some generalist surgeons performed up to 50 cases. Although MIS rates were not different between general gynecologists and gynecologic oncologists, this is potentially concerning given their lack of specialty training in lymphadenectomy or other cancer staging techniques. Additional contributing factors may be a low pre-operative suspicion of malignancy, patients who did not recognize symptoms of possible endometrial cancer and presented to surgeons with varying levels of experience, and lack of pre-operative endometrial sampling in patients undergoing planned hysterectomy.

In a retrospective cohort study involving four high-volume National Comprehensive Cancer Network (NCCN) centers, 86.5% of patients with endometrial cancer underwent successful MIS. In their population, disparities of age, race, and BMI were not observed; in fact, factors associated with failure to undergo MIS were uterine size > 12 cm and stage III or IV disease [24]. This study suggests that high rates of MIS are possible when patients are treated at high-volume centers, and laparotomy should be reserved for scenarios where it is deemed more appropriate based on clinical decision-making. Ultimately, we feel that general gynecologists should be cautioned that appropriate referral to a fellowship-trained gynecologic oncologist is preferred to decrease the risk for re-operation, incomplete staging, or dissemination of disease [25,26].

4.2. Strengths and weaknesses

Strengths of our study include the use of both inpatient and outpatient surgical data, as well as inclusion of a large sample of patients. This is the first study to our knowledge that evaluated disparities in MIS for endometrial cancer based on practitioner-level factors. Limitations of our study include the possibility that the population in Florida is not generalizable to the rest of the United States. Additionally, the administrative and retrospective nature of this data limits the ability to confirm diagnosis codes, follow patient outcomes, and obtain more detailed information regarding counseling or co-morbidities that may

have impacted choice of route of hysterectomy. We did not have access to the cancer stage, which precludes decision-making based on dissemination of disease. We also did not have access to the BMI of each patient, so obesity (BMI > 30) was considered to be a surrogate marker of this measure. Because the NPI numbers were de-identified, we were unable to determine the number of years of practice that each surgeon had after the completion of his or her training. In addition, our analysis of complications is limited to those encountered during the initial hospital stay or outpatient visit, as patient identifiers were not available to track patient revisits or readmissions. This is an inherent limitation of working with large databases, and will likely result in underreporting of the true complication rate.

5. Conclusion

Though Florida has a high adoption of MIS for endometrial cancer, laparotomy is still performed in higher rates among racial minorities, Medicaid-insured, and sicker patients. Although our study is unable to assess the individual surgical decision-making in each case, there are likely underlying provider and policy issues that contribute to this imbalance. In addition, we found a wide variety of case volume among the surgeons who perform hysterectomies for endometrial cancer in Florida. Although the majority of these providers are fellowship-trained gynecologic oncologists, some of the cases are performed by generalist gynecologists who have not received formal training in cancer staging procedures. We hope that by highlighting these cases, there will be even higher rates of referral to the appropriate providers in order to uphold the standard of care.

Disclosure statement

The authors report no conflicts of interest.

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