Estimated costs of preoperative evaluation of postmenopausal hysterectomy for prolapse at a safety-net hospital: an observational descriptive study

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BACKGROUND: In practice, preoperative evaluation prior to hysterectomy varies. Unnecessary preoperative evaluation may add cost and risk with little benefit to the patient.

OBJECTIVE: This study aimed to describe practice patterns and the associated costs related to preoperative evaluations before hysterectomy for prolapse at a safety-net hospital.

STUDY DESIGN: This was a retrospective cohort study of postmenopausal women who underwent a hysterectomy for prolapse. Nonfacility-associated cost data were obtained from the Centers for Medicare Services. The biopsy cost was estimated to be $172.55 and $125.23 for ultrasounds.

RESULTS: A total of 505 postmenopausal cases were identified. Of those, 155 (31%) underwent a preoperative biopsy, 305 (60%) had an ultrasound, and 124 (25%) had both. Of those, 72.9% had an indication for a biopsy. A total of 64 biopsies and 216 ultrasounds lacked clear indication. Of those, 56 biopsies were performed for bleeding in cases with an endometrial thickness of <4 mm. The total cost of nonvalue-added testing was $42,576.

CONCLUSION: Adherence to a strict preoperative algorithm would have saved $38,092 over the study period, although 0.50% of these biopsies would potentially have detected endometrial cancer preoperatively. These results underscore the value of clinical algorithms at teaching institutions.

Key words: biopsy, cost analysis, cost savings, preoperative evaluation, postmenopausal, ultrasound, value, waste

Introduction

Hysterectomy is the second most common procedure performed among women in the United States after cesarean delivery. There are nearly 600,000 benign hysterectomies performed per year in the United States alone, and almost half are estimated to be for the indication of pelvic organ prolapse (POP).[1] According to the International Federation of Gynecology and Obstetrics Working Group guidelines, transvaginal ultrasound (US) is not recommended for the primary evaluation of patients with POP.[2] However, a transvaginal US or an endometrial biopsy (EMB) may be indicated to rule out concomitant pathology in these patients if they also have pelvic pain or abnormal uterine bleeding.[3] Preoperative detection of abnormal pathology may affect the surgical approach.

A routine preoperative US and/or EMB before surgery would increase the rate of detection of abnormalities, but these come with added costs, potential delays, and risks to the patient.[4,5] In addition, there may be systematic inaccuracies in such screening methods, leading to false negatives.[6] Our primary objective was to examine the practice patterns and associated costs related to preoperative evaluations before hysterectomy for prolapse in postmenopausal women at a large teaching, safety-net hospital.

Safety-net hospitals are defined by the Institute of Medicine as organizations "that organize and deliver a significant level of health care and other related services to the uninsured, Medicaid, and other vulnerable patients."[7] Several authors have suggested that coding data, that is, the use of the International Classification of Diseases (ICD) codes, is inaccurate for the evaluation of quality and surgical outcomes, particularly in the safety-net system.[8,9] Significantly, safety-net hospitals are more likely to care for vulnerable patient populations.[10] Despite the use of electronic medical records, in our system, individual chart review is the most accurate, although labor intensive, way to obtain data for this disenfranchised patient population. Because preoperative

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Why was this study conducted?

This study aimed to identify nonvalue-added costs associated with the preoperative evaluation for pelvic organ prolapse surgery at an academic safety-net hospital.

Key findings

Nonvalue-added endometrial biopsies and ultrasounds led to an excess cost of $38,092 over 12 years. A total of 612 endometrial biopsies need to be performed to detect 1 endometrial cancer

What does this add to what is known?

Strict algorithms for preoperative evaluation can lead to a significant reduction in nonvalue-added testing and are recommended for safety-net systems.

evaluations may vary between providers, our secondary objectives were to describe any potentially nonvalue-added testing and to estimate the cost and safety implications if universal adherence to a preoperative algorithm (Figure 1) were mandated.

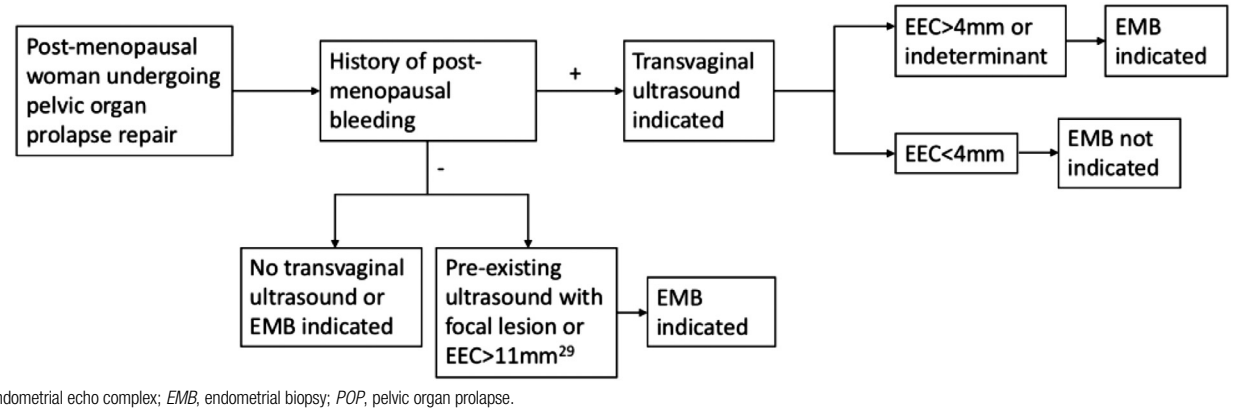
Materials and Methods

This was a retrospective cohort study of postmenopausal women who underwent hysterectomy for POP between July 1, 2007, and July 1, 2019, at a large, teaching, safety-net hospital. Clinical cases at this hospital are evaluated only by academic faculty in conjunction with residents or fellows. All surgical hysterectomy cases among postmenopausal women were reviewed and included if the operative note included the preoperative diagnosis of POP. Cases were excluded if the indication for hysterectomy included known malignancy, suspected malignancy, or atypical hyperplasia or if final histology results were not available for review. Medical records were reviewed for demographic data including age, self-reported race and ethnicity, body mass index, personal and family history of cancer, history of cytologic screening, history of abnormal uterine bleeding or pain, and menopausal status. The electronic medical record system that was in place during the study period allows access to all preoperative evaluations performed at the institution. Preoperative evaluation was reviewed including the cervical cytology screening, EMB, and US results. Operative details including estimated blood loss, surgical procedure, organs removed, and final histology results that were recorded and cross-referenced for accuracy. Procedures were defined as nonvalue added if there was no documentation in the clinical record that provided an indication for the procedure. Acceptable documented indications for EM included: postmenopausal vaginal bleeding or abnormal uterine bleeding. Acceptable indications for US included pelvic or abdominal pain, suspected mass on examination, previous suspicious imaging possibly indicating an adnexal mass, postmenopausal vaginal bleeding, and abnormal uterine bleeding.

Data were recorded using the Research Electronic Data Capture database hosted at the University of Southern California.[11] Statistical analysis was performed using SPSS software version 26 (IBM Corp, Armonk, NY). Descriptive statistics including rates and confidence intervals were performed to describe the rate of abnormal histology by organ type. Univariate comparisons for demographics and preoperative results were correlated with pathologic findings using Fisher's exact tests for binary variables, Student's *t* tests for continuous variables, and Mann-Whitney U tests for categorical variables.

National, nonfacility cost data were obtained from the Centers for Medicare & Medicaid Services (CMS) (accessed March 7, 2020). The estimate included the nonfacility price for EMB because the procedures are performed in an outpatient clinic. Both the cost of performance of the EMB and the pathology fee

FIGURE 1
POP preoperative screening algorithm[29]



EEC, endometrial echo complex; *EMB*, endometrial biopsy; *POP*, pelvic organ prolapse.

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to process and analyze the sample are included in the CMS estimate of $172.55. The US cost estimate included the cost of the transvaginal US of $125.23.

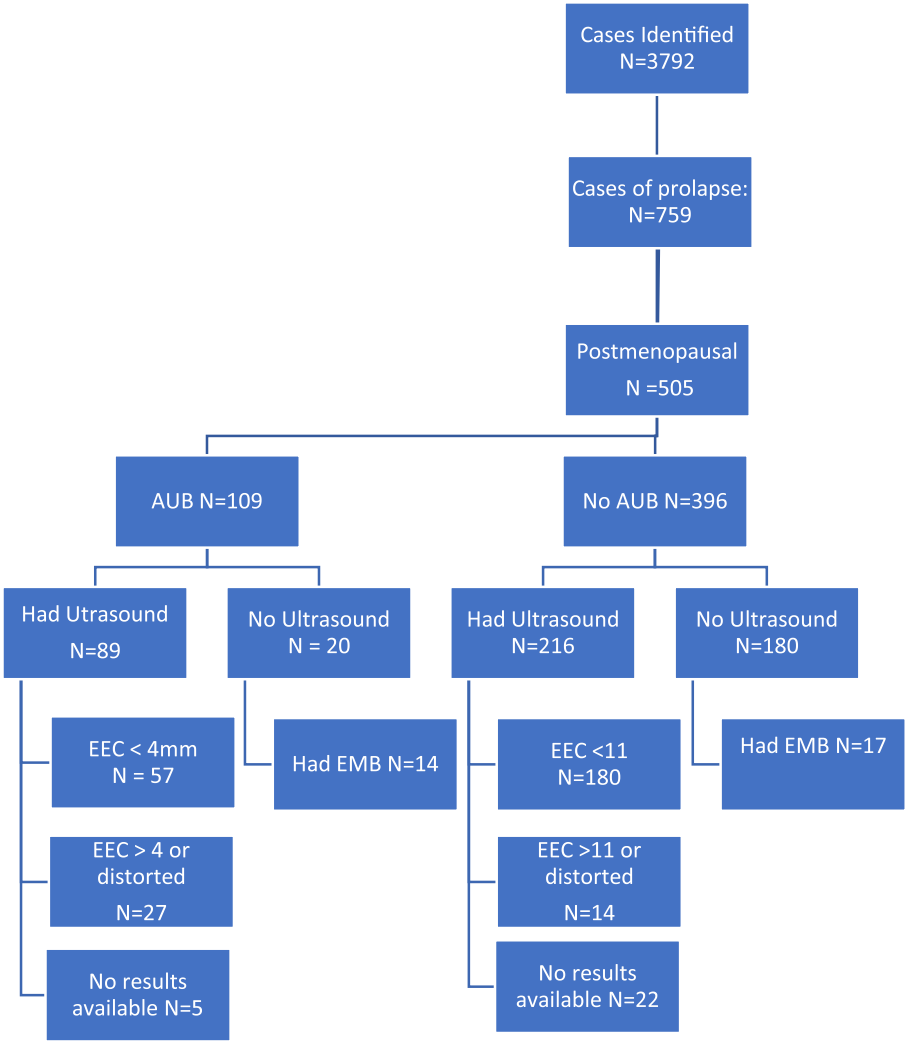
Results

A total of 3792 patients who underwent hysterectomy were identified between July 1, 2007, and July 1, 2019. Of those, 759 were for the indication of POP and 505 were for postmenopausal women. The flow diagram is shown in Figure 2. The demographics of the study population and the distribution of women who underwent EMBs and USs are shown in Table 1.

Overall, there were 155 women who underwent biopsy before surgery, 64 of whom did not have a clearly documented indication. As shown in Table 2, of these 64 women, 2 were found to have polyps, and none were found to have malignancy or premalignancy. The total cost of the nonvalue-added EMBs was estimated to be $11,043 over the study period. For comparison, the total cost of 117 indicated EMBs during the study period was $20,188.35 (assuming a cost of $172.55 per EMB). A sensitivity analysis was performed in which 50% of nonvalue-added EMBs were assumed to be truly indicated, but undocumented; using this estimate, the range of costs of nonvalue-added EMBs was $5521 to $11,043. Patient discomfort and anxiety were not recorded. To estimate the number needed to treat to identify a cancer, an estimated rate of 2% to 4.9% chance of malignancy within a polyp was used.[6,11] Assuming a 2% rate of malignancy within asymptomatic polyps, the number of EMBs that needed to be performed to detect 1 malignancy was 1600. Assuming a 4.9% rate of malignancy, the number of EMBs needed to detect 1 malignancy was 612.

Overall, there were 305 women who underwent a US before surgery, 216 of whom did not have a clearly documented indication for US. Of these 216

FIGURE 2
Flow of patients through the study



AUB, abnormal uterine bleeding; *EEC*, endometrial echo complex; *EMB*, endometrial biopsy.

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TABLE 1
Demographics and operative factors by type of preoperative evaluation

Characteristics	Everyone n=505	EMB (n=155)	Ultrasound (n=305)	Either (n=336)	Both (n=124)
Age (y), median (IQR)	61 (57–64.5)	60 (56–64)	60 (56–65)	60 (56–65)	60 (55.2–65)
BMI (kg/m^2), median (IQR)	28.4 (25.8–31.4)	28.2 (25.3–32.3)	28.3 (25.2–31.6)	28.4 (25.2–31.6)	27.9 (25.3–32.2)
Race and ethnicity					
Hispanic or Latina	435 (86.1)	135 (87.2)	267 (87.5)	293 (87.2)	109 (87.9)
White	12 (2.4)	5 (3.2)	5 (1.6)	7 (2.1)	3 (2.4)
Black or African American	5 (1.0)	0	2 (0.7)	2 (0.6)	0
Asian American	25 (5.0)	8 (5.2)	14 (4.6)	16 (4.8)	6 (4.8)
Other	11 (2.2)	2 (1.3)	6 (2.0)	7 (2.1)	1 (0.8)
Declined to state	17 (3.4)	5 (3.2)	11 (3.6)	11 (3.3)	5 (4.0)
Active oral HRT, n (%)	13 (2.6)	3 (1.9)	6 (2.0)	7 (2.1)	2 (1.6)
Personal history of cancer	18 (3.6)	4 (2.6)	9 (3.0)	9 (2.7)	4 (3.2)
Family history of cancer	31 (6.1)	17 (11.0)	38 (12.5)	39 (11.6)	16 (12.9)
Known smoker (current), n (%)	39 (7.7)	10 (6.5)	19 (6.2)	22 (6.5)	7 (5.6)
Pack-years, median (IQR)	12.5 (2.25–30)	24 (5–30)	5.5 (1.3–27.75)	8 (1.4–30)	16 (3.5–28.5)
Postmenopausal vaginal bleeding, n (%)	109 (21.6)	83 (53.5)	89 (29.2)	103 (30.7)	69 (55.6)
Vaginal estrogen, n (%)	79 (15.6)	29 (18.7)	52 (17.0)	54 (16.1)	27 (21.8)
Surgical approach					
Vaginal	338 (66.9)	90 (58.1)	210 (68.9)	225 (67)	75 (60.5)
Laparoscopic or robotic or laparoscopic vaginal	78 (15.4)	28 (18.1)	50 (16.4)	52 (15.5)	26 (21.0)
Abdominal	89 (17.6)	37 (23.9)	45 (14.8)	59 (17.6)	23 (18.5)

BMI, body mass index; *EMB*, endometrial biopsy; *HRT*, hormone replacement therapy; *IQR*, interquartile range.

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TABLE 2
Endometrial biopsy indications and results

Indications and results	n (%)	Benign	Polyp	Hyperplasia	Malignancy	Insufficient for diagnosis
Overall	155	120	16	1[a]	0[a]	16
Indication for bleeding	83 (53.5)	66 (55.0)	11 (68.75)	1[a] (100)	0[a]	5 (31.25)
Indication for bleeding and EEC >4 mm or indeterminate	27 (17.4)	18 (15.0)	7 (43.75)	1[a] (100)	0[a]	1 (6.25)
Indication for EEC >11 mm without any bleeding	7 (4.5)	3 (1.7)	3 (18.75)	0[a]	0[a]	1 (6.25)
Indication unclear (no bleeding documented) (1 outside result not recorded)	64 (41.3)	51 (42.5)	2 (12.5)	0[a]	0[a]	10 (62.5)

EEC, endometrial echo complex.

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[a] Because of the exclusion criteria of preoperative diagnosis of hyperplasia/malignancy, only unanticipated malignancies would be reported here.

women, incidental findings were found in 50, including 7 women with adnexal masses greater than 3 cm and 14 women with EECs thicker than 11 mm (Table 3). Patients with endometrial thickening were assessed using an EMB and were included in the risk of endometrial cancer calculation above. The total cost of the nonvalue-added USs was estimated to be $27,049. For comparison, the total cost of 89 indicated USs during the study period was $11,145.47 (assuming a cost of $125.23 per US). A sensitivity analysis was performed in which case 50% of nonvalue-

TABLE 3
Ultrasound indications and findings

Indications and findings	N %	Endometrial thickness >4 mm	Endometrial thickness >11 mm	Endometrial thickness indeterminate	Fibroids	Adnexal mass >3 cm
Overall	305	79	22	15	46 median size, 2.3 cm (1.4–3.2)	11
Indication for bleeding	89 (29.2)	27 (34.2)	8 (36.4)	4 (26.7)	15 (32.6) median size, 1.8 (1.25–3.0)	4 (36.4)
Unclear indication	216 (70.1)	52 (65.8)	14 (63.6)	11 (73.3)	31 (67.4)	7 (63.6)

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added USs were assumed to be truly indicated, but undocumented; using this estimate, the range of costs of nonvalue-added USs was $18,635 to $27,049. Assuming a conservative risk of 7% of malignancy (if all the cysts found were complex) then the number needed to treat to find 1 ovarian or uterine malignancy was 440.[12,13]

If a US strategic approach to postmenopausal vaginal bleeding had been used (EMB would be performed only for an US endometrial thickness of more than 4 mm), an additional 56 EMBs could potentially have been avoided for an additional cost savings of $9663. Table 4 shows the total costs expected if an US strategic approach was used with varying rates of positive US results.

Discussion

This study examined the practice patterns and associated costs related to preoperative testing before a hysterectomy for prolapse in postmenopausal women at a large, teaching, safety-net hospital. Throughout this examination, we sought to identify nonvalue-added testing and the estimate cost implications if universal adherence to a preoperative algorithm were mandated. Furthermore, we sought to estimate the potential dangers of forgoing nonvalue-added testing by extrapolating rates of potential malignancy from the literature.[6,12] We found 64 suspected nonvalue-added EMBs (41% of the total EMBs) and 227 suspected nonvalue-added USs (74% of the total USs) for a total excess financial cost of $38,092. Extrapolated across the many safety-net institutions in the United States, this could represent a significant excess cost of care. There is little data on the comparison of rates of nonvalue-added testing because rates of biopsy and imaging before surgery varies by site[4,14] and may depend on national or society guidelines.[15,16] For otherwise healthy individuals undergoing a primary evaluation for POP, US is not recommended and EMBs are indicated only for women with postmenopausal bleeding.[3]

Altogether, we identified a significant amount of nonvalue-added testing that led to unnecessary costs and presumably added anxiety, discomfort, and potentially delays for our patients. Adherence to a standardized preoperative algorithm (Figure 1) that reserves US for the evaluation of symptoms would certainly have decreased the number of nonvalue-added USs.[17–19] US examinations often find incidental findings that may lead to excess anxiety for the patient and the doctor or potentially change the planned surgical procedure.[20,21] In addition, US examinations take time, are invasive and uncomfortable,[22] and require the patient to return for multiple visits, all of which are barriers to receiving timely surgery, particularly in the safety-net system.[23]

TABLE 4
Total costs using recommended algorithm, assuming variable percentages of ultrasound-indicated biopsies among women with postmenopausal vaginal bleeding

Reference	Proposed	Total number of women with noted endometrial thickness or total sample size (%)	Ultrasound total cost (n)	Endometrial biopsy total cost (n)	Total cost
—	Current cohort	n/a	$38,195.15 (n=305)	$26,745.25 (n=155)	$64,940.40
—	Using proposed algorithm	94/305 (30.8)	$13,650.07 (n=109)	$5866.70 (n=34)	$19,516.77
Karlsson et al,[30] 1995	Using proposed algorithm	620/1138 (54.5)	$13,650.07 (n=109)	$10,353.00 (n=60)	$24,003.07
Ferrazzi et al,[31] 1996	Using proposed algorithm	456/930 (49.0)	$13,650.07 (n=109)	$9317.70 (n=54)	$22,967.77
Gull et al,[32] 2003	Using proposed algorithm	161/339 (47.5)	$13,650.07 (n=109)	$8972.60 (n=52)	$22,622.67
Wong et al,[33] 2016	Using proposed algorithm	1558/4383 (35.5)	$13,650.07 (n=109)	$6729.45 (n=39)	$20,379.52

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Similarly, we identified a significant amount of nonvalue-added biopsies. Adherence to the standard approach of reserving a biopsy for anyone with bleeding and a suspicious US would have prevented 64 women from having biopsies. Each EMB is painful, anxiety inducing, and costly. We were unable to estimate the rate of EMB positivity from our study sample that excluded women who were found preoperatively to have endometrial cancer or hyperplasia. However, 10.3% of our patients were found to have polyps from the EMB. By estimating the rate of malignancy in a polyp to be 4.9%[12] and by extrapolating from our polyp rate, the rate of malignancy identified in nonvalue-added EMBs was 0.50%, which is similar to a large population study[24] that found an endometrial cancer prevalence among women with prolapse of 0.6%. Taken together, thess data suggest that 612 routine preoperative EMBs (cost of $105,600 assuming $172.40/EMB) would be needed to detect 1 malignancy.

This study represents real practice in a safety-net system−−a patient population that may be underrepresented in studies that are based on national registries or coding data. Many registries included safety-net hospitals (NSQIP), although data on safety-net hospitals outside the registry system is limited. Furthermore, there are significant concerns about the accuracy, reliability, and representation of coding data, which especially may be magnified in the low-resource setting.[25−28] Our data suggest that actual practice varies, and we suspect that coding data and other registry data may not be representative of nonparticipatory safety-net systems like the 1 sampled in this study. Another strength is the long study period, allowing evaluation of low frequency but high impact events. A weakness of the study owing to the long study period was the effect of inflation on the estimated cost to the system. The cost of biopsy at the beginning of the study period may be less than the cost at the end of the study period and using 2020 costs was 1 of several assumptions made in the model. In addition, weaknesses of this study are related to the retrospective approach, which relied on limited clinical documentation. Furthermore, the reasons for nonvalue-added testing are not explored in this project. We used a strict definition of indicated, and instead of relying on ICD-9 or ICD-10 codes, we relied on documentation of the medical indications for testing (pain, bleeding, mass detected on examination, referred for a previous image suggestive of abnormality). We acknowledge that in a retrospective study, certain indications, particularly pain, may be undercaptured. In contrast, our study may also underestimate preoperative testing performed in another medical system. Finally, we intentionally excluded women with known malignancy or hyperplasia preoperatively, making it impossible to estimate the rate of EMB positivity in this patient sample.

Conclusion

Based on the outcomes of this study, our results support the use of a standardized algorithm for the preoperative evaluation of POP in postmenopausal women. Furthermore, we encourage continued reporting of detailed chart audits of clinical outcomes in capitated safety-net health systems, which may ultimately be compared with coding data and may impact how we evaluate health outcome disparities. Our findings have prompted several quality initiatives in our system aimed at reducing nonvalue-added testing. Analyzing specific reasons for nonvalue-added diagnostics was beyond the scope of this study, and therefore, we also suggest that further research should look specifically at clinician decision-making in individualizing risk assessments. ■

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