



Original research article

## Nationwide salpingectomy rates for an indication of permanent contraception before and after published practice guidelines<sup>☆</sup>



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### ABSTRACT

**Objective:** To identify the nationwide rate of salpingectomy for permanent contraception before and after the January 2015 American College of Obstetricians and Gynecologists (ACOG) Committee Opinion, *Salpingectomy for Ovarian Cancer Prevention*.

**Study Design:** Using ICD-9/10 diagnosis and procedure codes within the Vizient database, we identify permanent contraception procedures with and without salpingectomy, among females 18–50 years old between January 2013 and January 2017. Subject, hospital characteristics and costs information were recorded. To determine the changes in salpingectomy rates over time analysis was conducted using the Cochran-Armitage trend test and logistic regression models.

**Results:** A total of 211,312 women across 303 Vizient-member hospitals underwent a permanent contraception procedure over the study period. Of these, 174,930 subjects were selected from 160 hospitals that contributed data over the full 49-month period. Overall, 25,882 (14.8%) subjects underwent a salpingectomy for an indication of permanent contraception. Higher salpingectomy rates were identified among larger ( $p < .0001$ ), teaching ( $p < .0001$ ) hospitals versus smaller, non-teaching hospitals and in subjects with commercial/private payers ( $p < .0001$ ). A lower salpingectomy rate was observed in Northeast hospitals ( $p < .0001$ ). Median total hospital costs differed by \$25 between permanent contraceptions performed with and without salpingectomy. The proportion of salpingectomies was <1% in January 2013 slowly rising to 20.6% in October 2015 and then 61.5% by January 2017 ( $p < .0001$ ). During the pre-opinion period (Jan 2013–Dec 2014) the monthly increase in the odds of salpingectomy was 6% (OR 1.06, 95% CI 1.05, 1.06) compared to a monthly increase of 18% (OR 1.18, 95% CI 1.18, 1.18) during the post-opinion period (Jan 2015–Jan 2017).

**Conclusions:** The nationwide rate of salpingectomies for permanent contraception has steadily increased among Vizient-member hospitals since the ACOG committee opinion.

**Implications:** Salpingectomy as an approach to permanent contraception in the United States is increasing since the ACOG Committee Opinion with differing utilization rates by hospital type, region, size, and patient payer types. Physician behavior may be influenced by practice guidelines but other factors mitigate the effect.

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### 1. Introduction

Given high mortality, lack of effective screening approaches and an evolving understanding of ovarian carcinogenesis, removal of the fallopian tubes has been identified as a plausible ovarian cancer risk reduction method [1]. Relative to tubal occlusion, women may as well

prefer this surgical contraceptive approach given perceived greater contraceptive efficacy [2]. In 2015, an American College of Obstetricians and Gynecologists (ACOG) Committee Opinion recommended that surgeons discuss the possible cancer prevention benefits of bilateral salpingectomy with patients considering permanent contraception [3].

Opportunistic bilateral salpingectomy has increased since 2011, however, one physician survey found only 7.2% of surgeons perform bilateral salpingectomy for an indication of permanent contraception despite 54% reporting the practice at the time of hysterectomy [4–6]. More recently, in a large integrated health system the rate of salpingectomy for permanent was as high as 78% for interval procedures but only 9%

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in the postpartum context [7]. Relative to tubal occlusion, bilateral salpingectomy does increase operative time by 6–10 minutes but complications such as length of hospital stay, readmission, or blood transfusion are not different [8]. The relative safety and anticipated low cost of salpingectomy as an approach to permanent contraception, given the potential cancer prophylaxis benefits, are additional factors endorsing the practice. However, implementation in the United States appears to be meager and factors influencing that implementation are incompletely understood.

A systematic review of strategies to reduce regional variation in surgery found practice guidelines have an incomplete effect in changing surgeon behavior [9]. In previous studies evaluating the effect of clinical guidelines and practice variation, breast conserving therapy increased with the dissemination of applicable clinical practice guidelines, yet the vaginal approach to hysterectomy remains low in the United States despite longstanding and widespread supporting guidelines. Uptake of salpingectomy for permanent contraception increased following a policy statement among Kaiser Permanente Northern California physicians [7]. In a like manner, we sought to determine if surgeon use of bilateral salpingectomy for the indication of permanent contraception changed after the 2015 ACOG Committee Opinion encouraged this surgical approach. Similarly, we explored patient, hospital and hospital costs, as well as regional characteristics associated with permanent contraception procedures.

## 2. Materials and methods

Approval for the study was obtained from the University of Cincinnati Institutional Review Board. Following approval, a de-identified data extraction was performed by a Vizient research analyst (author SH) from the Vizient Clinical Data Base, a definitive analytic platform created by Vizient. Participants in the Vizient Clinical Database are members of Vizient and subscribe to participate in the database that consists of clinical and administrative records from more than 50 health care systems and 160 community hospitals across the nation. The Vizient Clinical Data Base represents approximately 97% of not-for-profit academic medical centers in the United States but also includes about 10% of non-teaching, not-for-profit hospitals in the country. The Vizient Clinical Data Base includes a variety of patient outcome data, including mortality, length of stay, complication rates, readmission rates, hospital-acquired conditions, resource utilization, and other clinical parameters.

Analysis focused on female patients between 18 and 50 years of age who underwent a permanent contraception procedure between January 2013 and January 2017 (2 years before and 2 years after the 2015 ACOG Committee Opinion). Patients were included in the study if their medical record included an *International Classification of Diseases, 9<sup>th</sup> and 10<sup>th</sup> Revision (ICD-9/10)* diagnosis code for permanent contraception (V25.2/Z30.2). Subjects were then identified as undergoing a bilateral salpingectomy based on ICD-9/10 procedure codes or Physicians' Current Procedural Terminology Coding System (CPT) codes deemed relevant to the target procedure by the authors and hospital coding professionals (Table 1). A total of 211,312 patients undergoing permanent contraception were identified during January 2013 to January 2017 from 303 Vizient hospitals. Of this number, 30,647 patients were excluded from 143 hospitals that did not contribute data over the entire study period, as well as 5,735 patients who were missing ICD and/or CPT based procedure coding. To estimate the rate change over the study period, included hospitals had to provide cases over the full 49-month study period.

Differences in proportion of salpingectomy for permanent contraception across hospital region, teaching status, bed count and patient payer types were analyzed using the chi-square test. Changes in salpingectomy rates over time were analyzed using the Cochran-Armitage trend test and logistic regression models with subject characteristics and hospital characteristics as covariates. An initial logistic

**Table 1**

The CPT, ICD-9/10 codes for bilateral salpingectomy, used to search the Vizient database\*

CPT	ICD-9	ICD-10				
58661	6561	0UT70ZZ	0UT70ZX			
58700	6563	0UT74ZZ	0UT70ZX			
58720	6651	0UT70ZZ	0UT74ZZ	0UT77ZZ	0UT78ZZ	0UT7FZZ
		0UT70ZX	0UT74ZX	0UT77ZX	0UT78ZX	0UT7FZX
	6663	0UB70ZZ	0UB73ZZ	0UB74ZZ	0UB77ZZ	0UB78ZZ
		0UB70ZX	0UB73ZX	0UB74ZX	0UB77ZX	0UB78ZX

Common Procedure Terminology

*International Classification of Diseases, 9<sup>th</sup> and 10<sup>th</sup> revision*

Related procedure codes across coding systems are linked across rows.

\* The Vizient Clinical Data Base is a definitive analytic platform created by Vizient wherein member participants share clinical and administrative records representing more than 50 health care systems and 160 community hospitals across the nation.

regression modeled the monthly change in odds of salpingectomy during the pre-opinion period (Jan 2013–Dec 2014) versus during the post-opinion period (Jan 2015–Jan 2017) as the primary interest and patient payer, hospital size, teaching status and region as covariates. To account for differences between the ICD-9 and ICD-10 coding systems in the identification of salpingectomy procedures, a second logistic regression modeled the monthly change in odds of salpingectomy during the pre-opinion period when the ICD-9 coding system was in effect (Jan 2013–Dec 2014) and during the post-opinion periods when the ICD-9 coding system was in effect (Jan 2015–Sep 2015) and when the ICD-10 coding system was in effect (Oct 2015–Jan 2017) along with the previous covariates. Difference in median cost of hospitalization without and with salpingectomy was analyzed using the Mann-Whitney *U* test and differences in median cost of hospitalization with salpingectomies across hospital types and insurance type were analyzed utilizing the Kruskal-Wallis test.

Cost of hospitalization with salpingectomy was also analyzed in relation to patient diagnoses listed with the hospitalization. The number of patient diagnoses were used to create four categories (1–2, 3–6, 7–10 and  $\geq 11$ ) and, based on other tools to estimate patient morbidity [10], used as a proxy of patient illness. Patient diagnoses were not categorized by kind or severity.

## 3. Results

The Vizient database identified 211,312 patients who underwent a permanent contraception procedure across 303 hospitals between January 1, 2013, and January 31, 2017. The final study cohort consisted of 174,930 permanent contraception patients, with 36,382 patients excluded, either because the hospitals did not provide patient data for the full study period or the patients were missing data on CPT/ICD-based procedures. Overall, 25,882 (14.8%) of women in the study cohort were identified as having undergone a salpingectomy for an indication of permanent contraception based on either ICD-9/10 codes or CPT codes. Of these, 20,135 (78%) women were identified via ICD-9/10 codes, 5,747 (22%) women were identified using CPT procedure codes. The hospitals included in the Vizient database were geographically spread across the United States and of differing sizes by bed count, with teaching hospitals accounting for the majority (Table 2).

Significant differences in rate of salpingectomies are demonstrated across hospital regions (Northeast 13.1%, Midwest 16.2%, South 15% & West 15.2%,  $p < .0001$ ) (Table 3). Teaching hospitals had a higher rate of salpingectomies for an indication of permanent contraception relative to non-teaching hospitals (15.0% vs. 14.2%,  $p = .0001$ ) as did larger hospitals compared to smaller hospitals (<250 beds 14.8%, 250–499 beds 13.4%, 500–749 beds 13.1% &  $\geq 750$  beds 17.4%,  $p < .0001$ , respectively). Significant differences were also seen across the rate of salpingectomies performed for an indication of permanent contraception by insurance type (Commercial/Private 15.7%, Medicaid/Title V Maternal & Child (M&C) 14.3%, Medicare/State/County 14.4% & all other 13.7%,  $p < .0001$ ).

**Table 2**

Hospital characteristics (region, teaching status and bed count) among Vizient database\* institutions recording permanent contraception procedures from January 2013 and January 2017.

Hospital characteristic		Frequency
Region	Midwest	47 (29.4%)
	Northeast	52 (32.5%)
	South	37 (23.1%)
	West	24 (15%)
Teaching status	No	57 (35.6%)
	Yes	103 (64.4%)
Hospital bed count	< 250	36 (22.5%)
	250-499	49 (30.6%)
	500-749	39 (24.4%)
	> 750	36 (22.5%)

\* The Vizient Clinical Data Base is a definitive analytic platform created by Vizient wherein member participants share clinical and administrative records representing more than 50 health care systems and 160 community hospitals across the nation.

The overall proportion of salpingectomies in patients receiving a permanent contraception procedure was <1% in January 2013 but slowly rose until October 2015 when the proportion climbed to 20.6%, rising to 61.5% by January 2017. An overall increasing trend in rates of salpingectomy for permanent contraception from 2013 to 2017 was noted using the Cochran-Armitage trend test ( $p < .0001$ ). Logistic regression modeling, adjusted for patient payer type and hospital size, teaching status and region, identified a monthly increase of 6% in the odds of salpingectomy for an indication of permanent contraception (OR 1.06, 95% CI 1.05, 1.06) during the pre-opinion period (Jan 2013–Dec 2014) compared to a monthly increase of 18% in the odds of salpingectomy (OR 1.18, 95% CI 1.18, 1.18) during the post-opinion period (Jan 2015–Jan 2017) (Table 4). The corresponding adjusted odds ratio [95% CI] of salpingectomy for the covariates were: payer type (Commercial/Private – reference, Medicaid/Title V M&C 0.84 [0.81, 0.87], Medicare/State/County 0.73 [0.66, 0.81] & All Other 0.91 [0.84, 0.99]), hospital size (<250 beds – reference, 250-499 beds 0.97 [0.91, 1.03], 500–749 beds 1.01 [0.94, 1.08] &  $\geq 750$  beds 1.64 [1.53, 1.76]), teaching status (non-teaching – reference, teaching 0.96 [0.91, 1.01]) and region (Northeast - reference, Midwest 1.37 [1.31, 1.43], South 1.22 [1.17, 1.27] & West 1.40 [1.32, 1.48]).

A distinct transition in procedure count was noted in ICD-coded salpingectomies between September 2015 and October 2015 (Fig. 1). To explore this phenomenon, a separate logistic regression modeling identified a monthly increase of 7% in the odds of salpingectomy (OR 1.07, 95% CI 1.05, 1.09) during the post-opinion period when the ICD-

**Table 4**

Logistic regression models of the monthly change in the odds of salpingectomy among Vizient database\* institutions.

Predictor		Model 1 Odds ratio (95% confidence limits)	Model 2 Odds ratio (95% confidence limits)
Monthly change	Pre-opinion <sup>1</sup>	1.06 (1.05, 1.06)	-
	Post-opinion <sup>2</sup>	1.18 (1.18, 1.18)	-
Monthly change	Pre-opinion (ICD-09) <sup>3</sup>	-	1.06 (1.05, 1.06)
	Post-opinion (ICD-09) <sup>4</sup>	-	1.07 (1.05, 1.09)
	Post-opinion (ICD-10) <sup>5</sup>	-	1.12 (1.12, 1.13)
Staffed beds	<250	Reference	Reference
	250-499	0.97 (0.91, 1.03)	0.97 (0.91, 1.03)
	500-749	1.01 (0.94, 1.08)	1.01 (0.94, 1.08)
	$\geq 750$	1.64 (1.53, 1.76)	1.64 (1.53, 1.77)
Region	Northeast	Reference	Reference
	Midwest	1.37 (1.31, 1.43)	1.37 (1.31, 1.43)
	South	1.22 (1.17, 1.27)	1.22 (1.17, 1.27)
	West	1.40 (1.32, 1.48)	1.39 (1.32, 1.48)
Teaching status	No	Reference	Reference
	Yes	0.96 (0.91, 1.01)	0.96 (0.92, 1.01)
Payer	Commercial/private	Reference	Reference
	Medicaid/Title V	0.84 (0.81, 0.87)	0.84 (0.81, 0.87)
	Medicare/state/county	0.73 (0.66, 0.81)	0.73 (0.66, 0.81)
	All other	0.91 (0.84, 0.99)	0.90 (0.83, 0.98)

\* The Vizient Clinical Data Base is a definitive analytic platform created by Vizient Inc. wherein member participants share clinical and administrative records representing more than 50 health care systems and 160 community hospitals across the nation.

<sup>1</sup> Change during the pre-ACOG opinion period (Jan. 2013–Dec. 2014)1 versus the post-opinion period (Jan. 2015–Jan. 2017).

<sup>2</sup> Change during the pre-opinion period when the ICD-9 coding system was in effect (Jan 2013–Dec 2014).

<sup>3</sup> Versus during the post-opinion periods when the ICD-9 coding system was in effect (Jan. 2015–Sep. 2015).

<sup>4</sup> And when the ICD-10 coding system was in effect (Oct. 2015–Jan. 2017).

<sup>5</sup> Model 2 may account for coding changes potentially effecting identification of salpingectomy procedures.

9 coding system was in effect (Jan 2015–Sep 2015) compared to a monthly increase of 12% in the odds of salpingectomy (OR 1.12, 95% CI 1.12, 1.13) during the post-opinion period when the ICD-10 coding system was in effect (Oct 2015–Jan 2017) (Table 4). The adjusted odds ratios during the pre-opinion period and those of the covariates were similar to those observed in the previous logistic regression. While procedure counts for CPT-coded salpingectomies also demonstrate a

**Table 3**

Number and frequency of permanent contraception procedures among Vizient database\* institutions by hospital characteristics and patient payer status from January 2013–January 2017

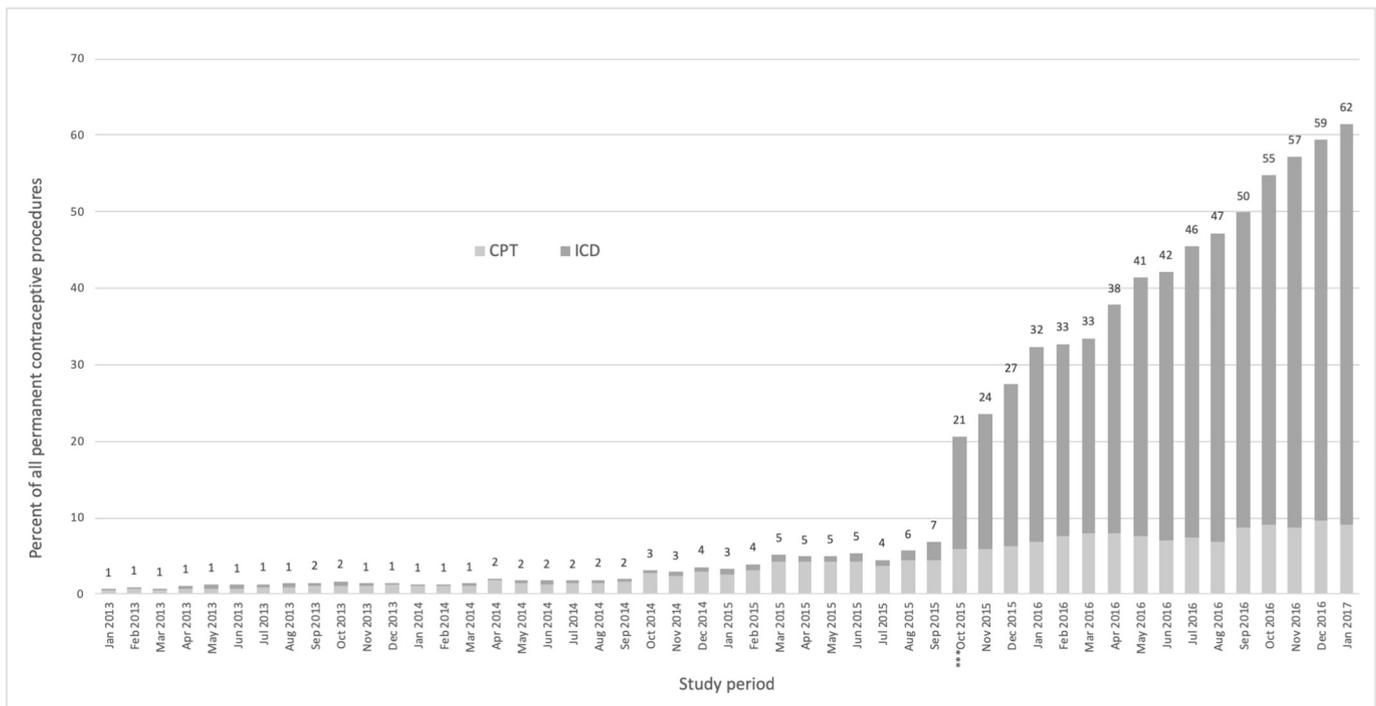
Hospital characteristic		Frequency of permanent contraceptions (N=174,930)	Salpingectomy Rate† (%)	p
Region	Northeast	47,733 (27.3%)	13.1	$p < .0001$
	Midwest	43,946 (25.1%)	16.2	
	South	62,326 (35.6%)	15	
	West	20,925 (12%)	15.2	
Teaching status	Non-teaching	42,061 (24%)	14.2	$p = .0001$
	Teaching	132,869 (76%)	15	
Hospital bed count	< 250	17,486 (10%)	14.8	$p < .0001$
	250-499	48,939 (28%)	13.4	
	500-749	49,006 (28%)	13.1	
	> 750	59,499 (34%)	17.4	
Payer	Commercial/Private	61,990 (35.4%)	15.7	$p < .0001$
	Medicaid/Title V M&C‡	100,261 (57.3%)	14.3	
	Medicare/State/County	4,625 (2.6%)	14.4	
	All Other	8,054 (4.6%)	13.7	

Statistical testing by chi-square analysis.

\* The Vizient Clinical Data Base is a definitive analytic platform created by Vizient wherein member participants share clinical and administrative records representing more than 50 health care systems and 160 community hospitals across the nation.

† Salpingectomy rate calculated for the population that underwent permanent contraception.

‡ Title V Maternal and Child (M&C) is a federal funding program targeted to improve the health of mothers and children.



**Fig. 1.** The percent of salpingectomy for permanent contraception per total number of permanent contraception procedures among Vizient database\* institutions between the years 2013–2017 by month. \*\*\*Compliance requirement for implementation of *ICD-10* coding system. \*The Vizient Clinical Data Base is a definitive analytic platform created by Vizient wherein member participants share clinical and administrative records representing more than 50 health care systems and 160 community hospitals across the nation.

significant increasing trend ( $p < .0001$ ) over the study period they do not illustrate these effects related to the October 2015 transition to *ICD-10*.

Overall the median total hospital costs differed by \$25 between permanent contraceptives that were performed with and without salpingectomy (\$5809 vs. \$5784,  $p < 0.0001$ ). Differences in median total hospital costs of permanent contraception with salpingectomy were observed across hospital regions (Northeast \$5257, Midwest \$5579, South \$6192 & West \$6172,  $p < 0.0001$ ), teaching versus non-teaching status (\$6015 vs. \$5237,  $p < 0.0001$ ) and hospital size (<250 beds \$5603, 250–499 beds \$5811, 500–749 beds \$5541 &  $\geq 750$  beds \$6000,  $p < 0.0001$ ). Significant differences in median total hospital costs of permanent contraception with salpingectomy were also by insurance type (Commercial/Private \$5499, Medicaid/Title V M&C \$6176, Medicare/State/County \$6055 & All Other \$4457,  $p < 0.0001$ ) and patient's number of diagnoses in the hospitalization (1–2 DXs \$3828, 3–6 DXs \$5054, 7–10 DXs \$6762,  $\geq 11$  DXs \$8546,  $p < 0.0001$ ).

#### 4. Discussion

The frequency of salpingectomies in the United States for an indication of permanent contraception has steadily increased at Vizient member hospitals since the 2015 ACOG Committee Opinion. The uptake of this practice, however, does vary by hospital type, region and size, as well as patient payer types. While our study cannot specifically link a causal relationship between the published practice guideline and uptake of this surgical practice, the 12% increased odds of salpingectomy following January 2015 is striking. Even accounting for the apparently improved coding efficiency of *ICD-10*, there was 5% increased odds of salpingectomy before and after the January 2015 ACOG committee opinion. Based on the study by Powell et al. [7], we would presume the majority of these procedures are done in an interval context. This study is also notable insofar as our 2017 national rate for these procedures in this context approaches that seen in the Kaiser Permanent Northern California system and that in both cases the increase in rate was preceded by an endorsed guideline. Like other studies, practice guidelines appear to have an effect on surgical practice. The uptake of

any guideline, however, would be predictably impacted by the macro- and microsystems within which surgeons' practice.

The location, size and kind of hospital a surgeon operates in are elements of clinical operations systems. Significant differences were noted in salpingectomy for permanent contraception across differing regions, teaching status, and hospital size. This kind of variation in care utilization has been extensively studied and represents a potent target for quality improvement efforts [9]. The reasons for variations in care delivery are multifactorial but the best explanation relates to differences in the motivations and opinion of doctors on the effectiveness of a given care approach for a given malady [11]. Accordingly, one study found physician uptake of opportunistic salpingectomy was affected by concerns for increased complications and operative time [12]. Based on published studies on this practice this concern is unjustified and our study adds that even hospital costs are not remarkably different across the permanent contraception approaches. Given regional differences in surgeon behavior relate to physician opinion, and that the decision to perform opportunistic salpingectomy appears to vary by opinion, there is a performance improvement opportunity that could be explored in smaller, non-teaching hospitals.

McAlpine et al. [12] described a substantially increased uptake of opportunistic salpingectomy in British Columbia, Canada after implementation of an educational initiative begun in 2010. The success of this educational initiative must be understood within the context in which it was implemented (nationalized health system) and notably uptake of minimally invasive hysterectomies in this same region were improved via a local educational effort [13]. Physician uptake of any practice reflects as much the setting in which the policy is implemented as however compelling are the population health benefits of it. Healthcare that renders average clinical outcomes at high cost (i.e., poor value) can limit care access as fewer resources are available to expand access than if those resources were used more efficiently. Understanding population health to include this impact of poor value care on patient care access, there are notable examples where physicians continue to use poor value care despite the available evidence or endorsing guidelines (e.g., use of the surgical robot in benign gynecology) [14]. Determining factors associated with successfully changing physician behavior is a

priority and examining the differences across successful and unsuccessful examples is a reasonable early approach [9].

In our sample, teaching and larger hospitals had a significantly higher proportion of salpingectomies for tubal permanent contraception. Generally, larger hospitals and those with resident and fellow physicians are associated with improved care quality [15,16]. There are several factors that allow hospitals with greater surgical volume to more easily respond to emerging evidence [15]. Continued exposure to learners provides a platform for continued medical education and integration of new evidence such as would occur when new practice guidelines are published. Likewise, a surgeon working within a larger community of physicians, independent of learners, would plausibly increase the chances new practice guidelines are shared.

Our results show that salpingectomy for permanent contraception resulted in minimal increase to the patients' total hospitalization cost. Piazza et al. [2] demonstrated in a very recent study that women seeking permanent contraception would prefer a bilateral salpingectomy over tubal occlusion. In agreement with Creinin and Zite [1], given low procedure costs, demonstrated safety and patient preference, bilateral salpingectomy for permanent contraception should be routinely offered.

Understanding the rate of salpingectomy for permanent contraception was confounded by the ICD-9 to ICD-10 transition that occurred October 1, 2015. The 9<sup>th</sup> revision of the *International Classification of Diseases* (ICD) coding system was in use in the United States since 1979 but worldwide this coding system was deemed obsolete leading to the development of ICD-10. Since its delayed implementation, significant improvements in diagnosis and procedural data capture have been seen, but not without some challenges as we encountered. The greater detail of ICD-10 can lead to troublesome complexity in merging procedural data across ICD-9 and ICD-10 [17]. Indeed, the jump seen in the rate of permanent salpingectomy across the two ICD coding versions likely reflects not only a growing adoption of this procedure (as distinctively demonstrated with the rising CPT coded results (Fig. 1) but also a greater efficiency in capturing bilateral salpingectomy procedures with ICD-10. We recognized this matter and accounted for it in separate logistic regression analyses that were all largely consistent with the finding that the rate of increase in salpingectomy for an indication of permanent contraception rose after January 2015.

The strengths of this study rest on the benefits of the Vizient database. This large and detailed database offers a comprehensive view of surgical practice over the years studied. The Vizient database, however, includes primarily academic medical centers, and thus other hospital types are underrepresented. Correspondingly, the greater than 60% rate of salpingectomy for an indication of permanent contraception arguably over-represents the rate that would be found in smaller, non-teaching hospitals. As with any large database study, reliance on coded medical practice introduces the possibility of coding error,

although arguably coding errors are balanced for and against any specific procedure documentation.

Plausibly corresponding with the 2015 ACOG Committee Opinion, practitioners in the United States are increasingly performing salpingectomy in the context of permanent contraception although region and hospital context mitigate the effect. The long-term implications of this practice behavior on population ovarian cancer rates will require prospective confirmation but there is already compelling reasons to make this practice routine. Further research is warranted regarding strategies to alter physician behavior to reduce variation in the use of this surgery.

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