Articles

The Impact of Nonclinical Factors on Practice Variations: The Case of Hysterectomies

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Objective. This study investigates the role of nonclinical factors (physician characteristics) in explaining variations in hysterectomy practice patterns.
Data Sources and Study Setting. Patient discharge data are obtained from the Arizona state discharge database for the years 1989–1991. Physician data are obtained from the Arizona State Medical Association. The analyses are based on 36,104 cases performed by 339 physicians in 43 hospitals.
Study Design. This article measures the impact of physician factors on the decision to perform a hysterectomy, controlling for a host of patient and hospital characteristics. Physician factors include background characteristics and training, medical experience, and physician's practice style. Physician effects are evaluated in terms of their overall contribution to the explanatory power of regression models, as well as in terms of specific hypotheses to be tested.
Data Collection. The sources of data were linked to produce one record per patient.
Principal Findings. As a set, physician factors account for a statistically significant increase in the explanatory power of the model after addition of patient and hospital effects. Parameter estimates provide further support for the hypothesized effects of physicians' background, experience, and practice characteristics.
Conclusions. Overall, the results confirm that nonclinical (physician) factors play a statistically significant role in the hysterectomy decision. Substantively, however, these factors play a smaller, secondary role compared to that of clinical and patient factors in explaining practice variations in hysterectomies. The results suggest that efforts to reduce unnecessary hysterectomies should be directed at identifying the appropriate clinical indications for hysterectomy and disseminating this information to physicians and patients. This may require such intervention strategies as continuing clinical education, promulgation of explicit practice guidelines, peer review, public education, and greater understanding and inclusion of patient preference in the decision process.
Key Words. Hysterectomy, nonclinical factors, variations, practice patterns, physicians

Hysterectomy is the second most common major surgical procedure for women in the United States. Approximately 590,000 hysterectomies are performed annually, although recent data suggest the possibility of a downward trend since the mid-1980s. However, by the time a woman reaches 60 years of age, she has a 33 percent chance of having undergone such an operation. Annual hospital costs for this surgery exceed $5 billion (Bernstein, McGlynn, Kamberg, et al. 1993; Carlson, Nichols, and Schiff 1993; National Center for Health Statistics 1992), making it the 15th costliest procedure for hospitalizations in the United States, according to HCUP-2 national estimates for 1987 (Agency for Health Care Policy and Research 1993). All of these factors make hysterectomy an important public health issue.

Because of the large number of hysterectomies performed on women each year with the associated morbidity, mortality, and cost of the operation, this procedure may have important quality of care implications. The overall mortality rate is about 22 per 10,000. This figure varies substantially based on the indication for hysterectomy: from 6–11 deaths per 10,000 for indications not involving cancer or pregnancy, to 29–38 deaths per 10,000 for pregnancy-associated indications, to 70–200 per 10,000 when the diagnosis is associated with cancer. The risk of mortality also increases with age; a 65-year-old woman undergoing a hysterectomy has more than double the average risk of mortality (Bernstein, McGlynn, Siu, et al. 1993; Wingo, Huezo, Rubin et al. 1985).

Postoperative morbidity is common following this surgery. The complication rate ranges from 24 percent for vaginal hysterectomy to 43 percent for abdominal hysterectomy (Dicker, Greenspan, Strauss, et al. 1982; Bernstein, McGlynn, Siu, et al. 1993), although a recent study by Carlson, Miller, and Fowler (1994) reported in-hospital complications at 7 percent. A range of long-term medical and psychological complications have also been reported. Some studies report long-term problems in 50 percent of patients (Bernstein, McGlynn, Siu, et al. 1993). Estimates of the proportion of women suffering from postoperative psychiatric problems range from 4 percent to 66 percent

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(Martin, Roberts, and Clayton 1980; Melody 1962), although the risk of psychiatric problems appears greatest for women with preoperative psychiatric disorders (Ackner 1960). Carlson, Miller, and Fowler (1994), however, report the development of new physical and psychological symptoms in women to be infrequent.

Due to increasing concern over the hysterectomy rate, several studies have focused on the appropriateness of hysterectomy as a surgical procedure (Doyle 1953; DeFriese et al. 1989; Dyck, Murphy, and Murphy 1977; Jenkins 1977; Dranov 1986; Gambone et al. 1989; Bernstein, McGlynn, Siu, et al. 1993). The recent RAND study (Bernstein, McGlynn, Siu, et al. 1993) developed criteria to assess the appropriateness of use of hysterectomy. The authors then applied these criteria to women in seven managed care organizations and found that 16 percent of hysterectomies were performed for inappropriate reasons, the rate varying from 10 percent to 27 percent by plan. Estimates are that elimination of these unnecessary procedures alone would result in an annual savings of $500–800 million.

Hysterectomy rates also appear to vary substantially within the United States and between the United States and other countries (National Center for Health Statistics 1992; McPherson et al. 1982; Wennberg and Gittelsohn 1982). For example, a woman living in the United States is three times as likely to have a hysterectomy as a woman living in England (Coulter, McPherson, and Vessey 1988). Within the United States, hysterectomy rates vary regionally, with the highest rates in the South and Midwest and the lowest in the Northeast, and these major interregional differences persist (Dicker et al. 1982a; National Center for Health Statistics 1992).

Efforts to identify reasons for this variation have considered both clinical and nonclinical factors. Recent studies suggest that nonclinical factors may account for variations in practice patterns. These factors include the patient's demographic characteristics and use of health care resources (Dicker et al. 1982; Roos 1984; Coulter et al. 1988), and hospital characteristics such as ownership, size, and geographic location (Roos 1984). They also include financial and convenience incentives facing the physician, the physician's practice style and practice setting (Roos 1984), the physician's background and experience (Wennberg and Gittelsohn 1973; Domenighetti, Luraschi, and Marazzi 1985), and professional attitudes and behavior (Bickell et al. 1994; Wennberg and Gittelsohn 1982; McPherson et al. 1982).

Our article has two aims. First, we calculate the relative importance of three sets of influences (patient, hospital, physician) on hysterectomy rates using data from the state of Arizona. Second, we investigate the relative role of physician factors in explaining variations in hysterectomy practice patterns. These factors include background, training, medical experience, and financial incentives facing the physician.

The next section of this article reviews previous research regarding the effects of both clinical and nonclinical factors on hysterectomy rates and formulates the hypotheses to be tested. The remaining sections outline the data and methods employed to test these hypotheses, our results, and our conclusions regarding the relative importance of physician level effects.

PRIOR RESEARCH

There is general agreement that the vast majority of hysterectomies are due to four major clinical indications: uterine leiomyomas (30 percent), dysfunctional uterine bleeding (20 percent), endometriosis and adenomyosis (20 percent), and genital prolapse (15 percent). The remaining 15 percent are generally classified as other diagnoses such as chronic pelvic pain, endometrial hyperplasia, cancers, and obstetrical indications (Pokras and Hufnagel 1988; Carlson, Nichols, and Schiff 1993). The emphasis on clinical explanations for the high hysterectomy rate has prompted national efforts directed at physician education and peer review as strategies for controlling the use of this procedure (American College of Obstetricians and Gynecologists 1989). Several methods of targeting inappropriate hysterectomies have been evaluated, including second opinion programs (Finkel and McCathy 1991), validation through pathology examinations (Gambone et al. 1989), and mass media campaigns (Domenighetti et al. 1988). However, these efforts have been very slow to effect change (Carlson, Nichols, and Schiff 1993).

Regardless of clinical indication, hysterectomy rates vary according to the woman's personal/demographic characteristics. However, the evidence regarding the impact of the patient's race, education, and socioeconomic status on hysterectomy rates is fairly inconsistent. Some studies have found that women who are African American, with less education, and with no children are more likely to have a hysterectomy (Dicker et al. 1982a; Meilahn et al. 1989). Kjerluff, Guzinski, Langenberg, et al. (1993) found that the average age-adjusted hysterectomy rate was higher for African American women than for white women. In fact, the average age at hysterectomy was younger in African American women for nearly all diagnostic categories. The authors also found significant racial differences for certain principal diagnoses. For 65.4 percent of the hysterectomies in African American women, the principal diagnosis was uterine fibroids, compared to 25.5 percent for white women.

White women were more likely to have hysterectomy for diagnoses of uterine prolapse, endometriosis, cancer, or menstrual disorders.

In contrast, Wilcox, Koonin, Pokras, et al. (1994) found that total hysterectomy rates for African American women were similar to those for white women, although African American women were more likely to be younger when undergoing the procedure. They also found that the rate of hysterectomy for fibroids was more than twice as high for African American women as for white women. The Health Care Financing Administration (HCFA) reports that among Medicare enrollees, whites have 54 percent more hysterectomies than blacks (Agency for Health Care Policy and Research 1993).

There is, however, fairly consistent evidence regarding the impact of the patient's age on hysterectomy rates. Women 30–49 years of age run the greatest risk for this procedure, accounting for roughly 65 percent of all hysterectomies. The highest rates, about 19 percent, are for women in the age group 40–44 years (National Center for Health Statistics 1992).

There is very little evidence regarding the impact of the patient's method of payment on the hysterectomy decision. DeFriese et al. (1989) found that women who underwent hysterectomies at high-rate hospitals were more likely to be white, younger than 40 years, and with private health insurance. Other researchers (Stafford 1990; Goldfarb 1984; Placek, Taffel, and Moien 1988; Haynes de Regt et al. 1986), however, report that surgical rates for some procedures (i.e., cesarean sections) are highest among patients covered by private insurance, intermediate among patients covered by Medicaid, and lowest among self-paying patients. Such findings suggest that physicians and hospitals may be motivated by economic self-interest.

There is also relatively little evidence regarding the impact of physician background and experience factors on hysterectomy rates. Domenighetti, Luraschi, and Marazzi (1985) report that female gynecologists perform about half as many hysterectomies as male gynecologists. Bickell et al. (1994) found that male gynecologists performed 60 percent more hysterectomies than female gynecologists. Wennberg and Gittelsohn (1982) conclude that differences among physicians in diagnostic styles or beliefs in the efficacy of specific treatments, or both, contribute substantially to observed variations in hysterectomy rates. Wennberg and Gittelsohn (1973) also contend that regional differences in physician training and practice contribute to differences in hysterectomy rates. That is, doctors deliver the kind of services they are trained to give.

Finally, as several studies have noted, the significant variation in hysterectomy rates across geographic areas suggests the presence of clinical policies and practice styles that may be at odds with the recommendations and published evidence regarding the appropriate indications for hysterectomy. Consequently, interest is growing in studying the role of physician practice styles and decisions in health care utilization.

STUDY HYPOTHESES

This study measures the relationship of patient, hospital, and physician factors on the probability of a hysterectomy. In addition, we test hypotheses regarding the impact of specific physician background and practice characteristics. The physician level hypotheses are outlined below.

We argue that the physician's choice of performing a hysterectomy is based not only on clinical indications (e.g., leiomyomas, dysfunctional uterine bleeding, etc.), patient factors (e.g., social and demographic characteristics), and hospital factors, but also on the physician's background/experience and role as self-interested economic agent.

Background and experience factors encompass the physician's gender, years of experience, and board certification.

Hypothesis 1. We hypothesize that women physicians will perform significantly fewer hysterectomies than their male counterparts.

Research suggests that in areas relating to "women's issues," female medical students and physicians are more sensitive to issues regarding appropriate health care for women (Margolis, Greenwood, and Heilbron 1983; Weisman, Nathanson, Teitelbaum, et al. 1986). Such differences in attitude are found to persist from medical school throughout residency and into practice (Heins 1979; Leichner and Harper 1982; Leserman 1981). Also, there is some evidence to suggest that, in fact, female gynecologists perform significantly fewer hysterectomies than male gynecologists (Bickell et al. 1994; Domenighetti, Luraschi, and Marazzi 1985).

Hypothesis 2. We expect the probability of hysterectomy to be lower for more recent medical school graduates.

More recent graduates may have had medical training different from that of older physicians (i.e., trained more than 15 years ago), since the belief in the efficacy of specific treatments and of the clinical role of hysterectomy has under-gone significant change. New clinical models may emphasize more endemic approaches to the management of patients with many of the benign clinical indications associated with hysterectomy. Indeed, Bickell et al. (1994)

has shown that physicians who are further out from training have higher hysterectomy rates. Therefore, we anticipate a cohort effect for physicians coming out of medical school in different periods: (5–9 years; 10–14 years; 15–19 years; 20–24 years, 25–29 years; 30–34 years, 35–39 years; and 40 or more years experience; physicians with 0–4 years experience are the excluded contrast).

Hypothesis 3. We expect the probability of a hysterectomy will be higher for board-certified than for non-board-certified physicians.

This may reflect more years of experience as well as more specialized training. It may also reflect heightened concern among specialists regarding the role of medical malpractice.

Economic models of physician behavior (Pauly and Redisch, 1973; Eisenberg 1986; Phelps 1992) characterize physicians as self-interested economic agents. As such, they are expected to maximize their income. We argue that the probability of a hysterectomy likewise varies according to the physician's case mix. Researchers have argued that the probability of performing surgery is positively influenced by direct financial incentives facing the physician.

Hypothesis 4. The probability of a hysterectomy is expected to be greatest among patients with private insurance and least among self-pay patients.

Because insurance is a patient-level effect, we also attempt to develop proxy measures for the physician's financial incentives using various practice-setting indicators.

Hypothesis 5. We expect the probability of performing a hysterectomy to be greatest for physicians who treat a high proportion of privately insured (commercial and HMO) patients than for those who treat publicly insured (Medicaid and Medicare) and self-pay patients.

METHODS AND MEASURES

This research measures the relationship of physician factors on the decision to perform a hysterectomy, controlling for a host of patient and hospital characteristics. Physician effects are evaluated in terms of their overall contribution to the explanatory power of regression models. In addition, a number of hypotheses are tested to further determine which physician factors specifically affect the hysterectomy decision (see Study Hypotheses). The unit of analysis is the individual patient admitted by her physician to a particular hospital in Arizona over a three-year period (1989–1991). This allows data to be directly linked on the patient, hospital, and physician, thus avoiding the threat of aggregation bias. This also allows for examination of the interdependence of physicians and the various hospitals in which they practice. It is important to note here that we are looking at the decision to perform hysterectomy among only hospitalized patients. We are missing data on each physician's outpatient caseload, thus introducing some bias.

Multiple regression is used to evaluate the study's research hypotheses. The dependent variable is a binary indicator of whether or not a hysterectomy is performed. The traditional method for modeling a dichotomous variable is to use a logit or other nonlinear technique because it is efficient. However, these models are sensitive to minor specification errors such that they do not always identify a solution on the response surface. This is particularly true in the case of clinical decision modeling, such as this research, where we are testing for the impact of multiple possibly correlated factors–in these cases, where the axiom of specification does not hold or is traded off against the clinical richness of the model. When the sample size is large (e.g., more than 500 observations), ordinary least squares (OLS) can be used instead of logit. OLS is inefficient but it does not produce biased estimates on binary data and, more importantly, it always identifies the maximum solution. Moreover, OLS has the desirable characteristic of stability so that its fitted values are not affected by small changes in specification of the model.

The sample consists of all women hospitalized with at least one of the common clinical indications for hysterectomy (see Table 1 further on). Cases from the state hospital discharge files are included based on ICD-9 (International Classification of Diseases) diagnosis codes.

Several alternative specifications of our model are estimated, in which the contribution made by each set of factors is assessed by that improvement in the model R^2. The first model includes only patient characteristics; the second, patient characteristics and hospital dummy variables; the third, patient characteristics and physician dummy variables; the fourth, patient characteristics, hospital dummy variables, and physician dummy variables; and the fifth substitutes physician characteristics for the physician dummy variables to test for specific hypothesized effects. Models 2–4 employ dummy variables for hospital and physician effects as a test for aggregate relationships between these variables and the hysterectomy rate. These dummy variables allow for the systematic variation across individual physicians or hospital facilities that is not manifested through observable operating or behavioral characteristics of these physicians or facilities.

Several patient characteristics are specified in the model. We included several variables to represent each of the clinical indications for hysterectomy (see Table 1). We also controlled for the potentially confounding effects of complications and other comorbidities. Complications are defined as events that occur after admission to the hospital. The methodology used to determine complications is a decision theoretic model that assigns to combinations of admitting and secondary diagnoses an expected rate of complications for a typical patient (Brailer et al. in press). Comorbidities measure the number of comorbid conditions present on admission that are not the reason for admission and cannot have developed during an inpatient stay (Brailer et al. in press).

Sociodemographic measures include the patient's age, income, and method of payment. Five dummy variables are included for patient age: 15–24, 25–34, 35–44, 45–54, and 55–64 (65 is the excluded contrast). Income is the mean household income for the patient's reported zip code as defined by the U.S. Bureau of Census using the 1990 census data, and is reported in dollars. It is included as a proxy for social-demographic characteristics. Type of insurance coverage (HMO/Blue Cross, Arizona Health Care Cost Containment System/Medicaid, commercial, and Medicare, with self-pay as the excluded contrast) is also included in the model.

The regression model incorporates several characteristics about the physician's practice. We model physician gender as a dummy variable (female = 1), as we do with board certification (certified = 1). We have defined medical experience as the number of years from the date of medical school graduation to 1990. Experience is coded as eight dummy variables that define successive cohorts of physicians coming out of medical school: 5–9 years; 10–14 years; 15–19 years; 20–24 years, 25–29 years; 30–34 years, 35–39 years; and 40 or more years experience (0–4 years experience is the excluded contrast). Patient mix measures the percentage of the physician's caseload that is either (1) commercially insured, (2) managed care (i.e., HMO), (3) AHCCCS/Medicaid, or (4) Medicare.

SOURCES OF DATA

Our analyses take advantage of a statewide database containing information on the patient, the hospital, and the attending physician. The data needed to conduct these analyses are taken from several sources. Patient discharge data are reported by hospitals to the state Department of Health Services, which then collates and releases the information. The database includes only nonfederal general hospitals with 50 or more beds. All federal (e.g., Veterans Affairs, Department of Defense, and Public Health Service), nongeneral (e.g., psychiatric), and general hospitals with fewer than 50 beds are omitted. In general, hysterectomies are not performed at the majority of the omitted hospitals.

The state discharge database includes information on each patient's date of birth, dates of admission and discharge, length of stay, status of discharge, principal diagnosis (DRG), secondary diagnoses and procedures, insurance coverage, zip code of residence, attending physician and license number, and hospital utilized. In the present study, patient data cover the hospital reporting period from January 1, 1989 through December 31, 1991. Physician data are obtained from two sources. Using the physician's license number, we merged the clinical information contained in the state discharge database with biographical information obtained with the cooperation of the Arizona State Medical Association.

DESCRIPTION OF THE SAMPLE

Patients and Conditions. The analyses are based on a sample of 36,104 admissions that have at least one of the clinical conditions (see Table 1) associated with hysterectomy in Arizona from 1989 through 1991. Of the 36,104 admissions, 20,013 (55 percent) resulted in a hysterectomy. Univariate statistics on the patient's demographic characteristics are shown in Table 1. Data are presented for all women admitted to the hospital with at least one clinical indication associated with hysterectomy and for those women undergoing a hysterectomy. The mean patient age for a woman undergoing a hysterectomy is 45.04; the average length of stay is 3.99 days. In terms of payment method, 36.4 percent of women have commercial insurance, 40.3 percent HMO/Blue Cross, 5.3 percent AHCCCS/Medicaid, 11 percent Medicare, and 6.7 percent other/self-pay.

Table 1 also includes univariate statistics relating to clinical indications for hysterectomy. Common clinical diagnoses for hysterectomy include leiomyomas (19.7 percent of all women with hysterectomies), endometriosis/adenomyosis (26.7 percent), dysfunctional uterine bleeding (16 percent), genital prolapse (12 percent), chronic pelvic pain (12 percent), and stress incontinence (nearly 11 percent). A number of other clinical indications are also present. These data reveal statistically significant differences in the prevalence of indications between those women admitted to the hospital with a clinical indication for hysterectomy and those women actually undergoing

Table 1: Univariate Statistics for Patients

Variables Relating to Patient	*All Women Admitted to Hospital* (N = 36,104)* Mean	s.d.	*Women with Hysterectomy (N = 20,013)* Mean	s.d.
Average age	41.05	15.52	45.04	13.01
%15–24	.120	.324	.008	.094
25–34	.273	.445	.189	.391
35–44	.273	.445	.389	.487
45–54	.145	.352	.217	.412
55–64	.070	.255	.076	.265
≥65	.116	.320	.118	.323
Length of stay (Number of days)	3.47	3.12	3.99	2.68
Income ($)	35,059	12,708	36,017	13,216
% Method of payment:				
Commercial	.314	.464	.364	.481
HMO/Blue Cross	.366	.481	.403	.490
AHCCCS/Medicaid	.120	.325	.053	.224
Medicare	.108	.311	.110	.313
Self-pay/Other	.089	.286	.067	.251
% Clinical indications for hysterectomy:				
Leiomyomas	.120	.325	.197	.397
Dysfunctional uterine bleeding	.094	.292	.160	.367
Endometriosis/Adenomyosis	.173	.378	.267	.442
Genital prolapse	.102	.303	.120	.325
Chronic Pelvic pain	.085	.279	.120	.325
Cancers	.022	.149	.006	.082
Endometrial hyperplasia	.020	.140	.035	.184
Pelvic inflammatory disease/Other inflammatory diseases of uterus	.175	.380	.024	.147
Obstetrical indications	.0001	.012	0	0
Stress incontinence	.082	.275	.109	.312

*All women admitted to hospital with at least one clinical indication associated with hysterectomy.

hysterectomy, suggesting that important differences may exist between these two groups of women. It becomes important, therefore, to control for these clinical indications in our effort to explain variation in hysterectomy rates.

Physicians. Table 2 presents the univariate statistics for physician measures used in the analyses. The average physician is 46 years old; 90 percent of them are male, and 83 percent are board-certified. Only 5 percent of the physicians have been practicing for less than five years, while another 7 percent have more than 35 years of experience. The majority (87 percent) of physicians treating these cases have between 5 and 35 years experience since medical school graduation. Table 2 also describes some of the practice characteristics of physicians. The largest portion of the physicians' gynecological caseload is HMO/Blue Cross patients (36.6 percent), with commercial patients (31.4 percent), and AHCCCS and Medicare patients fairly evenly distributed (12 percent and 10.8 percent, respectively).

EMPIRICAL RESULTS

Decomposition of Explained Variation. Table 3 decomposes the variation in the hysterectomy decision as explained by patient, hospital, and physician factors. The R^2 from five models is presented. The first line of entry provides the model R^2 explained by (1) patient factors only (R^2 = .431); (2) patient factors and hospital dummy variables (R^2 = .44), (3) patient factors and physician dummy variables (R^2 = .473), (4) patient factors, hospital and physician dummy variables (R^2 = .475), and (5) patient factors, hospital dummy variables, and physician characteristics (R^2 =.446). The second line of

Table 2: Univariate Statistics for Physician Characteristics ($N = 339$)

Physician Characteristics	*Mean*	*s.d.*
Age	46.21	9.78
% Gender		
Male	.90	
Female	.10	
Experience (number of years since graduation)		
%0–4 years experience	.050	.217
5–9 years experience	.173	.378
10–14 years experience	.200	.400
15–19 years experience	.127	.333
20–24 years experience	.164	.371
25–29 years experience	.109	.311
30–34 years experience	.103	.304
35–39 years experience	.042	.200
≥ 40 years experience	.028	.166
% Board-certified	.830	.375
% Caseload (by type of reimbursement)		
Commercial	.314	.187
HMO/Blue Cross*	.366	.224
AHCCCS/Medicaid†	.120	.172
Medicare	.108	.125

*The Arizona discharge database combines HMO and Blue Cross patients into one category.

†Arizona's Medicaid program is known as The Arizona Health Care Cost Containment System (AHCCCS).

entry provides the F-tests and significance for the *increment* in the explained variation due to the addition of hospital and physician characteristics.

An overview of Table 3 indicates that all three sets of factors contribute significantly to the explained variation in the hysterectomy decision. However, patient characteristics are the major determinants of a hysterectomy, as much of the literature suggests. By comparison, hospital and physician dummy variables increase the R^2 by .09 and .042, respectively. Physician dummy variables as a set contribute more to the explanatory power of the model than do hospital dummy variables. The physician characteristics only begin to capture the variation explained by the physician dummy variables.

Parameter Estimates. Table 4 presents the coefficients from the regression of the hysterectomy decision on the three sets of characteristics. As supported in much of the research, the common clinical indications of hysterectomy significantly increase the probability of this operation (leiomyomas, dysfunctional uterine bleeding, endometriosis/adenomyosis, chronic pelvic pain, endometrial hyperplasia, inflammatory diseases of the uterus, and stress incontinence). Interestingly, we found a negative relationship between uterine prolapse and hysterectomy. As might be expected, we found the effect of comorbidity and complications to be negative, suggesting that the procedure is likely to be performed on less sick or less complicated patients.

We also conducted further analysis on some of the uterus-sparing treatments of common hysterectomy indications. While we found that such alternative treatments (i.e., myomectomy, hysteroscopy, lysis of adhesions,

Table 3: Variation in the Hysterectomy Decision Explained by Patient, Hospital, and Physician Characteristics; and Significance of the Incremental Variation Explained by Addition of Each Set of Factors

	R^2 *for Regression Models and* F*-Tests for Significance of Incremental Variation Explained by Inclusion of the Following Models:*†			
Patient Factors	*Patient Factors and Hospital Dummy Variables*	*Patient Factors and Physician Dummy Variables*	*Patient Factors and Hospital and Physician Dummy Variables*	*Patient Factors and Hospital Dummy Variables and Physician Characteristics*
$R^2 = .431$	$R^2 = .440$ $F = 11.95^{****}$	$R^2 = .473$ $F = 7.79^{****}$	$R^2 = .475$ $F = 7.39^{****}$	$R^2 = .446$ $F = 15.14^{****}$

$^*p < .05$; $^{**}p < .01$; $^{***}p < .001$; $^{****}p < .0001$.

†F-Tests for significance of incremental variation explained by addition of each set of factors as compared to model with patient factors only.

Table 4: Regression of Hysterectomy Decision on Patient and Physician Factors

Independent Variables	*Parameter Estimate (s.e.)*
A. Variables Relating to Patient	
Principal indications for hysterectomy	
Leiomyomas (fibroid tumors)	1.82 (.062)****
Dysfunctional uterine bleeding	3.01 (.087)****
Endometriosis/Adenomyosis	1.02 (.039)****
Genital prolapse	.293 (.079)***
Chronic pelvic pain	.211 (.102)****
Cancer	7.82 (.409)****
Endometrial hyperplasia	13.24 (.793)****
Inflammatory diseases of uterus	.349 (.036)****
Obstetrical indications	.681 (.721)
Stress incontinence	.310 (.013)***
Age	
15–24	.326 (.016)****
25–34	.127 (.015)****
35–44	.123 (.015)****
45–54	.132 (.015)****
55–64	.000 (.016)
Income	.000 (.000)
Means of payment	
Commercial	.041 (.008)****
HMO/Blue Cross	.054 (.008)****
AHCCCS/Medicaid	.031 (.009)***

Continued:

Table 4: Continued

Independent Variables	*Parameter Estimate (s.e.)*
Medicare	.049 (.017)**
B. Variables Relating to Physician	
Gender (1 = female)	.015 (.007)*
Medical experience	
5–9 years	.015 (.012)
10–14 years	.002 (.012)
15–19 years	.031 (.013)*
20–24 years	.008 (.013)
25–29 years	.030 (.014)*
30–34 years	.024 (.014)
35–39 years	.023 (.016)
40 ≥ years	.021 (.018)
Board-certified Ob/Gyn	.004 (.007)
Payer mix:	
% HMO/Blue Cross	.082 (.024)***
% Commercial	.081 (.026)**
% AHCCCS/Medicaid	.013 (.028)
% Medicare	.003 (.031)

*$p < .05$; **$p < .01$; ***$p < .001$; ****$p < .0001$.

lysis of the endometrium) were provided, they did not occur with much frequency. For example, in our sample, only 1.5 percent of the patients had myomectomies, 1.2 percent lysis/excisions of adhesions or tissue, and .01 percent had hysteroscopy.

Similar to previous research, we find that the probability of a hysterectomy is positively associated with middle age. Younger women (15–34) are significantly less likely to undergo a hysterectomy, while women in the 35–54 age group are significantly more likely. While we did not find an effect for income of the patient (our proxy for socioeconomic status), we did find that women with any type of health care coverage were more likely to have a hysterectomy than women who were self-pay (the omitted contrast).

Several physician factors also exert significant effects on the probability of hysterectomy. Among the background/experience factors we found a marginally significant effect of the physician's gender on the hysterectomy decision (Hypothesis 1). Surprisingly, our results suggest that female physicians are more likely to perform a hysterectomy than their male counterparts. It should be noted, however, that women make up only 10 percent of the physician sample ($N = 34$). We found that physicians with 15–19 and 25–29 years experience perform significantly more hysterectomies than do less experienced physicians (0–4 years experience was the excluded contrast). There was no effect for any other age cohort. Contrary to Hypothesis 3 we did not find that board-certified physicians are more likely to perform a hysterectomy than those not board-certified.

We also find that physician case mix exerts a significant effect on the hysterectomy decision. Physicians with a heavier caseload of privately insured patients (commercial and HMO/Blue Cross) are more likely to perform a hysterectomy than are physicians treating publicly insured patients (AHCCCS/Medicaid and Medicare).

DISCUSSION

This study investigates the relationship of various factors to the hysterectomy decision. We have specified three major sets of characteristics (patient, hospital, and physician) and have weighed their relative importance in explaining variation in the occurrence of hysterectomies. We have developed explanatory models at the individual rather than the aggregate level and have examined the effects of some previously unexplored physician characteristics.

Certain data limitations may limit the study's external validity. The data are taken from only one state over three calendar years (1989–1991). We therefore make no claims regarding the generalizability of these results over other geographic areas and time periods. These data also exclude small, rural hospitals and federal hospitals (Indian Health Service), and thus are not representative of all institutions and women admitted in those hospitals.

In addition, the Arizona state discharge database contains relatively limited clinical information, typically only diagnoses and procedures. Excluded are potentially critical factors such as patient history, sociodemographic factors, and patient preferences.

Finally, our sample is limited to women who are hospitalized for any one of the clinical conditions associated with hysterectomy. Physicians who practice with an "aggressive treatment style" may hospitalize patients more frequently than physicians who are predisposed to "watchful waiting." Therefore, we may be looking at only a select portion of patients, that is, those women treated by physicians practicing a more interventionist style of medicine.

With these caveats in mind, our findings offer some important contributions. First, they suggest that, as a set, physician factors explain a statistically significant component of hysterectomy rate variations. In fact, physician factors contribute more explanatory power to the model than do hospital factors, despite being added last.

Second, our research provides some surprising evidence regarding the hypothesized effects of some physician practice characteristics and background/experience factors not previously demonstrated. Prior research suggests that physician gender has a measurable effect on practice style (Domenighetti, Luraschi, and Marazzi 1985; Bickell et al. 1994). Our results support this assumption; however, we find that female (not male) physicians perform significantly more hysterectomies. Given the small sample size of women physicians and the large number of observations, we hesitate to suggest this as a definitive finding. Our results regarding the influence of medical experience on hysterectomy rates suggests a pattern consistent with previous research (Bickell et al. 1994). Consistent with our hypothesis regarding recency of medical training, we find that physicians with 15 or more years of experience since medical school (15–19 and 25–29 years) appear to perform significantly more hysterectomies than do more recent graduates. This does not hold true, however, for physicians with more than 30 years experience. Board-certified physicians do not perform significantly more hysterectomies than do non-boarded physicians, suggesting that there is no specialized training and patient referral effect. And last, our findings suggest that physicians may perform hysterectomies to enrich themselves financially. Those physicians with a higher caseload of privately insured patients are significantly more likely to perform a hysterectomy than physicians treating publicly insured patients.

These findings raise some interesting issues. First, as noted in Table 3, physician dummy variables explain a significant increment in the variation surrounding the hysterectomy decision. This suggests that elements of the physician's background or practice style impinge on this decision. However, the specific physician characteristics used in this study to model the physician level effect do not account for most of the variation explained by the physician dummy variables. This raises the issue of identifying other unspecified physician characteristics that may influence the hysterectomy decision. Such factors as residency training, practice setting, and physician beliefs may be important areas to examine in future research given that these factors have been shown to be significant influences in other surgical decision making (i.e., cesarean sections) (Haynes de Regt et al. 1986). Second, our findings regarding the effect of gender are of some import. As previously noted, we found that female physicians are more likely than their male counterparts to perform a hysterectomy. Such discrepant findings from prior research certainly warrant further investigation. They may indicate regional differences in medical practice.

POLICY IMPLICATIONS

Overall, the results confirm that nonclinical (both hospital and physician) factors play a statistically significant role in the decision to perform hysterectomies. Focusing on the role of the physician, the model suggests that background, experience, and patient mix may exert an influence on the hysterectomy decision. Substantively, however, physician factors play a smaller, secondary role compared to clinical/patient factors in explaining practice variations in hysterectomies. The results suggest that efforts to reduce unnecessary hysterectomies should be directed at identifying the appropriate clinical indications for hysterectomy and disseminating this information to physicians and patients. This may require such intervention strategies as continuing clinical education, promulgation of explicit practice guidelines, peer review, and public education, as well as a greater understanding and inclusion of patient preference in the treatment decision process (Eisenberg 1986; Finkel and McCathy 1991; Gambone et al. 1989).

Such strategies have been successful in changing practice style for other medical procedures. In the 1960s a dramatic reduction occurred in the number of elective tonsillectomies and adenoidectomies. Physician education–in particular, feedback comparing one's performance to that of other doctors–was found to be more effective than regulation by government or peer review mechanisms (Wennberg et al. 1977; Moore and Pratt 1981).

While hysterectomies are not always elective procedures, education strategies are still possible. Successful efforts are likely to focus on instituting explicit protocols regarding such services. Myers and Gleicher (1988) reported on a program that successfully reduced cesarean section use through the implementation of rigorous practice protocols. Even though this was a voluntary program, the c-section rate was reduced from 17.5 percent in 1985 to 11.5 percent in 1987.

Several methods of targeting inappropriate hysterectomies have been implemented, including second opinion programs (Finkel and McCathy 1991) and validation through pathology examinations (Gambone et al. 1989). These programs, however, have been slow to affect physician behavior.

The patient factor is another important consideration in this change process. Given the medical uncertainty that surrounds the hysterectomy decision, approaches to lower the hysterectomy rate must seek ways to extend reeducation not only to physicians and hospitals but also to patients. One such approach to reduce inappropriate hysterectomies was a mass media campaign targeted at women in a Swiss canton. Hysterectomy rates declined by 25 percent in the targeted area and increased by 1 percent in a comparison canton (Domenighetti et al. 1988).

In conclusion, this research has measured the influence of patient, hospital, and physician factors on the probability of a hysterectomy. The results have extended our understanding of the factors, both clinical and nonclinical, that influence the hysterectomy decision. We have found that although nonclinical factors play a significant role in the hysterectomy decision, substantively these factors play a smaller role in comparison to clinical factors. Therefore, greater attention to the influence of clinical factors and their interpretation by clinicians in the hysterectomy decision is warranted. In addition, as recent work by Carlson, Miller, and Fowler (1994) has demonstrated, continued monitoring of hysterectomy rates and alternative therapies is critical.

Finally, research regarding the influence of patient preferences on treatment decisions is also of great importance. In many cases, hysterectomy is an elective procedure performed to relieve symptoms and improve quality of life. Patient preferences, therefore, become a critical influence in any decision-making process. The RAND study (1992, 1993) found that 16 percent of women in their sample underwent hysterectomies for clinically inappropriate reasons and another 25 percent for uncertain reasons. However, we have no way of knowing if this inappropriately high surgical rate was induced by physician or patient. Future research to assess patients' preferences regarding treatment options is needed. All of this information can be useful in determining the most cost-effective quality of care available and in helping to establish guidelines to accomplish that goal.

REFERENCES

Ackner, B. 1960. "Emotional Aspects of Hysterectomy: A Follow-up Study of 50 Patients under the Age of 40." *Advanced Psychosomatic Medicine* 1 (3): 248–52.

Agency for Health Care Policy and Research. 1993. "Trends in Hospital Procedures for Blacks and Whites: National Estimates from the Hospital Cost and Utilization Project, 1950–1987." Rockville, MD: AHCPR, 29 July.

American College of Obstetricians and Gynecologists Task Force on Quality Assurance. 1989. *Quality Assurance in Obstetrics and Gynecology.* Washington, DC: American College of Obstetricians and Gynecologists.

Bernstein, S. J., E. A. McGlynn, A. Siu, C. P. Roth, M. J. Sherwood, J. W. Kessey, J. Kosecoff, N. R. Hicks, and R. H. Brook. 1993. "The Appropriateness of Hysterectomy: A Comparison of Care in Several Health Plans." *Journal of the American Medical Association* 269 (18): 2398–2402.

Bickell, N. A., J. A. Earp, J. M. Garrett, and A. T. Evans. 1994. "Gynecologists' Sex, Clinical Beliefs, and Hysterectomy Rates." *American Journal of Public Health* 84 (10): 1649–52.

Brailer, D. J., M. V. Pauly, K. Kroch, and J. P. Huang. (in press). "Co-morbidity Adjusted Complication Risk: A New Outcome Quality Measure."

Carlson, K. J., D. H. Nichols, and I. Schiff. 1993. "Indications for Hysterectomy." *The New England Journal of Medicine* 328 (12): 856–60.

Carlson, K. J., B. A. Miller, and F. J. Fowler. 1994. "The Maine Women's Health Study: I. Outcomes of Hysterectomy." *Obstetrics and Gynecology* 83 (4): 556–65.

Coulter, A., K. McPherson, and M. Vessey. 1988. "Do British Women Undergo Too Many or Too Few Hysterectomies?" *Social Science and Medicine* 27 (9): 987–94.

DeFriese, G. H., A. T. Evans, T. C. Ricketts, and E. P. Cromartie. 1989. *North Carolina Medical Society Practice Variation Study of Hysterectomy.* Chapel Hill: University of North Carolina.

Dicker, R. C., M. J. Scally, J. R. Greenspan, and P. M. Layde. 1982a. "Hysterectomy among Women of Reproductive Age: Trends in the United States, 1970–1978." *Journal of the American Medical Association* 248 (3): 323–27.

Dicker, R. C., J. R. Greenspan, L. T. Strauss, M. R. Cowart, M. J. Scully, and H. B. Peterson. 1982b. "Complications of a Vaginal and Abdominal Hysterectomy among Women of Reproductive Age in the United States: The Collaborative Review of Sterilization." *American Journal of Obstetrics and Gynecology* 144 (7): 841–48.

Domenighetti, G., P. Luraschi, and A. Marazzi. 1985. "Hysterectomy and Sex of the Gynecologist." *The New England Journal of Medicine* 313, no. 23 (5 December): 1482.

Domenighetti, G., P. Luraschi, A. Casabianca, F. Gutzwillel, A. Spinelli, and E. Pedrinis. 1988. "Effects of Information Campaign by the Mass Media on Hysterectomy Rates." *Lancet* 2, no. 8626–8627 (24–31 December): 1470–73.

Doyle, J. C. 1953. "Unnecessary Hysterectomies: Study of 6248 Operations in Thirty-five Hospitals during 1948." *Journal of the American Medical Association* 151 (3): 360–65.

Dranov, P. 1986. "Do You Need These Operations?" *Health* (June): 24–27.

Dyck, F. J., F. A. Murphy, and J. K. Murphy. 1977. "Effect of Surveillance on the Number of Hysterectomies in the Province of Saskatchewan." *The New England Journal of Medicine* 296 (23): 1326–28.

Eisenberg, J. M. 1986. *Doctor's Decisions and the Cost of Medical Care.* Ann Arbor, MI: Health Administration Press.

Finkel, M. L., and E. G. McCathy. 1991. "On the Cost and Value of Second Surgical Opinion Programs: Comment and Response." *Journal of Health, Politics, Policy, and Law* 16 (2): 397–99.

Gambone, J. C., Lench, Slosinski, and Moore. 1989. "Validation of Hysterectomy Indications and the Quality Assurance Process." *Obstetrics and Gynecology* 73 (6): 1045–49.

Goldfarb, M. 1984. *Who Receives Caesareans: Patient and Hospital Characteristics.* Department of Health and Human Services Publication No. (PHS) 84–3345. Rockville, MD: National Center for Health Services Research, 2–18.

Haynes de Regt, R., H. L. Minkoff, J. Feldman and R. H. Schwarz. 1986. "Relations of Private or Clinic Care to the Cesarean Birth Rate." *The New England Journal of Medicine* 315 (10): 619–24.

Heins, M. 1979. "Career and Life Patterns of Women and Men Physicians." In *Becoming a Physician: Development of Attitudes and Values in Medicine,* edited by Shapiro & Lowenstein. Cambridge, MA: Ballinger Press.

Jenkins, V. R. 1977. "Unnecessary-Elective-Indicated? Audit Criteria of the American College of Obstetricians and Gynecologists to Assess Abdominal Hysterectomy for Uterine Leiomyomas." *Quality Review Bulletin* 3 (5): 7–12.

Kjerluff, K. H., G. M. Guzinski, P. W. Langenberg, P. D. Stolley, N. E. Adlermoye, and V. A. Kazandjian. 1993. "Hysterectomy and Race." *Obstetrics and Gynecology* 82 (5): 757–64.

Leichner, P., and D. Harper. 1982. "Sex Role Ideology among Physicians." *Canadian Medical Association Journal* (127): 380–83.

Leserman, J. 1981. *Men and Women in Medical School.* New York: Praeger.

Margolis, A. J., S. Greenwood, and D. Heilbron. 1983. "Survey of Men and Women Residents Entering United States Obstetric and Gynecology Programs in 1981." *American Journal of Obstetrics and Gynecology* 146 (5): 541–46.

Martin, R. L., W. V. Roberts, and P. J. Clayton. 1980. "Psychiatric Status after Hysterectomy: A One-Year Prospective Follow-up." *Journal of the American Medical Association* 244 (4): 350–53.

McPherson, K., J. E. Wennberg, O. B. Hovind, and P. Clifford. 1982. "Small Area Variation in the Use of Discretionary Surgery: An International Comparison Between New England, England, and Norway." *The New England Journal of Medicine* 307 (21): 1310–14.

Meilahn, E. N., K. A. Mathews, G. Egeland, and S. F. Kelsey. 1989. "Characteristics of Women with Hysterectomies." *Maturitas* 11 (4): 319–29.

Melody, G. F. 1962. "Depressive Reactions Following Hysterectomy." *American Journal of Obstetrics and Gynecology* 83 (4): 410–13.

Moore, F. D., and L. W. Pratt. 1981. "Tonsillectomy in Maine: Regulation versus Education as Modulators of Medical Care." *Annals of Surgery* 194 (2): 232–41.

Myers, S. A., and N. A. Gleicher. 1988. "A Successful Program to Lower Cesarean Section Rates." *The New England Journal of Medicine* 319 (23): 1511–16.

National Center for Health Statistics. 1992. National Hospital Discharge Survey: Annual Summary, 1990. *Vital and Health Statistics.* Series 13. No. 112. Department of Health and Human Services Publication No. (PHS)92–1773. Washington DC: Government Printing Office.

Pauly, M. V., and M. Redisch. 1973. "The Not-for-Profit Hospital as a Physicians' Cooperative." *American Economic Review* 63 (1): 87–89.

Phelps, C. E. 1992. *Health Economics.* New York: Harper Collins.

Placek, P. J., M. Taffel, and M. Moien. 1988. "1986 C-Sections Rise; VBACs Inch Upward." *American Journal of Public Health* 78 (5): 562–63.

Pokras, R., and V. G. Hufnagel. 1988. "Hysterectomy in the United States, 1965–84." *American Journal of Public Health* 78 (7): 852–53.

Roos, N. P. 1984. "Hysterectomy: Variations in Rates across Small Areas and across Physicians' Practices." *American Journal of Public Health* 74 (4): 327–35.

Stafford, R. S. 1990. "Cesarean Section Use and Source of Payment: An Analysis of California Hospital Discharge Abstracts." *American Journal of Public Health* 80 (3): 313–15.

Weisman, C. S., C. A. Nathanson, M. A. Teitelbaum, G. A. Chase, and T. M. King. 1986. "Abortion Attitudes and Performance among Male and Female Obstetrician-Gynecologists." *Family Planning Perspectives* 18 (2): 67–73.

Wennberg, J. E., L. Blowers, R. Parker, and A. M. Gittelsohn. 1977. "Changes in Tonsillectomy Rates Associated with Feedback and Review." *Pediatrics* 59 (6): 821–26.

Wennberg, J. E., and A. M. Gittelsohn. 1973. "Small Area Variations in Health Care Delivery." *Science* 182 (117): 1102–8.

——. 1982. "Variations in Medical Care among Small Areas." *Scientific American* 246 (4): 120–34.

Wilcox, L. S., L. M. Koonin, R. Pokras, M. A. Strauss, Z. Xia, and H. B. Peterson. 1994. "Hysterectomy in the United States, 1988–1990." *Obstetrics and Gynecology* 83 (4): 549–55.

Wingo, P. A., C. M. Huezo, G. L. Rubin, and H. W. Ory. 1985. "The Mortality Risk Associated with Hysterectomy." *American Journal of Obstetrics and Gynecology* 152 (7, Part 1): 803–8.