

Cervical Cancer Screening Overuse and Underuse: Patient and Physician Factors

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Objectives: Despite recommendations for triennial cervical cancer screening for low-risk women 30 years and older, annual screening remains common. We studied how often women receiving care from an academically affiliated medical group were screened, and patient and provider factors associated with overuse and underuse. We also explored the impact of changing measurement intervals on computed screening frequency.

Design: The study included women 30 years and older continuously enrolled over a 3-year period and excluded women with history of abnormal screening and conditions of high risk for cervical cancer.

Methods: Administrative and laboratory data were merged to link Papanicolaou (pap) test results with patient and ordering provider characteristics. We used logistic regression to analyze multivariate models for overuse and underuse, and modified measurement intervals to test sensitivity to early and late pap smears.

Results: The 8018 women had a mean age of 48 years and 95% had an ambulatory physician visit during the observation period. Thirty-four percent of women received guideline-based screening, 45% had overuse, and 21% had underuse. Factors independently associated with overuse included younger age, more medical visits, contraceptive management visits, and gynecology provider specialty. Underuse was associated with older age, fewer medical visits, and increased comorbidity. Overuse was 47% if unsatisfactory paps were not considered and was reduced to 35% if the observation interval was reduced from 36 to 30 months.

Conclusions: Overuse and underuse of cervical cancer screening are common and clinician and patient factors are identifiable to target quality improvement interventions. Modifying the measurement interval may improve the measure.

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For author information and disclosures, see end of text.

For a decade, US medical professional organizations^{1,2} and the US Preventive Services Task Force (USPSTF)³ have suggested that low-risk women (history of multiple normal Papanicolaou [pap] tests, age over 30 years) receive cervical cancer screening every 3 years as part of routine preventive services. Prior to these guidelines, observational and case control studies supported similar clinical outcomes between 1- and 3-year intervals.⁴⁻¹¹ However, surveys showed that most (60-70%) gynecologists and primary care providers continued to perform annual screening, and many were unaware of the new guidelines.^{12,13} Recently, the USPSTF solidified its recommendations for the 3-year interval¹⁴⁻¹⁷ and they and the American College of Obstetricians and Gynecologists suggest a 5-year interval with negative HPV testing.^{18,19}

A 2010 study using the National Ambulatory Medical Care Survey projected that triennial screening would reduce testing by 6.3 million pap tests per year and reduce costs by \$403.8 million.¹⁷ An earlier study projected that an additional 69,665 pap smears and 3861 colposcopies would need to be performed in women 30 to 44 years of age to avert 1 case of cervical cancer by screening every year instead of every 3 years. For women 45 to 59 years old, 209,324 pap tests and 11,502 colposcopies would need to be performed.⁴ Using National Health Interview Survey data, projected compliance with triennial screening would decrease the annual number of pap smears from 75 million to 34 million.²⁰

Since 2009, a pay for performance measure has been applied to managed care plans in California to encourage triennial rather than more frequent screening, but there has been little exploration of cervical cancer screening rates in populations affected by this measure. Furthermore, preventing overuse might encourage underuse, so both should be simultaneously evaluated. To encourage targeted use of screening, understanding physician and patient factors associated with overuse and underuse is needed. We evaluated usage of cervical cancer screening in 1 medical group's patients with the goal of identifying factors amenable to intervention. In addition, we varied the time period of the 3-year measure and accounted for clinically insufficient pap tests to evaluate the proportion of patients that were close to receiving appropriate screening to test the clinical applicability of the measure, which is important in order to promulgate interventions with clinicians.

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METHODS

We evaluated cervical cancer screening provided to female patients in an academic medical center–affiliated group (commercial health maintenance organization [HMO] and Point of Service enrollees). We linked laboratory data for pap smear pathology with patient encounter data and then linked this with patient general claims data and administrative records for physicians in order to link testing patterns to patient and physician characteristics. After categorizing cervical cancer screening patterns, multivariate models were constructed to identify factors independently associated with screening overuse and underuse.

Data Sources and Participants

Eligible female patients were women 30 years and older continuously enrolled with the practice from January 1, 2007, to December 31, 2009. The study population was refined using the following exclusion criteria: (1) ICD-9 codes for cervical or endometrial cancer or DES exposure, any grade of cervical dysplasia (CIN) or abnormal cervical cytology (ASCUS, ASC-H, LSIL, HSIL, AGC) or HPV infection, and high-risk conditions for cervical cancer (HIV infection, leukemia, neutropenia, history of organ transplantation) and (2) CPT codes for procedures related to abnormal cervical cytology (colposcopy, LEEP, or cryotherapy). These criteria were applied during the study period and the preceding 3 years.

Pathology results were available for every pap smear performed on a patient, which also identified the ordering provider. The text of the cytology result was analyzed to identify and eliminate unsatisfactory pap smears. Characteristics of ordering providers were collected from an online physician database maintained by the health system. The UCLA Institutional Review Board approved the study.

Main Dependent Variable

Each patient in the study population was assigned a cervical cancer screening category, based on the total number of satisfactory pap smears performed during the 36-month observation period. Assignment of category accounted for age and whether a woman had a hysterectomy. Pap smears deemed inadequate for histologic evaluation were excluded from analysis. The 3 cervical cancer screening categories were: (1) *Underuse*–0 screening episodes for a woman with a uterus (measure not applicable for age greater than 67 years), (2) *Guideline-consistent use*–exactly 1 screening episode over the 3-year observation period for a woman with a uterus (0 or

Take-Away Points

- Underuse and overuse of cervical cancer screening are prevalent and coexistent in clinical practice.
- Analysis of medical group encounter and laboratory data can identify patient and provider targets for quality improvement.
- Measured overuse is lower when high-risk conditions and unsatisfactory Papanicolaou smears are accounted for and the time interval is relaxed to account for variability in scheduling.

1 acceptable for women over 67 years) or 0 screening episodes for a woman without a uterus, and (3) *Overuse*–2 or more screening episodes for a woman with a uterus or 1 or more screening episodes for a woman without a uterus.

Covariates

Patient-level variables: Using billing data, we collected patient age (at study entry), race/ethnicity (Asian/Pacific Islander, Hispanic, non-Hispanic black, non-Hispanic white, and non-Hispanic other), and preferred language (English, Spanish, or other). Age was subdivided into 3 categories (30-50 years, 51-70 years, 71 years and older). In cases where ethnicity information was missing (5.9%), non-Hispanic was assigned, as this was the modal condition (82%). Using billing and encounter data, we also collected total outpatient visits over the observation period (categorized as 1-10 and greater than 10), presence of comorbidities (diabetes, coronary artery disease, hypertension, cerebrovascular disease, and depression), average total Medicare Risk Adjustment Factor (RAF) score (which reflects patient complexity and illness severity), any visits for contraceptive management over the observation period, and for women over 40 years, number of mammograms received during the 3-year interval.

Provider-level variables: Utilizing the laboratory data link to physician, we derived a variable describing specialty mix of ordering providers for all pap smears performed on each patient (primary care only, gynecology only, primary care and gynecology, neither primary care nor gynecology). We collected information on the gender of provider, years since medical school graduation, and clinical specialty. We also included a variable indicating whether a provider attended a medical group–sponsored CME meeting about cervical cancer screening guidelines.

Analyses

We described patient characteristics and computed for each patient her cervical cancer screening category. We compared patient characteristics across the 3 screening categories using Pearson's χ^2 and simple logistic regression, as appropriate. We also examined distribution of screening category by pap smear

provider specialty mix. All analyses were performed using SAS version 9.2 (SAS Institute, Cary, North Carolina).

We separately evaluated predictors of overuse compared with guideline use and underuse compared with guideline use, using hierarchical logistic regression. The underuse model contained only patient characteristics because no pap provider existed. These models included the following patient characteristics (described above): age, race/ethnicity, language (English and non-English), greater than 10 outpatient visits over the study period (versus 10 or less), RAF score, comorbid conditions, and whether the patient had a visit for contraception. The overuse model included each of these variables plus provider gender, specialty, attendance at a cervical cancer screening CME lecture, and greater than 8 years in practice. For the overuse model, we carried out a sub-analysis for women 40 years and older that added mammogram count. This analysis aimed to understand whether adherence to one guideline was associated with adherence to another or whether screening was performed in a regular, non-targeted fashion.

We performed an analysis to understand how sensitive the triennial measure is to pap smears performed at the extremes of or just outside of the measurement period. An additional 6 months of data were collected from January 1, 2010, to June 30, 2010. Alternate observation periods of 30 months (January 2007 to June 2009) and 42 months (January 2007 to June 2010) were used to re-compute the cervical cancer screening category for each patient. In order to evaluate the effect of a pap smear being performed late and just outside the 3-year interval, we compared underuse rates in the 42- and 36-month study intervals. In order to evaluate the effect of a pap smear being performed early and just inside the 3-year interval, we compared overuse rates in the 30- and 36-month study intervals. In order to evaluate the secular trend, we compared overuse and underuse in the original 36-month window (January 1, 2007, to December 31, 2009) with the 36-month window of July 1, 2007, to June 30, 2010. The multivariate analysis was repeated to examine the effect of changing observation period on the multivariate results.

RESULTS

There were 10,111 women continuously enrolled with the medical group from January 1, 2007, to December 31, 2009. After exclusions were applied, 8018 women remained in the sample. Laboratory data from the study period showed that 10,998 pap smears were performed on this group of 8018 women. A total of 450 unsatisfactory test results were removed from the analysis. The final laboratory sample had 10,548 unique pap smear results. These tests were performed by 166 providers (see [Table 1](#)).

Fifty-four percent of the 8018 women were 50 years or younger (mean 48 years, standard deviation [SD] 10.5, range 30-91 years). Over half were white non-Hispanic ethnicity and 16.5% were Asian/Pacific Islander. Nearly all women were English-speaking. Ninety-five percent had at least 1 outpatient clinic visit, with an average of 16 visits over the 3-year study period (SD 15, range 1-186 visits). Most visits were to primary care providers.

The most common comorbidity was hypertension (28.2% of all women), followed by diabetes (9.0%) and depression (6.1%). Nine percent of women had at least 1 clinic visit coded for contraceptive management. Eighty-five percent of women 40 years and older had at least 1 mammogram during the study period.

Of the 8018 women, 6030 (75%) had at least 1 satisfactory pap smear during the study period. Using the criteria described above, most women were classified into the overuse category of cervical cancer screening (45.3%), with 21.2% categorized as underuse and 33.5% as receiving guideline-based screening. If unsatisfactory pap smears were not excluded, 47.0% of women would have been classified as having overuse. In the cohort of women enrolled in an HMO plan ($n = 5187$), the rate of guideline-based cervical cancer screening was similar (32.1%), while apparent underuse was lower (18.1%) and apparent overuse was higher (49.8%).

Of the 166 providers who performed the pap smears, half (49%) were female. Providers had been in practice a mean of 21.8 years (SD 11.7, range 5-55 years). Most of the providers (43.4%) specialized in internal medicine, followed by gynecology (29.5%), family medicine (25.3%), and other (1.8%). Ten percent of providers attended a medical-group CME session on cervical cancer screening.

Factors Associated With Overuse and Underuse. In bivariate analyses, there were statistically significant differences between screening category groups for the variables of patient age; race/ethnicity; number of outpatient visits over the observation period; number of mammograms (in women 40 years and over); presence of hypertension, or diabetes; and whether a patient was seen for contraceptive management ($P < .001$). The differences between categories was less robust for coronary artery disease ($P = .002$) or depression comorbidity ($P = .008$). Preferred language and presence of cerebrovascular disease were not different between groups.

Most pap smears (65.5%) were performed by primary care physicians (internal medicine or family medicine). A total of 59% of women who received their testing from only primary care providers were in the overuse category, whereas 63% of women who received testing from only gynecology providers were in the overuse category (by definition all women who received testing by both primary care and gynecology were considered overuse). Among women 40 years or older with

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Table 1. Demographic and Clinical Characteristics of Study Patients, Overall and by Cervical Cancer Screening Category

	All women N = 8018	Underuse N = 1703 (21.2%)	Guideline-based N = 2686 (33.5%)	Overuse N = 3629 (45.3%)	P
Age	Mean 48.5 ± 10.5 Range 30-91 y	Mean 50.8 ± 9.9 Range 30-67 y	Mean 50.5 ± 11.2 Range 30-91 y	Mean 45.9 ± 9.7 Range 30-78 y	<.0001
30-50 years	4364 (54.4%)	720 (42.3%)	1300 (48.4%)	2344 (64.6%)	<.0001
51-70 years	3478 (43.4%)	983 (57.7%)	1223 (45.5%)	1272 (35.1%)	
71-91 years	176 (2.2%)	—	163 (6.1%)	13 (0.4%)	
Race					
Asian/PI	1319 (16.5%)	259 (14.7%)	462 (17.2%)	606 (16.7%)	.0001
Hispanic	955 (11.9%)	157 (9.2%)	345 (12.8%)	453 (12.5%)	
Black non-Hispanic	709 (8.8%)	155 (9.1%)	225 (8.4%)	329 (9.1%)	
Other non-Hispanic	800 (10.0%)	208 (12.2%)	245 (9.1%)	347 (9.6%)	
White non-Hispanic	4235 (52.8%)	932 (54.7%)	1409 (52.5%)	1894 (52.2%)	
Language	N = 7795	N = 1584	N = 2638	N = 3573	
English	7632 (97.9%)	1555 (98.2%)	2581 (97.8%)	3496 (97.8%)	.45
Spanish	111 (1.4%)	16 (1.0%)	42 (1.6%)	53 (1.5%)	
Other	52 (0.7%)	13 (0.8%)	15 (0.6%)	24 (0.7%)	
Total visits	Mean 15.7 ± 14.8 Range 0-186	Mean 12.4 ± 15.0 Range 0-186	Mean 15.2 ± 13.9 Range 0-150	Mean 17.8 ± 14.9 Range 0-162	<.0001
Zero	420 (5.2%)	258 (15.2%)	72 (2.7%)	90 (2.5%)	<.0001
1-10	3091 (38.6%)	748 (43.9%)	1145 (42.6%)	1198 (33.0%)	
Greater than 10	4507 (56.2%)	697 (40.9%)	1469 (54.7%)	2341 (64.5%)	
Number of visits					
Primary Care	Mean 7.9 ± 7.1 Range 0-82	Mean 6.4 ± 7.3 Range 0-60	Mean 8.1 ± 6.9 Range 0-61	Mean 8.5 ± 7.0 Range 0-82	<.0001
OB Gyn	1.2 ± 3.7 0-58	0.2 ± 1.1 0-21	0.7 ± 2.5 0-49	2.0 ± 4.8 0-58	<.0001
Other specialties	6.6 ± 10.2 0-137	5.7 ± 10.1 0-126	6.3 ± 9.7 0-137	7.2 ± 10.6 0-135	<.0001
Average RAF	N = 7744 Mean 0.39 ± 0.23 Range 0.17-3.55	N = 1555 Mean 0.43 ± 0.28 0.17-2.74	N = 2589 Mean 0.41 ± 0.23 0.21-3.55	N = 3600 Mean 0.37 ± 0.21 0.21-2.92	<.0001
Cerebrovascular disease	306 (3.8%)	62 (3.6%)	110 (4.1%)	134 (3.7%)	.65
Hypertension	2262 (28.2%)	508 (29.8%)	848 (31.6%)	906 (25.0%)	<.0001
Coronary artery disease	262 (3.3%)	68 (4.0%)	104 (3.9%)	90 (2.5%)	.0013
Diabetes	719 (9.0%)	195 (11.5%)	276 (10.3%)	248 (6.8%)	<.0001
Depression	488 (6.1%)	77 (4.5%)	181 (6.7%)	230 (6.3%)	.0058
Contraception visit	708 (8.8%)	34 (2.0%)	184 (6.9%)	490 (13.5%)	<.0001
Mammograms^a					
0	888 (14.7%)	557 (39.0%)	234 (10.9%)	97 (3.9%)	<.0001
1	5114 (84.4%)	854 (59.9%)	1890 (87.8%)	2370 (95.5%)	
2	60 (1.0%)	16 (1.1%)	28 (1.3%)	16 (0.6%)	
Number of paps	N = 6030		N = 2401	N = 3629	
1	2479 (41.1%)	0	2401 (100%)	78 (2.2%)	
2	2215 (36.7%)			2215 (61.0%)	<.0001
3	1261 (20.9%)			1261 (34.8%)	
4 or more	75 (1.2%)			75 (2.1%)	

OB Gyn indicates obstetrics/gynecology; PI, Pacific Islander; RAF, risk adjustment factor.

Cervical cancer screening categories are: 1) Underuse – 0 screening episodes for a woman with a uterus, 2) Guideline-based use – exactly 1 over the 3-year observation period for a woman with a uterus or 0 for a woman without a uterus, and 3) Overuse – 2 or more for a woman with a uterus or 1 or more for a woman without a uterus.

^aLimited to women aged 40 years and over (N = 6062).

■ **Table 2. Multivariate Hierarchical Logistic Regression of Overuse^a**

Covariates	Adjusted OR	95% CI
Patient: Age 30-50 years (ref 51-70 years)	1.50 ^b	1.32-1.72
Patient: Preferred language not English	1.13	0.76-1.69
Patient: Hispanic race/ethnicity (ref white race)	0.87	0.72-1.04
Patient: Asian race/ethnicity	0.99	0.84-1.17
Patient: Black race/ethnicity	1.02	0.83-1.26
Patient: Other race/ethnicity	0.90	0.74-1.11
Patient: >10 outpatient visits during study period	1.84 ^b	1.62-2.09
Patient: Contraception visit during study period	1.80 ^b	1.46-2.21
Patient: Diabetes comorbidity	0.70 ^c	0.56-0.88
Patient: Coronary artery disease comorbidity	0.82	0.57-1.17
Patient: Hypertension comorbidity	0.95	0.82-1.10
Patient: Cerebrovascular disease comorbidity	1.30	0.95-1.81
Patient: Depression comorbidity	0.75 ^c	0.60-0.95
Patient: Risk Adjusted Factor score	0.93	0.67-1.29
Provider: Gynecology specialty (ref Family Medicine)	1.81 ^c	1.22-2.69
Provider: Internal Medicine specialty	1.00	0.70-1.44
Provider: Female gender	1.09	0.81-1.48
Provider: CME attendance	1.04	0.65-1.67
Provider: Greater than 8 years in practice	1.36	0.77-2.40

CI indicates confidence interval; CME, continuing medical education; OR, odds ratio.

^aExcludes unsatisfactory pap results and limited to women 30 to 70 years of age. Sample size 5826 women.

^b $P < .001$.

^c $P < .05$.

zero mammograms, 63% were in the underuse and 11% in the overuse category. Among women with 1 or more mammograms, there was 17% underuse and 46% overuse.

The hierarchical logistic regression model showed that patient characteristics significantly associated with overuse were increased number of outpatient visits during the study period (adjusted odds ratio [OR] 1.84, 95% confidence interval [CI] 1.62-2.09) and seeing a physician for contraceptive management (OR 1.80, 95% CI 1.46-2.21). Provider specialty in gynecology was associated with overuse (OR 1.81, 95% CI 1.22-2.69). Factors significantly associated with less overuse were older patient age (51-70 years compared with 30-50 years) and having diabetes (Table 2). Analytic sample size was reduced to 5826 patients and 151 providers due to missing data on covariates. The sub-analysis of women 40 years and older (N = 4220 patients, 142 providers) showed that each additional mammogram received was positively associated with overuse (OR 2.13, 95% CI 1.63-2.78). Other significant covariates in this sub-sample were the same as for the full sample.

The multivariate model of underuse revealed that higher RAF score (OR 2.17, 95% CI 1.52-3.10) was associated with greater underuse (N = 3946 patients). Factors associated with

less underuse were younger age (OR 0.80, 95% CI 0.69-0.93), increased outpatient visits (0.58, 95% CI 0.50-0.68), seeing a physician for contraceptive management (OR 0.39, 95% CI 0.26-0.57), and Hispanic and Asian race/ethnicity (see Table 3).

Changing the Observation Period. Moving the original 36-month observation period (model 1 in Table 4) forward 6 months (model 2) to test for secular trend showed a decrease in overuse from 45.3% to 41.9%, an absolute decrease of 3.4%. The sensitivity analyses aimed at understanding whether small changes in timing affected underuse and overuse categorizations showed minimal effect on the former, but a large effect on the latter. Extending the acceptable duration of time in which to receive a pap smear from 36 to 42 months (model 3) reduced underuse by only 1.8%. However, lower rates of overuse were identified when the acceptable window in which to receive a pap was decreased to 30 months (models 4 and 5). Compared with the original 36-month time frame (January 2007-December 2009), the shortened study period reduced overuse rates by 8.1%, and an absolute reduction of 12.9% was seen if a later 30-month window (January 2008-June 2010) was examined. We repeated the multivariate mod-

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Table 3. Multivariate Hierarchical Logistic Regression of Underuse^a

Covariates	Adjusted OR	95% CI
Patient: Age 30-50 years (ref 51-70 years)	0.80 ^b	0.69-0.93
Patient: Preferred language not English	1.08	0.67-1.74
Patient: Hispanic race/ethnicity (ref white race)	0.71 ^b	0.57-0.89
Patient: Asian race/ethnicity	0.80 ^b	0.66-0.97
Patient: Black race/ethnicity	1.02	0.80-1.30
Patient: Other race/ethnicity	1.06	0.84-1.34
Patient: >10 outpatient visits during study period	0.58 ^c	0.50-0.68
Patient: Contraception visit during study period	0.39 ^c	0.26-0.57
Patient: Diabetes comorbidity	1.21	0.96-1.54
Patient: Coronary artery disease comorbidity	1.05	0.74-1.50
Patient: Hypertension comorbidity	1.04	0.88-1.22
Patient: Cerebrovascular disease comorbidity	1.07	0.76-1.52
Patient: Depression comorbidity	0.67 ^b	0.50-0.90
Patient: Risk Adjusted Factor score	2.17 ^c	1.52-3.10

CI indicates confidence interval; OR, odds ratio.
^aExcludes unsatisfactory pap results and limited to women 30 to 70 years old. Sample size 3946 women.
^bP < .05.
^cP < .001.

Table 4. Effect of Changing the Observation Period on Screening Category Interval

	Time Period				Screening Rate (%)		
	January 1- December 31, 2007	January 1- December 31, 2008	January 1- December 31, 2009	January 1- December 31, 2010	Underuse	Guideline-Based	Overuse
1					21.2	33.5	45.3
2					22.4	35.7	41.9
3					19.4	30.2	
4						37.9	37.2
5						40.4	32.4

els of overuse and underuse after changing the observation periods, resulting in no changes to the statistical significance of the associations of predictors with overuse/underuse.

DISCUSSION

It takes time for medical care patterns to change in response to changes in guidelines, even when the guideline change means performing an uncomfortable medical procedure less often. This may be particularly true when insurance plans still reimburse for more frequent screening. The data presented here show that 5 to 8 years after a shift in guidelines, about 40% of women were still screened more often than recommended and about one-fifth of women were under-screened. The multivariate analysis demonstrates patient characteristics that can guide interventions to target women for appropriate

cervical cancer screening. Younger women, those receiving contraception, and those who see gynecologists can be targeted for education about overuse. Older women and those with greater level of illness need to be targeted for interventions aimed at underuse of pap smears. Interventions appear to be particularly needed for gynecologists, at least in the group studied, and it appears that coordination is needed when a patient sees both a primary care physician and a gynecologist.

In the last several years, multiple studies have explored cervical cancer screening utilization from the patient or provider perspective, but the analysis presented here may be unique in linking patient and provider factors to explore both overuse and underuse. We found a decreased rate of overuse compared with the 50% to 70% found in other studies,²¹⁻²⁴ which may be explained by study design and/or secular trend. We accounted for inadequate pap smears, which yields a low-

er—more clinically accurate—characterization. Similar to our findings, other studies found lower overuse among older women and women in poorer health²¹ and when provider specialty was family or internal medicine.²³ The association between cervical cancer and breast cancer screening found here confirms similar findings in a US and Canadian study.²⁵

Measures are used for a variety of reasons, but a key purpose is to feed back information to providers to improve care. One obstacle to feedback is that measures are often imperfect and that clinicians do not believe the results of measures or that they apply to them.²⁶ The analysis performed here shows that accounting for unsatisfactory pap smears and narrowing the 3-year screening interval by 6 months reduces observed overuse from 47% to 37% (with improvement to 32% during the later 30-month interval). These data suggest that if an intervention were targeted at all patients with overuse, it would reach 10% to 15% of women who may not merit intervention. Mistargeted interventions reduce the effectiveness of efforts to improve care, emphasizing the importance of constructing accurate measures that reflect the clinical realities of practice.

Our conclusions are limited to associations between patient and provider characteristics and screening utilization, and cannot prove causality. A small proportion of the sample was enrolled in a Point of Service plan and we cannot account for cervical cancer screening received by women outside the studied practice. Additionally, these data are from a single medical group and may not be generalizable to other populations. Furthermore, the accuracy of clinical information (comorbidities, use of non-pap screening procedures) is limited in administrative data. Finally, we were conservative in our analysis by labeling either 0 or 1 pap smears in women aged over 67 years guideline-based, although current guidelines have an upper age limit of 65 years to stop screening entirely.

Variation in clinical practice has led to interest in defining appropriate use of common clinical procedures.^{27,28} However, there remains tension between patient-centered and evidence-based medicine.²⁹⁻³¹ Guidelines aimed at changing clinical behavior must account for clinical and structural variability in care, and when feasible, both underuse and overuse should be addressed. We studied cervical cancer screening here; however, the general principle applies to many diagnostic and treatment modalities.

CONCLUSION

We demonstrate that analyses using available data can be performed at the medical group level in order to identify areas for improvement and to target interventions. This analysis also suggests improvements in measurement for cervical cancer screening that can make the measure more clinically

meaningful. Underuse should be evaluated simultaneously with overuse of cervical cancer screening.

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