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## Liquid-based Cytology Test Use by Office-based Physicians: United States, 2006–2007

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### Abstract

*Background*—In the United States, liquid-based cytology (LBC) has become a common screening method for cervical cancer. However, the extent of LBC use, and how it varies by patient and practice characteristics, is unknown.

*Objective*—This report describes the ordering and provision of Papanicolaou (Pap) tests, with a major focus on the extent to which LBC has supplanted conventional cytology. The type of Pap test is examined for visits made to primary care physicians in 2006–2007 by females aged 15–64.

*Methods*—Estimates of Pap test cytology use (both LBC and conventional) are based on combined data from the 2006–2007 National Ambulatory Medical Care Survey (NAMCS), an annual nationally representative survey of visits to nonfederal office-based physicians in the United States, as well as on information reported by sample physicians in Cervical Cancer Screening Supplements fielded as part of NAMCS during the same years.

*Results*—In 2006–2007, LBC was used in approximately 75% of Pap tests for which the type of cytology was known. LBC was less likely to be used for Medicare patients than for privately insured patients, although LBC use did not vary significantly according to the other patient or practice characteristics examined.

*Conclusion*—The high percentage of LBC use by office-based physicians in 2006–2007 confirms the widespread use of this screening method among primary care providers, as has been reported in the literature.

**Keywords:** physician visits • cervical cancer screening

### Introduction

In the United States, liquid-based cytology (LBC) has rapidly become a common method used in cervical cancer screening (1–4). Its popularity with both medical professionals and insurance companies may be related to the ease of microscopic interpretation and the potential for performing additional medical tests on the same sample (2,5,6). This popularity may also be attributable to direct marketing to physicians, to patients, and to laboratories (1). However, limited information is available on the extent of LBC use and how use varies by patient and practice characteristics; previous studies (1,3,4) were based on selected specialties or were conducted in limited geographic areas. This report examines the type of cytology test ordered or provided at primary care visits to office-based physicians made by females aged 15–64 in the United States in 2006–2007.



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## Methods

All data were obtained from the National Ambulatory Medical Care Survey (NAMCS), conducted by the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics. NAMCS is a national probability sample survey of visits to nonfederal office-based physicians selected from the master files of the American Medical Association and the American Osteopathic Association. In 2006, NAMCS began including a separate stratum—community health centers (CHCs)—which produced an additional sample of up to 250 clinicians. NAMCS utilizes a multistage probability sample design involving patient visits within physician practices among 112 geographic primary sampling units. Sampled physicians were asked to complete Patient Record Forms (PRFs) for a systematic random sample of up to 30 office visits occurring during a randomly assigned 1-week reporting period. For each sampled visit, a sample weight is computed that takes into account all stages of the survey design as well as physician response. The 2006–2007 unweighted response rate was 60.3%, with 65,963 PRFs completed (7,8).

This report examines the type of cytology—LBC, conventional, or unspecified—provided or ordered at visits to office-based physicians in primary care specialties [general/family practice, obstetrics-gynecology (ob-gyn), internal medicine, and pediatrics] for females aged 15–64 who had a Papanicolaou (Pap) test ( $n = 1,667$ ). The weighted percentage of cytology test visits where type of cytology was originally reported as unspecified was 19.4%. The percentage of PRFs abstracted by a Census field representative rather than by someone in a physician's office was higher for visits with unspecified type of cytology (79.6%) than for visits with known type (44.9%). Physician responses to the 2006 and 2007 Cervical Cancer Screening Supplements (CCSS) to NAMCS were used to edit the unspecified responses. CCSS is sponsored by CDC's Division of Cancer

Prevention and Control to examine provider practices regarding cervical cancer screening. CCSS is self-administered in physician offices as part of NAMCS, and all physician specialties in this study were eligible for CCSS. Using this information, 181 of the 365 visits with unspecified cytology type were inferred to equal the type of cytology reported to be used by sample physicians in CCSS. When physicians in CCSS reported using both methods, unspecified tests were not changed. After editing, 10.4% of cytology test visits remained unspecified (weighted).

Physician characteristics examined included practice size (solo, 2–5 physicians, 6–10 physicians, or 11 or more physicians), physician specialty [ob-gyn, general or family practice, or other (e.g., internal medicine or pediatrics)], practice ownership [physician or group practice, health maintenance organization (HMO), CHC, or other ownership], and location of the practice (geographic region and metropolitan statistical area status). Patient characteristics included age and race, expected payment source, reason for visit (preventive or not), and whether a human papillomavirus (HPV) test was ordered or provided at the sample visit.

Bivariate differences in the type of cytology test, by selected patient and practice characteristics, were examined using chi-square tests of association at the  $\alpha = 0.05$  level, with Bonferroni adjustments for multiple comparisons. If chi-square tests were statistically significant, a post hoc *t*-test procedure was used to make pairwise comparisons of type of cytology used between different categories of practice or patient characteristics. Significant results from the post hoc procedure are reported here. Differences in types of cytology (controlling for patient and provider characteristics) were analyzed in a logistic regression model, with LBC compared with conventional cytology as the dependent variable. All estimates were obtained using SUDAAN software to account for the complex sample design of NAMCS (9).

## Results

In 2006–2007, females aged 15–64 made an estimated 210 million visits to primary care physicians annually. Cytology screening was performed at 12.5% (26.2 million) of these visits (data not shown). Approximately 67.2% of tests used LBC, 22.3% used conventional cytology, and 10.4% had unspecified type of cytology. The percentage of tests using LBC varies according to assumptions made about the nature of the unspecified tests. If the unspecified tests are assumed to use conventional cytology, 67.2% of cytology tests use LBC; however, if the same tests are assumed to use LBC, 77.7% of all cytology tests use LBC. If unspecified tests are assumed to be missing at random (i.e., if only tests of known type are included in the denominator), 75.1% of tests use LBC.

NAMCS estimates that assume unspecified tests use LBC (81.2% for ob-gyns compared with 69.6% for family physicians) or are missing at random (79.3% for ob-gyn and 65.6% for family physicians) are more consistent with previous study estimates (80%–82% LBC among ob-gyns and 75% among family physicians) (1,5,6) than are estimates assuming that the unspecified tests use conventional cytology (72.2% for ob-gyns and 58.0% for family physicians). In the analysis that follows, tests with unspecified cytology were assumed to be randomly distributed and were therefore deleted.

Among visits with known type of cytology, a significant bivariate association between type of test and physician specialty was found ( $p < 0.05$ ) (Table 1). Ob-gyns were significantly more likely to order LBC (79.3%) than other primary care physicians (63.0%–65.6%) ( $p < 0.05$  in both cases). Practice ownership was also associated with LBC provision ( $p < 0.05$ ): CHCs ordered fewer LBC tests (51.1%) than physician- and group-owned practices (77.5%) ( $p < 0.05$ ). Although the overall effect of patient's primary expected payment source was only marginally significant ( $p = 0.06$ ), privately insured females were significantly more likely

to have LBC (77.2%) than females enrolled in Medicare (50.0%) ( $p < 0.05$ ).

Results of a logistic regression for LBC relative to conventional cytology are presented in Table 2. Relative to visits with conventional cytology tests, females enrolled in Medicare [odds ratio (OR) = 0.28; 95% confidence interval (CI) = 0.12–0.65] had lower odds of having LBC tests than females relying on private insurance, all else remaining constant. Practice ownership, region, metropolitan statistical area status, patient age, race, HPV test provision, and preventive care visits were unrelated to LBC use in the model. A logistic regression model that included all unspecified tests and assumed that they were all LBC had virtually identical results (data not shown).

## Discussion

For six decades, cytology testing has been used to detect precancerous or early cancerous changes in the cervix (6). Although in 2003 the U.S. Preventive Services Task Force (10) cited insufficient evidence to recommend LBC over conventional cytology for cervical cancer screening, LBC has become the most common testing method. In the present nationally representative study of outpatient visits for 2006–2007, approximately 75% of cytology tests were liquid-based (assuming missing cytology type was missing at random). This finding is consistent with LBC's rapid replacement of conventional cytology as the most common screening method for cervical cancer.

Although significant bivariate associations were found between LBC use and physician specialty and practice ownership, these associations were not significant when simultaneously controlled for in a multivariate logistic regression. These bivariate findings are, however, consistent with results from provider surveys that show that providers who practice in environments where resources are scarce, or providers managed by a larger organization, may

be more likely to use the less expensive conventional Pap (11,12). Although the model for the present study found that Medicare patients were less likely to have LBC relative to conventional cytology tests (when controlling for all other practice and patient characteristics), this finding requires further research.

LBC tests are more expensive than conventional Pap tests. In 2005, Medicare reimbursement was approximately \$15 for a conventional Pap test and \$27 for LBC (6). The higher cost of LBC screenings has put financial pressure on public screening programs for underserved females, such as the National Breast and Cervical Cancer Early Detection Program. Because clinics providing services for the program had a difficult time contracting with providers and laboratories that performed conventional Pap tests, the program changed its reimbursement policy to allow payment for a Pap test at the higher Medicare rate for LBC, provided the LBC screening was only done biennially (6).

The data have certain limitations. First, the fact that 10.4% of tests had unspecified type of cytology means that it is not possible to provide a precise national estimate of the percentage of cytology visits with LBC compared with conventional cytology. Even with this limitation, the study confirms the widespread use of LBC among primary care providers, based on a nationally representative sample of office visits during 2006–2007. Although the ease of conducting HPV testing on the remaining LBC sample has been cited as an advantage of LBC, evidence of comparable sensitivity and specificity of LBC and conventional cytology suggests no advantage of one method over the other for detecting cervical cancer (13–15). HPV testing can also be conducted at lower cost with conventional cytology through co-collection (12). These findings raise questions about the impact of frequent use of LBC on health care costs (5).

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**Table 1. Distribution of cytology test visits, and type of test, for females aged 15–64, by selected characteristics: United States, 2006–2007**

Selected characteristic <sup>1</sup>	Distribution of selected characteristics among visits with known type of cytology test	Percent distribution of cytology test visits by type <sup>2</sup>		
		Total	LBC <sup>3</sup>	Conventional
All visits ( <i>n</i> = 1,483)	100.0	100	75.1	24.9
Practice size <sup>4</sup> ( <i>p</i> = 0.102)				
Solo	28.4	100	86.0	*14.0
2–5 physicians	43.5	100	72.4	27.6
6–10 physicians	21.7	100	71.6	28.4
11 or more physicians	6.4	100	56.7	43.3
Physician specialty ( <i>p</i> = 0.033)				
Obstetrics or gynecology	70.8	100	79.3	20.7
General or family practice	21.1	100	65.6	34.4
Other primary	*8.1	100	63.0	37.0
Practice ownership ( <i>p</i> = 0.020)				
Physician or group	79.9	100	77.5	22.5
Health maintenance organization	*2.5	100	*30.6	69.4
Community health center	3.1	100	51.1	48.9
Other ownership	14.5	100	74.7	*25.3
Geographic region ( <i>p</i> = 0.144)				
Northeast	18.3	100	75.6	24.4
Midwest	20.2	100	72.7	27.3
South	41.9	100	81.6	18.4
West	19.6	100	63.1	36.9
MSA <sup>5</sup> status ( <i>p</i> = 0.212)				
MSA	90.5	100	76.5	23.5
Non-MSA	9.5	100	62.0	38.0
Patient age ( <i>p</i> = 0.136)				
15–24 years	15.6	100	72.1	27.9
25–44 years	47.1	100	78.1	21.9
45–64 years	37.4	100	72.6	27.4
Patient race ( <i>p</i> = 0.137)				
White	80.1	100	76.5	23.5
Black	15.5	100	70.9	29.1
Other	4.5	100	64.1	35.9
Primary payment source ( <i>p</i> = 0.064)				
Private insurance	81.2	100	77.2	22.8
Medicare <sup>6</sup>	1.9	100	50.0	50.0
Medicaid or SCHIP <sup>7</sup>	6.9	100	65.3	34.7
All other sources	10.0	100	69.1	30.9
HPV <sup>8</sup> DNA test ordered or provided ( <i>p</i> = 0.405)				
Yes	9.4	100	80.7	*19.3
No	90.6	100	74.5	25.5
Preventive care reason for visit ( <i>p</i> = 0.517)				
Yes	80.2	100	75.8	24.2
No or unknown	19.8	100	72.4	27.6

\* Figure does not meet standards of reliability or precision.

<sup>1</sup> *p* values reflect chi-square test of association between type of test and characteristic.<sup>2</sup> Excludes 10.4% of cytology tests with type unspecified.<sup>3</sup> LBC is liquid-based cytology.<sup>4</sup> Includes imputed practice size for 0.1% of visits.<sup>5</sup> MSA is metropolitan statistical area.<sup>6</sup> Includes patients dually eligible for Medicare and Medicaid.<sup>7</sup> SCHIP is State Children's Health Insurance Program.<sup>8</sup> HPV is human papillomavirus.

SOURCE: CDC/NCHS, National Ambulatory Medical Care Survey, 2006–2007.

**Table 2. Adjusted odds ratio for liquid-based cytology test, and 95% confidence interval among visits made to primary care physicians with known type of cytology test, for females aged 15–64 who had a Pap test, by selected characteristics: United States, 2006–2007**

Selected characteristic	Adjusted odds ratio for LBC <sup>1</sup>	95% confidence interval
<b>Practice size<sup>2</sup></b>		
Solo . . . . .	Reference	...
3–5 physicians . . . . .	0.43	0.17–1.10
6–10 physicians . . . . .	0.40	0.15–1.08
11 or more physicians . . . . .	0.30	0.07–1.34
<b>Physician specialty</b>		
Obstetrics or gynecology . . . . .	Reference	...
General or family practice . . . . .	0.74	0.33–1.70
Other primary . . . . .	0.54	0.25–1.17
<b>Practice ownership</b>		
Physician or group . . . . .	Reference	...
Health maintenance organization . . . . .	0.26	0.04–1.75
Community health center . . . . .	0.61	0.26–1.39
Other ownership . . . . .	0.88	0.32–2.42
<b>Geographic region</b>		
Northeast . . . . .	Reference	...
Midwest . . . . .	0.91	0.24–3.49
South . . . . .	1.11	0.40–3.11
West . . . . .	0.53	0.18–1.56
<b>MSA<sup>3</sup> status</b>		
MSA . . . . .	2.15	0.69–6.76
Non-MSA . . . . .	Reference	...
<b>Patient age</b>		
15–24 years . . . . .	Reference	...
25–44 years . . . . .	1.30	0.83–2.03
45–64 years . . . . .	1.06	0.66–1.70
<b>Patient race</b>		
White . . . . .	Reference	...
Black . . . . .	0.70	0.39–1.26
Other . . . . .	0.83	0.46–1.52
<b>Primary payment source</b>		
Private insurance . . . . .	Reference	...
Medicare <sup>4</sup> . . . . .	0.25	0.10–0.60
Medicaid or SCHIP <sup>5</sup> . . . . .	0.64	0.32–1.25
All other sources . . . . .	0.81	0.45–1.44
<b>HPV<sup>6</sup> DNA test ordered or provided</b>		
Yes . . . . .	1.23	0.48–3.15
No . . . . .	Reference	...
<b>Preventive care reason for visit</b>		
Yes . . . . .	1.20	0.68–2.11
No or unknown . . . . .	Reference	...

... Category not applicable.

<sup>1</sup>LBC is liquid-based cytology. Based on 1,483 visits with known type of cytology test.

<sup>2</sup>Includes imputed practice size for 0.1% of visits.

<sup>3</sup>MSA is metropolitan statistical area.

<sup>4</sup>Includes patients dually eligible for Medicare and Medicaid.

<sup>5</sup>SCHIP is State Children's Health Insurance Program.

<sup>6</sup>HPV is human papillomavirus.

SOURCE: CDC/NCHS, National Ambulatory Medical Care Survey, 2006–2007.



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