

# Papanicolaou Smear Adequacy: Effect of Different Techniques in Specific Fertility States

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Six hundred fifty-four Papanicolaou smears were studied prospectively to determine the yield of endocervical cells within specific fertility states by technique used. Smears from postmenopausal women had the lowest yield of endocervical cells (32 percent,  $P < 0.01$ ). Smears from postpartum women had a higher yield of endocervical cells than those from pregnant women (69 percent vs 59 percent,  $P > .05$ ). Swabbing excess mucus from the cervix prior to scraping uniformly improved the yield of endocervical cells (70 percent vs 62 percent,  $P < .02$ ). In swabbed postmenopausal women, use of a Milex spatula had a significantly higher yield than the use of a wooden spatula and a cotton-tipped applicator (43 percent vs 27 percent,  $P < .03$ ).

The controversy over the recommended frequency of cervical cytology screening continues despite the American Cancer Society's recent recommendation that low-risk women be screened every three years.<sup>1</sup> Several recent studies<sup>2</sup> support the recommendation by the American College of Obstetrics and Gynecology that all women be screened annually. The controversy continues partly because the incidence of false-negative Papanicolaou smears remains uncertain; estimates range from 6 to 55 percent.<sup>2</sup> False-negative tests lower the sensitivity of the Papanicolaou smear as a screening tool for cervical cancer. The sensitivity of a test is the number of true-positive tests

divided by the total number of tested patients with disease

$$\left( \frac{\text{true positives}}{\text{true positives} + \text{false positives}} \right)$$

The false-negative rate for Papanicolaou smears is unknown. However, many studies confirm that the location of sampling affects the incidence of false-negative Papanicolaou smears: vaginal pool sampling has the highest number of false-negative smears, cervical scraping has a lower number of false-negative smears, and endocervical sampling has the lowest number of false-negative smears.<sup>3,4</sup> Sensitivity is strictly defined as the percentage of tests positive in patients known to have a specific disease.

Papanicolaou smear screening is done in a population largely free of disease. Sensitivity in such populations more properly relates to the likelihood that a sample obtained would demon-

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Table 1. Endocervical Cell Yield by Fertility States and Techniques

Fertility State	Wooden spatula and cotton applicator without swab			Milex without swab			Wooden spatula and cotton applicator with swab			Milex with swab			Total		
	No.	SEC*	%	No.	SEC*	%	No.	SEC*	%	No.	SEC*	%	No.	SEC*	%
Nonpregnant, premenopausal	116	86	74.1	82	66	80.5	74	59	79.7	93	81	87.1	365	292	80.0
Pregnant	26	15	57.7	23	13	56.5	29	17	58.6	32	20	62.5	110	65	59.1
Postpartum	13	10	76.9	14	07	50.0	08	07	87.5	10	07	70.0	45	31	68.9
Postmenopausal	49	11	22.4	33	13	39.4	22	06	27.3	30	13	43.3	134	43	32.1
Total	204	112	59.8	152	99	65.1	133	89	66.9	165	121	73.3	654	431	65.9
$\chi^2$ (df = 3)	39.99 (P < .01)			20.30 (P < .01)			23.54 (P < .01)			24.79 (P < .01)			102.91 (P < .01)		

\*SEC—Samples with endocervical cells

strate an abnormality if it were present. The presence of endocervical cells in the Papanicolaou specimen is evidence that this critical zone has been sampled. It is postulated that Papanicolaou smears without endocervical cells or squamous metaplasia are inadequate samples and therefore increase the rate of false-negative results and reduce the sensitivity of Papanicolaou smears as a screening tool for cervical cancer. Further, it is postulated that a reduction in the number of Papanicolaou smears without endocervical cells or squamous metaplasia will decrease the number of false-negative smears and thereby improve the sensitivity of the Papanicolaou smear for detection of cervical cancer. Many laboratories, however, report smears without endocervical cells or squamous metaplasia as negative rather than as inadequate samples.

The purpose of this study was to determine (1) the effect of fertility status on endocervical cell yield and hence possible sensitivity of the Papanicolaou smear, and (2) whether changes in sampling technique could improve the yield of endocervical cells and thereby improve sensitivity. Papanicolaou smears from four fertility groups were examined: (1) nonpregnant, premenopausal, (2) pregnant, (3) postpartum, and (4) postmenopausal.

## Methods

All Papanicolaou smears obtained from September 1, 1982 through March 31, 1983 in the Department of Family Medicine of the Medical

University of South Carolina were studied prospectively. Papanicolaou smears were obtained by 50 physicians (43 residents, 2 fellows, and 5 faculty). Each physician was informed of the study's design to compare the yield of endocervical cells in four patient groups using different techniques.

The clinic's female population consisted of 37 percent white, 61 percent black, and 2 percent other.

The study was divided into three phases. First, from September 1, 1982 through November 14, 1982, Papanicolaou smears were obtained with a wooden spatula and cotton-tipped applicator. Second, from November 15, 1982 through December 31, 1982, the Milex spatula was used. The Milex spatula is a plastic spatula with an extended tip allowing endocervical and ectocervical scraping simultaneously. Proper use of the Milex spatula was demonstrated to the physicians by the group nurses, who were taught by one of the nurses who had previously used the spatula on a mobile Papanicolaou smear unit. Third, from January 3, 1983 through March 31, 1983, the Milex spatula and the wooden spatula and cotton-tipped applicator were randomly assigned to the 24 examining rooms of the clinic. During this time, the physicians were requested to swab any excess mucus from the cervix prior to obtaining a Papanicolaou smear regardless of spatula used. Several authors<sup>5</sup> recommend this practice. All smears were read by cytopathology technologists at the Medical University of South Carolina. Abnormal smears were reviewed by a staff pathologist.

**Table 2. Bartholomew's Test of Homogeneity for Ordered Alternatives**

Fertility State	$\bar{X}^2$ Bartholomew's Test
Nonpregnant, premenopausal	5.471 (0.025 < P < 0.05)
Pregnant	0.216 (P > .05)
Postpartum	0.007 (P > .05)
Postmenopausal	4.881 (0.025 < P < 0.05)
All patients	7.400 (.01 < P < .025)

It was postulated that the choice of spatula was of major importance in improving the yield of endocervical cells and that the choice of swabbing was secondary.

The null hypothesis was that there was no difference in the yield of endocervical cells for the four methods. The alternate hypothesis was that Milex with swab is better than Milex without swab, which is better than wooden spatula with swab, which is better than wooden spatula without swab.

These hypotheses were tested for each of the four fertility states and over all patients using Bartholomew's test.<sup>5</sup>

## Results

After excluding smears of 54 women who had had complete hysterectomies, 709 Papanicolaou smears were obtained. Fifty-five were excluded because the technique was not recorded or the physician did not follow the study protocol, eg, wooden spatula or cotton-tipped applicator used alone.

The results of the 654 remaining Papanicolaou smears were evaluated according to time phases, fertility states, and technique used.

The yield of endocervical cells by fertility state and method are presented in Table 1. For all four methods combined, smears from postmenopausal women had the lowest yield of endocervical cells (32 percent), while smears from nonpregnant, premenopausal women had the highest yield (80 percent). Smears from pregnant women and postpartum women had intermediate yields, 59 percent and 69 percent, respectively. These differences are statistically significant (P < 0.01).

Results of Bartholomew's test for each of the

fertility states and for all the fertility states are given in Table 2.

There was insufficient evidence to reject the null hypothesis of homogeneity of yield of the four methods for pregnant and postpartum patients. However, the null hypothesis was rejected in favor of the ordered alternate hypothesis for nonpregnant, premenopausal patients vs postmenopausal patients and for all patients combined.

For all fertility states combined, the yield of endocervical cells was 73 percent with the Milex and cervical swab, 65 percent with the Milex alone, 67 percent with the wooden spatula and cotton-tipped applicator and cervical swab, and 60 percent with the wooden spatula and cotton-tipped applicator alone.

In postmenopausal women, the yield of endocervical cells was significantly higher using a Milex spatula than wooden spatula and cotton-tipped applicator regardless of swabbing (Table 1).

An examination of the data in Table 1, along with the above statistical decisions, suggests that swabbing uniformly improved the yield of endocervical cells. Use of a Milex spatula produced a significantly higher yield, or the same yield, as a wooden spatula and cotton-tipped applicator.

## Discussion

Significant differences in the yield of endocervical cells on Papanicolaou smears were found between fertility states. With aging and pregnancy, changes occur in the anatomy of the cervix and endocervical canal and in the characteristics of the cervical mucus, which may explain the lower yield of endocervical cells in postmenopausal and pregnant women. The ectocervix is lined by squamous cells. The endocervical canal is lined by columnar cells. The junction of these two cell types is the transformation zone. Eighty-five to 90 percent of cervical cancer arises in this transformation zone. The location of the transformation zone changes throughout a woman's life (Figure 1). In premenopausal women, it is often on the ectocervix; however, with menopause, the cervical os becomes stenotic, and the transformation zone migrates into the endocervical canal. Because the transformation zone frequently cannot be visualized on a routine examination,<sup>6</sup> sampling cells from this zone becomes difficult in postmenopausal women. Moreover, as the incidence of cervical cancer increases through the fifth dec-

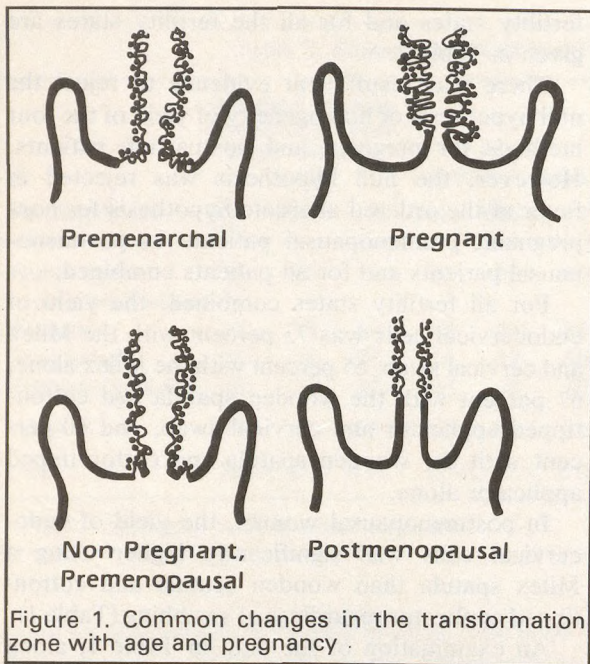


Figure 1. Common changes in the transformation zone with age and pregnancy.

ade and thereafter remains steady, postmenopausal women, who have the highest incidence of cervical cancer and therefore the greatest need of screening for cervical cancer, are most likely to have potentially inadequate Papanicolaou smears.

Although the yield of endocervical cells in postpartum patients was higher than in pregnant patients, the number of smears was small and the difference was not significant. During pregnancy, the endocervical canal is filled with a tenacious mucus that can block access to the columnar cells underneath. Additionally, the pregnant woman's cervix is very vascular, often friable, and therefore bleeds easily. Examiners may be reluctant to scrape the pregnant woman's cervix adequately because of fear of causing bleeding, as blood may interfere with the interpretation of the Papanicolaou smear. The finding of a higher yield of endocervical cells in the postpartum patient suggests that routine Papanicolaou smears should be done in the postpartum visit rather than in the first prenatal visit, provided a normal smear has been obtained in the previous year. Further study of this matter is warranted.

Swabbing the cervix prior to scraping allows excess mucus to be removed. This procedure may provide better access to the columnar cells and may allow a thinner, more interpretable specimen to be made.

The longer and narrower tip of the Miley spatula may improve its access to the transformation zone in postmenopausal women.<sup>7</sup> The serrated edge on the Miley tip may improve the removal of endocervical cells. In addition, Rubio found that endocervical cells remained on both the wooden spatula and cotton-tipped applicator after the smear was placed on the glass slide.<sup>8</sup> Endocervical cells did not adhere so much to the plastic spatula as to the wooden spatula and cotton-tipped applicator.<sup>8</sup>

## Conclusions

This study found that (1) the yield of endocervical cells varied significantly between fertility states (smears from postmenopausal women had the lowest yield), (2) the yield of endocervical cells was improved by swabbing excess mucus from the cervix prior to scraping, and (3) the Miley spatula significantly increased the yield of endocervical cells in swabbed postmenopausal women. Techniques that improve endocervical cell yield should reduce the number of false-negative Papanicolaou smears for cervical cancer and thereby improve its sensitivity.

Based on these results, physicians are encouraged to use a Miley spatula after swabbing excess mucus from the cervix for all Papanicolaou smears. Further studies are being undertaken to increase the sensitivity of the Papanicolaou smear for postmenopausal patients.

## Acknowledgment

Alvin Byars, program analyst, wrote the computer program for this study.

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