

Papanicolaou Smear Cell Recovery Techniques Used By Primary Care Physicians

Kathi D. Clement, M.D., and Pamela D. Christenson, Ph.D.

Abstract: Nine hundred Tennessee-based internists, family physicians, and obstetrician-gynecologists were randomly selected and surveyed to identify Papanicolaou smear cell recovery methods used in their practices. This 16-item survey also requested typical laboratory reporting procedures on Papanicolaou smears. The most frequently reported cell sampling technique was the combination cotton-tipped applicator and spatula, which was used by 47 percent of all physicians. Use of the cervical cytobrush for Papanicolaou smears, which has been shown to improve the detection of cervical dysplasia, was used alone or in combination by 19 percent of those surveyed, of whom 72 percent were gynecologists. Cervical sampling should contain cells from the transformation zone as evidenced by an adequate number of endocervical cells on the smear. Laboratories reporting the presence of endocervical cells were significantly different ($P < 0.05$) among the specialties, with 26 percent of the internists', 18 percent of the family physicians', and 15 percent of the obstetricians' laboratories not providing this information in their reports. Reporting inadequate smears is a necessary first step toward improved sampling technique. Without this information, physicians risk missing pathology through reports of false-negative Papanicolaou smears. (J Am Board Fam Pract 1990; 3:253-8.)

The purpose of the Papanicolaou (Pap) smear is to identify cells that reflect cancerous or precancerous epithelial changes. The original cytologic sampling of the uterine cervix for the diagnosis of cancer was introduced by a Rumanian pathologist, Aureli Babes, in April 1928.¹ George N. Papanicolaou, M.D., Ph.D., presented a similar finding in May 1938. Papanicolaou, in conjunction with Herbert Traut,² noted that cancer cells could be identified on vaginal smears in a number of patients with malignant tumors of the uterine cervix and endometrium. Shortly after the introduction of the Pap test, scientists noted that cancerous changes still confined to the epithelium of the cervix also could be identified. It followed that the test should be used as a cancer detection and prevention tool and has been used as such since 1947.

Items used to obtain Pap smears include moistened cotton-tipped applicators, wooden spatulas, plastic spatulas, cervical pipettes, and endocervical brushes. The methods of cervical cell collection have traditionally been a matter of clinician

preference; however, recent medical literature strongly suggests that one form of sampling, the endocervical brush or cytobrush, may be superior to other forms of cell collection, when used in conjunction with accurate feedback from the laboratory.²⁻⁵ The cervical sample should contain cells from the squamous epithelium of the vaginal portion of the cervix, from the squamocolumnar junction, or transformation zone, and from the endocervical epithelium.^{6,7} Baker and others maintain that the transformation zone of the cervix is the most important area for cytologic sampling.^{8,9} Furthermore, this zone contains a temporary "genetic disarray," where abnormal changes occur with greater frequency than in areas of stable epithelium.¹⁰

When the percentage of Pap smears containing endocervical cells increases, the detection rate for cervical intraepithelial neoplasia and carcinoma increases. Elias and associates found that the rate of detection increased by more than 60 percent in smears with endocervical cells compared with smears without endocervical cells.⁷ This finding was confirmed by Vooijs, et al. in 1985.¹¹

Pap smears have a false-negative rate of 6 percent to 56 percent.^{12,13} According to Noel, approximately two-thirds of false-negative smears represented inadequate sampling of the cervix, and one-third laboratory error.¹⁴ The primary

From the Department of Family Medicine, The University of Tennessee, Memphis. Address reprint requests to Kathi D. Clement, M.D., Department of Family Medicine, University of Tennessee, Memphis, 1121 Union Avenue, Memphis, TN 38104.

sampling error was failure to obtain cells from the transformational zone, where cervical cancer is known to develop.¹⁵ A prospective study by Deckert and associates compared the effectiveness of three collection devices – the cytobrush, the extended-tip spatula, and the cotton-tipped swab. The cytobrush yielded greater numbers of endocervical cells than the other methods tested.¹⁶ Other studies found that the instrument dramatically improved endocervical cell recovery by 200 percent in older women (45 years and greater) and by 57 percent in younger women.¹⁷ A 1988 study comparing the efficacy of a combined endocervical and ectocervical nylon brush with the cotton-tipped applicator and wooden spatula for obtaining cervical cytologic smears concluded that the cytobrush results in fewer false-negatives and inadequate smears.¹⁸ Additional investigations using paired smears from 130 high-risk patients confirmed the superior effectiveness of the cytobrush.¹⁹

Cytobrush utilization deforms sampled cells less²⁰ and reduces variations based on the expertise of samplers.^{21,22}

The cytobrush is not recommended for use in pregnant patients; however, it can be used postpartum. Painless spotting can occur for a day or two after the Pap smear, but this is not usually important. Other methods, such as the extended-tipped spatula, can also cause spotting. Finally, there are rare instances when the cytobrush cannot be inserted into the endocervical canal because of cervical stenosis.¹⁴

In light of these studies showing that the cytobrush is a highly effective tool for endocervical cell collection, we designed this study to identify cell recovery techniques used by private physicians in Tennessee, along with laboratory reporting procedures that they receive.

Methods

Subjects

A simple random sample of 300 physicians from each of the specialties – family medicine, internal medicine, and obstetrics-gynecology – was selected from a September 1987 directory of physicians licensed and registered in Tennessee. There were 559 completed surveys returned, and 89 were returned unopened from 13 family physicians, 13 obstetricians, and 63 internists. The overall response rate was 69 percent; 74 percent

from both family medicine and obstetrics and 58 percent from internal medicine.

Design and Instrumentation

The study was conducted by The University of Tennessee, Memphis, Department of Family Medicine. Return-addressed, stamped questionnaires were mailed with an explanatory cover letter to physicians in mid-November 1988, followed by two additional mailings to non-responders. The final mailing occurred in mid-January 1989.

The questionnaire contained 16 questions on one page. We asked for demographic information, endocervical cell recovery techniques, and cytology data. The questionnaire was pilot tested by 7 family physician educators and 3 research design specialists for comments on face and content validity. The final survey instrument was revised based on this feedback.

Statistical Analysis

Chi-square analyses were done for differences between physician specialty groups on the following variables: gender, community size, practice type, residency training, board certification, Pap smear recommendations, number of smears performed daily, percent of abnormal Pap smears, and cell recovery techniques. Bonferroni-type multiple comparisons controlled experiments with an alpha-level at $P < 0.05$ comparing single and multiple techniques for cell retrieval by physician specialty and number of Pap smears done by physician specialty. Analysis of variance (ANOVA) tested for differences in physician age by specialty and length of practice by physician specialty.

Results

Demographics

The age range of physicians who responded was 26 to 78 years, and their length of time in practice ranged from less than 1 year to 51 years. Gender was 85 percent men and 15 percent women; this proportion held for each specialty (family physicians, 86 percent men; internists, 87 percent; obstetricians, 84 percent). The data in Table 1 show internists are significantly younger than family physicians and obstetricians ($P < 0.05$) and report fewer years in practice than the other specialties ($P < 0.04$).

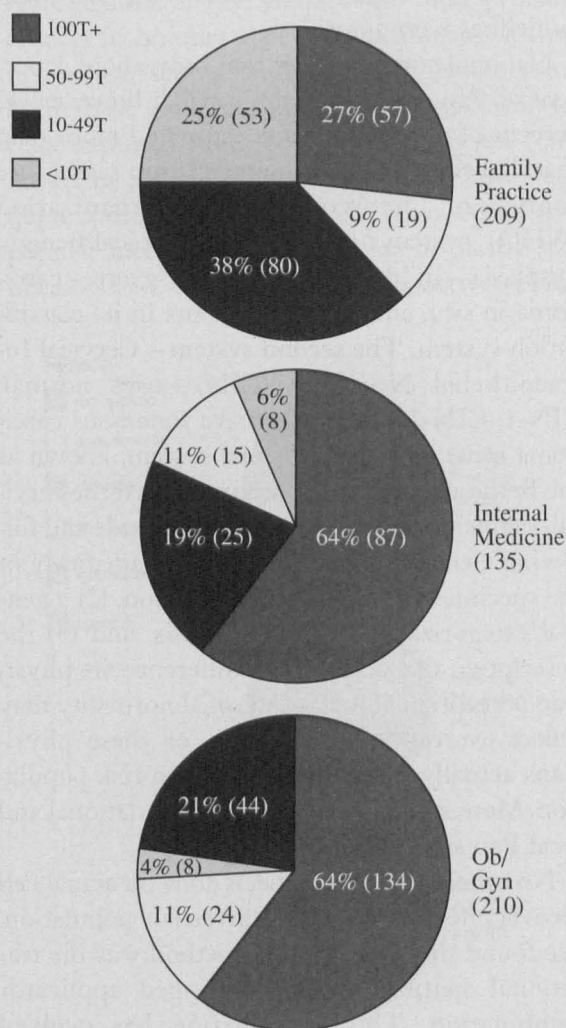
Table 1. Age and Practice Length by Specialty.

| Specialty | Mean Age* (Years) | S.D. | Average Years in Practice† | S.D. |
|-----------------------|----------------------|------|-------------------------------|------|
| Family practice | 45.3 | 12.5 | 15.9 | 12.4 |
| Internal medicine | 42.5 | 10.6 | 12.5 | 10.9 |
| Obstetrics-gynecology | 45.4 | 12.1 | 14.7 | 11.9 |

Analysis of Variance (ANOVA):

* $F = 3.02$ $P < 0.05$.† $F = 3.25$ $P < 0.04$.

Physician distribution by size of community is presented in Figure 1. Internal medicine and obstetrics are almost identical, with both groups reporting greatest numbers in the metropolitan areas. Family practice indicated greater numbers (38 percent) in towns of 10,000–49,999, and physician distribution was significantly different

**Figure 1. Specialty by population of location.**

($P < 0.001$). We found that most physicians were in group practice (46 percent) or solo practice (36 percent), with multispecialty groups and other (not defined) less than 20 percent.

Figure 2 shows residency training and board certification by specialty. Significantly fewer family physicians (61 percent) were residency trained ($P < 0.001$), while a greater number (84 percent) were board certified ($P < 0.04$) compared with physicians in internal medicine and obstetrics-gynecology.

Pap Smears

Pap smears were done by 97 percent of family physicians and 99 percent of obstetricians, but only 80 percent of internists surveyed reported doing this office procedure ($P < 0.001$).

Yearly Pap smears were recommended by 89 percent of respondents, and 8 percent followed the American Cancer Guidelines (three normal annual Pap smears, followed by a Pap smear every 3 years). Specialty recommendations varied; 99 percent of the obstetricians recommended yearly Pap smears, while 87 percent of the family physicians and 72 percent of the internists followed these guidelines ($P < 0.001$).

Physician estimates of the daily number of Pap smears performed are shown in Table 2. Most obstetricians (83 percent) did more than six Pap smears daily, but family physicians (95 percent) and internists (96 percent) estimated fewer than five Pap smears daily ($P < 0.001$).

Physicians estimated the percentage of Papanicolaou smear abnormalities (defined as greater than Class I) even though that term and the Papa-

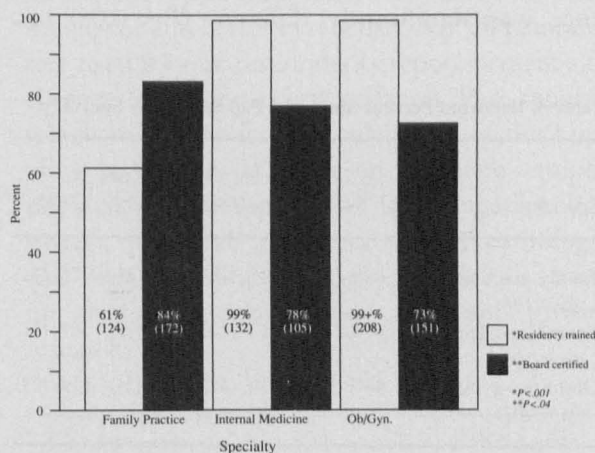
**Figure 2. Percent of specialty by credentials.**

Table 2. Daily Number of Pap Smears by Specialty.

| Specialty | Number of Pap Smears Performed Daily* | | |
|------------------------------------|---------------------------------------|----------|----------|
| | 1-5 | 6-10 | 10+ |
| Family practice (n = 199) | 95% (189) | 4% (8) | 1% (2) |
| Internal medicine (n = 107) | 96% (103) | 3% (3) | 1% (1) |
| Obstetrics-gynecology (n = 205) | 17% (35) | 47% (97) | 36% (73) |

*Chi-square = 329.3 $P < 0.01$.

nicolaou classification system have been replaced by three other classification systems. Because none of them is dominant in our region and some laboratories still incorporate the old classification into the Pap report, we believed that most physicians would understand "abnormality greater than Class I." Table 3 shows that obstetricians reported significantly greater percent of abnormality than did family physicians and internists ($P < 0.001$).

For the total physician sample, Figure 3 shows that the most popular cell recovery method was the wooden or plastic spatula in combination with the cotton-tipped applicator (47 percent), followed by the wooden or plastic spatula alone (27 percent), and the spatula and cytobrush (9 percent). Figure 4 further clarifies techniques by specialty. Significance is noted ($P < 0.001$) with obstetricians utilizing the cytobrush either alone or in combination with some other method (36 percent), while 11 percent of family physicians and 7 percent of internists utilize the cytobrush in some way.

Laboratory reporting of endocervical cell presence was significantly different ($P < 0.05$) be-

tween the specialties. Twenty-six percent of the internists replied that their laboratory did not report presence of endocervical cells on the Pap report. Among family physicians and obstetricians, 18 percent and 15 percent, respectively, noted this lack.

Discussion

Various organizations have recommended schedules for Pap smears. These include the American College of Obstetrics and Gynecology (ACOG) guidelines for yearly Pap smears and the American Cancer Society (ACS) guidelines of three consecutive normal annual examinations followed by Pap smears every 3 years. Additional reporting procedures have been suggested by the National Cancer Institute. Obstetricians in our study followed the ACOG guidelines almost exclusively, while 75 percent of the family physicians and internists used them also. Most physicians in the small group following the ACS guidelines were internists.

National surveys show that only about 5 percent of Pap smears are abnormal²³; however, 42 percent of our respondents estimated more than that. Recent changes in nomenclature may cause confusion. The World Health Organization (WHO) system uses normal, atypical-benign, dysplasia—mild, moderate, and severe—carcinoma in situ, and adenocarcinoma in its classification system. The second system—Cervical Intraepithelial Neoplasia (CIN)—uses normal, CIN-1, CIN-2, CIN-3, invasive squamous carcinoma in its schema. The final system, known as the Bethesda System, recommends that the cervical-vaginal cytopathology report include the following elements: (1) a statement on adequacy of the specimen for diagnostic evaluation, (2) a general categorization of the diagnosis, and (3) the descriptive diagnosis. This difference in physician perception of magnitude of abnormality may reflect overreporting and bias, or these physicians actually may be seeing a high-risk population. More study is needed to clarify national and local Pap smear abnormality rates.

No other studies have been done on actual cell recovery techniques by a physician population. We found the most popular method was the traditional spatula and cotton-tipped applicator combination. This combination has evolved through the years since the introduction of the

Table 3. Reported Percent Abnormal Pap Smears by Specialty.

| Specialty | Percent Abnormalities | | | |
|------------------------------------|-----------------------|----------|----------|----------|
| | 0-5% | 6-10% | 11-25% | 25+% |
| Family practice (n = 196) | 65% (128) | 24% (46) | 4% (8) | 7% (14) |
| Internal medicine (n = 106) | 71% (75) | 21% (22) | 2% (2) | 6% (7) |
| Obstetrics-gynecology (n = 202) | 46% (92) | 31% (62) | 12% (25) | 11% (23) |

*Chi-square = 30.9 $P < 0.001$.

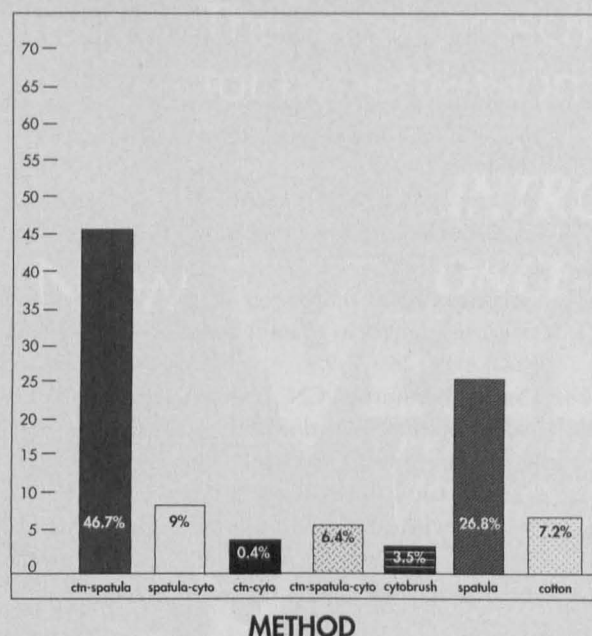


Figure 3. Cell collection method.

Ayre spatula in the mid-1950s²⁵ and probably reflects techniques that most physicians learned in medical school and residency. Rubio found both these samplers actually trap endocervical cells within their matrix. Fewer cells are transferred to the slide from either, and fewer adequate specimens are reported.²⁶ The second most popular method was the wooden or plastic spatula alone; we did not differentiate between blunt

wooden and pointed plastic spatulas, which sample different areas. Because the wooden spatula is unreliable for sampling the endocervical area, it should not be used by itself. While the plastic pointed spatula is better for obtaining endocervical cells, it yielded fewer than the cytobrush in one study.²⁷ The third method, the combination cytobrush and spatula, used by less than 10 percent of those surveyed, is the best method for obtaining an adequate specimen, even though its use is contraindicated in pregnant women and sometimes causes bleeding that obscures endocervical cells. The lack of universal use of the cytobrush may reflect these drawbacks or simply may be due to its relatively recent introduction in the United States (1983).

We are concerned that 94 of our sample physicians used laboratories that do not uniformly report the presence or absence of endocervical cells. Without this information, physicians have no idea whether the completed Pap smear was suitable for interpretation. The Council on Scientific Affairs of the AMA recommends that all laboratories describe presence or absence of endocervical cells.²⁸

Limitations

In any survey that requests approximates (population size, number of Pap smears performed daily, percent of abnormal smears), recall bias must be acknowledged as a potential confounder. Also, our Tennessee data may not generalize to other parts of the country.

Summary

Papanicolaou smears are a proven screening tool. Actual sample techniques used by the survey physicians reflect traditional methods rather than the newer and better cytobrush. Not all laboratories used by our respondents report presence or absence of endocervical cells on Pap reports, which raises the issue of adequacy of the sampling technique. Without an adequate sample, physicians risk reports of false-negative Pap smears, potential worsening patient pathology, and liability. These issues provide an arena for continuing medical education and further research.

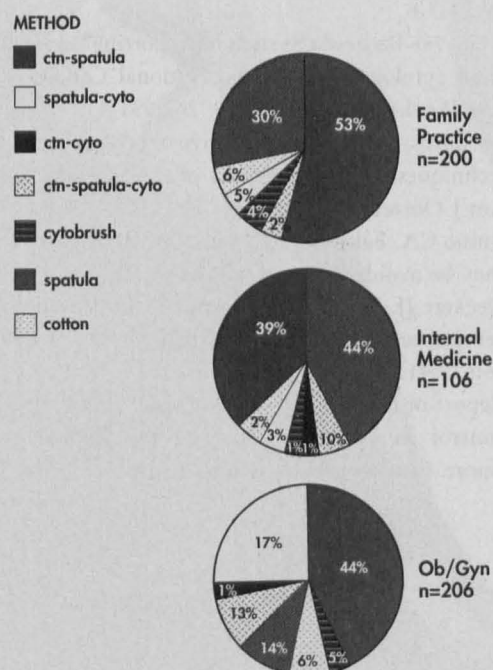


Figure 4. Cell collection method by specialty.

We appreciate the statistical assistance of Kristopher L. Aheart, M.S., Department of Biostatistics and Epidemiology,

The University of Tennessee, Memphis. The Family Practice Development Center, Waco, Texas, also provided encouragement and direction through their Clinical Teaching Fellowship in Family Medicine, for which this paper is partial fulfillment of the requirements.

References

1. Hinsey JC. George Nicholas Papanicolaou, 1883-1962. *Acta Cytol* 1962; 6:483-6.
2. Babes A. Diagnostic du cancer du col uterin par les frottis. *Presse Med* 1928; 36:451-4.
3. Douglass LE. A further comment on the contributions of Aurel Babes to cytology and pathology. *Acta Cytol* 1967; 11:217.
4. Koss LG. The Papanicolaou test for cervical cancer detection. A triumph and a tragedy. *JAMA* 1989; 261:737-43.
5. Spurrett B, Ayer B, Pacey NF. The inadequacies of instruments used for cervical screening. *Aust N Z J Obstet Gynaecol* 1989; 29:44-6.
6. Hamblin JE, Brock CD, Litchfield L, Dias J. Papanicolaou smear adequacy: effect of different techniques in specific fertility states. *J Fam Pract* 1985; 20:257-60.
7. Elias A, Linthorst G, Bekker B, Vooijs PS. The significance of endocervical cells in the diagnosis of cervical epithelial changes. *Acta Cytol* 1983; 27:225-9.
8. Baker RM. Improving the adequacy of Pap Smears. *Am Fam Physician* 1989; 39:109-14.
9. Peto R. Introduction: geographic patterns and trends. In: Peto R, zur Hausen H, eds. *Viral etiology of cervical cancer*. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory 1986:3-15.
10. Koss LG. Sequence of events in carcinogenesis of the uterine cervix. In: Peto R, zur Hausen H, eds. *Viral etiology of cervical cancer*. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory 1986:179-84.
11. Vooijs PG, Elias A, van der Graaf Y, Veling S. Relationship between the diagnosis of epithelial abnormalities and the composition of cervical smears. *Acta Cytol* 1985; 29:323-8.
12. Richart RM, Vaillant HW. Influence of cell collection techniques upon cytological diagnosis. *Cancer* 1965; 18:1474-8.
13. Berkowitz RS, Ehrmann RL, Lavizzo-Mourey R, Knapp RC. Invasive cervical carcinoma in young women. *Gynecol Oncol* 1979; 8:311-6.
14. Noel ML. Papanicolaou smear adequacy: the cervical cytobrush and Ayre spatula compared with the extended-tip spatula. *J Am Board Fam Pract* 1989; 2:156-60.
15. Fluhmann CF. The squamocolumnar transitional zone of the cervix uteri. *Obstet Gynecol* 1959; 14:133-48.
16. Deckert JJ, Staten SF, Palermo V. Improved endocervical cell yield with Cytobrush. *J Fam Pract* 1988; 26:639-41.
17. Reissman SE. Comparison of two Papanicolaou smear techniques in a family practice setting. *J Fam Pract* 1988; 26:525-9.
18. Dotters DJ, Carney CN, Droegemueller W. Nylon brush improves collection of cervical cytologic specimens. *Am J Obstet Gynecol* 1988; 159:814-9.
19. Van Erp FJ, Blaschek-Lut CH, Arentz NP, Trimbos JB. Performance of the Cytobrush in patients at risk for cervical pathology: does it add anything to the wooden spatula? *Eur J Gynaecol Oncol* 1988; 9: 456-60.
20. Boon ME, Alons-van Cordelaar JJ, Rietveld-Scheffers PE. Consequences of the introduction of combined spatula and Cytobrush sampling for cervical cytology. Improvements in smear quality and detection rates. *Acta Cytol* 1986; 30:264-70.
21. Taylor PT Jr, Andersen WA, Barber SR, Covell JL, Smith EB, Underwood PB Jr. The screening Papanicolaou smear: contribution of the endocervical brush. *Obstet Gynecol* 1987; 70:734-8.
22. Brink AL, du Toit JP, Deale CJ. In search of more representative cervical cytology. A preliminary prospective study. *S Afr Med J* 1989; 76:55-7.
23. Gay JD, Donaldson LD, Goellner JR. False-negative results in cervical cytologic studies. *Acta Cytol* 1985; 29:1043-6.
24. The 1988 Bethesda System for reporting cervical/vaginal cytological diagnoses. National Cancer Institute Workshop. *JAMA* 1989; 262:931-4.
25. Nieburgs HE. A comparative study of different techniques for the diagnosis of cervical carcinoma. *Am J Obstet Gynecol* 1956; 72:511-5.
26. Rubio CA. False negatives in cervical cytology: can they be avoided? *Acta Cytol* 1981; 25:199-202.
27. Deckert JJ, Staten SF, Palermo V. Improved endocervical cell yield with Cytobrush. *J Fam Pract* 1988; 26:639-41.
28. Report of the Council on Scientific Affairs. Quality control in cervical cytology—the Papanicolaou smear. Chicago: AMA Report E, January 1988.