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# Effectiveness of Screening for Cervical Cancer in an Inpatient Hospital Setting

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## Abstract

**OBJECTIVE—**To estimate the effectiveness of an inpatient, hospital-based cervical cancer screening program at a single institution.

**METHODS—**Between January 1999 and December 2002, 1,117 women admitted to the Johns Hopkins Hospital underwent Papanicolaou (Pap) test screening during their hospital stay. In that time period, 111,933 women were screened at all of the combined Hopkins outpatient clinics. We compared rates of abnormal Pap tests in these cohorts (retrospective cohort study). Our main outcome measure was the prevalence of abnormal Pap tests among the screening population by age group, ethnicity, and insurance status compared between our outpatient and inpatient populations.

**RESULTS—**The prevalence of abnormal Pap tests in the inpatient cohort was twice as high as that in the outpatient setting (15.5% versus 7%). The prevalence of high-grade squamous intraepithelial lesions (HSIL), the immediate precursor lesion to cervical cancer, was nearly 5-fold higher in the inpatient cohort compared with the outpatient cohort (3% versus 0.7%). In multivariable models, younger women had greater risk for all types of abnormal Pap tests, and black women had greater risk for HSIL. Previous abnormal Pap and human immunodeficiency virus-positive status were associated with all abnormal tests and with HSIL results.

**CONCLUSIONS—**A hospital-based, inpatient Pap test program is an efficient strategy for targeting limited screening funds toward women at high risk of invasive cervical cancer. (Obstet Gynecol 2004;103:310–6.

Cervical cancer is one of the few cancers for which screening is widely available. Routine use of the Papanicolaou (Pap) test has contributed to the dramatic decline in both incidence and mortality of invasive cervical cancer in the United States.[1] Recent studies, however, have demonstrated that older women, particularly those who are poor, live in rural areas, have less education, and/or are of minority ethnicity are less likely to be screened with regular Pap tests.[2] In many cases, these women continue to have regular contact with the health care system.[3] One approach to improving rates of screening with these women is offering cervical cancer screening to women hospitalized for nongynecological ailments. Several states, including Maryland, have passed legislation mandating that all hospitalized women be offered routine screening for cervical cancer. We evaluated the value of hospital-



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based screening by comparing the incidence of abnormal Pap tests between women screened as part of routine primary care in an outpatient setting and those screened during inpatient hospitalization in the same medical system.

## MATERIALS AND METHODS

The Johns Hopkins Medical Institutions include an acute hospital with 977 beds and a network of 40 outpatient clinics with more than 700,000 visits annually. The Pap test volume is approximately 30,000 per year. Pap tests performed at the outpatient sites are obtained by obstetrician/gynecologists, by internists, family practitioners, pediatricians, and nurse-midwives.

The current program of hospital-based screening was instituted in 1999 in response to a state mandate. A single, dedicated 40% full-time equivalent nursing position was assigned to the in-house screening program. At all times, the screening nurse has had access to the medical director of the screening program. The database was approved by the Johns Hopkins Institutional Review Board.

Each woman admitted, whether through the admitting office or through the emergency department, was asked about Pap test screening by admissions office staff. The only women not included were those admitted to either the pediatrics service or to an intensive care unit. A list of women desiring screening was collected daily from the admitting office. In addition, admitting physicians, including house officers, contacted the screening nurse about patients desiring screening. The screening nurse made hospital rounds 3 times a week. Patients were approached directly by the screening nurse, and Pap tests were obtained on the inpatient floors.

The Pap tests were processed through the hospital cytopathology laboratory, and the results were collected by the same screening nurse. A letter to the admitting physician containing results and follow-up recommendations, if necessary, was sent for each patient screened. All results were reviewed by the medical director once a week. The screening nurse made appointments for colposcopy for those patients for whom it was indicated.

Three sources of data were obtained and used in analyses. Data on women approached for screening were collected by the screening nurse from either patient report or medical record review, with Pap test results added from pathology reports. Data on all hospital admissions used for demographic comparison were obtained from hospital administrative databases. Data on volume and results for outpatient screening provided from the Johns Hopkins Medical Institutions were obtained from cytopathology quality assurance/quality control database. All inpatient data and test results were entered into a database by the screening nurse. Data were cleaned and analyzed using SPSS 10.0 (SPSS Inc, Chicago, IL).

For analysis, all Pap test results were grouped into 5 categories: normal (no evidence of abnormality), ASC (atypical squamous cells), LSIL (low-grade squamous intraepithelial lesion), HSIL (high-grade squamous intra-epithelial lesion), and AG-US (atypical glandular cells of undetermined significance). Reports of multiple types of abnormal cells were categorized by the most clinically significant type of abnormality (eg, a result reporting the presence of both LSIL and HSIL was categorized as HSIL). Results reporting adenocarcinoma, endometrial cells or lesions, or unsatisfactory specimens were not included in analyses.

In Table 1, the demographic characteristics of women approached for screening and those screened are compared with all women inpatient admissions during the 4-year time period (1999–2002). In Table 2, bivariate analysis describes the distribution of Pap test results

among screened women by sociodemographic, medical, and previous screening characteristics.

Table 3 reports the results of multiple logistic regression analyses to estimate the increased risk of 2 types of abnormal Pap results (at least, atypical squamous cells of undetermined significance and only HSIL) associated with each of the independent characteristics of interest. For each of the 2 outcomes, we report 2 multivariable logistic regression models, the first including all covariates and the second including only those covariates that were significant at the $P < .05$ level, by using backward elimination.

Table 4 compares rates of each of the 5 categories of Pap test results among women screened in the inpatient screening program and those of patients screened at the hospital outpatient sites during the 4-year time period (1999–2002). Odds ratios (ORs) and 95% confidence intervals (95% CIs) are used to identify statistically significant differences in rates between the 2 groups.

## RESULTS

During the period January 1999 to December 2002, a total of 86,697 female patients were admitted to the Johns Hopkins Hospital. Of these, 22% were aged 21 years or younger. Of the women admitted, 1,482 were approached for cervical cancer screening. These women had indicated at the time of hospital admission that they were interested in taking advantage of the in-house cervical cancer-screening program. Some women were referred to the screening program by their admitting physicians. Of the women who requested screening, a total of 1,117 (75.4%) underwent Pap test screening during their hospital admission.

The age distribution of the women who underwent screening was more heavily concentrated among women aged 20–60 years (84%) compared with the overall hospital population. The proportion of uninsured/self-pay patients in the screened population was slightly higher (26%) than in the overall hospital population (21%). Of the women screened, 62% were black and 35% were white compared with 44% and 51%, respectively, in the overall hospital population. The average length of stay for all inpatients during this time was 6.2 days (data not shown).

Reasons that initially identified women were not screened included general illness; specific contraindication to the examination, such as hip or back surgery or menses; psychiatric conditions, such as mania or dementia; and patients changing their mind for reasons not specified.

Table 2 shows that approximately half of the women screened were admitted to the internal medicine service, and another 25% were admitted to psychiatry. Fourteen percent were known to be human immunodeficiency virus (HIV) positive, although only 5% were admitted to the acquired immunodeficiency syndrome (AIDS) service. A substantial proportion of women screened reported a history of a sexually transmitted disease (STD) (28%) or a history of an abnormal Pap test (14%), and 57% of women screened reported having had a Pap test within the previous 3 years.

Sixteen percent of the inpatient Pap tests performed identified abnormal cervical cells, with 3% of tests identifying HSIL. Bivariate distributions in Table 2 suggest differences in the distribution of Pap test outcome by year, patient age, ethnicity, service, HIV status, and history of STD and abnormal Pap, but no substantial variation by insurance status or reported proximity of last Pap. Table 2 identifies several characteristics of women more likely to have HSIL Pap results: aged 16–40 years, black ethnicity, both admission to the AIDS service and positive HIV status, and history of STD and of previous abnormal Pap.

In Table 3, the final models identify 3 characteristics associated with significant risk for any abnormal test and 3 characteristics specifically predictive of HSIL. The 15.5% of women screened whose results showed atypical squamous cells, LSIL, HSIL, or atypical glandular cells of undetermined significance were significantly more likely to be younger, with a reduction in risk of 2% with each year of age older than the median age of 42 (OR 0.98; 95% CI 0.96, 0.99). Chart documentation or patient report of positive HIV status increased a woman's risk of abnormal results more than 6-fold (OR 6.32; 95% CI 4.30, 9.27). In addition, if the woman or her medical record reported that she had a history of a previous abnormal Pap, her risk of abnormal results more than doubled (OR 2.47; 95% CI 1.61, 3.77). No other variable, including whether or not the woman was on the AIDS service, retained significance in the multivariable model.

The second final model identifies characteristics of women whose Pap result identified HSIL, the abnormality most predictive of risk for invasive cancer. Black women in this population had almost a 4-fold risk of this result, adjusted for other variables in the model (OR 3.72; 95% CI 1.27, 10.93). In addition, HIV-positive status was associated with a 4-fold risk in HSIL result (OR 4.11; 95% CI 2.00, 8.43). As in the model for all types of abnormal results, a previous abnormal test adds a 2.5-fold risk for HSIL results (OR 2.42; 95% CI 1.12, 5.24).

In contrast to the inpatient screening program rate of 15.5%, during this time period, the overall rate of abnormal Pap results in the outpatient clinics ($n$ = 111,933) was 7% (OR 2.44; 95% CI 2.07, 2.82) (Table 4). Although rates for each of the 4 categories of abnormal test are significantly higher in the inpatient screening program than the outpatient data, the greatest difference is seen in the prevalence of HSIL results, with an almost 5-fold increase in the rate of high-grade lesions (3% versus 0.7%; OR 4.63; 95% CI 3.28, 6.52).

## DISCUSSION

We evaluated the effectiveness of an inpatient, hospital-based cervical cancer screening program at a single institution and found that the prevalence of high-grade pre-invasive disease, the immediate precursor to cervical cancer, was between 4- and 5-fold higher in the inpatient cohort compared with all outpatient screenings performed in the Hopkins system during the same time period. During that time period, the prevalence of HSIL in our inpatient screening program was 3%, whereas the prevalence in our outpatient screening clinics was 0.7%. Although specific demographic data on the outpatient screening population are not available for these analyses, these outpatient settings serve a wide range of patients in both urban and suburban Baltimore and are therefore more similar to the general U.S. population. The Centers for Disease Control and Prevention Breast and Cervical Cancer Screening Program has reported a national HSIL prevalence of 1.1%[4]

We found that black race independently increased the chance of an HSIL Pap test in this self-selected group of patients. In addition, in our study, women known to be HIV seropositive were more likely to have HSIL Pap tests.

The strengths of this analysis include data spanning a 4-year period, including more than 1,000 women who requested and underwent cervical cancer screening during inpatient hospitalization at a single institution, that was read by one cytopathology laboratory. We compared rates of abnormal Pap tests to those observed in our combined outpatient clinics, which were read by the same laboratory during the same time period. The out-patient sample included more than 100,000 Pap tests.

Weaknesses of our data set include incomplete information on the screening history of our cohorts and demographic data, including risk factors, on the outpatient cohort. We also

lacked data on some risk factors in the inpatient cohort. Screening histories obtained were by patient report. Patient recall of Pap test screening is often less than accurate.[5,6] This cohort is a self-selected one in that the inpatients who are reported here requested screening after being asked by and large at the time of their hospital admission. We do not know how representative they are of our overall hospital admissions. All women admitted were offered a Pap test; most of those who declined in-house screening at the time of admission did so because they had established care and care providers already. Finally, although our cohort of women was large, our analyses may have had limited statistical power because of the relatively rare outcome events we were examining. Therefore, we cannot rule out that with larger sample or case-control design additional variables would be statistically significant predictors of abnormal Pap test results.

Data describing prevalence of abnormal Pap tests in hospitalized patients is scarce. Klassen et al[7] surveyed 37 acute-care Maryland hospitals about their Pap screening policies. In 31 of 37 hospitals, women were routinely offered a Pap test. In most hospitals, however, this was not accompanied by an evaluation of a patient's individual need for a Pap test, patient education about cervical cancer, or a physician recommendation to the patient about screening. Only 2 hospitals had a specific person designated to counsel women about Pap tests and to perform them. Therefore, most hospitals complied with the letter of the law but did not effectively increase screening among their highest-need patients. Earlier work found that hospitalization appeared to increase the likelihood of a recent Pap test among women aged 45–54 years with household income more than $20,000 a year but not among older or poorer women.[8]

Why are women in the United States still being diagnosed with cervical cancer? Despite the widespread availability of Pap tests, the American Cancer Society estimated that in 2003, 13,000 women will be diagnosed with cervical cancer and that 4,100 women will die of the disease (American Cancer Society, Facts and Figures 2003, www.cancer.org). The Pap test is an inexpensive, relatively noninvasive, socially acceptable screening test. In the developed world, there exists an extensive, although cumbersome and expensive, infrastructure for the evaluation and treatment of women with abnormal Pap tests. There is a low but appreciable false-negative rate, and compliance with follow-up of abnormal results can be problematic. Perhaps the most important reason, however, is that many women do not get screened regularly. At least half of women diagnosed with cervical cancer have not had a Pap test in the 3 years previous to their diagnosis.[2,3] Nationally, women who are less likely to undergo regular screening include women who are older, obese, poor, and rural, and whose native language is not English.

Certain chronic medical conditions, such as HIV infection, may be associated with less adherence to care, especially routine health maintenance. This analysis does not address the role of comorbidity, such as substance abuse, in our inpatient cohort. In women whose health is precarious enough to require hospitalization, routine health care issues such as screening may well be a lower priority for both the patient and for her health care providers. This analysis found that younger women represented a higher-than-expected percentage of those with high-grade lesions. Older age has been consistently shown to be a risk factor for noncompliance with screening guidelines and for cervical disease.[9] The constellation of risk factors that increase a young woman's need for hospitalization may also place her at increased risk for cervical dysplasia. Conversely, older women may think that they do not need or want screening for cervical cancer and so may decline screening.

Hospital-based screening has been advocated as one potential opportunity to reach women who are not undergoing regular outpatient screening. In the 1970s, several states, including Maryland, New York, Ohio, and Hawaii, passed laws mandating that women admitted to

hospitals be offered a Pap test. In general, however, these laws did not provide funding for such services. The development of an effective hospital-based cervical cancer-screening program requires several critical elements. These include designation of a specific individual to counsel and perform Pap tests and to follow up on the results, as well as individualized evaluation of each patient's need for a Pap test, counseling about cervical cancer and screening, and support for screening from the patient's admitting physician. In addition, a designated physician with expertise in the appropriate management of abnormal Pap tests must coordinate the program and direct follow-up management plans as needed. In our system, the annual budget, including a 40% full-time equivalent nursing position and Pap test supplies and processing costs, is approximately $50,000. The budget is supported by hospital nursing and administrative funds.

Our data suggest that hospital-based screening can capture women at increased risk for cervical disease. In terms of feasibility, in-house screening is reasonable considering that the average length of stay was 6.2 days and the screening nurse made rounds 3 times a week. Hospital-based screening, therefore, appears to provide a relatively low-cost, targeted intervention to improve screening for cervical cancer in a cohort of women at higher risk for disease than those accessing routine out-patient screening clinics. It must be emphasized that the inpatient population at an inner-city academic institution reflects a cohort with more risk factors for cervical disease than the general population. Therefore, inpatient screening would be more cost-effective in this setting than in hospitals serving more heavily screened patients. Nonetheless, it appears that offering screening for cervical cancer at the time of hospital inpatient admission is a method of targeting a population that is at higher risk for precancerous lesions than the rest of the population and so represents an efficient use of limited screening resources.

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## Table 1

Demographic Comparison of Women Approached* and Screened With Patient Population Johns Hopkins Hospital Inpatient Cervical Cancer Screening Program, 1999–2002

| | All female admissions ($n$ = 86,697)† | Women approached for Pap testing ($n$ = 1,482)* | Women screened ($n$ = 1,117) |
|---|---|---|---|
| Age group (y) | | | |
| ≤ 20 | 22 | 1 | 1 |
| 21–40 | 26 | 40 | 42 |
| 41–60 | 26 | 39 | 42 |
| 61–80 | 21 | 17 | 15 |
| ≥ 81 | 5 | 3 | 1 |
| Insurance status | | | |
| Insured | 79 | 80 | 74 |
| Uninsured | 21 | 20 | 26 |
| Ethnicity | | | |
| White | 51 | 36 | 35 |
| Black | 44 | 61 | 62 |
| Other | 5 | 3 | 3 |

Data are presented as percentages.

*All adult female admissions were asked about Pap testing by admitting staff. Those interested in testing were approached by screening staff during admission.

†Inpatient population from January 1, 1999, through December 12, 2002.

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**Table 2**

Results of Screening by Patient and Admission Characteristics

| | Normal (*n* = 933, 84%) | Atypical squamous cells (*n* = 66, 6%) | Low-grade squamous intraepithelial lesion (*n* = 60, 6%) | High-grade squamous intraepithelial lesion (*n* = 35, 3%) | Atypical glandular cells of undetermined significance (*n* = 11, 1%) |
|---|---|---|---|---|---|
| Year | | | | | |
| 1999 (24%) | 86 | 7 | 5 | 1 | 1 |
| 2000 (26%) | 82 | 8 | 5 | 3 | 2 |
| 2001 (26%) | 84 | 6 | 4 | 5 | 1 |
| 2002 (24%) | 85 | 3 | 8 | 3 | 1 |
| Age | | | | | |
| 16–40 (43%) | 79 | 8 | 7 | 5 | 1 |
| 41–60 (41%) | 86 | 5 | 6 | 2 | 1 |
| 61–80 (15%) | 93 | 4 | 1 | 1 | 1 |
| 80–87 (1%) | 100 | 0 | 0 | 0 | 0 |
| Ethnicity | | | | | |
| White (35%) | 89 | 5 | 4 | 1 | 1 |
| Black (62%) | 82 | 7 | 6 | 4 | 1 |
| Other (3%) | 92 | 3 | 5 | 0 | 0 |
| Service | | | | | |
| Neurological (9%) | 91 | 6 | 2 | 0 | 1 |
| Psychological (25%) | 87 | 7 | 3 | 2 | 1 |
| AIDS (5%) | 52 | 7 | 32 | 9 | 0 |
| Medicine (48%) | 84 | 6 | 5 | 4 | 1 |
| Surgery (11%) | 90 | 5 | 2 | 1 | 2 |
| Other (2%) | 87 | 4 | 0 | 4 | 4 |
| HIV status | | | | | |
| Positive (14%) | 54 | 11 | 24 | 11 | 1 |
| Negative/Unknown (86%) | 90 | 5 | 2 | 2 | 1 |
| Insurance status | | | | | |
| Insured (74%) | 85 | 6 | 5 | 3 | 1 |
| Self-pay (26%) | 83 | 5 | 7 | 5 | 0 |

| | Normal (*n* = 933, 84%) | Atypical squamous cells (*n* = 66, 6%) | Low-grade squamous intraepithelial lesion (*n* = 60, 6%) | High-grade squamous intraepithelial lesion (*n* = 35, 3%) | Atypical glandular cells of undetermined significance (*n* = 11, 1%) |
|---|---|---|---|---|---|
| History of sexually transmitted disease | | | | | |
| Yes (28%) | 76 | 8 | 10 | 5 | 1 |
| No/Unsure (72%) | 87 | 5 | 4 | 3 | 1 |
| History of abnormal Pap test results | | | | | |
| Yes (14%) | 67 | 9 | 16 | 7 | 1 |
| No/Unsure (86%) | 87 | 5 | 4 | 3 | 1 |
| Years since last Pap test | | | | | |
| < 3 (57%) | 85 | 6 | 5 | 3 | 1 |
| 3–5 (9%) | 85 | 3 | 9 | 3 | 0 |
| > 5 (15%) | 89 | 4 | 5 | 1 | 1 |
| Never (1%) | 91 | 0 | 9 | 0 | 0 |
| Unsure (18%) | 79 | 8 | 6 | 5 | 2 |

Data are presented as percentages.

Analysis includes 1,105 of 1,117 women given Pap tests between January 1, 1999, and December 12, 2002. Twelve women were not included due to adenocarcinoma (1), endometrial cells/lesions (9), and unsatisfactory specimen taken (2).

**Table 3**

Factors Associated With Risk of Any Abnormal and With HSIL Pap Test Results Among Hospitalized Women Receiving Pap Tests, Multivariable Logistic Regression Results

| | Outcome 1: any abnormal Pap test result (172 of 1,105, 15.5%) | | | | Outcome 2: Only HSIL Pap test result (35 of 1,105, 3%) | | | |
|---|---|---|---|---|---|---|---|---|
| | Full model | | Final model | | Full model | | Final model | |
| **Variable** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | **95% CI** | **OR** | **95% CI** |
| Age* | 0.98 | (0.96, 0.99) | 0.98 | (0.96, 0.99) | 0.98 | (0.95, 0.02) | | |
| Year of test | 0.99 | (0.84, 1.16) | | | 1.23 | (0.89, 1.71) | | |
| Black race | 1.23 | (0.81,1.87) | | | 3.00 | (1.00, 9.08) | 3.72 | (1.27, 10.93) |
| Insured | 0.83 | (0.55,1.25) | | | 0.54 | (0.25, 1.16) | | |
| Medicine service | 1.18 | (0.79,1.75) | | | 1.77 | (0.75, 4.20) | | |
| AIDS service | 1.25 | (0.59, 2.63) | | | 1.23 | (0.31, 4.89) | | |
| HIV positive | 5.66 | (3.51, 9.15) | 6.32 | (4.30, 9.27) | 4.40 | (1.91, 10.14) | 4.11 | (2.00, 8.43) |
| Last Pap test< 3 years ago | 0.85 | (0.59, 1.23) | | | 0.99 | (0.49, 2.03) | | |
| History of abnormal Pap test† | 2.63 | (1.69, 4.08) | 2.47 | (1.61, 3.77) | 2.60 | (1.16, 5.84) | 2.42 | (1.12, 5.24) |
| History of sexually transmitted disease† | 0.97 | (0.65, 1.46) | | | 0.76 | (0.35, 1.63) | | |

HSIL = high-grade squamous intraepithelial lesion; OR = odds ratio; CI = confidence interval.

Final models contain only those variables significant at the $P < .05$ level, by using forward selection.

*Age centered at median value for population (42 years).

†Prior abnormal Pap test result and sexually transmitted disease with either patient or medical record confirmation.

## Table 4

Comparison of Inpatient and Outpatient Screening Results, 1999–2002

| | Inpatient (*n* = 1,105) | Outpatient (*n* = 111,933) | Odds ratio | 95% confidence interval |
|---|---|---|---|---|
| Test result | | | | |
| Any abnormal | 15.5 | 7 | 2.44 | (2.07, 2.82) |
| Atypical squamous cells | 6 | 4 | 1.52 | (1.18, 1.96) |
| Low-grade squamous intraepithelial lesion | 5.4 | 2 | 2.77 | (2.13, 3.61) |
| High-grade squamous intraepithelial lesion | 3 | 0.7 | 4.63 | (3.28, 6.52) |
| Atypical glandular cells of undetermined significance | 1 | 0.2 | 3.38 | (1.85, 6.18) |

Inpatient and outpatient data are presented at percentages.

Outpatient Pap test results are from all Johns Hopkins–affiliated outpatient settings in the Baltimore area.