

Ambulatory Care Visits for Pap Tests, Abnormal Pap Test Results, and Cervical Cancer Procedures in the United States

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Human papillomavirus (HPV) testing, approved for routine cervical cancer screening in 2003, and the HPV vaccine, approved for routine vaccination of girls in 2006, are shifting the paradigm of cervical cancer screening and management. Recommendations for the use of HPV DNA testing for cervical cancer screening and management and HPV vaccination for cervical cancer prevention since 2003 and 2006, respectively, could dramatically affect the volume of Pap testing, a traditional and successful method of screening for cervical cancer. Management of cervical cancer-related procedures can be expensive: \$2.3 billion to \$6 billion are spent each year on direct medical costs from abnormal Pap test results and other low-grade lesions.¹⁻³ Human papillomavirus vaccination and DNA testing are expected to decrease these costs by reducing the required numbers of annual Pap tests and cervical cancer-related procedures.

In 2003, several organizations endorsed pairing HPV testing with Pap tests (HPV cotesting) as part of routine cervical cancer screening for women 30 years and older. Recent surveys of primary care providers estimate that about one-fifth of providers who offer Pap tests use the HPV test as a cotest.⁴ If most providers follow the recommended guideline of increasing the screening interval from 1 to 3 years for women who have both normal Pap tests and negative HPV test results, HPV cotesting is expected to decrease the number of Pap tests administered by 30%, from 65 million to 45.5 million, by 2010.⁵ By 2026, the HPV vaccine (approved for use in female subjects aged 11-26 years) is projected to decrease Pap test volume further by 13% as a result of shifting the age of Pap test initiation from 18 to 25 years among the fully vaccinated cohort of girls.^{5,6} Modeling studies also have projected a decrease in abnormal Pap test results and cervical cancer precursor lesions as a result of HPV vaccination. Sanders and Taira⁷ estimated a 21% reduction in the incidence of low-grade abnormal Pap test results over the lifetime of a vaccinated cohort of girls aged 12 years. Similarly, Kohli et al⁸ estimated a reduction in abnormal results of cytologies, colposcopies, and biopsies and in treatment of cervical intraepithelial neoplasia lesions over the lifetime of a 12-year-old cohort because of the HPV 16/18 vaccine. The numbers of colposcopies and other more serious procedures are projected to decrease by 12% and 42%, respectively, among women (negative to 14 HPV types at baseline) receiving the HPV vaccine based on evidence after 4 years of follow-up.⁹

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Objectives: To establish current estimates and project potential reductions in the volume and cost of annual Pap tests administered at visits to physician office and hospital outpatient departments in light of cervical cancer screening changes and HPV vaccination.

Study Design: Assessment of baseline national administrative data and future projection.

Methods: We used data from the National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS) to analyze physician office and hospital outpatient department visits made by female subjects 15 years and older from 2003 through 2005.

Results: Pap tests were ordered annually at 30.2 million physician office and hospital outpatient department visits in the United States from 2003 through 2005. Among visits by young women aged 15 to 26 years, Pap tests were ordered at 5.8 million visits each year, representing 19.3% of all Pap tests ordered. Among visits made by women of childbearing age that included Pap tests, 76.0% occurred in obstetrics and gynecology offices or clinics. Using a simple projection model, we estimated an overall annual decrease of 1.2 million Pap tests for young women aged 15 to 26 years and a corresponding cost reduction of \$77.6 million after routine HPV vaccination and HPV DNA testing. Among female subjects 15 years and older, the estimated potential decrease in Pap tests was 6.3 million, with an estimated \$403.8 million in cost reduction.

Conclusions: The NAMCS and NHAMCS provide baseline data to estimate the effects of HPV vaccination and HPV DNA testing on cervical cancer screening policy. These future technologies may result in changes to cervical cancer screening policies and, when fully accepted and implemented, may reduce economic costs associated with cervical cancer in the United States.

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Take-Away Points

Assessment of the pre-human papillomavirus (HPV) vaccination burden of ambulatory care visits and procedures related to cervical cancer screening is provided, with projection of how HPV vaccination and testing may affect this burden.

- Human papillomavirus vaccination and testing may affect the volume of Pap tests and cervical cancer procedures in the future.
- National administrative data are used to assess baseline volumes of Pap tests and cervical cancer procedures and to project the effects of HPV vaccination and testing on numbers and cost.

Most projections of the number of Pap tests conducted annually are based on women's self-reports.^{5,10} Self-reported data are subject to bias and could lead to an overestimation of adherence to screening.^{11,12} To date, no known study has used data abstracted from medical records to project the numbers of Pap tests and other cervical cancer-related procedures (ie, abnormal results of cytology, colposcopy, or biopsy and treatment of high-grade lesions) that are performed annually in the United States. Furthermore, few data are available on the number of abnormal Pap test results or colposcopies performed annually.

The objectives of this study were to use data from the National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS) from 2003 through 2005 to establish a baseline for the number of Pap tests ordered in physician offices and hospital outpatient departments (OPDs) and the number of follow-up procedures related to the management of abnormal Pap test results performed before the 2006 approval of the HPV vaccine. We use these estimates to project the degree to which HPV vaccination and HPV DNA testing could reduce the use of ambulatory cervical cancer-related tests and procedures and to estimate the potential reduction in screening and procedure costs from a reduction in cervical cancer-related tests and procedures because of HPV vaccination and HPV DNA testing.

METHODS

The NAMCS and NHAMCS are annual probability sample surveys conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention (CDC). The NAMCS uses a 3-stage probability sampling procedure that includes (1) 112 geographic primary sampling units, (2) a probability sample of physicians within primary geographic sampling units selected from the master files maintained by the American Medical Association and the American Osteopathic Association, and (3) a sample of about 30 visits during a randomly assigned reporting period of 1 week throughout the year. Sample design, sampling variance, and estimation procedures of the NAMCS have been

described elsewhere.¹³ The NHAMCS uses a 4-stage probability sampling procedure that includes (1) the same 112 geographic primary sampling units used in the NAMCS, (2) a probability sample of nonfederal short-stay and general hospitals within the sampled primary sampling units selected from a publicly available database of all US hospitals, (3) emergency service areas within 24-hour emergency departments and clinics within OPDs, and (4) a sample of about 100 visits to emergency departments and 150 to 200 visits to OPDs during a randomly assigned reporting period of 4 weeks throughout the year; a published study¹⁴ describes the plan and operation of the NHAMCS. Only the OPD component of the NHAMCS was used in our analysis. The US Census Bureau is responsible for inducing NHAMCS hospitals and NAMCS physicians and for collecting sample encounter data. Additional information about the methods of the NAMCS and NHAMCS can be found on the Internet (<http://www.cdc.gov/nchs/ahcd.htm>).

From 2003 through 2005, the survey response rates averaged 66% for NAMCS and 86% for NHAMCS OPDs. The annual numbers of participating NAMCS physicians and NHAMCS OPDs were 1300 and 220, respectively, and the annual numbers of patient record forms completed by physician offices and OPDs were 25,000 for the NAMCS and 32,000 for the NHAMCS. Estimates for visits by female subjects 15 years and older are based on 88,151 sample records that resulted in 5165 sample visits at which a Pap test was ordered during the 3-year study period.

The same patient record form was used for NAMCS physicians and NHAMCS OPDs and contained demographic data about patients and information about the visit, including diagnosis, diagnostic and screening services, and ambulatory surgical procedures. As many as 3 diagnoses were coded according to the *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)*.¹⁵ "Pap test" is a check box on the patient record form and is marked if the test is ordered or provided. "Procedures" that were ordered or provided were written in and coded using *ICD-9-CM* procedure codes. For this analysis, it was assumed that the Pap test or procedure was provided at this visit or at a later date. "Preventive care (eg, routine, prenatal, well-child, screening, insurance, and general examinations)" is a check box on the patient record form.

We examined data from selected physician and OPD clinic specialties for which Pap test ordering is most likely to occur. Physician and clinic specialty is determined during the induction interviews for the NAMCS and NHAMCS, respec-

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Table 1. Key Assumptions Used in Calculating Potential Reduction in Costs Due to a Reduction in the Volume of Pap Tests and Cervical Procedures Performed

Variable	Base	Low	High	Source
Baseline No.				
Pap tests ordered				
Age ≥15 y	30,200,000	—	—	Authors' estimate
Age 15-26 y targeted for vaccination	5,800,000	—	—	Authors' estimate
Colposcopies and other cervical procedures ordered or performed				
Age ≥15 y	1,700,000	—	—	Authors' estimate
Age 15-26 y	786,000	—	—	Authors' estimate
Reduction, %				
Pap tests for age ≥30 y with both negative HPV test result and negative 3-year Pap test result	30.0	29.0	32.0	Eltoum and Roberson, ⁵ 2007
Colposcopies and other cervical procedures ordered or performed (eg, biopsy) because of HPV vaccination for age ≥15 y	24.5	12.0	37.3	Kohli et al, ⁸ 2007; R. Haupt, Gardasil Update, CDC Cancer Conference, 2007; Huh et al, ⁹ 2008
HPV vaccination coverage rate for age 9-26 y eligible to receive HPV vaccine	70.0	0.7	1.0	Chesson et al, ¹⁸ 2008; Eltoum and Roberson, ⁵ 2007
Cost, Mean, \$				
Pap test	63.67	36.47	93.78	Ekwueme et al, ¹⁹ 2008; Kulasingam et al, ²⁰ 2006
Colposcopy with biopsy and office visit	286.61	108.37	433.47	Kulasingam et al, ²¹ 2006

CDC indicates Centers for Disease Control and Prevention; HPV, human papillomavirus.

tively. Physician specialty is not collected for the NHAMCS. For the NAMCS, obstetrics/gynecology (OB/GYN) was defined as a physician with that specialty, and general medicine (GM) was defined as a physician with the specialty of family medicine, internal medicine, or GM. For the NHAMCS, OB/GYN clinics included OPD clinics with that specialty. For the NHAMCS, GM clinics were defined more broadly than were GM physicians and may have included clinics that did not provide primary care.

Abnormal Pap test result and cervical dysplasia were defined as ICD-9-CM diagnosis codes 795.0 (without 622.1) and 622.1 (without 795.0), respectively. The ICD-9-CM procedure codes were used to define cervical procedures. Colposcopy was coded as 70.21 (vaginocopy). Other cervical procedures were coded as 67.1 (diagnostic procedures on cervix), 67.2 (conization of cervix), and 67.3 (other excision or destruction of lesion or tissue of cervix, excluding 67.31).

We presented our data by various age categories (15-26, 27-44, and ≥45 years). The first age category is a group that could be eligible for receipt of the HPV vaccine under the current guidelines.¹⁶ The second and third age categories would not be eligible for HPV vaccine.

The NAMCS and NHAMCS data were weighted to produce national estimates, and 3 years of data were combined to increase the reliability of the estimates. The NAMCS weight includes the following 4 components: selection probability, nonresponse adjustment, physician-population weighting ratio adjustment, and weight smoothing. The NHAMCS weight includes the following 3 components: selection probability, nonresponse adjustment, and ratio adjustment to fixed totals. SUDAAN software 9.0.1 (Research Triangle Institute, Research Triangle Park, NC) was used for all statistical analyses.

The determination of statistical significance was based on χ^2 test and 2-tailed *t* test (with a .05 level of significance). Bonferroni inequality was used to establish the critical value for statistically significant differences on the basis of the number of possible comparisons within a particular variable, or combination of variables, of interest. The complex sample designs of the NAMCS and NHAMCS were figured into the standard errors used to calculate the 95% confidence intervals around the estimates. Estimates based on fewer than 30 cases in the sample data did not meet CDC standards of reliability or precision.¹⁷

The NAMCS and NHAMCS protocols were approved by the Research Ethics Review Board of the CDC's National

Center for Health Statistics. Requirements to obtain informed consent from patients and patient authorization for healthcare providers to release medical record data were waived.

We anticipate that the initial cervical cancer screening age among the vaccinated cohort would change because of decreased HPV prevalence of HPV 16 and HPV 18, the lower positive predictive value of cytology, the rarity of cervical cancer in younger women, and anticipated guidelines change.⁶ We used the estimated baseline data and published assumptions to assume that HPV vaccination delayed the onset of Pap testing until age 26 years. This differs slightly from the age (25 years) presented in an article by Eltoum and Roberson⁵ because we wanted to make our categories mutually exclusive. We also assumed that the use of HPV DNA tests in screening decreased Pap testing volume among women 30 years and older by at least 30% (range, 29%-32%)⁵ (Table 1). Furthermore, we assumed that HPV vaccination and HPV

DNA testing would reduce the annual incidence of colposcopy and other cervical cancer-related procedures by a mean of 24.5% (range, 12.0%-37.3%)^{8,9} (R. Haupt, MD, Gardasil Update, CDC Cancer Conference, August 2007). We used these data to project the potential annual reduction in the number of Pap tests because of HPV vaccination and HPV DNA testing. The potential annual reduction was obtained by using the estimated number of annual Pap tests ordered, the percentage reduction in Pap testing because of HPV vaccination, and the vaccination coverage rate. We also estimated the potential annual reduction in costs of Pap testing and other cervical procedures performed as a result of the potential annual reduction in the number of Pap tests ordered because of HPV vaccination and HPV DNA testing. We used a simple static model to calculate the potential annual reduction in screening and procedure costs. Formally, this model is expressed as follows: Potential Reduction in Screening Costs and Other

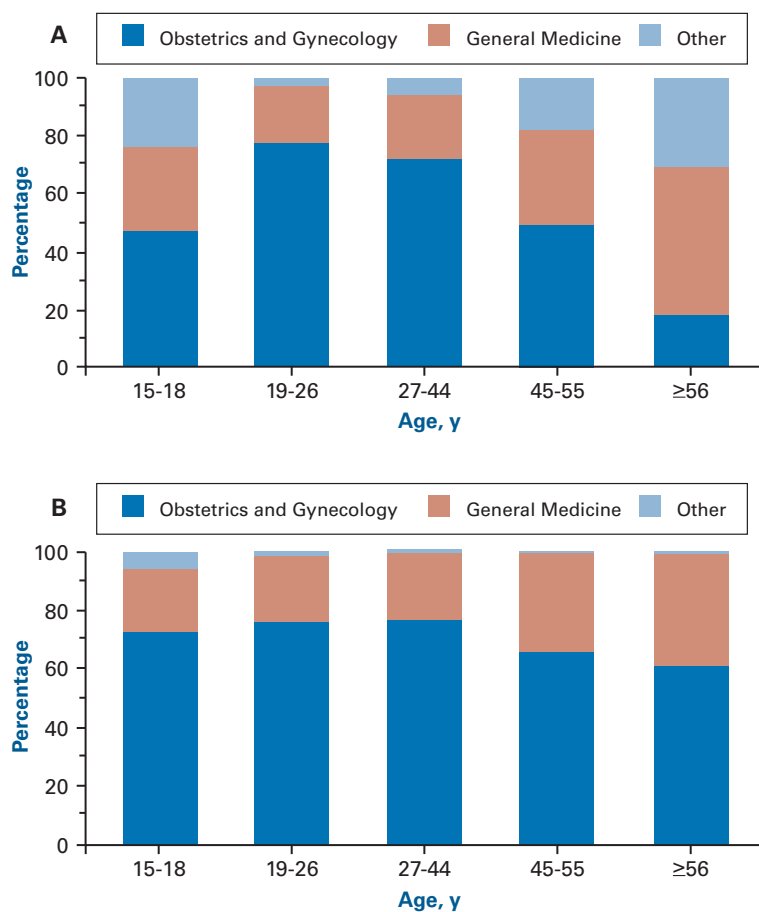
Procedures per Year = (BPT × VCR × % RPT) × AC, where BPT is number of baseline Pap tests and other procedures per year; VCR is vaccination coverage rate; RPT is the annual percentage reduction in Pap tests and other procedures; and AC is the annual mean cost of Pap tests and other procedures.

The input variables used to calculate the potential reduction in net cost for the numbers of screening and other procedures performed are given in Table 1. The medical care component of the consumer price index from the US Bureau of Labor Statistics was used to adjust all costs to 2005 US dollars.²² The mean cost of a Pap test was \$63.67 (range, \$36.47-\$93.78).^{19,20} The mean cost for colposcopy with biopsy and office visit was \$286.61 (range, \$108.37-\$433.47).²¹ The baseline HPV vaccination coverage rate of 70% was obtained from a study by Chesson and colleagues,¹⁸ and we varied this rate from 65% to 100% to calculate the minimum and maximum values.

RESULTS

From 2003 through 2005, there were more than 519 million annual visits to physician offices and hospital OPD clinics made by female subjects 15 years and older, of which 18.1% were for preventive care. Where a subject went for preventive care varied by age. Among young women aged 15 to 18 years, almost half of visits for preventive care were to OB/GYN

■ **Figure 1.** Annual Percentage Distribution by Age According to Specialty, United States, 2003 Through 2005



A. Preventive ambulatory care visits. **B.** Ambulatory care visits at which a Pap test was ordered. General medicine includes general, family practice, and internal medicine. "Other" comprises all other specialties, including pediatricians. Estimates for "other" specialty did not meet standards of reliability or precision except for women 56 years and older.

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physician offices or hospital OPD clinics; the other visits were split equally between GM providers and other providers, mostly pediatricians. About 73% of preventive care visits made by women aged 19 to 44 years were to OB/GYN offices and clinics. Fewer preventive care visits were to OB/GYN offices and clinics beginning at age 45 years versus at ages 19 to 44 years ($P < .05$) (Figure 1A). For visits at which a Pap test was ordered, a similar pattern was observed, with the proportion of visits to OB/GYN offices and clinics decreasing with age ($P < .05$) (Figure 1B). A higher proportion of visits at which a Pap test was ordered occurred in OB/GYN offices and clinics among female subjects aged 15 to 44 years (76.0%) versus 45 years and older (63.2%) ($P < .05$).

Pap tests were ordered at 30.2 million visits made by female subjects 15 years and older (25.7 visits per 100 female subjects), representing 5.8% of all visits. For visits by female subjects aged 15 to 26 years, Pap tests were ordered at 5.8 million visits, representing 8.8% of all visits among this age group and 19.3% of Pap test visits among female subjects 15 years and older. Among female subjects 15 years and older, a diagnosis of abnormal Pap test result (without a cervical dysplasia diagnosis) accounted for 1,371,000 visits, and a diagnosis of cervical dysplasia (without a diagnosis of abnormal Pap test result) accounted for 1,400,000 visits each year (Table 2). Rates of abnormal Pap test result and cervical dysplasia varied by age, with young women aged 15 to 26 years having higher rates of abnormal Pap result and cervical dysplasia diagnoses than women in the other 2 categories combined ($P < .05$) (Figure 2).

Cervical procedures were ordered or performed at 1.7 million visits; 1.2 million of these visits included a colposcopy, and another 712,000 visits included other cervical procedures. These 1.7 million visits represented 0.3% of all visits among female subjects 15 years and older. Visits that included a colposcopy or other cervi-

Table 2. Percentage Distribution of Ambulatory Care Visits Made by Female Subjects 15 Years and Older by Age and Race/Ethnicity According to Selected Diagnosis, United States, 2003 Through 2005

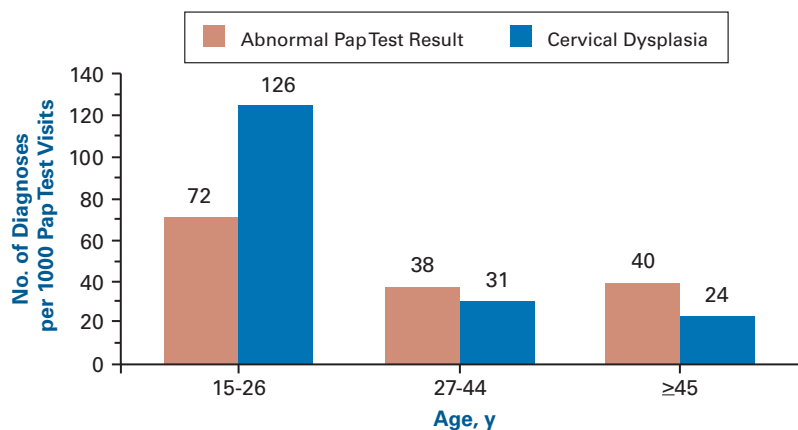
Variable	Percentage (95% Confidence Interval) ^a	
	Abnormal Pap Test Result Diagnosis Without a Cervical Dysplasia Diagnosis (n = 1,371,000)	Cervical Dysplasia Diagnosis Without an Abnormal Pap Test Result Diagnosis (n = 1,400,000)
Age, y		
15-26	30.5 (21.8-40.7)	52.3 (41.6-62.8)
27-44	33.9 (24.8-44.4)	26.9 (16.0-41.7)
≥45	35.6 (23.4-50.0)	20.8 (12.0-33.5)
Race/ethnicity		
White	86.3 (77.7-92.0)	80.9 (70.9-88.1)
Black	10.7 (5.7-19.1)	16.0 (9.9-24.8)
Other ^b	—	—

^aBased on 3-year annual means.

^bDoes not meet standards of reliability or precision.

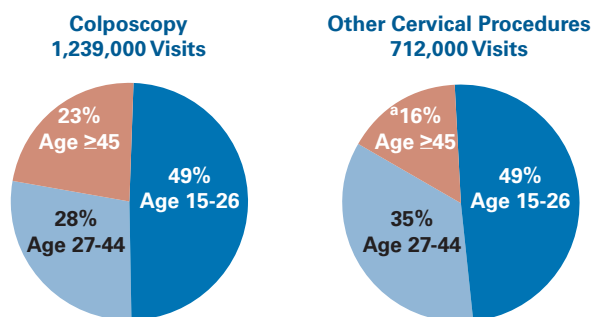
cal procedure accounted for 31.2% of visits with a diagnosis of abnormal Pap test result (without a cervical dysplasia diagnosis) or cervical dysplasia and represented 32.4% of visits with a diagnosis of cervical dysplasia (without an abnormal Pap test result diagnosis) (data not shown). There was no significant difference in the race/ethnicity distribution of visits with a diagnosis of abnormal Pap test result versus cervical dysplasia. Almost half (49.1%) of the visits at which colposcopies and other cervical procedures were ordered or

Figure 2. Annual Rate of Ambulatory Care Visits at Which a Pap Test Was Ordered by Age and Diagnosis, United States, 2003 Through 2005



Abnormal Pap test result is defined as *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* diagnosis code 795.0 without 622.1. Cervical dysplasia is defined as *ICD-9-CM* diagnosis code 622.1 without 795.0.

■ **Figure 3.** Annual Percentage Distribution of Ambulatory Care Visits at Which Cervical Procedures Were Ordered or Provided by Age, United States, 2003 Through 2005



^aEstimates for the rate of cervical dysplasia in women 45 years and older did not meet standards of reliability or precision.

Colposcopy is defined as *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) procedure code 70.2*. Other cervical procedures are defined as *ICD-9-CM procedure codes 67.1 through 67.2 and 67.32 through 67.39*.

performed were made by female subjects aged 15 to 26 years. There was no significant difference in the proportion of visits for colposcopy in the 2 older age categories (28.1% and 22.8%) (Figure 3).

We estimated an overall annual decrease of 1.2 million Pap tests for young women aged 15 to 26 years, with a corresponding reduction in screening costs of \$77.6 million (range, \$39.9 million-\$174.1 million) after routine HPV vaccination and HPV DNA testing (Table 3). Among female subjects 15 years and older, the estimated potential decrease in Pap tests was 6.3 million (range, 5.7 million-9.7 million), with an estimated \$403.8 million (range, \$207.6 million-\$906.3 million) reduction in screening costs. The estimated potential decrease in the number of cervical procedures and the estimated annual reduction in their costs are given in Table 3.

DISCUSSION

We used NAMCS and NHAMCS data to derive baseline data on the annual number of ambulatory care visits in the United States at which Pap tests (30.2 million) and colposcopies and other cervical cancer-related procedures (1.7 million) were provided. We used these baseline data to estimate the potential annual reduction in the number of Pap tests administered and other cervical cancer-related procedures performed because of the widespread implementation of HPV vaccination and HPV DNA testing as part of cervical cancer screening. On the basis of these baseline data and other assumptions, we estimated an annual 6.3 million reduction in the number of Pap tests, with a corresponding cost reduction of \$403.8 million and a 291,550 reduction in the number of

colposcopies and other cervical cancer-related procedures, with a corresponding cost reduction of \$83.6 million.

It is difficult to project whether the use of the HPV vaccine will result in any changes in cervical cancer screening immediately or in the future, especially given the reluctance of providers to screen patients at older ages and issues of medicolegal liabilities.^{23,24} Furthermore, the use of HPV DNA testing may not result in any extension of screening intervals but rather may promote annual HPV and Pap testing, as predicted by experts.^{25,26} If this scenario occurs, then a baseline number of Pap tests performed among various age categories serves as a useful marker to measure the adoption of screening and vaccine recommendations. The estimated reduction in the screening costs and costs of other cervical cancer-related procedures illustrates how screening and other procedural costs can be contained if HPV vaccination and HPV DNA testing lead to a policy of less frequent screening intervals.

Our study has some limitations. Because midlevel healthcare providers were not sampled, the numbers of visits for Pap tests and other outcomes may have been underestimated. We reported 30.2 million annual Pap tests from 2003 through 2005 among female subjects 15 years and older. The 2007 article by Solomon et al¹⁰ reports 65.6 million annual Pap tests among women 18 years and older in 2003. The self-report likely overestimates the number, as has been seen in the literature.¹² We suspect that the NAMCS and NHAMCS data may underestimate because of several reasons. However, midlevel providers may have been included in the hospital OPDs because clinics, not providers, were sampled. Other surveys show that midlevel providers perform many Pap tests and follow-up procedures.^{4,24} Pap tests and other procedures also may be performed in settings not covered by the NAMCS or NHAMCS such as college health units, military clinics, or ambulatory surgical centers. In addition, health departments, community health centers, family planning clinics, large group practices, health maintenance organizations, and faculty practice plans have a low probability of coverage by the surveys. The NAMCS and NHAMCS collect diagnoses that are coded to *ICD-9-CM* codes and not *Current Procedural Terminology* codes. We were unable to examine abnormal Pap test or cervical dysplasia results in more detail because the *ICD-9-CM* codes that existed during the study period did not allow us to differentiate the abnormal Pap test result category from the cervical dysplasia category, as is now possible. In addition, the *ICD-9-CM* codes for abnormal Pap test results and cervical dysplasia have the potential for misclassification because many providers may not discriminate between cytology and histology. The 2005 edition of the *ICD-9-CM*²⁷ contains several changes for coding cervical cytology to differentiate between

diagnoses that are based on Pap test results (code 795) and diagnoses that are based on biopsy results (code 622). New entries under code 795.0 (abnormal Papanicolaou smear of cervix and cervical HPV) were expanded to reflect more accurately the terminology used in the revised Bethesda system for atypical cells of undetermined significance, atypical glandular cells of undetermined significance, cervical dysplasia, unsatisfactory cell sampling, and nonspecific abnormalities.²⁸

Another potential limitation is that our simple model did not take into account the dynamic changes occurring in cervical cancer screening. Such changes may include increases among the populations of women in various age ranges, changes in the prevalence of hysterectomy, and an increase in the use of liquid-based cytology and computerized screening. These omissions may have resulted in underestimating or overestimating the true potential reduction in annual Pap tests, procedures, and associated costs. Another potential limitation is the use of data on different age groups from the literature to quantify potential reduction in Pap testing and other cervical procedures. These data are based on assumptions that may not be realized. For example, in estimating the potential decrease in Pap tests for young women aged 15 to 26 years, we used data from women 30 years and older. Newer guidelines have already been released that recommend screening women at age 21 years.²⁹ Therefore, the estimated results are as good as the input data and assumptions. We did not include the cost of HPV vaccination and HPV DNA testing because our study was not designed to include such cost in our estimations. Because these new screening technologies are more expensive compared with conventional methods, the estimated reduction in the costs of cervical screening may be overstated. Based on these limitations, our simple model offers only a rough approximation of the potential reduction in screening and procedure costs from a reduction in cervical cancer–related tests and procedures because of HPV vaccination and HPV DNA testing. Data from the NAMCS and NHAMCS have the advantage of being obtained from medical records rather than from self-reports. Similar to other abstraction, there may not be 100% compliance of the tests or procedures in the medical records, so we may have overestimated some of the prevalence.

These limitations notwithstanding, our study reported 30.2 million annual Pap tests from 2003 through 2005 among female subjects 15 years and older. This is clearly lower than 2-fold higher estimates using a self-reported survey of 65.6 million among women 18 years and older in 2003.¹⁰ Two meta-analyses^{11,12} confirm that women are significantly more likely to

Table 3. Estimated Total Annual Reduction in the Number of Pap Tests and Cervical Procedures and Cost Reduction by Age

Age, y	Annual Reduction, Millions	
	No., Mean (Range)	Cost, Mean (Range), \$
Pap tests		
15-26	1.22 (1.09-1.86)	77.56 (39.87-174.06)
≥15	6.34 (5.69-9.66)	403.82 (207.61-906.29)
Cervical procedures		
15-26	0.13 (0.06-0.29)	38.63 (6.64-127.08)
≥15	0.29 (0.13-0.63)	83.56 (14.37-274.86)

overreport Pap tests compared with documentation of Pap tests in the medical record (range, 1.2-1.8 higher self-reports compared with the medical records), consistent with our findings. The NAMCS and NHAMCS are the only national surveys in the United States that collect data on procedures performed in physician offices and OPDs. Furthermore, they allow for trend analysis of Pap testing and colposcopy visits over time. Long-standing surveys such as the NAMCS and NHAMCS have provided a baseline and an opportunity to analyze the future effects of the HPV vaccine and newer screening recommendations as vaccine coverage and HPV testing increase in the future. If newer screening recommendations that include HPV DNA testing are used appropriately, they could decrease the number of Pap tests performed annually. After taking into account the health effects and costs of HPV tests and HPV vaccines, these technologies might offer an opportunity to further reduce the health burden and economic costs of cervical cancer in the United States during the coming decades.

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