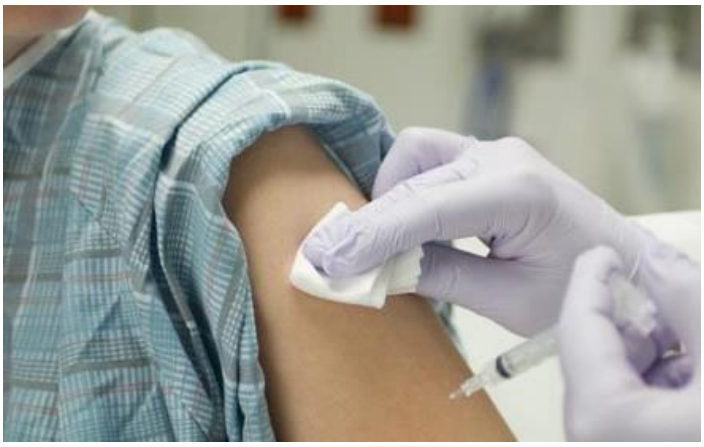
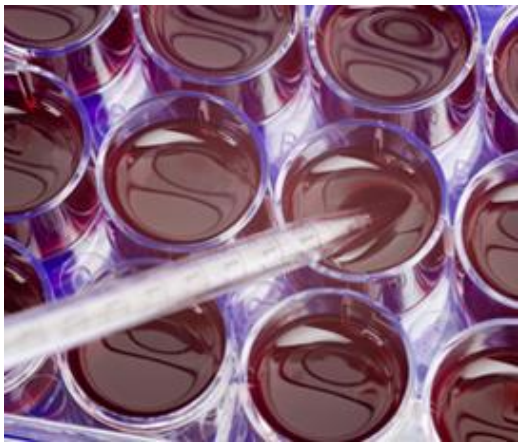
Diffusion of Preventive Innovation: Racial and Rural Differences in Cervical Cancer Prevention and Control Practices





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Diffusion of Preventive Innovation: Racial and Rural Differences in Cervical Cancer Prevention and Control Practices

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Executive Summary

Background and Study Objectives

The national cervical cancer incidence rate is 7.9 per 100,000 and the mortality rate is 2.3 per 100,000; a Healthy People 2020 goal is to reduce cervical cancer mortality to 2.0 per 100,000. Cervical cancer incidence and mortality rates are markedly higher among racial and ethnic minority women in the United States. African-American (AA), Asian, and Hispanic women are more likely to die of cervical cancer than European American (EA) women. These differences exist even though minority women experience lower overall cancer rates compared to EA women and screening rates have steadily increased for minority and underserved women. Low-income, minority, and rural women are particularly at risk for poor cervical cancer screening, treatment, and survival. Access to preventive services contributes to differences in cervical cancer rates among different racial and ethnic groups. Increased uptake of innovative screening modalities, such as liquid-based versus traditional Pap screening and human papilloma virus (HPV) DNA screening, may reduce disparities. We examined differences in receipt of cervical cancer screening and HPV vaccination associated with residence and race/ethnicity. Data for the study were drawn from two nationally representative samples of medical practices, the National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS).

Key Findings

Patient Receipt of Cervical Cancer Screening or Vaccination Services

- No significant differences were observed for type of cervical cancer screening modality (conventional, liquid or unspecified) by patient residence (urban versus rural) or by race/ethnicity (white versus African American women).
- A significantly higher proportion of women living in rural counties (69.6%) received liquid based Pap testing in hospital outpatient settings than women in urban counties (39%).
- A significantly higher proportion of women residing in urban counties received HPV DNA testing versus women residing in rural counties (10% versus 3.3%, respectively).
- No significant differences were observed in the receipt of HPV vaccination by patient residence.

Physician Providers for Women Receiving Pap or Other Cervical Screening Services

- Most patients receiving cervical screening, regardless of residence, were seen by urban physicians (92.4%).
- A significantly higher proportion of patients in rural practices were publicly insured than patients in urban practices (36.7% versus 23.0%, respectively).

Policy Implications

While women residing in rural counties did not differ from urban women in the type of Pap test received, rural women were less likely to receive HPV DNA testing. No differences by race/ethnicity were observed. More research is needed to determine if observed differences are the result of provider or patient barriers and acceptability. Expanded access to cervical cancer prevention services may increase uptake of innovative services, particularly liquid-based cytology and HPV DNA testing.

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Figures and Tables

Introduction

Deaths from cervical cancer, once a leading cause of mortality in women, have been greatly reduced as a result of the implementation of routine cervical cytology screenings (i.e. Pap smears) in the United States.[1] Despite these strides, certain segments of the population have higher cervical cancer incidence and mortality rates than others. Low-income, minority, and rural women have been identified to be particularly at risk for poor cervical cancer screening, treatment and survival. [2-4] Higher incidence rates of cervical cancer in minority women further compound these disparities.[5-8]

The cervical cancer incidence rate in the United States is 7.9 per 100,000 women and the mortality rate is 2.3 per 100,000.[9] The Healthy People 2020 target for cervical cancer mortality is 2.0 per 100,000. Advances in cervical cancer screening make this goal attainable. Cervical cancer is one of the few cancers in which screening represents primary prevention, and for which strong protection through vaccination is available.

Recently, three notable advancements in cervical cancer prevention have been introduced. The first is liquid Pap cytology for secondary prevention of cervical cancer. For the original test introduced by George Papanicolaou, cells are scraped from the cervix and spread (or "smeared") onto a slide using a spatula-type instrument. In the newer liquid based Pap technique, the cells are collected via a conical brush-type instrument and instead dropped into a liquid preservative, creating less damage to the specimen and allowing for better laboratory examination of the captured cells.[10] Liquid-based cytology (LBC) has been adopted by many practitioners over conventional Pap cytology and fewer labs rely solely on conventional cytology as the technology available has improved. [11,12]

Second, human papillomavirus (HPV) DNA testing has become an option to triage abnormal Pap test results for women 21 years of age and older and as an adjunct to routine screening for women 30 years of age and older. An estimated 99.7% of invasive cervical cancers are due to HPV infection.[13] HPV DNA testing is considered superior to Pap smears because it detects actual high-risk HPV infection rather than signs of cervical changes due to an HPV infection.[14] In addition, a negative HPV DNA test provides longer term assurance than a negative Pap smear that cervical cancer will not develop and thus allows for longer screening intervals.[15] HPV DNA testing has not been as broadly adopted by practitioners as liquid-based Pap cytology and will not replace cytology triage [16,17]; however, the American Cancer Society includes a statement on appropriate utilization of HPV DNA testing issued in 2009 as a companion to cervical cytology in its cervical screening recommendations.[17]

Finally, a vaccine to prevent HPV became available in 2006. Both of the currently available HPV vaccines have been shown to be greater than 90% effective in the prevention of HPV infection.[16,18,19] These innovative prevention tools have the potential to greatly reduce the cervical cancer burden on women in the United States, particularly those in underserved populations.[1]

Study Purpose

We sought to ascertain whether rural women, particularly those of minority race and ethnicity, had equal access to advanced cervical cancer prevention technologies including liquid-based Pap test cytology and HPV DNA testing, and HPV vaccination. We analyzed racial and rural differences in cervical cancer screening practices in a cross-sectional study using data from

the 2006 through 2008 National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS). Detailed information about the data sources and analyses is included in the technical notes. Considering what is known about cervical cancer disparities, we hypothesized that women living in rural areas would be less likely to receive liquid-based cytology or DNA testing for cervical cancer screening than those living in urban areas. We hypothesized that rural African-American women in particular would be less likely to receive liquid-based cytology or DNA testing for cervical cancer screening than rural European-American women.

Results

Description of the Population: Rural and Urban Women

Table 1, Appendix A, describes the characteristics of all females in the datasets eligible for HPV vaccination or screening, that is, women between the ages of 9 and 70 (n=80,151). Refer to the technical notes for more detailed information about the data sources, variables of interest, and analyses. More African-American patients resided in urban areas compared to rural areas (15.2% vs. 8.9%, $p<0.01$). Patients aged 9 to 70 were included in the analysis and older women (46-70 years) comprised the largest age group among both urban (46.1%) and rural (51.1%) residents. Women residing in rural counties were older and had more comorbidities compared to women residing in urban counties.

Of the total sample, 11.49% of the women in the sample were not insured. As might be expected with an older population, patients living in rural counties had higher rates of public health insurance, with 33.8% reporting either Medicaid or Medicare coverage, compared to 23% of patients in urban counties. Rural patients were less likely to visit the physician for preventive care (20.1%) compared with nearly a quarter of urban patients (24.4%; $p= 0.02$). Most patients visited physician offices rather than hospital outpatient departments, with no differences by patient residence (86.5% for rural patients and 89.5% for urban patients; $p=0.27$). Most visits by female patients in any setting (92.6%) did not include any cervical cancer screening.

Table 2, Appendix A, describes the characteristics of women sorted by whether they visited a rural or an urban physician. Preventive care was the major reason for a visit to the physician for 76.3% of visits (Table 2). More patients treated by urban physicians reported preventive care as the major reason for the visit (24.4%) compared to those treated by rural physicians (19.0%; Table 2). Of the patients treated by rural physicians, 57.5% had at least one diagnosis of a comorbid condition, compared to 51.5% of patients treated by urban physicians ($p=0.04$; Table 2). Similar proportions of cervical cancer screening by patient characteristics were reported in visits to rural and urban practices (Table 4, Appendix A).

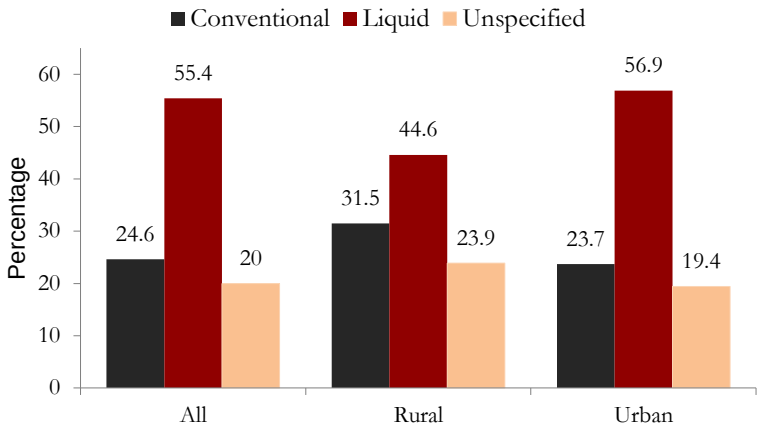
Description of Rural versus Urban Providers

Most physicians providing cervical cancer screening to patients in the study sample, in both rural and urban areas, were white, male, and younger than 45 years old (Table 3, Appendix A). More than a third of rural physicians were generalists or in a family medicine specialty (Table 3). While a higher proportion of urban than rural physician were obstetric/gynecology specialists (19% and 11%, respectively), this difference was not statistically significant (Table 3). The majority of patients, not specific to cervical cancer screening, were treated by urban physicians (92.4%; data not in table).

Cervical Cancer Screening Using Pap Tests

Within the approximately 5,000 visits with cervical cancer screening, there were no differences in type of cytology screening by residence (p=0.21; Table 4 and Figure 1, below). Liquid-based Pap tests were the most commonly used cervical cancer screening test nationwide (Table 4), with 44.6% of rural residents and 56.9% of urban women receiving liquid-based Pap tests (Table 4). In approximately 20% of visits, type of screening was not reported. Lack of specificity regarding Pap type may stem from the voluntary nature of NAMCS participation and reporting.

Figure 1: Cervical Cancer Screening Cytology Method, by patient residence, 2006-2008

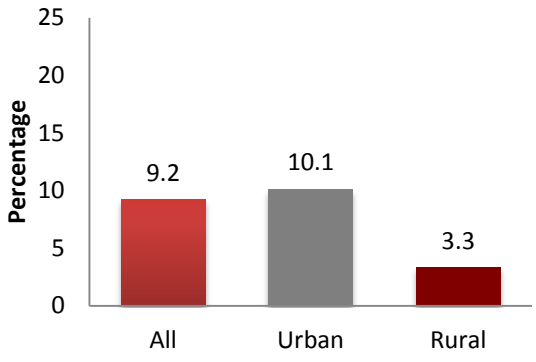


Insurance type was related to screening modality. Both rural and urban publicly insured women were less likely to receive liquid screening (rural, 35.6%, urban 37.6%) than were privately insured women (rural 46.1%, urban 61.2%; Table 5). Within women receiving care in hospital outpatient offices, rural women were more likely to receive liquid-based Pap tests (69.6%), while similar urban women were more likely to receive conventional screening (61.0%; p = 0.02; Table 5).

DNA Testing to Identify High Risk HPV Strains

Women residing in rural counties were significantly less likely to receive HPV DNA testing as part of women's health exams (Figure 2; Table 6). Privately insured women were more likely to receive HPV DNA testing during visits than publicly insured and uninsured women (p<0.01; Table 6). African-American patients were more likely to receive HPV DNA testing in hospital outpatient departments rather than physician offices (28.4%) than were European-American patients (7.6%; p<0.01; Table 6).

Figure 2: Percent of women receiving HPV DNA test in a visit for a gynecological exam, by patient residence, 2006-2008



The National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS) sample included visit data of female patients between the ages of 9 and 70 (2006 – 2008). The analysis in this section only looks at patients who received cervical cancer screening and prevention services, defined as a Pap test using any cytology, HPV DNA test, or at least one dose of the HPV vaccine. The cervical cancer screening and HPV DNA test analysis was limited to those with receipt or an order of a Pap test in an office visit (n= 5,251).

HPV Vaccination

Two vaccines (Cervarix and Gardasil) are available to protect females against HPV-mediated diseases. The vaccines have been shown to protect against cervical, anal, vaginal, and vulvar cancers. One of these vaccines (Gardasil) also protects against most genital warts associated with HPV infection. Either vaccine is recommended for 11 and 12 year-old girls, and for females 13 through 26 years of age, who did not get any or all of the shots when they were younger. These vaccines can also be given to girls beginning at 9 years of age but are most effective at 11-12 years of age.

Delivery of the HPV vaccination was low during the 2006-2008 period studied (1.0%; Table 2), possibly due to the newness of the vaccine and the relatively narrow recommended age window. The absolute number of women with reported receipt of HPV vaccination in the dataset was too low to permit stable estimates for rural women, so no rural-urban comparisons can be made.

Conclusions

There were no differences in liquid based cervical cancer screening for women residing in rural counties compared to urban women. Similarly, there were no racial differences among respondents in the receipt of liquid-based Pap test. There were, however, significant differences by insurance type, such that patients with public insurance were less likely to receive liquid-based Pap in comparison to women with private insurance.

Publicly insured women in this sample were less likely to receive screening using liquid cytology compared to conventional Pap tests, which may suggest a difference in adoption of new technologies by providers across payer type. Liquid based cytology offers improved specimen quality compared to conventional Pap tests, but is slightly more expensive. More research is needed to determine potential benefits of various types of liquid based cytology modalities[10], and the cost effectiveness of these modalities.

Rural women were less likely than their urban peers to receive an HPV DNA test as part of cancer screening, and so few rural women received an HPV vaccination that accurate population estimates cannot be made. The conjunction of these two findings suggests that advanced screening and prevention modes are not being accessed by, or are not available to, rural women at levels equal to urban women. Further research is needed to ascertain whether difficulties stem from the newness of some of these services, their cost, or, in the case of the HPV DNA test, the absence of specialized laboratories to perform the analysis.

Policy Implications

Strategies to help ameliorate cervical cancer disparities include expanded health insurance coverage, greater provider availability, and increased uptake of technological advances in cervical cancer screening. Lack of provider availability or supply has been identified in previous research as a major barrier to cancer-preventive services for rural residents in underserved areas.[15,20] Health insurance is a critical factor in access to quality cervical cancer prevention services and has been noted as a potential source of racial, ethnic, and geographic cancer disparities in the United States.[18]

While health insurance is important for access to cancer prevention and control, cancer disparities still exist despite coverage [21] and cervical cancer mortality disparities have been noted in publicly-insured women.[22] Expanded Medicaid coverage, an optional mechanism for states to increase coverage, is a major provision of the Patient Protection and Affordable Care Act (ACA), which may increase access to preventive health services for uninsured, low-income women in need of cervical cancer screening.[23] As a result, the demand for primary care providers is expected to increase. Targeted programs to increase access to quality care should also address multiple points of entry including primary care providers, facilities, and at-risk women. As part of ACA, the Bureau of Health Professions in the Health Resources and Services Administration will receive additional funding to place primary care providers in medically underserved areas[24] and community health centers will receive additional resources to bolster the public health safety net for underserved patients.[25] Finally, programmatic efforts such as the National Breast and Cervical Cancer Early Detection Program (NBCEDP), which is an effort to address differential access to screening among low-income uninsured women,[26] have been shown to increase cancer screening for low-income and uninsured women. Extensive penetration of innovative and existing programs into rural areas will enhance the delivery of cervical cancer preventive services to women identified as higher risk in this study.

Another provision of the ACA expected to improve access to quality care is the removal of out-of-pocket expenses for preventive services recommended by the US Preventive Services Task Force (USPSTF).[23] The USPSTF recommends cervical cancer screening for sexually-active women with an intact cervix and routine screening up to age 65 in women with normal Pap test histories.[27] Consequently, the out-of-pocket expenses for cervical cancer screening will be eliminated by 2014.[23]

In March, 2012 the USPSTF issued a statement about the routine use of new cervical cancer screening technologies (HPV DNA test and/or liquid-based cytology).[23] The new recommendations offer women more options: either cytology every three years, or for women who potentially want to move to 5-year screening intervals, usual cytology plus HPV testing. The recommendations are nuanced and recommend that physicians discuss the implications of the more sensitive HPV test, which may return positive findings when the cytology findings do not indicate any problems. Further research is needed to ascertain how women and their providers respond to these new recommendations.

Overall, uptake of HPV vaccination was quite low in the study sample. Strong provider recommendations are major influences on HPV vaccination among adult women [28] and it has been suggested that providers advocate for HPV vaccination among their patients.[29] While catch-up vaccination is recommended up to age 26, adolescent HPV vaccination is expected to yield the greatest public health benefit.[30] Given high levels of parental acceptability for HPV vaccination [31-33], increased awareness about vaccination assistance programs may lead to higher uptake of adolescent vaccination. HPV vaccines are part of the Vaccines for Children (VFC) Program, which provides low-cost vaccines to uninsured and Medicaid-eligible children in rural health clinics and community health centers.[29,30] Targeted interventions to raise awareness about HPV-associated cancers and address potential safety concerns among adolescents and their caregivers may also lead to increased uptake.[31]

Future Research

Our work provides preliminary evidence for decreased implementation of some of the more recent advances in the field of cervical cancer prevention in rural areas and overall poor uptake of innovative practices such as HPV vaccination. In addition, there is evidence that this may be related to insurance type, suggesting that reimbursement policies may be partially driving this observation. Future research is needed to further explore this observation. In addition, further exploration into patient and provider preferences in screening and vaccination are warranted, particularly if additional women gain coverage through the Affordable Care Act.

Appendix A. Detailed Tables

Table 1. Demographic characteristics of all female patients between the ages of 9 and 70, by patient residence, NAMCS and NHAMCS combined, 2006-2008

	Total		Rural		Urban		
	n	% (SE)	n	% (SE)	n	% (SE)	p value
Patient Race							
White	62485	85.84 (1.02)	9805	91.13 (1.96)	52680	84.85 (1.05)	<0.01
Black	17666	14.16 (1.02)	1008	8.87 (1.96)	16658	15.15 (1.05)	
Patient Age							
9-29	24089	26.31 (0.55)	2856	25.63 (1.52)	21233	26.44 (0.57)	<0.01
30-45	22184	26.78 (0.43)	2693	23.23 (0.91)	19491	27.45 (0.44)	
46-70	33878	46.91 (0.70)	5264	51.14 (1.94)	28614	46.11 (0.69)	
Health Insurance Type/Source							
Private	36453	63.76 (0.83)	5346	56.42 (2.00)	31107	65.14 (0.84)	<0.01
Public	28922	24.74 (0.70)	3866	33.83 (1.96)	25056	23.03 (0.63)	
Uninsured	12435	11.49 (0.49)	1323	9.74 (0.97)	11112	11.82 (0.53)	
Major reason for visit							
Preventive care	19687	23.73 (0.81)	1968	20.17 (1.54)	17719	24.40 (0.84)	0.02
Other	59049	76.27 (0.81)	8627	79.83 (1.54)	50422	75.60 (0.84)	
Setting							
Physician Offices	34571	89.00 (0.83)	5270	86.50 (2.69)	29301	89.48 (0.75)	0.27
Hospital Outpatient Departments	45580	11.00 (0.83)	5543	13.50 (2.69)	40037	10.52 (0.75)	
Co-morbidities							
Yes (1 or more)	40658	52.24 (0.80)	6253	57.66 (1.74)	34405	51.20 (0.85)	<0.01
No	36992	47.76 (0.80)	4346	42.34 (1.74)	32646	48.80 (0.85)	

Table 2. Demographic characteristics of all female patients between the ages of 9 and 70, by provider location, NAMCS and NHAMCS combined, 2006-2008

	Total		Rural		Urban		
	n	% (SE)	n	% (SE)	n	% (SE)	p value
Patient Race							
White	62485	85.84 (1.02)	7765	90.99 (2.97)	54720	85.10 (1.11)	0.10
Black	17666	14.16 (1.02)	615	9.01 (2.97)	17051	14.90 (1.11)	
Patient Age							
9-29	24089	26.31 (0.55)	2205	27.00 (2.37)	21884	26.21 (0.54)	0.02
30-45	22184	26.78 (0.43)	2088	23.09 (1.14)	20096	27.31 (0.44)	
46-70	33878	46.91 (0.70)	4087	49.90 (2.72)	29791	46.47 (0.68)	
Health Insurance Type/Source							
Private	36453	63.76 (0.83)	4132	54.47 (2.55)	32321	65.11 (0.84)	<0.01
Public	28922	24.74 (0.70)	3169	36.67 (2.19)	25753	23.01 (0.63)	
Uninsured	12435	11.49 (0.49)	850	8.86 (1.05)	11585	11.88 (0.54)	
Major reason for visit							
Preventive care	59049	76.27 (0.81)	1475	19.02 (1.88)	18212	24.41 (0.86)	0.03
Other	19687	23.73 (0.81)	6709	80.98 (1.88)	52340	75.59 (0.86)	
Setting							
Physician Offices	34571	89.00 (0.83)	4097	86.11 (3.56)	30474	89.42 (0.80)	0.38
Hospital Outpatient Departments	45580	11.00 (0.83)	4283	13.89 (3.56)	41297	10.58 (0.80)	
Co-morbidities							
Yes (1 or more)	40658	52.24 (0.80)	4871	57.54 (2.30)	35787	51.46 (0.84)	0.04
No	36992	47.76 (0.80)	3356	42.46 (2.30)	33636	48.54 (0.84)	

Table 3. Characteristics of physicians providing cervical cancer screening services in NAMCS by provider location (rural/urban), 2006-2008Table 3. Characteristics of physicians providing cervical cancer screening services in NAMCS by provider location (rural/urban), 2006 – 2008

	Total			Rural		Urban		
	n	% (SE)		n	% (SE)	n	% (SE)	p value
Physician Race								
White	11649	73.42	2.03	1093	81.1 (3.88)	10556	72.6 (2.30)	0.26
Black	999	5.12	0.94	77	4.2 (2.61)	922	5.2 (1.05)	
Other	3160	21.46	2.03	228	14.79 (3.75)	2932	22.17 (2.24)	
Physician Age								
Less than 45 years	24456	80.39	0.90	2033	82.8 (2.98)	22423	80.2 (0.93)	0.39
45 years and older	6586	19.61	0.90	508	17.2 (2.98)	6078	19.8 (0.93)	
Physician Sex								
Male	21733	71.08	1.21	1886	77.4 (4.14)	19847	70.5 (1.28)	0.18
Female	9597	28.92	1.21	655	22.6 (4.14)	8942	29.5 (1.28)	
Physician Specialty								
General/Family Medicine	7615	23.80	1.07	800	33.4 (5.56)	6815	22.9 (1.10)	0.10
Internal Medicine	2848	14.88	0.82	204	14.6 (3.42)	2644	14.9 (0.84)	
Pediatrics	1213	4.90	0.36	92	5.9 (2.26)	1121	4.8 (0.33)	
Obstetrics & Gynecology	4731	17.91	1.08	302	11.0 (2.30)	4429	18.6 (1.14)	
Other	14948	38.51	1.16	1143	35.1 (3.73)	13805	38.8 (1.23)	
Median Patient Household Income								
Quartile 1 (≥ $61,056)	7113	23.28	1.61	0	0.0 (0.00)	7113	25.5 (1.98)	<0.01
Quartile 2 ($49,853-$61,055)	9402	30.62	2.84	172	4.9 (3.20)	9230	33.0 (3.08)	
Quartile 3 ($46,407-$49,852)	3577	11.30	2.66	512	17.8 (8.14)	3065	10.7 (2.86)	
Quartile 4 (≤ $46,406)	11251	34.80	3.05	1857	77.3 (8.39)	9394	30.9 (3.49)	
Percent of Adult Uninsured Population, 18-64								
Quartile 1 (≥ 21.0%)	10118	33.22	3.04	861	35.1 (11.83)	9257	33.1 (3.32)	0.09
Quartile 2 (17.5-20.9%)	7018	22.77	3.22	143	7.5 (3.58)	6875	24.2 (3.48)	
Quartile 3 (14.3-17.4%)	6665	21.79	2.77	502	20.7 (7.66)	6163	21.9 (2.94)	
Quartile 4 (≤ 14.2)	7542	22.22	2.04	1035	36.7 (10.64)	6507	20.9 (2.39)	

Table 4. Cancer screening and prevention services for female patients with a Pap test between the ages of 9 and 70, by patient residence and provider location, NAMCS and NHAMCS combined, 2006-2008.

	Total		Rural		Urban		
	n	Weighted Percentage (SE)	n	Weighted Percentage (SE)	n	Weighted Percentage (SE)	**p value**
By where the woman lives:							
Cervical Cancer Screening Method							
Conventional	1506	24.63 (2.55)	113	31.52 (6.15)	1,393	23.67 (2.64)	0.21
Liquid	2580	55.38 (3.18)	298	44.60 (6.22)	2,282	56.89 (3.25)	
Unspecified	1165	19.99 (2.32)	110	23.89 (5.00)	1,055	19.44 (2.52)	
HPV DNA Test							
Yes	596	9.25 (1.26)	47	3.34 (1.03)	549	10.07 (1.43)	<0.01
HPV Vaccination							
Yes	42	1.00 (0.25)	*4*	1.22 (0.62)	38	0.96 (0.26)	*0.70*
By where the provider is located:							
Cervical Cancer Screening Method							
Conventional	1506	24.63 (2.55)	91	35.77 (8.20)	1415	23.55 (2.62)	0.35
Liquid	2580	55.38 (3.18)	42	42.21 (0.25)	2403	56.66 (3.33)	
Unspecified	1165	19.99 (2.32)	90	22.02 (5.67)	1075	19.79 (2.53)	
HPV DNA Test							
Yes	596	9.25 (1.26)	32	2.81 (1.10)	564	9.87 (1.38)	<0.01
HPV Vaccination							
Yes	42	1.00 (0.25)	*4*	1.48 (0.71)	38	0.95 (0.26)	*0.51*

Note: italicized estimated percentages are based on fewer than 30 observations and thus are statistically unreliable.

Table 5. Characteristics of women receiving liquid versus conventional or unspecified Pap tests, by patient residence and type of test, NAMCS and NHAMCS combined, 2006 -2008.

	Rural				Urban				
	Liquid		Convention/Other		Liquid		Convention/Other		P value
	n	% (SE)	n	% (SE)	n	% (SE)	n	% (SE)	
Patient Race									
White	258	45.44 (6.22)	186	54.56 (6.22)	1617	57.79 (3.64)	1630	42.21 (3.64)	0.34
Black	40	39.47 (13.34)	37	60.53 (13.34)	665	52.93 (4.24)	818	47.07 (4.24)	
Patient Age									
9-29	99	49.16 (7.36)	62	50.84 (7.36)	783	55.11 (3.53)	863	44.89 (3.53)	0.38
30-45	88	42.16 (8.28)	66	57.84 (8.28)	797	59.12 (3.74)	827	40.88 (3.74)	
46-70	111	42.91 (7.83)	95	57.09 (7.83)	702	56.01 (4.04)	758	43.99 (4.04)	
Enabling									
Payment Source									
Private	167	46.13 (7.23)	135	53.87 (7.23)	1229	61.21 (3.70)	834	38.79 (3.70)	<0.01
Public	59	35.56 (6.24)	57	64.44 (6.24)	606	37.56 (4.06)	1162	62.44 (4.06)	
Uninsured	72	53.75 (13.45)	31	46.25 (13.45)	447	51.66 (5.33)	452	48.34 (5.33)	
Visit Setting									
Physician Office	112	42.06 (6.71)	158	57.94 (6.71)	1016	58.91 (3.63)	826	41.09 (3.63)	0.02
Hospital OP Dept	186	69.63 (7.29)	65	30.37 (7.29)	1266	38.96 (5.14)	1622	61.04 (5.14)	

Table 6. Characteristics of urban women receiving HPV DNA testing as part of a gynecological exam, by race, NAMCS and NHAMCS combined, 2006-2008.

	White		Black		
	n	% (SE)	n	% (SE)	**p value**
Patient Age					
9-29	191	32.72 (4.15)	124	37.75 (7.61)	0.25
30-45	200	37.55 (4.16)	93	43.57 (7.32)	
46-70	113	29.74 (4.34)	67	18.67 (4.57)	
Enabling					
Payment Source	258	81.21 (3.57)	44	56.25 (8.28)	<0.01
Private	190	12.23 (2.75)	201	36.71 (7.33)	
Public	56	6.56 (2.58)	39	7.04 (2.58)	
Uninsured	258	81.21 (3.57)	44	56.25 (8.28)	<0.01
Visit Setting					
Physician Office	170	92.41 (1.83)	40	71.62 (7.66)	<0.01
Hospital OP Dept	334	7.59 (1.83)	244	28.38 (7.66)	

Appendix B. Technical Notes

A cross-sectional study of visit level data collected between 2006 and 2008 by the National Ambulatory Medical Care Survey (NAMCS) and National Hospital Ambulatory Medical Care Survey (NHAMCS) was used to examine women's receipt of cervical cancer preventive services. The NAMCS is based on a stratified sample of all office-based physicians in the US. The NHAMCS examines hospital-based physicians, and includes visits from both outpatient department files and emergency room department files. Here, only visits from outpatient files were analyzed.

Populations

The study population of interest varied according to whether Pap smears or HPV DNA testing was examined. To examine the likelihood of receiving a liquid-based Pap smear, the study population was limited to visits involving white and African American women between 9 and 70 years of age where a Pap smear was conducted. Women with missing information on rurality, age, insurance type, comorbidities, type of visit (preventive or other) or the geographic variables were excluded.

To examine the likelihood of receiving an HPV DNA test, the study population was limited to visits to white and African American women between 9 and 70 years of age where 'preventive screening visit' (e.g. routine prenatal, well-baby, screening, insurance, general exams) rather than a visit for a 'new problem,' 'chronic problem,' or 'pre-/post-surgery' was marked on the NAMCS patient record form. Here again, women with missing information on rurality, age, insurance type, comorbidities, type of visit (preventive or other) or the geographic variables were excluded.

Variables

Several variables were analyzed to examine cervical cancer screening practices. Women were categorized as receiving a Pap smear that was liquid-based, conventional or unspecified. In analysis, liquid based Pap smears were compared to conventional and unspecified Pap smears. Due to small numbers, conventional and unspecified Pap smears were combined. Women were recorded as yes or no for having had an HPV DNA test during their visit.

Race and Rurality

Women were categorized as white or black/African American. Due to small sample sizes, Hispanic ethnicity was not considered in our definition of white or black/African. Location was examined based on the physician's location as well as the patient's location. When defined according to the physician location, the physician's ZIP code was used to define urban-rural based on the OMB Bulletin. When defined according to the patient location, the patient's ZIP Code was used to determine urban-rural location using the NCHS Urban-Rural Classification. In analysis, a two-level variable capturing urban and rural was examined.

Other Variables

Patient level characteristics included age (9-29, 30-45, 46-70), chronic conditions (none, 1 or more), type of visit (preventive or other), and health insurance coverage (private, government, other/self-pay). Geographic and environmental variables included median

household income, percent of population with a high school diploma, percent of population who is white and percent of the population between the ages of 18 and 64 who is without health insurance. To examine these geographic and environmental variables, the NAMCS/NHAMCS was linked to the 2009 Area Resource File (ARF) based on both the provider and patient/visit location. The provider location was linked directly using state and county FIPS codes. The patient/visit location was linked using the US Department of Housing and Urban Development (HUD)-USPS ZIP-COUNTY Crosswalk Files, which crosswalk patient zip codes from NAMCS/NHAMCS to county and state FIPS codes.

Analytic approach

NAMCS/NHAMCS use complex sampling frames, which required appropriate weighted analysis. SAS-callable SUDAAN was used to appropriately account for these weights in all analyses. Descriptive statistics and bivariate comparisons were computed for all variables of interest using chi square tests.

Development of variables and preliminary analyses were conducted at the SCRHRC using public use data sets and analyses incorporating restricted data (environmental and geographic variables and physician characteristics) were conducted at the National Center for Health Statistics (NCHS) Research Data Center in Hyattsville, MD.

This analysis was conceptualized into two 2 foci: provider self-reported practices and patient visits. For provider self-reported practices, inclusion criteria are: Obstetrics/gynecology or primary care specialty; race of "White" or "Black/African American"; and cervical cancer screening services. From patient visits encounters, inclusion criteria are: obstetric/gynecology or primary care provider visits; "White" or "Black/African American" women aged 18-70 years; and no previous history of cancer.

Cervical Variables: Several variables will be analyzed to examine cervical practices and vaccination recommendation. Table 1 in Appendix C lists questions, variables, and classifications which were used for this analysis.

Race and Rural Variables: Both provider and visit survey forms request the subject's (either physician or patient) zip code. Using this variable, rural-urban commuting area codes (RUCA) for each zip code were merged onto the master file. With this designation, a two 2 category variable was defined with urban (1.0-3.0) and micropolitan/rural (4.0-10.6). Other independent variables which considered were race (EA versus AA) for both patient and physician.

Other Variables: Other variables examined included: age of the provider or patient, insurance type (private, public, no charge, self-pay, or other), year of participation or visit, physician type of professional activities, size of practice (1 vs. > 1 physician), specialty (single vs. multiple), and ownership (self vs. other).

Analytic Approach: The analysis incorporates many data items which are not available within the public use dataset provided by the National Center for Health Statistics (NCHS). Thus, the study investigators submitted a research proposal to the Research Data Center (RDS) of the NCHS and all analyses were conducted on-site. Given the complex sampling design of the NAMCS, all analyses incorporate the recommended weighting factors and were conducted using SAS-callable SUDAAN. Descriptive statistics were computed for all variables related to physician, physician practice, and patient demographics, cervical screening practices, and HPV vaccination practices. As appropriate, chi-square and t-tests were used to make comparisons by rural/urban status and race.

Study Strengths and Limitations

Strengths of the study include use of a nationally representative sample of the US office-based physician population. In addition, the NAMCS and NHAMCS data sets contain provider reports on cancer screening and vaccination practices, rather than patient reports. Thus, bias from faulty participant recall was greatly reduced. Furthermore, the HPV vaccines have only been available since 2006, so this is one of the first data sources available on the use of this vaccine in urban and rural populations. Finally, by linking the Area Resource File, we were able to examine the impact of environmental and/or neighborhood contextual variables on cervical screening practices.

A limitation to the research is the small sample size for many of the cervical screening variables, even combining three years of data. To minimize the impact of this phenomenon, we sought to limit the levels of stratification in our analysis. Finally, it is worth noting that the data represent a sample of patient encounters with a clinical system, not all individuals. Hence, findings should not be interpreted as estimates of cervical cancer screening in the general population.

Appendix C.

Table 1. Patient-Level Variables included in the analysis.

Concept of Interest	Survey Question	NAMCS Form	Designation
Patient Cervical Screening Receipt	7. Diagnostic Screening Services (NAMCS) 7. Diagnostic Screening Services (NHAMCS) (2006-2008)	Patient Visit Form (NAMCS) Outpatient Department Patient Record (NHAMCS)	Pap test indicated (conventional, liquid-based or not specified)- Yes/No HPV DNA test Yes/No
Patient Vaccination Receipt	10. Medications and Immunizations (2006-2008)	Patient Visit Form	HPV vaccination indicated*- Yes/No

Appendix D.

Table 2: Provider-Level Variables

	Survey Question	NAMCS Form	Designation
Provider Cervical Screening Practices	1a. Does your practice use conventional Pap testing?	Cervical Cancer Supplement	Yes/No
	1b. Does your practice use liquid base cytology?	Cervical Cancer Supplement	Yes/No
	3a. Does your practice ever order or collect the Human Papillomavirus (HPV) DNA test?	Cervical Cancer Supplement	Yes/No
	4a. If a patient's Pap test result is borderline or abnormal, does your practice routinely order reflex HPV DNA testing?	Cervical Cancer Supplement	Yes/No
	6a. Does your practice routinely order or collect an HPV DNA test at the same time as the Pap test as part of routine cervical cancer screening?	Cervical Cancer Supplement	Yes/No
	7 (sections a-g). Given the following screening histories, when would your practice recommend that a woman between 30 and 60 years of age return for her next Pap test?	Cervical Cancer Supplement	Adheres to clinical recommendations/does not adhere to clinical recommendations
Provider Vaccination Practices	30a. Does your practice currently recommend the Human Papillomavirus (HPV) vaccine?	Physician Induction Form	Yes/No
	30b. Does your practice plan on recommending the HPV vaccine?	Physician Induction Form	Yes/No

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