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Primary Human Papillomavirus Test Uptake and Cervical Cancer Screening Trends in the Midwest, United States

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Abstract

Introduction/Objectives: Despite U.S. Preventive Services Task Force and American Cancer Society endorsement of primary HPV screening, limited published data shows low uptake. **Primary Aim:** Assess cervical cancer screening rates over time, particularly primary HPV test uptake, among patients in a midwestern practice. **Secondary Aim:** Evaluate associations between sociodemographics and screening adherence. **Methods:** Cross-sectional study. Qualifying subjects and type of screening test used were identified by applying ICD-9, ICD-10, lab test, and CPT codes to the Unified Data Platform. Sociodemographics were found through the electronic health record. **Results:** Primary HPV uptake represented <1% of annual screening from 1/2017 to 1/2022. On 1/1/2022, only 55% of 21 to 29 year old and 63% of 30 to 65 year old were up to date with screening among the studied population. For 21 to 29 year old, compared with White women, Black women were 28% less likely to be screened [RR = 0.72 (0.66-0.79)]. Compared with never-smokers, current smokers were 9% less likely to be screened [RR = 0.91 (0.87-0.96)], past smokers were 14% more likely [RR = 1.14 (1.09-1.2)]. Among 30 to 65 year old, compared with White women, Black women were 14% less likely to be screened [RR = 0.86 (0.81-0.9)]. Compared with never-smokers, current smokers were 21% less likely to be screened [RR = 0.79 (0.77-0.81)], past smokers were 6% less likely [RR = 0.94 (0.92-0.95)]. Jointly considering race, ethnicity, smoking status, Charlson score, and rurality, findings were similar for 21 to 29 year old; Black women were screened less than White women [RR = 0.73 (0.67-0.79)]; current smokers [RR = 0.9 (0.85-0.94)] and past smokers [RR = 1.12 (1.06-1.17)] were screened less than never smokers. For 30 to 65 year old, Black women were screened less than White women [RR = 0.83 (0.79-0.88)]; current smokers [RR = 0.8 (0.78-0.81)] and past smokers [RR = 0.95 (0.93-0.96)] were screened less than never smokers. **Conclusions:** Screening rates remained below the Healthy People 2030 goal of 79.2% over time, particularly for younger Black women and current smokers, with minimal use of primary HPV screening.

Keywords

early detection of cancer, practice guideline, human papillomavirus DNA tests, uterine cervical neoplasms

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Introduction

Cervical cancer screening is an integral aspect of caring for a primary care population and is supported by demonstrated reductions in cervical cancer incidence and mortality.[1] Cervical cytology (Pap) every 3 years for ages 21 to 65 year or human papillomavirus (HPV)-based testing (primary HPV or Pap/HPV co-test) every 5 years for ages 30 to 65 years are acceptable evidence-based screening options.[2] Despite availability of effective secondary prevention through screening followed by treatment of precancer, the American Cancer Society (ACS) estimates 13 820 new cervical cancer cases and 4360 deaths from cervical cancer in US in 2024.[3] Extensions in screening intervals from historic guidelines of annual screening to every 3 to 5 years may be presumed to improve overall screening rates but

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based on National Health Interview Survey (NHIS) data, the proportion of screened individuals decreased from 85.6% in 2005 to 77.0% in 2019 to 72.4% in 2021, below the revised Healthy People 2030 goal of 79.2%.[4-6]

Primary HPV screening was FDA approved in 2014 and an interim endorsement was provided by multiple guideline societies in 2015.[7,8] Primary HPV screening was endorsed by the U.S. Preventive Services Task Force (USPSTF) in 2018 and recommended as the preferred screening option by the American Cancer Society (ACS) in 2020.[2,9] A primary HPV test is collected by the clinician using the same procedure as a Pap or co-test collection, with the cervical sample placed in a liquid-based medium. The lab conducts high-risk HPV testing first and if results are negative, screening is recommended in 5 years. If HPV genotypes 16 or 18 are identified, the patient is referred for colposcopy. If "non-16/18" high-risk HPV types are identified, the lab runs a reflex test (Pap) on the specimen and the combined results will determine subsequent recommendations, using the ASCCP management guidelines.[10]

There are benefits that differentiate primary HPV testing from a Pap test alone or a Pap/HPV co-test. Compared with primary HPV testing, a Pap test has lower sensitivity, requiring more frequent screening to rule out precancer. Additionally, Pap tests may identify minor cervical cell changes that lead to further testing even though likelihood of clinical significance is low. While sensitivity is minimally increased with Pap/HPV co-testing compared to primary HPV, modeled outcomes show similar reductions in cervical cancer diagnoses and deaths, providing an opportunity to address the higher false positive rates observed with co-testing that are associated with additional testing and colposcopy.[11,12]

Clinician surveys assessing primary HPV screening support and use reflect mixed results. In 2015, 40.8% of 843 physician survey respondents across the US reported recommending primary HPV screening for their patients aged 30 years and older, similar to the 34.5% of primary care clinicians in a Midwest practice reporting primary HPV test use in 2020.[13,14] In contrast, only 3% of Indiana clinician respondents reported using primary HPV screening and among obstetrician-gynecologists in Missouri, there was no use of primary HPV screening.[15,16] Despite current guidelines recommending primary HPV screening, the limited evidence of confirmed primary HPV test use reflects low uptake of this screening method. Among 6.88 million women in commercial or Medicare databases in 2019 using medical test codes for confirmation, primary HPV screening represented $<0.5\%$ of all screening tests conducted.[17]

There are multiple potential reasons for low uptake of primary HPV testing despite USPSTF and ACS endorsement. Clinicians cannot order the test unless their reference laboratory has an FDA-approved lab platform for primary HPV screening and capacity to support the recommended triage of HPV-positive results, and many labs do not.[18] Beyond the issue of test access, adoption of updated screening guidelines requires familiarity with and acceptance of the newest recommendations. Studies of clinician adherence to guideline-based cervical cancer screening recommendations report overscreening and misuse of test type by age.[16,19] Clinician uncertainty about the effectiveness of primary HPV screening and perceived limitations of the test suggest knowledge gaps that may limit uptake.[15]

Curiosity about discrepancies in self-reported clinician use of primary HPV screening and a gap in the literature in reporting confirmed utilization of primary HPV screening informed our primary aim of evaluating cervical cancer screening rates and test types used over time. We hypothesized that despite USPSTF endorsement of primary HPV testing in 2018, use among clinicians in the Midwest practices of interest would remain low across the study period. Our secondary aim was to assess associations between sociodemographics and cervical cancer screening rates.

Methods

We evaluated cervical cancer screening rates and the type of screening tests used on January first of each year from 2017 to 2022 among women aged 21 to 65 years old who were empaneled to a primary care provider in a network of midwestern primary care clinics. Division of the study population into 2 age groups, 21 to 29 and 30 to 65 years, for data reporting and analysis was done to align with differences in the USPSTF screening guidelines by these age groupings.[2] Demographics were selected to explore previously reported predictors of screening status.[4,20,21] All of the clinics provide preventive services. The insurance payor mix includes 40% commercial/private insurance, 18.5% on a health system employee/dependents plan, 17% Medicaid, and 24.5% Medicare. The start date for the evaluation was selected based on the timing of the addition of primary HPV testing as an option in the healthcare system. The end date reflects the project timeline for the data pull.

Research-authorized study subjects' cervical cancer screening histories and screening test types were identified in the Unified Data Platform (UDP) by applying Current Procedural Terminology (CPT) code sets and lab codes for screening Pap and HPV tests. Given our intent to study average-risk screening candidates, we applied codes from the International Classification of Diseases, Ninth and Tenth Revisions (ICD-9 and ICD-10), to identify and exclude individuals with a history of CIN 2, CIN 3, adenocarcinoma in situ, cervical cancer, prior hysterectomy, prior cervicectomy, HIV, immunosuppression, in utero exposure to diethylstilbestrol, or solid organ transplant (Supplemental File).

Demographic independent variables of race, ethnicity, and tobacco use were retrieved from the electronic health record and were patient reported. These demographics

were summarized using count and percentage of total for the years 2017 and 2022. The Deyo Age-Weighted Charlson Comorbidity Index was calculated based on ICD-9 and ICD-10 diagnoses in the 3 years prior to patient empanelment.[22] Geographic location was based on USDA Rural-Urban Commuting Areas (RUCA) classification codes determined by individual's zip codes and a RUCA code of 2 or greater was considered rural, otherwise urban.[23] Dependent variables included screening adherence status and type of screening test used. Cervical cancer screening adherence rates were calculated on January 1st of each year as the number of women with a Pap screen completed within the last 3 years, or HPV testing within the last 5 years (primary HPV or co-test) divided by the total number of women who qualified for average-risk screening and were empaneled to a Midwest practice primary health care provider on the same day. Rates were then compared across year by type of screening and age group (21-29 and 30-65 years) using Poisson regression. For the 2022 cohort, rates of cervical cancer screening completion by screening type (Pap alone, HPV alone, co-testing, or any screening) were compared between demographic factors using Poisson regression stratified by age group and presented as relative risks with corresponding 95% confidence intervals. Similarly, in the 2022 cohort, Poisson regression was used to model cervical cancer screening rates, by screening type, stratified by age group with all predictors included in each model. To test the association of the predictors and the rate of each type of screening, likelihood ratio tests were conducted, comparing models with and without the predictor of interest. All analyses were conducted using SAS v9.4 and R v4.2.2 software.

The study was reviewed and declared exempt by our Institutional Review Board.

Results

In 2017, among 137 518 women 21 to 65 years, eligible for average-risk cervical cancer screening and empaneled to a primary care provider, only 60.7% were up to date, similar to the 2022 screening rate of 61.3% among 140 498 screening-eligible women. The 2022 study population was primarily white (90.4%), non-Hispanic (95.7%), living in a rural residence (60%), never-smoking (65.2%), with healthy (57.7%), or mild (34.4%) CCI scores. Primary HPV screening uptake represented <1.0% of total screening tests performed annually from 2017 to 2022. (Table 1)

Moving prevalence rates of screening adherence and screening test type used from 2017 to 2022 as of January 1st of each year are shown as a proportion of the screening-eligible population, defined as receipt of a Pap test in the previous 3 years or a Pap/HPV co-test or primary HPV test in the previous 5 years. Figure 1a for 21 to 29 years illustrates a decrease over time in rates of Pap test from 48.5% of screening-eligible women in 2017 to 45.8% in 2022 ($P < .001$) and a decrease in Pap/HPV co-testing from 9.2% to 8.9% ($P < .001$), while no change was found in primary HPV test use of 0.12% to 0.18% ($P = .23$). Consistent with USPSTF guidelines, the Pap test was the most frequently used screening test for this age group, though overall screening rates were low at 57.7% in 2017 and 54.9% in 2022. For 30 to 65 years, shown in Figure 1b, significant trends were observed with increasing uptake of Pap-HPV co-testing from 42.5% in 2017 to 58.3% in 2022 ($P < .001$), increase in primary HPV testing from 0.46% to 0.89% ($P < .001$), and decrease in Pap test alone from 18.5% to 3.9% ($P < .001$). Overall screening rates among 30- to 65-year-old women were 61.5% in 2017 and 63.0% in 2022. Although primary HPV testing

Table 1. Demographic and Clinical Characteristics for 2017 and 2022.

	2017 N (%)	2022 N (%)
Characteristics	n = 137 518	n = 140 498
Age (years)		
21-29	27 461 (20)	30 635 (21.8)
30-65	110 057 (80)	109 863 (78.2)
Race		
White	126 567 (92)	127 060 (90.4)
Black	2916 (2.1)	4082 (2.9)
Asian	3218 (2.3)	4405 (3.1)
Other/unknown	4817 (3.5)	4951 (3.5)
Ethnicity		
Non-Hispanic	133 023 (96.7)	134 407 (95.7)
Hispanic	4495 (3.3)	6091 (4.3)
Tobacco use		
Never	85 701 (62.3)	91 669 (65.2)
Past	23 412 (17)	27 991 (19.9)
Current	22 165 (16.1)	19 347 (13.8)
Unknown	6240 (4.5)	1491 (1.1)
Charlson Comorbidity Index		
Healthy (0)	76 651 (55.7)	81 065 (57.7)
Mild (1-2)	51 799 (37.7)	48 272 (34.4)
Moderate (3-4)	7028 (5.1)	8006 (5.7)
Severe(5+)	2026 (1.5)	3155 (2.2)
Geography of residence		
Rural	87 268 (63.5)	84 252 (60)
Urban	50 166 (36.5)	56 197 (40)
Cervical cancer screening		
Ages 21-29 years		
None	11 606 (42.3)	13 810 (45.1)
Pap alone	13 306 (48.5)	14 040 (45.8)
HPV alone	34 (0.1)	56 (0.2)
Co-testing	2515 (9.2)	2729 (8.9)
Ages 30-65 years		
None	42 419 (38.5)	40 599 (37)
Pap alone	20 323 (18.5)	4278 (3.9)
HPV alone	501 (0.5)	979 (0.9)
Co-testing	46 814 (42.5)	64 007 (58.3)

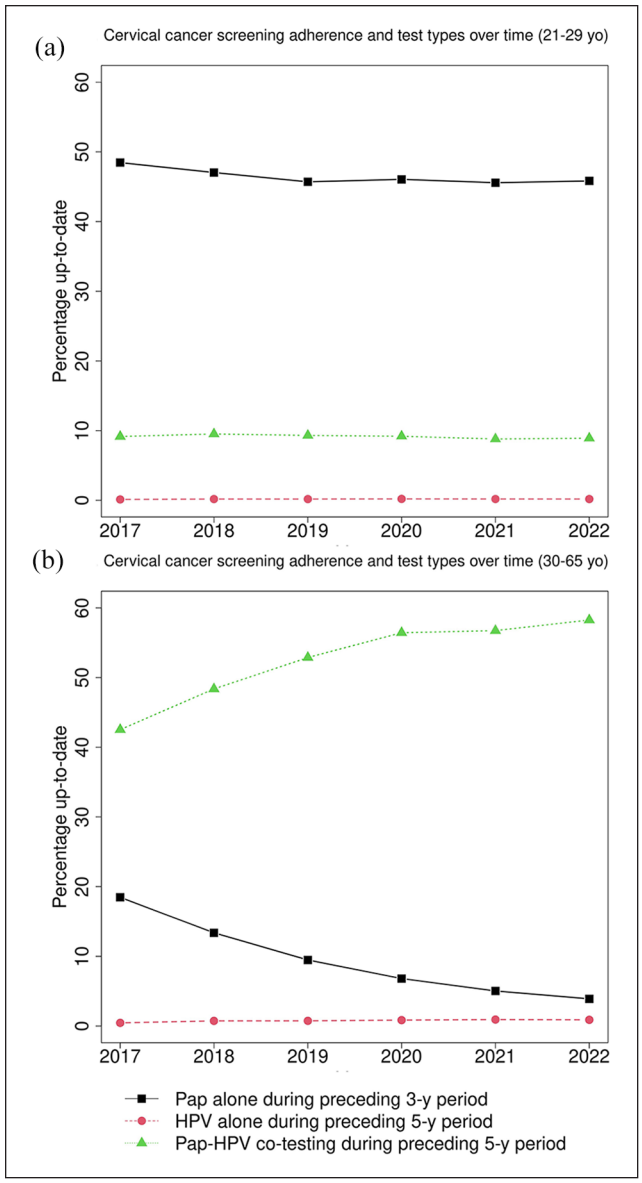

Figure 1. (a) Cervical cancer screening adherence and test types over time (21- to 29-years-olds) and (b) cervical cancer screening adherence and test types over time (30- to 35-years-olds).

use increased among 30 to 65 years, the rates remained below 1.0%.

A single-predictor model was used to analyze the association between individual sociodemographic variables and cervical cancer screening adherence.

In women aged 21 to 29 years (Table 2A), compared with White women (referent), Black women were 28% less likely to be adherent with screening [RR = 0.72 (95% CI = 0.66-0.79)] and Asian women were 11% less likely to be screened [RR = 0.89 (95% CI = 0.81-0.98)]. Compared with never-smokers (referent), current smokers were 9% less likely to be screened [RR = 0.91 (95% CI = 0.87-0.96)] and past smokers were 14% more likely to be screened [RR = 1.14 (95% CI = 1.09-1.2)]. Women with a CCI score of 1 to 2 (mild) had a 30% greater likelihood of prior screening [RR = 1.3 (95% CI = 1.23-1.37)] than the healthy (referent) population. Compared with a rural geography of residence (referent), urban residents were 6% less likely to be screened [RR = 0.94 (95% CI = 0.91-0.97)].

Among women aged 30 to 65 years (Table 2B), compared with White women (referent), Black women were 14% less likely to be adherent with screening [RR = 0.86 (95% CI = 0.81-0.9)]. Compared with never-smokers (referent), current smokers were 21% less likely to be screened [RR = 0.79 (95% CI = 0.77-0.81)] and past smokers were 6% less likely to be screened [RR = 0.94 (95% CI = 0.92-0.95)]. Screening likelihood decreased with progressive increases in CCI scores that correlate with greater comorbidities. Compared with the referent healthy population, screening was 9% [RR = 0.91 (95% CI = 0.89-0.92)], 16% [RR = 0.84 (95% CI = 0.81-0.86)], and 24% [RR = 0.76 (95% CI = 0.72-0.79)] less likely among women with CCI scores reflecting mild, moderate, and severe comorbidity scores. Compared with a rural geography of residence (referent), urban residents were 4% more likely to be screened [RR = 1.04 (95% CI = 1.03-1.06)].

Multivariable analysis was conducted to assess the joint association of race/ethnicity, smoking status, CCI, and geography of residence with cervical cancer screening adherence.

Table 3A illustrates that among women aged 21 to 29 years, compared with White women (referent), Black women were 27% less likely to be adherent with screening [RR = 0.73 (95% CI = 0.67-0.79)]. Compared with never-smokers (referent), current smokers were 10% less likely to be screened [RR = 0.9 (95% CI = 0.85-0.94)] and past smokers were 12% more likely to be screened [RR = 1.12 (95% CI = 1.06-1.17)]. Women with mild CCI scores of 1 to 2 were 29% more likely to be screened [RR = 1.29 (95% CI = 1.22-1.36)] than healthy referents. Compared with a rural geography of residence (referent), urban residents were 4% less likely to be screened [RR = 0.96 (95% CI = 0.94-0.99)].

For women aged 30 to 65 years (Table 3B), compared with White women (referent), Black women were 17% less likely to be adherent with screening [RR = 0.83 (95% CI = 0.79-0.88)] and Asian women were 7% less likely [RR = 0.93 (95% CI = 0.89-0.97)]. Compared with never-smokers (referent), current smokers were 20% less likely to be screened [RR = 0.8 (95% CI = 0.78-0.81)] and past smokers were 5% less likely to be screened [RR = 0.95 (95% CI = 0.93-0.96)]. Compared with a rural geography of residence (referent), urban residents were 3% more likely to be screened [RR of screening = 1.03 (95% CI = 1.02-1.05)]. Geography of residence was predictive of screening receipt by Primary HPV testing in the multi-predictor model. Compared with rural residency (referent), women living in an urban setting were 53% more likely to

Table 2. A: Screening Type Choice Versus Clinical Characteristics in 21- to 29-Year-Olds.

	Relative risk of screening type versus others (95% confidence interval)		
	Pap alone	Co-testing	Any screening
Characteristics	n = 14 040	n = 2729	n = 16 825
Race			
White	Reference	Reference	Reference
Black	0.73 (0.67-0.8)	0.66 (0.52-0.82)	0.72 (0.66-0.79)
Asian	0.94 (0.85-1.03)	0.68 (0.52-0.87)	0.89 (0.81-0.98)
Other/unknown	0.74 (0.68-0.81)	0.75 (0.61-0.91)	0.75 (0.69-0.81)
P-value	<.0001	<.0001	<.0001
Ethnicity			
Non-Hispanic	Reference	Reference	Reference
Hispanic	0.98 (0.91-1.05)	0.99 (0.84-1.15)	0.98 (0.92-1.04)
P-value	.5395	.8902	.4662
Tobacco use			
Never	Reference	Reference	Reference
Past	1.09 (1.03-1.14)	1.45 (1.3-1.61)	1.14 (1.09-1.2)
Current	0.84 (0.8-0.9)	1.29 (1.15-1.44)	0.91 (0.87-0.96)
Unknown	0.37 (0.3-0.46)	0.38 (0.22-0.61)	0.37 (0.3-0.45)
P-value	<.0001	<.0001	<.0001
Charlson Comorbidity Index			
Healthy (0)	Reference	Reference	Reference
Mild (1-2)	1.28 (1.21-1.35)	1.41 (1.24-1.59)	1.3 (1.23-1.37)
Moderate (3-4)	0.98 (0.65-1.41)	1.37 (0.59-2.66)	1.04 (0.73-1.44)
Severe (5+)	1.71 (1.07-2.58)	0.44 (0.03-1.96)	1.5 (0.95-2.24)
P-value	<.0001	<.0001	<.0001
Geography of residence			
Rural	Reference	Reference	Reference
Urban	1 (0.96-1.03)	0.69 (0.64-0.74)	0.94 (0.91-0.97)
P-value	.8343	<.0001	<.0001

B: Screening Type Choice Versus Clinical Characteristics in 30- to 65-Year-Olds.

	Relative risk of screening type vs. others (95% confidence interval)			
	Pap alone	HPV alone	Co-testing	Any screening
Characteristics	n = 4278	n = 979	n = 64 007	n = 69 264
Race				
White	Reference	Reference	Reference	Reference
Black	1.05 (0.87-1.26)	1.38 (0.96-1.92)	0.84 (0.79-0.88)	0.86 (0.81-0.9)
Asian	1.28 (1.1-1.49)	1.19 (0.84-1.64)	0.96 (0.92-1.01)	0.98 (0.94-1.03)
Other/unknown	0.96 (0.8-1.14)	1.14 (0.8-1.57)	0.86 (0.82-0.9)	0.87 (0.83-0.91)
P-value	.0189	.2162	<.0001	<.0001
Ethnicity				
Non-Hispanic	Reference	Reference	Reference	Reference
Hispanic	1.38 (1.2-1.57)	0.89 (0.61-1.23)	0.95 (0.91-0.99)	0.97 (0.93-1.01)
P-value	<.0001	.4849	.0078	.1412
Tobacco use				
Never	Reference	Reference	Reference	Reference
Past	0.75 (0.69-0.81)	0.9 (0.77-1.05)	0.95 (0.93-0.97)	0.94 (0.92-0.95)
Current	0.74 (0.67-0.81)	0.76 (0.62-0.93)	0.79 (0.77-0.81)	0.79 (0.77-0.81)
Unknown	0.25 (0.13-0.43)	0.73 (0.31-1.41)	0.41 (0.36-0.46)	0.4 (0.36-0.45)
P-value	<.0001	.0325	<.0001	<.0001

(continued)

Table 2. (continued)

	Relative risk of screening type vs. others (95% confidence interval)			
	Pap alone	HPV alone	Co-testing	Any screening
Characteristics	n = 4278	n = 979	n = 64 007	n = 69 264
Charlson Comorbidity Index				
Healthy (0)	Reference	Reference	Reference	Reference
Mild (1-2)	0.44 (0.41-0.47)	1.08 (0.94-1.23)	0.95 (0.93-0.96)	0.91 (0.89-0.92)
Moderate (3-4)	0.42 (0.36-0.49)	0.87 (0.66-1.13)	0.87 (0.85-0.9)	0.84 (0.81-0.86)
Severe (5+)	0.43 (0.34-0.54)	1.07 (0.72-1.52)	0.78 (0.74-0.82)	0.76 (0.72-0.79)
P-value	<.0001	.3742	<.0001	<.0001
Geography of residence				
Rural	Reference	Reference	Reference	Reference
Urban	1.24 (1.16-1.31)	1.56 (1.38-1.77)	1.02 (1.01-1.04)	1.04 (1.03-1.06)
P-value	<.0001	<.0001	.0030	<.0001

Table 3. A: Multivariable Model of Screening Type Choice Versus Clinical Characteristics in 21- to 29-Year-Olds.

	Relative risk of screening type versus others (95% confidence interval)		
	Pap alone	Co-testing	Any screening
Characteristics	n = 14 040	n = 2729	n = 16 825
Race			
White	Reference	Reference	Reference
Black	0.73 (0.66-0.8)	0.71 (0.56-0.89)	0.73 (0.67-0.79)
Asian	0.94 (0.85-1.04)	0.79 (0.61-1.02)	0.92 (0.84-1.01)
Other/unknown	0.74 (0.67-0.81)	0.79 (0.64-0.97)	0.75 (0.69-0.81)
P-value	<.0001	.0008	<.0001
Ethnicity			
Non-Hispanic	Reference	Reference	Reference
Hispanic	1.04 (0.97-1.12)	1 (0.85-1.18)	1.03 (0.97-1.1)
P-value	.2354	.9621	.3224
Tobacco use			
Never	Reference	Reference	Reference
Past	1.07 (1.01-1.13)	1.37 (1.23-1.52)	1.12 (1.06-1.17)
Current	0.84 (0.79-0.89)	1.21 (1.08-1.36)	0.9 (0.85-0.94)
Unknown	0.38 (0.3-0.47)	0.41 (0.24-0.66)	0.38 (0.31-0.46)
P-value	<.0001	<.0001	<.0001
Charlson Comorbidity Index			
Healthy (0)	Reference	Reference	Reference
Mild (1-2)	1.28 (1.2-1.35)	1.35 (1.19-1.53)	1.29 (1.22-1.36)
Moderate (3-4)	1.01 (0.67-1.44)	1.07 (0.42-2.17)	1.01 (0.7-1.41)
Severe (5+)	1.8 (1.12-2.71)	0.47 (0.03-2.07)	1.58 (1-2.36)
P-value	<.0001	.0001	<.0001
Geography of residence			
Rural	Reference	Reference	Reference
Urban	1.02 (0.98-1.05)	0.73 (0.67-0.78)	0.96 (0.94-0.99)
P-value	.3253	<.0001	.0217

(continued)

Table 3. (continued)

B: Multivariable Model of Screening Type Choice Versus Clinical Characteristics in 30- to 65-Year-Olds.

	Relative risk of screening type versus others (95% confidence interval)			
	Pap alone	HPV alone	Co-testing	Any screening
Characteristics	n = 4278	n = 979	n = 64 007	n = 69 264
Race				
White	Reference	Reference	Reference	Reference
Black	0.87 (0.72-1.04)	1.21 (0.84-1.69)	0.82 (0.78-0.87)	0.83 (0.79-0.88)
Asian	1.03 (0.88-1.2)	1.01 (0.71-1.39)	0.92 (0.88-0.97)	0.93 (0.89-0.97)
Other/unknown	0.74 (0.62-0.89)	1.12 (0.77-1.57)	0.85 (0.81-0.9)	0.85 (0.81-0.89)
P-value	.0048	.6891	<.0001	<.0001
Ethnicity				
Non-Hispanic	Reference	Reference	Reference	Reference
Hispanic	1.36 (1.17-1.56)	0.87 (0.6-1.24)	0.97 (0.93-1.01)	0.99 (0.95-1.03)
P-value	<.0001	.4632	.1657	.7303
Tobacco use				
Never	Reference	Reference	Reference	Reference
Past	0.81 (0.75-0.88)	0.93 (0.8-1.09)	0.95 (0.94-0.97)	0.95 (0.93-0.96)
Current	0.78 (0.71-0.86)	0.81 (0.66-0.99)	0.8 (0.78-0.82)	0.8 (0.78-0.81)
Unknown	0.23 (0.12-0.4)	0.7 (0.3-1.36)	0.41 (0.36-0.46)	0.4 (0.36-0.45)
P-value	<.0001	.1548	<.0001	<.0001
Charlson Comorbidity Index				
Healthy (0)	Reference	Reference	Reference	Reference
Mild (1-2)	0.44 (0.41-0.48)	1.11 (0.97-1.26)	0.94 (0.93-0.96)	0.9 (0.89-0.92)
Moderate (3-4)	0.44 (0.38-0.51)	0.91 (0.69-1.18)	0.88 (0.85-0.9)	0.84 (0.81-0.87)
Severe (5+)	0.46 (0.36-0.57)	1.12 (0.75-1.6)	0.79 (0.75-0.83)	0.76 (0.73-0.8)
P-value	<.0001	.3076	<.0001	<.0001
Geography of residence				
Rural	Reference	Reference	Reference	Reference
Urban	1.17 (1.1-1.25)	1.53 (1.34-1.74)	1.02 (1-1.03)	1.03 (1.02-1.05)
P-value	<.0001	<.0001	.0310	<.0001

be screened with a Primary HPV test [RR = 1.53 (95% CI = 1.34-1.74)], 17% more likely to be screened with a Pap test alone [RR = 1.17 (95% CI = 1.1-1.25)] but only 3% more likely to be screened with any test type [RR = 1.03 (95% CI = 1.02-1.05)]

Discussion

We observed persistently low cervical cancer screening rates of approximately 60% from 2017 to 2022 in a large midwestern healthcare system among women empaneled with a primary care clinician, similar to billing-confirmed screening rates observed in a county level population in the Midwest from 2005 to 2016.[24] These rates are well below the recently revised Healthy People 2030 goal of 79.2%.[6] NHIS data reflects a downward trend in screening adherence, with 86.5% of respondents self-reporting an up to date screening status in 2000, compared with only 72.4% in 2021.[5] Self-reported cervical cancer screening rates in the 2020 Behavioral Risk Factor Surveillance System (BRFSS) for the states in our healthcare system ranged from 75.5% TO 79.3%.[25] The lower screening rates in our study compared with the NHIS and BRFSS results may be partly explained by over-estimation of screening by patient self-report.[26] In contrast, the Health Resources and Services Administration's National Health Center Program provides care to underserved populations and reported confirmed (not patient-reported) 2022 cervical cancer screening rates of 53.9%, below rates observed in our less vulnerable population.[27]

Few studies have explored the uptake of primary HPV screening despite it being supported by USPSTF and preferred by ACS. Qin et al explored trends in cervical cancer screening tests during 2013 to 2019, and reported primary HPV rates below 0.5% in all age groups, similar to our observed primary HPV rates representing <1.0% of all tests.[17] We expected low uptake of primary HPV screening in 21- to 29-year-old women given the USPSTF does not support use of the test before age 30 years. However, we had anticipated uptake might increase in our 30- to 65-year-old population to reflect the current screening guidelines.

Associations between cervical cancer screening rates and sociodemographics from 2021 NHIS data are similar to our findings in regards to lower screening rates in younger women and Black women (compared with White women), with lower screening also observed in the NHIS cohort who identified as having a disability, comparable to our findings of lower screening rates in 30 to 65 year olds with more comorbidities by CCI score.[20] Previous studies have demonstrated that not all comorbidities are associated with lower cancer screenings. Austin et al noted that obesity, COPD, and kidney disease were associated with being less likely to complete cervical cancer screening. However, no association was seen with hypertension, diabetes, cardiovascular disease, arthritis, and depression.[28] This is in contrast to our findings as the CCI does include cardiovascular disease and diabetes. Our data also showed that current smokers were less likely to complete cervical cancer screenings than never smokers. This has been demonstrated in other studies, showing that patients who use tobacco products are less likely to be adherent to cancer screenings when compared to the non-smoking population.[21,29,30] It is especially important to consider cervical cancer screening rates among smokers as, for women with HPV infection, smoking is associated with a 2-fold increase in the odds of developing cervical cancer.[31]

It is evident from our study results and national-level reports that strategies to improve cervical cancer screening adherence are needed, particularly among groups identified as less likely to complete screening. As recommended by the Community Preventive Services Task Force, the most effective interventions to improve cervical cancer screening uptake incorporate multiple components addressing the broad categories of increasing community demand, community access, and clinician delivery of cervical cancer screening along with addressing structural barriers to screening through a combination of patient, provider, and clinic-level interventions.[32]

Study strengths include our use of robust CPT and lab code-based data to confirm cervical cancer screening completion and test types. Few studies have explored the confirmed uptake of primary HPV screening in a sizeable population. There are limitations as our results may not be generalizable to other healthcare systems outside of the Midwest. The study sample was composed mostly of White, non-Hispanic, rural, never-smokers, with a healthy, or mild CCI score. As well, study subjects may have had screening outside of our healthcare system which could result in under-estimation of screening rates.

Conclusions

Investigation of our primary aim found that cervical cancer screening rates among women empaneled with a primary care provider in our Midwest healthcare system were concerningly low from 2017 to 2022 and primary HPV screening remained an underutilized approach. Demographic factors including race and current smoking status were associated with lower screening rates, awareness of which may guide future interventions to improve screening uptake. Anticipated FDA approval of patient self-collection of a vaginal swab for primary HPV testing has the potential to improve screening rates among historically un/under-screened women by removing structural barriers to traditional clinic-based screening. In the interim, further work is needed to create multi-level interventions to increase cervical cancer screening rates and raise awareness about primary HPV screening. The data from this study may be useful to inform those strategies.

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Supplemental Material

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