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Adherence Patterns to Extended Cervical Screening Intervals in Women Undergoing HPV and Cytology Cotesting

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Abstract

Although guidelines have recommended extended interval cervical screening using concurrent human papillomavirus (HPV) and cytology ("cotesting") for over a decade, little is known about its adoption into routine care. Using longitudinal medical record data (2003-2015) from Kaiser Permanente Northern California (KPNC), which adopted triennial cotesting in 2003, we examined adherence to extended interval screening. We analyzed predictors of screening intervals among 504,202 women undergoing routine screening, categorizing interval length into early (

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Conflicts of Interest**:** Mark Schiffman has declared that the NCI has received testing of specimens at reduced or no cost for the independent evaluation of human papillomavirus (HPV) typing and/or cytology from Qiagen, BD, and Roche Molecular Systems. Philip E. Castle has received commercial HPV tests for research at reduced or no cost from Roche, Qiagen, Norchip, and MTM. All other authors have no other conflicts to report.

ABSTRACT

Although guidelines have recommended extended interval cervical screening using concurrent human papillomavirus (HPV) and cytology ("cotesting") for over a decade, little is known about its adoption into routine care. Using longitudinal medical record data (2003-2015) from Kaiser Permanente Northern California (KPNC), which adopted triennial cotesting in 2003, we examined adherence to extended interval screening. We analyzed predictors of screening intervals among 504,202 women undergoing routine screening, categorizing interval length into early (<2.5 years), adherent (2.5<3.5 years), or late (3.5<6.0 years). We also examined repeated early screening in a subgroup of 50,864 women. Predictors included: cohort year (defined by baseline cotest, 2003-2009), race/ethnicity, and baseline age. Compared to the 2003 cohort, women in the 2009 cohort were significantly less likely to screen early (aOR=0.22, 95% CI=0.21, 0.23) or late (aOR=0.46, 95% CI=0.45, 0.48). African American (AA) and Hispanic women were less adherent overall than Non-Hispanic White women, with increased early [(AA: aOR=1.21, 95%CI=1.17, 1.24) (Hispanic: aOR=1.08, 95%CI=1.06, 1.11)] and late screening [(AA: aOR=1.23, 95%CI=1.19, 1.27) (Hispanic: aOR=1.05, 95%CI=1.03, 1.08)]. Asian women were more likely to screen early (aOR=1.03, 95%CI=1.00, 1.05), and less likely to screen late (aOR=0.92, 95% CI=0.90, 0.94). Women aged 60-64 years were most likely to screen early for two consecutive intervals (aOR=2.06, 95%CI=1.88, 2.26). Our study found that widespread and rapid adoption of extended interval cervical cancer screening is possible, at least in managed care. Further research examining multilevel drivers promoting or restricting extended interval screening across diverse healthcare settings is needed.

INTRODUCTION

Over the last two decades, cervical cancer screening guidelines have changed considerably from annual screening with cytology ("Pap" testing) to less frequent screening using concurrent testing with high-risk human papillomavirus (HPV) and Pap testing ("cotesting"), or Pap testing alone[1-5]. These shifts reflect a growing body of evidence documenting the limited benefit and increased potential harm conferred by more frequent screening[2]. The great majority of new infections with high-risk HPV types, the primary cause of cervical cancer[6], will not result in cancer. Thus, reducing the frequency of screening helps to decrease potential harm by reducing unnecessary treatment of HPV infection-related cervical abnormalities that would likely resolve without medical intervention[7,8]. In addition to possible psychosocial harms, these treatments can result in adverse reproductive and pregnancy outcomes[9,10]. Furthermore, in comparison to cytology alone, HPV-based screening is substantially more sensitive and provides greater protection against invasive cervical cancer[11,12], and thus provides additional benefit beyond reduced frequency of screening.

Drawing from this evidence, the American Cancer Society (ACS)[1] and the American College of Obstetricians and Gynecologists (ACOG)[5] first included extended interval cotesting as an option for screening in 2002-2003, but did not exclude annual screening as an option. In contrast, more recent 2012 guidelines from the United States Preventive Services Task Force (USPSTF)[2], ACS[3], and ACOG[4] all recommend against annual screening, and recommend that routine screening using cotesting or cytology alone not occur before three years. Two organizations, ACS and ACOG, go further to state that cotesting is the preferred screening strategy[3,4].

Despite strong evidence and consensus guidelines, several studies have shown resistance to extended intervals. For women, higher levels of worry and perceived risk, limited knowledge, and history of abnormal Pap screening have been shown to be potential barriers to extended intervals[13-16]. A 2012 study reported that only 45% of physicians offer triennial cotesting to women aged 30 years and older, citing patient concerns as the primary factor hindering extended intervals[17]. A more recent 2014 study found that only 15.3% of providers recommended guideline-appropriate screening across all age groups[18]. Several provider-level barriers have also been identified including distrust of guidelines, longer years since medical school graduation, and concerns that extended intervals will negatively impact patient satisfaction and health, and reduce clinic volume[18-21]. While informative, most of these studies rely on self-report and do not directly measure screening using clinical records. Additionally, while there is some evidence that young women (18-29 years old) are screening less frequently[22,23], little is known about screening intervals in the recommended cotesting age group (30-64 years old).

In 2003, Kaiser Permanente Northern California (KPNC), a large integrated healthcare organization, shifted from annual Pap testing to 3-year interval cotesting as the preferred routine screening strategy for women aged 30-64 years old. Although 2012 guidelines recommend cotesting every five years, there is continued debate over this[24], and to date, KPNC has continued to recommend triennial screening. The KPNC cervical screening program has been described in detail elsewhere[25-27]. These data have been pivotal in evaluating the effectiveness of cotesting as a screening strategy[25,28] and in providing additional evidence for the revised 2012 guidelines[2,3]. In the present study, we use these data to examine adherence patterns to extended interval screening over time.

METHODS

We used data from the KPNC cervical screening program, which includes all women, aged 30-64 years, enrolled at KPNC who had at least one screening event in 2003-2015. As of the last update (December 31, 2015), the full dataset includes over 1 million women, over 2 million screening visits, and up to 13 years of follow-up per person. While the dataset is comprised of extracted medical record data from all KPNC women, only data regarding screening visits (visit dates, results of cytology and/or HPV test, and follow-up treatment to abnormal results), and baseline characteristics (patient age, race, and hysterectomy status) are available for analysis.

To avoid biases due to differences in follow-up time, we only included women in the 2003-2009 cohorts (N=805,668), with cohort enrollment defined by year of baseline screening event. In our primary analysis, we also excluded women who did not undergo cotesting at baseline (n=50,809) because annual screening was still recommended for women receiving cytology alone in 2003. We also excluded women without at least one additional screening event (within 6.0 years) after baseline (n=174,699) because we do not have KPNC enrollment data to distinguish non-screeners from women who left KPNC. Lastly, we excluded women inappropriate for extended interval screening including women who at baseline a) reported a hysterectomy (n=17,588); b) had a previous history of CIN2 or worse (CIN2+) (n=952); or c) were HPV-positive (n=57,407) or CIN2+ (n=11). These exclusions resulted in a study population of 504,202 women eligible for extended interval screening. The KPNC institutional review board (IRB) approved use of these data, and the National Institutes of Health Office of Human Subjects Research and Albert Einstein College of Medicine deemed this study exempt from IRB review.

Measures

The primary outcome was length of screening interval following baseline cotest. We determined length of screening interval by calculating the number of years between the baseline cotesting, T0, and sequential screening, T1. To examine screening in relation to KPNC guidelines, we collapsed screening intervals into three mutually exclusive groups: "early screeners" (interval length < 2.5 years), "adherent screeners" (interval length 2.5 years<3.5), and "late screeners" (interval length 3.5<6.0 years). We also examined a second outcome, repeated early screening, among a subgroup of women who screened early in the first interval (T0-T1), had at least two screening events within 8.0 years after baseline cotest, and had their first baseline cotest in 2003-2006 (n=50,864). Within this group, we classified women as repeated early screeners if they screened early in both the first interval (T0-T1) and second screening interval (T1-T2). For subgroup analysis, women who did not screen early in the first interval or who enrolled after 2006 were excluded due to differences in follow-up time. Lastly, we calculated baseline screening modality (cotesting versus cytology only) in all women screened at KPNC (N=805,668) to provide an overview of cotesting uptake across 2003-2009 cohorts.

In each analysis, we included three predictors: cohort (defined by the year of baseline cotest), patient baseline age (categorized into seven age groups ranging from 30-64 years of age), and patient race/ethnicity (categorized by census groups and as listed in the KPNC medical record). Due to the high proportion of missing data for race/ethnicity (20.1%), which is common in electronic medical records and likely not to meet the missing-at-random assumptions required for

imputing data[29], we categorized these women as "unknown race/ethnicity" and retained them in all analyses.

Statistical Analyses

We conducted univariate analyses to calculate the distribution of screening behaviors across cohorts, and used bivariate analysis to compare cohorts at baseline using the Pearson X^2 test of independence. We used similar analyses to describe and compare women identified as repeated early screeners to those women who screened early only in the first screening interval, and to calculate proportions of repeated early screening by predictors over time.

We used bivariate and multivariate multinomial logistic regression analysis to examine the association between cotesting interval length and predictors. Additionally, we used bivariate and multivariate logistic regression to examine associations between repeated early screening and predictors. For all models, we estimated odds ratios (ORs) and corresponding 95% confidence intervals (CIs), and tested for linear trends by cohort and by age (p_{trend}). To assess the potential impact of including women with missing race/ethnicity data, we conducted sensitivity analysis using only women with complete race data (n=402,716). We found no substantial differences in the point estimates or patterns for any model, and therefore report analyses using the full study population. We conducted all analyses in 2016 using StataSE 13.1 (College Station, TX).

RESULTS

Across all women screened from 2003-2009 at KPNC, 93.7% (754,859/805,668) underwent cotesting at baseline. In the 2003, the first year of triennial interval cotesting, 52.4%

(36,847/70,326) of screened women underwent cotesting at baseline. In 2004, the cotesting rate rapidly increased to 95.7% (157,890/165,017) and reached 99.0% (123,319/124,583) in the 2009.

Among the 504,202 women eligible for extended interval screening, we identified the proportion of women in each cohort adhering to triennial interval screening (Figure 1; see Table S1, Supplemental Digital Content 1, for detailed characteristics of women). Adherent screening increased in each successive calendar year cohort, from 35.9% in the 2003 cohort to 63.7% in the 2009 cohort ($p_{trend}<0.001$). This increase was primarily driven by a decrease in the proportion of early screeners, from 39.0% for the 2003 cohort to 15.9% for the 2009 cohort ($p_{trend}<0.001$). The decrease in the proportion of late screeners was more modest ($p_{trend}=0.012$), from 25.0% for the 2003 cohort to 20.4% for the 2009 cohort, with the lowest proportion occurring in the 2007 cohort (18.4%).

Table 1 provides the results of the adjusted multinomial logistic regression model. We found a significant decreasing trend in early screeners across cohorts ($p_{trend}<0.001$), with women in the 2009 cohort having the lowest likelihood of being an early screener (aOR=0.22, 95% CI=0.21, 0.23) in contrast to women in the 2003 cohort, controlling for age and race/ethnicity. We observed a similar, but more modest, trend of late screeners across cohorts ($p_{trend}=0.000$), with women in the 2009 cohort being 54% less likely to screen late than women in the 2003 cohort (aOR=0.46, 95% CI=0.45, 0.48).

We also found differences in screening patterns by age and by race/ethnicity. Although we did observe a moderate trend by age ($p_{trend}<0.001$), in comparison to women aged 30-34, the

likelihood of being an early screener was the least in women aged 55-59 years (aOR=0.55, 95% CI=0.53, 0.56), not the oldest age group (aOR=0.77, 95% CI=0.75, 0.80). Compared to women aged 30-34 years, women aged 55-59 years were 24% less likely to be a late screener (aOR=0.76, 95% CI=0.74, 0.78) and 60-64 years were 14% less likely to be a late screener (aOR=0.86, 95% CI=0.83, 0.89). In comparison to Non-Hispanic White (NHW) women, African American women were less adherent overall, being more likely to screen early (aOR=1.21, 95% CI=1.17, 1.24) and to screen late (aOR=1.23, 95% CI=1.19, 1.27). We observed similar patterns for Hispanic women, with an increased likelihood of screening early (aOR=1.08, 95% CI=1.06, 1.11) and late (aOR=1.05, 95% CI=1.03, 1.08). Asian women were more likely to screen early (aOR=1.03, 95% CI=1.00, 1.06), and less likely to screen late (aOR=0.92, 95% CI=0.90, 0.94) than NHW women.

Among women who screened early in the first screening interval (T0-T1) and enrolled in 2003-2006, we observed moderate decreases in the proportion of women who screened early for two consecutive intervals ("repeated early screeners") over time (see Table S2, Supplemental Digital Content 2, for detailed characteristics of early screeners). The percentage of repeated early screeners was the lowest in the 2006 cohort (25.5%), but only marginally lower than the 2003 cohort (32.2%), and we observed a rise in repeated early screeners in the 2004 cohort (37.3%). In women aged 30-59 years, we observed marginal differences in the proportion of repeated early screeners across age groups over time (Figure 2). However, we observed a marked difference among women aged 60-64 years, who had the highest percentage of repeated early screeners across age groups in the 2003 (45.1%), 2004 (50.4%), 2005 (43.4%) and 2006 cohorts (40.0%).

Table 2 provides the results of the adjusted logistic regression model examining predictors of repeated early screening. In comparison to the youngest age group, women aged 60-64 had the greatest likelihood of being a repeated early screener (aOR=2.06, 95% CI=1.84, 2.23). By cohort, we observed an overall decreasing (but not consistent) trend ($p_{trend}<0.001$). In contrast to the 2003 cohort, we observed a significant increase in the odds of repeated early screening in the 2004 cohort (aOR=1.24, 95% CI=1.17, 1.32), a slight, but insignificant, decrease in the 2005 cohort (aOR=0.98, 95% CI=0.92, 1.04), and a significant decrease in the 2006 cohort (aOR=0.74, 95% CI=0.69, 0.80), after adjusting for age and race/ethnicity. In contrast to NHW women, Asian women were significantly more likely (aOR=1.14, 95% CI=1.08, 1.20), while Hispanic women were significantly less likely (aOR=0.91, 0.85, 0.97), to screen early for two consecutive intervals.

DISCUSSION

In this study, we provide novel empirical data documenting increased and relatively rapid clinical adoption of triennial interval cotesting for routine cervical screening over time. Given the number of studies documenting provider and patient resistance to extended intervals[13-15, 17], our results are promising, at least for women in managed care. In contrast to other studies, which reported extended screening rates ranging from 6.3%[15] to 24%[13], our results show that most women at KPNC (over 63% in the 2009 cohort) were adherent to extended triennial interval screening. While our results are encouraging, the program at KPNC is particularly well poised to implement guideline changes in an efficient manner. Further research that captures specific system-level mechanisms (e.g. provider education, electronic health record reminders, incentives) by which KPNC achieved such rapid uptake is needed to understand how best to

compare and translate these findings to other healthcare systems. Additionally, KPNC triennial guidelines differ somewhat from national guidelines recommending even longer intervals[23], and therefore our results might not reflect screening patterns in other settings. Furthermore, although most women in the 2009 cohort screened triennially, over 15 percent of women continued to cotest earlier than is recommended. While we cannot assess contributing factors in these analyses, given the documented roles of patient attitudes or provider recommendation in other studies, it is likely that a multitude of factors contributed to adherent and nonadherent patterns. Additional interventions that simultaneously aim to increase patient knowledge regarding the potential harms of overscreening[30], and to address provider concerns regarding potential negative consequences (financial, health, or otherwise) of less frequent screening might further reduce early screening behaviors[13,16].

Our results regarding differences by age are somewhat divergent, but we hypothesize may reflect two competing forces. In line with health behavior theories that argue that past behavior is often the greatest predictor of future behavior[31], it is reasonable that the oldest group of women, who have been screening annually for the greatest number of years, would be the hardest group in which to achieve behavior change. Our results analyzing repeated early screening support this theory. However, when examining just the first screening interval (T0-T1), we did not observe this pattern as clearly. Surprisingly, we observed a general decrease in the odds of early screening with increases in age, except for the oldest group, which had the second to highest odds of screening early. The increased frequency in the oldest group might be driven in part by guidelines, which recommend discontinuing screening at age 65 among women with *adequate prior screening*. It is possible that providers might be screening women aged 60-64 without

documented screening history more frequently before discontinuing screening. Beyond this oldest group, the general decrease in frequency by age might be linked in part to reproductive years. Younger women might have more frequent gynecologic needs related to family planning that could result in more frequent exams and testing. Providers might also be more strongly encouraging this age group to screen more frequently[17]. Across women, these factors in the younger groups might be countering the impact of habitual behavior, which would be stronger in the older groups. As such, multifocal interventions that address habitual behavior and provide comprehensive care without frequent screening might be needed to further increase adherent screening in all groups.

In contrast to NHW women, Asian women were significantly more likely to be early screeners, and significantly less likely to be late screeners. Asian women were also significantly more likely to be repeated early screeners, highlighting an overall pattern of early screening in this population. African American and Hispanic women, however, were both more likely to screen early and to screen late in comparison to NHW women, indicating increased likelihood of non-adherence overall. There is little information on racial differences in screening interval length[32-34]. However, based on extensive evidence documenting racial disparities in cervical screening rates[34, 35], these results are somewhat difficult to interpret. While the overall pattern of greater non-adherence among African American and Hispanic women support evidence of disparities, the pattern of Asian women, who at the population level also have lower screening than NHWs[36], is more difficult to interpret. There are known differences in cancer outcomes between Asian American subpopulations,[37,38] and thus our broad categorization may be hiding any

intragroup disparities or differences due to income, acculturation and other factors[39,40]. Further research that examines interval patterns by race and by other socioeconomic factors is needed.

For those women identified as late screeners, we observed less drastic changes over time. One factor that likely is shaping these patterns is that we only examined screening behaviors among women who had at least two screening events and thus are unable to fully examine underscreening. Additionally, although KPNC continued to recommend triennial cotesting after 2012 guidelines, it is likely that these national shifts impacted interval patterns among women in the later cohorts. As such, the practice of screening later than is recommended by KPNC, but still screening within five years, does not raise substantial concern of underscreening in our view. Additional research is needed to fully examine any potential negative impact of extended interval screening on underscreening.

Limitations

In addition to strengths mentioned above, this study has limitations as well. We were unable to assess data from prior to 2003, and therefore cannot establish causality between KPNC guideline changes and adherence to cotesting guidelines. Additionally, due to study eligibility criteria, it is likely that women included in our analysis are different than those excluded in unmeasured ways. Although beyond the purpose of this study, we acknowledge that examining predictors of screening uptake across all women—rather than just behaviors of those who screened—would add insight and help identify any negative impact of guidelines shifts on screening uptake overall. Lastly, although we excluded all women who cotested positive (HPV+ or CIN2+) at any point in the study or had a history of CIN2+ at baseline, there is a possibility that some women

included in our analysis may have other clinical risk factors (e.g. HIV+) that support more frequent screening. However, given the size of the study population and the low prevalence of these risk factors, it is unlikely that our results would be meaningfully modified on this basis.

Despite documented patient- and provider-level concerns, our study found that widespread and rapid adoption of extended interval cervical cancer screening is possible, at least in the context of managed care. Although our results are promising, further research examining the multilevel drivers that promote or restrict adoption of extended interval screening across diverse healthcare settings is needed to fully understand how to decrease overscreening and increase underscreening across populations.

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SUPPLEMENTAL DIGITAL CONTENT

Supplemental Digital Content 1.docx

Supplemental Digital Content 2.docx

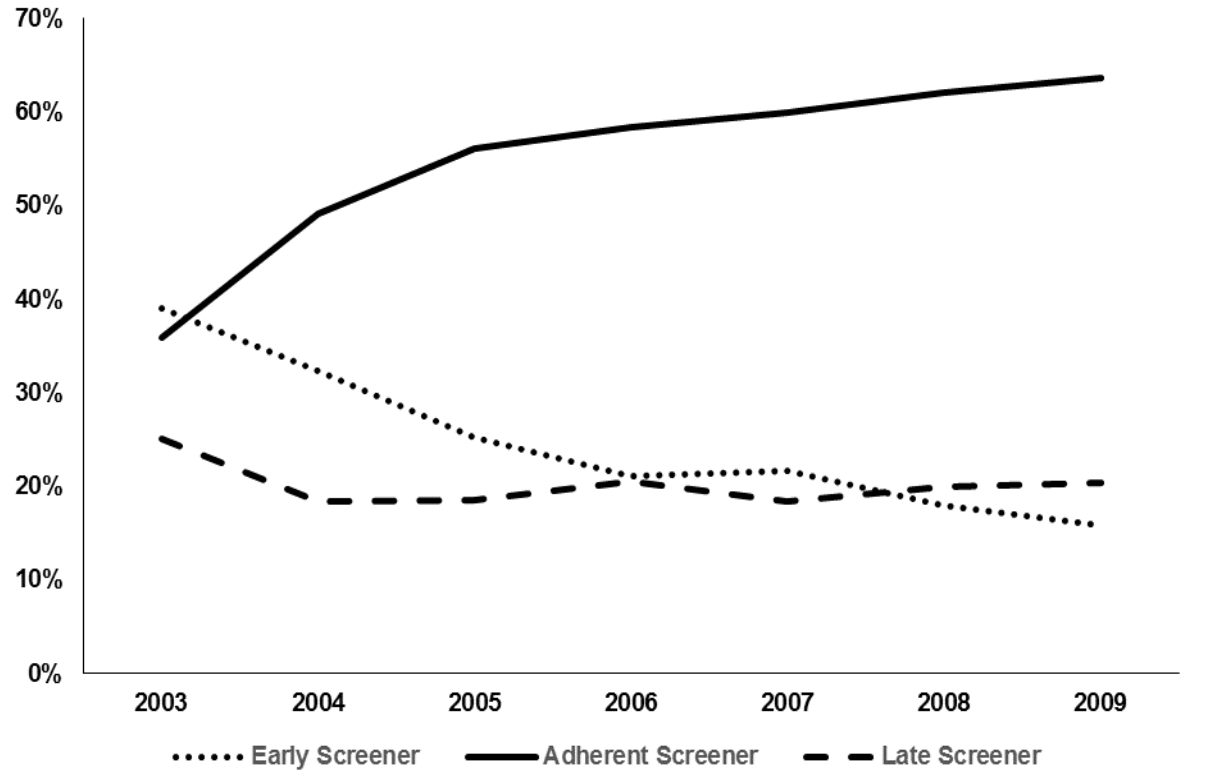
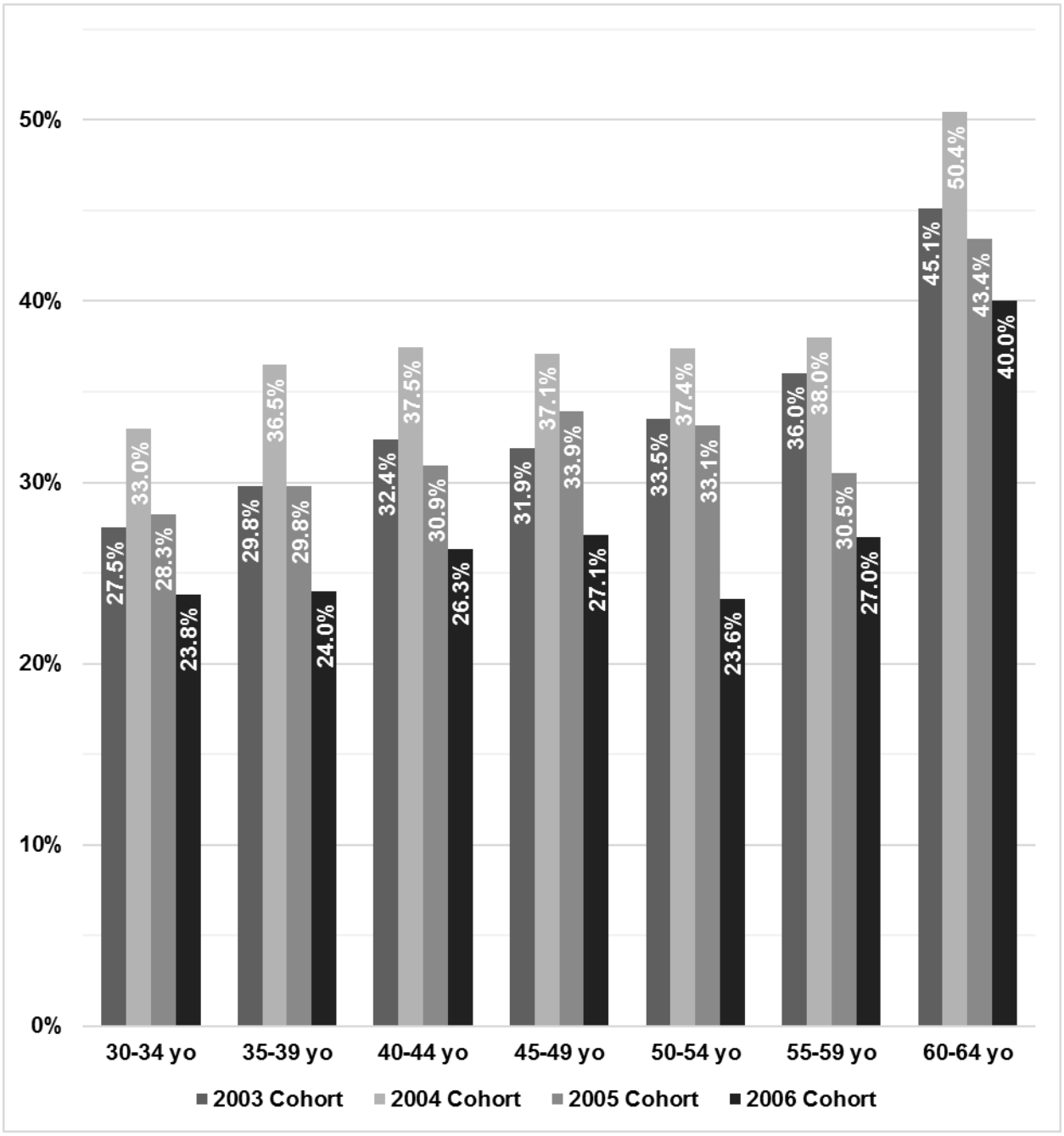


Figure 1. Proportion of early, adherent, and late screening behaviors by cohort year, 2003-2009

Note: Analysis in the figure limited to KPNC patients who had baseline cotest in 2003-2009, completed sequential screening within 6.0 years, cotested negative on all screenings since baseline, had no history of CIN2+ before or since baseline, and had not undergone a hysterectomy (N=504,202). Screening behavior determined by length of interval between baseline cotest and subsequent screening (T0-T1). Interval length categorized into three screening behaviors based on KPNC guidelines: early (<2.5 years), adherent (2.5<3.5 years) and late (3.5<6.0 years).

Figure 2. Proportion of repeated early screeners by age group and cohort year, 2003-2006



Note: Percentage of repeated early screeners was calculated for each age group and for each cohort. The numerator included women categorized as repeated early screeners (defined as women who screened early (<2.5 years) in both the first (T0-T1) and second (T1-T2) intervals). The denominator included only a subgroup of women (n=50,864) from the larger analysis (patients who had baseline cotest in 2003-2006, screened early in the first interval (T0-T1), had two screening events within 8.0 years after baseline, cotested negative on all screenings since baseline, had no history of CIN2+ before or since baseline, and had not undergone a hysterectomy.

Table 1. Multinomial Logistic Regression Model for Screening Behaviors by Patient Characteristics (N=504,202)

Characteristic	Early Screening (n=119,585) vs. Adherent Screening *n*	aOR(95%CI)	Late Screening (n=98,746) vs. Adherent Screening *n*	aOR(95%CI)
Cohort (year of baseline cotest)				
2003	9,429	1.00 (ref)	6,048	1.00 (ref)
2004	35,852	**0.61 (0.59, 0.63)**	20,453	**0.54 (0.52, 0.56)**
2005	19,843	**0.41 (0.40, 0.43)**	14,551	**0.48 (0.46, 0.49)**
2006	10,643	**0.33 (0.31, 0.34)**	10,393	**0.51 (0.49, 0.53)**
2007	14,422	**0.32 (0.31, 0.33)**	12,258	**0.44 (0.42, 0.46)**
2008	16,137	**0.26 (0.25, 0.27)**	17,963	**0.46 (0.45, 0.48)**
2009	13,259	**0.22 (0.21, 0.23)**	17,080	**0.46 (0.45, 0.48)**
Baseline Age (years)				
30-34	27,856	1.00 (ref)	18,715	1.00 (ref)
35-40	19,140	**0.76 (0.75, 0.78)**	16,306	1.02 (0.99, 1.04)
40-44	18,594	**0.71 (0.69, 0.72)**	16,825	1.01 (0.99, 1.04)
45-49	18,482	**0.69 (0.67, 0.70)**	16,096	**0.94 (0.92, 0.97)**
50-54	15,248	**0.61 (0.60, 0.63)**	14,290	**0.90 (0.88, 0.93)**
55-59	12,229	**0.55 (0.53, 0.56)**	10,879	**0.76 (0.74, 0.78)**
60-64	8,036	**0.77 (0.75, 0.80)**	5,635	**0.86 (0.83, 0.89)**
Race/Ethnicity				
White	50,966	1.00 (ref)	42,327	1.00 (ref)
African American	7,702	**1.21 (1.17, 1.24)**	7,028	**1.23 (1.19, 1.27)**
American Indian	390	1.09 (0.97, 1.23)	429	**1.39 (1.24, 1.56)**
Asian/Pacific Islander	18,466	**1.03 (1.00, 1.05)**	14,555	**0.92 (0.90, 0.94)**
Hispanic	14,115	**1.08 (1.06, 1.11)**	11,785	**1.05 (1.03, 1.08)**
Other	1,768	1.06 (1.00, 1.12)	1,592	**1.10 (1.04, 1.17)**
Unknown	26,178	**1.17 (1.15, 1.19)**	21,030	**1.14 (1.12, 1.16)**

Note: Analysis in the table used data from women eligible for extended screening intervals (N=504,202) which includes all KPNC women who had baseline cotest in 2003-2009, had a sequential screening within 6.0 years, cotested negative on all screenings since baseline, had no history of CIN2+ before or since baseline, and had not undergone a hysterectomy. Boldface indicate statistical significance ($p<0.05$).

[a]Multinomial logistic regression model calculated the adjusted odds ratio (aOR) as a measure of association between screening behavior (early *versus* adherent and late *versus* adherent) and cohort, adjusting for age and race/ethnicity. The base group in multinomial regression model is adherent screening.

[b]Screening behavior determined by length of interval between baseline cotest and subsequent screening (T0-T1). Interval length categorized into three screening behaviors based on guidelines: early (<2.5 years), adherent (2.5<3.5 years) and late (3.5<6.0 years).

Table 2. Logistic Regression Model for Repeated Early Screening by Patient Characteristics (n=50,864)[a]

Characteristic	Repeated Early Screening[b] (n=17,031)	
	n	aOR(95% CI)
Cohort (year of baseline cotest)		
2003	2,122	1.00 (ref)
2004	8,928	**1.24 (1.17, 1.32)**
2005	4,169	0.98 (0.92, 1.04)
2006	1,812	**0.74 (0.69, 0.80)**
Baseline Age (years)		
30-34	2,855	1.00 (ref)
35-40	2,644	**1.11 (1.04, 1.18)**
40-44	2,879	**1.18 (1.11, 1.26)**
45-49	2,896	**1.21 (1.14, 1.29)**
50-54	2,497	**1.20 (1.12, 1.28)**
55-59	2,095	**1.23 (1.14, 1.32)**
60-64	1,165	**2.06 (1.88, 2.26)**
Race/Ethnicity		
White	7,914	1.00 (ref)
African American	844	1.03 (0.94, 1.12)
American Indian	48	0.92 (0.65, 1.29)
Asian/Pacific Islander	2,753	**1.14 (1.08, 1.20)**
Hispanic	1,714	**0.91 (0.85, 0.97)**
Other	247	1.05 (0.90, 1.23)
Unknown	3,511	**1.21 (1.15, 1.27)**

Note: Analysis in the figure only included data on KPNC women who had baseline cotest in 2003-2006, screened early in the first interval (T0-T1), had two screening events within 8.0 years after baseline, cotested negative on all screenings since baseline, had no history of CIN+2 before or since baseline, and had not undergone a hysterectomy (n=50,864). Boldface indicates statistical significance ($p<0.01$).

[a]Logistic regression model assessing association between repeated early screening and cohort year, adjusting for age and race/ethnicity.

[b]Repeated early screening defined as women who screened early (<2.5 years) in both the first (T0-T1) and second (T1-T2) intervals).