

© Copyright 2020

Hitomi Kariya

**The Effect of Mailing HPV Self-sampling Kits to Women Underscreened for
Cervical Cancer on Uptake of Preventive Health Services**

Hitomi Kariya

A thesis

submitted in partial fulfillment of the
requirements for the degree of

Master of Public Health

University of Washington

2020

Committee:

Rachel L. Winer

Diana S. M. Buist

Linda K. Ko

Melissa L. Anderson

Program Authorized to Offer Degree:

Health Services

University of Washington

Abstract

The Effect of Mailing HPV Self-sampling Kits to Women Underscreened for Cervical Cancer on Uptake of Preventive Health Services

Hitomi Kariya

Chair of the Supervisory Committee:
Dr. Rachel L. Winer
Department of Epidemiology

Background

Previous studies reported that adults who attended an in-clinic health screening are more likely to attend other preventive services, yet the effect of home-based screening on adherence to other preventive services is unknown. This study examined the effect of receiving or using a high-risk (hr) human papillomavirus (HPV) kit among women who were underscreened for cervical cancer on uptake of breast cancer screening (mammography), colorectal cancer (CRC) screening, influenza vaccination, depression screening, and hemoglobin A1c (HbA1c) testing for monitoring diabetes.

Methods

This study was a secondary analysis of electronic medical record data from the Home-based Options to Make cervical cancer screening Easy (HOME) trial, a pragmatic randomized controlled trial to examine the effect of mailing hrHPV self-sampling kits among women underscreened for cervical cancer. A total of 16,590 women were randomized to either a mailed hrHPV self-sampling kit intervention or usual care reminders to attend Papanicolaou (Pap) screening. Uptake of each preventive service 12-months post-randomization was assessed between the control and intervention arms using univariate logistic regression models to estimate odds ratios (ORs). Among women randomized to the intervention arm, uptake of each preventive service was also compared across categories of women's cervical cancer screening behavior (returned a kit, received a Pap, or did nothing) using logistic regression models adjusted for demographic, health, or healthcare utilization covariates that changed OR estimates by 10% or more.

Results

Preventive services uptake varied by service and ranged from 20.9% for depression screening to 79.9% for HbA1c testing among women who were randomized to the control group, with no significant differences between the intervention vs. control groups for any of the five preventive

services. Preventive services uptake was similar in women who returned a kit vs. women who received a Pap test, but higher than in women who did nothing. Among women randomized to receive a mailed kit, the analyses except for HbA1c testing showed a significant difference between women who completed a kit and women who did nothing. Comparisons between kit returners and those who remained underscreened were 55.2% versus 26.6% for mammography (unadjusted OR = 3.39 [95% CI, 2.46 – 4.68]), 58.1% vs 15.1% for CRC screening (OR adjusted for time since last Pap = 7.22 [95% CI, 5.33 – 9.77]), 43.6% vs 29.1% for influenza vaccination (unadjusted OR = 1.91 [95% CI, 1.66 – 2.20]), 24.2% vs 19.1% for depression screening (OR adjusted for time since last Pap = 1.24 [95% CI, 1.05 – 1.46]), and 82.5% vs 74.4% for HbA1c testing (unadjusted OR = 1.62 [95% CI, 0.79 – 3.32]).

Conclusions

Mailing hrHPV self-sampling kits to women who were underscreened for cervical cancer did not result in a decrease or increase in other preventive health services uptake. In the intervention arm, preventive services uptake was higher in women who received cervical cancer screening by either completing a home-screening kit or attending Pap screening compared with women who did neither. Mailing the kits may have motivated women to engage in preventive care, however, a majority of women remained underscreened for cervical cancer and also had low uptake of other preventive services. Future home screening interventions need to target how to engage hard-to-reach populations in preventive care in general.

Chapter 1. INTRODUCTION

Cervical cancer is preventable with guideline-recommended screening.^{1,2} In the United States, the mortality of cervical cancer significantly declined with the increased use of Papanicolaou (Pap) screening,³ yet approximately 1 in 4 women remain underscreened for cervical cancer.^{4,5} More than 50% of cervical cancers diagnosed occur in underscreened women.^{6–8} Previous studies suggested multiple barriers to cervical cancer screening uptake such as lack of time or transportation, difficulties finding childcare or taking time off work, fear of Pap screening, and prior negative experiences with screening.^{6,9–13} Women who are underscreened for cervical cancer often have other important preventive care gaps.^{14,15}

Home-based high-risk (hr) human papillomavirus (HPV) kits are an option that could address these well-known barriers for cervical cancer screening. Previous studies suggested that home-based hrHPV kits were effective in increasing cervical cancer screening participation, particularly in hard-to-reach populations.^{16–32} However, one concern about offering home-screening is that removing in-clinic visits could result in a greater care gap for other preventive health services, as attending in-clinic screening offers opportunities for interaction with healthcare providers. Previous studies suggested that adults who attended one health screening are more likely to attend other screenings or preventive services.^{15,16,33–40} In a cross-sectional study among Latinas in Colorado, Pap screening adherence was significantly associated with breast cancer screening (mammography) adherence.³³ The odds of receiving mammography was 6.6 times higher among women who had received Pap screening within the past 3 years than women who had never attended Pap screening or received Pap screening more than 3 years ago.³³ Other studies found that Pap-adherent women were more likely to attend colorectal cancer (CRC) screening.^{40,41} A cross-sectional Behavioral Risk Factor Surveillance System (BRFSS)

study reported the odds of having attended CRC screening was two times higher among women who attended Pap screening within the previous three years than women who had never attended Pap screening or had a Pap screening more than 3 years ago.⁴⁰

These studies suggest positive associations among in-clinic health screenings. We are unaware of studies that have evaluated the effect of home-based cancer screening modalities, such as Fecal Immunochemical Test (FIT) kits for CRC screening or hrHPV kits for cervical cancer screening, on uptake of other preventive services. Participation in home screening could activate individuals to engage in other preventive services; however, unlike onsite health screening, home screening may reduce opportunities for individuals to attend other preventive services by removing the in-person visit. To date, it is unknown whether or not hrHPV self-sampling kits have an impact on uptake of other preventive services than cervical cancer screening.

To address this question, we used data from Home-based Options to Make cervical cancer screening Easy (HOME), a pragmatic randomized controlled trial of mailed hrHPV self-sampling kits in 30 to 64-year-old women who were overdue for cervical cancer screening within Kaiser Permanente Washington (KPWA), a U.S. integrated healthcare delivery system.⁴² We selected five preventive services that are routinely recommended for women (or a subset) within the same age range as the HOME trial, and are included in KPWA's annual preventive services reminders birthday letter,^{43–45} part of Healthcare Effectiveness Data and Information Set quality metrics, and often offered opportunistically during clinic visits: 1) mammography; 2) CRC screening; 3) influenza vaccination; 4) depression screening; and 5) hemoglobin A1c (HbA1c) testing in diabetics. We compared preventive services uptake over 12 months in women randomized to receive the home-testing kit versus usual care Pap reminders. Additionally, we

evaluated preventive services uptake among women in the intervention arm by their cervical cancer screening behavior: a) women who returned a kit regardless of attending Pap screening; b) women who attended Pap screening only; and c) women who did not use a kit or attend Pap screening.⁴²

Chapter 2. METHODS

We conducted a secondary analysis of data from the HOME trial.⁴² The primary purpose of the HOME trial was to compare cervical cancer screening uptake, detection and treatment of cervical pre-cancers between two different strategies: 1) usual care plus adding a mailed hrHPV self-sampling kit (intervention group); and 2) usual care Pap screening reminders only (control group).

The HOME trial identified eligible women through the electronic medical record (EMR) at KPWA. Women were eligible for the trial if they: 1) were between the ages of 30 and 64 years, 2) had an intact uterus, 3) had a primary care provider within KPWA's integrated delivery system, 4) had been continuously enrolled for at least 3 years and 5 months, and 5) had not had a Pap within 3 years and 5 months.⁴² These eligibility criteria were assessed weekly from February 2014 through August 2016. 17,256 women met these five eligibility criteria, and of these women, 666 were excluded per the following criteria: 1) previously indicated they did not want to be contacted for research studies, 2) had a pregnancy-related procedure or diagnosis code in their EMR within the prior 3 months, or 3) had an "interpreter needed" flag in their EMR (because the kit materials were only available in English).⁴²

A total of 16,590 women were 1:1 randomized to the intervention arm or the control arm. Women who were randomized to the control group received usual care outreach protocols. Standard of care for all women at KPWA include an annual birthday letter with tailored recommendations and reminders for preventive care based on when they are due for services that are specific to their age and previous receipt of preventive services.⁴⁴ Additionally, there are clinician-targeted automatic alerts for preventive services, centralized outreach to inform women of care gaps and primary care outreach to bring in individuals who have care gaps, and opportunistic preventive care.^{44,46} Women randomized to the intervention group received usual care outreach protocols and a mailed hrHPV self-sampling kit 5 months following their birthday letter, which indicated they were overdue for cervical cancer screening. This time period was selected to ensure traditional outreach strategies had an opportunity to activate women to receive in-clinic screening.⁴² The mailed kit included an invitation letter, research information sheet, educational materials on how to self-collect and return a sample, and a prepaid return envelope addressed to the KPWA clinical laboratory. The letter advised women to attend routine Pap screening regardless of whether they chose to complete the hrHPV self-sampling kit because hrHPV self-screening is not standard of care in the United States. Women were informed participation was voluntary and were provided with a telephone number to call with questions or to opt-out of having their individual-level medical record data used for research. Following KPWA's standard outreach protocols, if the kit was not returned within 3 weeks, study staff conducted up to 3 reminder calls. Use of the kit and uptake of Pap screening was captured within six months after randomization from their EMR.

We compared uptake of the five preventive services by randomization arm, and by cervical cancer screening behavior in the intervention arm. We excluded women who opted out

of EMR review (n=96), and women who died or disenrolled from KPWA during the 12-month follow-up period (n=1,917), leaving 14,218 women who were enrolled for at least 12-months after randomization in the analysis. A diagram of the study design is presented in **Figure 1**.

We used EMR data to identify the first receipt of each preventive service within 12 months after randomization. HbA1c testing measures the average glucose levels over the past three months and is used to monitor glucose levels for diabetes.⁴⁷⁻⁵⁰ Uptake of HbA1c testing was restricted to women with diabetes (n=1,036). For uptake of mammography and CRC screening, we used Healthcare Effectiveness Data and Information Set (HEDIS) definitions.^{51,52} Mammography analyses were restricted to women who were between the ages of 52 and 64 years and not up to date per HEDIS at randomization (n=3,500).⁵¹ CRC screening analyses were restricted to women who were between the ages of 51 and 64 years and not up to date per HEDIS at randomization (n=4,482).⁵² Women were due for CRC screening if they had not had a fecal occult blood test (FOBT) in the past year, a stool DNA test in the past 3 years, flexible sigmoidoscopy or computed tomography colonography in the past 5 years, or a colonoscopy in the past 10 years.⁵² There were no restrictions for influenza vaccination uptake or depression screening, as these services are recommended annually for all adults.

Our data was analyzed in aggregate due to human subjects restrictions on obtaining individual level data for HOME trial intervention arm women who did not return the home-based hrHPV kit. The details of data aggregation were published previously.⁴²

Chapter 3. STATISTICAL ANALYSIS

We fit a univariate logistic regression model for each exposure (randomization arm or intervention subgroup) and preventive service outcome (10 models total). For each woman in the analysis, the binary indicator of whether the health service was completed (yes/no) was the dependent variable, and a binary or three-level indicator for the exposure group was the independent variable. The models estimated odds ratios (OR) for associations between using the preventive health services and either randomization arm or intervention subgroups. Statistical significance was defined as two-sided with a p-value <0.05 .

We evaluated demographic covariates extracted from the EMR, measured at randomization. Regression analyses for comparisons by randomization arm were not adjusted for demographic covariates, because covariates between the randomized intervention group and control group were balanced in the HOME trial.⁴⁶

For within-intervention arm comparisons, we adopted a data-driven approach to assess confounding. We adjusted for variables that changed estimates by 10% or more when they were added individually to models.⁵³ Variables assessed as potential confounders included: age (30-39, 40-49, 50-59, 60-64); race (White or non-White); Charlson Comorbidity Index (0, 1, or ≥ 2)⁵⁴; women's U.S. Census block median household income⁵⁵ ($< \$50,000$, $\geq \$50,000$ to $\leq \$74,999$, $\geq \$75,000$ to $\leq \$99,999$, $\geq \$100,000$, or unknown); duration of health care enrollment (≥ 3.4 years or < 10 years or ≥ 10 years); and time since last Pap test (had never attended during the enrollment or had attended Pap screening more than 3.4 years ago). Ethnicity, body mass index, and tobacco use were not evaluated as potential confounders due to missing values. Aggregate data restrictions precluding cell sizes less than five limited our ability to assess demographic covariates as potential confounders for some outcomes. All variables were assessed

for influenza vaccination and depression screening. We could only assess age, enrollment duration, and time since last Pap test for mammography, and age, race, length of health care enrollment, and time to since last Pap test for CRC screening, and none for HbA1c testing. The variables assessed as potential confounders are summarized in **Supplement 1**.

Chapter 4. RESULTS

Baseline characteristics were similar between the randomized arms for all preventive services (**Table 1**). The distribution of Charlson Comorbidity Index for HbA1c testing was different from the other four preventive services; more than 90% of women had one or more Charlson Comorbidity Index score for HbA1c testing unlike the other four preventive services.

4.1 COMPARISON BY RANDOMIZATION ARM

Preventive services uptake varied by service and ranged from 20.9% for depression screening to 79.9% for HbA1c testing among women who were randomized to the control group, with few differences between the intervention vs. control groups. Overall, none of the analyses showed a significant difference between the intervention and control arms on uptake of any of the five preventive health services (**Table 2**).

The proportion of women up-to-date with mammography at 12 months was 33.8% vs. 33.4% in the intervention versus control arms, respectively (OR = 1.01 [95% CI, 0.88 – 1.17]). For CRC screening, 23.4% of women randomized to the intervention arm were up-to-date by 12 months, compared with 23.7% of women randomized to the control arm (OR = 0.98 [95% CI, 0.86 – 1.13]). In the comparison of influenza vaccination uptake, 33.6% of women in the intervention arm were vaccinated, compared with 33.9% of women in the control arm (OR =

0.98 [95% CI, 0.92 – 1.05]). Depression screening was also similar between the arms: 22.0% of women in the intervention arm; and 20.9% of women in the control arm (OR = 1.07 [95% CI, 0.99 – 1.16]). Similarly, there was no significant difference in uptake of HbA1c testing in diabetics. 77.0% of women in the intervention arm received HbA1c testing, compared with 79.9% of women in the control arm (OR = 0.85 [95% CI, 0.70 – 1.19]).

4.2 WITHIN-INTERVENTION ARM COMPARISON

Preventive services uptake was higher in woman who received cervical cancer screening by either using a kit or attending Pap screening than in women who did nothing. Overall, there was a significant difference among the subgroups of the intervention arm for all five preventive services. All comparisons between women who completed a kit and women who did nothing were significant, except for HbA1c testing. Unadjusted ORs are reported in **Table 3**. The analysis to assess demographic characteristics as potential confounders found that time since last Pap screening changed OR estimates by 10% or more for CRC screening and depression screening uptake; adjusted ORs are also included in **Table 3**. No other characteristics were identified as potential confounders for these services, and no potential confounders were identified for mammography or influenza vaccination.

Mammography adherence was considerably higher among women who attended Pap screening within the 6-months post randomization (76.7%) than in women who returned a home kit (55.2%) or did neither (26.6%). Compared with women who did neither, the OR for mammography adherence was 9.06 (95% CI, 6.10 – 13.46) for women who attended Pap screening, and 3.39 (95% CI, 2.46 – 4.68) for women who returned a kit.

CRC screening adherence was higher among women who completed a kit (58.1%) or attended Pap screening (53.4%) than women who did neither (15.1%). Compared with women

who did neither, the adjusted OR for CRC screening adherence was 7.22 (95% CI, 5.33 – 9.77) for women who completed a kit, and 5.76 (95% CI, 4.29 – 7.73) for women who attended Pap screening.

Influenza vaccination uptake was similar among women who attended Pap screening (44.4%) and women who returned a kit (43.9%), and lower compared with women who did neither (29.1%). Compared with women who did neither, the OR for influenza vaccination uptake was 1.95 (95% CI, 1.70 – 2.22) for women who attended Pap screening, and 1.91 for women who returned a kit (95% CI, 1.66 – 2.20).

Depression screening also was higher among women who attended Pap screening (32.8%; adjusted OR = 1.85 (95% CI, 1.60 – 2.14)) and women who returned a kit (24.2%; adjusted OR = 1.24 (95% CI, 1.05 – 1.46)), compared with women who did neither (19.1%).

In the comparison of HbA1c testing uptake, the adherence was higher among women who attended Pap screening (89.8%) than women who did neither (74.4%; OR = 3.04 (95% CI, 1.27 – 7.29)). The proportion with HbA1c testing was also higher in women who completed the kit (82.5%) than women who did nothing, but the difference was not statistically significant (OR = 1.62 (95% CI, 0.79 – 3.32)).

Chapter 5. DISCUSSION

This study evaluated the effect of mailing hrHPV self-sampling kits on preventive services uptake other than cervical cancer screening, including other routine cancer screening (mammography and CRC screening) and annual influenza vaccination, depression screening, and HbA1c testing for monitoring diabetes. Among women in an integrated healthcare delivery

system who were underscreened for cervical cancer, we found no significant differences in preventive service uptake between women randomized to receive a mailed self-sampling kit versus usual care Pap screening reminders. Although mailing hrHPV self-sampling kits to underscreened women increased cervical cancer screening,^{6/18/2020 1:53:00 AM} there did not appear to be a negative or positive impact on other preventive services.

Among women randomized to receive hrHPV self-sampling kits, preventive services uptake was higher in woman who completed cervical cancer screening by using a kit or attending Pap screening than in women who remained underscreened. Similar to previous studies,^{15,33,35,36,39,40} we observed positive associations between cervical cancer screening attendance and breast and colorectal cancer screening. We also observed a positive association between cervical cancer screening and influenza vaccination, in contrast to a previous study that found no association between history of cervical cancer screening and influenza vaccination receipt using self-reported data from the population-based 2016 BRFSS survey.⁵⁶

Preventive services use was generally higher in women who came into the clinic for Pap screening only, compared with women who did a kit. This was especially pronounced for mammography uptake, which is consistent with previous studies suggesting that women who attended Pap screening are more engaged in female cancer screenings than other types of cancer screenings.^{36,57} Some women may have had a Pap screening and mammography at the same clinic visit, as both screenings can be offered opportunistically. However, we did not have the ability to assess this with these data. On the other hand, CRC uptake was slightly higher in women who completed the kit than women who attended Pap screening only. These findings are consistent with the hypothesis that breast and cervical cancer screening may have taken place opportunistically at an in-clinic visit,^{36,57} which is not feasible for colonoscopy, which requires

preparation. There may also be a correlation between women who use home FOBT or FIT kits for CRC screening and women who were willing to use the HPV kit although we did not have the data to assess this.

Mailing home screening kits may have motivated some women in the intervention arm to engage or re-engage in preventive care. Compared to no cervical cancer screening, completing an hrHPV self-sampling kit was associated with increased uptake of all five preventive services.

5.1 STRENGTHS

A strength of this study includes reduced participation bias, as all eligible women were enrolled into the HOME trial under a waiver of consent. Women were excluded if they chose to opt out of having their EMR data used for the trial, but there were only 96 women (0.6%) who opted out of medical record review. As the study used EMR data,⁵⁸ recall bias, Hawthorne effects, and social disability bias are also reduced.

Other strengths of this study are the randomized trial design, large sample size (except for HbA1c testing), and the novelty of looking at the effect of a screening outreach intervention on other preventive services. To our knowledge, no other studies have looked at associations between hrHPV self-sampling kits and other preventive services. Associations between Pap screening and depression screening or HbA1c testing for monitoring diabetics also have not been examined by any other studies.

Including HbA1c testing uptake as an outcome was also a strength as it offered a comparison of a preventive service that is used for routine monitoring in a subgroup of individuals with a chronic condition versus the other services used for prevention or early detection. Our study revealed HbA1c testing uptake was relatively higher than the other preventive services.

5.2 LIMITATIONS

The present study has several limitations. First, the aggregate data restriction limited adjusting for demographic covariates when there were cell sizes less than 5. In particular, HbA1c screening could not be adjusted for any of the demographic covariates. Additionally, temporality between cervical cancer screening and other preventive services could not be established in the within-intervention arm comparison due to the overlapping time periods for assessing the exposure (6-months post-randomization) and the outcomes (12-months post-randomization). For example, a woman could have received her annual influenza vaccination before she returned a kit or attended Pap screening. While we cannot infer a causal relationship of using an hrHPV self-sampling kit or attending Pap screening on increased participation in the other preventive services,^{59,60} the temporality is not all that important in this context because our primary objective was to evaluate whether mailing hrHPV kits impacts adherence to other preventive service recommendations. These are all recommended preventive services, so what matters is whether or not women are up-to-date for each preventive service.

Since this study was restricted to women who were underscreened for cervical cancer, the findings are not applicable to cervical cancer screening-adherent women. The impact of mailing hrHPV self-sampling kits to women who are adherent to cervical cancer screening is still unknown. Gaps in preventive services by removing the in-person Pap screening could potentially be introduced if home testing is introduced as an option for adherent women. The sample of this study was a subset of insured women with access to care at KPWA, which, like the underlying region of the US, has a high proportion of non-Hispanic White, high income, and highly educated individuals. Additionally, all women in the study had insurance and access to healthcare; therefore, our findings may not be generalizable to other US populations. Our results

also may not be applicable to women with limited English proficiency, since women with an “interpreter needed” flag in their EMR were excluded.

5.3 CONCLUSIONS

Mailing hrHPV self-sampling kits to women who were underscreened for cervical cancer did not result in a decrease or increase in adherence to mammography, CRC screening, influenza vaccination, depression screening, or HbA1c testing in diabetics. With the exception of mammography, rates of engagement in preventive services were similar between women who used a mailed kit and women who received Pap testing; and rates were higher in both of these groups, compared with women who remained unscreened. Mailing the kits may have motivated some women to engage in preventive care; however, a majority of women remained underscreened for cervical cancer and also had low uptake of other preventive services. While cervical cancer screening rates remained low,⁴⁶ mailing hrHPV self-sampling kits improved screening rates, without adversely impacting the rates of participation in other preventive services. The recommended next step for integrated healthcare delivery systems is to target how to engage hard-to-reach populations in preventive care and consider additional strategies besides sending reminders and mailing a home screening kit.

APPENDIX A

Figure 1: *Diagram of the Study Design*

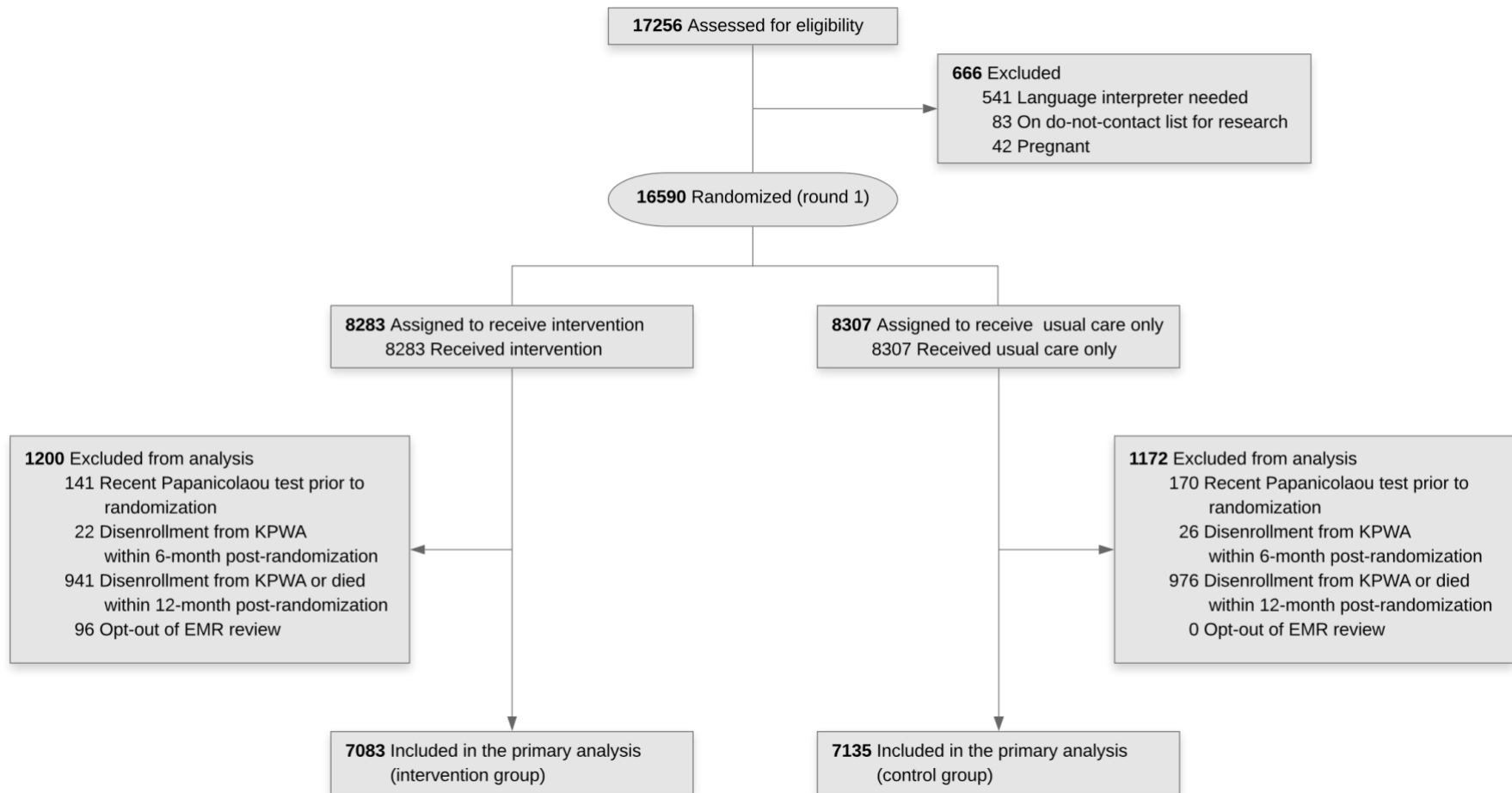


Table 1: Demographic Characteristics of Control and Intervention Group Participants by Preventive Health Services Eligibility

Characteristic ^e	Mammography (n=3500) ^a		CRC screening (n=4482) ^b		Influenza vaccination (n=14,218) ^c		Depression screening (n=14,218) ^c		HbA1c testing (n=1036) ^d	
	Control (n=1752)	Intervention (n=1748)	Control (n=2293)	Intervention (n=2189)	Control (n=7135)	Intervention (n=7083)	Control (n=7135)	Intervention (n=7083)	Control (n=522)	Intervention (n=514)
	% _f [n] _g	% _f [n] _g	% _f [n] _g	% _f [n] _g	% _f [n] _g	% _f [n] _g	% _f [n] _g	% _f [n] _g	% _f [n] _g	% _f [n] _g
Age at randomization, y										
30-39	-	-	-	-	17.2	17.6	17.2	17.6	7.3	4.7
40-49	-	-	-	-	25.8	26.4	25.8	26.4	16.3	18.3
50-59	63.4	65.6	66.8	68.7	37.3	37.0	37.3	37.0	43.3	45.1
60-64	36.6	34.4	33.2	31.3	19.7	19.0	19.7	19.0	33.1	31.9
Race										
White	72.4	72.2	74.1	74.5	72.6	72.1	72.6	72.1	66.1	67.7
Asian or Native Hawaiian or other Pacific Islander	9.4	8.3	9.3	7.9	10.5	10.5	10.5	10.5	13.0	11.7
Black or African American	4.6	4.3	4.2	3.7	4.3	4.6	4.3	4.6	5.0	6.6
Other	13.6	15.2	12.4	13.9	12.6	12.8	12.6	12.8	15.9	14.0
Ethnicity										
Non-Hispanic	95.0	95.3	95.1	95.1	94.7	94.7	94.7	94.7	90.8	94.6
Hispanic	5.0	4.7	4.9	4.9	5.3	5.3	5.3	5.3	9.2	5.4
Unknown	7.6 [133]	8.1 [141]	6.2 [141]	6.6 [144]	5.8 [414]	5.4 [384]	5.8 [414]	5.4 [384]	4.4 [23]	3.5 [18]
Length of health plan enrollment before randomization, y										
3.4 to < 5	20.6	22.6	21.4	23.6	23.9	23.9	23.9	23.9	27.2	19.8
5 to < 10	23.7	25.2	23.1	24.4	28.5	30.4	28.5	30.4	20.9	25.3
≥ 10	55.7	52.2	55.5	52.0	47.6	45.7	47.6	45.7	51.9	54.9
Time since last Pap test (by length of enrollment), y										
<i>Enrolled 3.4 to < 5</i>										
No Pap test	79.7	76.0	76.0	72.3	67.5	65.8	67.5	65.8	68.3	70.6
> 3.4 to < 5	20.3	24.1	24.0	27.7	32.5	34.2	32.5	34.2	31.7	29.4
<i>Enrolled 5 to < 10</i>										
No Pap test	47.1	46.0	45.7	42.7	28.7	29.7	28.7	29.7	28.4	30.8
> 3.4 to < 5	37.0	39.2	40.4	45.9	58.1	57.0	58.1	57.0	56.0	53.1
5 to < 10	15.9	14.7	14.0	11.4	13.1	13.3	13.1	13.3	15.6	16.2

<i>Enrolled ≥ 10</i>										
No Pap test	20.7	20.6	18.2	19.1	12.3	12.6	12.3	12.6	11.4	12.8
> 3.4 to < 5	37.9	39.8	43.8	45.8	58.2	59.2	58.2	59.2	57.2	56.0
5 to < 10	26.1	24.5	23.9	22.4	20.5	19.9	20.5	19.9	18.8	20.9
≥ 10	15.3	15.1	14.2	12.7	9.0	8.3	9.0	8.3	12.6	10.3
Women's census block: Median Household Income, \$										
<49,999	24.7	25.0	24.8	25.0	23.9	24.3	23.9	24.3	29.4	31.2
50,000-74,999	38.6	37.0	37.1	36.6	37.5	37.6	37.5	37.6	43.3	42.1
75,000-99,999	26.1	25.9	26.0	26.0	27.3	26.7	27.3	26.7	19.8	19.5
100,000+	10.6	12.1	12.2	12.4	11.3	11.4	11.3	11.4	7.5	7.3
Unknown	9.3	8.9	8.7	9.0	7.4	7.3	7.4	7.3	8.1	7.0
	[162]	[155]	[200]	[196]	[529]	[517]	[529]	[517]	[42]	[36]
Travel time from women's home to primary care clinic, min_n										
< 10 minutes	34.3	32.7	34.0	33.0	32.9	33.2	32.9	33.2	35.0	NA
10 - < 20 minutes	40.7	43.9	40.1	42.3	41.7	42.3	41.7	42.3	39.5	NA
20 - < 30 minutes	14.6	13.9	15.2	14.1	14.5	14.5	14.5	14.5	13.6	NA
30 + minutes	10.3	9.4	10.6	10.6	10.9	10.1	10.9	10.1	11.9	NA
Unknown	1.7	0.9	1.5	1.0	1.1	0.8	1.1	0.8	1.5	
	[29]	[16]	[35]	[21]	[77]	[58]	[77]	[58]	[8]	NA
BMI, kg/m₂ _i										
< 24.9	25.6	28.1	26.0	27.5	28.0	28.2	28.0	28.2	7.8	10.7
25 – 29.9	28.2	25.7	28.5	25.0	26.4	25.7	26.4	25.7	17.0	16.4
30 – 34.9	19.7	20.7	19.5	19.9	19.2	18.4	19.2	18.4	23.1	18.4
35 – 39.9	13.5	12.5	12.9	13.6	12.6	13.0	12.6	13.0	21.5	20.0
≥ 40	13.0	13.1	13.1	14.0	13.7	14.7	13.7	14.7	30.5	34.6
Unknown	22.2	21.1	19.1	17.4	13.3	12.1	13.3	12.1	2.1	3.7
	[389]	[369]	[438]	[381]	[950]	[854]	[950]	[854]	[11]	[19]
Tobacco use										
Never	57.6	53.7	59.7	56.1	61.8	61.5	61.8	61.5	57.0	51.9
Current	18.4	21.2	16.8	18.8	14.4	14.3	14.4	14.3	13.9	15.9
Former	24.0	25.1	23.5	25.1	23.8	24.2	23.8	24.2	29.2	32.2
Unknown	20.4	19.6	17.6	17.2	12.7	11.8	12.7	11.8	2.1	3.3
	[358]	[343]	[404]	[377]	[908]	[836]	[908]	[836]	[11]	[17]
Charlson Comorbidity Index score^{e54}										
0	82.8	80.7	81.3	81.0	81.1	81.0	81.1	81.0	5.9	7.2
1	9.1	11.4	10.4	11.3	11.6	11.1	11.6	11.1	39.5	36.2
2	4.3	4.4	4.7	4.5	4.0	4.4	4.0	4.4	26.8	30.2

3+	3.8	3.5	3.6	3.2	3.3	3.5	3.3	3.5	27.8	26.5
Randomization year										
2014	63.4	62.0	58.6	58.2	52.3	52.5	52.3	52.5	57.1	55.8
2015	24.9	25.6	28.7	28.1	31.0	30.7	31.0	30.7	27.2	26.5
2016	11.8	12.4	12.7	13.8	16.6	16.8	16.6	16.8	15.7	17.7

Abbreviation: BMI, Body Mass Index.

a The sample size varies by preventive service due to differences in eligibility. For mammography, analyses were restricted to women who were between the ages of 52 and 64 years and not considered up to date per HEDIS.⁵¹

b For CRC screening, analyses were restricted women who were between the ages of 51 and 64 years and not considered up to date per HEDIS.⁵²

c There were no restrictions for influenza vaccination uptake or depression screening, as these services are recommended annually for all adults.

d Uptake of the HbA1c testing was restricted to women with diabetes.

e Based on electric medical record data.

f The proportions were calculated without missing observations.

g The number of missing observations is presented as unknown with [n] and the percentage of total.

h Distributions of travel time to from women' s home to primary care clinic are not available for participants in the intervention group of HbA1c testing as those values are redacted due to indirect identifiability of cell sizes less than 5.

i Calculated as weight in kilograms divided by height in meters squared.

Table 2: Odds Ratios (ORs) for Preventive Health Services Receipt by Randomization Arm

Preventive Health Services by Randomized Arms	Received preventive health service ^a n (%)	OR, Unadjusted (95% CI)
Mammography^b		
Control (n=1752)	586 (33.4)	Ref
Intervention (n=1748)	590 (33.8)	1.01 (0.88, 1.17)
CRC screening^c		
Control (n=2293)	544 (23.7)	Ref
Intervention (n=2189)	512 (23.4)	0.98 (0.86, 1.13)
Influenza vaccination^d		
Control (n=7135)	2422 (33.9)	Ref
Intervention (n=7083)	2377 (33.6)	0.98 (0.92, 1.05)
Depression screening^e		
Control (n=7135)	1488 (20.9)	Ref
Intervention (n=7083)	1556 (22.0)	1.07 (0.99, 1.16)
HbA1c testing^f		
Control (n=522)	417 (79.9)	Ref
Intervention (n=514)	396 (77.0)	0.85 (0.63, 1.14)

^a Uptake of the preventive health services were assessed in the 12 months after randomization.

^b For mammography, the analysis was restricted to women who were between the ages of 52 and 64 years and not considered up to date per HEDIS.⁵¹

^c For CRC screening, the analysis was restricted women who were between the ages of 51 and 64 years and not considered up to date per HEDIS.⁵²

^d There was no age restriction for influenza vaccination uptake. Influenza vaccination is recommended annually for all adults.

^e There was no age restriction for depression screening uptake. Depression screening is recommended annually for all adults.

^f There was no age restriction for HbA1c testing, but the analysis was restricted to women with diabetes.

Table 3: Preventive Health Services Receipt and Odds Ratios (ORs) for Preventive Health Services Receipt by Intervention Subgroup

Preventive Health Services by Subgroups of Intervention ^a	Received preventive health service ^b n (%)	OR, Unadjusted (95% CI)	OR, Adjusted (95% CI)
Mammography^c			
Did nothing (n=1424)	379 (26.6)	Ref	-
Attended Pap screening only (n=150)	115 (76.7)	9.06 (6.10, 13.46)	-
Completed the kit (n=174)	96 (55.2)	3.39 (2.46, 4.68)	-
CRC screening^d			
Did nothing (n=1740)	262 (15.1)	Ref	Ref
Attended Pap screening only (n=232)	124 (53.4)	6.48 (4.85, 8.65)	5.76 (4.29, 7.73)
Completed the kit (n=217)	126 (58.1)	7.81 (5.79, 10.54)	7.22 (5.33, 9.77)
Influenza vaccination^e			
Did nothing (n=4997)	1455 (29.1)	Ref	-
Attended Pap screening only (n=1123)	499 (44.4)	1.95 (1.70, 2.22)	-
Completed the kit (n=963)	423 (43.6)	1.91 (1.66, 2.20)	-
Depression screening^f			
Did nothing (n=4997)	955 (19.1)	Ref	Ref
Attended Pap screening only (n=1123)	368 (32.8)	2.06 (1.79, 2.38)	1.85 (1.60, 2.14)
Completed the kit (n=963)	233 (24.2)	1.35 (1.15, 1.59)	1.24 (1.05, 1.46)
HbA1c testing^g			
Did nothing (n=398)	296 (74.4)	Ref	-
Attended Pap screening only (n=59)	53 (89.8)	3.04 (1.27, 7.29)	-
Completed the kit (n=57)	47 (82.5)	1.62 (0.79, 3.32)	-

^a The subgroups were defined by cervical cancer screening behavior in the 6 months after randomization.

^b Uptake of the preventive health services were assessed in the 12 months after randomization.

^c The model to assess mammography uptake was not adjusted for demographic covariates. The analysis was restricted to women who were between the ages of 52 and 64 years and not considered up to date per HEDIS.⁵¹

^d The model to assess CRC screening was adjusted for time since last Pap screening. The analysis was restricted to women who were between the ages of 51 and 64 years and not considered up to date per HEDIS.⁵²

^e The model to assess influenza vaccination uptake was not adjusted for demographic covariates. There was no age restriction for influenza vaccination uptake, as the service is recommended annually for all adults.

^f The model to assess depression screening uptake was adjusted for time since last Pap screening. There was no age restriction for depression screening uptake, as the service is recommended annually for all adults.

^g The model to assess HbA1c testing uptake was not adjusted for demographic covariates. There was no age restriction for HbA1c testing uptake, but the analysis was restricted to women with diabetes.

APPENDIX B

Supplement 1: *Demographic Covariates Assessed as Potential Confounders by Preventive Service^a*

Covariates adjusted ^b	Cervical cancer screening behavior	Mammography		CRC screening		Influenza vaccination		Depression screening	
		OR estimates	% change ^c	OR estimates	% change ^c	OR estimates	% change ^c	OR estimates	% change ^c
Unadjusted	Did nothing	ref	ref	ref	ref	ref	ref	ref	ref
	Attended Pap screening only	9.06	-	6.48	-	1.95	-	2.06	-
	Completed the kit	3.39	-	7.81	-	1.91	-	1.35	-
Age	Did nothing	ref	ref	ref	ref	ref	ref	ref	ref
	Attended Pap screening only	9.27	2.35%	6.51	0.43%	1.95	0.20%	2.06	-0.17%
	Completed the kit	3.43	1.20%	7.84	0.41%	1.91	-0.05%	1.35	0.05%
Race	Did nothing	ref	ref	ref	ref	ref	ref	ref	ref
	Attended Pap screening only	NA	NA	6.48	0.00%	1.94	-0.58%	2.05	-0.72%
	Completed the kit	NA	NA	7.82	0.06%	1.86	-2.52%	1.29	-4.27%
Duration of healthcare enrollment before randomization	Did nothing	ref	ref	ref	ref	ref	ref	ref	ref
	Attended Pap screening only	9.05	-0.15%	6.45	-0.34%	1.95	0.00%	2.06	0.04%
	Completed the kit	3.39	-0.09%	7.78	-0.39%	1.87	-2.01%	1.35	0.22%
Time since last Pap test (by length of enrollment)	Did nothing	ref	ref	ref	ref	ref	ref	ref	ref
	Attended Pap screening only	8.34	-7.90%	5.76	-11.09%	1.78	-8.68%	1.85	-10.21%
	Completed the kit	3.18	-6.39%	7.22	-7.56%	1.78	-6.78%	1.24	-8.28%
Women's US Census block median household income	Did nothing	ref	ref	ref	ref	ref	ref	ref	ref
	Attended Pap screening only	NA	NA	6.44	-0.52%	1.94	-0.44%	2.07	0.53%
	Completed the kit	NA	NA	7.79	-0.23%	1.90	-0.44%	1.36	1.00%
Charlson Comorbidity Index score ⁵⁴	Did nothing	ref	ref	ref	ref	ref	ref	ref	ref
	Attended Pap screening only	NA	NA	NA	NA	2.05	5.23%	2.16	4.71%
	Completed the kit	NA	NA	NA	NA	1.96	2.67%	1.37	1.53%

^a None of the covariates could be assessed as potential cofounders for HbA1c testing due to cell sizes less than five.

^b Covariates which could not be assessed due to cell sizes less than five are shown as NA.

^c Percent change comparing the adjusted OR estimate to the unadjusted OR estimate.

REFERENCES

1. CDC. CDC VitalSign: Cervical Cancer is Preventable. Centers for Disease Control and Prevention. Published January 6, 2020. Accessed May 28, 2020. <https://www.cdc.gov/vitalsigns/cervical-cancer/index.html>
2. Can Cervical Cancer Be Prevented | Ways to Prevent Cervical Cancer. Accessed May 28, 2020. <https://www.cancer.org/cancer/cervical-cancer/causes-risks-prevention/prevention.html>
3. Cervical Cancer Statistics | Key Facts About Cervical Cancer. Accessed May 28, 2020. <https://www.cancer.org/cancer/cervical-cancer/about/key-statistics.html>
4. White A, Thompson TD, White MC, et al. Cancer Screening Test Use — United States, 2015. *MMWR Morb Mortal Wkly Rep*. 2017;66(8):201-206. doi:10.15585/mmwr.mm6608a1
5. Cervical Cancer Screening. NCQA. Accessed May 28, 2020. <https://www.ncqa.org/hedis/measures/cervical-cancer-screening/>
6. Leyden WA, Manos MM, Geiger AM, et al. Cervical Cancer in Women With Comprehensive Health Care Access: Attributable Factors in the Screening Process. *JNCI J Natl Cancer Inst*. 2005;97(9):675-683. doi:10.1093/jnci/dji115
7. Kinney W, Sung HY, Kearney KA, Miller M, Sawaya G, Hiatt RA. Missed opportunities for cervical cancer screening of HMO members developing invasive cervical cancer (ICC). *Gynecol Oncol*. 1998;71(3):428-430. doi:10.1006/gyno.1998.5135
8. The screening histories of women with invasive cervical cancer, Connecticut - ProQuest. Accessed May 28, 2020. https://search-proquest-com.offcampus.lib.washington.edu/docview/215108490?rfr_id=info%3Axri%2Fsid%3Aprimomo
9. Oscarsson MG, Benzein EG, Wijma BE. Reasons for non-attendance at cervical screening as reported by non-attendees in Sweden. *J Psychosom Obstet Gynecol*. 2008;29(1):23-31. doi:10.1080/01674820701504619
10. Glasgow RE, Whitlock EP, Valanis BG, Vogt TM. Barriers to mammography and pap smear screening among women who recently had neither, one or both types of screening. *Ann Behav Med*. 2000;22(3):223. doi:10.1007/BF02895117
11. Eaker S, Adami H-O, Sparén P. Reasons Women Do Not Attend Screening for Cervical Cancer: A Population-Based Study in Sweden. *Prev Med*. 2001;32(6):482-491. doi:10.1006/pmed.2001.0844
12. Waller J, Bartoszek M, Marlow L, Wardle J. Barriers to cervical cancer screening attendance in England: a population-based survey: *J Med Screen*. Published online December 1, 2009. doi:10.1258/jms.2009.009073

13. Implementation of Systems Strategies for Breast and Cervical Cancer Screening Services in Health Maintenance Organizations. *AJMC*. Accessed May 28, 2020. <https://www.ajmc.com/journals/issue/2003/2003-11-vol9-n11/nov03-1683p745-755>
14. Schueler KM, Chu PW, Smith-Bindman R. Factors Associated with Mammography Utilization: A Systematic Quantitative Review of the Literature. *J Womens Health*. 2008;17(9):1477-1498. doi:10.1089/jwh.2007.0603
15. Wirth MD, Brandt HM, Dolinger H, Hardin JW, Sharpe PA, Eberth JM. Examining connections between screening for breast, cervical and prostate cancer and colorectal cancer screening. *Colorectal Cancer*. 2014;3(3):253-263. doi:10.2217/crc.14.18
16. Lea CS, Perez-Heydrich C, Des Marais AC, et al. Predictors of Cervical Cancer Screening Among Infrequently Screened Women Completing Human Papillomavirus Self-Collection: My Body My Test-1. *J Womens Health*. 2019;28(8):1094-1104. doi:10.1089/jwh.2018.7141
17. Kobetz E, Seay J, Koru-Sengul T, et al. A Randomized Trial of Mailed HPV Self-Sampling for Cervical Cancer Screening among Ethnic Minority Women in South Florida. *Cancer Causes Control CCC*. 2018;29(9):793-801. doi:10.1007/s10552-018-1055-7
18. Morgan K, Azzani M, Khaing SL, Wong Y-L, Su TT. Acceptability of Women Self-Sampling versus Clinician-Collected Samples for HPV DNA Testing: A Systematic Review. *J Low Genit Tract Dis*. 2019;23(3):193-199. doi:10.1097/LGT.0000000000000476
19. Carrasquillo O, Seay J, Amofah A, et al. HPV Self-Sampling for Cervical Cancer Screening Among Ethnic Minority Women in South Florida: a Randomized Trial. *J Gen Intern Med*. 2018;33(7):1077-1083. doi:10.1007/s11606-018-4404-z
20. Ilangovan K, Kobetz E, Koru-Sengul T, et al. Acceptability and Feasibility of Human Papilloma Virus Self-Sampling for Cervical Cancer Screening. *J Womens Health*. 2016;25(9):944-951. doi:10.1089/jwh.2015.5469
21. Abdullah NN, Daud S, Wang SM, Mahmud Z, Kornain NKM, Al-Kubaisy W. Human Papilloma Virus (HPV) self-sampling: do women accept it? *J Obstet Gynaecol*. 2018;38(3):402-407. doi:10.1080/01443615.2017.1379061
22. Ma'som M, Bhoo-Pathy N, Nasir NH, et al. Attitudes and factors affecting acceptability of self-administered cervicovaginal sampling for human papillomavirus (HPV) genotyping as an alternative to Pap testing among multiethnic Malaysian women. *BMJ Open*. 2016;6(8). doi:10.1136/bmjopen-2015-011022
23. Vanderpool RC, Jones MG, Stradtman LR, Smith JS, Crosby RA. Self-collecting a cervico-vaginal specimen for cervical cancer screening: An exploratory study of acceptability among medically underserved women in rural Appalachia. *Gynecol Oncol*. 2014;132(0 1):S21-S25. doi:10.1016/j.ygyno.2013.10.008

24. Crosby RA, Hagensee ME, Vanderpool R, et al. Community-Based Screening for Cervical Cancer: A Feasibility Study of Rural Appalachian Women. *Sex Transm Dis*. 2015;42(11):607-611. doi:10.1097/OLQ.0000000000000365
25. Smith JS, Des Marais AC, Deal AM, et al. Mailed Human Papillomavirus Self-Collection With Papanicolaou Test Referral for Infrequently Screened Women in the United States. *Sex Transm Dis*. 2018;45(1):42-48. doi:10.1097/OLQ.0000000000000681
26. Reiter PL, Shoben AB, McDonough D, et al. Results of a Pilot Study of a Mail-Based HPV Self-Testing Program for Underscreened Women from Appalachian Ohio. *Sex Transm Dis*. 2019;46(3):185-190. doi:10.1097/OLQ.0000000000000944
27. Madzima TR, Vahabi M, Lofters A. Emerging role of HPV self-sampling in cervical cancer screening for hard-to-reach women. *Can Fam Physician*. 2017;63(8):597-601.
28. Snijders PJF, Verhoef VMJ, Arbyn M, et al. High-risk HPV testing on self-sampled versus clinician-collected specimens: A review on the clinical accuracy and impact on population attendance in cervical cancer screening. *Int J Cancer*. 2013;132(10):2223-2236. doi:10.1002/ijc.27790
29. Marshall S, Vahabi M, Lofters A. Acceptability, Feasibility and Uptake of HPV Self-Sampling Among Immigrant Minority Women: a Focused Literature Review. *J Immigr Minor Health*. 2019;21(6):1380-1393. doi:10.1007/s10903-018-0846-y
30. Olusola P, Ousley K, Ndetan H, Singh KP, Banerjee HN, Dasgupta S. Cervical Cancer Prevention in Racially Disparate Rural Populations. *Medicines*. 2019;6(3). doi:10.3390/medicines6030093
31. Tranberg M, Bech BH, Blaakær J, Jensen JS, Svanholm H, Andersen B. HPV self-sampling in cervical cancer screening: the effect of different invitation strategies in various socioeconomic groups – a randomized controlled trial. *Clin Epidemiol*. 2018;10:1027-1036. doi:10.2147/CLEP.S164826
32. Tranberg M, Bech BH, Blaakær J, Jensen JS, Svanholm H, Andersen B. Preventing cervical cancer using HPV self-sampling: direct mailing of test-kits increases screening participation more than timely opt-in procedures - a randomized controlled trial. *BMC Cancer*. 2018;18. doi:10.1186/s12885-018-4165-4
33. González P, Borrayo EA. Role of Physician Involvement on Latinas' Mammography Screening Adherence. *Womens Health Issues Off Publ Jacobs Inst Womens Health*. 2011;21(2):165-170. doi:10.1016/j.whi.2010.09.001
34. Immunization and Moral Hazard: The HPV Vaccine and Uptake of Cancer Screening - Ali Moghtaderi, Avi Dor., Accessed May 7, 2020. <https://journals.sagepub.com/doi/abs/10.1177/1077558719847887?journalCode=mcrd>

35. Kang SK, Jiang M, Duszak R, Heller SL, Hughes DR, Moy L. Use of Breast Cancer Screening and Its Association with Later Use of Preventive Services among Medicare Beneficiaries. *Radiology*. 2018;288(3):660-668. doi:10.1148/radiol.2018172326
36. Bertaut A, Coudert J, Bengrine L, Dancourt V, Binquet C, Douvier S. Does mammogram attendance influence participation in cervical and colorectal cancer screening? A prospective study among 1856 French women. *PLoS ONE*. 2018;13(6). doi:10.1371/journal.pone.0198939
37. Guo F, Hirth JM, Berenson AB. Human Papillomavirus Vaccination and Pap Smear Uptake Among Young Women in the United States: Role of Provider and Patient. *J Womens Health*. 2017;26(10):1114-1122. doi:10.1089/jwh.2017.6424
38. Williams WW, Lu P-J, Saraiya M, et al. Factors associated with human papillomavirus vaccination among young adult women in the United States. *Vaccine*. 2013;31(28):2937-2946. doi:10.1016/j.vaccine.2013.04.041
39. Carlos RC, Fendrick AM, Patterson SK, Bernstein SJ. Associations in breast and colon cancer screening behavior in women. *Acad Radiol*. 2005;12(4):451-458. doi:10.1016/j.acra.2004.12.024
40. Carlos RC, Fendrick AM, Ellis J, Bernstein SJ. Can breast and cervical cancer screening visits be used to enhance colorectal cancer screening? *J Am Coll Radiol*. 2004;1(10):769-776. doi:10.1016/j.jacr.2004.05.018
41. Shapiro JA, Seeff LauraC, Nadel MarionR. Colorectal cancer-screening tests and associated health behaviors. *Am J Prev Med*. 2001;21(2):132-137. doi:10.1016/S0749-3797(01)00329-4
42. Winer RL, Tiro JA, Miglioretti DL, et al. Rationale and design of the HOME trial: A pragmatic randomized controlled trial of home-based human papillomavirus (HPV) self-sampling for increasing cervical cancer screening uptake and effectiveness in a U.S. healthcare system. *Contemp Clin Trials*. 2018;64:77-87. doi:10.1016/j.cct.2017.11.004
43. Bowles EJA, Gao H, Brandzel S, Bradford SC, Buist DSM. Comparative effectiveness of two outreach strategies for cervical cancer screening. *Prev Med*. 2016;86:19-27. doi:10.1016/j.ypmed.2016.01.016
44. Buist DSM, Gao H, Anderson ML, et al. Breast cancer screening outreach effectiveness: Mammogram-specific reminders vs. comprehensive preventive services birthday letters. *Prev Med*. 2017;102:49-58. doi:10.1016/j.ypmed.2017.06.028
45. Preventive-Care Outreach | Kaiser Permanente Washington. Accessed May 31, 2020. <https://wa.kaiserpermanente.org/healthAndWellness/index.jhtml?item=%2Fcommon%2FhealthAndWellness%2FcareDecisions%2FyourCare%2Freminders.html>
46. Winer RL, Lin J, Tiro JA, et al. Effect of Mailed Human Papillomavirus Test Kits vs Usual Care Reminders on Cervical Cancer Screening Uptake, Precancer Detection, and Treatment:

A Randomized Clinical Trial. *JAMA Netw Open*. 2019;2(11):e1914729-e1914729.
doi:10.1001/jamanetworkopen.2019.14729

47. Comprehensive Diabetes Care. NCQA. Accessed May 28, 2020.
<https://www.ncqa.org/hedis/measures/comprehensive-diabetes-care/>
48. Sherwani SI, Khan HA, Ekhzaimy A, Masood A, Sakharkar MK. Significance of HbA1c Test in Diagnosis and Prognosis of Diabetic Patients. *Biomark Insights*. 2016;11:95-104.
doi:10.4137/BMI.S38440
49. Hemoglobin A1C (HbA1c) Test: MedlinePlus Lab Test Information. Accessed May 11, 2020. <https://medlineplus.gov/lab-tests/hemoglobin-a1c-hba1c-test/>
50. CDC. All About Your A1C. Centers for Disease Control and Prevention. Published August 21, 2018. Accessed May 11, 2020. <https://bit.ly/2Nc2IA0>
51. Breast Cancer Screening. NCQA. Accessed May 11, 2020.
<https://www.ncqa.org/hedis/measures/breast-cancer-screening/>
52. Colorectal Cancer Screening. NCQA. Accessed May 11, 2020.
<https://www.ncqa.org/hedis/measures/colorectal-cancer-screening/>
53. Lee PH. Is a Cutoff of 10% Appropriate for the Change-in-Estimate Criterion of Confounder Identification? *J Epidemiol*. 2014;24(2):161-167. doi:10.2188/jea.JE20130062
54. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *J Chronic Dis*. 1987;40(5):373-383. doi:10.1016/0021-9681(87)90171-8
55. Onega T, Duell EJ, Shi X, Wang D, Demidenko E, Goodman D. Geographic access to cancer care in the U.S. *Cancer*. 2008;112(4):909-918. doi:10.1002/cncr.23229
56. Oancea SC, Watson IW. The association between history of screening for cancer and receipt of an annual flu vaccination: Are there reinforcing effects of prevention seeking? *Am J Infect Control*. 2019;47(11):1309-1313. doi:10.1016/j.ajic.2019.05.009
57. Lo SH, Waller J, Wardle J, von Wagner C. Comparing barriers to colorectal cancer screening with barriers to breast and cervical screening: a population-based survey of screening-age women in Great Britain. *J Med Screen*. 2013;20(2):73-79. doi:10.1177/0969141313492508
58. Casey JA, Schwartz BS, Stewart WF, Adler NE. Using Electronic Health Records for Population Health Research: A Review of Methods and Applications. *Annu Rev Public Health*. 2016;37:61-81. doi:10.1146/annurev-publhealth-032315-021353
59. Hill AB. The Environment and Disease: Association or Causation? *Proc R Soc Med*. 1965;58(5):295-300.

60. Rothman KJ, Greenland S. Causation and Causal Inference in Epidemiology. *Am J Public Health*. 2005;95(S1):S144-S150. doi:10.2105/AJPH.2004.059204