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Breast Cancer Screening Outreach Effectiveness: mammogram-specific reminders vs. comprehensive preventive services birthday letters

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Abstract

We compared the effectiveness of two outreach strategies on timely mammography adherence: a mammogram-specific reminder letter (sent just before a woman was due) to a birthday letter (addresses multiple preventive services and not timed around due dates). We evaluated screening mammography adherence following 79,848 mammogram-specific and 151,626 birthday letters mailed between 2002–2012 to women aged 40–74 years enrolled in Kaiser Permanente Washington. Screening mammogram adherence was specifically tied to due-date and was evaluated separately by age group and up-to-date or overdue status at the time of mailing. We used generalized estimating equations to account for correlation between repeated observations, to model the odds of screening mammography adherence by letter type. Among women up-to-date, adherence following birthday letters was 22–76% lower compared to the mammogram-specific reminders, with the greatest decreases in adherence in women aged 70–74. Birthday letters were more effective at activating screening uptake among some subgroups of overdue women aged 50–69 and most overdue women aged 70–74, but universally low adherence rates were observed in overdue women. Increasing number of recommended services for women aged 50–74 who were up-to-date resulted in 12–17% lower mammography adherence, but had no effect in women aged 40–49 or in overdue women. Birthday letters are less effective than mammogram-specific reminder letters at prompting women to undergo timely breast cancer screening, particularly among women up-to-date with screening. Birthday letters may be effective at increasing overall preventive care; however, supplemental outreach may be needed around the due date to increase timely preventive services receipt.

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Keywords

preventive services; reminder letters; adherence; preventive care; outreach; screening programs; breast cancer screening

Introduction

Outreach and reminders are effective at activating women to receive screening mammograms.¹ Population-based cancer screening effectiveness rests on individuals' initial and continued participation in screening.^{2,3} However, much of health care in the US is provided without sufficient coordination, leading to over- and under-use of preventive services. This is particularly true for screening that needs to be provided at different intervals, tailored to individuals' risk, and tied to previous screening test results in order to achieve optimal participation. Reminder letters have been shown to improve screening participation,^{4–13} but evidence gaps exist in understanding the efficiency and effectiveness of different types of reminder letters and their timing on screening adherence. Understanding how to provide personalized, proactive cancer screening outreach that reminds individuals at the appropriate time to receive the most effective test is an important area of inquiry to maximize cancer screening adherence.

Kaiser Permanente Washington (formerly Group Health Cooperative) is a mixed-model delivery system in Washington State, providing health care and insurance to >640,000 individuals. It has had a population-based breast cancer screening program since 1985, which has provided risk-based tailored reminder letters to women for screening mammography.^{14–20} Starting in 2007, our preventive-care outreach strategy shifted to an annual personalized letter sent around a woman's birthday. The "birthday" letter includes a list of all upcoming recommended preventive care services, including mammography, and their corresponding due dates.

Our transition from mammography-specific reminders to person-centered reminders offered a unique opportunity to evaluate the effectiveness of mammography-specific reminder letters compared to person-centered birthday reminder letters on mammography screening adherence. In this report, we expand on a prior analysis conducted in a subset of this study population²¹ to include longer follow-up, age stratification and new analytic approaches including a regional comparison population.

Methods

We evaluated the effectiveness of two distinct outreach programs on screening mammography adherence by evaluating a system-based programmatic change among women enrolled in Kaiser Permanente Washington's integrated delivery system. Our cohort included women aged 40–74 years, who were *due for a screening mammogram* and received an outreach letter between 2005 and 2012. Women were required to be continuously enrolled from the date the reminder letter was sent through the mammogram due date, to ensure outcome measurement. This study was approved by our Institutional Review Board with a waiver of consent.

Our population-based breast cancer screening reminder program^{14–18} sent mammogram-specific reminders 4-months before a woman's mammogram was due with different screening reminders for higher and lower-risk women (Appendix A). Evidence-based screening guidelines are updated on a routine basis.²² Screening recommendations during the study period were aligned with recommendations from the US Preventive Services Task Force. Between 2007–2008, we transitioned to personalized birthday letters, signed by patients' primary care provider, sent about two-weeks before the patient's birthday with due dates for recommended clinical screenings and preventive care services, including mammography (Appendix B). Each birthday letter includes up to 7 service recommendations tailored to individuals by age, gender, and comorbidities (e.g., HbA1c testing for diabetics). Birthday letters contain a table with breast cancer risk factors and recommended screening intervals for women with different characteristics. Higher risk women (based on previously collected risk factors and based on our guidelines e.g., personal and family breast and ovarian cancer, radiation therapy to the chest²²) were recommended to receive annual screening and were provided with one due date in their birthday letter. Lower risk women were provided two potential due dates to choose between corresponding to 1-year and 2-years after their last mammogram (women choose their own screening interval) (Appendix C). If a last mammogram was more >2 years prior or there was no mammogram on record, the birthday letter would instead list "due now".

Reminder letter was our unit of analysis, with a separate observation for each time a woman was sent a letter indicating she was due for a mammogram (Figure 1). A total of 444,600 letters were sent to 109,639 women from 2005–2012 (Figure 2). We excluded letters sent during the transition period between when birthday letters started (April 2007) and mammogram-specific letters ended (March 2009), when women could receive both reminders for the same due date. We excluded: multiple letters sent within 6-months of each other, women with insufficient enrollment time to define adherence, and letters with incorrect due dates. Our final sample included 231,474 letters received by 96,300 unique women.

We expected screening mammography adherence to be related to a woman's up-to-date status^{23,24} and age;²¹ therefore, all analyses were stratified by adherence with last mammography recommendation and age (40–49, 50–69 and 70–74 years). Up-to-date letters (N=143,564) were sent to women who had a screening mammogram in the previous 12–24 months. Overdue letters (N=87,910) included combination of women who did not have a mammogram in the previous 12–24 months or who never had a prior mammogram.

Screening adherence was defined based on screening mammogram receipt²⁵ within a 6-month window specifically timed to the due-date indicated in the reminder letter. All overdue women had 6-months from the letter to complete screening, regardless of letter type (Figures 1c, 1d). Adherence timing windows for women up-to-date with screening depended on letter type. Up-to-date women receiving a mammogram letter had 6-months from the time of the letter to complete screening, since the letter was timed relative to the due date (Figure 1a). Among up-to-date women, birthday letters for high-risk women were adherent if they completed screening during the 3-months before or after their due date (Figure 1b). Lower risk women, were considered adherent if they completed screening during the 3-

months before or after the first or second due date. If they received screening in the first interval, they were considered adherent and not followed for another year; however, if they did not receive screening in the first interval they were able to become adherent by having their mammogram during the second eligible period. The allowance of two adherence windows for up-to-date women receiving the birthday letter biases the analysis toward birthday letter effectiveness. Mammograms received outside the 6-month windows were not considered adherent.

Demographic and risk factor data were collected from self-reported data.^{14,15,18,20} We used administrative, diagnostic and procedure data²⁶ to calculate Charlson Comorbidity Index⁶ at each letter; health care interactions including primary care, well care, and OB/GYN visits in the 12-months before the letter; number of recommended preventive services; and insurance benefits (e.g., preventive care waiver covering all preventive services in full and/or a high annual deductible >\$500). We used Network Analyst (ArcInfo v 9.1) to calculate travel time from each woman's address to their primary care and mammography facility using geographic centroids of census blocks and geocoded street address.²⁷

To address the potential that temporal trends in mammography screening could confound our results, we compared trends in Kaiser Permanente Washington's Healthcare Effectiveness Data and Information Set²⁸ (HEDIS) mammography rates to Washington State rates.²⁹ HEDIS rates include the percentage of woman aged 52–69 who received 1 screening mammogram over the past 2-years (except 7/2013–6/2014, which included women aged 50–74 because of HEDIS measure changes³⁰) providing directly comparable estimates of regional trends in mammography screening rates.

Analysis

Each letter was included as a separate observation. We reported the proportion adherent, and used logistic regression to model the odds of adherence for women receiving a birthday letter compared to a mammogram-specific reminder. Generalized estimating equations with an independence working correlation structure was used to account for correlation among repeated observations within a woman and non-nested clustering within primary care providers.³¹ Separate models were fit for each strata defined by age group and up-to-date status, adjusting for age continuously.³² To explore effect modification, we also estimated the relative odds of adherence by letter type by further stratifying by participant characteristics.

Differences in HEDIS rates were tested by fitting a modified Poisson regression model that assumed a log-linear relationship with time including an interaction term between group and time, to allow separate time trends by group.

All analyses were conducted using SAS (Cary, NC).

Results

Letters to women up-to-date with screening represented 62.0% of the overall study population. (Figure 2). The majority of the study population was aged 50–69 (66.5%),

followed 40–49 (24.7%) and 70–74 (8.9%) (Table 1). Women aged 50–69 were more likely to be up-to-date (65.9%), followed by 70–74 (60.8%) and 40–49 (52.1%). Most women had a health care visit in the 12-months before their reminder letter, with greater proportions among up-to-date women across all age groups. Approximately 75% of women live within 15-minutes of a Kaiser Permanente Washington primary care clinic and 20-minutes of a mammography facility. Regardless of age, overdue women were more commonly overweight and had fewer healthcare interactions than women receiving up-to-date letters; there were no differences observed within age groups for Charlson comorbidity.

Mammogram letters generally resulted in higher adherence when compared with the birthday letter, with important adherence differences by up-to-date status and age (Tables 2a–2c; Appendix D). Adherence was significantly higher among up-to-date compared to overdue women regardless of age group or letter type.

For women in their 40s, we observed clinically and statistically significant lower adherence across all risk factors following the birthday letter implementation (54.5%) compared to the mammogram-specific letter (62.8%), except among peri-menopausal women, women with a prior breast cancer, and women with a Charlson score ≥ 3 (Table 2a). We generally observed the same patterns of adherence by risk factor between the two letter types. There was no notable trend in mammography adherence by number of recommended preventive services. Very few women in their 40s had no health care visit in the year before their reminder letter; adherence was much lower for these women regardless of reminder type.

Although adherence differences were statistically significant in women aged 50–69 (67.2% mammogram, 62.4% birthday) the magnitude of the differences were substantially smaller compared to younger and older women (except for Charlson ≥ 3 and 0–1 health care visits in the last year) (Table 2b). Adherence decreased with additional preventive services recommended from 67.1% for 1–2 services to 59.0% for 6–7 services.

We observed the greatest difference in adherence between outreach strategies among older women aged 70–74 years (77.3% mammogram vs. 44.7% birthday; OR 0.24; 95% CI 0.22–0.26) (Table 2c). Adherence patterns differed from younger age groups with less variability between risk factor categories. Adherence increased with more health system visits, but letter effectiveness did not differ. Adherence decreased with increasing number of preventive services from 46.3% for 1–2 to 38.8% for 6–7 services. Adherence increased most markedly in the years following the birthday letter implementation in these women from 40.1% in 2009 to 51.6% by 2012.

Letter effectiveness was more variable in overdue women with different patterns by age (Tables 2a–2c). For women aged 40–49, adherence was higher (OR 0.51; 95% CI 0.48–0.55) with the mammogram letter (28.3%) compared with the birthday letter (16.7%) (Table 2a). The birthday letter yielded greater adherence variability across risk factors than the mammogram letter. Adherence was universally low in women with limited health care engagement before letter receipt and was unaffected by number of recommended preventive services.

Overdue women aged 50–69 had low adherence rates regardless of reminder type, but slightly higher adherence following the birthday letter (16.9% vs. 19.6%) (Table 2b). Although there were several differences in adherence by letter between risk factor categories, few were clinically significant. Adherence was unaffected by number of recommended preventive services.

Birthday letters resulted in the greatest adherence improvement in overdue women aged 70–74 (15.8% mammogram vs. 22.9% birthday; OR 1.59; 95% CI 1.39–1.82). There were no differences in adherence by reminder type between risk factor categories. There was a slight reduction in mammography adherence with a greater number of recommended preventive services from 24.2% for 1–2 services to 17.2% for 6–7 services.

Screening mammography time trends significantly differed between Kaiser Permanente Washington and Washington State. There was a significant annual decline observed in Washington State for screening adherence (RR 0.989; 95% CI: 1.006–1.012) compared to the previous year, and an increasing trend within Kaiser Permanente Washington (RR 1.009; 95% CI: 1.006–1.012) during the same time period (Figure 3). Despite our observed lower mammography adherence following the birthday letter, we did not observe any decrease in Kaiser Permanente Washington's mammography HEDIS rates over the study period.

Discussion

Healthcare delivery systems in the U.S. are facing unprecedented opportunities to improve efficiency, performance, and access; national policymakers have identified promoting cost-effective clinical preventive services and health promotion interventions as a priority. Our birthday letter was designed to be a cost-effective strategy for promoting overall prevention including mammography. This analysis expands on our prior report²¹ evaluating the comparative effectiveness of a mammogram-specific reminder to a birthday letter that included 48,583 women aged 52–74, where we reported significant reductions in mammogram adherence associated with the birthday letter. Our prior analysis had important constraints with limited follow-up time after the transition, no age stratification, and no regional comparator to ensure our declines in adherence were not confounded by mammography temporal trends. Our current study also demonstrated important reductions (22–76%) in mammography screening adherence following a change from mammogram-specific screening reminders to annual preventive care reminders timed around a woman's birthday, with the smallest differences observed in women aged 50–69. The greatest adherence decrease was observed in up-to-date women aged 70–74, the group of women who likely had the greatest exposure to mammography letters. Annual birthday preventive care reminders were more effective at activating screening among some subgroups of overdue women aged 50–69 and most overdue women aged 70–74, but not in women aged 40–49. There were universally low adherence rates in overdue women across age group, which supports identifying additional effective outreach strategies for prevention among this population. We transitioned to a birthday letter to facilitate a whole-person approach to preventive services. More US physician practices are adopting new integrated care approaches.^{33,34} We examined independent variable in relation to adherence³⁵ including

predisposing factors (e.g., risk/demographics) and enabling factors (e.g., insurance generosity/distance to mammography facility). Reminder letters recommending all preventive services together was designed to increase convenience and reduce logistical barriers compared to a series of disease-specific letters throughout the year. They can also provide a cue to action that can increase individual participation in preventive services³⁵, perhaps through increasing perceived susceptibility by associating the reminder with individual's aging (i.e., birthday).³⁶ However, receiving multiple recommendations at once could result in differential activation. Our analysis exploring time to mammography receipt emphasizes that tying reminders to due dates may be critical for ensuring appropriate uptake of timely preventive services. Birthday letters during this time period included up to 7 recommended preventive services with different due dates for each service including some services that may not be due for several years. Our evaluation of mammography screening uptake relative to the recommended due date provides support that regardless of age, up-to-date women will choose to receive their mammograms around their due-date. Overdue women will have an initial group of women who come in right away with letter effectiveness quickly tapering off, also emphasizing the need for additional outreach strategies for these individuals. While there was some evidence of reduced birthday letter effectiveness with a greater number of recommended preventive services, the letters still activated women with to receive their mammogram even when they had 7 preventive services recommended. We were unable to evaluate the uptake of other recommended preventive services to evaluate whether there was differential activation around other important preventive services. Our previous analysis on birthday letter effectiveness on cervical cancer screening adherence found no differences in Pap test adherence by the number of recommended preventive services in the birthday letter; however that was conducted in a younger population (ages 20–65) who may have had fewer recommendations overall.³⁷

Small declines in mammography adherence since 2000 have been reported in the US^{38–41} and mixed results followed the 2009 USPSTF changes in screening recommendations;^{42–45} however, recent HEDIS rates suggest modest screening increases in the US.⁴⁶ We compared regional HEDIS rates over time within our population to the underlying Washington State community to help rule out temporal mammography trends as the underlying mechanism of our observed adherence rates. Our regional comparison suggests that Kaiser Permanente Washington's mammography HEDIS rates were rising during the study period, which is in opposition to the declining adherence we observed with the birthday letter. This study was designed to examine timely screening activation following reminders; therefore, our adherence rates were directly tied to due dates women received in their reminder letters. Our study adherence measures should not be considered HEDIS-comparable, nor should they be used for comparison as overall rates of screening adherence. For example, women who received screening mammography outside our 6-month adherence window likely would have counted towards HEDIS adherence, but were considered non-adherent for our analysis. Women aged 40–51 and 70–74 are not included in HEDIS rates (except 7/2013–6/2014, which included women aged 50–74). Annual adherence did not demonstrate important changes in adherence by year following the birthday letter for women aged 40–49, but did suggest important increases by year in women aged 70–74, suggesting there could be some temporal changes in adherence by age in older women. Our study population is

representative of our state and has comparable age distributions to US women. Among US women aged 40–74, 34% are aged 40–49, 58% 50–69 and 8% 70–74 years vs. our observed distribution in this study (25%, 67% and 9%, respectively).⁴⁷ We anticipated the observed proportion of women aged 40–49 in our study population would be less than the observed proportion of women in this age group in the US, because not all women in this age group are recommended to receive screening mammograms.

Our findings demonstrated higher adherence among women with more exposure to health care, as measured by increased encounters, but little difference in adherence among women with a preventive care waiver. With the Affordable Care Act⁴⁸ providing full preventive services coverage,⁴⁹ it will be important to continue to seek out effective preventive care outreach strategies, which likely includes different strategies for different populations including multiple strategies among women who are overdue.⁵⁰

Different time intervals between the date the letter was mailed and the mammogram due date is a fundamental difference between the two reminder systems and may contribute to observed differences in adherence. Lower-risk, up-to-date women potentially had two periods to be adherent based on their choice for a one or two year screening interval, which would bias our results in favor of the birthday letter. It is unlikely a birthday letter sent 20-months before a woman was due for a mammogram would result in adherence during that time interval and more likely that the second birthday letter reminder proximal to the 20-month time frame resulted in activation—both birthday letters would have received adherence credit in this situation. However, this type of variability reflects the true nature of the person-centered prevention programs. Any analyses examining fundamentally different outreach strategies will have comparable complexities. Since our objective was to determine if adherence differed between the two reminder types, it was important to allow the same minimum amount of time for women to adhere to the recommendation and to allow the maximum follow-up times to vary based on the reminder system protocol.

We were unable to measure cognitive/affecting factors⁵¹ such as beliefs and values before or after the birthday letter transition with this analysis. However, we were able to conduct 11 focus groups with 66 women (21–75 years) to understand motivators and barriers to obtaining cancer screening and preferences about reminders following the birthday letter roll out; no single optimal strategy was identified.^{52,53} Differences by age and health beliefs drove participants' screening choices and reminder preferences. The importance of personalized, proactive outreach may have been inadvertently reduced with the birthday letter, but could be substantially increased with a better understanding of what works for mammography outreach for different women. Given comparable costs associated with the mammogram and birthday letters, the birthday letter may still be a cost effective way of improving preventive health more broadly, but may also require additional outreach more proximal to each preventive service through efficient systems such as interactive voice recognition.⁵⁴ Successful reminders require a health care system to be nimble enough to use a multi-faceted approach that allows customization.^{52,53}

While a population-based randomized trial comparing outreach strategies would be ideal, it would require an extremely large sample, long follow-up, and substantial funding. Natural

history studies provide opportunities to explore the effectiveness of innovations without the cost of conducting a prospective randomized trial. Having an external comparison between Kaiser Permanente Washington and Washington State HEDIS mammography rates provides strong evidence our findings are not confounded by temporal declines in mammography.

Conclusion

Despite them having some potential benefits, annual preventive services reminder letters are less effective than mammogram-specific reminder letters at prompting women to undergo timely breast cancer screening particularly among women up-to-date with screening, with the greatest difference observed in women aged 40–49 and 70–74 years. It is likely that additional outreach is needed around the due date to increase screening uptake. Health systems may need to learn more about how to personalize the type and timing of outreach for individuals in order to maximize cancer screening adherence.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Screening Reminder Type

Figure 1.

Definitions for screening mammography adherence by reminder letter type for up-to-date and overdue women who are enrolled in Kaiser Permanente Washington between 2002–2012

Figure 2.

Number of letters (number of women^a) by up-to-date or overdue status at mailing; stratified by letter type (mammogram vs. birthday) and age (Letters sent to women who are enrolled in Kaiser Permanente Washington between 2002–2012)

^anumber of women in each group are not mutually exclusive

Figure 3. Breast cancer screening HEDIS rates^a and associated 95% confidence intervals for Washington state and Kaiser Permanente Washington 2008–2014

^aHealthcare Effectiveness Data and Information Set²⁸ (HEDIS) rates defined as percentage of woman aged 52–69 who received 1 screening mammogram over the past 2 years (except for the period 7/2013–6/2014, which included women aged 50–74 because of HEDIS measure changes)³⁰

Table 1

Characteristics of women by reminder letter type (mammography letter (ML) vs. birthday letter (BL)), stratified by age and up-to-date status who are enrolled in Kaiser Permanente Washington between 2002–2012

	40–49 (24.7% of the study sample)			50–69 (66.5% of the study sample)			70–74 (8.9% of the study sample)		
	Up to date		Overdue	Up to date		Overdue	Up to date		Overdue
	ML	BL	ML	BL	ML	BL	ML	BL	ML
	10,427	19,365	6,319	21,048	39,079	62,233	16,343	36,163	5,981
Column ^a %									
Race									
White	79.3	73.0	78.5	71.9	84.3	82.3	82.0	88.6	87.7
Not White	20.7	27.0	21.5	28.1	15.7	17.7	18.0	11.4	12.3
Unknown	[1.2]	[2.2]	[6.3]	[14.7]	[1.7]	[1.5]	[14.3]	[0.3]	[0.4]
Ethnicity									
Hispanic	4.4	5.5	4.6	5.5	3.2	3.2	3.6	4.2	2.3
Not Hispanic	95.6	94.5	95.4	94.5	96.8	96.8	96.4	95.8	97.5
Unknown	[0.5]	[1.3]	[5.3]	[12.5]	[1.4]	[1.0]	[11.2]	[0.2]	[0.2]
Education									
HS or less	12.7	14.0	15.4	17.2	16.2	14.5	21.2	17.0	25.8
Some college	32.1	31.6	37.3	34.3	35.3	33.7	40.5	37.5	35.1
College Grad	30.7	30.2	26.2	28.4	21.6	24.2	19.9	22.9	13.2
Post-College	24.5	24.2	21.1	20.2	26.9	27.6	18.5	22.7	15.1
Unknown	[4.6]	[8.4]	[48.0]	[70.7]	[7.1]	[6.7]	[63.9]	[51.9]	[2.6]
BMI (kg/m2)									
<25	39.3	37.0	35.1	34.1	31.7	31.6	26.1	27.7	31.4
25–29.9	28.3	27.5	25.6	26.6	31.0	30.5	28.1	28.4	34.3
30+	32.4	35.5	39.3	39.3	37.4	37.9	45.8	43.9	33.1
Unknown	[1.3]	[1.4]	[13.9]	[10.6]	[2.9]	[1.3]	[26.4]	[10.7]	[0.2]
Menopausal Status									
Pre	75.8	89.9	81.0	89.2	8.2	10.8	3.9	6.2	0.0
Peri	13.6	0.5	10.2	2.7	5.8	0.3	2.0	0.6	0.0

	40–49 (24.7% of the study sample)						50–69 (66.5% of the study sample)						70–74 (8.9% of the study sample)					
	Up to date			Overdue			Up to date			Overdue			Up to date			Overdue		
	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL
Post	10.6	9.6	6,319	21,048	39,079	62,233	16,343	36,163	5,624	6,836	2,056	5,981	10.6	9.6	6,319	21,048	39,079	62,233
Unknown	[12.9]	[16.5]	[73.7]	[75.4]	[7.5]	[6.5]	[22.6]	[16.6]	[0.0]	[0.0]	[0.0]	[0.0]	[12.9]	[16.5]	[73.7]	[75.4]	[7.5]	[6.5]
Family History of Breast Cancer																		
None	50.2	56.3	58.6	53.0	55.7	55.0	62.3	51.5	56.9	55.2	65.2	52.5	50.2	56.3	58.6	53.0	55.7	55.0
First-degree	20.6	16.8	14.4	21.0	22.7	21.8	19.5	27.3	28.3	25.3	22.6	29.3	20.6	16.8	14.4	21.0	22.7	21.8
Second-degree	29.2	26.9	27.0	26.0	21.6	23.2	18.2	21.2	14.8	19.5	12.2	18.2	29.2	26.9	27.0	26.0	21.6	23.2
Unknown	[11.4]	[15.9]	[54.1]	[73.8]	[12.7]	[12.6]	[67.6]	[56.4]	[7.8]	[10.4]	[62.2]	[42.7]	[11.4]	[15.9]	[54.1]	[73.8]	[12.7]	[12.6]
Breast cancer history																		
Yes	4.2	1.9	1.1	0.5	8.9	6.1	3.7	2.3	16.0	13.2	7.8	4.8	4.2	1.9	1.1	0.5	8.9	6.1
No	95.8	98.1	98.9	99.5	91.1	93.9	96.3	97.7	84.0	86.8	92.2	95.2	95.8	98.1	98.9	99.5	91.1	93.9
Prior Breast biopsy																		
Yes	16.7	12.7	8.6	15.9	25.3	23.0	18.0	26.2	34.3	31.2	23.3	31.5	16.7	12.7	8.6	15.9	25.3	23.0
No	83.3	87.3	91.4	84.1	74.7	77.0	82.0	73.8	65.7	68.8	76.7	68.5	83.3	87.3	91.4	84.1	74.7	77.0
Unknown	[4.2]	[8.1]	[47.5]	[70.4]	[6.8]	[6.4]	[63.5]	[51.6]	[1.9]	[2.3]	[57.0]	[35.6]	[4.2]	[8.1]	[47.5]	[70.4]	[6.8]	[6.4]
Charlson Comorbidity Score																		
0	84.8	84.4	87.0	87.4	75.8	73.5	77.2	75.6	61.5	56.6	62.7	54.2	84.8	84.4	87.0	87.4	75.8	73.5
1	9.8	10.8	9.4	9.4	13.6	14.4	13.5	13.6	18.3	16.9	17.8	17.7	9.8	10.8	9.4	9.4	13.6	14.4
2	4.1	3.3	2.7	2.1	7.3	7.5	5.6	6.0	12.6	13.4	10.4	12.3	4.1	3.3	2.7	2.1	7.3	7.5
3+	1.3	1.5	0.9	1.0	3.2	4.6	3.7	4.8	7.6	13.0	9.2	15.9	1.3	1.5	0.9	1.0	3.2	4.6
Health care visit in Health care visit in past 12 months																		
0	18.4	19.0	29.4	36.5	16.9	17.5	37.5	35.4	10.8	10.0	27.8	20.8	18.4	19.0	29.4	36.5	16.9	17.5
1	16.7	18.0	19.1	20.4	15.3	17.9	17.6	19.8	13.2	15.2	16.0	18.5	16.7	18.0	19.1	20.4	15.3	17.9
2+	64.9	63.0	51.6	43.1	67.9	64.6	45.0	44.8	76.1	74.8	56.3	60.8	64.9	63.0	51.6	43.1	67.9	64.6
Primary care visit in past 12 months																		
0	19.8	21.3	30.3	38.0	17.8	18.9	37.9	36.1	11.1	10.7	28.0	21.4	19.8	21.3	30.3	38.0	17.8	18.9
1	26.4	28.4	24.6	26.6	23.4	26.9	21.1	24.5	17.4	21.2	18.1	21.7	26.4	28.4	24.6	26.6	23.4	26.9
2+	53.8	50.3	45.0	35.4	58.8	54.2	41.1	39.3	71.5	68.1	53.8	56.9	53.8	50.3	45.0	35.4	58.8	54.2

	40–49 (24.7% of the study sample)						50–69 (66.5% of the study sample)						70–74 (8.9% of the study sample)					
	Up to date			Overdue			Up to date			Overdue			Up to date			Overdue		
	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL
Well care visit in past 12 months	10,427	19,365	6,319	21,048	39,079	62,233	16,343	36,163	5,624	6,836	2,056	5,981						
0	65.3	66.7	79.9	82.6	66.4	68.7	87.6	85.0	74.2	73.5	89.6	86.0						
1+	34.7	33.3	20.1	17.4	33.6	31.3	12.4	15.0	25.8	26.5	10.4	14.0						
GYN/OB visit in 12 months																		
0	83.8	85.9	91.7	93.4	88.5	89.7	96.5	95.9	97.2	97.1	99.3	99.2						
1+	16.2	14.1	8.3	6.6	11.5	10.4	3.5	4.1	2.8	2.9	0.7	0.8						
Number recommended preventive services in birthday letter																		
1–2		83.7		85.8		30.7		26.1		80.8		75.9						
3–5		12.1		10.0		58.7		61.5		3.3		4.0						
6–8		4.2		4.3		10.6		12.4		16.0		20.1						
Preventive Care Waiver																		
Yes	72.3	80.7	71.9	82.7	77.6	86.0	75.6	86.4	91.8	93.8	90.7	94.8						
No	27.7	19.3	28.1	17.4	22.4	14.0	24.4	13.6	8.2	6.2	9.3	5.2						
Deductible >\$500 annually																		
Yes	5.5	9.1	5.4	13.7	5.8	9.2	6.1	12.6	0.1	0.5	0.1	1.1						
No	94.5	90.9	94.6	86.4	94.2	90.8	93.9	87.4	99.9	99.5	99.9	98.9						
Travel time to Primary care clinic																		
<5 min	14.9	16.1	16.4	18.2	15.9	16.4	17.9	18.2	18.5	18.1	19.6	19.3						
5–10 min	33.1	34.9	32.6	34.9	34.1	35.6	33.1	35.5	33.9	38.0	33.5	36.7						
10–15 min	24.3	22.7	22.7	21.6	22.7	22.2	21.4	21.2	22.3	20.8	18.6	20.4						
15–20 min	10.5	9.4	9.3	8.6	9.4	8.7	9.6	8.3	8.2	7.8	8.6	7.3						
20–30 min	10.5	10.1	10.4	9.6	9.3	9.0	9.3	9.0	8.3	6.2	10.3	7.5						
30 min +	6.8	6.8	8.5	7.1	8.6	8.1	8.8	7.7	8.9	9.1	9.5	8.8						
missing	[20.3]	[22.9]	[17.8]	[24.5]	[20.0]	[25.8]	[19.1]	[26.1]	[20.2]	[27.6]	[21]	[26.1]						
Travel time to nearest mammogram facility																		
<5 min	8.1	8.1	7.9	8.1	8.7	8.7	8.4	8.2	8.9	9.7	8.9	8.8						
5–10 min	23.7	24.5	22.1	23.5	24.6	25.3	22.0	23.6	22.7	24.4	22.8	25.1						

	(24.7% of the study sample)						(66.5% of the study sample)						(8.9% of the study sample)					
	40–49			50–69			70–74											
	Up to date	Overdue		Up to date	Overdue		Up to date	Overdue		Up to date	Overdue		Up to date	Overdue		Up to date	Overdue	
	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL	ML	BL
10–15 min	10,427	19,365	6,319	21,048	39,079	62,233	16,343	36,163	5,624	6,836	2,056	5,981						
	27.1	27.6	26.1	27.3	25.6	26.6	26.3	27.8	26.6	26.6	25.0	26.1						
15–20 min																		
	18.7	18.4	19.2	20.0	18.9	17.8	19.9	18.6	20.1	18.5	19.9	19.2						
20–30 min																		
	15.5	14.6	15.8	14.2	13.9	13.7	14.4	14.2	13.2	11.7	13.7	12.6						
30 min +																		
	6.9	6.9	8.9	7.0	8.4	8.0	9.0	7.6	8.5	9.2	9.8	8.3						
missing																		
	[0.0]	[1.5]	[0.2]	[1.7]	[0.1]	[1.8]	[0.1]	[1.8]	[0.1]	[2.3]	[0.3]	[1.9]						
Year letter mailed																		
2005																		
	45.8		51.9		44.6		44.0		45.5		41.4							
2006																		
	42.6		38.7		45.0		46.3		43.4		46.2							
2007																		
	11.6		9.4		10.5		9.8		11.1		12.4							
2009																		
		36.2		26.9		32.3		28.3		33.3		24.8						
2010																		
		27.1		19.6		26.6		19.0		25.4		20.7						
2011																		
		31.7		35.6		34.7		35.0		34.0		37.6						
2012																		
		5.0		17.9		6.4		17.8		7.3		17.0						

^aUnknown/missing % are not included in the column % distribution. Percent missing of total is indicated in brackets

Table 2

Unadjusted adherence^a to breast cancer screening following mammography letters (ML) versus birthday letter (BL) reminders stratified by up-to-date status and age (2a. 40–49 years; 2b. 50–69 years; 2c. 70–74 years). Age-adjusted odds ratios^b (95% Confidence Intervals) comparing screening adherence for the birthday letter relative to the mammography letter. Letters sent to women who are enrolled in Kaiser Permanente Washington between 2002–2012

2a. 40–49 years		Up-To-Date (40–49)				Overdue (40–49)			
		% adherent		OR	(95% CI)	% adherent		OR	(95% CI)
		ML%	BL%			ML%	BL%		
		(N=10,427)	(N=19,365)			(N=6,319)	(N=21,048)		
Overall adherence		62.8	54.5	0.72	(0.68– 0.75)	28.3	16.7	0.51	(0.48– 0.55)
Race	White	64.0	55.8	0.72	(0.68– 0.76)	29.0	18.8	0.57	(0.53– 0.62)
	Non-white	59.4	53.2	0.79	(0.71– 0.88)	30.9	19.7	0.55	(0.47– 0.63)
	Unknown	44.7	26.9	0.47	(0.30– 0.73)	11.3	3.3	0.23	(0.15– 0.35)
Education	High School	60.5	53.0	0.74	(0.64– 0.86)	32.8	24.6	0.66	(0.52– 0.84)
	Some college	59.9	54.9	0.83	(0.75– 0.91)	31.3	26.1	0.77	(0.65– 0.90)
	College Grad	65.3	57.4	0.72	(0.66– 0.80)	33.5	30.2	0.83	(0.69– 1.00)
	Post-College	67.5	58.5	0.68	(0.61– 0.76)	35.9	32.9	0.83	(0.67– 1.02)
	Unknown	48.0	35.2	0.56	(0.45– 0.70)	23.0	11.9	0.36	(0.32– 0.40)
Family History of breast cancer	None	64.0	55.3	0.70	(0.65– 0.76)	36.2	28.5	0.68	(0.59– 0.77)
	First-degree	64.6	60.9	0.86	(0.75– 0.97)	29.7	28.6	0.95	(0.74– 1.22)
	Second-degree	62.1	57.3	0.83	(0.75– 0.92)	28.3	30.5	1.09	(0.89– 1.33)
	Unknown	56.9	42.3	0.56	(0.49– 0.65)	24.1	12.3	0.37	(0.34– 0.41)
Charlson comorbidity	0	63.1	54.6	0.71	(0.67– 0.75)	28.5	16.4	0.49	(0.46– 0.53)
	1	60.1	53.6	0.78	(0.67– 0.91)	26.7	19.2	0.66	(0.53– 0.82)
	2	65.0	55.5	0.68	(0.52– 0.88)	23.7	17.9	0.69	(0.45– 1.07)
	3+	56.4	52.1	0.85	(0.56– 1.29)	29.8	15.2	0.45	(0.22– 0.93)
Healthcare visit in past 12 months	0	57.3	54.0	0.87	(0.78– 0.98)	20.9	12.6	0.54	(0.47– 0.61)
	1	60.7	52.0	0.71	(0.63– 0.80)	26.6	17.5	0.58	(0.49– 0.68)
	2+	64.9	55.4	0.68	(0.64– 0.72)	33.1	19.8	0.51	(0.47– 0.56)

2a. 40–49 years									
Up-To-Date (40–49)					Overdue (40–49)				
		% adherent				% adherent			
		ML%	BL%	OR	(95% CI)	ML%	BL%	OR	(95% CI)
		(N=10,427)	(N=19,365)			(N=6,319)	(N=21,048)		
Overall adherence		62.8	54.5	0.72	(0.68– 0.75)	28.3	16.7	0.51	(0.48– 0.55)
Primary care visit in past 12 months	0	57.7	53.3	0.84	(0.75– 0.93)	21.5	12.6	0.51	(0.45– 0.59)
	1	64.7	53.7	0.64	(0.58– 0.71)	28.8	18.6	0.56	(0.49– 0.64)
	2+	63.8	55.4	0.72	(0.67– 0.77)	32.5	19.7	0.52	(0.47– 0.58)
Well visit in past 12 months	0	59.5	53.5	0.79	(0.74– 0.84)	25.6	15.8	0.54	(0.50– 0.58)
	1+	69.0	56.4	0.59	(0.54– 0.64)	38.6	21.3	0.45	(0.39– 0.51)
OB/GYN visit in past 12 months	0	61.6	54.4	0.75	(0.71– 0.80)	27.5	16.3	0.52	(0.48– 0.55)
	1+	68.9	54.7	0.55	(0.48– 0.63)	36.9	22.1	0.50	(0.40– 0.62)
Number of recommended preventive services in BL	1 to 2	NA	54.5	NA		NA	16.7	NA	
	3 to 5	NA	56.0	NA		NA	17.1	NA	
	6 to 7	NA	49.1	NA		NA	16.7	NA	
Preventive care waiver	Yes	63.0	54.8	0.72	(0.68– 0.76)	28.3	16.8	0.51	(0.47– 0.56)
	No	62.3	53.1	0.69	(0.63– 0.77)	28.1	16.2	0.50	(0.43– 0.57)
Deductible >500 annually	Yes	58.8	49.5	0.69	(0.57– 0.84)	23.9	13.0	0.48	(0.36– 0.63)
	No	63.0	55.0	0.72	(0.69– 0.76)	28.5	17.3	0.53	(0.49– 0.56)
Travel time to primary care clinic (mins)	quartile 1	60.0	51.8	0.73	(0.64– 0.82)	26.2	16.0	0.54	(0.46– 0.63)
	2	63.9	54.8	0.69	(0.62– 0.78)	29.9	17.0	0.48	(0.41– 0.57)
	3	63.1	55.4	0.73	(0.65– 0.82)	27.7	17.5	0.55	(0.47– 0.64)
	4	62.8	54.7	0.73	(0.65– 0.81)	28.1	16.7	0.52	(0.44– 0.60)
Travel time to nearest mammography facility (mins)	quartile 1	64.1	55.4	0.70	(0.63– 0.78)	28.3	18.1	0.56	(0.48– 0.64)
	2	64.0	55.3	0.70	(0.63– 0.78)	28.2	17.0	0.53	(0.46– 0.60)
	3	61.2	53.5	0.74	(0.67– 0.82)	28.5	16.0	0.48	(0.42– 0.55)
	4	62.0	53.9	0.72	(0.65– 0.80)	28.2	15.8	0.48	(0.42– 0.55)

2b. 50–69 years		Up-To-Date (50–69)				Overdue (50–69)			
		% adherent		OR	(95% CI)	% adherent		OR	(95% CI)
		ML% (N=39,079)	BL% (N=62,233)			ML% (N=16,343)	BL% (N=36,163)		
Overall adherence		67.2	62.4	0.78	(0.76– 0.80)	16.9	19.6	1.19	(1.13– 1.25)
Race	White	69.1	64.1	0.77	(0.75– 0.79)	19.4	21.6	1.14	(1.08– 1.20)
	Non-white	62.8	57.7	0.79	(0.74– 0.85)	19.0	20.6	1.10	(0.97– 1.23)
	Unknown	13.1	17.9	1.43	(1.05– 1.93)	2.3	2.8	1.23	(0.87– 1.72)
Education	High School	66.9	61.1	0.79	(0.74– 0.85)	31.5	27.6	0.83	(0.72– 0.97)
	Some college	67.8	64.0	0.83	(0.79– 0.87)	32.3	30.2	0.90	(0.81– 1.00)
	College Grad	72.0	65.1	0.71	(0.66– 0.75)	35.8	32.6	0.85	(0.74– 0.98)
	Post-College	75.1	68.0	0.67	(0.63– 0.71)	37.6	36.5	0.93	(0.80– 1.07)
	Unknown	23.7	25.9	1.04	(0.92– 1.18)	7.4	8.4	1.16	(1.06– 1.26)
Family History of breast cancer	None	69.1	63.6	0.77	(0.74– 0.80)	33.1	30.8	0.89	(0.82– 0.98)
	First-degree	74.5	70.0	0.78	(0.73– 0.83)	36.0	34.5	0.93	(0.81– 1.08)
	Second-degree	71.6	65.6	0.74	(0.69– 0.79)	35.8	32.4	0.84	(0.72– 0.98)
	Unknown	42.2	40.7	0.85	(0.79– 0.92)	8.7	9.9	1.17	(1.07– 1.26)
Charlson comorbidity	0	67.4	62.5	0.77	(0.75– 0.80)	16.2	19.3	1.23	(1.16– 1.30)
	1	65.8	61.1	0.80	(0.74– 0.86)	20.6	20.9	1.02	(0.90– 1.16)
	2	69.5	64.4	0.78	(0.70– 0.86)	16.5	21.0	1.34	(1.09– 1.65)
	3+	62.8	60.5	0.88	(0.77– 1.02)	19.1	18.7	0.98	(0.77– 1.24)
Healthcare visit in past 12 months	0	58.2	57.8	0.93	(0.88– 1.00)	11.2	12.7	1.15	(1.04– 1.26)
	1	64.1	61.8	0.87	(0.81– 0.93)	17.0	20.2	1.22	(1.09– 1.37)
	2+	70.2	63.7	0.73	(0.70– 0.75)	21.6	24.8	1.19	(1.11– 1.27)
Primary care visit in past 12 months	0	57.4	57.4	0.95	(0.89– 1.01)	11.3	12.9	1.15	(1.04– 1.26)
	1	68.1	63.2	0.77	(0.73– 0.82)	18.0	21.8	1.25	(1.13– 1.39)
	2+	69.8	63.7	0.73	(0.71– 0.76)	21.5	24.5	1.18	(1.10– 1.26)
Well visit in past 12 months	0	63.9	61.1	0.86	(0.83– 0.89)	15.4	18.1	1.20	(1.14– 1.27)
	1+	73.8	65.0	0.64	(0.61– 0.67)	27.7	28.4	1.02	(0.91– 1.15)

2b. 50–69 years		Up-To-Date (50–69)				Overdue (50–69)			
		% adherent		OR	(95% CI)	% adherent		OR	(95% CI)
		ML%	BL%			ML%	BL%		
		(N=39,079)	(N=62,233)			(N=16,343)	(N=36,163)		
Overall adherence		67.2	62.4	0.78	(0.76– 0.80)	16.9	19.6	1.19	(1.13– 1.25)
OB/GYN visit in past 12 months	0	66.6	62.3	0.80	(0.77– 0.82)	16.7	19.3	1.18	(1.12– 1.24)
	1+	71.8	62.6	0.64	(0.59– 0.70)	22.9	27.6	1.25	(0.99– 1.57)
Number of recommended preventive services in BL	1 to 2	NA	67.1		NA	NA	22.9		NA
	3 to 5	NA	60.5		NA	NA	18.4		NA
	6 to 7	NA	59.0		NA	NA	18.5		NA
Preventive care waiver	Yes	67.9	62.7	0.77	(0.75– 0.80)	17.3	19.6	1.16	(1.10– 1.23)
	No	64.9	60.2	0.79	(0.74– 0.84)	15.9	19.5	1.28	(1.15– 1.43)
Deductible >500 annually	Yes	65.6	56.9	0.63	(0.57– 0.71)	17.9	16.5	0.87	(0.73– 1.05)
	No	67.3	62.9	0.80	(0.77– 0.82)	16.9	20.1	1.23	(1.17– 1.29)
Travel time to primary care clinic	quartile 1	65.7	61.4	0.81	(0.76– 0.87)	16.7	18.2	1.10	(0.98– 1.23)
	2	68.4	62.4	0.74	(0.70– 0.79)	16.1	20.2	1.31	(1.17– 1.47)
	3	67.4	63.5	0.81	(0.76– 0.86)	17.4	20.8	1.23	(1.10– 1.38)
	4	66.5	62.0	0.79	(0.74– 0.85)	17.4	19.7	1.16	(1.04– 1.29)
Travel time to nearest mammography facility	quartile 1	69.2	63.9	0.76	(0.72– 0.81)	16.4	20.0	1.26	(1.13– 1.39)
	2	67.1	63.1	0.80	(0.75– 0.85)	17.2	20.2	1.22	(1.11– 1.34)
	3	66.4	60.8	0.76	(0.72– 0.80)	16.6	18.8	1.15	(1.04– 1.27)
	4	66.1	61.7	0.80	(0.75– 0.84)	17.4	19.7	1.15	(1.05– 1.27)

2c. 70–74 years		Up-To-Date (70–74)				Overdue (70–74)			
		% adherent		OR	(95% CI)	% adherent		OR	(95% CI)
		ML%	BL%			ML%	BL%		
		(N=5,624)	(N=6,836)			(N=2,056)	(N=5,981)		
Overall adherence		77.3	44.7	0.24	(0.22– 0.26)	15.8	22.9	1.59	(1.39– 1.82)
Race	White	77.9	45.1	0.23	(0.21– 0.25)	16.4	23.8	1.59	(1.37– 1.84)
	Non-white	74.1	43.2	0.27	(0.21– 0.34)	18.2	22.5	1.30	(0.92– 1.83)

2c. 70–74 years									
Up-To-Date (70–74)						Overdue (70–74)			
		% adherent				% adherent			
		ML%	BL%	OR	(95% CI)	ML%	BL%	OR	(95% CI)
		(N=5,624)	(N=6,836)			(N=2,056)	(N=5,981)		
Overall adherence		77.3	44.7	0.24	(0.22– 0.26)	15.8	22.9	1.59	(1.39– 1.82)
	Unknown	38.9	16.7	0.29	(0.07– 1.22)	2.2	3.0	1.36	(0.33– 5.63)
Education	High School	76.7	42.7	0.23	(0.19– 0.26)	25.9	28.9	1.16	(0.88– 1.53)
	Some college	78.2	45.2	0.23	(0.20– 0.27)	31.9	30.6	0.94	(0.71– 1.23)
	College Grad	79.5	46.9	0.23	(0.18– 0.29)	34.2	34.8	1.02	(0.61– 1.72)
	Post-College	79.8	45.9	0.21	(0.17– 0.26)	32.3	38.6	1.31	(0.88– 1.95)
	Unknown	45.6	34.3	0.62	(0.38– 0.99)	5.6	6.1	1.10	(0.81– 1.49)
Family History of breast cancer	None	77.5	42.8	0.22	(0.19– 0.24)	30.0	31.8	1.08	(0.87– 1.35)
	First-degree	80.0	51.7	0.27	(0.23– 0.32)	30.1	35.5	1.27	(0.88– 1.82)
	Second-degree	79.3	46.1	0.22	(0.18– 0.28)	29.5	33.2	1.19	(0.75– 1.91)
	Unknown	63.5	36.5	0.33	(0.25– 0.42)	7.1	9.3	1.33	(1.04– 1.72)
Charlson comorbidity	0	79.3	46.0	0.22	(0.20– 0.25)	17.2	24.6	1.56	(1.32– 1.85)
	1	75.9	41.4	0.22	(0.19– 0.27)	12.3	22.4	2.03	(1.44– 2.87)
	2	76.8	48.0	0.27	(0.22– 0.34)	16.4	22.7	1.50	(1.00– 2.25)
	3+	65.2	40.5	0.36	(0.28– 0.46)	11.6	18.1	1.68	(1.04– 2.70)
Healthcare visit in past 12 months	0	73.2	43.0	0.28	(0.22– 0.35)	11.2	16.7	1.58	(1.17– 2.14)
	1	75.3	43.4	0.25	(0.20– 0.31)	15.6	23.9	1.70	(1.23– 2.37)
	2+	78.2	45.2	0.23	(0.21– 0.25)	18.1	24.8	1.49	(1.26– 1.77)
Primary care visit in past 12 months	0	73.1	42.9	0.28	(0.22– 0.35)	11.3	17.1	1.62	(1.20– 2.19)
	1	76.8	46.5	0.26	(0.22– 0.31)	15.0	24.5	1.83	(1.34– 2.50)
	2+	78.1	44.5	0.22	(0.20– 0.25)	18.3	24.6	1.45	(1.22– 1.72)
Well visit in past 12 months	0	75.6	42.8	0.24	(0.22– 0.26)	15.3	21.5	1.51	(1.30– 1.75)
	1+	82.3	50.2	0.22	(0.18– 0.25)	19.6	31.9	1.93	(1.33– 2.79)
OB/GYN visit in past 12 months	0	77.2	44.6	0.24	(0.22– 0.26)	15.7	23.0	1.60	(1.40– 1.84)
	1+	81.5	50.8	0.23	(0.14– 0.38)	26.7	18.0	0.60	(0.15– 2.40)

2c. 70–74 years									
Up-To-Date (70–74)					Overdue (70–74)				
		% adherent		OR	(95% CI)	% adherent		OR	(95% CI)
		ML%	BL%			ML%	BL%		
		(N=5,624)	(N=6,836)			(N=2,056)	(N=5,981)		
Overall adherence		77.3	44.7	0.24	(0.22– 0.26)	15.8	22.9	1.59	(1.39– 1.82)
	1 to 2	NA	46.3		NA	NA	24.4		NA
Number of recommended preventive services in BL	3 to 5	NA	35.9		NA	NA	23.9		NA
	6 to 7	NA	38.8		NA	NA	17.2		NA
Preventive care waiver	Yes	77.7	44.9	0.23	(0.21– 0.25)	15.9	22.9	1.56	(1.35– 1.80)
	No	72.8	41.6	0.27	(0.20– 0.36)	14.1	24.6	1.99	(1.22– 3.23)
Deductible >500 annually	Yes	50.0	42.4	0.83	(0.09– 7.63)	50.0	20.3	0.33	(0.02– 4.50)
	No	77.3	44.7	0.24	(0.22– 0.26)	15.7	23.0	1.60	(1.39– 1.83)
Travel time to primary care clinic	quartile 1	75.1	44.6	0.27	(0.22– 0.32)	15.8	20.9	1.41	(1.05– 1.89)
	2	77.6	43.3	0.22	(0.18– 0.26)	19.0	22.1	1.21	(0.90– 1.63)
	3	78.5	46.5	0.24	(0.20– 0.29)	14.7	23.2	1.75	(1.25– 2.45)
	4	77.7	41.5	0.20	(0.17– 0.25)	14.6	22.9	1.73	(1.27– 2.36)
Travel time to nearest mammography facility	quartile 1	79.6	45.8	0.21	(0.18– 0.25)	18.0	23.4	1.39	(1.06– 1.82)
	2	77.5	45.3	0.24	(0.20– 0.28)	13.7	21.2	1.70	(1.26– 2.29)
	3	76.1	45.0	0.26	(0.22– 0.30)	15.9	23.4	1.62	(1.24– 2.11)
	4	76.1	43.2	0.24	(0.20– 0.28)	15.6	23.6	1.65	(1.27– 2.16)

^a Adherence was defined as receipt of a screening mammogram with different time intervals for ML and BL letter and for women up-to-date vs. overdue.

^b The reference for each stratified model is the mammogram letter for the same group. For example, the odds ratio for “white race” compares the birthday letter to the mammogram letter among white women only, adjusting for age as a continuous variable within age categories.