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Impact of a false positive screening mammogram on subsequent screening behavior and stage at breast cancer diagnosis

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Abstract

Background—Experiencing a false positive (FP) screening mammogram is economically, physically and emotionally burdensome which may affect future screening behavior, by delaying the next scheduled mammogram or by avoiding screening altogether. We sought to examine the impact of a FP screening mammogram on the subsequent screening mammography behavior.

Methods—Delay in obtaining subsequent screening was defined as any mammogram performed more than 12 months from index mammogram. The Kaplan-Meier (product limit) estimator and Cox proportional hazards model were used to estimate the unadjusted delay and the hazard ratio of delay of the subsequent screening mammogram within the next 36 months from the index mammogram date.

Results—650,232 true negative (TN) and 90,918 FP mammograms from 261,767 women were included. The likelihood of a subsequent mammogram was higher in women experiencing a TN result than women experiencing a FP result (85.0% vs 77.9%, P <0.001). The median delay in returning to screening was higher for FP vs TN (13 months vs 3 months, P <0.001). Women with TN result were 36% more likely to return to screening in the next 36 months compared to women with a FP result HR=1.36 (95% CI: 1.35–1.37). Experiencing a FP mammogram increases the risk of late stage at diagnosis compared to prior TN mammogram (P<0.001).

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Conclusions—Women with a FP mammogram were more likely to delay their subsequent screening compared to women with a TN mammogram.

Impact—A prior FP experience may subsequently increase the 4-year cumulative risk of late stage at diagnosis.

Introduction

Screening mammography is an established routine public health procedure for the early detection of breast cancer and has been shown to reduce mortality from the disease (1). Along with the benefits of early detection, mammography screening is also associated with false positive (FP) results that lead to unnecessary additional imaging and biopsy procedures as well as associated financial costs, lost time and psychological and physical morbidity (2–4). FP rates have been estimated to be as high as 10% of screening mammograms (5) and roughly 50% of women who screen annually for 10 years can expect at least one FP mammogram finding of which 7–17% will require biopsy (6,7). The FP screening mammogram issue is part of an ongoing debate regarding the extent to which the risk of mammography screening might outweigh the benefits in certain women (8,9). Therefore, the most recent guidelines set forth by the United States Preventative Task Force (USPSTF) advised against routine screening in women aged 40–49 years of age and women 75 years or older (10).

Furthermore, a FP mammogram could lead women to alter their future screening behavior, either by delaying the next scheduled mammogram or foregoing the exam altogether. Studies that have examined the potential impact of a FP mammogram on subsequent adherence to screening mammography recommendations have yielded inconsistent findings. Several studies found that rescreening rates were actually higher among women who experienced a FP as opposed to a TN (11,12) while other studies found no difference in re-screening rates based on screening mammography outcome (13–16). Still other reports documented lower re-screening rates for women experiencing FP compared with those with TN mammograms (17–20). A 2007 meta-analysis which pooled data from the above studies found that in Europe and Canada, women who experienced a FP screening mammogram were less likely to return for their next screen compared to women with TN screen finding. Conversely, women in the United States were associated with greater subsequent screening mammography adherence after experiencing a FP (21). The primary study objective was to examine the impact of a FP screening mammogram on the receipt of subsequent screening mammography among a racially diverse population in a network of mammography centers within a large health care organization. The secondary objective was to determine whether the experience of a FP result at index mammogram increases the risk of subsequent late stage disease for those women subsequently diagnosed with breast cancer.

Materials and Methods

Mammography screening data on women were obtained from a large Health Care Organization with multiple facilities in the greater metropolitan Chicago area. Facilities within this healthcare organization used PenRad to collect radiology information and patient characteristics (22). PenRad was first introduced in 2001 and was implemented at all

facilities by 2005. Breast cancer incidence data were obtained from the Illinois State Cancer Registry (ISCR) (23) which collects information on all incident cancer cases in the state of Illinois.

The radiology data set included patient-level data on demographic characteristics and risk factors, and exam-level data on procedure types and results that were performed between January 1st, 2001 and December 31st, 2014. Each mammogram was interpreted by the reading radiologist and was given a score using the American College of Radiology (ACR) classification system known as Breast Imaging Reporting and Data System (BIRADS). BIRADS assessment for screening and diagnostic mammography ranges from 0 to 5 such that 0 = need additional imaging evaluation, 1 = negative finding, 2 = benign finding, 3 = probably benign finding, 4 = suspicious abnormality, and 5 = finding highly suggestive of malignancy.

Family history was self-reported and was defined as none (no first or second degree relatives affected), weak (only second degree relatives affected), moderate (one first degree relatives over age 50 affected), and strong (multiple first degree relatives affected or one under age 50). Age was determined by taking the difference between date of index mammogram and date of birth. Race/ethnicity was self-reported as Non-Hispanic (nH) White, nH-Black, Hispanic, other and unknown. Personal history of prior biopsy was defined as present if a prior biopsy existed in the radiology dataset or if it was self-reported. Time since last mammogram was defined as 9–18 months, 19–30 months, >30 months and no prior mammogram based on the radiology dataset. Breast density was defined following the ACR classification as composed almost entirely of fat, scattered fibroglandular densities, heterogeneously dense and extremely dense.

Women with a prior history of breast cancer or who developed breast cancer anytime during the study period were excluded from these analyses as were women with a history of breast reduction, breast implants and breast reconstruction or mastectomy. Screening mammograms which were preceded by any radiologic exam in the prior 9 months were also excluded. In the case of multiple exams on the same day, only the first exam in the sequence was used in the analysis.

A linkage of 755,567 screening mammograms completed between 2001 and 2010 to ISCR patients diagnosed with breast cancer for diagnosis years 2001–2011 was performed. To allow 12 months of follow up for cancer diagnosis, we restricted our analytic dataset to include bilateral screening mammograms that were performed January 1, 2001 and December 31, 2010. Based on the mammograms interpretation and cancer status within 12 months of the screen, screening mammograms were defined as true positive (TP), true negative (TN), FP and false negative (FN) screens. For these analyses, we compared the experiences of women with FP and TN mammograms. The unit of analysis was the screening mammogram.

A TN mammogram was defined as any mammogram with BIRADS (1,2,3) and that cancer was not detected in the subsequent 12 months from date of screening mammogram. Whereas, a FP mammogram was defined as any mammogram with BIRADS (0,4,5) and that

cancer was not detected in the subsequent 12 months from date of screening mammogram. The burden of FP was defined as the number of additional imaging after a FP mammogram and morbidity was defined as the receipt of biopsy after a FP mammogram. Women with a TN mammogram were assumed to have no additional work up during the follow up period.

Because the recommended interval for routine screening is at least 12 months, we defined the index date (T=0) as 365 days after the index screening date. Therefore, any index screening mammograms that were followed with a subsequent screening mammogram prior to 12 months were excluded (N= 14,417 1.9%). Follow up period was defined as the number of months between the index date and the date of the subsequent screening mammogram or 36 months, whichever came first. Women who did not return to screening at our network were considered right censored and their follow up time was estimated as the difference between index date and December 31, 2014. This date was used because our data included all screening mammograms that were performed on or before December 31, 2014. The dependent variable for the primary analysis was the number of months (T) after index date for both TN and FP mammograms (Figure 1).

In an additional analysis we adjusted the follow up time to account for the time required to resolve a positive mammogram by setting the index date to be the date of the last diagnostic procedure related to the index mammogram on file.

For the primary objective, we excluded exams from women who were diagnosed with breast cancer at any point during our study period. For the secondary analysis in which we examined the impact of FP on stage at diagnosis, we excluded screens that were followed with a breast cancer diagnosis in the subsequent 12 months as well as cancers that were diagnosed more than 48 months from screening mammogram. The dependent variable was late stage at diagnosis which was defined according to the American Joint Committee on Cancer (AJCC) and categorized as late stage (stage 2, 3, 4) vs. early stage at diagnosis (stage 0 or 1).

Patient characteristics by mammogram result (TN vs FP) and by stage at diagnosis were tabulated. The Kaplan-Meier (product limit) estimator was used to estimate the overall unadjusted delay in return to screening by mammogram result (TN vs FP), and log-rank tests were used to compare the differences between the two curves. Cox proportional hazard models were used to estimate the hazard ratio for delay in the receipt of subsequent screening mammogram within the next 36 months from the index mammogram date. Women who did not return to screening at this network were right censored as well as women who returned to screening after 36 months from index mammogram date. In addition to mammogram result (TN vs FP), the model included variables for age, race/ethnicity, family history of breast cancer, mammographic breast density, parity, prior history of biopsy, time since last screening mammogram, calendar year, availability of comparison film and facility. Stratum-specific hazard ratios were generated using the same model as above with the addition of each individual product term between the index mammogram result and the variable of interest. Similar results were observed when using the proportional hazards model with an independent working assumption and robust sandwich covariance matrix

estimate to account for the intracluster dependence. Therefore, the proportional hazards model without clustering was used.

In addition to multivariable models described above, a propensity score matching technique was used to match on the probability of a FP result. Logistic regression modeling was used to predict the probability of being FP vs TN adjusting for decade of age, race/ethnicity, family history of breast cancer, mammographic breast density, parity, prior history of biopsy, time since last screening mammogram, calendar year, availability of comparison film at interpretation, facility and any possible interaction terms that were significant at an alpha 0.05 level. Off support probabilities were excluded and greedy matching algorithm without replacement was used to match 1–1 TN and FP mammograms (24). The matched dataset was then analyzed using Kaplan-Meier estimator to estimate the probability of returning to screening by index mammogram result. Proportional hazards modeling was used to estimate the risk of not returning to recommended screening by index mammogram result.

To estimate the probability of late stage at diagnosis following a FP or TN screening mammogram, logistic regression with Generalized Estimating Equations (GEE) was utilized to account for clustering of screening mammograms within patients. All analyses were conducted using SAS (version 9.4; SAS Institute Inc, Cary, North Carolina) All p-values are two-sided.

Results

A total of 741,150 screening mammograms (FP=90,918, TN=650,232) from 261,767 women were included in this study. The overall FP rate was 12.3%. Women experiencing a FP result were less likely to have a subsequent screen in the database than women experiencing a TN result (22.1% vs 15.0% P-value <0.001). Women who did not return for screening at these facilities may have forgone screening altogether (a substantively important result of this study) or may have sought subsequent screening elsewhere (may have been lost to follow-up). Women with FP mammograms were younger, premenopausal and were more likely to be experiencing their first mammogram screening. Also, they were more likely to be nH-Black, have denser breasts and were less likely to have a comparison film available at interpretation (Table 1).

Regardless of index screen result, younger and premenopausal women as well as women who were obtaining their first screening mammogram or whose prior mammogram occurred more than 30 months before the index screen were more likely to delay their subsequent screening (Table 2). The median delay in return to screening was higher for FP than for TN mammograms (13 months vs 3 months, P-value <0.001) (Figure 2). Delays in returning for subsequent screening were consistently longer after a FP mammogram than after a TN mammogram across strata of patient characteristics (Table 2).

In the adjusted proportional hazards model, women with TN result were 36% more likely to return to screening in the next 36 months compared to women with a FP result HR=1.36 (95% CI: 1.35–1.37). In addition, a FP result was consistently associated with delays in subsequent screening within strata of patient characteristics and screening history (Table 3).

To examine whether the classification of 10,746 (1.45%) screening mammograms with BIRADS 3 as TN impacted our results we performed sensitivity analyses in which we 1) excluded screens with BIRADS 3 or 2) included BIRADS as FP mammograms. The results in both scenarios were nearly identical to those reported when we classified mammograms with BIRADS 3 as TN.

The results after resetting the index date to account for the time required to resolve a FP mammogram were similar to the results that were observed when using the actual mammogram date as the index date. Briefly, the median delay in return to screening was higher for FP than for TN mammograms (12 months vs 3 months, P-value <0.001). Delays in returning for subsequent screening were consistently longer after a FP mammogram than after a TN mammogram across strata of patient characteristics. In the adjusted proportional hazards model, women with TN result were 36% more likely to return to screening compared to women with a FP result HR=1.36 (95% CI: 1.36–1.39) (Data not shown).

Compared to women who did not receive additional work up, women who received additional imaging were 24% less likely to return to screening HR=0.76 (95% CI: 0.758–0.772) and women who received imaging and biopsy were 34% less likely to return to screening HR=0.66 (95% CI:0.64–0.67) (P-value for trend <0.001). Among FPs only, women who experienced additional imaging and biopsy were 19% less likely to return to screening compared to women who received imaging only HR=1.19 (95% CI: 1.15–1.22).

We re-analyzed our primary results using propensity score matching. We matched 90,095 (99.1 % of all FPs in the dataset) FP index mammograms to a similar number of true negative mammograms. The proportion of women who did not return to screening was slightly higher among women who experienced a FP mammogram compared to women with a TN exam (22.1% vs 19.2%, P-value <0.001). The two cohorts were balanced in terms of women's characteristics. Similar to the analysis which included all exams, delay in return to subsequent mammograms was longer among women with FP compared to women with TN mammograms. The median delay was 13 months among FP compared to 6 months among TN (P-value <0.001). After adjusting for patient characteristics, the chance of returning to screening was 34% higher in women with TN exams compared to women with FP mammograms HR=1.33 (95% CI: 1.32–1.35).

For the 751,347 screening mammograms defined as either false positive or true negative, 4-year cumulative risk of a late stage at diagnosis was found to be higher following a FP mammogram compared to a TN mammogram (0.4% vs 0.3%, for FP vs TN respectively, p=0.001, results not tabulated). Similar results were observed when adjusting for patient and clinical factors as well as clustering within patients such that the risk of late stage at diagnosis was 20% higher in FP compared to TN (p-value <0.001). Similarly, delays in returning to subsequent screening also increased the risk of late stage at diagnosis such that the risk increases by 0.3% for every one additional month delay (p<0.001, data not shown).

Discussion

We sought to examine how the experience of a FP mammogram might impact adherence to subsequent mammography screening in a large cohort of women from a single healthcare organization. Our results suggest that women who had a FP mammogram were less likely to return for screening within the following 36 months compared to those with TN mammogram results. This finding is consistent with another US-based study that used secondary data from telephone interviews and medical claims records for calendar years 2005–2008 on 2406 women which were followed for 36 months. This study found that 22.1% of women with FP mammogram compared to 15% of women with TN mammogram delayed their receipt of the subsequent screening (25). Conversely, studies conducted more than a decade ago using data from the 1990s found that women who experienced FP mammogram had better adherence to subsequent screening compared to women with a true negative mammogram exam outcome (11,12,26).

Several other studies from Europe and Canada found no difference in re-screening (13–16,27), and yet others have reported lower re-screening rates among FPs than among TNs (18–20,28–30). These inconsistent results suggest both secular and geographic variation in the impact of FP mammography on adherence to screening recommendations among the USA, Europe and Canada (21). The conflicting results for international comparisons may be attributed to variations in screening practices such as screening intervals are shorter in the US than in Europe, greater emphasis on accuracy in Europe by double readings which have been reported to result in 3 to 5% lower recall rates compared to the US, and differences in national mammography programs for Europe and US public and private screening providers. The inconsistency between the majority of the USA studies and our study might be explained by secular changes in how women perceive and adapt to a FP mammogram, which may be related to changes in guidelines (USPSTF guidelines 2002 and 2009) and increased awareness of the balance of benefits and harms of mammography screening over the last decade.

Our study findings suggest that the delay in returning to recommended mammography screening practices increased the risk of subsequent diagnoses with late stage breast cancer. A similar observation was reported from a study in the United Kingdom which found an increased likelihood of late stage at diagnosis among women with FP compared to those with TN mammogram results OR=1.37 (95% CI: 0.67–2.28) (20).

Some women who experience a FP result might decide to get their next screening mammogram 12 months after the completion of their diagnostic work-up, rather than 12 months after their last screen. When we adjusted the follow-up time for women with a FP screen to begin at the date of the last diagnostic procedure, our results were similar to the results generated when using the screening mammogram date as the index date. Thus, the potential for a perceived shift in the appropriate date for the next screen among women with a FP index mammogram could not account for the association of a FP result with delayed subsequent screening.

Strengths of this study include the availability of screening and diagnostic records of prior exams that were conducted within our network and the large number of exams from a diverse community-based cohort. Other studies (12, 26) have used women as the unit of analysis to estimate the probability of returning to the subsequent screening mammography which may be subject to recall bias because of the possible differences in the accuracy of the recollection of prior exams such that women who have experienced a prior false positive result may have a better memory of their experience than women with a prior TN exam.

This study has several limitations as well. First, we could not account for insurance status in our analysis as these data were not available in our data collection system. Women who are uninsured or underinsured may be more likely to be truly lost to follow-up if they lack a medical insurance. Alternatively, underinsured women may be more likely to delay or forgo altogether subsequent screening as a result of a FP screen, perhaps due to the concern regarding high out of pocket costs.

In these analyses, we included the 14% of exams that were not followed by a subsequent screening mammogram within our network as right censored. It is possible that these women may have never returned to screening or could have received their mammography screening somewhere else outside our network. It is also possible that some women who appeared to delay their subsequent screen may have obtained another screen elsewhere in the interim, outside this healthcare organization and thus not captured by our radiology database. This limitation may have impacted our results by differentially inflating the median follow up for FP and TN mammograms. When excluding those who did not have a subsequent mammogram in the system, we still observed longer median time to return to subsequent screening in women with FP compared to their TN counterparts (7 months vs 2 months, p-value <0.001). Similar finding was also observed after resetting the index date to account for the time required to resolve a FP mammogram. Given the high percentage (86%) of index screens were associated with a subsequent screen, loss to follow-up would appear to be modest, but this is could not be determined empirically.

In conclusion, our study found that women who experienced a FP mammogram were more likely to delay their subsequent screening compared to women with a TN mammogram. The finding is important in that women who experience a FP mammogram result should be provided with more information about the continued benefits of mammography screening and encouraged to maintain adherence to screening mammography recommendations.

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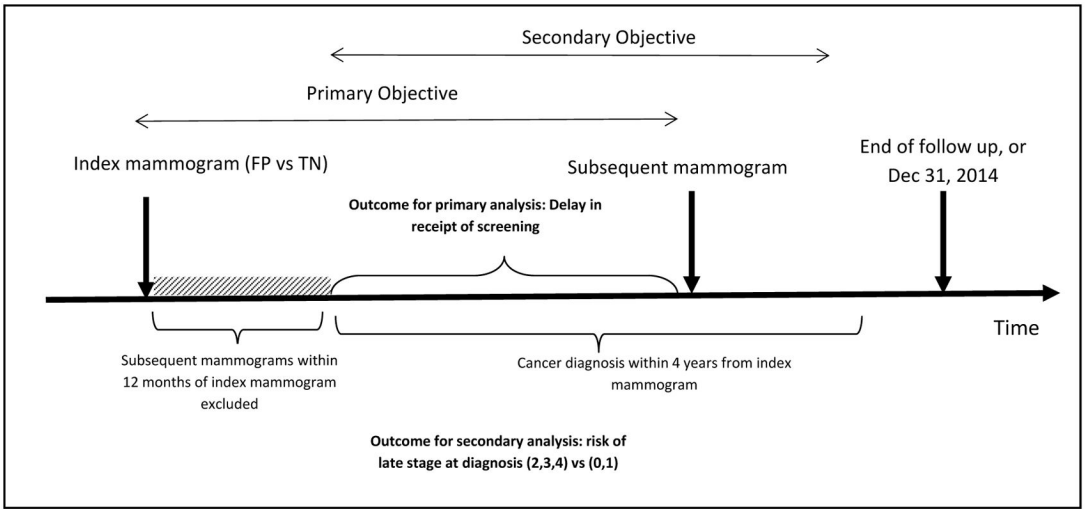

Figure 1.

Primary and secondary analyses design overview FP vs TN.

The first arrow represents the index mammogram (true negative and false positive mammograms only). The shaded area represents the first 12 months after index mammogram and index date (T=0) was defined at the end of the shaded area. Mammograms that were followed by a screening mammogram within 12 months were excluded. The second arrow represents the subsequent mammogram after index mammogram. For the secondary analyses the cumulative risk of late stage at diagnosis was estimated over a 4 years period following the index mammogram.

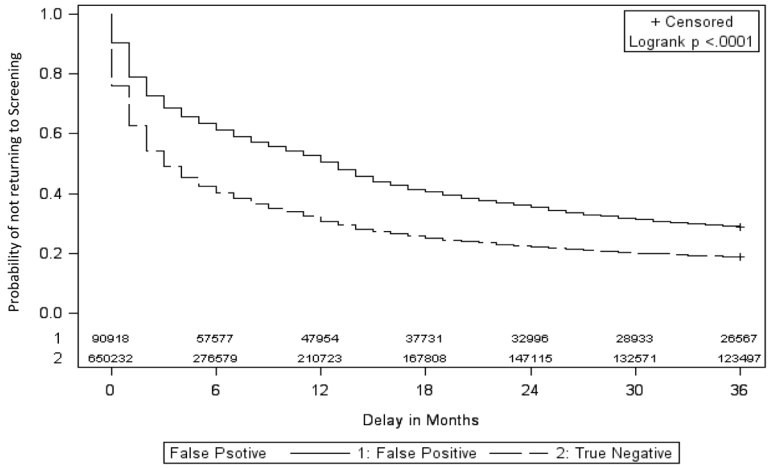

Figure 2.
Kaplan-Meier estimates for time to next screen in months by index mammogram result

Table 1

Patient characteristics of 741,150 screening mammograms by mammogram result for the period 2001–2010

	TN		FP	
	N	%	N	%
Loss to Follow up[1]				
Yes	97,380	15	20,073	22.1
No	552,852	85	70,845	77.9
Age				
<40	21,724	3.34	5,365	5.9
40–49	187,897	28.9	33,261	36.58
50–59	193,036	29.69	26,058	28.66
60–69	131,839	20.28	15,069	16.57
70–79	87,294	13.43	8,633	9.5
80+	28,442	4.37	2,532	2.78
Ethnicity				
nH White	362,647	55.77	49,319	54.25
nH Black	151,171	23.25	25,121	27.63
Other	136,414	20.98	16,478	18.13
Breast Density[2]				
Fatty	52,823	8.12	5,479	6.03
Scattered	266,089	40.92	31,747	34.92
Heterogeneous	276,742	42.56	45,560	50.11
Dense	54,512	8.38	7,961	8.76
Family history				
None	440,106	67.68	60,593	66.65
Weak	101,063	15.54	14,587	16.04
Moderate	77,450	11.91	10,715	11.79
Strong	31,613	4.86	5,023	5.52
Parity				
Nulliparous	79,395	12.21	11,151	12.26
Parous	516,967	79.51	69,331	76.26
Missing	53,870	8.3	10,436	11.5
Menopause				
Pre-menopausal	143,505	22.06	28,217	31.04
post-menopausal	506,727	77.93	62,701	68.96
Prior Biopsy				
Yes	114,582	17.62	75,164	82.67
No	535,650	82.38	15,754	17.33
Time since last screen				
9–18	370,815	57.03	37,811	41.59
19–30	114,806	17.66	13,943	15.34
>30	80,005	12.3	12,814	14.09

	TN		FP	
	N	%	N	%
First Screen	84,606	13.01	26,350	28.98
Comparison Film				
Yes	540,995	83.2	60,746	66.81
No	109,237	16.8	30,172	33.19

TN – True negative; FP – False positive; nH-non Hispanic

[1]Loss to Follow up was defined as those who never returned to screening in the database;

[2]237 exams were missing breast density

Table 2

Mean and median delay in months for follow-up screening mammography by patient characteristics and mammogram findings

	TN				FP			
	N	% Returned[1]	Median	P-value[2]	N	% Returned[1]	Median	P-value[2]
Age				<0.001				<0.001
<40	21,724	56	28		5,365	53	32	
40–49	187,897	80	5		33,261	70	14	
50–59	193,036	84	3		26,058	74	12	
60–69	131,839	86	2		15,069	77	9	
70–79	87,294	83	2		8,633	74	9	
80+	28,442	67	4		2,532	58	14	
Ethnicity				<0.001				<0.001
nH White	362,647	84	2		49,319	73	12	
nH Black	151,171	84	4		25,121	73	11	
Other	136,414	72	6		16,478	60	20	
Breast Density[3]				<0.001				<0.001
Fatty	52,823	79	4		5,479	64	16	
Scattered	266,089	81	3		31,747	72	12	
Heterogeneous	276,742	81	3		45,560	72	12	
Dense	54,512	81	4		7,961	68	15	
Family history				<0.001				<0.001
None	440,106	79	4		60,593	69	13	
Weak	101,063	81	3		14,587	74	12	
Moderate	77,450	81	2		10,715	77	9	
Strong	31,613	81	2		5,023	73	12	
Parity				<0.001				<0.001
Nulliparous	79,395	85	2		11,151	75	12	
Parous	516,967	83	3		69,331	26	12	
Missing	53,870	61	11		10,436	47	15	
Menopause				<0.001				<0.001
Pre-menopausal	143,505	68	10		28,217	59	22	

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	TN				FP			
	N	% Returned[1]	Median	P-value[2]	N	% Returned[1]	Median	P-value[2]
post-menopausal	506,727	85	3		62,701	76	10	
Prior Biopsy				<0.001				<0.001
No	535,650	80	4		15,754	70	13	
Yes	114,582	86	2		75164	77	10	
Time since last screen				<0.001				<0.001
9–18	370,815	89	1		37,811	83	4	
19–30	114,806	81	6		13,943	76	12	
>30	80,005	69	13		12,814	65	19	
First Screen	84,606	57	24		26,350	53	31	
Comparison Film				<0.001				<0.001
Yes	540,995	85	3		60,746	78	8	
No	109,237	63	16		30,172	44	26	

TN – True negative; FP – False positive; nH-non Hispanic;

[1]% returned to screening within 36 months;

[2]Log Rank Test;

[3]237 exams were missing breast density;

Table 3

Overall and stratified hazards ratios of returning to screening among true negative compared to false positive mammograms

	HR (TN vs. FP)[1]	P-value
Overall	1.36 (1.35, 1.37)	<0.001
Stratum-Specific		
Calendar Year		
≤2005	1.31 (1.30, 1.33)	<0.001
> 2005	1.4 (1.39, 1.42)	<0.001
Race/Ethnicity		
nH-Whites	1.42 (1.40, 1.43)	<0.001
nH-Blacks	1.28 (1.26, 1.30)	<0.001
Other	1.31 (1.28, 1.33)	<0.001
Age group		
<40	1.32 (1.30, 1.34)	<0.001
40–50	1.41 (1.39, 1.43)	<0.001
50–60	1.41 (1.38, 1.43)	<0.001
60–70	1.40 (1.37, 1.44)	<0.001
70–80	1.28 (1.22, 1.35)	<0.001
80+	1.03 (0.99, 1.07)	0.10
Time Since Screen		
First Screen	1.20 (1.18, 1.23)	<0.001
09–18	1.47 (1.46, 1.49)	<0.001
19–30	1.25 (1.22, 1.27)	<0.001
>30	1.23 (1.20, 1.26)	<0.001
Family History		
None	1.34 (1.33, 1.36)	<0.001
weak	1.42 (1.38, 1.45)	<0.001
Moderate	1.46 (1.42, 1.52)	<0.001
Strong	1.3 (1.32, 1.37)	<0.001
Prior Biopsy		
Yes	1.49 (1.46, 1.52)	<0.001
No	1.33 (1.32, 1.34)	<0.001
Comparison film		
Yes	1.22 (1.20, 1.24)	<0.001
No	1.41 (1.40, 1.42)	<0.001

TN – True negative; FP – False positive.

[1] Cox Proportional Hazards model adjusted for mammogram result (FP vs TN), decade of age, race/ethnicity, calendar year, breast density, family history, time since last screen, history of prior biopsy, parity, availability of comparison film and screening facility.