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The effect of individual radiographers on rates of attendance to breast screening: A 7-year retrospective study

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Abstract

Aim: Breast cancer is a common cause of female cancer death. For screening programs to be effective they require uptake rates to be consistently high. Multiple factors affect re-attendance rates. Patient care and communication by the radiographer at the time of the mammogram can influence a women's intention to re-attend for screening. To our knowledge screening client re-attendance rates according to individual radiographer have not previously been reported.

Materials and Methods: Women aged between 50 – 69 years were identified from a state-wide screening database at their first screening attendance during the study period (2007-2013). The radiographer performing the index screen and potential confounding factors were recorded, subsequent screening behaviour was assessed. Only women with normal screens were included. Clients known to have died during the time-period were excluded. Univariate analysis of data of 160,028 women was assessed using Chi square to compare those women who attended their next mammography as scheduled with non re-attenders. Logistic regression was used to calculate the likelihood of 're-attendance success' across a variety of demographic and clinical variables. Probability of re-attendance for eleven randomly selected radiographers was determined from the logistic regression model, whilst controlling for all the other confounding variables.

Results: Comparison of 110,330 (69%) women that attended the next round of screening with non re-attenders (n = 49,698) revealed significant differences across all the known parameters, including radiographer (Wald statistics = 1188, $p < 0.000$) even when all other known factors were controlled for in the model.

Conclusion: This large, population level study has demonstrated that individual radiographer factors appear to influence a women's decision to return on-time for their next screening round. Further research should be performed to identify underlying reasons for differing rescreen rates for individual radiographers and provide education and retraining of individual radiographers as appropriate.

Introduction:

Breast cancer remains the second greatest cause of cancer death amongst women in Australia.

There is much debate and controversy regarding the balance of benefit and harms of screening programs, with estimates of relative risk reduction for breast cancer mortality ranging from 26% (1) to 15% (2). A meta-analysis based on the UK screening program reported a 20% relative risk reduction in breast cancer mortality countered by an estimate of excess incidence of up to 19%.(3)

It remains undisputed that for any screening program to be a success population uptake must be both initially high and maintained throughout subsequent screening rounds.(4) In Western Australia, women considered of standard risk are screened biennially and women at higher risk women screened annually. During the study period women aged 50 – 69 years were invited to attend screening. The participation targets for women screened by our State-wide screening programme are: for ≥75% of women aged between 50-69 years to

have their first rescreen within 27 months and for ≥90% to attend subsequent rescreens.(5) Audit data from 2015 indicates that targets are not currently being met with only 45.9% of women attending first re-screens and 73.5% re-attending subsequent screening rounds.

The reasons why women fail to attend screening are broad; including nationality, ethnicity, socio-economic status, level of education, Body Mass Index (BMI), prior screening behaviour, distance to screening centre, fears about pain, embarrassment and radiation, and previous negative screening experiences.(6-8) Qualitative studies suggest that a women's intention to attend subsequent screening rounds may be influenced by interaction with staff at the time of screening mammogram (9, 10) and that the radiographer can affect the client's experience of pain.(11)

To our knowledge, there is no published evidence assessing whether the individual radiographer performing the screening mammogram affects the likelihood of the woman attending subsequent screening rounds.

We undertook this audit to establish whether individual radiographers had significantly different rescreening rates whilst controlling for other known confounding factors.

Materials and Methods:

Ethics Board approval for a retrospective audit study was obtained. Screening data from the screening database from the period 2007 – 2013 was extracted. This information provided a unique number for both the client and their radiographer, the rescreening interval of the woman (annual or biennial), a range of demographic and clinical information including age,

Aboriginal and Torres Straits Islander (ATSI) status, country of birth, previous history of breast or ovarian cancer, and postcode of residence.

Women who were outside the mammography screening program's target age range of 50 – 69 years, known to have died during the study period, or whose re-screen date fell outside the study period were excluded. Each eligible woman was only considered once, subsequent screening episodes were excluded.

The raw data was grouped into cohorts; country of origin was divided into Australia/New Zealand, Europe and Other. Postcode of residence was used to assign a region of residence (North Metropolitan, South Metropolitan, South West, and Rural and Remote) and quintile of socio-economic indexes for areas (SEIFA) disadvantage index was calculated based on the 2011 Australian Bureau of Statistics Census.(12)

The primary outcome measure was 're-attendance success'. For women on the biennial screening program re-attendance success was defined as returning for the next screening mammogram within 23-27 months from the index screen, and within 11-15 months from the index screen for those on the annual program. The woman's first mammogram during the study period was identified as the index-event. Whilst the index screen was the first screen within the study period for many women this may not represent their 'first ever' screening mammogram. Demographic data described above, along with the radiographer performing this index mammogram was recorded. Clients were then categorised as a re-attendance 'success' or 'failure' based on their subsequent behaviour. Failure included both

those who failed to attend 'on-time' (i.e. re-screened but outside the defined time frame for the next screening round) and those who failed to re-attend at all within the study period.

Statistical methodology

Comparison of demographic information for clients who successfully re-attended the next screening round was compared with those failing to re-attend using Chi square analysis as shown in table 1. Logistic regression was used to calculate the likelihood of 're-attendance success' and the possible independent impact of the index-screen radiographer, client age, rescreen interval, Aboriginality, country of birth, region of residence, socio-economic disadvantage and history of previous breast or ovarian cancer diagnosis. For a randomly selected cohort of 11 radiographers, the probability for their clients re-attending the next round of screening were calculated from the logistic regression model. Client complaints made against each radiographer in the subset of 11 radiographers were considered a proportion of total screens performed during the study period. All statistical calculations were performed using SPSS v24 software.

Results

Study population

During the study period of January 2007 – Dec 2013, the screening database held a total of 609,314 examinations from 252,824 individual women. Of these, 79% were aged in the screening target age group of 50 – 69 years (480,282 screenings; 201,621 women) and had an average 2.38 screenings across the seven years. Further restricting the study cohort to include only the woman's first screening event resulted in 160,028 screening episodes for the same number of women (see table 1).

The screening mammograms were performed by 66 radiographers employed by the state screening programme although the number working annually varied from 35 to 41. (see table 2).

Demographics and re-attendance success

In the study population, the vast majority of clients (78%) lived in the metropolitan area of greater Perth and over half (61%) originated from Australia or New Zealand. Very few mammograms were performed on women who were of Aboriginal or Torres Strait Islander ethnicity (1%). Details are shown in table 1. Overall, 69% of women attended for their subsequent screening mammogram within the expected timeframe. This is well below target.

Effect of screening radiographer

Univariate analysis of the success or failure of attendance to the next screening round by all 66 radiographers was highly significant ($Chi^2 = 2236$, $p<0.000$; n = 62,759 individual data not shown). Significant variation in re-attendance rates in the eleven randomly selected subset of radiographers was observed in both the univariate ($Chi^2 = 561$, $p<0.000$) and multivariate logistic regression where the odds ratio for attending the next screening mammogram ranged from 0.937 – 1.384 (table 3). The absolute numbers of re-screen success and failure by radiographer is illustrated in figure 1. Within this subset the average success rate was 69%, however, significant variation was observed between the radiographers (range: 59% - 76%; see figure 1). , (see figure 2). The similarly of the logistic regression results from the subset of randomly selected radiographer's cohort to those of the entire dataset suggests

that the observation of significant variation in the rescreening success rates between radiographers is also likely in the entire radiographer workforce.

Client complaints made against the subset of 11 individual radiographers during the study period were considered. As a proportion of the total number of screens performed, the proportion of women who subsequently lodged a complaint was incredibly low, ranging from 0% (radiographer D) to 0.07% (radiographer C). Although the probability of a woman returning to screening was marginally higher if screened by radiographer D rather than C, this was not statistically significant.

Effect of other factors

As shown in table 1, there are significant differences between the women who attended their next mammography screen on-time when compared to the non re-attenders in all of the recorded variables.

Similar results were observed in the logistic regression model except for women who had a previous history of ovarian cancer, which despite an increase in likelihood of rescreen success, failed to reach statistical significance possibly to small numbers (n=472). Women with previously diagnosed breast cancer were significantly more likely to rescreen within the expected timeframes (OR = 1.772, $p<0.000$). By contrast, women considered 'high risk' and therefore on the annual screening program were almost twice as likely to fail to re-attend even when all available confounding variables were included in the logistic regression (OR = 0.670, $p<0.000$). The proportion of women failing to re-attend was

program was 37% (n=4,289) and 31%, (n=45,409) for the annual and biennial screeners respectively (Chi^2 = 178.6, p< 0.000).

Of concern was the observation that Aboriginal women were half as likely to attend for their next screening mammogram, even when the analysis was controlled for other factors including age, area of residence (rural verses metropolitan) and socio-economic disadvantage (OR = 0.507, p<0.000).

Univariate analysis showed that the proportion of women from the five socio-economic quintiles differed statistically with the rescreen success rate ranging from 65% - 71%. Interestingly, logistic regression revealed that the likelihood of a rescreen success was higher in the middle range quintiles relative to the least disadvantaged group.

Women living in the north metropolitan area were more likely to attend their next screening examination on time relative to those living in all other regions of the state with the greatest difference being between North Metropolitan and the South West (OR = 0.671, p<0.000).

Rescreen success decreased slowly with client age (OR = 0.974, p<0.000). Women born in Europe were 5% more likely to re-attend than those born in Australia or New Zealand (OR = 1.055, p<0.000).

Discussion

Radiographers influence

In this audit we demonstrated significant variation in rates of screening re-attendance attributable to the individual radiographer performing the previous screening mammogram. To our knowledge this is the first study to have investigated and reported this finding. The similarly of the logistic regression results from the entire client cohort to those from the subset receiving examinations from the 11 randomly selected radiographers suggests that this finding is applicable to the entire radiographer workforce in the Western Australian Breast Cancer Screening Program.

Review of the literature offers insights into possible explanations. In a study of 3,295 women interviewed within 48 hours of screening mammogram regarding their experience there was a strong association with a feeling of dissatisfaction and a negative assessment of staff attitude. Both negative assessment of the radiographer's attitude, as well as not being provided with adequate information increased the probability of reporting very unpleasant discomfort by 1.7 and 1.4 times respectively.(13) Similarly Drosseart *et al* found that women who were less satisfied with treatment by staff were less likely to report an intention to rescreen (14), however, when the participants were followed-up they found negative experiences were not strongly predictive of actual re-attendance.(15) Further studies of re-attenders verses non re-attenders have found that those women who dropped out of screening programs were more likely to have had a previous negative experiences of mammograms (16, 17) and were less likely to have found staff competent, welcoming, courteous or easy to question during screening.(9, 18) Interestingly, in our audit, there was no significant difference in probability of client re-attendance between radiographer D who received no complaints and radiographer C, who had the highest ratio of complaints to number of clients screened (0.07%). This may be due to the incredibly low numbers of

complaints lodged, but also suggests that the absence of a complaint cannot be considered equivalent to a satisfied client.

Van Goethem reported that radiographers influence the chance of a woman finding mammography painful and that this in turn influences whether a woman is likely to return to the next round of screening. They reported that radiographers who had been performing mammograms for less than a year or over three years were at greatest risk of their client finding the mammogram painful. Factors found to diminish pain included conversation during mammogram and if the patient was told she could say 'stop' if compression was too strong.(19) Similarly a Norwegian study of 846 women found that the women's perception of the care they experienced was significantly correlated with pain. However these authors did not find the clients perception of care to have a significant effect on re-attendance, possibly due to the relatively small number of women included in the study.(20)

By contrast, in a study of 397 women Tang *et al* found that women who were less satisfied with clinic services were more likely to report that they had obtained a repeat mammogram at 12 months.(21) They do not report whether these women obtained their subsequent mammogram at the same facility or an alternative, possibly seeking a second opinion. Our study is only able to measure re-attendance to BreastScreen WA. It is possible, even probable, that some women apparently failing to re-attend have in fact opted to have subsequent mammograms in the private sector.

<u>Influence of other factors</u>

Interestingly, we found that those women considered most disadvantaged were significantly more likely to re-attend screening than those who were least disadvantaged. This is in contrast to the published literature where a low socio-economic status is identified as a barrier to screening.(4, 14, 22) However it is possible that rather than failing to attend breast screening, those women in the least disadvantaged groups are opting to screen privately. Not only are these least disadvantaged women more likely to be able to afford and therefore access private screening, they are also more likely to be working and therefore look for the convenience of a private clinic. Furthermore, a study conducted within BreastScreen New South Wales (BSNSW) of women who report they are currently screened privately found those women had higher levels of income, education, health insurance coverage as well as being more likely to have had a recent clinical breast examination and a family history of breast cancer.(23)

Consistent with existing evidence that women of ethnic minorities are less likely to attend breast screening programmes,(6, 24) we found that Aboriginal women were almost twice as likely to fail to attend the following screening round than the non-Aboriginal population. A New Zealand based study concentrating on communication at the time of breast screening offers possible insights into underlying causes. Brunton *et al* found that women of Pacific and Maori ethnicity had different communication needs. They were significantly less likely to state they had received a clear explanation of the procedure than European or Asian women and described spoken information as “confusing”, “too fast”, “overwhelming” and felt “there was no room for questions”. (24) In a further study, Treloar et al report that fear of cancer amongst the Aboriginal population prevented effective communication about the meaning and use of screening tests. (25)

We identified a small (5%) but significant increased chance of re-attendance success amongst women of European origin compared to those of born in Australia or New Zealand. We postulate that this variation may arise from personal experiences or understanding of alternative screening programs. The majority of European immigrants to Western Australia are British.(26) The well-established NHS screening program systematically calls every woman (aged between 50 and 70 years) registered with a general practitioner (GP) to a breast screen appointment. Although in some areas it is possible to have a mammogram in the private sector most women opt to attend the free NHS breast screening facilities.

Our results of re-screen success according to rurality are mixed. Whilst the group most likely to re-attend were those living in the urban North Metropolitan areas which is consistent with the publish literature, those in the urban South Metropolitan area were significantly less likely to re-attend.(6, 27) This variation within the Metropolitan area is difficult to explain, although due to the very high numbers (>60,000 women in both regions), any variation is more likely to reach significance. Interestingly, those within the most rural and remote communities did not have the poorest attendance rates. This may be because in the most remote areas the only provider of breast screening is the state-organised screening programme so women would have to travel great distances to access an alternative whereas those women living in the South West, whilst rural, do have access to alternative providers. Another possible explanation for the relatively higher attendance in the most remote communities may be related to social networks. All women within the community are screened at the same time, with minibuses collecting and bringing them to the

screening van. Social networks have been shown to influence a women's likelihood of attending breast screening.(28)

In our study women at higher risk of breast cancer and therefore on the annual screening program were less likely to re-attend than those on standard biennial screening. This may be in part due to a fear of cancer acting as a barrier, although interestingly those with a personal history of breast cancer were more likely to re-attend than those without. A literature review of women with a family history of breast cancer identified a weak positive association between higher perceived risk and adherence to mammographic screening.(29) However one paper included in this review found that a subset of women at very high levels of perceived risk were not more likely to attend, unlike those at a higher perceived risk, suggesting there may be a tipping point beyond which fear of cancer becomes too great.(30) In our study, this finding may also be due to the practicalities of attending screening. Screening vans visit an area every two years; therefore, high risk women are required to attend a static site alternate years. For some women, this may result in a physical barrier to screening, others may opt to screen alternate years in the private sector.

Limitations

This study has a number of significant strengths, including being a population level study from the largest mammography screening provider in Western Australia. However, as a retrospective audit study it was not possible to obtain information, additional to that stored in the screening database that would have informed this study. This includes factors such as BMI and a measure of pain experienced by women. It was not practicable to retrieve the

compression values for the >100,000 individual mammograms and it is noted that evidence suggests that compression alone is not an accurate surrogate marker for pain.(7)
In addition, whilst the state programme is the largest mammographic screening service in Western Australia we are not able to capture the screening behaviour of those women who opt to screen within the private sector. Due this, and the number of women who had migrated from overseas and out-of-state in most cases it was not possible to ascertain whether the study index screen was a women's 'first ever' mammogram. For this reason, we were unable to compare the behaviour of first re-attenders with that of established attenders.

In this audit, it was not possible to investigate potential factors pertaining to individual radiographers such as number of years' experience, age or personal experience of mammography as it would have jeopardised the anonymity of the radiographers.

Summary

This study provides quantitative evidence using multivariate logistic regression analysis that rates of re-attendance to screening may be related to the radiographer performing the previous mammogram. We have demonstrated significant variation in re-attendance rates for clients screened by radiographers, even when controlling for multiple confounding factors. As maintaining high attendance rates to screening programs is essential for the program's success, further prospective research is required to investigate the underlying causes for this variation.

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Figure legends

Table 1: Demographic data for all included women

Table 2: Logistic regression (161,005 examinations involving 101 radiographers)

Table 3: Logistic regression (62,031 examinations involving 11 radiographers)

Figure 1: Number of examinations by rescreen success and failure by radiographer.

Figure 2: Probability of client re-attending screening according to radiographer.

Tables 1 – Demographic data for all included women

Characteristic	Rescreen success (N = 112,537)		Rescreen failure (N = 50,604)		p-value
	N	%	N	%	
Rescreen interval					
11 - 15 months	7,445	7%	4,289	9%	0.000
23 - 27 months	102,885	93%	45,409	91%	
Age Group (years)					
50 - 54	38,386	35%	17,509	35%	0.000
55 - 59	30,992	28%	12,697	26%	
60 - 64	26,290	24%	8,989	18%	
65 - 69	14,662	13%	10,503	21%	
Country of origin					
Aust & NZ	66,156	60%	30,790	62%	0.000
Europe	30,472	28%	13,013	26%	
Other	13,702	12%	5,895	12%	
Aboriginality					
Non-Aboriginal	109,266	99%	48,088	98%	0.000
Aboriginal	940	1%	880	2%	
Area of residence					
Country	14,439	13%	6,790	14%	0.000
North metropolitan	47,256	43%	17,476	35%	
South Metropolitan	39,818	36%	19,476	39%	
South west region	8,173	7%	5,656	11%	
Previous diag. breast Ca					
No	107,919	98%	48,723	98%	0.004
Yes	2,411	2%	975	2%	
Previous diag. ovarian Ca					
No	110,034	100%	49,521	100%	0.002
Yes	295	0%	177	0%	
SEIFA					
Quintile 1 (Most disadv)	3,968	4%	2,119	4%	0.000
Quintile 2	16,562	15%	7,552	15%	
Quintile 3	28,551	26%	13,915	28%	
Quintile 4	23,266	21%	10,554	21%	
Quintile 5 (Least disadv)	37,739	34%	15,483	31%	

Table 2: Logistic regression (161,005 examinations involving 101 radiographers)

Characteristic	OR	95%CI	p-value
Rescreen interval			
11 - 15 months	0.670	0.639 - 0.703	0.000
23 - 27 months	1	ref	-
Age Group (years)			
50 - 69	0.974	0.972 - 0.976	0.000
Country of origin			
Aust & NZ	1	ref	-
Europe	1.055	1.055 - 1.028	0.000
Other	0.994	0.994 - 1.029	0.723
Aboriginality			
Non-Aboriginal	1	ref	-
Aboriginal	0.507	0.459 - 0.559	0.000
Area of residence			
Country	0.865	0.821 - 0.911	0.000
North metropolitan	1	ref	-
South Metropolitan	0.791	0.765 - 0.818	0.000
Southwest region	0.671	0631 - 0.712	0.000
Previous diag. breast Ca			
No	1	ref	-
Yes	1.772	1.621 - 1.937	0.000
Previous diag. ovarian Ca			
No	1	ref	-
Yes	1.129	0.928 - 1.372	0.225
SEIFA			
Quintile 1 (Most disadv)	0.956	0.897 - 1.019	0.171
Quintile 2	1.113	1.113 - 1.157	0.000
Quintile 3	1.056	1.056 - 1.023	0.001
Quintile 4	0.987	0.957 - 1.019	0.422
Quintile 5 (Least disadv)	1	ref	-
Radiographer			
All radiographers			0.000
Constant	12.803		0.000

Table 3: Logistic regression (62,031 examinations involving 11 radiographers)

Characteristic	OR	95%CI	p-value
Rescreen interval			
11 - 15 months	0.702	0.650 - 0.757	0.000
23 - 27 months	1	ref	-
Age Group (years)			
50 - 69	0.973	0.970 - 0.976	0.004
Country of origin			
Aust & NZ	1	ref	-
Europe	1.080	1.037 - 1.125	0.000
Other	1.022	0.970 - 1.077	0.419
Aboriginality			
Non-Aboriginal	1	ref	-
Aboriginal	0.554	0.478 - 0.641	0.000
Area of residence			
Country	0.869	0.801 - 0.942	0.001
North metropolitan	1	ref	-
South Metropolitan	0.728	0.694 - 0.764	0.000
Southwest region	0.764	0.693 - 0.843	0.000
Previous diag. breast Ca			
No	1	ref	-
Yes	1.734	1.501 - 2.003	0.000
Previous diag. ovarian Ca			
No	1	ref	-
Yes	1.161	0.838 - 1.608	0.369
SEIFA			
Quintile 1 (Most disadv)	1.056	0.960- 1.162	0.260
Quintile 2	1.180	1.107 - 1.258	0.000
Quintile 3	0.991	0.944 - 1.039	0.701
Quintile 4	1.022	0.975 - 1.072	0.367
Quintile 5 (Least disadv)	1	ref	-
Radiographer			
A	1.010	0.945 - 1.078	0.775
B	1	ref	-
C	0.937	0.856 - 1.026	0.162
D	0.968	0.895 - 1.046	0.410
E	0.810	0.723 - 0.906	0.000
F	1.293	1.197 - 1.396	0.000
G	0.950	0.884 - 1.021	0.162
H	1.384	1.273 - 1.505	0.000
I	1.215	1.126 - 1.310	0.000
J	1.237	1.144 - 1.338	0.000
K	1.290	1.175 - 1.417	0.000
Constant	2.647		0.002

Figure 1: Number of examinations by rescreen success and failure by radiographer.

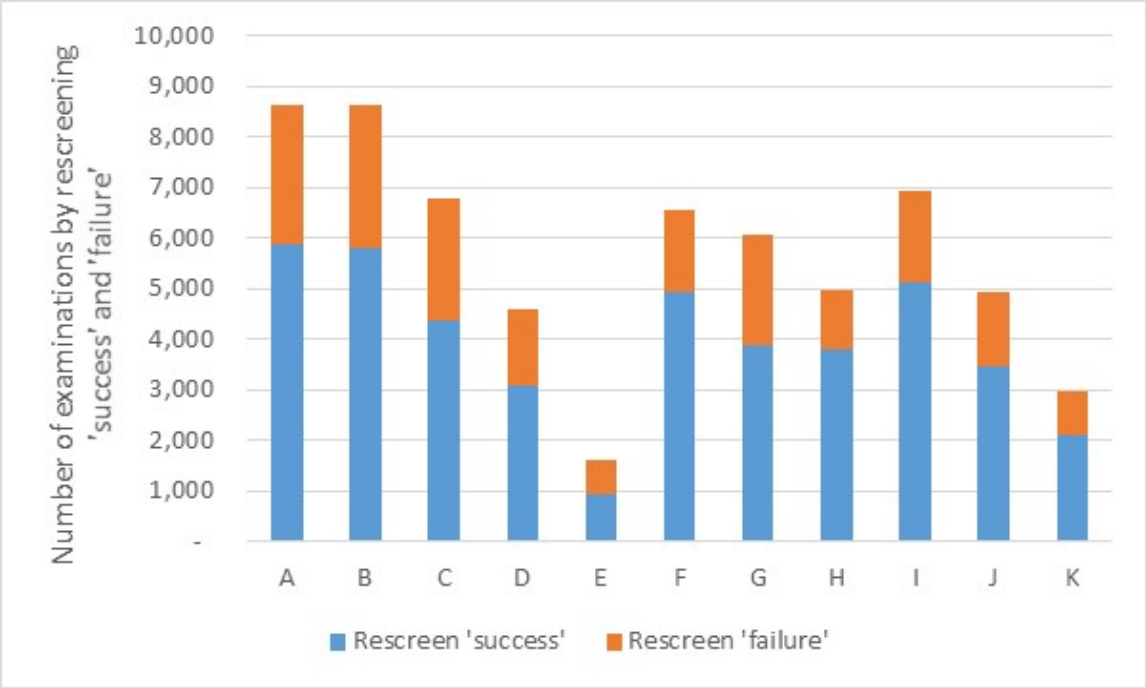

Figure 2: Probability of client re-attending screening according to radiographer.