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Test-set participation may impact cancer detection in screening mammography

Basel A. Qenam*, Ernest Ekpo, Tong Li, and Patrick C Brennan

Medical Image Optimisation and Perception Research Group (MIOPeG), School of Health Sciences, Faculty of Medicine and Health, The University of Sydney

Email: bqen8833@uni.Sydney.edu.au

Introduction

Every day, 9 Australians die from breast cancer [1]. Early detection through screening reduces deaths by 20-40% [2], but 30% of cancers are missed mostly due to reader-related limitations [3]. Simulation-based training via mammographic test sets is used to upskill readers [4-6]. However, little is known about how benefit gained in test sets could translate to the clinical environment.

Figure 1: Test-set training simulates the clinical environment of actual breast cancer screening.

Aim

To investigate if test-set participation affects routine breast cancer screening performance.

Methods

Participants:

- Clinical audit results for breast screening readers in New South Wales (NSW), Australia, was derived from Cancer Institute NSW.
- The results represented annual clinical performance for the readers between 2010 and 2018, inclusive.
- The dataset was de-identified and linked to BreastScreen Reader Assessment Strategy (BREAST) test-set participation history to define who have participated in test-set training and the year it was completed.
- To be eligible for this study, readers had to be radiologists (i.e. not trainees), have audit data for at least 7 years within the study's defined period, and in those read an average of > 2000 breast screening cases annually (Figure 2).

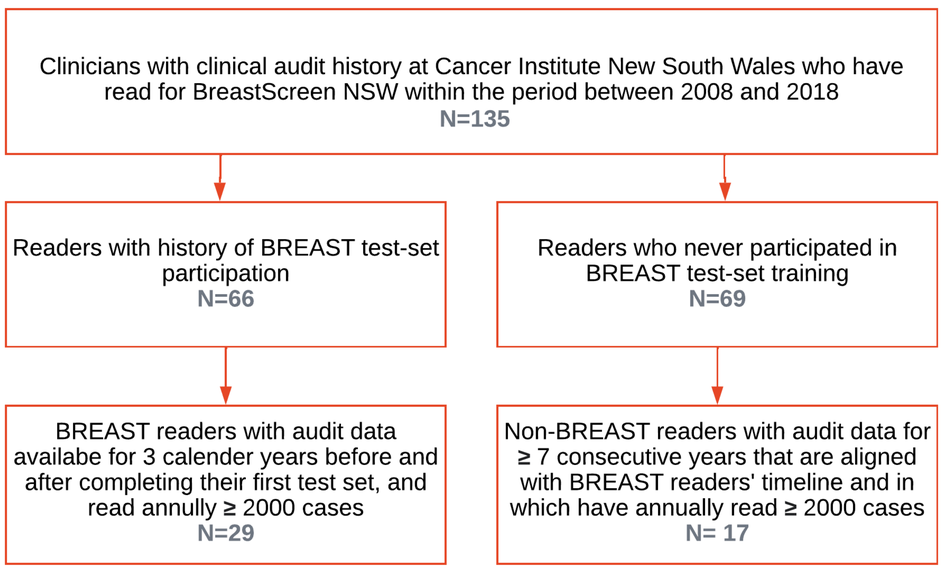

Figure 2: Flowchart shows the criteria of study participants and sub-groups

Analysis:

- The annual audit data for each BREAST reader was divided according to the year they completed their first test-set *(pre-training vs. post-training)* as shown in Figure 3.

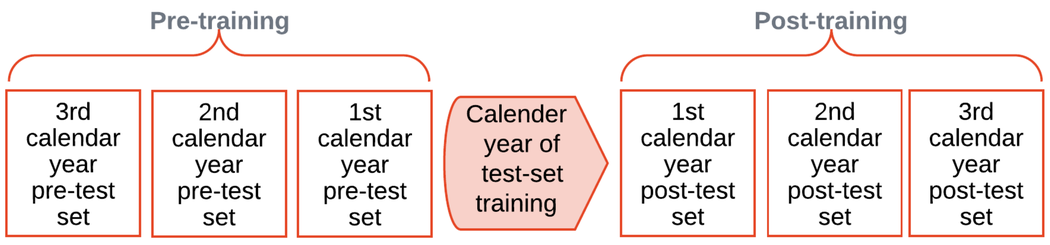

Figure 3: A timeline illustrating the two compared periods of the study

- Each non-BREAST reader was compared with a BREAST reader so that performance could be analysed over the same years.
- To identify differences in the progress of the two cohorts' performance, Wilcoxon Signed Ranks test (alpha = 0.05) was used to compare multiple audit-reported parameters, which represent actual breast-screening reading performance:

Recall rate - prevalent round	Recall rate - subsequent screening rounds	Positive predictive value (PPV)	Detection rate of invasive cancer	Detection rate of small invasive cancer	Detection rate of ductal carcinoma in situ (DCIS)	Detection rate of all invasive cancer and DCIS

Results

Table 1: The median (M) and standard deviations (SD) of BREAST reader's (n=29) audit performance parameters in the pre-training and the post-training periods.

Parameter	M (SD) pre-training	M (SD) post-training	p-value
Recall rate for prevalent round	13.22 (3.93)	13.44 (4.54)	0.34
Recall rate for subsequent screening rounds	5.56 (2.16)	5.11 (2.27)	0.09
PPV	8.44 (2.49)	10.07 (3.17)	**0.001**
Detection rate of invasive cancer*	40.99 (9.67)	47.43 (8.33)	**0.01**
Detection rate of small invasive*	24.29 (6.72)	26.31 (4.83)	0.38
Detection rate of DCIS*	10.08 (3.68)	12.65 (4.93)	**0.03**
Detection rate of all invasive cancer and DCIS*	51.59 (11.71)	60.06 (11.38)	**0.01**

** Because of the low prevalence in the screened population, breast cancer detection rates are reported per 10,000 cases in Australia [7].*

Table 2: The median (M) and standard deviations (SD) of non-BREAST reader's (n=17) audit performance parameters in the pre-training and the post-training periods.

Parameter	M (SD) pre-training	M (SD) post-training	p-value
Recall rate for prevalent round	12.82 (3.80)	11.37 (4.62)	0.96
Recall rate for subsequent screening rounds	6.06 (1.58)	4.79 (1.34)	**0.03**
PPV	8.41 (2.79)	10.15 (3.57)	**0.02**
Detection rate of invasive cancer*	46.94 (6.50)	47.66 (6.44)	0.82
Detection rate of small invasive*	28.09 (4.45)	26.96 (4.17)	1.00
Detection rate of DCIS*	7.85 (2.54)	10.69 (3.61)	0.12
Detection rate of all invasive cancer and DCIS*	54.77 (6.75)	55.35 (6.90)	0.28

** Because of the low prevalence in the screened population, breast cancer detection rates are reported per 10,000 cases in Australia [7].*

Conclusion

Participation in mammographic test sets is associated with improvements in cancer detection rates in routine screening mammography.

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