ORIGINAL ARTICLE

# Influences of Radiology Trainees on Screening Mammography Interpretation

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## Abstract

**Purpose:** Participation of radiology trainees in screening mammographic interpretation is a critical component of radiology residency and fellowship training. The aim of this study was to investigate and quantify the effects of trainee involvement on screening mammographic interpretation and diagnostic outcomes.

**Methods:** Screening mammograms interpreted at an academic medical center by six dedicated breast imagers over a three-year period were identified, with cases interpreted by an attending radiologist alone or in conjunction with a trainee. Trainees included radiology residents, breast imaging fellows, and fellows from other radiology subspecialties during breast imaging rotations. Trainee participation, patient variables, results of diagnostic evaluations, and pathology were recorded.

**Results:** A total of 47,914 mammograms from 34,867 patients were included, with an overall recall rate for attending radiologists reading alone of 14.7% compared with 18.0% when involving a trainee ($P < .0001$). Overall cancer detection rate for attending radiologists reading alone was 5.7 per 1,000 compared with 5.2 per 1,000 when reading with a trainee ($P = .517$). When reading with a trainee, dense breasts represented a greater portion of recalls ($P = .0001$), and more frequently, greater than one abnormality was described in the breast ($P = .013$). Detection of ductal carcinoma in situ versus invasive carcinoma or invasive cancer type was not significantly different. The mean size of cancers in patients recalled by attending radiologists alone was smaller, and nodal involvement was less frequent, though not statistically significantly.

**Conclusions:** These results demonstrate a significant overall increase in recall rate when interpreting screening mammograms with radiology trainees, with no change in cancer detection rate. Radiology faculty members should be aware of this potentiality and mitigate tendencies toward greater false positives.

**Key Words:** Screening mammography, breast radiologist, radiology education, medical education, radiology trainees

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## INTRODUCTION

Breast cancer is the most common form of cancer among women in the United States and the second leading cause of cancer death [1]. Mammographic screening for breast cancer is well established and widely performed throughout the world under different screening programs and in varying settings. There are established variables affecting mammography recall rates (RRs) and cancer detection rates (CDRs). These include patient factors such as breast density [2], age [3,4], use of hormone replacement therapy [2,5], interval since prior mammographic study [3], family history [6], and prior biopsy results [6]. Interpreting physician factors may include radiologist's sex [7], experience [7,8], practice setting [9], annual case volume [10], and fellowship training [7,11]. Practice-related influences may include the use of computer-aided detection (CAD) [12], double reading [13], and batch reading [14].

Many screening studies are performed at institutions at which trainees are present and participate directly in interpretation and reporting. There are currently 184 accredited radiology residency programs [15] and 76 radiology breast imaging fellowships [16] in the United

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States. Training in mammography, including the interpretation of screening mammograms, is an important component of a radiology residency program, and the Mammography Quality Standards Act sets forth minimum training standards for interpreting physicians [17].

To date, there is little published information regarding the effect of radiology trainees on interpreting physicians' performance in screening mammography. In fact, there has been little investigation into the effect of trainee involvement on diagnostic performance and accuracy in radiology in general. The purpose of this study was to investigate the effect of trainee involvement on screening mammographic interpretation and subsequent diagnostic outcomes.

## METHODS

This retrospective study was approved by the institutional review board and compliant with HIPAA, with a waiver of requirement to obtain informed consent.

### Study Population

Screening mammograms interpreted at an academic tertiary referral center by six dedicated breast imagers with varying years of experience between January 1, 2011, and December 31, 2013, were identified through a search of the radiology information system. The screening population included asymptomatic women 35 years of age and older without personal histories of prior breast cancer. The screening mammograms were performed using 2-D full-field digital mammography, with CAD available for each examination. Sites at which screening examinations were performed include a dedicated, full-service breast imaging center, six satellite imaging centers in the community, as well as a mobile mammography unit.

### Mammographic Interpretation

Screening mammograms were interpreted using a batch-reading format by six dedicated breast imagers with varying training characteristics and experience. Readers 1, 2, and 3 all had fellowship training in breast imaging and were newly out of fellowship at the beginning of the study period. Readers 4 and 5 both had fellowship training in breast imaging and had practiced breast imaging for four years. Reader 6 did not have dedicated fellowship training but had 28 years of practice experience in breast imaging. Mammograms were interpreted either by an attending radiologist alone or in conjunction with a trainee. The trainees included in this study were second- through fourth-year radiology residents as well as breast imaging fellows and fellows from other radiology subspecialties participating in breast imaging elective rotations. When involved in a case, trainees initially made a draft interpretation using dictation software and saved marks on the images to indicate findings they believed required additional imaging evaluation or discussion. Attending radiologists then reviewed cases in batch interpretation sessions with the trainees, discussing each case individually.

Screening mammograms were considered to have normal findings if assigned a BI-RADS® 1 (negative) or 2 (benign) assessment. Screening mammograms were considered to have abnormal findings when assigned a BI-RADS 0 (incomplete—need additional imaging evaluation) assessment. As a practice, BI-RADS assessments 3 (probably benign), 4 (suspicious), and 5 (highly suggestive of malignancy) were not assigned to screening mammograms. Repeats for technical reasons were classified on the basis of the final BI-RADS assessment after the insufficiency was corrected. Studies assigned to BI-RADS category 0, for which no data were available on diagnostic evaluation or subsequent mammography, were excluded from the analysis.

The participation of a trainee in the interpretation of a screening examination was recorded. Additional recorded variables associated with the screening study included the presence of prior comparative mammograms for review, patient age, if one or both breasts were recalled for additional imaging, the number of abnormalities reported per breast, and breast density as described in the BI-RADS manual [18]. The results of patients' subsequent diagnostic evaluations as well as the performance of subsequent biopsies and final pathologic results including cancer size, histology, and axillary nodal status were also recorded when available. Patients given diagnoses of invasive carcinoma or ductal carcinoma in situ within one year of the screening mammogram were included as representing breast cancer cases.

### Statistical Analysis

The data were analyzed using SAS version 9.3 (SAS Institute Inc, Cary, North Carolina). Before analysis, the data were examined for outliers, and no extreme values were found. Descriptive statistics are reported as either mean $\pm$ SD or total number with percentage and 95% confidence interval. Chi-square tests were used to explore associations between groups and other categorical variables. Student's $t$ tests or analysis of variance was used for group comparisons. The significance level was set at $\alpha \leq 0.05$.