

Assessing Resident Performance in Screening Mammography: Development of a Quantitative Algorithm

Petra J. Lewis, MBBS, Timothy B. Rooney, MD, Tracy E. Frazee, BS, Steven P. Poplack, MD

Rationale and Objectives: This study aims to provide objective performance data and feedback, including examination volumes, recall rates, and concordance with faculty interpretations, for residents performing independent interpretation of screening mammography examinations.

Method and Materials: Residents (r) and faculty (f) interpret screening mammograms separately and identify non-callbacks (NCBs) and callbacks (CBs). Residents review all discordant results. The number of concordant interpretations (fCB-rCB and fNCB-rNCB) and discordant interpretations (fCB-rNCB and fNCB-rCB) are entered into a macro-driven spreadsheet. These macros weigh the data dependent on the perceived clinical impact of the resident's decision. Weighted outcomes are combined with volumes to generate a weighted mammography performance score. Rotation-specific goals are assigned for the weighted score, screening volumes, recall rate relative to faculty, and concordance rates. Residents receive one point for achieving each goal.

Results: Between July 2013 and May 2017, 18,747 mammography examinations were reviewed by 31 residents, in 71 resident rotations, over 246 resident weeks. Mean resident recall rate was 9.9% and significantly decreased with resident level (R), $R_2 = 11.3\%$ vs $R_3 = 9.4\%$, $R_4 = 9.2\%$. Mean resident-faculty discordance rate was 10% and significantly decreased from $R_2 = 12\%$ to $R_4 = 9.6\%$. Weighted performance scores ranged from 1.1 to 2.0 (mean 1.6, standard deviation 0.17), but did not change with rotation experience. Residents had a mean goal achievement score of 2.6 (standard deviation 0.47).

Conclusions: This method provides residents with easily accessible case-by-case individualized screening outcome data over the longitudinal period of their residency, and provides an objective method of assessing resident screening mammography performance.

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INTRODUCTION

Resident training in screening mammography is challenging from both the resident learner and the faculty educator perspectives. Unlike other subspecialties in diagnostic radiology, residents rarely view mammograms outside of their dedicated mammography rotation and thereby tend to have less familiarity with the range of normal mammographic findings and manifestations of pathology. Furthermore, workstation requirements are tightly regulated and expensive (1), which often limits access to resident review of mammograms. Teaching screening mammography to diagnostic radiology residents poses unique challenges for the faculty. The screening paradigms in academic settings vary, often including some combination of batch interpretations, real-time reading

(while patients wait), or interpretation interspersed with diagnostic breast imaging examinations. Most high-volume academic screening practices rely on batch reading. Integrating residents into the batch reading process is particularly challenging for both residents and staff and in order for staff to maintain high levels of accuracy and efficiency, residents may be relegated to a more passive observer role. To maintain concentration, accuracy, and efficiency, staff may be less motivated or capable of providing adequate instruction (2).

Assessing resident performance in screening mammography also poses challenges. What metric or combination of metrics is most important—examination volumes, interpretative speed, recall rates, overall accuracy, or false-positive and false-negative rates? In light of these challenges, evaluation of resident screening mammography skills tends to be subjective, or at most, include minimal performance measures such as examination volume.

In our institution, screening mammograms are batch-read each morning by a single faculty member (40–60 per morning session). Residents rotate through the department during PGY 3–5 (R2–4), spending a minimum of 3 months in breast imaging as per Accreditation Council for Graduate Medical Education requirements. Rotations are typically 4-week blocks

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From the Department of Radiology, Dartmouth Hitchcock Medical Center, 1 Medical Center Drive, Lebanon, NH 03766 (P.J.L., T.J.R., T.E.F.); Mallinckrodt Institute of Radiology, Washington University, St. Louis, Missouri (S.P.P.). Received October 6, 2017; revised November 16, 2017; accepted November 21, 2017. Address correspondence to: P.J.L. e-mail: Petra.J.Lewis@Hitchcock.org

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and may be reduced to 3 weeks by vacation; fourth-year residents may have multiple shorter rotations. Based on the challenges in learning, teaching, and evaluating screening mammography, we decided to develop a system that would provide active independent resident viewing of screening examinations; timely resident feedback of performance metrics; and an objective/quantitative system to assess resident screening skills, based on volumes, recall rates, and concordance and discordance rates. This system would also define resident level-appropriate screening performance goals, and be used by faculty to evaluate residents and enable early intervention if necessary.

MATERIALS AND METHODS

Resident Screening Protocol

Residents are given explicit screening goals (Table 1), which are included in their breast rotation handbook, at the beginning of each rotation (3). Goals include weekly screening examination volumes, recall ratio (relative to staff), concordance rates, and weighted summary score. These goals are intended to maximize screening sensitivity over specificity (eg, higher resident recall rates are expected compared to staff rates). Volume, recall ratio, and concordance goals increase from the first (R2) to third (R4) residency years, as speed and accuracy should improve with experience (4). These goals were determined through discussion between the authors (PJJ, TBR

and SPP), all experienced breast imagers based on appropriate graduated volumes and the other parameters that they felt should be achievable by time of graduation.

Residents screen during uninterrupted half-day sessions, batch reviewing studies that have already been reported by faculty. Unlike other radiology subspecialties, resident “pre-reading” of screening mammograms does not save faculty time, as residents do not usually dictate screening mammograms so there are no gains in interpretation efficiency. Residents read each mammogram blindly and independently on a dedicated mammography workstation (Softcopy Workstation, Hologic Inc, Danbury, CT). This provides residents an opportunity for active interpretation, with the ability to control and develop their own report flow, system, and pace of interpretation. Recall status (determined by faculty) is opaque to the resident on the viewing interface. We recommend all residents spend at least 3 half-days per week interpreting screenings, although junior residents may initially require more sessions and self-adjust their screening frequency accordingly.

Residents are supplied a screening examination worksheet (Fig 1) that is used as the primary input to calculate performance metrics. Residents determine recall status (callback [CB] vs non-callback [NCB]), and when recall is designated, include recall finding type using BI-RADS descriptors (5) and recall location (ie, side and quadrant). Following each screening batch, the resident performs a concordance assessment and reviews discordant cases. Over the course of this study, two mechanisms were utilized by residents to review faculty screening results. From July 2013 to August 2015, residents accessed the worksheets completed by the reading faculty member. Beginning in September 2015, faculty switched to a paperless system. Consequently, residents compared their callbacks to faculty callback data generated by the mammographic workflow coordinator. The faculty decision is considered the “gold standard,” and residents discuss individual cases with the reading faculty member as necessary. Following review, worksheets are signed by faculty and submitted to assigned administrative personnel, who subsequently

TABLE 1. Resident Screening Mammography Goals by Resident Year

Goal	R2	R3	R4
Volume per week	60	70	80
Resident/Faculty recall ratio	100%–300%	100%–250%	75%–200%
Concordance rates	>70%	>80%	>90%
Weighted score	>1.4	>1.5	>1.6

Date: _____

Interpreting staff: _____

Mammo Screening Board

Resident: _____

					RESIDENTS FILL OUT THIS SIDE COMPLETELY												
SCORE	NAME	MRN	STAFF CALL BACK	RESIDENT CALL BACK	SITE			SIDE		FINDING		LIKELY FINAL BI-RADS					
			Y	Y N	U	L	O	I	L	R	MASS	CALCS	1	2	3	4	5
						RA	DC				ARCH	ASYM					
RESIDENT NOTES																	
STAFF NOTES																	
SCORE	NAME	MRN	STAFF CALL BACK	RESIDENT CALL BACK	SITE			SIDE		FINDING		LIKELY FINAL BI-RADS					
			Y	Y N	U	L	O	I	L	R	MASS	CALCS	1	2	3	4	5
						RA	DC				ARCH	ASYM					
RESIDENT NOTES																	
STAFF NOTES																	
SCORE	NAME	MRN	STAFF CALL BACK	RESIDENT CALL BACK	SITE			SIDE		FINDING		LIKELY FINAL BI-RADS					
			Y	Y N	U	L	O	I	L	R	MASS	CALCS	1	2	3	4	5
						RA	DC				ARCH	ASYM					
RESIDENT NOTES																	
STAFF NOTES																	

Figure 1. The worksheet used by residents to record their screening interpretations.

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