Published in final edited form as:

J Am Coll Radiol. 2015 December ; 12(12 0 0): 1419–1426. doi:10.1016/j.jacr.2015.06.001.

Characterizing the mammography technologist workforce in North Carolina

Louise M. Henderson, MSPH, PhD^{1,2}, Mary W. Marsh, MPH¹, Thad Benefield, MS¹, Elizabeth Pearsall, BSRT-R(M), Danielle Durham, MPH², Bruce F. Schroeder, MD^{1,3,4}, J. Michael Bowling, PhD⁵, Cheryl A. Viglione, MD, and Bonnie C. Yankaskas, PhD¹

¹Department of Radiology, The University of North Carolina, Chapel Hill, NC 27599

²Department of Epidemiology, The University of North Carolina, Chapel Hill, NC 27599

³Carolina Breast Imaging Specialists, Greenville NC 27599

⁴Departments of Radiology and Oncology, The Brody School of Medicine at East Carolina University, Greenville NC 27834

⁵Department of Health Behavior, The University of North Carolina, Chapel Hill, NC 27599

Abstract

Background—Mammography technologists' level of training, years of experience, and feedback on technique may play an important role in the breast cancer screening process. However, very little information on the mammography technologist workforce exists.

Methods—In 2013, we conducted a mailed survey to 912 mammography technologists working in 224 Mammography Quality Standards Act accredited facilities in North Carolina. Using standard survey methodology we developed and implemented a questionnaire focused on the education and training, work experiences, and workplace interactions of mammography technologists. We aggregated responses using survey weights to account for non-response. We describe and compare lead (administrative responsibilities) and non-lead (supervised by another technologist) mammography technologist characteristics, testing for differences using t-tests and chi-square tests.

Results—A total of 433 mammography technologists responded (survey response rate=47.5%; 95% confidence interval:44.2%-50.7%), including 128 lead and 305 non-lead technologists. Most mammography technologists were non-Hispanic, white, females and the average age was 48 years. Approximately 93% of lead and non-lead technologists had mammography specific training but <4% had sonography certification and 3% had MRI certification. Lead technologists reported more years performing screening mammography (p-value=0.02) and film mammography (p-

Address for Correspondence: Louise M. Henderson, MSPH PhD, Department of Radiology, CB #7515, The University of North Carolina, Chapel Hill, NC 27599-7515, Tel 919.843.7799, Fax 919.966.0525, Louise_Henderson@med.unc.edu.

Conflicts of Interest

Dr. Schroeder is a paid consultant for GE Healthcare and is a stockholder for Matakina, Inc. and Koning Corporation.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

value=0.03), more administrative hours (p-value<0.0001), and more workplace autonomy (p-value=0.002) than non-lead technologists. Non-lead technologists were more likely to report performing diagnostic mammograms (p-value=0.0004) or other breast imaging (p-value=0.001), discuss image quality with a peer (p-value=0.013), and have frequent face-to-face interaction with radiologists (p-value=0.03).

Conclusion—Our findings offer insights into mammography technologists' training and work experiences, highlighting variability in technologist characteristics between lead and non-lead technologists.

Keywords

mammography; workforce; technologist; variability

Introduction

National estimates indicate that over 38 million mammogram procedures are performed annually in Mammography Quality Standards Act (MQSA) accredited facilities.[1] Each of these mammograms are performed by a mammography technologist and interpreted by a radiologist. While there is considerable literature describing and evaluating radiologists' characteristics associated with mammography performance [2–8], there is little information available on the technologists who carry out these examinations. Often the technologist is the sole point of contact for the patient during her breast screening experience.

The mammography technologist is responsible for the quality of the image, which includes the accuracy of positioning which is crucial for the radiologist to make an accurate interpretation. The MQSA of 1993 requires technologists performing mammography to hold state licensure and/or certification from a Food and Drug Administration's (FDA) approved certifying agency.[9] MQSA also established minimum training and continuing education requirements specific to breast imaging for all technologists performing mammography, including a required minimum volume of 200 mammogram procedures performed in the 24 months prior to a facility's annual MQSA inspection.[9]

Given the sparse data on mammography technologists and the critical role they play in the breast cancer screening process, we sought to describe the mammography technologist workforce and compare technologist characteristics and workplace experiences among the lead and non-lead technologists. We hypothesize that attributes of lead and non-lead technologists differ and that these differences (i.e. in terms of the number of years of experience or how they interact and communicate with radiologists) are important in understanding the role of the mammography technologist.

Material and Methods

Survey Methodology

We conducted a mailed survey to all radiologic technologists at MQSA certified facilities in North Carolina. The MQSA certified facilities were identified through the FDA website which maintains a public database of registered mammography machines.[10] Using the

FDA database, we identified 236 accredited facilities in North Carolina during the fall of 2012. Since facility certification status may change over time, additional facilities may have been added or removed from this list to date. Each facility was contacted by phone to determine the number of technologists performing mammograms and the best point of contact for distributing surveys to the technologists. Through this process, 7 facilities were identified as satellite offices that rotate technologists and 5 facilities were identified as either no longer having a mammography machine or had plans to close the breast imaging department. Among the final sample of 224 North Carolina MQSA certified mammography facilities, 912 individual technologists performing mammography were identified. Of these, 238 served as lead technologists (defined as having administrative duties) and 674 served as non-lead technologists (defined as being supervised by another technologist) at the time of survey distribution in the spring of 2013.

The survey content was developed through collaboration with two breast imaging radiologists, three mammography technologists, an epidemiologist, and a survey methodologist. A total of 50 survey questions were included and focused on technologist socio-demographics, education and training, technologists' workplace involvement (responsibilities, experiences, and interactions with radiologists and other technologists), and facility level questions. Education questions included those related to degrees and certifications obtained, as well as continuing education. The work responsibility questions covered the type of imaging and non-imaging performed (film and digital mammography, other non-mammography breast imaging, other non-breast imaging, and administrative hours or non-clinical work), as well as the number of years of experience for each responsibility. Workplace interaction questions focused on communication and contact of technologists with peers and radiologists. These were designed to understand how the technologist works with peers as well as with one or several radiologists and how the technologist communicates with the radiologist (i.e. do they mark findings on images, make decisions about taking extra views without first consulting with the radiologist or have they ever been notified to improve positioning of the patient). Facility level questions were asked of the lead technologist to determine facility academic affiliation, staffing structure, and mammography certification requirements for mammography technologists.

The survey was pre-tested with three technologists from a breast imaging facility outside of North Carolina. The purpose of pre-testing was to receive feedback from technologists not participating in the study with regard to survey flow, design, and ease of understanding and responding to the survey questions. Responses from the pre-testing led to minor modifications in the survey to clarify the intent of several questions.

We employed the "Mail and Telephone Surveys, the Total Design Method" by Dillman for our survey methodology.[11] A pre-notification letter was mailed to the lead technologist at each of the 224 breast imaging sites 2 weeks prior to mailing each lead technologist a study packet. Study packets included a formal cover letter introducing the project, a research informational sheet which defined the rights and expectations of each survey participant, surveys for the lead and non-lead technologists, a \$10 cash incentive for the lead technologist and a \$5 cash incentive for the non-lead technologists, and a pre-paid return envelope. Lead technologists were asked to distribute the surveys to all other non-lead

technologists working at the mammography facility. Return of the survey implied consent for participation in the study. Reminder postcards were sent 2 weeks post survey distribution if the facility had at least one outstanding non-response. If no response was received after 2 weeks, additional copies of the survey with no incentive were mailed to the non-response facilities. A final reminder postcard was sent 2 weeks later. This prospective study was compliant with the Health Insurance Portability and Accountability Act and was approved by the University of North Carolina at Chapel Hill Institutional Review Board.

Responses from returned questionnaires were double entered into a secure database. Consistent data entry was confirmed using a statistical analysis package (SAS version 9.3). All data entry disagreements were compared to the returned questionnaire and adjudicated.

Statistical Analyses

We describe the characteristics and responses of the survey for the lead and non-lead technologists and compare survey responses between these two groups using t-tests and chi-square tests. To account for the study response rate, we used procedures that adjust for non-response by utilizing survey weights in the calculations of descriptive statistics.[12] The survey weights were calculated as the inverse of selection probabilities. The selection probabilities were derived by modeling the questionnaire response probabilities as a function of a set of facility-level covariates, using logistic regression. Probabilities and associated survey weights were assigned for each facility, based on their covariate values.[12]

Results

Socio-demographic Characteristics of the Technologists and Mammography Facilities

A total of 433 mammography technologists responded to the survey (response rate 47.5%; 95% Confidence Interval (CI): 44.2% – 50.7%). Of these, 128 were lead technologists (response rate 53.8%; 95% CI: 47.4%-60.1%) and 305 were non-lead technologists (response rate 45.3%; 95% CI: 41.5%-49.0%). The majority of technologists in our study were non-Hispanic, white, and female with an average age of 48 years (ranging from 24 to 71 years) (Table 1). Of the facilities surveyed, 85% were independent of an academic medical center and 81% were not a dedicated breast center. On average, facilities contained 1 to 2 mammography machines, 6 radiologists that interpreted mammograms, and had 4 technologists on site that perform breast imaging procedures on a given day. For these facilities, 99% of radiologists read screening mammograms in batches and 69% read diagnostic mammograms while the patient waited.

Technologists' Education and Training

Based on survey responses, lead and non-lead technologists had similar education and training experiences (Table 2). The most common type of education reported was an associate's degree (61% of lead technologists and 64% of non-lead technologists) followed by completion of a radiology certification program (31% of both lead and non-lead technologists). Additionally, 85–86% of both lead and non-lead technologists had mammography-specific training with an American Registry of Radiologic Technologists (ARRT) certification. Less than 25% of lead and less than 30% of non-lead technologists

had other certifications, with 2.3% of lead and 3.6% of non-lead technologists reporting sonography certification and 3.8% of lead and 1.8% of non-lead reporting MRI certification.

Technologists' Workplace Involvement

Lead technologists reported having more years of experience performing film mammography compared with non-lead technologists (14.5 years versus 11.9 years respectively, p -value= 0.029); however, the two groups did not differ in the number of years of experience performing digital mammography (Table 3). The average number of years performing screening mammography was significantly higher for lead than non-lead technologists (17.2 years versus 14.7 years respectively, p -value=0.02) with a wide range of 0 to 43 years of experience. Lead technologists also average more years of experience performing diagnostic mammograms but this was not statistically higher than that for non-lead technologists. As expected, lead technologists reported more hours of administrative activities per week than non-lead technologists (average of 8 hours versus 3 hours, respectively, p -value<0.0001). Both lead and non-lead technologists reported 2 or more hours of non-imaging clinical responsibilities per week.

The number of diagnostic examinations performed in 2012 was higher for non-lead versus lead technologists (p -value=0.04). Non-lead technologists reported performing diagnostic mammograms and non-mammography breast imaging more frequently than lead technologists (average of 7 hours per week versus 5 hours per week, respectively, p -value= 0.0004). Non-lead technologists averaged 2 hours a week completing non-mammography breast imaging such as breast ultrasound or MRI compared to an average of 1 hour for lead technologists (p -value=0.001).

Peer Interactions of the Technologists

In terms of interactions with their peers, non-lead technologists were more likely to have a mentor than to be a mentor (p -value< 0.0001); whereas lead technologists were less likely to have a mentor (p -value=0.001) and more likely to be the only technologist at their mammography facility (p -value< 0.0001) (Table 4). Survey responses showed that non-lead technologists reviewed mammograms or other breast images with other technologists more frequently than lead technologists for image quality (p -value=0.013) and for diagnostic assessment (p -value=0.002) before sending the image to a radiologist. Lead technologists were more likely to mark screening mammogram images prior to the radiologist's review (p -value= 0.009).

Interactions with Radiologists

Non-lead technologists reported more frequent, direct face-to-face interaction with radiologists compared to lead technologists (p -value= 0.03) (Table 5). In addition, non-lead technologists communicated with radiologists more frequently than lead-technologists with 84.3% of non-lead technologists having interactions more than once per week versus 72.9% of lead technologists (p -value=0.03). As expected, a low proportion of lead and non-lead technologists reported often having a discussion of screening mammograms with radiologists (10.7% and 7.4%, respectively); in contrast, 50.6% of lead and 62.6% of non-lead technologists reported discussing diagnostic mammograms with radiologists.

Discussion

The mammography technologist workforce in North Carolina is primarily composed of non-Hispanic, white women in their late 40s. In our sample of 433 mammography technologists we observed considerable variability in terms of the distribution of age, work experiences, and interactions with other technologists and radiologists. The lead and non-lead technologists were similar in terms of education and training yet compared with lead technologists, non-lead technologists were more likely to perform diagnostic mammography, other non-mammography breast imaging, have a mentor, review images with their peers for quality and diagnostic purposes, and communicate with radiologists face to face more than once a week.

Given that mammography technologists reported having frequent direct interaction with radiologists, one could predict that technologists play an important role in the performance of screening and diagnostic mammography. In our prior work, we found that technologists do in fact contribute to the observed variability of screening and diagnostic mammography performance.[13, 14] An important factor for mammography performance, specifically sensitivity, is breast positioning during the examination.[15] While the quality of the image is related to both the calibration of the mammography machine and the skill of the technologist, the technologist is ultimately responsible for obtaining correct positioning and sufficient compression to maximize image sharpness. Without quality imaging, mammography is at risk of failing and patients are at risk for later stage breast cancer diagnosis or interval cancers.[16, 17] We suspect that through regular image quality feedback from radiologists, technologists may have considerable impact on mammography performance.

Our survey results indicate that most mammography technologists are not certified for other screening modalities, with less than 4% of technologists reporting to have sonography certification and 3% reporting to have an MRI certification. Diagnostic breast sonography and MRI have their own technologist certification processes. It is rare for technologists to specialize in mammography and one of these certifications.[18, 19] Breast sonography has usually been performed by radiologists rather than technologists.[20] With the passage of the breast density legislation in 21 states across the country as of January 2015 [21] and in North Carolina effective January 1, 2014, women with dense breast tissue (defined as BI-RADS extremely dense or heterogeneously dense) are receiving notification in their results letter stating that they may benefit from supplemental imaging such as sonography or MRI. Given that an estimated 43% of women will fall into the dense breast category,[22] it appears as though there may be a need for more mammography technologists trained as subspecialists capable of performing supplemental breast imaging tests.

We found that non-lead technologists perform more diagnostic tests than the lead technologists. Lead technologists spend more time administratively and in a supervisory role, and this would explain the reduced diagnostic workload. Also, most of the diagnostic examinations are done immediately following the screening study, and more non-lead technologists are performing screening studies. This may also explain the more frequent

interaction of the non-lead technologist with the radiologist, as they are reviewing diagnostic examinations.

Our study has several potential limitations. Despite using standard survey methods with repeat mailings and an incentive, our response rate was 45%. This response rate is similar to those reported in other mailed surveys, ranging from 42–60%. [23–25] In addition, our study population is limited to technologists working at radiologic facilities in North Carolina so it is possible that our findings are not generalizable to other parts of the United States. We had two instances in which the lead technologist refused to participate and since this was the gatekeeper to the non-lead technologists, the non-lead technologists at these sites were not given the opportunity to participate.

This work has provided information on the roles of lead and non-lead technologists and highlighted the difference in their work effort and style. Given the observed variability in technologist characteristics, future studies should assess if specific technologist characteristics, work experiences or role as lead or non-lead are associated with mammography performance.

Acknowledgments

This work was supported by funding from the National Institute of Health, National Cancer Institute under grant R01CA155342 and U01CA70040.

We thank the participating facilities and the mammography technologists at these facilities, without whom this work would not have been possible.

References

1. U.S. Department of Health and Human Services, U.S. Food and Drug Administration. [Accessed April 15, 2015] Mammography Quality Standards Act National Statistics. Available from: <http://www.fda.gov/Radiation-EmittingProducts/MammographyQualityStandardsActandProgram/facilityScorecard/ucm113858.htm>
2. Beam CA, Layde PM, Sullivan DC. Variability in the interpretation of screening mammograms by US radiologists. Findings from a national sample. Archives of Internal Medicine. 1996; 156(2):209–13. [PubMed: 8546556]
3. Elmore JG, Jackson SL, Abraham L, et al. Variability in interpretive performance at screening mammography and radiologists' characteristics associated with accuracy. Radiology. 2009; 253(3): 641–51. [PubMed: 19864507]
4. Elmore JG, Wells CK, Howard DH. Does diagnostic accuracy in mammography depend on radiologists' experience? Journal of Women's Health / the official publication of the Society for the Advancement of Women's Health Research. 1998; 7(4):443–9.
5. Esserman L, Cowley H, Eberle C, et al. Improving the accuracy of mammography: volume and outcome relationships. Journal of the National Cancer Institute. 2002; 94(5):369–75. [PubMed: 11880475]
6. Miglioretti DL, Smith-Bindman R, Abraham L, et al. Radiologist characteristics associated with interpretive performance of diagnostic mammography. Journal of the National Cancer Institute. 2007; 99(24):1854–63. [PubMed: 18073379]
7. Molins E, Macia F, Ferrer F, et al. Association between radiologists' experience and accuracy in interpreting screening mammograms. BMC Health Services Research. 2008; 8:91. [PubMed: 18439248]
8. Elmore JG, Wells CK, Lee CH, et al. Variability in radiologists' interpretations of mammograms. The New England Journal of Medicine. 1994; 331(22):1493–9. [PubMed: 7969300]

9. U.S. Department of Health and Human Services, U.S. Food and Drug Administration. [Accessed April 15, 2015] Mammography Quality Standards Act Regulations: Subpart B -- Quality Standards and Certification, Sec 900.12(a)(2). Available from: <http://www.fda.gov/Radiation-EmittingProducts/MammographyQualityStandardsActandProgram/Regulations/ucm110906.htm-s90012>
10. U.S. Department of Health and Human Services, U.S. Food and Drug Administration. [Accessed April 15, 2015] Medical Devices - Databases - Mammography Facilities. Available from: <http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMQSA/mqsa.cfm>
11. Dillman DA. The Design and Administration of Mail Surveys. *Annual Review of Sociology*. 1991; 17:225–249.
12. Rao JNK, Scott AJ. On Simple Adjustments to Chi-Square Tests with Survey Data. *The Annals of Statistics*. 1987; 15:385–397.
13. Henderson LM, Benefield T, Bowling JM, et al. Do mammographic technologists affect radiologists' diagnostic mammography interpretative performance? *AJR. American Journal of Roentgenology*. 2015; 204(4):903–8. [PubMed: 25794085]
14. Henderson LM, Benefield T, Marsh MW, et al. The influence of mammographic technologists on radiologists' ability to interpret screening mammograms in community practice. *Academic Radiology*. 2015; 22(3):278–89. [PubMed: 25435185]
15. Popli MB, Teotia R, Narang M, et al. Breast Positioning during Mammography: Mistakes to be Avoided. *Breast Cancer : Basic and Clinical Research*. 2014; 8:119–24. [PubMed: 25125982]
16. Rauscher GH, Conant EF, Khan JA, et al. Mammogram image quality as a potential contributor to disparities in breast cancer stage at diagnosis: an observational study. *BMC Cancer*. 2013; 13:208. [PubMed: 23621946]
17. Taplin SH, Rutter CM, Finder C, et al. Screening mammography: clinical image quality and the risk of interval breast cancer. *AJR. American Journal of Roentgenology*. 2002; 178(4):797–803. [PubMed: 11906848]
18. Kaplan SS. Clinical utility of bilateral whole-breast US in the evaluation of women with dense breast tissue. *Radiology*. 2001; 221(3):641–9. [PubMed: 11719658]
19. Bassett LW, Dhaliwal SG, Eradat J, et al. National trends and practices in breast MRI. *AJR. American Journal of Roentgenology*. 2008; 191(2):332–9. [PubMed: 18647898]
20. Berg WA, Mendelson EB. Technologist-performed handheld screening breast US imaging: how is it performed and what are the outcomes to date? *Radiology*. 2014; 272(1):12–27. [PubMed: 24956046]
21. Slanetz PJ, Freer PE, Birdwell RL. Breast-density legislation--practical considerations. *The New England Journal of Medicine*. 2015; 372(7):593–5. [PubMed: 25671249]
22. Sprague BL, Gangnon RE, Burt V, et al. Prevalence of mammographically dense breasts in the United States. *Journal of the National Cancer Institute*. 2014; 106(10)
23. Asch DA, Jedrzejewski MK, Christakis NA. Response rates to mail surveys published in medical journals. *Journal of Clinical Epidemiology*. 1997; 50(10):1129–36. [PubMed: 9368521]
24. Kwak NBR, Radler B. A Comparison Between Mail and Web Surveys: Response Pattern, Respondent Profile, and Data Quality. *Journal of Official Statistics*. 2002; 18(2):257–273.
25. Shih TH, Fan X. Comparing Response Rates from Web and Mail Surveys: A Meta-Analysis. *Field Methods*. 2008; 20(3):249–271.

Summary Sentence

In our sample of 433 mammography technologists we observed considerable variability in terms of the distribution of age, work experiences, and interactions with other technologists and radiologists.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Take-Home Points

- Lead and non-lead mammography technologists were similar in terms of education and training but there were differences in work experiences and interaction behaviors.
- Lead mammography technologists reported more years performing screening mammography (p-value=0.02) and film mammography (p-value=0.03), more administrative hours (p-value<0.0001), and more workplace autonomy (p-value=0.002) than non-lead technologists.
- Non-lead mammography technologists were more likely to report performing diagnostic mammograms (p-value=0.0004) or other breast imaging (p-value=0.001), discuss image quality with a peer (p-value=0.013), and have frequent face-to-face interaction with radiologists (p-value=0.03) compared with lead technologists.

Table 1

Sociodemographic Characteristics of Mammography Technologists

Characteristic	Lead Technologist N=128		Non-Lead Technologist N=305		p-value*
	N	Weighted %	N	Weighted %	
Gender					
Female	124	97.0	297	97.0	0.05
Male	3	2.3	1	0.3	
Missing	1	0.8	7	2.1	
Race					
White	114	89.7	276	89.4	0.83
African American	7	5.4	18	7.1	
Asian	--	--	--	--	
American Indian/Alaska Native	2	1.1	2	0.7	
Hawaiian/Pacific Islander	--	--	--	-	
Other	5	2.8	9	2.8	
Ethnicity					
Hispanic	3	2.9	1	0.3	0.06
Non-Hispanic	123	96.2	292	96.2	
Missing	2	1.5	12	3.5	
Annual Salary					
< \$30,000	2	1.5	17	5.4	0.14
\$30,000 – 39,999	12	8.7	45	15.5	
\$40,000 – 49,999	26	22.4	59	18.5	
\$50,000 – 59,000	40	29.2	85	29.3	
\$60,000 or more	35	25.4	66	21.6	
Missing	13	12.7	33	9.7	

* Chi-squared test excluding missing category

Table 2**Mammography Technologist Education and Training**

Type of Education and Training	Lead Technologist N=128		Non-Lead Technologist N=305		p-value*
	N	Weighted %	N	Weighted %	
Formal Radiology Training Program					
Associate's Degree	80	61.2	193	63.9	0.54
Bachelor's Degree	9	6.7	12	4.0	
Radiology Certificate Program	38	31.4	97	31.2	
None	1	0.8	--	--	
Missing	--	--	3	0.9	
Registered with ARRT					
Yes	128	100	301	98.8	--
No	--	--	2	0.6	
Missing	--	--	2	0.7	
Mammography Specific Training					
Yes with ARRT Certificate	109	85.9	259	85.3	0.75
Yes with no ARRT Certificate	9	6.7	25	8.1	
No	410	7.4	19	5.9	
Missing	--	--	2	0.6	
Other Certifications					
Breast Sonography	3	2.3	6	1.9	0.79
Sonography	--	--	6	1.7	--
Vascular Sonography	--	--	--	--	--
Computed Tomography (CT)	11	8.4	31	11.2	0.41
Magnetic Resonance Imaging (MRI)	5	3.8	6	1.8	0.20
Quality Management (QM)	3	2.3	7	2.1	0.91
Bone Densitometry	9	6.9	18	5.8	0.67
Cardiac-Interventional (CI)	--	--	1	0.3	--
Vascular Interventional (VI)	--	--	2	0.6	--

Type of Education and Training	Lead Technologist N=128			Non-Lead Technologist N=305			p-value*
	N	Weighted %		N	Weighted %		
None	95	75.2		217	70.6		0.36
Number of Continuing Education Hours per 2 year ARRT Reporting							
24 Hour Minimum Requirement	25	18.4		74	23.8		0.46
25-35 Hours	92	73.1		204	67.7		
>35 Hours	9	6.9		24	7.4		
Missing	2	1.5		3	1.0		

* Chi-squared test excluding missing category

Table 3**Mammography Technologist Work Experiences**

Work Experiences	Lead Technologist N=128	Non-Lead Technologist N=305	p-value
Years performing film			
Mean (SE)	14.5 (0.97)	11.9 (0.65)	0.029
Range (years)	0 – 43	0 – 48	
Years performing digital			
Mean (SE)	3.5 (0.30)	4.1 (0.16)	0.070
Range (years)	0 – 13	0 – 12	
Years performing screening			
Mean (SE)	17.2 (0.88)	14.7 (0.66)	0.020
Range (years)	0 – 40	0 – 43	
Years performing diagnostic			
Mean (SE)	15.6 (1.02)	13.4 (0.66)	0.068
Range (years)	0 – 40	0 – 43	
Hours performing screening mammography per week			
Mean (SE)	17.6 (1.08)	16.2 (0.67)	0.21
Range (hours)	0 – 40	0 – 40	
Hours performing diagnostic mammography per week			
Mean (SE)	4.9 (0.49)	7.3 (0.43)	0.0004
Range (hours)	0 – 27	0 – 35	
Hours performing other breast imaging per week			
Mean (SE)	0.64 (0.17)	1.87 (0.33)	0.001
Range (hours)	0 – 30	0 – 40	
Hours performing administrative activities per week			
Mean (SE)	7.6 (1.11)	2.8 (0.46)	<0.0001
Range (hours)	0 – 50	0 – 50	

SE = standard error

Table 4

Type of Interactions between Mammography Technologists and Peers

Types of Interactions	Lead Technologist N=128		Non-Lead Technologist N=305		p-value*
	N	Weighted %	N	Weighted %	
Currently have a mentor					
Yes	54	43.2	193	62.6	0.001
No	73	56.1	108	36.2	
Missing	1	0.8	4	1.2	
Had a mentor during first 3 years					
Yes	88	68.3	202	66.8	0.114
No	38	30.2	81	25.9	
Still in first 3 years	2	1.5	19	6.4	
Missing	0	--	3	1.0	
Currently act as a mentor					
Yes	90	68.6	189	62.9	<0.0001
No	27	20.0	107	34.2	
I am the only tech at my practice	11	11.4	4	1.3	
Missing	0	--	5	1.6	
Frequency of image review with peers for image quality					
Often	26	22.4	60	19.7	0.013
Sometimes	38	28.2	113	38.6	
Rarely	41	29.1	99	31.6	
Never	20	18.3	24	7.5	
Missing	3	2.1	9	2.6	
Frequency of image review with peers for diagnostic assessment					
Often	24	20.9	44	14.2	0.002
Sometimes	40	29.3	125	42.1	
Rarely	35	25.7	95	31.0	
Never	26	22.2	31	9.6	

Types of Interactions	Lead Technologist N=128			Non-Lead Technologist N=305			p-value *
	N	Weighted %		N	Weighted %		
Missing	3			10	3.1		

* Chi-squared test excluding missing category

Table 5

Type of Interactions between Mammography Technologists and Radiologists

Types of Interactions	Lead Technologist N=128		Non-Lead Technologist N=305		p-value*
	N	Weighted %	N	Weighted %	
Primary type of communication					
Directly (face to face)	85	65.3	231	77.3	0.04
Indirectly (phone, email)	41	33.2	69	21.0	
I do not communicate with radiologist	2	1.5	3	1.0	
Missing	0	--	2	0.7	
Frequency of communication					
More than 1x/week	95	72.9	256	84.3	0.03
More than 1x/month but <1x/week	19	16.3	22	7.2	
Once a month or less	12	9.2	22	6.9	
Never	2	1.5	3	1.0	
Missing	0	--	2	0.7	
Frequency of discussing screening mammogram images with reviewing radiologist? **					
Often	15	10.6	23	7.4	0.08
Sometimes	43	30.9	84	27.0	
Rarely	54	46.3	138	45.1	
Never	11	8.4	52	18.2	
Missing	5	3.8	8	2.4	
Frequency of discussing diagnostic mammogram images with reviewing radiologist? ***					
Often	69	50.6	186	62.6	0.07
Sometimes	26	21.5	68	21.6	
Rarely	13	9.5	20	5.9	
Never	14	13.9	21	6.8	
Missing	6	4.6	10	3.0	
Frequency of receiving feedback from a radiologist regarding image quality? ***					

Types of Interactions	Lead Technologist N=128			Non-Lead Technologist N=305			p-value*
	N	Weighted %		N	Weighted %		
Often	20	14.2		40	13.1		0.52
Sometimes	48	35.4		127	41.7		
Rarely	50	42.8		110	36.5		
Never	6	4.6		20	6.4		
Missing	4	3.1		8	2.4		
Frequency of performing extra images without radiologist asking? **							0.80
Often	25	18.2		56	17.5		
Sometimes	53	38.1		138	44.2		
Rarely	30	25.5		75	24.0		
Never	16	15.2		28	11.9		
Missing	4	3.1		8	2.4		
Frequency of radiologist asking you to repeat images for image quality purposes? **							0.33
More than 1x/week	0	--		1	0.3		
More than 1x/month	4	3.1		8	2.6		
Once a month or less	74	57.3		204	64.9		
Never	47	37.6		84	29.7		
Missing	3	2.1		8	2.5		

* Chi-squared test excluding missing category

** asked within the last 5 years