

# Foreword: *Radiology* Select Volume 4—*Breast* *Cancer Screening*

Dear *Radiology* Select Reader:

The past 2 years since the introduction of *Radiology* Select have flown by. Initial volumes were about clinically important topic areas of lung nodules, stroke, and imaging of coronary artery disease. The fourth volume in the *Radiology* Select series: *Breast Cancer Screening*, follows a similar format to our prior compilations. Breast cancer screening is a topic that has engendered a large amount of research, as well as public interest. Research in this area spans from long-term population-based outcome studies, which clearly demonstrate the benefit of breast cancer screening, to research on improvements in diagnosis with digital mammography and computer-aided diagnosis, to studies on newer technologies such as tomosynthesis and breast-specific gamma imaging.

We chose Constance D. Lehman, MD, PhD, to be the guest editor of this volume given her reputation as a breast cancer researcher and her involvement in multiple impactful studies on breast imaging. Dr Lehman had the difficult task of reviewing original research and review articles recently published in *Radiology* and selecting among them for inclusion in this compilation. We are limited to the number of articles we can include to have a compilation of reasonable size; therefore, the final list of articles is, of necessity, somewhat subjective. The contents of this volume reflect a somewhat personal view of those that are the key articles and are not the result of a quantitative determination. Furthermore, it must be recognized that *Radiology* has published many more fine articles on the subject area than can be condensed into this 34-article volume. Some excellent and clinically important articles, therefore, had to be passed over and not included.

We believe that this collection of key articles will be a valuable resource for breast imagers and other providers of women's healthcare. Having the key articles together will allow the reader to identify the relationships between articles and to follow the development of trends in breast screening and breast cancer diagnosis research over time.

Continuing medical education (CME), in the form of CME credits as well as self-assessment CME (SA-CME) and self-assessment modules (SAMs), is an important aspect of clinical practice in radiology. Recent American Board of Radiology diplomates, in addition to needing CME, also need SA-CME for recertification. We believe that *Radiology* Select offers a perfect vehicle to provide up-to-date SA-CME to our readers and will help them better understand how research

evolves and translates into clinical practice. Therefore, Dr Lehman has identified key themes of the articles, grouped them by subject area, and indicated the subject areas that she thinks are be valuable as SAMs. The articles' corresponding authors are then contacted and asked to supply questions for CME and SAMs. In this volume, readers can obtain up to 15 SAM/15 SA-CME credits, allowing for focused learning in subject areas of clinical importance.

The online era provides multimedia opportunities for publications. We exploit this capability by providing audio and video conversations with authors to explore their views on the effect of their work and the work of others in the field with the benefit of hindsight. These conversations also allow experts to share their thoughts on future developments and the impact of their work on these. In this volume of *Radiology* Select, Dr Lehman has conversations with several groups of authors to discuss the pertinent topics in *Breast Cancer Screening*.

In keeping with the trend of increasing reliance on electronic publishing, we are offering *Radiology* Select in three formats: HTML on the Internet, a digital tablet edition, and print on demand. Print on demand is a printed compilation of the articles for those who prefer reading hard copy. The tablet edition is an electronic multimedia document that combines the electronic articles with audio and video; the articles have been formatted to allow viewing on tablet computers such as the Apple iPad and the numerous Android-powered devices. Images can be resized and compared in this format. We also offer an HTML version for viewing with a Web browser. Individual PDFs can be downloaded, and readers can listen to and view the audio and video conversations. The CME and SAM activities are available only through the online version.

We thank Dr Lehman for reviewing and selecting the articles collected in this volume. We are especially grateful to the authors of the articles, without whom *Radiology* Select would not be possible.

We believe *Radiology* Select will prove to be of educational value to our readers.

Sincerely,

Deborah Levine, MD, Series Editor, *Radiology* Select

Herbert Y. Kressel, MD, Editor, *Radiology*



#### Video

Online Education Edition and Tablet Edition of *Radiology* Select include a video with series editor Deborah Levine, MD.

# Introducing *Radiology* Select: *Breast Cancer Screening*

## Introduction

Few topics have received more attention in radiology than breast cancer screening. Mammography as a screening tool for breast cancer has been shown to enable diagnosis of breast cancers at an earlier stage, when less aggressive therapies can be offered and when cure is more likely. Randomized clinical trials with mortality as an endpoint have confirmed that women undergoing screening mammography have significantly lower breast cancer mortality rates compared with women who do not.

The first original research published in *Radiology* on mammography was in 1960 by Egan (1). Egan reported on 1000 consecutive diagnostic mammographic studies in women presenting with signs or symptoms of breast cancer. In 1964, at the 50th Scientific Assembly and Annual Meeting of the Radiological Society of North America in Chicago, Ill, Wolfe reported results from 3891 women, aged 46–81 years, undergoing screening mammography. In his subsequent 1965 *Radiology* publication (2), he concluded that

[t]he tedious task of examining about 250 women to detect one cancer seems relatively unrewarding unless it is realized that the cancer found is most likely to be in a curable stage. If left until it is clinically evident, the likelihood of salvage diminishes rapidly.... Carefully performed mammography is effective in the discovery of small, clinically occult cancers in a significant number of patients. In the great majority of these cases, the growth is found before axillary lymph node metastases appear. This is the measuring stick of effective early cancer detection in the breast.

The 1980s witnessed a large number of clinical research trials published on screening mammography performance, including reports of the American College of Radiology Breast Imaging Reporting and Data System (BI-RADS) program, developed to address a lack of standardization and uniformity in mammography practice reporting (3). This work also directly supported development of a voluntary accreditation program by the American College of Radiology, which led to the Mammography Quality Standards Act passed by Congress in 1992.

Since that time, hundreds of articles specific to screening for breast cancer have been published in *Radiology*. A PubMed search using terms “breast” and “screening” published in *Radiology* returned a total of 1463 articles (accessed Sept 6, 2012).



### Video

Online Education Edition and Tablet Edition of *Radiology* Select include a video with guest editor Constance D. Lehman, MD, PhD.

This *Radiology Select* collection covers research relevant to breast cancer screening between 2004 and 2012 and is limited to only 34 articles. Many outstanding articles are not included in this collection. Articles were chosen to represent five key topics in breast cancer screening and to represent findings from centers in and outside the United States. When possible, multi-center, prospective trials were emphasized. The five chapters are “Mammography Performance,” “Digital Mammography,” “Screening Mammography and Computer-aided Detection,” “Screening in High-Risk Patients,” and “Other Screening Tools.”

The articles selected for “Mammography Performance” include a sampling from the Breast Cancer Surveillance Consortium (BCSC), a National Cancer Institute–sponsored collaborative network of mammography registries with linkages to tumor registries in the United States (4-9). The BCSC was established in 1994 to evaluate the performance of mammography in a community practice and currently includes data from more than 9 million mammograms in the United States. These studies from the BCSC have substantially improved our understanding of breast cancer screening practices in the United States and continue to address important issues on accuracy, cost, and quality of screening programs.

The results of the long-term (29-year) effect of mammographic screening on breast cancer mortality are included in the report from the Swedish two-county study of women aged 40–74 years, who were invited to undergo one-view screening mammography or to receive the usual care (10). This study demonstrated a highly significant reduction in breast cancer mortality in the population invited to screening (RR = 0.69; 95% confidence interval: 0.56, 0.84;  $P < .0001$ ) and emphasized the impor-

tance of long-term follow-up in assessing absolute benefit of screening.

The second chapter is on digital mammography (11-16). Full-field digital mammography received approval by the Food and Drug Administration in 2000, and the first article comparing digital mammography with screen-film mammography in *Radiology* was published by Lewin et al in 2001 (17). The articles selected for this chapter include findings of the American College of Radiology Imaging Network (ACRIN) Digital Mammographic Imaging Screening Trial (DMIST), where 33 centers in the United States and Canada enrolled 49 528 women to undergo both screen-film and digital mammography (11). The study demonstrated that digital mammography performed significantly better than screen-film mammography for the specific subgroup of pre- and perimenopausal women younger than 50 years and with dense breasts. This chapter also includes findings on the performance of digital mammography from Spain (16), Norway (12), and the Netherlands (13). The most recent publication of 2012 from the Netherlands is particularly important because those investigators focus not only on the performance of digital versus screen-film mammography but also address the clinical relevance of the cancers detected.

The third chapter groups articles on computer-aided detection (CAD) in screening mammography (18-23), including results from studies performed at Duke University Medical Center (Durham, NC) (18), Stanford (Stanford, Calif) (19,21), and the United Kingdom (20). The Computer Aided Detection Evaluation Trial II (CADET II), a large multicenter prospective trial in Scotland of more than 31 000 women, is included and compares double reading to single reading with CAD (23). This report clarified that readers using either single reading with CAD or double reading need

to be aware of the strengths and weaknesses of each reading regimen to avoid missing cancers.

The fourth chapter on screening of high-risk patients includes studies from the United States, Canada, Germany, and Italy (24-29). A multicenter prospective trial from the International Breast MRI Consortium (Schnall, principal investigator) compared magnetic resonance (MR) imaging, ultrasonography (US), and mammography in screening high-risk women and found MR imaging to be the most sensitive method in detecting breast cancer in women at high risk (24). Similar results were reported by Sardenelli et al in the HIBCRIT study from Italy (25) and by Scharading and Kuhl from Germany (28). Finally, a study by Lee et al reported on the cost-effectiveness of breast MR imaging and screen-film mammography for screening *BRCA1* gene mutation carriers (29). This simulation model compared three strategies of screening with mammography and MR imaging, reporting that annual combined MR and mammography screening provides the greatest life expectancy and is likely cost-effective when the value placed on gaining an additional quality-adjusted life years is in the range of \$50 000–\$100 000.

Finally, the fifth chapter includes screening studies that evaluated potential methods of screening for breast cancer outside of mammography, US, and MR imaging (30-34). These “other” screening tools include preliminary results from dedicated breast CT, breast-specific gamma imaging, and breast tomosynthesis. This section also includes a recent study reporting on reasons women in the ACRIN 6666 study refused breast MR screening and raises important issues regarding the acceptance of new imaging technologies into screening programs (32).

In addition, the popular section *Controversies* in the journal *Radiol-*

ogy has provided summaries and scientific discourse for readers on challenging and controversial topics. In 2009, when the U.S. Preventive Services Task Force (USPSTF) published their update on breast cancer screening recommendations, the editor of *Radiology*, Dr Herbert Kressel, invited the task force to provide an overview of the rationale for their recommendations. At the same time, Kopans (35) provided his commentary on the USPSTF recommendations. Petitti and her colleagues on the USPSTF (36) provide a historic perspective of the mission of the task force, the methods used for developing their guidelines, and clarification of points that were fraught with misunderstanding by medical and lay populations alike. Kopans (35) provides a historic perspective of the controversies surrounding breast cancer screening and a summary of key issues in study design and analyses, including the challenges of comparing results from randomized controlled trials to those from computer modeling. Further, he explains the importance of assigning appropriate weighting to benefits and risks of screening mammography to guide effective and informed decision making by our patients and their clinicians. Taken together, these two editorials provide a comprehensive summary of the highly publicized and often misunderstood USPSTF recommendations, with particular emphasis on the recommendation regarding routine mammographic screening of women in their 40s.

Breast cancer continues to increase as a major source of morbidity and mortality around the world. Imaging has played a central role in early detection, diagnosis, and treatment of breast cancer. As new technology and new approaches continue to be developed, careful scientific investigation of these emerging applications is essential. This *Radiology Select* series

highlights the developments in the imaging sciences both in technical developments and clinical practice. The results of the research summarized should help guide us in better care of our patients.

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*Radiology Select* is a continuing series of *Radiology* articles chosen by a guest editor for their importance in radiologic science. It is published biannually with each volume focusing on a specific subspecialty topic. The series is

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