Mammographic Imaging

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Mammographic Imaging: A Practical Guide
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Fourth Edition

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Dedication

This book is dedicated with much love and gratitude to our mentors Dr. Wende Logan-Young and Dr. Tamnit Ansusinha. By example, you instilled in us a commitment to deliver the highest quality possible for each examination and to treat each individual with dignity and respect.

We also dedicate this textbook to the technologists we have met along the way, either as educators, students, or as coworkers. We have seen your dedication to this profession. We are proud to be a part of this extraordinary group.

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Foreword

It is a privilege for me to write the foreword to the fourth edition of *Mammographic Imaging: A Practical Guide,* by Shelly Lillé and Wendy Marshall. As a radiologist practicing in Madison, Wisconsin, I was instrumental in introducing the two authors in 1986. At the time, I could not have known that 21 years later, the three of us would reunite once again to provide mammography training to technologists on the other side of the world.

In 1986, our facility in Wisconsin was transitioning from xeromammography to screen/film imaging. The success of the pioneering Elizabeth Wende Logan-Young Breast Center in Rochester, New York, had been widely publicized, and I wanted the imaging techniques used by Logan-Young's technologists to be taught to our Madison technologists. Shelly, Dr. Logan-Young's chief technologist, agreed to come to Madison to work with our group. This would be the first meeting between Shelly and Wendy, one of the mammography technologists in our Madison group.

As a radiologist responsible for interpreting the mammographic study, I have always understood the importance of the technologist's role in executing this procedure. The detection of breast cancer requires excellence in imaging techniques, and for this reason, I have always advocated for the mammography technologist. Each patient encounter requires the technologist to expertly deliver the technical aspects of the examination while demonstrating genuine compassion to the patient. Dr. Logan-Young aptly described the essential attributes of the mammography technologist in the foreword of the second edition of this textbook:

“The role of the technologist remains as important and as difficult as ever…The technologist must win each woman's confidence, and treat her as if she is the most important person in the clinic. Once rapport is established, the patient and technologist can work together as a team to obtain the best possible mammogram…The radiologist knows more than anyone the importance of the technologist's role.”

While practicing in Madison, I continued to build upon my dream of returning to Thailand to set up a breast center. In 1994, on a visit to Thailand, I was very fortunate to have a chance to present my idea to Somdech Phra Srinagarindra Boromarajajonani, known to the Thai people as Princess Mother, the mother of King Rama 9 of Thailand.

HRH Princess Mother advocated programs to improve the lives of Thai people and my presentation of the breast center fit well with her mission to help Thai women. She accepted my proposal to open a breast center, and in early 1995, I retired from Madison Radiologists SC to return to Bangkok and set up the first breast center in Thailand.

Later in 1995, Thanyarak Breast Center was opened at the Siriraj Hospital, Mahidol University in Bangkok, Thailand. My core belief in the importance of the technologist's role in this examination became a cornerstone of Thanyarak Breast Center, and to convey this value along with establishing the importance of the technologist's role within Thanyarak, I had Wendy travel to Thailand several times to mentor my technologists in all aspects of the mammography service.

It was from her initial experience training the technologists at Thanyarak that Wendy's career as a mammography instructor began. Upon her return to Madison, in addition to her lead mammography technologist role at the Dean Clinic (SSM Health), she provided training for new mammography technologists through mammography courses offered throughout the United States.

Soon after Shelly visited Madison to provide training to our technologists, she left her position at the Elizabeth Wende Logan-Young Breast Center to embark on a full-time career of providing mammography education to technologists. Since 1986, she has traveled extensively to share her mammography passion and expertise with hundreds of facilities and thousands of technologists, affectionately earning her the nickname, “Janey Appleseed.”

The authors commitment to provide quality mammography education to technologists would eventually bring Wendy and Shelly together again in 2004, when they were asked to team teach an initial qualifications course in mammography throughout the United States. This partnership would bring the three of us together again after 21 years, when they traveled to the Thanyarak Breast Center in Bangkok to provide educational training to our technologists in 2007. Thanyarak has flourished since then, and our technologists are among the best in their profession.

Today, Thanyarak Breast Center is a state-of-the-art facility that currently provides mammography services to 65,000 women each year. Each day the Thanyarak staff perform 250 mammograms, 200 ultrasounds, and 10 biopsy procedures.

I have always had a very strong appreciation for Wendy and Shelly, both in the United States and in Thailand, and I am proud of them both for their efforts in the field and for updating this textbook. As in the mammography courses they have taught together over the last many years, the authors share their knowledge in all aspects of the mammography procedure and the patient experience inside the pages of this book.

It is invaluable how Wendy and Shelly share their expertise in the technical aspect of the examination, quality assurance and quality control, breast anatomy, and positioning and compression are just some of the subjects that satisfy the reader's desire to understand more about this challenging field. And because the authors have continued to practice mammography alongside their educational careers, they are able to bring practical solutions to the challenging techniques critical to image quality.

Thank you, Wendy and Shelly for continuing in your efforts to help provide the important foundations for practice to all current and future technologists.

To all the technologists who read this textbook, please know that I and every other radiologist are grateful to you for your role in providing each patient with quality imaging and for the compassionate care you impart to each individual. I applaud you all for your commitment to this significant medical imaging modality. It takes a special person to work in this discipline, someone who understands the meticulous requirements of creating the image, while also preserving the dignity of the patient.

My best wishes to you all throughout your career in this important field.

Tamnit Ansusinha, MD

Co-Founder, Madison Radiologists, Madison, Wisconsin

Secretary General, Thanyarak Foundation Under Patronage of Her Royal Highness Princess Somdech Phra Srinagarindra

Chairman, Thanyarak Breast Center, Siriraj Hospital, Mahidol University

Bangkok, Thailand

Preface

The history of *Mammographic Imaging: A Practical Guide*.

1992, the first edition. Authors: Valerie Andolina, Shelly Lillé, Kathleen Willison. 300 pages.

2001, the second edition. Authors: Valerie Andolina, Shelly Lillé, Kathleen Willison. 500 pages.

2011, the third edition. Authors: Valerie Andolina and Shelly Lillé. 600 pages.

2019, the fourth edition. Authors: Shelly Lillé and Wendy Marshall. 608 pages.

Anyone who knows me knows my penchant for making analogies. While sitting at the kitchen table over my morning cup of coffee and contemplating what to write for the preface, I turned to my comfort zone—an analogy: writing a textbook is like buying a house. Growing up, one lives in a house—but this does not prepare you to purchase a house; similarly, one can read books, but this does not prepare you to write a book.

As young technologists, writing the first edition was like buying our first house. As a first-time home buyer, you must be educated in financial matters: that is, interest rates, closing costs; schooled in looking at home construction features: that is, cracked foundation walls, pitch of the roof; neighborhood scrutiny: that is, deed restrictions, school system; and learn to set and adhere to a budget before you actually start looking at houses. As authors, we had to learn about contracts and deadlines, artlogs, camera-ready art, galleys, references, permissions, and so much more. Then we had to decide which topics to consider, research these topics, and finally pick up a pen and actually start writing.

The second edition was so much easier to write because we were familiar with the entire process. The second edition was like remodeling our first house; we knew what we liked in our original house, and we knew what additions we wanted to make. In many respects, a new edition is like remodeling an old house; sometimes, it is painful to let things go that have sentimental value, but you do so because it is necessary to move on.

Edition 3 was nostalgic. Kathy Willison went to work in the commercial sector, so she opted out of involvement with this edition. It was like having one of the family members leave home to go off to college. The house got bigger for the two occupants left inside. We did some rearranging of the furniture and transformed the newly unused bedroom into a new living space.

With the fourth edition, I am moving into a brand new house. And I have a new co-owner of the house because Valerie Andolina retired from working... and from writing.

I am delighted to welcome Wendy Marshall. I have lectured with Wendy for more than 20 years. In our Initial Training course, she taught the art of positioning and unraveled the mysteries of QC, while I taught physics, anatomy, and pathology. Wendy has an innovative way of presenting positioning and compression. When she taught technologists just entering the field of mammography how to perform the CC and MLO projections, the students were well prepared when it came time for the hands-on positioning workshops. You will find the positioning chapters in this book to be user-friendly, and a helpful reference guide.

Wendy's true passion is QC. Analog QC was easier to teach than digital QC. In analog imaging, QC tests were standardized; whether you used Kodak film, or Agfa, or Fuji, all QC was the same. But with digital imaging, each manufacturer establishes their own QC requirements, plus the ACR offers an alternative version that attempts to standardize QC among all the manufacturers. I give much credit to Wendy for tackling this now convoluted topic.

A house can be built in 6 months; a textbook takes 2 years. With each of these textbook editions, it took a year and a half of researching and writing, followed by 6 months for the publisher to prepare the material for publication. We have already started our list of topics for the next edition to be published in 2029!

Wendy and I trust you will find this fourth edition to be a valuable resource.

Shelly LillÃ©

Acknowledgments

With each edition of this textbook, the list of people I am indebted to grows longer. As I was making my list of acknowledgments for this fourth edition, I thought of the academy award shows on television, such as The Oscars, where the winning actors are on stage accepting their award…they take a piece of paper from their pocket and begin reading off a long list of names. The actors acknowledge the assistance of many others, without whose efforts there would be no award.

This textbook was not written by just Wendy and me, it is from all the interactions we've had with our mentors, teachers, medical physicists, service engineers, x-ray equipment company representatives, administrators, IT personnel, coworkers, patients, and our families. How do you thank all the people you have interacted with for decades? I have made my list and trust you all know how grateful I am for your willingness to explain concepts, for the time you expended on my behalf, and for your friendship.

Wende Westinghouse Logan-Young, MD. Even though you are now retired, you remain my mentor. Much gratitude to you for conducting mammography seminars beginning in the 1970s; this guided me to my career-long “Janey Appleseed” role.

Angie and (the late) Jack Cullinan. The impetus for writing the first edition. Without Angie's and Jack's encouragement, there never would have been a textbook.

The group from Wolters Kluwer:

Jay Campbell—acquisitions editor

Amy Millholen—product manager

Emily Buccieri—editorial coordinator

Bonnie Arbittier—photographer

I would be lost without the staff from WK to point the way. Jay: the extraordinary team leader. Amy: you did such fantastic work on third edition, thankfully we were reunited on the fourth edition. Thank you for all of your suggestions and solutions. Emily: you are fortunate to have Amy as a mentor; follow her lead and you'll be fantastic too. Bonnie: our nimble photographer who was able to contort herself in various positions in order to obtain photos from the correct perspective. And to our models for the positioning chapters, we are grateful to you for your patience in maintaining a pose until the photo was “just right.”

Valerie Andolina and Kathy Willison. My original coworkers and coauthors. Thank you for establishing the foundation for this textbook. Wendy and I carry on your legacy.

The supportive team from Manatee Memorial Hospital in Bradenton, Florida:

Amy Beaubien for discovering a method that saved me from months of searching for cases in PACS. Jason McLeod for reviewing and making suggestions for the MRI chapter. Mary Anne Edwards and Patricia Scruggs—it is impossible for me to put into words how much I value your support and needed your encouragement throughout this entire project. I managed to include you in photos in this book so that when I am old and gray and look at these pages, I will remember you both and all fun we had collecting cases.

Marcy Adcox and Hologic, Inc. You have been a true friend and a valuable resource for almost every chapter in this book. How fortunate our paths crossed almost 40 years ago. Please “hang around” for the fifth edition, 10 years from now. Your e-mail in-box will again be flooded with requests for figures and information.

Dr. Ed Barnes and Don Jacobson. Medical physicists. Thank you for expanding my knowledge base in mammography physics and for your willingness to share your information in my physics chapters. For 30 years, you have been my physics mentors.

My family. Joanne Lillé—artist. The creative one of the group. Thank you for the drawings; your art will live on through these textbooks. My sisters: Marlaya and Elizabeth. Your encouragement and taking over of daily chores freed up time to research, write, edit, rewrite, and edit some more.

Contributing author: Gerald Kolb, president of The Breast Group. Thank you for contributing the breast density section in Chapter 21. As always, your skill with a pen is logical, methodical, and factual.

Contributing author: Dr. Gale Sisney. Chapter 10 needed the perspective of a radiologist, so thanks to Wendy for volunteering you to write this chapter. Mark your calendar for 10 years from now for the three of us to undertake the fifth edition.

The Koning Corporation representatives: Roger Zhang and David Georges. Dave has had an impressive career in women's health care; he taught me about the business side. Contributing author: Dr. Avice O'Connell, University of Rochester Medical Center, for the section on Coned Beam Breast CT in Chapter 21. Thank you for your willingness to share your experience with this exciting technology.

My “bosom buddies”: Rosalind Hall and Thelma. Ros, you have been a steadfast friend. Thank you for all the prayer chains. Thelma, I have told you more than a million times how thankful I am that we are life-long friends.

Ken Lillé. My rock. Steadfast, supportive, strong.

Shelly LillÃ©

Mammography has interested me since I was a student in radiology science. I was drawn to it because of its complex blend of science, art, and communication. It was my good fortune that an opportunity to work in this discipline arose early in my career, which has allowed me to spend almost 40 years continually learning about the breast imaging industry as it has evolved. Coauthoring this textbook has given me a unique opportunity to reflect on years of practice, objectives, and growth, and pull from them the knowledge and experiences that will provide the most value and meaning to those who wish to learn about this exciting and rewarding field. In doing so, I am reminded of the people and circumstances that have been so formative and influential throughout this journey. I have been fortunate to observe and learn from a number of professionals who have modeled the highest standards in quality and commitment to their craft. I am eternally grateful to those individuals who have “stood out” among the many; these are the colleagues and patients who have inspired my passion for this work, and whose valuable messages are imprinted in the pages of this book.

I am indebted to the many people who provided their expertise, advice, and assistance and to those who offered their steadfast support throughout this process. To all of these individuals, I would like to express my heartfelt appreciation.

To my husband Richard. Thank you for your never-ending patience, understanding, encouragement, and love. I am so lucky to share my life with you. To my three daughters, Lauren, Leah, and Lydia. The greatest privilege of my life has been being your mom. I have learned so much from you, thank you for teaching me.

To my mentor, Dr. Tamnit Ansusinha, whose example instilled in me the desire to learn and understand the science and art of mammography. He taught me that sharing knowledge is an obligation and an opportunity to empower others to improve patient care.

To the folks at Wolters Kluwer who entrusted the coauthorship of this textbook to me. My sincere thanks to Jay Campbell, Amy Millholen, and Emily Buccieri for their expertise and continual guidance throughout my foray into their world. Their advice will always be appreciated and their patience and professionalism always remembered. To Bonnie Arbittier, our unflappable photographer, we are grateful for your precision in capturing the artistic message in your photos.

To my friend and coauthor Shelly Lillé who so generously shared her knowledge and experience as an author with me throughout the entire process. I am so grateful for the privilege of working with Shelly. She is a wealth of knowledge and has a heart of gold. Many thanks to her husband Ken, who also lent his support in assisting me. They are friends for life.

To Kathy Willison and Valerie Andolina, the authors of the previous editions of this book. Although we have never met, I feel I know you. We share the same commitment to empowering the technologist. Thank you for framing the foundation of this book; your efforts provided a blueprint to build upon.

To SSM Health, Dean Medical Group, radiology administration. Thank you for cultivating an environment that encourages professional growth and fosters educational experiences. These endeavors promote the highest quality care for patients. Special thanks to Seth Teigen and Jolene Kent for their generous support during this process.

To Gale Sisney, MD, (Global Radiology Outreach) for her valuable contribution to the fourth edition. Her unique ability to educate technologists is shared in Chapter 15 through an exercise she designed to explain the medical audit. Chapter 10, Practical Applications in Problem Solving is described through the lens of Dr. Sisney's vast experience as a breast imaging specialist, providing the technologist a solid foundation for mammography imaging protocols. It has been my privilege to work with Dr. Sisney on many educational projects. She is a respected mentor to technologists, recognizing their valuable contribution to breast imaging, and committed to their success. Gale has been my teacher and my friend for many years, for which I am so grateful.

To Tom Aufdemberge, MS, DABR, (Medical Physics Consultants, Inc.), for helping me to understand the technical intricacies of achieving image quality in mammography. His willingness to provide answers to my endless questions and requests for explanations of mammography physics and equipment analysis over the past 16 years sparked in me a deep interest in quality improvement and mammography performance metrics that I would never have otherwise discovered. His advisement for Chapters 15 and 16 is greatly valued and appreciated. Thank you, Tom, for your generous gift of time and your incredible patience.

To my fellow technologists at SSM Health, Dean Medical Group, who supported me in so many ways throughout this process. They were always ready to lend me assistance whenever it was needed and for their kindness and support I will always be grateful. Special thanks go to Mary Klund, Chris Andrews, Cindy Pack, Ginger Anderson, Kathy Seltzner, Beth Mecum, Anne Koller, Dana Borgerding, Denise Konopacki, and Linda Smith for going above and beyond. You are the best!

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Thank you for your contribution to the fourth edition, your willingness to help made a difference and is greatly appreciated.

Wendy Marshall, RTR (M)(QM)

User's Guide

This User's Guide introduces you to the helpful features of *Mammographic Imaging: A Practical Guide, Fourth Edition*, that enable you to quickly master new concepts and put your new skills into practice.

Objectives help you focus on the most important information to glean from the chapter.

Key Terms for the most important concepts are listed at the beginning of the chapters, bolded at first mention in the chapter, and defined in the online Glossary.

Helpful **Figures** and **Tables** throughout the text aid the visual learner.

Case Studies allow for practical application of chapter material.

Review Questions at the end of each chapter encourage critical thinking.

ADDITIONAL LEARNING RESOURCES

Valuable ancillary resources for both students and instructors are available on thePoint companion Website at http://thepoint.lww.com. See the inside front cover for details on how to access these resources.

Student Resources include a registry exam style question bank, glossary, PowerPoint slides, and case studies with situational judgment questions.

Instructor Resources include a test bank, PowerPoint slides, answers to chapter review questions and case studies, and answers to situational judgment questions.

Contents

UNIT 1 Mammography: Common Topic

1 History of Mammography

Those who cannot remember the past are condemned to repeat it.

—George Santayana

Objectives To relate the growth of mammography over its 95 years to 3 eras of development: a long and slow use of general x-ray units to serve only symptomatic patients (1925 to 1970), dedicated mammography units adopted with growing support for mammography specialization servicing asymptomatic women (1970 to 1990), and rapid professional and public support for screening mammography to connect with many imaging and treatment modalities (1990 through present) To identify early mammography practices that are no longer in use To gain an appreciation for the connection between scientific advances from technology and biology that made mammography what it is today

Key Terms

analog mammography

breast cancer

dedicated mammography machine

digital mammography

screening mammography

xeroradiography

Introduction

"I remember the exact moment I found my breast cancer. Time stood still as my heart pounded. My brain tried to rationalize away this newfound lump in my breast," the woman sobbed. So many times, as the radiologic technologist performing a mammogram on such a woman, I've wanted to ask, "Why ... why did you ***wait*** *to have a mammogram?"*

Breast cancer is emotional. Breast cancer is biologic. Mammography technologists must continue to search for a better understanding of both aspects of the disease to improve the technical skills necessary to detect disease and to strengthen interpersonal skills to help their patients.

This book addresses the biologic aspects of breast cancer from many viewpoints. These viewpoints include the etiology of breast disease and its appearance, the anatomy of the breast, how breast tissue affects and is affected by the design and performance of dedicated mammography machines, the appearance of breast tissue on a mammographic image, and positioning of the breast. Dealing with the emotional aspects of women who may/may not have breast cancer depends on your knowledge of the examination and your interpersonal skills. The radiologic technologist's focus is to help the patient progress through the mammogram. Firm breast compression and general anxiety worry most women. From the important initial meeting with the patient, through history taking and discussing breast health issues, the radiologic technologist allays the woman's fears. A patient's emotions can range from a mild case of embarrassment to hostile resistance. Mammographers have a responsibility to care about patients and to help them in a professional manner.

The history of mammography makes three points clear:

1. Breast cancer continues to be a major killer of women in the United States.

2. Early detection is necessary to improve the survival rate of women with breast cancer.

3. Knowledge of breast disease coupled with improved technical skills and a genuine concern for the health and well-being of your patients motivates the radiologic technologist to detect disease and to educate their patients about better breast care.

This book is written *by* radiologic technologists *for* radiologic technologists. The authors share their experiences, collect information about mammography, and present it from a practical viewpoint that is useful to the radiologic technologist.

History

The Oldest Story in Mammography

Legend has it that the concept of mammography was first proposed in 1924 when a group of male radiologists in Rochester, NY, assembled around a viewbox "admiring" the chest x-ray of a buxom woman (Figure 1-1). After a brief discussion that included both playful and serious remarks, the radiologists' thoughts and discussions turned toward speculation about the ability to x-ray the breast to locate tumors. Stafford Warren, MD, published the first article on mammography in 1930. [1] Warren described the use of double-emulsion film and intensifying screens; a moving grid; a 60-kVp, 70-mA, 2.5-second exposure; and a 25-in. source-image detector distance. Articles detailing radiography of mastectomy specimens were published before 1930.

Figure 1-1 The outline of the breast is apparent on a chest x-ray. This realization triggered the first attempts to x-ray the breast for evidence of disease.

The Father of Mammography

It was not until the 1960s that the "father of mammography," Robert Egan, MD, then at M.D. Anderson Hospital in Houston, began teaching his mammographic technique. With his assistance, the American College of Radiology (ACR) established training centers for radiologists and technologists throughout the United States.

Not all in the medical community were as impressed with mammography and its potential as were those in the field of radiology. Many surgeons were concerned that a negative mammogram might delay or prevent an exploration suggested on clinical grounds. Experts … protested that if a cancer was present, their fingers would find it, and that the "new-fangled" modality was not only unnecessary, but perhaps insidious. Many radiologists furtively attempting the new technique were effectively suppressed by blown x-ray tubes, less than 98% accuracy, and supercilious sneers of their surgical colleagues. However, a few radiologists persisted, excited by the potential of mammography. After all, there was a great need for improved diagnosis in breast disease, especially in that gray area of "fibrocystic disease." Also at times, cancer was detected when clinical findings were questionable and, even more remarkably, completely non-palpable cancers which turned out to have a high degree of no axillary nodal involvement were often discovered.[2]

We acknowledge and appreciate the efforts of the countless radiologists who valiantly maintained their belief in mammography. Any new procedure will be scrutinized and compared with current detection modalities. If the new procedure endures through initial doubts of its integrity, and the basic tenets upon which the examinations are proven to be sound, then those who helped evolve the examinations' principles deserve our gratitude.

The Vision: Early Detection

Early attempts in mammography were crude compared to the quality of images produced today. From mammography's advent in 1924 until the early 1980s, mammograms were done primarily on symptomatic patients who were referred to radiologists for the purpose of verifying breast disease before her appointment with a surgeon. The cancers were clinically obvious (Figure 1-2).

Figure 1-2 **(A)**Clinical signs of an advanced breast cancer. **(B)**With these clinically advanced cancers, the tumor is readily identified on the mammogram. Note the thickened, retracted skin line.

Few radiologists had any interest in mammography, yet all understood the futility of rendering a diagnosis for cancer in a later stage of development. The pioneers, men and women with a clear vision for change, developed screening mammography for asymptomatic women and pulled us into what wasn't possible in 1924 but was everywhere on earth before the end of the century.

Our resolute images today allow us to discover impalpable cancers; cancers so small that unless the interpreter remains ever vigilant, they easily can be overlooked. Radiologists need to maintain focused concentration while searching every image for these smaller indicators of disease and/or subtle changes in breast tissue when compared with prior images.

Earlier and Earlier

The ACR has always promoted efforts for change. Doctor Franklin Alcorn lauded their efforts in his 1971 paper, lamented that perhaps a physician assistant could help the radiologist, and called for his profession to do more to improve mammography.[3] During the 1970s, Doctor Lazlo Tabar and his colleagues in Sweden pioneered a three-county mammography screening trial of asymptomatic women as part of their country's national health program. In the United States, Doctors Philip Strax and Ferris Hall, forward-thinking clinicians, were moderators for a 1978 medical conference that featured papers and reports on early studies to detect breast disease in asymptomatic patients. Doctor Wende Logan-Young and others tested new special films for mammography and new dedicated mammography machines. Doctors Logan-Young and Edward Sickles pioneered magnification. In the 1980s, Doctors Lawrence Bassett and Stephen Feig worked on studies to improve the quality of mammograms. Doctors Young, Sickles, Tabar, Bassett, Feig, McLelland, Dowd, Alcorn, Strax, Hall, and countless other visionaries helped lay the groundwork with new techniques, positioning, and clinical practice to elevate mammography and women's health care to the levels we currently practice. Every visionary shared their passion for mammography and earlier breast cancer detection through innovations to their clinical practice, research, participation in professional and public efforts related to mammography, and in their publications. They shaped much of what is common today in mammography centers around the world. A closer look into one such medical practice provides us with an excellent example of this paradigm shift from imaging only symptomatic woman in the later stages of breast disease to screening asymptomatic women to detect breast disease earlier.

Doctor Wende Westinghouse Logan-Young

In her 1977 book *Breast Carcinoma: The Radiologist's Expanded Role*, published 53 years after the start of mammography, Doctor Wende Westinghouse Logan-Young foretold the future: the creation of specialized breast care centers staffed by radiologists who actively participate in diagnostic mammography exams (Figure 1-3).

Figure 1-3 *Breast Carcinoma: The Radiologist's Expanded Role*, by Wende Westinghouse Logan. Published in 1977.

When Dr. Young opened her private practice breast center in Rochester, New York, in 1974, she participated in every patient's exam ranging from performing the clinical breast exam, ultrasound, cyst aspiration, ductogram, preoperative wire localization, and FNAC, and sometimes, she even positioned the woman for her mammogram! Before the woman left the center, Dr. Young always gave her the results of the mammogram.

Dr. Young realized imagers (radiologists) were in the best position to take charge of this image-directed diagnostic procedure. The radiologist is the diagnostician who is able to correlate the clinical breast exam with the findings on x-ray and ultrasound images, to focus on regions of interest during the diagnostic mammogram, and to perform a biopsy using ultrasound or x-ray guidance when required. Dr. Young's belief was that radiologists were in a unique position to become active participants in breast health care. Her philosophy had radiologists behaving as clinicians; up until this time, most were passive participants, isolated in the reading room. The reward for the breast imaging specialist is that they follow the patient from her screening mammogram to her final diagnosis. They are able to go full circle with patients and become more of a clinician.

Today, we find mammography centers throughout the world, staffed by radiologists who interact with their patients and who encourage their radiologic technologists to assist far beyond simply performing the mammogram. Radiologists have embraced their expanded role: once a screening exam becomes a diagnostic study, a radiologist actively participates in the exam.

I (SL') had the good fortune to work with and to learn from Dr. Logan-Young, to assist her in performing clinical breast exams, ultrasound, cyst aspiration, ductogram, preoperative wire localization, FNAC, mammograms, and other procedures. I came to share her passion for quality mammography and her focus on saving a woman's life. Her vision for the future was for radiologists to expand their role for better patient care; the authors' vision is for radiologic technologists to expand their role for earlier detection of breast disease and better patient care.

Improvements to mammography continue; it progresses while riding on the hopes of current visionaries. Compared with the 3D digital images we produce today, these initial attempts in mammography were of limited value and are considered archaic (Figure 1-4). But to put things in perspective, in the future when breast cancer is detected in its earliest, cellular stage, current mammography will be considered primitive.

Figure 1-4 **(A)** Image taken with an all-purpose x-ray machine (circa 1960). **(B)** The same breast imaged with a dedicated mammography machine (circa 1970).

In the Beginning

Doctor Warren produced his initial breast images in 1924 using the only x-ray machine in his facility (Figure 1-5). His all-purpose x-ray machine produced chest radiographs in the morning and mammograms in the afternoon. Tungsten target tubes with glass windows and aluminum filtration resulted in low-contrast mammographic images because of the high half-value layer (HVL) associated with this system. Initially double-emulsion film in conjunction with two intensifying screens captured the image. Due to poor contrast and resolution, this recording system yielded to the use of direct exposure single-emulsion medical or industrial film packaged inside a cardboard holder. Few physicians showed an interest in mammography over the next 35 years; it remained in the shadows of clinical medicine.

Figure 1-5 Initial attempts to image the breast (circa 1930). Photo courtesy of Pam Fulmer.

The Times They Were A-Changin': 1960s

The turbulent 1960s were a watershed for changes in society, feminist politics, and mammography. The clarion call sounded for mass screening and lower-dose mammography. Women saw the dramatic decrease in the number of deaths due to cervical cancer because the Pap smear was used in mass screening; they hoped **screening mammography** could replicate the success of the Pap smear and reduce the death rate from breast cancer.

During the early 1960s, the Haloid Corporation, with their principal investigator, John Wolfe, MD, began experimenting with a new recording system that eventually would become known as **xeroradiography** (Figure 1-6). X-ray facilities could continue to use their general all-purpose x-ray machine to produce breast images with xeroradiography by changing only the recording medium. The purchase of selenium plates to capture the latent image and the purchase of a processing and conditioning unit were required to produce these lower-dose, better resolution images with its wonderful edge-enhancing capability. Xeroradiography became available commercially in 1971.

Figure 1-6 Xeromammography image displays as blue toner deposited on white paper. No viewbox required.

The Start of Modern Mammography

Meanwhile, on the other side of the Atlantic Ocean, Charles Gros, MD, and the CGR Company developed the first **dedicated mammography machine** in France in the mid-1960s. This was the first significant step in the development of mammography for mass screening.

The heart of the new unit, the molybdenum target tube, evolved from technology developed for quality control efforts in automobile and truck tire production. Tire manufacturing companies initially used the molybdenum target tube to produce high-contrast images of their tires to search for imperfections during final inspection. Until Gros adapted this invention, the ceiling-mounted, tungsten target diagnostic x-ray unit used for chest radiographs and other general radiologic studies was also used for mammography.

The new dedicated mammography unit, introduced commercially in the United States in 1969, incorporated a molybdenum target, utilized low kVp's, and had an integral device for compressing the breast (Figure 1-7). These three important contributions solved a major shortcoming of early mammography: low-contrast images. However, other problems persisted. Only direct exposure film (either medical or industrial) was available, and it required long x-ray exposure times and hand processing in the darkroom, both of which were time-consuming and cumbersome. Also, 8 to 12 R was a typical patient dose. Excessive radiation dose became an easy target for the early critics of mammography.

Figure 1-7 An early dedicated mammography machine (circa 1975).

Meanwhile, xeroradiography flourished in the United States during the 1970s. By the mid-to-late 1980s, this method of imaging the breast was all but extinct. Frequent repairs to the conditioning and processing units along with a higher radiation dose contributed to the rapid demise of this modality. Screen–film (analog) imaging, introduced in 1972, quickly surpassed xeroradiography as the preferred method of imaging.

Change, Change, and More Change

Xeroradiography, **analog mammography**, and **digital mammography** imaging systems have a common purpose: to x-ray the breast; but the similarities end there. The transition from xeroradiography to analog imaging was difficult for physicians and technologists because the two methods are dissimilar. Unfortunately, some misconceptions about mammography and some outmoded practices based on xeroradiographic principles still persist. It is important to recognize these outdated practices and to understand how they are often at odds with high-quality mammography of today.

The Major Differences

There are three major differences between xeroradiography and analog or digital imaging:

1. X-ray equipment and recording systems

2. Technical factors and radiographic physics

3. Patient positioning and radiographic landmarks

Various chapters in this book present information in each of these major categories as they apply to digital mammography. This section deals with the differences that confuse technologists even today (Table 1-1). The author assumes the reader is familiar with the principles of xeroradiography.

Table 1-1 Comparisons between Mammographic Systems

Case Study 1-1

Refer to Table 1-1 and respond to the following questions:

1. Is positioning the breast the same in all three modalities?

2. Can the same mammography machine be used in all three modalities?

3. Is a distinctly separate processing unit used in all three modalities?

Nipple in Profile

“The nipple must always be imaged in profile” was a basic protocol and cardinal rule of xeroradiography. Toner robbing occurred on a xeromammogram when the nipple was projected into the breast (Figure 1-8). Analog and digital imaging do not have toner deposition problems.

Figure 1-8 Xeromammography displays edge enhancement, a beneficial image-processing effect that highlights spiculation associated with architectural distortion, and also enhances the visualization of calcifications. The unwanted effect of edge enhancement: toner robbing. Toner robbing occurs when the nipple is not in profile (rather it is rolled into the breast), when skin folds are present, and when metallic particles associated with antiperspirant use are present in the high apex of the axilla. Toner robbing is a similar effect to iron filings attracted by a magnet; no filings are evident in the area surrounding the magnet. This same effect happens with blue toner deposited on the Xerox paper: there is no (*blue*) image surrounding the nipple, skin fold, or antiperspirant. (Image from Shutterstock, Inc.)

The nipple is centrally located on the breast for most women; therefore, the nipple will be in profile or nearly in profile upon final compression. However, this is not the case for all women. Some women will be full either inferiorly (the bottom half of the breast), with little tissue in the superior aspect, or the opposite. When positioning these women for a xeromammogram, the technologist pulled posteroinferior or posterosuperior tissue, respectively, *off the image receptor* to image the nipple in profile.

The nipple should, whenever possible, be projected tangentially. However, it is not always possible to observe this rule and at the same time include a maximal portion of the breast. In general, it is more important to visualize the posterior portion of the breast. It is usually not difficult to identify the nipple even if it is projected over breast tissue in one of the views.[4]

In mammography, there are three instances in which the nipple must be in profile:

1. Women who have spontaneous unilateral nipple discharge. Papillomas account for the vast majority of cases of nipple discharge and the vast majority of papillomas are within 1 cm of the nipple.

2. When performing a mammogram on a male. Males have rudimentary breast buds, as in an adolescent female. These tiny buds of tissue lie directly behind the nipple. The nipple must be in profile to visualize this small amount of tissue adequately. If this means removing some posterior “breast” tissue that you have captured on the image receptor, you are actually removing pectoral muscle because males have bigger, more developed muscles.

3. To determine the exact location of a region of interest (ROI) in order to perform triangulation for preoperative wire localization, fine-needle aspiration cytology (FNAC), or stereotactic core biopsy.

Mammography technologists work diligently to capture all the breast tissue on an image. Strict adherence to the outmoded xeroradiographic protocol of imaging the nipple in profile is counterproductive because it removes some tissue from the image.

Many think the nipple must be in profile to ascertain the location of a lesion. The nipple does not need to be perfectly in profile to do so. Craniocaudal (CC) views indicate whether the lesion lies in the medial half of the breast or in the lateral half. A nipple rolled into the breast tissue provides this same information. Lateral views (ML/LM) give superior or inferior location of a lesion relative to the nipple. Again a nipple rolled into the breast tissue provides this same information.

When the mammographer suspects a lump or lesion in the patient's nipple area, and the nipple does not fall in profile, she will take an additional image. Routine images should demonstrate as much breast tissue as possible; the extra image visualizes just the anterior portion of the breast with the nipple in profile. If possible, magnify the second image. The information obtained from magnifying the nipple and retroareolar region in profile will be far greater than that of the standard image. Visualization of the Ribs

Technical differences between xeroradiography and analog mammography made it necessary to modify positioning and technique to meet the specific requirements of each modality. It was disconcerting to the technologist experienced in xeroradiography to exclude the ribs from the analog study. However, every position we subject the patient to will miss a portion of the breast, regardless of the imaging method—whether it is xeroradiography or analog or digital imaging and whether or not the ribs are included. The reason for this is that breasts attach to the rib cage, a curvilinear structure (Figure 1-9).

Figure 1-9 **(A)** In xeromammography, the central ray is directed tangentially across the rib cage. Because of the curve of the compression device and the need to visualize into the lung field, the breast cannot be pulled away and kept away from the ribs as compression is applied. Thus, posterolateral tissue is not visualized; however, the CC view will be laterally oriented to include this area. Medial tissue also is not included because of the divergence of the x-ray beam. **(B)** In analog and digital imaging, the chest wall edge of the image receptor is placed along the midaxillary line. The posterolateral portion of the breast is captured on the image because the IRSD "goes around the corner" of the rib cage. By going this far around the curve of the rib cage, medial tissue will be missed when applying compression. Thus, visualization of the medial portion of the breast is required on the CC projection. (Reprinted from Sinclair WK. Mammography—A Users Guide. NCRP Report No. 85. Bethesda, MD: National Council on Radiation Protection and Measurement; 1986, with permission.)

Xeroradiography demonstrated the retroglandular fat space and the ribs in the Lateral view. Early mammographers believed displaying these structures on a single image ensured all breast tissue was visualized. However, this belief created a false sense of security because the image visualized only the portion of the ribs and retroglandular fat space tangential to the x-ray beam. Posterolateral tissue that wraps around the curvature of the ribs was superimposed. Xeroradiography compensated for the nonvisualization of posterolateral breast tissue in the Lateral view by including this area on the laterally exaggerated CC view (Figure 1-10C).

Figure 1-10 The "blind" areas of the standard mammography view. When the breast is compressed for the CC view, the superior–posterior portion of the breast is not imaged (*shaded area* in **A**). Furthermore, either a posteromedial or a posterolateral portion is not included, depending on how the patient is rotated (*shaded areas* in **B** and **C**). In the Lateral view, the posterolateral portion tends not to be imaged **(B)**, whereas in the oblique view, the posteromedial portion of the breast tends not to be imaged **(C)**. The CC projection can be either laterally or medially oriented. Usually, it is obtained so that the lateral posterior portion is included rather than the medial posterior portion. This is logical only if two views are used and the other view is the Lateral, which tends to omit the posterior lateral portion. If, on the other hand, the oblique view is used together with the CC view as a two-view standard, it might be wise to obtain the CC in a more medially oriented fashion. This is recommended since the oblique projection tends to miss the juxtathoracic medial portion of the breast. (Reprinted from Andersson, I. Mammography in clinical practice. Med Radiogr Photogr. 1986:62:2, with permission.)

Case Study 1-2

Refer to Figure 1-10 and respond to the following questions:

1. A specific portion of the breast is missed in each position we do. What area does the CC view miss? The MLO view? The Lateral view?

2. Which view images the most breast tissue? What portion of the breast is not included in this view?

Analog and digital mammography have strengths and weaknesses as well. Visualization of one portion of the breast is “sacrificed” in each standard projection to completely capture other areas (Figure 1-10 A to C).

No single radiograph can ever display all the structures contained within a 3-dimensional object; nevertheless, it is the technologist's responsibility to visualize as much tissue as possible in every projection.

Lateral Versus Oblique Positioning

Before the design of the dedicated mammographic unit, mammographers used an x-ray table, a ceiling-mounted x-ray tube, and a suction cup compression device. Despite the constraints of this equipment, mammographers performed CC, Lateral, and axillary tail views. The 1965 development of the dedicated mammographic unit with an integrated compression device and C-arm design permitted versatility in positioning. Patients could stand or sit.

Xeroradiography receptors had the recording latitude to demonstrate the breast, from ribs to nipple, using a curved compression device. Analog recording systems do not offer this wide recording latitude and thus require an evenly compressed breast (Figure 1-11). Even compression of the breast means the ribs must be excluded. Exclusion of the ribs afforded analog and digital mammography the opportunity to position the breast in an oblique orientation, the direction in which the breast is attached to the body.

Figure 1-11 Compression devices. **(A)** A curved compression device allowed visualization of the ribs. **(B)** Straight chest wall edge compression device. **(C)** X-rays taken using the curved versus straight compression devices.

By the mid-1970s, Scandinavian mammographers reported advantages of a new position—the oblique view.[5] Breast compression applied in an oblique plane corresponds with the anatomical attachment of the breast to the body allowing more posterior tissue to be included on the oblique image than with a Lateral view (see Chapter 7).

When positioning for the Lateral view, the compression device “fights” against the muscular attachment of the breast to the body. Today, the Lateral position is a supplementary view relegated to the role of definitive lesion localization prior to preoperative wire localization or stereotactic core biopsy.

Visualization of the Skin Line

Another obsolete requirement from xeroradiography was to visualize the skin line. In high-contrast analog mammography, there is no need to show the skin line. Cancerous cells in the breast do not arise in the skin, and they do not arise from adipose tissue. “The primary focus of a breast cancer is rarely located in the subcutaneous fat zone. Thus, tumors with their epicenter in the subcutaneous tissue are, in all likelihood, benign and are usually inflammatory processes or hematomas. It should be noted that metastasis from cancers other than breast cancer may be located in the subcutaneous tissue.”[4]

In high-contrast analog imaging, the skin line and the subcutaneous fat layer are considerably darker than the parenchyma of the breast in all cases except those of breasts that compress to approximately 2 cm or less and are composed primarily of adipose tissue. In direct opposition, xeroradiography used a low-contrast technique to allow for even densities on the resulting image from structures as radiolucent as the skin to structures as radiopaque as the ribs. It was this lack of contrast and density differentiation that trained xeroradiographers to look at the “halo” just outside the skin line to ascertain whether their radiographs were properly exposed. For xeroradiography, visualization of the skin line was very important; for analog and digital mammography, it is not. It should be noted that only 2% of the skin line is visualized in tangent on a mammogram; thus, 98% remains hidden, superimposed on top or underneath the breast mound.

In the early days of film mammography, when the ability to find nonpalpable cancer was virtually nonexistent, the cancer that was confirmed by x-ray was already clinically evident; in fact, a prerequisite for having a mammogram in those days was a palpable mass. By the time the cancer had grown to an advanced stage and the person became symptomatic, secondary signs such as skin thickening, skin dimpling, and nipple retraction were often present (Figure 1-2).

The mass … has an irregular margin. In addition, there are spicules around its periphery, representing retraction of tissue strands toward the tumor. It is often referred to as scirrhous carcinoma. Microscopically, this type of cancer is characterized by retractive fibrosis. Thus, much of each tissue strand surrounding such a tumor represents thickened normal structures of the breast. The central lesion and the strands surrounding it undergo shortening (retraction), which is the basis for the skin dimpling and nipple retraction which is sometimes seen with these tumors. The skin is usually thickened in the area of retraction. *This type of breast cancer usually feels larger than its radiographic size.* (Leborgne Principle).[4]

Minimal breast cancers, which are unexpected clinically but have the best prognosis, will not exhibit the secondary signs of more advanced tumors. Diagnosis then relies primarily on evaluation of the mammogram. “*Retraction and thickening of the skin are secondary signs of cancer which may be helpful radiographically. Besides being non-specific, these signs are often not evident, or completely absent, with small tumors.* For the detection of small tumors, the demonstration of the mass and its primary characteristics on high-quality mammograms are crucial.”[4]

With technical improvements in analog and digital mammography, cancerous tumors of minimal size (not clinically evident) are discovered. It is necessary to image the breast with high-contrast methods to detect these smaller lesions hiding within the glandular tissue. This means overexposing the skin line and subcutaneous fat with analog imaging. It is necessary in most cases to “bright light” the skin.

With the arrival of digital imaging in 2000, the dynamic range capability offered by the digital platform and computer monitor allows visualization of the skin, adipose tissue, and glandular tissue of the breast evenly. Digital systems can record and display approximately 16,000 shades of gray while analog systems capture about 100 shades. The extended dynamic range of digital imaging allows visualization of the breast and all of its internal structures evenly from the skin line to the base of the breast. Unlike xeroradiography, digital imaging does not need to sacrifice its contrast scale to do this. Using digital is like “having your cake and eating it too.”

Use of Sponges

Mammographers used sponges as a positioning aid in xeroradiography to ensure the ribs were included on the image and to achieve the following:

1. Support the breast to match the thickness of the ribs so that the breast would not “disappear” around the curvature of the ribs as the woman lies on her side

2. Help form the breast into a relatively flat surface over which compression could be distributed evenly

Analog and digital mammograms do not visualize the ribs; therefore, the use of sponges is not necessary. By inserting a sponge between the breast and image receptor support device (IRSD), the imaged body part (the breast) moves away from the recording system (Figure 1-12). This results in geometric unsharpness.

Figure 1-12 Sponges inserted between the breast and recording device.

Mammographers search for finite structures such as microcalcifications or the irregular borders of a mass, which require sharp images. The breast will always be in direct contact with the recording system in analog and digital imaging, which improves geometric resolution. Additionally, sponges may contain artifacts that imitate or obscure pathology.

Use of Antiperspirants and Powders

The use of antiperspirants and powders that contain aluminum, calcium, and zinc particles adversely affected a xeromammogram but should not interfere with the interpretation of an analog or a digital mammogram. Nevertheless, if a woman appearing for her exam has applied liberal amounts of powder or antiperspirant that has clumped in visible deposits along the moisture-prone inframammary fold (IMF) or in the axilla, ask her to clean that area before the mammogram is performed. Aluminum and zinc when clumped together can mimic microcalcifications. However, they will be found in the apex of the axilla where there are no ductal structures or glandular tissue, only lymph nodes (refer to Figure 1-13A).

Figure 1-13 **(A)** Antiperspirant can be seen in the axilla. **(B)** Ductal structures align in a “north-to-south” direction; the IMF runs “east to west.” **(C)** Powder in the IMF. An obvious artifact as it runs east to west in orientation, following the direction of the IMF.

Approximately 30% to 50% of primary breast cancers have mammographically detectable calcifications. These calcifications may be the only radiographic finding that suggests malignancy. When such neoplasms metastasize to axillary lymph nodes, the nodes may appear dense but usually lack mammographically detectable calcifications or other abnormalities. Reports of calcified metastatic neoplasm in axillary nodes draining a primary breast cancer are rare.... Mammographically detectable calcifications in axillary lymph nodes usually are caused by previous inflammatory disease. Rarely they may be associated with metastatic breast carcinoma, especially in advanced cases. A recent report even suggests that punctate axillary nodal calcifications are more often indicative of intranodal gold deposits (in women treated for rheumatoid arthritis) than metastases.6

Talcum powder, which contains aluminum and calcium particles, is often applied over the entire surface of the breast but will tend to clump along the IMF, where the inferior half of the breast and the abdominal wall meet. This deposition of powder may be seen on the mammogram because efforts are made to include this area on the CC projection. Talcum powder can be distinguished from tumors when looking at the CC image because the IMF runs “east to west,” whereas the ductal structures in which tumors would be found run “north to south” (Figure 1-13B and C).

Breath Holding

Because the ribs and lung field were included on a xeromammogram, which used considerably less compression than analog or digital imaging, respiration had to be suspended.

Because analog and digital imaging do not include the ribs or lungs, and because one of the objectives of compression is to immobilize the breast effectively, suspension of respiration is unnecessary except under the following circumstances:

1. The patient will not allow adequate compression of the breast.

2. The patient has implants and we perform the nondisplaced views.

3. The patient has emphysema or a similar respiratory problem.

Inadequate compression of the breast or excessive movement of the thorax invites motion; thus, some patients may need to suspend respiration.

Simply advise the patient to “stop breathing” rather than to hold her breath. A person tends to inhale a large volume of air to last for the duration of the x-ray exposure when advised to hold their breath. Inflating the lungs causes the rib cage to expand and the pectoral muscle to contract. Expansion of the ribs can cause the loss of posterior breast tissue on the mammogram because this bony structure now offers serious opposition to the compression device. Contracting the pectoral muscle causes the breast to be held more tightly to the body; in turn, the compression will be more uncomfortable for the patient and the breast cannot easily be dislocated from the ribs.

To See More Clearly: Five Decades of Change and Still Counting

Significant changes in mammography occurred from 1965 to date. Innovators applied their research and advances from technology, medicine, electronics, and related fields to increase the effectiveness of the mammogram. Improvements came rapidly in equipment, accessories, compression devices, film, and techniques to better image glandular breasts and breast cancers.

1965

CGR developed the first dedicated mammography machine with a molybdenum target tube, use of low kVp, and an integral compression device and C-arm configuration.

1967

First commercial CGR Senographe unit was shown at RSNA.

1969

First CGR unit was sold in the United States.

1971

Although its use was reported in the literature as far back as 1960, xeroradiography was not introduced commercially until 1971. Many physicians preferred its lower x-ray dose (2 to 4 R) and its blue powder/white paper images to the available film systems. Xeroradiography also afforded the hospital the ability to use one of its existing diagnostic x-ray machines; thus, it was not necessary to purchase a special machine to perform mammography. However, specialized processing and conditioning units had to be acquired and maintained.

1972

R.E. Wayrynen, PhD, and the DuPont Company developed the LoDose I analog imaging system: a single calcium–tungstate–intensifying screen in conjunction with a single-emulsion film packaged in a polyethylene bag from which air was evacuated to achieve good screen–film contact. The radiation dose with this system was approximately 1 to 1.5 R, another improvement over existing systems. The development of this improved imaging system was needed to realize the potential benefits from dedicated mammography machines. Mass screening was considered by many to be on the horizon.

1973

Three manufacturers introduced new dedicated units: the Siemens' Mammomat, Philips'

MammoDiagnost, and Picker's Mammorex. 1974

General Electric Healthcare (GE) introduced their dedicated MMX unit.

The 3M Company introduced the rare-earth phosphor generation of intensifying screens.

The variety of new dedicated mammography machines in the market and the availability of lower-dose analog imaging systems had a significant impact on mammography. Clinical practice began to change as xeroradiography and the new dedicated analog machines replaced the older equipment and methods for producing mammograms. The gap between mammographers who used dedicated machines versus those attempting mammography with standard x-ray equipment and industrial or medical film increased. 1976

Kodak introduced a low absorption cassette for use with a rare-earth screen and film combination—the Min-R system, with a dose measurement of approximately 0.08 R. At the same time, DuPont began to market their improved LoDose II system. Agfa-Gevaert also entered the film and cassette market during this period.

In response to concern about the x-ray dosage for mammography, those performing xeroradiography increased the filtration and recommended kVp settings to lower the dose to approximately 0.5 R. 1977

Techniques that allowed clearer, bigger, brighter, and better images were a major focus of equipment research and design at this time as clinicians and researchers sought to emulate successes in other types of imaging. In 1977, Xonics manufactured an x-ray machine that used electron radiography. The Radiologic Science Inc. unit (later known as Pfizer and then as Elscint) introduced the microfocus tube (a 0.09-mm round focal spot) to allow for magnification. Systems that used the new electronics and computer-based technologies influenced the designs and directions taken by later generations of mammographic systems. 1978

Philips introduced a moving grid with special carbon fiber interspace material for low absorption of the soft x-ray beam necessary for analog mammography. 1984

Liebel-Flarsheim began marketing a fine-line stationary grid that was placed inside the cassette. This was an acceptable alternative for machines that could not be retrofitted with a moving grid.

LoRad Medical Systems introduced the high-frequency/constant-potential generation of dedicated mammography machines. 1986

Kodak introduced Min-R-T screens and film: two intensifying screens within a cassette combined with a double-emulsion film. This system increased speed and reduced dosage, but with slightly less resolution and contrast, for use with younger or infirm patients.

National Council on Radiation Protection and Measurement issued a mammography user's guide. 1991

ARRT offers advanced certification in mammography to technologists (M). 1992

Siemens developed the first multianode tube. The dual target is composed of molybdenum and tungsten. GE followed with another dual-target x-ray tube but incorporated molybdenum and rhodium (see Chapter 11).

Fischer and LoRad simultaneously introduced small-field digital mammography for use with stereotactic core biopsies (see Chapter 18).

DuPont (then Sterling, then Agfa) developed a new generation of film emulsion, a cubic grain film that provides another dimension to high-contrast images.

MQSA is signed into law: effective October 1, 1994. 1993

The FDA bans the use of silicone implants. 1995

LoRad marketed a new high-transmission cellular grid that improves contrast for thicker, glandular breasts (see Chapter 11). 1996

All manufacturers have added features to make mammography machines more “user-friendly.” Technologists simply press the exposure button and the machine does the rest. 1998

The FDA approves CAD (computer-aided detection) equipment to be used only with analog mammography (see Chapter 11). 2000

GE receives FDA approval for full-field digital mammography (FFDM), although the images must still be printed on film. 2001

Fischer is the second company to gain FDA approval for their digital unit. Within 5 years, Fischer's slot scanning method of producing digital images will no longer exist; the company was purchased by a competitor and the slot technology phased out.

CAD is approved for use with digital mammography systems.

ACR begins the DMIST/ACRIN study to compare analog and digital imaging of women with glandular breasts. 2002

On October 28, the final MQSA equipment regulations take effect. The older noncompliant units are replaced primarily with analog units since the preliminary results from the DMIST/ACRIN study will not be published until 2005.

Hologic and Siemens Medical received FDA approval for their digital machines. The race for the digital market is on. 2005

Preliminary results from DMIST/ACRIN report that digital mammography is equivalent to analog imaging when dealing with an adipose breast; digital is superior when imaging the glandular breast.

U-Systems conducts studies using an automated breast ultrasound (ABUS) prototype.
2006

Fuji CR mammography was approved for use by FDA.

ACS no longer promotes BSE; CBE is still strongly recommended.

The FDA once again allows use of silicone implants. 2007

MRI of the breast is recommended as a screening test done in conjunction with mammography on women with a high risk for developing breast cancer.[6] 2008

The FDA approved tungsten target tubes for digital mammography.

Breast tomosynthesis enters the final phase of FDA acceptance. 2009

USPS Task Force issues controversial mammography guidelines. The ACS and almost all other medical organizations decry the task force recommendations.[7] 2011

Hologic receives FDA approval for digital breast tomosynthesis (DBT). 2014

GE receives FDA approval for digital breast tomosynthesis. 2015

Siemens receives FDA approval for digital breast tomosynthesis.

Koning Corp. receives FDA approval for coned beam breast CT, a diagnostic procedure.

ACS aligns with 2009 USPS Task Force guidelines. CBE is no longer promoted.[8]

Summary

The history of mammography began with good-natured discussion and scientific curiosity in 1924. From the start of modern mammography with Dr. Egan and his cohorts, the field progressed slowly during the 1950s and into the 1960s with help from the industrial sector. Mammography benefited greatly during the 30 years from 1970 through 2000 from rapid and remarkable technologic advances in electronics, computer sciences, plastics, and the emergence of other sophisticated medical imaging devices.

The interdependence between the recording system and x-ray system continues to be a major factor in producing the best image at the lowest dose. This relationship is central to the manufacturers' efforts to improve equipment, accessories, and image contrast and resolution as they strive to make the next breakthrough. Mammography capable of detecting breast cancers at an early stage could, with a regular screening program, reduce the mortality from breast cancer as dramatically as the Pap smear reduced the death rate from cervical cancer. The newer technologic advances in manufacturing, materials development and design, computer sciences (medical imaging without film), and biologic sciences (use of DNA technology) also have potential applications for the detection of breast cancer. Chapter 21 includes brief descriptions of alternative methods, some still in the research stage, that attempt to discover breast disease through cellular physiology.

One of the most powerful drives in humans is pleasure taken in their skills. They love to do what they do well, and having done well, work to do better. We see this process in every human endeavor. That bodes well for mammography too.

Review Questions

1. Name three differences in positioning and/or imaging between mammography done before and after dedicated machines were introduced.

2. List some advantages when using dedicated mammography machines rather than a general x-ray machine to produce an image.

3. How has the dose in mammography changed since it was first performed?

References

1. Warren SL. Roentgenologic study of the breast. Am J Roentgenol. 1930;24:113.

2. Strax P. Evolution in techniques in breast screening. In: Strax P, ed. Control of Breast Cancer Through Mass Screening. St Louis, MO: Mosby-Year book Inc; 1978:167.

3. Alcorn FS, O'Donnell EO, Ackerman LV. Training nonradiologists to scan mammograms. Radiology. 1971;99:523–529.

4. Andersson I. Mammography in clinical practice. Med Radiogr Photogr. 1986;62:2.

5. Lundgren B. The oblique view at mammography. Br J Radiol. 1977;50:626–628.

6. Helvie M, Rebner M, Sickles E, et al. Calcifications in metastatic breast cancer in axillary lymph nodes. Am J Roentgenol. 1988;l5l:921.

7. Barclay L. USPSTF issues new breast cancer screening guidelines. Medscape Medical News. November 16, 2009. Available at: [Medscape.com]

8. Simon S. American Cancer Society releases new breast cancer society guidelines. October 20, 2015. Available at: [Cancer.org]

2 Background: Need for Screening Mammography

Objectives To relate an increased risk for breast cancer to aging To define the terms incidence, mortality, and recurrence To provide patients with reasons and support for screening mammograms and early detection To explain the benefits from early detection of a cancer as critical to treatment, and relate stages of cancer development to higher levels of mortality To discuss the screening mammography guideline controversy

Key Terms

guidelines

incidence rates

mortality rates

National Strategic Plan for the Early Detection and Control of Breast and Cervical Cancers

Update 2011 Edition

Three changes during the 1990s demanded a complete revision of this chapter from our first edition (1992) to the second edition (2001). First was acceptance by health insurance companies and the medical community at large that screening mammography can visualize nonpalpable malignant breast tumors and effectively detect disease in its early stages. As the quality of mammograms improved, so did the ability to visualize small cancers. This was a significant paradigm shift regarding the efficacy of screening mammography. Second, the coupling of preventive medicine and consumer involvement in maintaining health became an accepted concept in the United States during this period. Finally, the statistics on breast cancer and medical treatment required an update.

With this, our third edition, we are pleased to report mammography remains an accepted screening procedure supported by the health care community, health insurance companies, and government programs. At imaging centers today, mammograms are as plentiful as chest x-rays. But most encouraging of all is that *screening* mammograms now account for approximately 80% of all mammograms done in the United States. 2019 Edition

The 2011 update mentions acceptance by health insurance companies and the medical community at large that screening mammography can visualize nonpalpable malignant breast tumors and effectively detect disease in its early stages, and that screening mammograms account for 80% of all mammograms that are done in the United States With this fourth edition, we find screening mammography has taken a step backward in time: In 2009, the U.S. Preventive Services Task Force (USPSTF) stunned the mammography community with reduced guidelines due to increased harms and reduced benefits associated with screening mammography In 2015, the American Cancer Society (ACS) changed its long-held guidelines concerning the age to begin screening mammography as well as changes in interval frequency We expect health insurance companies to align their policies with the new USPSTF/ACS guidelines.

For those in the mammography community who fought long and hard to gain acceptance for this screening exam, this change is a bitter pill to swallow. The Starting Point for Breast Cancer

The first written description of breast cancer was on ancient Egyptian papyrus.[1] The doctor described inflammatory breast cancer. He said treatment was futile and that the woman should be left alone. Ancient Greeks,[2] around 200 AD, thought an excess of black bile caused breast cancer. It was thought that the monthly menstrual flow naturally relieved women of this excess, which explained why breast cancer was more common after menopause.

Amazingly, this belief held until the early 1800s when Müller described the cellular nature of breast cancer; it consists of large, sticky cells. Today, research of the cause and behavior of various types of cancer has given us the knowledge that “Cancer results from a cascade of genetic changes in a single cell, all of which may be required for malignant conversion. Different changes, or combinations of changes, may result in different types of cancer … Some cancers do, however, have a major genetic susceptibility component, making those strategies already developed for genetic testing in other diseases applicable to cancer.”[3] At Risk for Breast Cancer

In the year 2017, approximately 316,000 females and 2,500 males in the United States will develop breast cancer. According to these statistics, the most important risk factor is being a female. Next is having already been diagnosed and treated for breast cancer. A third risk factor is having a genetic predisposition to developing the disease based on a positive family history, such as a premenopausal mother, sister, or daughter. As always, bilateral cancer in such instances presents a higher risk than does unilateral cancer.

Unfortunately, according to Strax, a “statistical study by the ACS teaches us that less than 25% of cancers develop in women with any of these [risk] factors. The vast majority, up to 75% of breast cancer, occurs in women with none of the known risk factors. The sad truth is that we have to consider all women over the age of 30 at risk for this disease.”[4] We must not wait until a woman meets certain risk profiles, nor should we wait until someone (the woman or her physician) feels something in the breast to justify having a mammogram. What are we *waiting* for? Early Detection

Major considerations that support early detection include the following: The disease is important. It has a recognizable presymptomatic stage. Reliable tests exist that are acceptable in terms of risk, cost, and patient discomfort. Therapy in presymptomatic stages reduces morbidity and mortality more than does therapy initiated after the presence of symptoms. Screening programs should take precedence over other needs competing for the same resource money. Facilities are available for the diagnosis and treatment of patients with positive screening results.

Early detection of any type of cancer is critical to successful treatment and the quality of life.

Screening mammograms of asymptomatic women are vital in the battle against breast cancer. However, before the discussion of *how* to obtain a good image begins, it must first be understood *why* technical expertise and interpretation are so vital in mammography. White on White

Mammography images cancer in white—either as white microcalcifications or as a white mass that displays one of the following characteristics: (a) the borders of the mass are irregular, (b) the mass appears to be new when compared with previous mammograms, or (c) the mass has increased in size when compared with previous mammograms. The glandular tissue from which cancers arise also appears white on the mammogram. As women with varying parenchymal patterns age, all but one of these patterns experience a decrease in the amount of glandular tissue. Each pregnancy greatly displaces the amount of glandular tissue remaining, whereas each month during the menstrual cycle a much smaller scale of replacement occurs. The dark-appearing adipose tissue replaces the white-appearing glandular tissue. When looking for cancer in the typical young woman's more glandular breast, we are looking for a white dot on a white background. In the typical postmenopausal, adipose-replaced breast, we are looking for a white dot on a dark background. Use of hormone replacement therapy (HRT) throughout the postmenopausal years causes some of the glandular tissue to be retained.

Mammography is not appropriate for everyone. For women below the age of 40, routine mammography is not recommended for various reasons: first, younger women's breasts are more radiosensitive; second, the incidence is too low in this group to make screening cost-effective; finally, the white-on-white image in the younger woman's mostly glandular breast further compounds the inaccuracy rate. When a young woman is clinically symptomatic, she is better advised to see a surgeon before seeking a mammogram. Detection of Breast Cancer

As women age, the likelihood of developing breast cancer increases. Table 2-1 illustrates the incidence rates of naturally occurring breast cancer cases per million women per year at various ages. Breast cancer is a disease directly related to age. Therefore, as women age, the need for mammography becomes more critical.

Table 2-1 2016 Estimated Breast Cancer Incidence and Mortality, per Million Women per Year*a*

*a*Estimated breast cancer incidence and mortality segregated by: Age In situ Invasive Deaths

Source: National Center for Health Statistics. Health, U.S. 2016 with Chartbook on Trends in the Health of Americans. Hyattsville, MD: National Center for Health Statistics; 2017.

The data from Table 2-2, Breast Cancer Risk for U.S. Women, are correlated to the incidence data and U.S. Census population data for women aged 40 and over from 1950 through census projections for these age groups until 2030. The result is presented as a bar graph in Figure 2-1, which illustrates the dramatic increase in the incidence of breast cancer as we age. There are particularly sharp increases in the number of breast cancer cases occurring from the ages of 25 to 49. Indeed, 25% of all breast cancers occur in women below age 50. From age 50 on, the number of cases per 100,000 women continues to increase, but at a much slower rate.

Table 2-2 Breast Cancer Risk for U.S. Women*a* *a* As women age, the likelihood of developing breast cancer increases.

Source: DevCan: Probability of Developing or Dying of Cancer Software, version 6.7.3. Statistical Research and Applications Branch, National Cancer Institute, 2015. Available at: www.srab.cancer.gov/decan.

Figure 2-1 This is an example of how aging, increasing risk of breast cancer, and a life expectancy of age 85 would affect a woman. In our example, we track her entry into the screening mammography pool in 1986 and follow her increasing risk through the next 45 years to 2031, when she reaches age 85, the forecasted life expectancy for U.S. females. She enters the mammography suite at age 40 with a risk of 1 in 225 and ends at age 85 with a lifetime risk of 1 in 8.

Utilization

Mammography should be done on a screening basis, just as the Pap test is done, because the average time it takes for breast cancer to grow large enough to feel (approximately 1 cm) is 10 to 12 years.[4,5,6,7] If mammography is done well technically, with a qualified radiologist interpreting the images, the average malignancy should be detected 2 to 4 years before it becomes palpable.[8] Often, in this case, the cure rate approaches 95%.[9,10] A lead time of 1.7 years is reported in women aged 40 to 49 and between 2.6 and 3.8 years for women aged 50 to 74 years.[11]

People with health insurance are more likely to have screening examinations (Table 2-3). If there is no health insurance, then compliance rates decrease almost in half. When the woman has private health insurance, only 8% of breast cancer cases are later stages III or IV; 18% if uninsured; 19% if Medicaid provides health insurance coverage. The National Center for Health Statistics reports the utilization of preventive and screening services. In 2003, the rate for the Pap test for women aged 55 to 64 was 85.5%; in 2013, it was 75.9%. For mammography use in 2003, compliance was 76.9%, and in 2013, use was 71.3%.[12]

Table 2-3 Use of Mammography among Women Aged 40 and Older, by Selected Characteristics, United States, Selected Years 1987 to 2015[a]

a Women with health insurance are twice as likely to have a mammogram as women without health insurance.

Source: National Center for Health Statistics. Health, U.S. 2016 with Chartbook on Trends in the Health of Americans. Hyattsville, MD: National Center for Health Statistics; 2017.

Reducing the mortality rate of breast cancer depends on early detection through mass screening, as proven in the use of the Pap test to reduce cervical cancer deaths. Cervical cancer mortality rates declined by 70% with the introduction of the Pap test in 1928. Between 1990 and 2010, breast cancer **mortality rates** fell from 33/100,000 per year to 21.3/100,000; a decline of 36%.[13]

Routine use of screening mammography begins in the United States in the mid 1980s, and within 10 years we see the beginnings of a reduction in mortality; breast cancer mortality rates have decreased approximately 2% each year beginning in the mid 1990s (Table 2-4). For women aged 50+ years, there is a 34% reduction in mortality; for 40- to 49-year-olds, there is a 51% reduction.[13]

Table 2-4 Trends: Breast Cancer Death Rates for Females in the United States[a] *a* Screening mammography begins in the United States in the mid 1980s. By the mid 1990s, we see the beginnings of a downward trend in mortality.

Source: U.S. Mortality Data, 1990–2016. National Center for Health Statistics, Center for Disease Control and Prevention; 2016.

Case Study 2-1

Refer to Table 2-4 and respond to the following questions:

1. When does the morality rate begin a downward trend?

2. In which year did the rules and regulations of MQSA take effect?

3. Could there be a cause-and-effect relationship between the signing of MQSA and the reduction in the number of deaths attributed to breast cancer?

This coincides with the increased use of screening mammography and the Federal government's enactment of the Mammography Quality Standards Act (MQSA) in October 1994. It's a Plan

In Sweden, the United Kingdom, and other countries, where screening is a matter of official national policy in the context of a national health care delivery system, the support for breast and cervical cancer screening goes beyond recommendations for participation. This support includes resources for a system of elements necessary to both accomplish and realize the fullest benefits of early cancer detection. This system includes the following elements: promotion of screening, quality assurance, follow-up for women with abnormal findings, and routine monitoring of program effectiveness, costs, and benefits.[14]

In March of 1990, the U.S. government began development of the **National Strategic Plan for the Early Detection and Control of Breast and Cervical Cancers**. "Health services for breast and cervical cancers should be available to all women, regardless of age, geographic location, socioeconomic status, race, ethnicity, or cultural background ... the Plan is designed for use by public and private organizations at the national, state, and local levels in planning specific programmatic activities"[14] (Figure 2-2).

Figure 2-2 The National Strategic Plan. The U.S. initiative to provide the means to discover breast and cervical cancers early.

Six critical components formed the framework of this Plan: Integration and coordination Public education Professional education and practice Quality assurance: breast cancer screening Quality assurance: cervical cancer screening Surveillance and evaluation

Additional costs to the nation for breast and cervical cancer screening will be incurred with or without a Plan. The costs will be a shared responsibility of the public and private sectors and will increase gradually as more women take advantage of these lifesaving preventive services. However, these costs will be offset by treatment savings resulting from the detection of cancers of the breast and cervix at earlier stages of development.[14]

This Plan provided for screening examinations regardless of the woman's ability to pay. In 1991,

$30 million was appropriated for this purpose; in 1992, $50 million; in 1993, $70 million; and in 2010, $100 million. Today, $169 million/year is allocated to this nationwide program. In 2016 the Plan: screened 290,095 women for breast cancer with mammography and diagnosed 2,639 invasive breast cancers and 829 premalignant lesions screened 140,073 women for cervical cancer with the Pap test and diagnosed 171 cervical cancers and 5,919 premalignant cervical lesions, of which 39% were high grade[15]

This Plan also provided support in several ways: It supported the ARRT's efforts to develop a competency examination in mammography for technologists. It encouraged continuing education in mammography for physicians and technologists. It provided money to standardize the training for medical physicists, radiologists, and radiologic technologists. It encouraged the manufacturing of high-quality mammography machines.

MQSA was an outgrowth of this plan. The Economics of Early Detection

The cost of medical care in America has become as important an issue as the need for care. Economic considerations fueled a renewed emphasis on disease prevention, patient participation in health decisions, and trade-offs in medical care. The true cost of treating a disease in its later stages is staggering. The economics of screening and early detection of cervical cancer through the Pap test are understood and accepted because these steps prevent future costs—in both lives and money. The cost of screening mammography is compared to other cancers (Table 2-5).

Table 2-5 Cost of Medical Care[a]

a YLL = years of life lost. To calculate YLL, subtract age at death from life expectancy. YLL weighs severity of death by the age a person is killed.

Lost productivity is estimated from the present value of lifetime earnings of all people who die of this cancer this year.

Source: Carter A, Nguyen C, et al. A comparison of cancer burden and research spending reveals discrepancies in the distribution of research funding. BMC Public Health. 2012;12:526.

Managed care programs establish policies that encourage women to have mammograms. Outside of HMOs, women must be educated in the importance of screening mammograms. However, even insurance coverage does not automatically guarantee women will have this examination; approximately 64% of Medicare beneficiaries used this feature.

Barriers to having mammograms include the following[16,17,18,19,20,21]: No symptoms, therefore unnecessary

Solution: medical organizations must educate the public on the need for mammograms Fear that cancer will be found

Solution: reinforce that if cancer is found early, survival rates are higher and breast-conserving surgery may be possible Cost

Solution: divide into less costly screening examinations versus more expensive diagnostic examinations; also encourage mandatory health insurance coverage Discomfort

Solution: most women do not find the procedure uncomfortable Concern about overdiagnosis resulting in unnecessary biopsies

Solution: radiologists must use problem-solving tree and audit results Time consuming and/or inconvenient

Solution: mammograms are mostly an outpatient procedure with scheduled appointment times Radiation

Solution: an earlier primary fear has been dispelled by public education about use of low-dose mammography systems

Women between the ages of 65 and 74 are most likely to comply. Almost half of the women who had not had a mammogram said their doctor never encouraged them to have it done.
Breast Cancer in America

Empirical data concerning breast cancer and mammography are both instructive and discomforting. The ACS estimates the risk of developing breast cancer for American women as 1 in 8, whereas the risk of dying from breast cancer is 1 in 37.[22] While the 1 in 8 statistic conveys the cumulative lifetime risk for women who live past the age of 85, perhaps more meaningful is stating the risk by decade. This risk never exceeds 1 in 26 in any single decade (Table 2-2). Age-adjusted **incidence rates** for breast cancer have been slowly rising over the past several decades[23] (Table 2-6). Incidence rates reflect the occurrence and frequency of breast cancer (Table 2-7).

Table 2-6 Age-Adjusted Breast Cancer Incidence Rates in the United States by Cancer Site, 1990–2013 (Rates per 100,000)[a]

a Experts believe the 10% decline in incidence rates that began in 2000 is due to the sudden decline in mammography compliance that began that year. With fewer women having screening mammograms, it is the delay in discovery that accounts for the apparent decline.

Source: National Center for Health Statistics. Health, U.S. 2016 with Chartbook on Trends in the Health of Americans. Hyattsville, MD: National Center for Health Statistics; 2017.

Table 2-7 SEER 18 Incidence and Mortality of Breast Cancer, Age-Adjusted and Age-Specific Rates, by Race and Sex[a]

a Breast cancer is a disease of old age; as women age, the likelihood of developing this disease increases.

Rates are per 100,000 and are age-adjusted to the 2000 U.S. Standard Population.

Source: SEER Cancer Statistics Review 2009–2013.

1.5 million cases of breast cancer were projected worldwide in 2016. The year 2017 projections are 255,180 new cases of invasive breast cancer and 63,400 cases of ductal carcinoma in situ (DCIS) will occur in the United States, and an additional 40,610 people will die of this disease.[24] This means every 12 minutes, 6 American women will develop breast cancer and 1 will die (Figure 2-3). The median age at diagnosis is 62 years, while the median age at death is 68.

Figure 2-3 The likelihood that a woman will be diagnosed with breast cancer exceeds that of all the other cancers; that likelihood more than doubles compared to the second most common cancer—lung. (Source: American Cancer Society. Breast Cancer Facts & Figures 2017-2018. Atlanta, GA:American Cancer Society, Inc.; 2017.)

Case Study 2-2

Refer to Figure 2-3 and respond to the following questions:

1. Women are most likely to develop which type of cancer?

2. How much more likely is a woman to develop breast cancer than the second most frequent cancer—lung cancer?

Between 1973 (with an incidence of 85 cases of breast cancer per 100,000 population) and 2000 (with 137 cases per 100,000 population), the incidence rose by 60%. Breast cancer incidence rates increased in Black women during the early 2000s; in 2012, the incidence rates for Caucasian and Black women converged.[25]

The National Cancer Institute (NCI) announced breast cancer mortality rates decreased by an average of 37% between 1989 and 2012, from 32.9 cases per 100,000 women in 1984 to 20.7 cases in 2013.[13] Table 2-8 illustrates the long-term trend in mortality between 1950 and 2015. Screening for the detection of early breast cancer works.

Table 2-8 Breast Cancer Mortality Rates, USA: 1950–2015 (Age-Adjusted Death Rate per 100,000 Population)[a]

a The mortality rate from breast cancer steadily decreases from its peak in 1990.

Source: National Center for Health Statistics. Health, U.S. 2016 with Chartbook on Trends in the Health of Americans. Hyattsville, MD: National Center for Health Statistics; 2017.

Swedish Survival Statistics

Five mammography screening trials began in Sweden in the 1970s and ended in the 1980s. These were large, comprehensive, well-designed, and well-conducted studies.[26,27] After more than 30 years of follow-up, these screening trials show a 32% decrease in mortality.[28,29] While there are no comparable long-term screening trials in the United States, the results of the Swedish trials provide useful information about breast cancer and survival rates. A much smaller U.S. study, completed in 1989, found a 30% reduction in mortality.[30] The good news today is that 80% of women who develop this disease do not die of it.

From the Swedish studies, we see that tumors less than 15 mm received particular attention, while those less than 10 mm in size seem to be of a different breed altogether. Women with cancer detected at an early stage have excellent outcomes: survival rates of approximately 95% at 12 years.[29] The histologic grade of the tumor does not appear to matter when the cancer is tiny, nor does lymph node status or the woman's age, pre- or postmenopausal. Early detection at this stage means long-term survival.

Case Study 2-3

Refer to the text section “Swedish Survival Statistics” and respond to the following questions:

1. The histologic grade of a breast cancer has little effect on survival as long as the tumor is under ___________ mm in size.

2. The Swedish screening trials show a long-term mortality reduction of ___________ % after ___________ years of follow-up.

Lesion Size and Survival Rates

By the time a nonpalpable 0.5 cm lesion increases in size to a palpable 1 cm, its mass has increased eight times (Figure 2-4). A 1-cm tumor contains from 100 million to 1 billion cells. By the time they reach 2 cm in size, these lesions often have metastasized. For patients with metastatic lesions, the median time of survival is 2 years. As the tumors increase in size, the cell types become more heterogeneous and respond less predictably to various drugs, radiation therapy, and biologic markers. In general, the duration of the patient's survival is inversely related to the size of the tumor; thus the larger the tumor, the lower the survival rate. This is why it is important to detect the smallest lesion possible.

Figure 2-4 Size of breast lumps.

An NCI medical audit stated that 73% of invasive cancers are invasive ductal carcinoma (IDC) and 9% are invasive lobular carcinoma (ILC), while 85% of in situ cancers are DCIS and 11.5% are lobular carcinoma in situ (LCIS).[31]

Survival rates of those women with lesions whose borders are smooth (such as mucinous carcinoma) are better than those whose lesions have irregular borders (such as the typical scirrhous carcinoma): 80% versus 38% at 10 years.

Ever-changing Guidelines

During the authors' four decades of working in the field of mammography, they have seen mammography screening guidelines from national medical organizations change, always for the better ... until 2009 (Table 2-9).

Table 2-9 USPSTF Guidelines and ACS Guidelines[a]

a Ever-changing USPSTF and ACS mammography screening guidelines for the woman at average risk.

In the 1970s, when the authors started working in this discipline, only diagnostic mammograms were performed; women with advanced clinical symptoms of advanced breast disease were imaged. Thanks to our European colleagues, particularly those from Sweden, our images improved in quality to a point that we began performing screening mammograms in the mid 1980s. In 1991, Medicare began coverage of annual mammograms for its beneficiaries. Once Medicare agrees to pay for a service, other insurance companies follow suit.

Once we begin performing routine screening exams, within a decade we see the beginnings of an ultimate 30% reduction in mortality due to earlier detection and improved treatments of those diagnosed with breast cancer. Since 1990, breast cancer mortality rates have decreased yearly by 2.3% overall and 3.3% for 40- to 49-year-old women.[32]

For the 50 years before screening exams were done in the United States, the mortality rate remained the same (Figure 2-5).

Figure 2-5 The first mammogram is performed in 1924. Screening mammography begins in the mid 1980s. Medicare begins annual coverage for this exam in 1991. Only after screening exams are widely utilized does the mortality rate decline. (Source: Siegel RL, Miller KD, Jemal A. Cancer statistics, 2016. CA Cancer J Clin. 2016;66(1):7–30; with permission of John Wiley and Sons.)

Old Guidelines

Old **guidelines** for mammography considered all women to be at equal risk for developing breast cancer; these old guidelines relied strictly on age. We now apply a different approach, one that considers age as well as the unique parenchymal pattern of each woman's breast tissue. Closer surveillance is recommended for women with more glandular breast tissue. Women whose tissue is adipose replaced may, if they so desire, extend this interval. Women at high risk are advised to have annual mammograms and an MRI.

In the early 1980s the guidelines for screening mammography were altered to include younger women as our knowledge of the disease process became better defined. Cancer detected in women younger than 50 is usually more aggressive, with a faster growth rate.[8,33,34,35]

1980–1995 Guidelines

Mammography in its infancy (1924 to 1964) could find only clinically evident breast cancer. Indeed, the only women who had mammograms had lumps. In the late 1960s to early 1970s, use of general x-ray equipment and x-ray film gave way to dedicated mammography machines and specialized mammography recording systems. Gradually, as our positioning and radiographic physics techniques were refined, our ability to find smaller lesions (Table 2-10) resulted in the declaration from the ACS in 1976 to begin yearly screening mammograms on asymptomatic women aged 50 and older.[35] In 1980, a baseline exam, between ages 35 and 39, was added to provide images for future comparison. In 1983, the guidelines were changed to include screening every 1 to 2 years for women aged 40 to 49.

Table 2-10 Cancer of the Female Breast, Incidence Rates, 1975–2013 by Age, In Situ versus Malignant All Races[a]

[a]There is a marked increase in in situ lesions in both the under- and over-age-50 groups. There is a slow but steady increase in malignant lesions in both the under- and over-age-50 groups.

Rates are age-adjusted to the 2000 U.S. Standard Population (19 age groups—Census P25-1103).

Source: SEER 9 areas.

The battle in the 1990s was over what to do with women in their 40s. In 1993, the National Cancer Institute withdrew its support for screening mammograms for women younger than age 50. The NCI stated research had not shown a reduction in mortality rates for women who were screened in their 40s the way that it does for women older than 50 years of age.[36] Immediately after NCI's withdrawal of support for screening younger women, 18 other medical societies (ACS, ACR, AMA, ACOG, etc.) urged women to disregard this decision and to continue to follow the old guidelines of every 1 to 2 years for women in their 40s.[37,38]

To bolster support for screening women during the years 40 to 49, numerous articles appeared in print in the early 1990s. Statistics citing the benefits of screening came from the reevaluated Health Insurance Plan of New York (HIP) and Breast Cancer Detection Demonstration Project (BCDDP) studies in the United States, the Edinburgh Screening Trial, UCSF Service Screening Program, and Albuquerque Audit; the most important and impressive data came from the five Swedish screening trials regarding the efficacy of screening women in their 40s. Evidence quickly began to mount in favor of screening women annually beginning at age 40. By 1996, the battle between those for and those against screening mammograms of women aged 40 to 49 reached a climax.

1997 Guideline Controversy

At the urging of NCI Director Richard Klausner, MD, the National Institutes of Health (NIH) convened a conference to settle the issue of screening women in their 40s. For 3 days in January 1997, 32 speakers presented information to a panel of 13 (a major criterion for panel selection was an unbiased attitude concerning the screening issue as manifested by the absence of any articles or portions of articles addressing screening premenopausal women).38 When the conference concluded, the panel issued a statement *against* recommending screening women younger than age 50. The panel suggested that women in their 40s should decide for themselves whether to be screened.

Immediately after the conference, media coverage of the panel's conclusions was unmerciful. A mockery was made of the panel's suggestion that women should decide for themselves (Figure 2-6). Public outcry against the decision was fueled by a hue and cry from many medical organizations. Even a Senate Appropriations Subcommittee hearing ensued. “NCI Director Richard Klausner, at whose urging the conference convened, publicly denounced the panel's findings, the first time in the history of the NCI that its Director has publicly disagreed with a consensus panel decision.”39

Figure 2-6 What's a woman to do? A mockery of guidelines. Drawing courtesy J. Lille'

Immediately after the panel's decision, the ACS and other medical groups announced their new guidelines: yearly mammograms for all women beginning at age 40.40 Even Medicare announced annual coverage of mammograms beginning in 1998—not subject to satisfying the participant's yearly deductible. Shortly thereafter, the NCI/NIH altered their guidelines to recommend screening mammograms for women aged 40 to 49 be done every 1 to 2 years.

*Use of mammography and clinical breast examination has increased significantly from the time of the first ACS recommendations in 1980. The number of women older than 40 years who have ever had a mammogram increased 200 percent during the 1980s ... Between 1985 and 1990, 44 states passed legislation requiring health insurance companies to cover the mammographic examination. In 1991, Medicare began reimbursement for screening mammograms every other year in women age 65 years and older.*35

What a vindication for mammography.

2009 United States Preventive Services Task Force Recommendations

We were mystified when in 2009 the USPSTF issued their new recommendations for screening exams (Table 2-11). The USPSTF is an independent panel of primary care physicians funded and staffed by the Health and Human Services (HHS) Agency for Healthcare Research and Quality (AHRQ). Beginning in 2008, when determining what preventive services Medicare will cover, HHS is allowed to consider USPSTF recommendations; this is why the USPSTF recommendations are so vital: health insurance companies tend to follow Medicare's lead. Beginning in 2009, USPSTF evaluates the need for screening mammography using a new filter: harms versus benefits rather than the traditional filter: benefits. The USPSTF concludes mammography reduces breast cancer mortality in women aged 40 to 74 by 19%, with the greatest benefit for women aged 60 to 69, and the smallest benefit with women aged 40 to 49.41

Table 2-11 USPSTF 2016 Final Recommendation Statement: Breast Cancer Screening*a*

a False-positive findings are more common in the under-50 age group.

Number of biopsies performed is constant for all age groups.

False-negative findings are the same for all age groups.

Source: USPSTF Final Recommendation Statement: Breast Cancer Screening. Accessed January 30, 2018. USPSTF Recommendations

A “C” recommendation rating was issued for mammography use in women age 40 to 49. This C rating designates only a small benefit to screening women below the age of 50. It is *not* that mammograms are not recommended below age 50; rather the USPSTF states that women should weigh the harms versus the benefits and make a personal decision.

The “I” rating for women 75 years of age and above is a consequence of insufficient evidence from screening trial results whether or not there is a benefit in screening elderly women. Therefore, mammograms are not recommended for women above the age of 75.

The “B” rating for women aged 50 to 74 designates a benefit to screening for this age group; however, the USPSTF states that a large proportion of the benefits of screening mammography are maintained with biennial (every other year) screening. The USPSTF states that the harms of mammography screening are reduced by 50% by going to biennial rather than annual screening.

Clinical breast exam (CBE) is given a rating of “I,” while breast self-exam (BSE) is rated “D.” Digital mammography (2D FFDM), digital breast tomosynthesis (DBT), and breast MRI are given ratings of “I.”

The USPSTF lists the harms of detection and early intervention to substantiate their B, C, D, and I ratings:

Psychological Harms Anxiety Unnecessary imaging tests: additional views, ultrasound, MRI Unnecessary biopsies in women without cancer Inconvenience of false-positive screening results (more common in women aged 40 to 49) (Table 2-12) Additional doctor appointments: family physician, surgeon, mammography facility

Table 2-12 Harms of 1X Mammography Screening*a*

*a*False-positive findings are more common in the under-50 age group

Number of biopsies performed is constant for all age groupsFalse-negative findings are the same for all age groupsThe following source must be cited when reproducing these data:

"*Data collection and sharing was supported by the National Cancer Institute-funded Breast Cancer Surveillance Consortium (HHSN261201100031C). A list of the BCSC investigation and procedures for requesting BCSC data for research purposes are provided at:* http://breastscreening.cancer.gov/."

Harms Treatment of noninvasive and invasive breast cancers that would not become clinically apparent during a women's lifetime (overdiagnosis; more common in older women) Unnecessary earlier treatment for breast cancer that would become clinically apparent but would not shorten a woman's life (overtreatment) False-negative (missed cancer) results provide false reassurance Effects of radiation exposure from a screening exam

The USPSTF recognizes that the benefit of screening mammography is equivalent for the age groups 40 to 49 and 50 to 59; however, the incidence of breast cancer and the consequences differ (Figure 2-7). More cancers are diagnosed in the 50 to 59 age group, so the harms are less, while fewer cancers are diagnosed in the 40 to 49 age grovup, so the harms are larger. The USPSTF states that the net benefit to the age 40 group is small; with the age 50 group, the benefit is moderate; for women in their 60s, the benefit is the greatest; women aged 70 to 74 have a moderate benefit; and for the woman aged 75+, there is insufficient data.

Figure 2-7 Breast cancer incidence by age. Advancing age places a woman at higher risk for developing this disease. (Source: National Center for Health Statistics. Health, U.S. 2014 with Chartbook on Trends in the Health of Americans. Hyattsville, MD: National Center for Health Statistics; 2015. National Cancer Institute Surveillance, Epidemiology, and End Results (SEER) 18 registries.)

Response

More women in their 50s are diagnosed with breast cancer than those in their 40s, but younger women's cancers tend to be more aggressive.[42,43]

Twenty-five percent of women who die of breast cancer are diagnosed in their 40s.[44]

The 2010 Affordable Health Care Act did not support the 2009 USPSTF recommendations; "Obamacare" mandated that insurance companies cover screening mammography services beginning at age 40. This was reaffirmed by the Consolidated Appropriations Act, 2016 (H.R. 2029) in which Federal lawmakers extended that guarantee. 2015 American Cancer Society Guidelines

October is breast cancer awareness month, the time each year that everyone gets "pink-ed"—from football players sporting pink sneakers and socks to pink lights on downtown landmark buildings. Everyone supports the pink cause: early detection.

It was a cruel turn of events for the ACS to announce their change in guidelines in October 2015, a policy shift that discounts the need for screening mammography. The new mammography screening guidelines were formulated after a committee was tasked with balancing the benefits versus the harms. The new 2015 ACS guidelines are not as extreme as those advocated by the USPSTF (Box 2-1).

BOX 2-1

2015 American Cancer Society Recommendations for Early Breast Cancer Detection in Women without Breast Symptoms For women at average risk Women aged 40 to 44 should have the choice to start annual breast cancer screening with mammograms if they wish to do so. Women aged 45 to 54 should get mammograms every year. Women aged 55 and older should switch to mammograms every 2 years, or have the choice to continue yearly screening. Screening should continue as long as a woman is in good health and is expected to live 10 more years or longer. All women should be familiar with the known benefits, limitations, and potential harms associated with breast cancer screening. They should also be familiar with how their breasts normally look and feel and report any changes to their health care provider right away.

Source: https://www.cancer.org/content/cancer/en/healthy/find-cancer-early/cancer-screening-guidelines/american-cancer-society-guidelines-for-the-earlydetection-of-cancer.html. Reprinted by the permission of the ACS.

According to the ACS, since the last guideline update in 2003, new studies have been published about the harms and drawbacks of screening mammography. Screening mammograms find something suspicious on the image: a BIRADS 0 classification; this requires further testing: additional views, ultrasound, or perhaps a biopsy, after which the suspicious area turns out to be (thankfully) benign. These additional tests carry risks: pain, anxiety, and other side effects. A recent screening trial conducted in the United Kingdom reported false-positive rates ranging from 0.9% to 6%, with higher rates for younger women and lower rates with older women.45

In the United States, approximately 10% of screening mammograms are recalled for additional evaluation; this is the same recall rate as the Pap test. One to two percent are ultimately biopsied; 20% to 40% of biopsied lesions are cancer. The economic cost of recalls is estimated to be $1.6 billion. The Mammography Community Responds To USPSTF Recommendations and ACS Guidelines

Mammography community leadership from the American College of Radiology (ACR) and the Society of Breast Imaging (SBI) formulated a response to this new risk-based assessment of the value of screening mammography used by the USPSTF and the ACS.46

The mammography community is “gravely concerned” about the new benefits versus harms assessment method that underestimates the benefits of screening mammography and overstates the harms associated with this exam. The ACR/SBI response addressed both written and insinuated points covered in the USPSTF guideline recommendations:

1. ***Task Force membership***

No Task Force member is an expert in breast cancer diagnosis or care. In fact, a requirement for appointment to this Task Force was the total absence of any authoritative books, white papers, or articles on the topic of breast cancer.

Response

The ACR and SBI opinion is that formulation of guidelines with such important implications should be drafted by a multidisciplinary group representing all viewpoints of merit.

2. ***Statistical errors and assumptions***

The Institute of Medicine (IOM), established in 1970, guides policy makers, health care professionals, the private sector, and the public in providing objective, evidence-based advice.

Response

The ACR/SBI stated that many of the types of significant statistical errors and inappropriate assumptions made by the USPSTF in formulating their recommendations were foreseen and could have been rectified by following the IOM document.[47]

3. ***Mortality reduction statistics***

The USPSTF relied primarily on randomized clinical trial (RCT) data to compile statistics of a 19% mortality reduction (Table 2-13).

Response

RCT data results vary significantly between initiation-to-screen (invited versus not invited) versus exposure-to-screening (screened vs. nonscreened) trials. The former states a 25% reduction in mortality while the latter is 38%.[48]

The United States has limited current data with RCT studies. The United States performs opportunistic screening, while the European countries conduct screening programs. The majority of the RCT studies cited by the USPSTF were performed in the United States more than 40 years ago, using state-of-the art imaging techniques employed in those bygone eras; no current RCT studies employing modern imaging techniques are under way in the United States; therefore, we must look to our European colleagues for these statistics.

Results of opportunistic screening compare most closely to a more recent Euroscreen Working Group systematic review of 20 incidence-based trials, showing a 31% mortality reduction, plus 8 case-controlled studies with a 48% reduction.[48]

Opportunistic screening more closely aligns with exposure-to-screening (screened vs. nonscreened) programs. A Canadian study with 20 million person-years of follow-up shows a 40% mortality reduction with the screened versus nonscreened group.[49]

Table 2-13 Breast Cancer Deaths Avoided (95% CI) per 10,000 Women Screened by Repeat Screening Mammography over 10 Years: Data from Randomized, Controlled Trials[*b*,*b*] 2016 USPSTF Final Recommendation Statement

a All women did not have 100% adherence to all rounds of screening offered in the randomized, controlled trials.

*b*Over a 10-year period, screening 10,000 women aged 40–49 will result in 3 fewer breast cancer deaths; age 50–59 will result in 8 fewer; age 60–69 results in 21 fewer deaths.

Current as of: January 2018

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http://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/

breast-cancer-screening

4. ***Mortality reduction in women aged 40 to 49***

The data used by the USPSTF showed only a 12% reduction in mortality screening of women aged 40 to 49.

Response

The 2009 USPSTF failed to note a Swedish study of women aged 40 to 49 that showed a 26% mortality reduction for the screened versus nonscreened populations. An updated 2016 USPSTF paper mentions that the Task Force reviewed this study; their conclusion: more contemporary evidence using modern-day imaging is important to consider due to the age and obsolete technology used to gather the RCT data.

The Swedish study compared two matched groups of women in their 40s: those screened for breast disease and those not screened. Whether in the screened or the nonscreened group, all women diagnosed with breast cancer were given similar treatments. The screened group showed a 26% reduction in mortality versus the nonscreened group. This comparison showed there was no reduction in mortality for the nonscreened group who were diagnosed only when their cancer advanced to a symptomatic stage; mortality reduction occurred only in the screened group.50

The Pan-Canadian Screening Study with 20 million person-years of follow-up showed the following mortality reduction based on exposure to screening (screened vs. nonscreened populations):

The rate of mortality reduction is similar for each decade of life. Although the incidence of breast cancer increases with increasing age, early detection of disease benefits all age groups equally.49

A study conducted in England showed a mortality reduction of 48% in women aged 40 to 49, and 44% for the 40 to 69 age group.51

5. ***"C" rating for women aged 40 to 49***

A "C" recommendation rating was designated by the USPSTF for screening mammograms of women between ages 40 and 49. Seventeen million women are in this age bracket in the United States. The Affordable Health Care Act of 2010 required that insurance companies include coverage for screening exams with a rating of "B" or above; the "C" rating given to mammography would exclude women from receiving the benefits of this exam. USPSTF advocates women in their 40s should decide for themselves whether or not to undergo screening mammograms by comparing the harms versus the benefits (Figure 2-6).

Response

Breast cancers in nonscreened women aged 40 to 49 still occur, only they will be advanced cancers with clinical signs and symptoms when discovered. A study by Webb et al. reported that most deaths from breast cancer occurred in nonscreened women (71%), and half of these deaths were in women younger than age 50.52

There are four major reasons to screen women aged 40 to 49: (a) it is effective; (b) cancer tends to have a rapid growth rate in women aged 40 to 49; (c) there is an increased incidence of developing cancer in women in their 40s; and (d) annual screening means a reduced mortality rate.

Screening of asymptomatic women in their 40s is effective in detecting small cancers.[27,28,30,35,53,54,55,56,57,58,59,60,61,62] Detecting cancer in its early stages offers a greater chance for recovery and more choices for intervention to stop the cancer from spreading beyond the breast tissue. Screening women annually beginning at age 40 will detect more cancers than by delaying annual screening to age 50. Newer techniques and equipment allow skilled technologists to image smaller malignant tumors and skilled physicians to perceive the subtle changes in these early growth stages.

Some malignant breast tumors progress faster from the early stages to their more advanced and deadly stages in women aged 40 to 49.[29,33,63,64] These aggressive tumors also take a significantly shorter time to develop in women of this age group, which strongly suggests the need for an annual mammogram. For now, the key to survival for women in their 40s is a quality mammogram every year, an accurate interpretation of their mammograms, and the detection of tumors under 10 mm in size.

In 2013, there were approximately 65,000 cases of breast cancer diagnosed in women younger than age 50.

6. ***"I" rating for women age 75+***

An "I" recommendation rating was designated by the USPSTF for screening mammograms for women aged 75 and older. Not much data has been published on screening mammography outcomes for women in this age group. The "I" rating is due to insufficient data.

The USPSTF issued this policy to stop screening for all elderly women, regardless of their health status, due to their limited life expectancy and comorbidity likelihood.

Response

Ten million women in the United States are aged 75+. Actuarial tables provide life expectancy rates:

Women who live to age 75: 25% live another 17 years. 50% live another 12 years. 25% live another 7 years.

Data from a Breast Cancer Surveillance Consortium (BCSC) Screening Study, comprising over 4 million mammograms, done in the United States between 1996 and 2006 (Table 2-14) demonstrate a much higher cancer detection rate/1,000 women for the 70 to 80+ age groups than for the 60 to 69 age groups, which are the age groups the USPSTF states makes the most sense to screen.[65]

SEER data report that 30% of invasive breast cancer occurs in the 70+ age group. CISNET modeling data show that both age groups (70 to 74 and 75+) have similar incidence rates. The USPSTF gives a "B" rating for screening women age 70 to 74 and an "I" rating for age 75+.

Breast cancers in nonscreened women above age 74 still occur; only, they will be advanced cancers with clinical signs and symptoms when discovered.

Table 2-14 Cancer Rate (Per 1,000 Examinations) and Cancer Detection Rate (Per 1,000 Examinations) for 1,838,372 Screening Mammography Examinations from 2004 to 2008 by Age–based on BCSC Data through 2009

From Sinclair N, Littenberg B, Geller B, et al. Accuracy of screening mammography in older women. AJR Am J Roentgenol. 2011;197(5):1268–1273. Reprinted with permission from the American Journal of Roentgenology.

7. ***Annual versus biennial screening***

The USPSTF recommends biennial screening for women aged 50 to 74, a "B" recommendation rating (Table 2-15).

Response

Screening intervals are based on tumor sojourn time. Whether screening mammograms are done annually or biennially, the same ***total*** number of breast cancer cases are identified. The difference is in the size and stage of the tumor. A computer simulation method built on breast cancer growth rates calculates that annual screening yields a 52% reduction in distant metastatic disease versus 27% with biennial screening.[66]

Annual screening finds cancers at a smaller size, more likely node-negative, at an earlier stage, with longer survival rates, with reduced treatment regimens, and with a reduction in mortality. The downside to annual screening is an increase in false-positive exams because it is more difficult to find early disease. Biennial screening has fewer false-positive findings because it is easier to identify more advanced cancers. The price to be paid for finding disease earlier is more frequent recalls of patients for additional views plus more biopsies.

CISNET modeling of annual screening of women aged 40 to 74 yields 46.5% more lives saved and 57% more life-years saved than when screening is delayed until age 50.

Table 2-15 Lifetime Benefits and Harms of Annual versus Biennial Screening Mammography per 1,000 Women Screened: Model Results Compared with No Screening[a,b] 2016 USPSTF Final Recommendation Statement

a Values reported are medians (ranges).

*b*The rationale behind the new biennial versus annual guidelines. With biennial screening: There is a modest decrease in mortality There is a slight reduction in life-years gained False positives are reduced by half Biopsies are reduced almost by half There is a slight reduction in overdiagnosis

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8. ***Benefits of screening other than mortality reduction*** Screening detected (earlier stage disease) versus palpation detected (more advanced) breast cancer. Earlier detection results in less surgery. Advanced cancers require extensive surgery: the Halsted radical mastectomy;

screening detected cancers are smaller, resulting in less surgery: lumpectomy. Due to earlier detection of breast cancer, we rarely, if ever, perform Halsted radical mastectomies today. Modified radical mastectomies are performed today, but most screening detected cancers are treated with lumpectomy. Beginning in 1990, the NIH recommends breast conservation therapy (BCT) for early (stage I or II) breast cancer. Currently, approximately 65% of women choose lumpectomy.67 Chemotherapy: less frequent and less aggressive treatment regimes with fewer serious side effects for screening detected cancer. Generally, if a tumor is under 1 cm in size, no chemotherapy is needed. Increased anxiety for the 10% of incomplete exams (BIRADS 0); but 90% of women have decreased anxiety due to true negative results. Decreased anxiety in women diagnosed with early-stage disease because they know early detection results in better survival rates with reduced therapies (surgery, radiation, chemotherapy). There is a certain peace of mind when cancer is found early. Overdetection, Overdiagnosis, Overtreatment

Overdetection: Radiologist

Overdiagnosis: Pathologist

Overtreatment: Surgeon/Oncologist

The USPSTF refers to the harms of overdiagnosis of breast cancer; it is considered the most significant of all the harms associated with screening mammography. The USPSTF estimates overdiagnosis at 19%; in women below 50 years of age, the rate of overdiagnosis is between 20% and 40%.68 The USPSTF estimates that 20 women/1,000 who undergo a lifetime of screening will be overdiagnosed; this is a 2% lifetime frequency.

Overdiagnosis of invasive carcinoma is virtually nonexistent. Overdiagnosis generally deals with DCIS, especially low-grade tumors, which are 20% of DCIS cases. DCIS does not always progress to IDC; in fact, less than half of untreated DCIS advance to the invasive stage. Therefore, surgical removal with/without adjuvant therapy may represent overdiagnosis/overtreatment. The NCI recommends that DCIS should no longer be classified as breast cancer; instead, it should be considered as an indolent lesion.69

A study by Javitt reports that up to 30% of DCIS lesions treated only with local excision recur.70

In 1983, there were 4,900 cases of DCIS reported; in 2017, there are 63,400 cases projected.71 DCIS has gone from 5% to 20% of findings on mammograms (Table 2-10). Forty percent of nonpalpable lesions detected at screening are DCIS. With appropriate treatment of DCIS, survival rates are 99.5%.72 Overdetection

Overdetection is a function of the radiologist; sensitivity and specificity rates are monitored by the annual medical outcomes audit. The sensitivity in mammography is between 77% and 95%, and specificity is 94% to 97%.73,74

Currently, it is impossible to determine if a screening detected cancer would have remained indolent, never causing a health care incident for which the woman is treated for cancer. This causes us to treat all screening detected cancers as malignant. Upon biopsy, we know if the DCIS tumor is low grade; it is this group of 20% that overdiagnosis impacts. But for 80% of cases that are the higher grade tumors, this is early detection. Early detection means less extensive treatment regimens.

Perhaps the best estimate of overdiagnosis is by Puliti et al., between 1% and 10%. The harm of overtreatment is removal of this lesion.75 Mitigate Overdetection

At this time, there do not appear to be any palatable methods to mitigate overdetection.

1. ***Raise the radiologist's threshold for considering findings sufficiently abnormal before recommending additional imaging as well as when to biopsy***

This means waiting until a cancer advances in its growth until it clearly and unambiguously changes the architecture on an image. When the cancer advances and presents with classic radiographic characteristics of malignancy, there is no need for additional views, ultrasound, or any other ancillary procedures.

2. ***Delay the age for beginning screening mammography***

In the 1980s, we performed a baseline mammogram between the ages of 35 and 39; this was abandoned. In 1992, the ACS guidelines changed to begin annual screening at age 40. In 2015, the ACS guidelines changed to begin at age 45; the USPSTF recommends beginning at age 50.

3. ***Lengthen the interval between screening exams***

The USPSTF recommends biennial rather than annual exams for women aged 50 to 74.

4. ***Do not perform BSE/CBE***

When we perform a physical examination of the breasts and feel “something,” we take action to discover what it is: perform imaging (mammogram/ultrasound); interval follow-up in 6 months; refer the patient to a surgeon; and perhaps escalate to a biopsy. Most of the time the symptomatic area is not cancer. If we do not examine the breasts, then these “harms” would not happen.

5. ***Do not screen elderly women due to a comorbidity likelihood***

6. ***Do not treat screening-detected DCIS***

Half or fewer of DCIS cases progress to invasive disease. Continue surveillance and treat only those cases that increase in size/symptoms.

There is not a single reported case of spontaneous disappearance of DCIS or invasive breast cancer happening without treatment. Conversely, there are thousands of examples of cancers visible in hindsight on previous exams, where the current exam shows the cancer has increased in size between the prior and current exams.

Nonscreened women still undergo false-positive tests due to clinical signs and symptoms. A study by Barton reported 16% of women (32% in their 40s) went to a physician for a breast “problem.” Twenty-one percent had a biopsy, proving the symptomatic area was benign: in USPSTF terminology, an “unnecessary” biopsy.[76]

The USPSTF does not mention the harm of later detection of a breast cancer.

Since the advent of screening mammography in the United States in the mid 1980s, there are conflicting reports about the value of screening exams. This has led to confusion and mistrust on behalf of the public as well as those in the health care field who are asked by patients when is the correct age to begin screening, what age should this exam be discontinued, and what is the correct interval between exams.

What is the rationale behind this new policy? The ACS now aligns more closely with the findings of the 2009 USPSTF. The guidelines are beginning to align with those of our European colleagues. The baseline mammogram between ages 35 and 39 has long disappeared; annual exams no longer begin at age 40, and instead age 45 is the new recommendation; BSE has long been optional to perform; and now annual CBE is no longer recommended. No monthly BSE, no annual exam by your doctor, a delay until age 45 to begin mammography, and a reduction in the number of lifetime mammograms each woman undergoes—what impact will all these have on the strides we've made in early detection and a reduction in mortality rates? With the new guidelines just announced, we must wait years to learn the long-term effects.

Summary

The prevention, detection, and treatment of breast cancer continues to be a major goal in the health care of women. This disease strikes 1 in every 8 American women and is a major cause of death. We cannot prevent this disease at this time. We can, however, detect it at an earlier stage when the word “cure” can be more than something the woman hopes for. Mammography technologists promote breast health and inspire their patients to encourage their family members and friends to have mammograms. “You can survive breast cancer if it is detected early, and you can detect it early through monthly breast self-examination and periodic mammograms.”[77]

Review Questions

1. Refer to Figure 2-2. What is the purpose of the National Strategic Plan for the Detection and Control of Breast and Cervical Cancers? When did this Plan begin? How much money is spent annually on this program?

2. Will the results of the Swedish screening trials apply to screening done in the United States?

3. Mammography guidelines are rewritten every few years. Why is this necessary?

4. Screening mammography has dramatically increased the detection of DCIS. What are the harms associated with detection of this stage of disease?

References

1. Breasted JH. The Edwin Smith Papyrus. Chicago, IL: University of Chicago Press; 1930:403–406.

2. Baum M. Breast cancer 2000 BC to 2000 AD—time for a paradigm shift? Acta Oncol. 1993;32(1):3–8.

3. Statement of the American Society of Human Genetics on genetic testing for breast and ovarian cancer predisposition. Am J Hum Genet. 1994;55:i–iv.

4. Strax P. Control of breast cancer. Adm Radiol. September 1989;30–36.

5. Dakins D. Diagnostic problem-solving takes a back seat in breast screening. Diagn Imaging. 1987;9(11):372.

6. Vinocur B. The breast cancer battle: screening with mammography. Diagn Imaging. 1986;8(7):84.

7. Self-exams, mammograms recommended. USA Today. October 19, 1987.

8. Gladwell M. How safe are your breasts? New Republic. October 24, 1994.

9. Subtle mammographic signs disclose presence of early breast cancer. Radiol Today. 1987;4(4):4.

10. Egan R. The new age of breast care. Adm Radiol. September 1989;9.

11. Tabar L, Vitak B, Chem JJ, et al. The Swedish 2 county trial 20 years later. Radiol Clin North Am. 2000;38:625–652.

12. National Center for Health Statistics. Health, United States, 2014: With Special Feature on Adults Aged 55–64. Hyattsville, MD: National Center for Health Statistics; 2015.

13. Narod SA, Javaid I, Miller AB. Why have mortality rates declined? J Cancer Policy. 2015;5:8–17.

14. CDC. The National Strategic Plan for the early detection and control of breast and cervical cancers. U.S. Department of Health and Human Services, Public Health Service, CDC, 1993.

15. National Breast and Cervical Cancer Early Detection Program. Centers for Disease Control and Prevention. Accessed October 18, 2017. Available at: https://www.cdc.gov/cancer/nbccedp/about.htm

16. Bassett LW. Screening strategies aim to increase compliance. Diagn Imaging. 1991;13:75–79.

17. Rebner M. Can government legislation improve screening mammography use? Radiology. 1996;198:636–637.

18. King A. Not everyone agrees with the new mammographic screening guidelines designed to end the confusion. JAMA. 1989;262(9):1154.

19. Rubin R. Study finds mammograms not as frequent as thought. USA Today. September 12, 2005:7D.

20. Song J. Women start mammography on time, but fail to followup. Advance. October 4, 2004:17.

21. Many women skipping breast exams. Available at: healthatoz.com. Downloaded November 1, 2007.

22. What are the key statistics for breast cancer? Available at: www.cancer.org. Accessed June 1, 2016.

23. National Center for Health Statistics. Health, U.S. 2014 with Chartbook on Trends in the Health of Americans. Hyattsville, MD: National Center for Health Statistics; 2015.

24. Siegel RL, Miller K, Jemal A. Cancer statistics, 2017. CA Cancer J Clin. 2017;67(1):7–30.

25. DeSantis CE, Fedewa SA, Sauer AG, et al. Breast cancer statistics, 2015: convergence of incidence rates between black and white women. CA Cancer J Clin. 2016;66(1):31–42.

26. Nystrom L, Rutqvist LE, Wall S, et al. Breast cancer screening with mammography: overview of Swedish randomized trials. Lancet. 1993;341:973–978.

27. Tabar L, Fagerberg G, Day NE, et al. Breast cancer treatment and natural history: new insights

from results of screening. Lancet. 1992;339:412–414.

28. Tabar L, Dufy SW, Burhenne L. New Swedish breast cancer detection results for women aged 40–49. Cancer. 1993;72(4):1437–1448.

29. Tabar L, Vitak B, et al. Swedish two county trial: impact of mammographic screening on breast cancer mortality during 3 decades. Radiology. 2012;260(3):653–663.

30. Shapiro S. Determining the efficacy of breast cancer screening. Cancer. 1989;63:1873–1880.

31. Howlader N, Noone AM, Krapcho M, et al., eds. SEER Cancer Statistics Review, 1975–2013. Bethesda, MD: National Cancer Institute. Available at: Available at: http://seer.cancer.gov/csr/1975_2013/, based on November 2015 SEER data submission, posted to the SEER web site, April 2016.

32. Horner MJ, Reis LAG, Krapcho M, et al., eds. SEER Cancer Statistics Review 1975–2006. Bethesda, MD: National Cancer Institute; 2009.

33. Feig S. Determination of mammographic screening intervals with surrogate measures for women aged 40–49 years. Radiology. 1994;193:311–314.

34. Cancer Study Cites Rapid Growth. Sarasota Herald Tribune. July 3, 1996.

35. Mettein C, Smart C. Breast cancer detection guidelines for women aged 40–49 years: rationale for the American Cancer Society reaffirmation of recommendations. CA Cancer J Clin. 1994;44:248–255.

36. Cancer Agency Changes Mammogram Advice. Sarasota Herald Tribune. December 5, 1993.

37. Slantez P, Moore RH, Hulka CA, et al. Screening mammography: effect of national guidelines on current physician practice. Radiology. 1997;203:335–338.

38. D'Orsi C. NIH consensus development conference statement: breast cancer screening for women ages 40–49. SBI News. February 1997.

39. Linver M. Summary: mammography outcomes in a practice setting by age: prognostic factors, sensitivity and positive biopsy rate. SBI News. February 1997.

40. Leitch A. ACS guidelines for the early detection of breast cancer: update 1997. CA Cancer J Clin. 1997;47(3):150–153.

41. Siu AL; U.S. Preventive Services Task Force. Screening for breast cancer: US Preventive Services Task Force Recommendation Statement. Ann Intern Med. 2016;164(4):279–296.

42. Moskowitz M. Breast cancer: age-specific growth rates and screening strategies. Radiology. 1986;16(1):37–41.

43. Tabar L, Fagerberg G, Chen HH, et al. Efficacy of breast cancer screening by age. New results from the Swedish two county trial. Cancer. May 1995;75(10):2507–2517.

44. Buist DS, Porter PL, Lehman C, et al. Factors contributing to mammography failure in women

aged 40–49 years. J Natl Cancer Inst. 2004;96(19):1432–1440.

45. Johns LE, Moss SM. False positive results in the randomized controlled trial of mammographic screening from age 40. Cancer Epidermiol Biomarkers Prev. 2010;19(11):2758–2764.

46. Monsees B, Monticciolo D, Murray R. Electronic Response on Behalf of ACR and SBI to USPSTF Re: Draft USPSTF Recommendations on Breast Cancer Screening.

47. Graham R, Mancher M, Miller Wolman D, et al., eds.; Institute of Medicine of the National Academies. Clinical Practice Guidelines We Can Trust. Washington, DC: National Academies Press; 2011.

48. Broeders M, Moss S, Nyström L, et al. The impact of mammographic screening on breast cancer mortality in Europe: a review of observational studies. J Med Screen. 2012;19(Suppl 1):14–25.

49. Coldman A, Phillips N, Wilson C, et al. Pan-Canadian study of mammography screening and mortality from breast cancer. J Natl Cancer Inst. 2014;106(11):261–263.

50. Hellquist BN, Duffy SW, Abdsaleh S, et al. Effectiveness of population-based service screening with mammography for women ages 40 to 49 years: evaluation of the Swedish Mammography Screening in Young Women (SCRY) cohort. Cancer. 2011;117(4):714–722.

51. Wald NJ, Murphy P, Major P, et al. UKCCCR multicenter randomized controlled trial of one and two view mammography in breast cancer screening. BMJ. 1995;311: 1189–1193.

52. Webb ML, Cady B, Michaelson JS, et al. A failure analysis of invasive breast cancer: most deaths from disease occur in women not regularly screened. Cancer. 2014;120(18): 2839–2846.

53. American College of Radiology. News Releases. USPSTF Breast Cancer Screening Recommendations Could Endanger Women. News Release January 11, 2016. Available at: www.acr.org/MediaCenter. Accessed June 27, 2016.

54. Siedman H, Mushinski M. Breast cancer incidence, mortality, survival, prognosis. In: Feig S, McLelland R, eds. Breast Carcinoma: Current Diagnosis and Treatment. New York: Mason; 1983.

55. Benning T. Komen for the cure founder Nancy Brinker blasts proposed new mammography guidelines. The Dallas Morning News. November 23, 2009.

56. Ferrini R, Mannino E, Ramsdell E, et al. Screening mammography for breast cancer, American College of Preventive Medicine Practice Policy Statement. Am J Prev Med. 1996;12(5):340–341.

57. Mammography Screening Guidelines. American College of Obstetricians and Gynecologists. Available at: www.acog.org. Accessed April 21, 2010.

58. Newman J. Early detection techniques in breast cancer management. Radiol Technol. 1997;68(4):309–324.

59. Burkenne L, Burkenne H, Kan L. Quality oriented mass mammography screening. Radiology. 1995;194:185–188.

60. Baker L. BCDDP: 5 year summary report. CA Cancer J Clin. 1992;32:194–225.

61. Sickles E. Summary of presentation screening outcomes: clinical experience with service screening using modern mammography. SBI News. February 1997.

62. Sampson D; American Cancer Society. American Cancer Society report finds breast cancer death rate continues to drop. Breast Cancer Facts & Figures, September 25, 2007.

63. Pelikan S, Moskowitz M. Effects of lead-time, length bias, and false negative reassurance on screening for breast cancer. Cancer 1993;71:1998–2005.

64. Tabar L, Fagerberg G, Day NE, et al. What is the optimum interval between screening examination? An analysis based on the latest results of the Swedish two county breast cancer screening trial. Br J Cancer. 1987;55:47–51.

65. Sinclair N, Littenberg B, Geller B, et al. Accuracy of screening mammography in older women. AJR Am J Roentgenol. 2011;197(5):1268–1273.

66. Michaelson JS, Halpern E, Kopans DB. Breast cancer computer simulation method for estimation of optimal intervals for screening. Radiology. 1999;212:551–560.

67. Kummerow KL, Du L, Penson DF, et al. Nationwide trends in mastectomy for early stage breast cancer. JAMA Surg. 2015;150(1):9–16.

68. Allen JD, Blumethmann SM, Sheets M, et al. Women's responses to changes in US Preventive Services Task Force's mammography screening guidelines: results of focus groups with ethnically diverse women. BMC Public Health. 2013;13:1169.

69. Forbes LJ, Ramirez AJ. Expert group on information about breast screening. Offering informed choice about breast cancer screening. J Med Screen. 2014;21(4):194–200.

70. Javitt MC. Section editors notebook: breast cancer screening and over diagnosis unmasked. AJR Am J Roentgenol. 2014;202(2):259–261.

71. Nelson HD, Tyne K, Naika A, et al. Screening for Breast Cancer: Systemic Evidence Review Updated for the U.S. Preventive Services Task Force. Evidence synthesis No. 74. AHRQ Publication No. 10-05142-EF-1. Rockville, MD: Agency for Healthcare Research and Quality; 2009.

72. Feig SA. Screening mammography benefit controversies: sorting out the evidence. Radiol Clin North Am. 2014;52(3): 455–480.

73. Humphrey LL, Helfand M, Chan BK, et al. Breast cancer screening: a summary of the evidence for the U.S. Preventive Services Task Force. Ann Intern Med. 2002;137: 347–360.

74. Biesheuvel C, Barratt A, Howard K, et al. Effects of study methods and biases on estimates of invasive breast cancer overdetection with mammography screening: a systematic review. Lancet Oncol. 2007;(12):1129–1138.

75. Puliti D, Duffy SW, Miccinesi G, et al. Overdiagnosis in mammographic screening for breast cancer in Europe: a literature review. J Med Screen. 2012;19(Suppl 1): 42–56.

76. Barton MB, Elmore JG, Fletcher SW. Breast symptoms among women enrolled in a health maintenance organization: frequency, evaluation, and outcome. Ann Intern Med.

1999;130(8):651–657.

77. Silbner J. How to beat breast cancer. US News & World Report. July 1, 1988:52.

3 Patient Considerations

Objectives Understand the obligations of the health care system and individuals serving the patient to positively impact the patient experience To help the technologist better understand the patient's emotional needs and responses throughout the breast imaging process To empower the technologist through relevant information that provides emotional comfort, support, and relief to the patient Understand the importance of effective communication in reducing anxiety during the mammography patient experience Understand the patient preparation necessary for the mammography examination

Keywords

decision aids

Health Insurance Portability and Accountability Act (HIPAA)

Hospital Consumer Assessment of Healthcare Providers and Systems Survey

interpersonal skills

patient-centered care

patient experience

shared decision-making

Introduction

Today's health care environment is immersed in strategies to ensure that the patient is satisfied over a wide range of services. These strategies are necessary due to the increasing requirements associated with health care reimbursement and the competitive health care market that exists today. There are several factors that contribute to assuring that excellence in health care is achieved across all service aspects. In 2006, the Centers for Medicare and Medicaid Services (CMS) implemented the **Hospital Consumer Assessment of Healthcare Providers and Systems Survey**, referred to as the Hospital CAHPS Survey (pronounced “H-caps”). The HCAHPS Survey is a standardized method developed by the CMS and the Agency for Healthcare Research and Quality to measure the patient's perspective of their hospital experience. Among other purposes, this survey is used to evaluate the perspective of the *inpatient* hospital experience allowing hospitals the opportunity to improve their quality of care.[1,2] The culture of measuring the quality of service in the health care industry has firmly taken root, with outpatient facilities also recognizing the need to ensure that exemplary care is delivered to their customers. The practice model of **patient-centered care**, health care that is organized around the patient, originally described the interaction and communication between the provider and the patient in an effort to satisfy the needs and the expectations of the patient.[3,4] Today, organizations recognize the need for patient-centered health care systems, where every employee of the organization has the responsibility to invest in the patient's quality of care.[5] These measures influence a change in the traditional medical imaging environment by calling for the radiologist to incorporate the patient-centered care model into the medical imaging practice and organizing radiology processes to address the needs and preferences of the patient.[3] This chapter discusses essential practices by the medical facility, medical imaging staff, radiologist, and technologist that serve to ensure a positive and safe **patient experience** throughout the mammography procedure.

Compassionate, Comforting Care

Mammography is a sensitive and personal examination, generally causing some degree of discomfort to the patient.6 This knowledge may commonly invoke feelings of nervousness, anxiety, 7 or, less common, frustration in the person reporting for the procedure. Each woman arriving for a mammogram carries within her different degrees of these feelings when she arrives for her appointment. According to many resources, the common fears and apprehensions that contribute to feelings of nervousness or anxiety associated with mammography include a combination of physical, emotional, and intellectual fears.7,8,9

Some fears associated with the mammography procedure: That breast cancer will be detected Pain or discomfort Embarrassment Modesty Body image Radiation Waiting for results Cost Competency/professionalism of the technologist That the procedure may cause cancer Previous unpleasant or bad experiences Frightening stories shared by friends or relatives Relatives or friends with a recent diagnosis of breast cancer First time mammography examination (baseline)

These are just *some* of the fears that may influence the emotional state of the patient arriving for a screening mammogram. Patients who have been called back for additional imaging generally report for their return mammography appointment with increased levels of anxiety. It should be noted that there are several preparatory provisions established to reduce patient anxiety in the screening and the diagnostic setting that are discussed later in this chapter. A perceptive mammography technologist understands the personal nature of the mammography examination and the potential for patients to harbor anxiety. There are significant reasons why the technologist should pay special attention to methods that help reduce patient anxiety during mammography. Technologists who understand the multipurpose necessity of ensuring patient relaxation and cooperation during the procedure allow the facility and the patient to benefit in these important aspects of the examination:

1. Demonstrating compassion and support to the anxious patient provides a positive patient experience in spite of their anxiety.

2. Patients perceive the quality of their experience with the facility through the professionalism and interpersonal skills of the staff. These experiences, whether positive or negative, are shared with others in the community.10

3. For the technologist, adequate capture of the posterior margin of the breast is the most challenging component of the mammography examination. In order to successfully *achieve capture and clarity* of tissue adjacent to the chest wall, the patient's chest wall muscles (thorax) must be completely relaxed.9

4. Generally, the posterior breast tissue adjacent to the chest wall can be captured *with reduced discomfort* to the patient when the muscles adjacent to the thorax are relaxed.

5. Research supports that the interaction between the technologist and the patient during the initial mammography procedure is an indicator of whether or not the patient will return for subsequent examinations.8

The fears associated with the mammography procedure are well documented, requiring the health care professional taking care of these patients to provide compassionate reassurance throughout the examination. Randi Gunther, PhD, in preparing for a presentation of “The Key Role of Mammogram Technologists in Mammogram Compliance,” conducted in-depth interviews with radiologists, physicians, patients, and mammography technologists to better understand the role of the technologist in the breast imaging team. The results of her interviews demonstrated that mammography technologists share common personality characteristics with others working in a healing profession. According to Dr. Gunther, mammography technologists are more likely to be self-sacrificing individuals who have a greater interest in nurturing than in power, carry out their responsibility without complaint, are uncomfortable in confronting people in authority positions, and are interested in pleasing others.

The compassionate heart of a mammography technologist offers sincerity throughout the specific requirements of the patient experience. This essential element must be supported through additional efforts that are known to positively impact patient satisfaction and reduce anxiety. Mammography services that are knowledgeable about how patients perceive the care they have received are aware that the pain, discomfort, and distress associated with mammography negatively impacts patient satisfaction,[11] while in addition to these factors, satisfaction with the clinic service and health care provider are also important factors that influence the patient experience.[12] Researchers in Norway developed a questionnaire to measure patient satisfaction with mammography in an effort to better understand subsequent screening compliance. According to the researchers, assessment of the patient's mammography experience includes quality measures of four examination categories[11]:

Structure: describes the convenience, accessibility, and physical environment of the patient experience during mammography
Process: describes the information transferred between the patient and the mammography personnel, the interpersonal skills of personnel, and the perceived technical skills of personnel
Discomfort: describes the physical and psychological discomfort experienced by the patient
General satisfaction: describes elements that pertain to future mammography compliance

These important areas, examined to better understand patient adherence to breast screening, can also provide important feedback to the facility, medical imaging leadership, the mammography technologist team, and the individual mammography technologist who is interested in continuous quality improvement of the mammography service. An example of a patient satisfaction survey is illustrated in Figure 3-1. Each service category that influences the experience of the patient scheduled for a mammogram is discussed in this chapter.

Figure 3-1 Example of a patient satisfaction survey. From MGMA AdminiServe Parner, Sullivan Luallin Healthcare Consulting. https://www.samhsa.gov/sites/default/files/programs_campaigns/samhsa:hrsa/patient-satisfaction-survey-sample.pdf

First Impressions: Patient Scheduling and Registration

In today's fast-paced society, scheduling medical appointments has become a sophisticated service demanding options for customers of varying age groups and varying abilities to access the Internet. Facilities need to project a convenient and positive “first impression” model of efficiency and friendliness whether the process is accomplished through face-to-face interaction, a phone call, or an automated process. During this interaction, sensitive information about the patient and her health history is collected. Whatever method is used to gather this information, the facility must abide by the regulations established by the **Health Insurance Portability and Accountability Act (HIPAA)** passed into law in 1996. This federal law establishes a set of national standards for the protection of certain health information through the Privacy Rule and establishes standards for the security of electronic protected health information (e-PHI) through the Security Rule.[13] Mammography personnel are expected to know and abide by these regulations.

Scheduling: Automated

The popularity of automated patient scheduling provides the 24-hour flexibility that an increasing number of customers prefer. The convenient access of automated information addresses a number of services surrounding the customer experience that include access to a secure Internet portal to schedule the examination, receive reminders of the appointment date and time, and access the examination results.14 Like communication that addresses these services using a face-to-face or phone call method, the end result must provide an organized solution that ensures the correct patient is scheduled for the correct exam at the correct time.10,15 Technology used for the purpose of improving patient workflow must include the participation and input of the staff and physicians to ensure a successful outcome.10 Scheduling and Registration: Direct Patient Contact

The requirements of patient privacy due to the HIPAA regulations are common practices considered by facilities in today's health care environment. Direct patient contact either face-to-face or by a phone call is conducted through facility practices that limit the opportunity of other customers to overhear conversations intended to be private. Customers scheduling a mammography examination or checking in for a scheduled appointment expect privacy, professionalism, and efficiency when interacting with the health care staff in the reception area or on the phone. Scheduling: Face-to-Face or Phone Call

Scheduling the mammography appointment requires the reception personnel to gather detailed information from the patient that ensures accuracy in selecting the correct patient for the correct mammography procedure. Friendly frontline staff who are aware of privacy concerns and considerate of the sensitive nature of the information being collected provide the patient with a positive experience. An example of the information necessary to schedule the mammography appointment includes: Name, address, and phone number Date of birth Name of the referring physician Previous breast health history (surgeries or diagnosis) Current breast health problems if applicable Whether or not the patient has breast implants Location of previous mammography studies (including ultrasound, MRI, other pertinent breast imaging studies if applicable) Date of her most recent mammography examination The patient's medical insurance information

Some of these questions may require the patient to divulge information to the receptionist that is uncomfortable or disconcerting to report. Additional information to discern whether the patient should be scheduled for a screening or a diagnostic examination may require the patient to answer questions that pertain to symptoms describing nipple discharge or the presence of breast lumps. Protocols developed by the facility to reduce patient discomfort, such as succinct written questionnaires capturing the patient's reasons for the appointment, do so limiting the need for a verbal answer for others to hear.

Determining the type of procedure the patient should be scheduled for is significant for two reasons: To ensure that the patient receives appropriate health care. Incorrectly scheduled procedures disrupt predicted scheduled workflows, affecting the service of other customers.

The symptomatic patient may conceal the fact that she has found a lump in her breast. She may think that if a lump exists, it will be revealed on the mammogram image. Because the overall sensitivity of mammography is approximately 84%, some breast cancers may not be detected by mammography; however, due to her symptoms, additional procedures such as ultrasound may be indicated. Any lump or other symptoms identified by the patient or her physician should be specifically addressed. Understanding the potential vulnerability of the patient, whether scheduling a mammography examination or arriving to have the procedure performed, requires the personnel assisting her to convey a courteous and patient demeanor. Arrivals and Registration

The initial encounter between the patient and the health care staff throughout the check-in process is an important factor in the overall satisfaction of the patient experience. Patient satisfaction surveys for the mammography procedure include specific components of the registration process[3]: Efficiency and speed of the process Courtesy and helpfulness of the registration staff Cleanliness and comfort of waiting area Ease of facility navigation

The reception area represents the beginning of an experience in which the patient's feelings and privacy are respected, thereby contributing to her trust in the facility. To ensure that the patient experience begins with a good first impression, some health care organizations may provide a concierge service to greet the patient at the entrance of the facility and assist them through the check-in process. The concierge service offers many conveniences for customers who may need to have their car parked, require wheelchair transport, are unsure of how to find their provider's office, or simply just need to be greeted by a friendly smile.

The Examination Environment

When a woman arrives for her first mammogram, she does not know what to expect. She may envision the mammography setting as similar to the traditional radiographic examinations that she has previously experienced: a cold, sterile room with a large intimidating machine, where she is left alone and exposed to radiation while the technologist retreats behind a lead wall. These thoughts alone may cause anxiety. Creating a comfortable and relaxed environment in both waiting and examination rooms can help to alleviate feelings of anxiety and embarrassment that are associated with mammography[10] (Figure 3-2). Room temperature, comfortable furniture, muted or soft colors, and soothing artwork all contribute to a more comforting, rather than clinical, setting. Soft lighting from table lamps, or recessed lighting, creates a more calming effect than harsh overhead fluorescent fixtures. Decaffeinated warm beverages and comfortable robes ward off chills and feelings of insecurity and immodesty and are extra personal touches that women appreciate. Modern breast imaging centers are designed with waiting areas resembling a cozier, home-like setting, while others create more of a spa-like atmosphere[9,16] complete with massage areas. Many have fresh flower arrangements, and some give patients a small memento to take home at the end of their appointment. These touches can make the environment feel more casual, soothing, and personable. Most women are more comfortable if they wait in an area separate from patients who are having other types of examinations; however, space constraints within a facility can make this expectation difficult to achieve. Patient-centered care encourages privacy throughout the examination process.[3] If patients wait in a general area after changing into their examination gowns, modesty is a concern. Thick gowns or capes in both small and large sizes that provide full coverage for all women are an important consideration.

Figure 3-2 Creating a comfortable and relaxed environment in both waiting and examination rooms helps to alleviate feelings of anxiety and embarrassment associated with mammography.

The seating arrangement in the waiting room can also affect the comfort level and privacy consideration of the patient.[3,9] For this personal examination, many women feel more at ease if they have a sense of semi-seclusion, or “personal space.” Style of the furniture, placement of leafy plants, and smaller seating groups within the room can help achieve this feeling. A fish tank can be soothing to patients and separates the room into smaller, more private seating arrangements. If a patient must breastfeed a child before her examination, a private, comfortable area should be available.

As important as these amenities are in ensuring that the patient is relaxed and comfortable throughout the mammography experience, there are other expectations that concern the patient when in a health care environment. Cleanliness was most often mentioned during focus groups conducted by the Picker Institute, with patients considering this aspect of health care to be a major failure if neglected.3,17 Meeting patient expectations also may contribute to the satisfaction they feel about the physical environment of their health care facility. Patients expect the facility they select to use up-to-date equipment for mammography services capable of delivering the latest technology.10,18 Patients also have expectations of the facility personnel that care for them throughout their mammography examination.

Interpersonal Skills: Technologist Communication and Patient Interaction

Although cleanliness and comfort are essential to the patient experience in a health care setting, other factors used to describe patient satisfaction include the overall quality of efficiency, punctuality, and flexibility experienced during the mammography visit.10,18 The empathy, **interpersonal skills**, and professionalism of mammography personnel is factored into the perception of quality10,18 the patient feels she has received during this highly personal and likely uncomfortable procedure. A formidable challenge for the mammography professional is balancing the restricted time that is allotted to deliver the mammography procedure with the requirements of high image quality standards.19 These demands are discussed further in Chapter 15. Acknowledging this balance requires the mammography professional to strengthen communication and interpersonal skills that effectively convey understanding of the patient's emotional and physical needs. A study conducted at the University of Johannesburg, South Africa, observed personality traits of the mammography technologist and how these traits influence the perception of care the patient receives, providing insight into the significance of the patient–technologist interaction.20 Based on this study, patients rated the approachable nature of the technologist, along with her honesty and gentleness, to be among the most important of personality traits. Table 3-1 describes the importance or unimportance of personality traits in mammography technologists that were rated by patients. These traits contribute to how the technologist is perceived by the patient in terms of20:

Table 3-1 Survey Results Indicating the Importance or Unimportance of Personality Traits of the Mammography Technologist

Source: Louw, A., Lawrence, H. & Motto, J., 2014, 'Mammographer personality traits – elements of the optimal mammogram experience', Health SA Gesondheid 19(1), Art. #803, 7 pages. http://dx.doi.org/10.4102/hsag.v19i1.803

- Feeling safe
- Feeling trust
- Concern or interest (care) conveyed
- The communication skills of the technologist

Although the mammography appointment is complex in the variables that contribute to its success, a short amount of time may be allotted for its delivery. This requires that the technologist understand that the need for effective communication, both verbal and nonverbal, begins immediately upon greeting the patient. Assessment of the patient's physical and intellectual abilities is important as these qualities affect both the medical intake (history) component of the examination as well as the patient's ability to cooperate with the positioning/compression demands of the procedure. Facility workflow determines the amount of time the technologist spends with the patient prior to beginning the mammography procedure. Generally, the technologist greets and verifies the patient, communicating with her as they make their way to the changing area. This interval is an important factor in the examination process and should be used by the technologist to encourage feelings of trust and safety in the patient through a calm and reassuring demeanor. Within just a few minutes from this point, the examination will require the technologist to gather sensitive information from the patient while also ensuring that the patient is sufficiently relaxed for the purpose of obtaining superior quality images. During the imaging process, the technologist steps into the personal physical space of the patient; both verbal and nonverbal communication by the technologist is necessary to convey a sense of dignity and respect to the patient. A helpful tool developed by the Studer Group assists health care professionals in effective communication. The AIDET method provides the technologist with a communication strategy throughout the examination process, ensuring that essential communication skills are easily remembered. The acronym describes five foundations of effective communication[8,21]:

Acknowledge Introduce Duration Explanation Thank you

Perhaps the most effective and immediate remedy for patient anxiety or apprehension is in the acknowledgment and introduction when greeting the patient. Feelings that result in shoulders tight with nervous tension and facial expressions of concern can be disarmed with reassuring actions by the technologist. Greeting the patient by name, introducing yourself, making eye contact and smiling are outward indications for the patient that you are approachable. Continued light conversation in a calm and unhurried manner provides added reassurance and distraction to the patient when in the vicinity of others, while ensuring the purpose of her visit to the facility remains protected until in a private setting.

Workflows differ from one facility to another. The designated room to acquire the patient's health history may not be the mammography procedure room. When the patient is settled and comfortable for the purpose of collecting the health history information (discussed in Chapter 4), provide her with an overview of the examination process and the estimated time it will take to complete her procedure. An explanation of the examination should take place in the mammography room so that the patient may view the equipment as the procedure is explained to her. Finally, inform the patient of the reporting process, ensuring that she understands how and when she will receive her examination result. Give her the opportunity to ask any questions she may have before sincerely thanking her for choosing your facility for her health care.

Patient Preparation for the Examination

Patient-centered care provides a model of health care that considers and respects the values, needs, and preferences of the patient.[3,22] With this principle in mind, before the patient ever arrives for a mammography appointment, a discussion surrounding the benefits, harms, and risks of the examination has more than likely occurred between the patient and her health care provider. An important factor in patient-centered care is effective patient–provider communication and **shared decision-making**.[22] Shared decision-making involves communication between the patient and the provider that serves to inform the provider of the patient's needs and preferences while informing the patient of the knowledge and experience of the provider in making medical decisions such as beginning medication, having a cancer screening examination, or elective surgery.[23] Additional educational tools used by providers to assist the patient in making medical decisions are called **decision aids**. Patients may be given booklets to read after visiting their health care provider's office or may be directed to their health care organization's Web site where they may find online resources explaining detailed information about the procedure or treatment being considered. Electronic information about tests or procedures may also be sent directly to the patient via their online chart portal from their provider. Sophisticated decision aids may be interactive, allowing the patient to have all of the pertinent information concerning a medical procedure at their fingertips. The Radiological Society of North America (RSNA) and the American College of Radiology (ACR) have developed an information Web site, RadiologyInfo (http://radiologyinfo.org), available to the public, radiology practices, and medical providers (Figure 3-3). The Web site may be viewed in both English and Spanish, offering explanations and photos of 200 radiologic procedures. The patient interested in learning more about having a mammogram is offered the following information when choosing to review this procedure:

Figure 3-3 The introductory page of the Mammography Examination information developed by the American College of Radiology (ACR) and the Radiological Society of North America, Inc. (RSNA). Source: https://www.radiologyinfo.org/en/info.cfm?pg=mammo What is mammography? What are some common uses of the procedure? How should I prepare? What does the equipment look like? How does the procedure work? How is the procedure performed? What will I experience during and after the procedure? Who interprets the results and how do I get them? What are the benefits versus risks? What are the limitations of mammography?

Many of the questions included in educational material for the patient are discussed with their provider prior to making the procedure appointment. When the patient makes the decision to have the mammography procedure, health care facilities know that patients who are prepared for the examination and know what to expect experience less anxiety about the procedure.24 A study published online in the Journal of the American College of Radiology, October 2015, describes the effects of providing a 1-hour educational session about the mammography examination by a specially trained radiologist to various community groups. Surveys were completed by the attendees prior to listening to the educational session and again after the session. Before listening to the presentation, complete with questions and answers, the attendees listed concerns that included the uncertainty about the procedure and whether or not it would be painful. After the informative session, the attendees were questioned about other factors, such as the need for breast cancer screening and anxiety. Researchers found that people who attended the presentation better understood why mammography was useful, suffered less anxiety concerning the procedure, and would more likely utilize mammography.24 To ensure that patients are prepared for the examination, health care facilities at a minimum offer educational material on how to prepare for the mammography procedure (online and in paper form) and what to expect during their visit. This is reinforced by the mammography technologist or other health care staff throughout the patient experience. A variety of useful information is offered to patients depending on the facility they choose. Box 3-1A and B provides the information included on the American Cancer Society Web site (cancer.org) under “How to prepare for your mammogram” and “Tips for getting a mammogram.”25

BOX 3-1A

How to Prepare for Your Mammogram If you have a choice, use a facility that specializes in mammograms and does many mammograms a day. Try to go to the same facility every time so that your mammograms can easily be compared from year to year. If you're going to a facility for the first time, bring a list of the places and dates of mammograms, biopsies, or other breast treatments you've had before. If you've had mammograms at another facility, try to get those records to bring with you to the new facility (or have them sent there) so the old pictures can be compared to the new ones. Schedule your mammogram when your breasts are not tender or swollen to help reduce discomfort and get good pictures. Try to avoid the week just before your period. On the day of the exam, don't wear deodorant or antiperspirant. Some of these contain substances that can show up on the x-ray as white spots. If you're not going home afterwards, you may want to take your deodorant with you to put on after your exam. You might find it easier to wear a skirt or pants, so that you'll only need to remove your top and bra for the mammogram. Discuss any new findings or problems in your breasts with your health care provider before getting the mammogram.

Source: American Cancer Society, Web site: https://www.cancer.org/cancer/breast-cancer/screening-tests-and-early-detection/mammograms/mammograms-what-to-know-before-you-go.html. Reprinted by the permission of the American Cancer Society, Inc. www.cancer.org.

BOX 3-1B

Tips for Getting a Mammogram Always describe any breast changes or problems you are having to the technologist doing the mammogram. Also describe any medical history that could affect your breast cancer risk—such as surgery, hormone use, breast cancer in your family, or if you've had breast cancer before. Before getting any type of imaging test, tell the technologist if you're breastfeeding or if you think you might be pregnant

Source: American Cancer Society, Web site: https://www.cancer.org/cancer/breast-cancer/screening-tests-and-early-detection/mammograms/mammograms-what-to-know-before-you-go.html. Reprinted by the permission of the American Cancer Society, Inc. www.cancer.org. A Word About Deodorants, Antiperspirants, Powders, Creams, and Lotions

Mammography technologists working in the field may notice that some facilities are more vigilant than others in ensuring the removal of deodorant or antiperspirant products. Figure 3-4A and B illustrates several varieties of deodorants and antiperspirants with a resulting digital radiographic image of the products. The image demonstrates that deodorants typically do not contain minerals that cause mammographic artifacts, while antiperspirants may or may not cause mammographic artifacts depending on the brand and how liberally it is applied. Antiperspirants and powders are usually seen on an image within skin folds or creases, where perspiration has caused them to become caked. These artifacts can usually be differentiated from calcifications that typify carcinoma. Caked talcum powder is usually seen as a line that runs in a lateral-to-medial direction, along the inframammary fold (Figure 3-5A, B) while cancer calcifications will orient in a linear ductal pattern toward the nipple. Caked antiperspirant will usually be found in the area of the axilla (Figure 3-5C, D). Occasionally, ointments or powders can also collect in the creases of a nevus or mole or in the nipple region. Unfortunately, the potential exists for any of these products to cause an artifact that may mimic microcalcifications or diminish tissue clarity, possibly resulting in a repeat exposure to the patient as well as adding time to the examination to ensure thorough cleansing of the axilla. Instructions addressing the preparation for mammography typically include the direction to abstain from using these types of products prior to the mammography procedure due to the potential of artifacts. It is common practice for mammography technologists to inquire about the patient's use of powders, deodorants, and lotions prior to the procedure. Single-use cleansing towelettes designed for the purpose of removing these types of products are made available in changing rooms when patients have not been informed or have forgotten this request. Providing amenities such as deodorant towelettes at the conclusion of their procedure is a courtesy gesture appreciated by the patient.

Figure 3-4 Several varieties of deodorants and antiperspirants **(A)**, illustrating resulting digital radiographic image of the products **(B)**.

Figure 3-5 **(A and B)** Caked talcum powder is usually seen as a line that runs in a lateral-to-medial direction, along the inframammary fold **(A)**, same radiograph enlarged to better appreciate the effect of talcum powder artifact **(B)**. **(C and D)** Radiograph demonstrating caked antiperspirant usually found in the axillary area **(C)**, same radiograph enlarged to appreciate antiperspirant artifact **(D)**.

Case Study 3-1

1. Refer to Figure 3-4. Deodorant does not leave an artifact on the mammogram image; however, what other hygiene product may create an artifact? Depending on the formulation of this other product, an artifact may/may not be visible.

Patient Concerns about Dose

Some of the fears associated with the mammography procedure include (a) that cancer could be detected, (b) that the examination may be painful, and (c) that the exposure to radiation may cause cancer. The media hype of the 1970s that suggested mammography was dangerous remains a concern for some women in the general public, particularly older women. Fortunately, technological advances within the last few decades have shown that the benefits associated with mammography outweigh the potential harms. Today, patients are assured that the amount of radiation involved in a mammography procedure is safe. According to the MQSA Final Rule, "*the average glandular dose delivered during a single craniocaudal view of an FDA-accepted phantom simulating a standard breast shall not exceed 3.0 milligray (mGy) (0.3 rad) per exposure. The dose shall be determined with technique factors and conditions used clinically for a standard breast*."[26]

Compared with the 8 to 12 rad measurement of exposure the patient received in the early 1970s, radiation dosage to the breast tissue has been reduced substantially throughout the decades.[27] The American Cancer Society reports that the average dose received for a mammography study that includes 2 views of each breast is approximately 0.4 mSv.[25] The International System of Units describes a Sv (Sievert) as a measurement of radiation, with the prefix "m" indicating "milli." Although these statistics are significant, to most patients, they would have little meaning. In order to put this dose into perspective for women who are concerned about radiation exposure, the exposure received from background radiation (radiation exposure to natural surroundings) to people in the United States each year is an average of approximately 3 mSv. This dose equals about the same dose that a person receives from her natural surroundings in a 7-week period.[25, 28, 29] As with any radiographic examination, unnecessary exposure to radiation should be avoided.

A Word about Thyroid Shielding

Until September, 2010, the subject of shielding a patient's thyroid during a mammography procedure would not have been included in a mammography textbook. Today, technologists should be aware of the ACR and Society of Breast Imaging (SBI) position regarding thyroid shielding for mammography: thyroid shielding is not necessary and its use is not recommended. The question of taking this precaution during mammography originated with a segment on a popular medical advice television show. During a segment discussing the possible reasons for an increase in thyroid cancer in women, the show's host discussed a study involving dental x-rays but further explained that the potential radiation exposure resulting from dental x-rays and mammography may have played a part in the increase. In speaking with the audience, the host expressed the wisdom in asking for a thyroid shield during the mammography procedure. This incident, assisted by social media, sparked an interest in patient's requesting thyroid shields for mammography across the nation.[30] In an effort to resolve this issue, the ACR and the SBI published a statement that addressed the safety of the mammography examination in regard to radiation exposure and to explain the potential that image quality could suffer needlessly through the practice of thyroid shielding. Mammography technologists should be aware of the recommendations made by the ACR and SBI in order to better serve the patient through education (Box 3-2). Technologists new to the field of mammography may wish to proactively discuss the subject of thyroid shielding requests and facility protocols that address this subject with mammography leadership.

BOX 3-2

The ACR and Society of Breast Imaging Statement on Radiation Received by the Thyroid from Mammography

Concern that the small amount of radiation a patient receives from a mammogram may significantly increase the likelihood of developing thyroid cancer simply is not supported in scientific literature.

The radiation dose to the thyroid from a mammogram is extremely low. The thyroid is not exposed to the direct x-ray beam used to image the breast and receives only a tiny amount of scattered x-rays (less than 0.005 mGy). This is equivalent to only 30 minutes of natural background radiation received by all Americans from natural sources.

For annual screening mammography from ages 40 to 80, the cancer risk from this tiny amount of radiation scattered to the thyroid is incredibly small (less than 1 in 17.1 million women screened). This minute risk should be balanced with the fact that thyroid shield usage could interfere with optimal positioning and could result in artifacts—shadows that might appear on the mammography image. Both of these factors could reduce the quality of the image and interfere with diagnosis.

Therefore, use of a thyroid shield during mammography is not recommended. Patients are urged not to put off or forego necessary breast imaging care.

For more information on this issue, please see Summary of Thyroid Cancer Risks Due to Mammography by R. Edward Hendrick, PhD, FACR.

For more information on why you should start annual mammograms at 40 years of age, please visit www.MammographySavesLives.org.

Source: Mammography Saves Lives: Home (http://www.mammographysaveslives.org)

The Pregnant or Lactating Patient

Pregnant or lactating patients who present with a palpable mass are promptly evaluated using appropriate imaging modalities and necessary image-guided procedures supervised by a radiologist in an effort to provide a timely diagnosis. Depending on the individual needs of the pregnant patient, the radiologist may use ultrasound or ultrasound with mammography to provide a diagnosis. Depending on the individual needs of the lactating patient, the radiologist may use ultrasound, ultrasound with mammography, and possibly MRI to provide a diagnosis. When mammography is used to evaluate the lactating patient, the patient is asked to empty the breasts of any milk immediately before the procedure through nursing or pumping the breasts. Doing this helps to reduce the density associated with lactation as much as possible.[28] The care of a pregnant or lactating patient with a palpable mass commonly is initiated through provider to radiologist communication prior to the patient reporting to the mammography department.

Mammography Patient Access

In the late 1970s, the American Cancer Society (ACS) established the first breast cancer screening guidelines for the use of mammography.

Earlier research demonstrated that through adherence to regular screening mammography, the risk of dying from breast cancer was significantly reduced.[31] By 1983, ACS updated guidelines addressed using mammography to screen for breast cancer between the ages of 35-39 with a baseline mammogram; 40-49, every 1-2 years; and every year beginning at age 50. These guidelines would remain in effect for the next 14 years.[25] In spite of the published guidelines during these early years, data gathered in 1987 demonstrate that only about 25% of women age 50 and older received mammograms regularly, while poor and nonwhite women were less likely to be screened.[31,32] Efforts to initiate public education programs that partnered with communities for the purpose of increasing screening and awareness for women's health began. One such program was the Rhode Island Breast Cancer Project. The Rhode Island Department of Health partnered with communities to develop a program that successfully increased screening capacity and accessibility, educated the public concerning the need for screening, and reduced the false-positive/false-negative test results.[31] The Rhode Island project was successful in providing women with low-cost screening mammography. Other states implementing women's health initiatives included Colorado, Oklahoma, Maine, Washington, California, and the Navajo Nation. The states' women's health initiatives coincided with action from the Center for Disease Control and Prevention (CDC) in conducting research to understand the cause of various cancers. Several more projects would be funded by the CDC during the 1980s that served to provide the foundation for today's national cervical and breast cancer program. Successful progress made by the CDC-funded programs, along with support from state agencies and other influential organizations, paved the way for the Breast and Cervical Cancer Mortality Prevention Act that was signed into law on August 10, 1990.[31,33] The detail contained in this initiative that ensures underserved women receive appropriate health care services to detect breast and cervical cancer cannot be adequately explained in this chapter; however, a brief summary follows. The individuals, government offices, and organizations that shaped what is now the National Breast and Cervical Cancer Early Detection Program (NBCCEDP), funded by the CDC, sponsor programs in every state and territory in the United States, impacting thousands of lives. Although the CDC defines the eligibility and policies for the program, some flexibility is granted to each state. Federal guidelines direct services to uninsured or underinsured women at or below 250% of the federal poverty level. The services provided in each of the 50 states, the District of Columbia, 5 U.S. territories, and 11 American Indian/Alaska Native tribes or tribal organizations[34] funded by the NBCCEDP are allowed to determine the unique name of their program. The Wisconsin Well Woman Program portrays the intention of the NBCCEDP program funded by the CDC. Screening services are provided by a network of local hospitals and clinics. Covered screening services include a pelvic exam, Pap test, breast examination, and mammogram.[35] Diagnostic breast and cervical services may also be covered in some states.

This information is necessary knowledge for the technologist working in the field of breast imaging. Technologists may receive phone calls or inquiries from patients needing mammography services that they feel they cannot afford. Individual health care entities may also offer internal programs for patients that cannot afford to have a necessary medical procedure. Ensuring that frontline appointment and registration staff, along with all mammography personnel, are familiar with programs offering financial assistance to underserved patients is a responsibility that must be shared.

Patient Communication Barriers

On any given day, mammography personnel care for patients arriving for the mammography examination with language barriers that may diminish their understanding and purpose of the procedure. Ensuring that “limited English proficiency” (LEP) patients are provided quality health care equal to that of English speaking patients is a serious obligation of the health care industry. This obligation requires that facilities comply with federal and individual state laws that ultimately protect its citizens from discriminatory practices. The authority of the 1964 Civil Rights Act provides the foundation in addressing language access to all patients receiving care. It is the responsibility of Health and Human Services (HHS) to ensure that federal dollars are not used to support discriminatory practices in health care settings through the oversight of the Office for Civil Rights. Health care facilities must also adhere to federal laws such as the Americans with Disabilities Act, and Health Insurance Portability and Accountability Act (HIPAA), as well as individual state laws when providing services for LEP patients.[36] Health care organizations have increasingly used language assistance services to address this obligation to LEP patients. Facilities may provide in-house medical language and medical sign language interpreters for patients to utilize during their health care appointments. When this solution is not practical, medical language interpreters are available by phone through companies specializing in this need. Recent technology available for patients who are deaf or hearing impaired is video remote interpreting (VRI). This technology uses video conferencing to provide a sign language interpreter to the patient and the technologist through the use of video conferencing equipment. Figure 3-6 shows that the sign language interpreter is connected remotely to the equipment in the mammography room and appears on a computer screen through webcam technology. The patient and the interpreter can communicate with each other using sign language as the interpreter relays the information to the technologist.

Figure 3-6 Video remote interpreting (VRI) technology available for patients who are deaf or hearing impaired. This technology uses video conferencing to provide a sign language interpreter to the patient and the technologist using video conferencing equipment.

Case Study 3-2

1. Refer to Figure 3-6. Discuss communication solutions for women who present with various disabilities, such as hearing or vision impairment and language barriers. Patient Support Organizations

Patients recently diagnosed with breast cancer or who have family members recently diagnosed are faced with an avalanche of emotions and unknowns. Fortunately, in many cases, health care facilities are prepared to help the patient as she navigates herself and her family through the maze of information she must familiarize herself with. Along with the services that the patient's health care system provides in answering questions the patient may have, support exists through a wide variety of services offered by many valuable organizations. Patients coping with breast cancer may need assistance to better understand the cancer diagnosis, various treatment options, sexuality, transportation for appointments, and financial concerns that impact their lives. Support blogs and legislative and public policy advocacy are also important components in offering support to patients diagnosed with breast cancer. The following organizations address these important aspects of patient support: American Cancer Society, www.cancer.org, 1(800) 227-2345 Susan G. Komen, ww5.komen.org, 1-877, GO KOMEN 1(877) 465-6636 National Cancer Institute, www.cancer.gov, 1(800) 4-CANCER Ü, breastcancer.org, 120 East Lancaster Ave., Suite 201, Ardmore, PA National Breast Cancer Foundation, Inc., nationalbreastcancer.org Look Good...Feel Better, lookgoodfeelbetter.org, 800-395-LOOK Mammography Saves Lives (Society of Breast Imaging), mammographysaveslives.org, 1(703)715-4390, e-mail: info@SBI.online.org National Breast Cancer Coalition (NBCC), breastcancerdeadline2020.org, info@breastcancerdeadline2020.org, 800-622-2838 or 202-296-7477 National Alliance of Breast Cancer Organizations (NABCO), www.nabco.org, 888-80-NABCO, 212-719-0154 Cancer Care, Inc., cancercare.org, 800-813-HOPE (4673) National Coalition of Cancer Survivorship (NCSS), www.canceradvocacy.org, (877) NCCS-YES, Cancerbreast-Breastcancer.org, 120 East Lancaster Avenue, Suite 201, Ardmore, PA 19003 A Word About the Male Patient

The American Cancer Society reports an estimate of 2,600 new cases of invasive breast cancer in men, with 440 male deaths from breast cancer in 2016. Other statistics relating to breast cancer in males include25: Breast cancer is about 100 times less common among men than among women A male's lifetime risk of developing breast cancer is about 1 in 1,000 Breast cancer cases in men, relative to the ever-increasing population, have been fairly stable over the last 30 years.

Providing mammography services to males is not uncommon. Facilities and technologists should develop a workflow that considers the patient experience from the male's perspective when being cared for in an environment that usually accentuates female comfort. Many facilities are creative when addressing: Where the male patient may be comfortable waiting to have the examination Escorting the male patient back to an adjacent waiting area in close proximity to the mammography department

Male patients should be provided with the traditional professionalism the facility extends to any patient receiving mammography services. Due to the potential awkwardness or embarrassment the male patient may feel when requiring mammography, forethought of reducing these feeling should be considered by the facility.

Chapter Summary: A Letter to the Technologist

Caring for the mammography patient in today's competitive health care setting requires the technologist to acquire strong interpersonal and communication skills (which includes the art of listening). Through verbal and body language expression to the patient, the technologist delivers care in a sensitive setting that is ultimately evaluated through the patient's perception. The satisfaction of the patient experience is impacted through two important factors: (a) facility practices and (b) the interaction of the patient and the technologist. A quality experience is more likely to be achieved when the technologist gives her full attention to the patient. Distraction is perceived by the patient when the technologist is multitasking while answering questions that the patient may have or when documenting patient health history. Time constraints imposed by the facility restricting adequate examination time impact not only the perception of the patient as being rushed through her appointment but also may impact resulting image quality. It is paramount in a successful mammography service to balance the intervals of the mammography schedule with the ability of the technologist to provide appropriate quality service to the patient. This subject is addressed further in Chapter 4. Chapter 3 focuses on the importance of the patient experience in today's health care market and factors that influence service delivery through the interpersonal skills of mammography personnel and the environmental setting of the facility. Although the measurement of this satisfaction is now a necessity in the health care service environment, consider this letter (modified only in the salutation and patient name) sent to a mammography facility in the 1980s describing the experience of the patient's mammography visit:

The need to ensure basic human dignity does not change from decade to decade. Factors that influence patient experience expectations should be identified in each workflow unique to individual mammography services that include the balance of practical examination time intervals. Through this endeavor, authentic, genuine compassion, kindness, and skill expressed to every patient can be a realistic goal.

Review Questions

1. Patients may present for the mammography procedure nervous or anxious. What are some of the ways this is manifested in patients?

2. Explain the importance of the patient experience in health care and methods used to measure the process.

3. Explain what aspects of communication can be used to assist the patient in reducing the feeling of anxiety.

4. Discuss the technological advances in preparing the patient for the mammography examination, making appointments, and receiving reports.

5. What federal laws should be considered when caring for a patient with limited English proficiency?

References

1. HCAHPS Fact Sheet, June 2015. Baltimore, MD: Centers for Medicare and Medicaid Services

(CMS). http://www.Hcahpsonline.org/Facts/aspx. Accessed January 18, 2017.

2. HCAHPS: patient's perspective of care survey. CMS.gov. Accessed January 18, 2017.

3. Itri JN. Patient-centered radiology. Radiographics. 2015; 35(6):1835–1846.

4. Beach MC, et al. The role and relationship of cultural competence and patient-centeredness in health care quality. The Commonwealth Fund; October 2006.

5. Gamble M. Developing a workforce strategy for patient-centered care: 6 key steps. Beckers Hospital Review. 2013. https://www.beckershospitalreview.com/hospital-management-administration/developing-a-workforce-strategy-for-patient-centered-care-6-key-steps.html. Accessed January 20, 2017.

6. Minimizing Pain and Discomfort During Mammography (Dateline July 26, 2000). Imaginis—The Women's Health and Wellness Resource Network; 2000. http://www.imaginis.com/breast-health-news/minimizing-pain-and-discomfort-during-mammography-dateline-july-26-2000. Accessed January, 2017.

7. Keller BR, Evans KD. Fighting anxiety in order to improve the quality of breast imaging for women. eRADIMAGING.com. Available at: https://eradimaging.com/site/article.cfm?ID=758#.WdvXA1tSzIU. Published December 15, 2010. Accessed January, 2017.

8. Arnold L. Patient care, communication, and safety in the mammography suite. Radiol Technol. 2016;88(1):33M–47M.

9. Randel S. Mammograms: reducing patient anxiety. Radiol Technol. 2016;87(6):707–709.

10. Johnson S, Johnson J. Managing a mammography center: a model to thrive. Radiol Technol. 2010;82(1):22–32.

11. Loeken K, et al. A new measure of patient satisfaction with mammography. Validation by factor analytic technique. Fam Pract. 1996;13:67–74.

12. Tang TS, et al. Women's mammography experience and its impact on screening adherence. Psycho-Oncology. 2009;18(7):727–734.

13. United States Department of Health and Human Services (HHS.gov). Accessed January 18, 2017.

14. Manual vs. Automated Appointment Scheduling, Appointment-Plus, © Appointment-Plus, 2012.

15. Sharrock R. A well-appointed establishment. Ind Eng. 2007; 39(4):44–48.

16. Rimer BK, et al. Why women resist screening mammography: patient-related barriers. Radiology. 1989;172 (1):243–246.

17. Through the patient's eyes; understanding and promoting patient-centered care. In: Gerteis M, et al., eds. Picker/Commonwealth Program for Patient-Centered Care. San Francisco, CA: Jossey-Bass, 1993.

18. Hamilton EL, Barlow J. Women's views of a breast screening service. Health Care Women Int. 2003;24(1):40–48.

19. Morris N. When health means suffering: mammograms, pain and compassionate care. Eur J Cancer Care. 2015;24:483–492.

20. Louw A, et al. Mammographer personality traits—elements of the optimal mammogram experience, Health SA Gesondheid. 2014;19(1), Art. #803, 7 pages, http://dx.doi.org/10.4102/hsag.v19i1.803 © The Authors, 2014.

21. Rubin R. AIDET® in the Medical Practice: More Important than Ever. The Studer Group; 2014. A Huron Solution http://www.studergroup.com. Accessed January 18, 2017.

22. Institute of Medicine. Chapter 3. Patient-centered communication and shared decision making. In: Delivering High-Quality Cancer Care: Charting a New Course for a System in Crisis. Washington, DC: The National Academies Press; 2013. By the National Academy of Sciences. All rights reserved. For more information, see the Bookshelf Copyright Notice.

23. The Common Wealth Fund. Helping patients make better treatment choices with decision aids. Quality Matters Archive; 2012.

24. Information Eases Anxiety About Screening Mammograms. Breast Cancer.org. Published on November 16, 2015.

25. American Cancer Society Website/Cancer.org. Accessed January 17, 2017.

26. Fda.gov. Mammography Quality Standards Act/Guidance/Policy Guidance Help System (PGHS). Accessed January 18, 2017.

27. Andolina VF, Lille SL. Mammographic Imaging: A Practical Guide. 3rd ed. Philadelphia, PA: Wolters Kluwer/Lippincott Williams & Wilkins; 2011.

28. Vashi R. Breast imaging of the pregnant and lactating patient: imaging modalities and pregnancy-associated breast cancer. AJR Am J Roentgenol. 2013;200(2):321–328. Read more at http://www.ajronline.org/doi/full/10.2214/AJR.12.9814.

29. RadiologyInfo.org website. Patient safety: radiation exposure in X-ray and CT exams; 2012. Available at: www.radiologyinfo.org/en/safety/index.cfm?pg=sfty_xray. Accessed January 18, 2017.

30. Hardy K. Dr. Oz, Thyroid Shields & Mammography—the popular TV host sparks a debate with radiology. Radiol Today. 2011;12(6):18.

31. Lee NC, et al. Implementation of the National Breast and Cervical Cancer Early Detection Program: the beginning. Cancer. 2014;120(Suppl 16):2540–2548.

32. Centers for Disease Control and Prevention. Health, United States, 2009: With Special Feature on Medical Technology. Hyattsville, MD: Centers for Disease Control and Prevention, US Department of Health and Human Services; 2010.

33. Breast and Cervical Cancer Mortality Prevention Act of 1990. Pub L No. 301-354. [Accessed May 31, 2012]; Available at: http://www.cdc.gov/cancer/nbccedp/legislation/law.htm.

34. Centers for Disease Control and Prevention (CDC). Cancer screening—United States, 2010. MMWR Morb Mortal Wkly Rep. 2012;61(3):41–45.

35. Wisconsin Department of Health Services. Wisconsin Well Women's Program. dhs.wisconsin.gov. Accessed January 21, 2017.

36. Chen AH, et al. The legal framework for language access in healthcare settings: title VI and beyond. J Gen Intern Med. 2007;22(Suppl 2):362–367. Published online October 24, 2007. doi: 10.1007/s11606-007-0366-2.

4 The Role of the Technologist

Objectives

To acknowledge the technologist's role in breast imaging

To recognize the technologist's role in the health care team

To understand the skills necessary to successfully perform the mammography procedure

Key Terms

actual quality

diagnostic mammogram

exam management

expected quality

perceived quality

risk factors

screening mammogram

soft skills

Introduction

Over the past several decades, the goal to detect breast cancer in its early stages has been assisted by the evolution of premium breast imaging options. For the majority of cases that require ancillary breast imaging modalities (discussed in Chapters 20 and 21), the process begins with the screening or diagnostic mammography examination. MQSA national statistics report 39,302,089 annual mammography procedures performed as of February 1, 2017 in the United States[1] (Table 4-1). Many of these mammography procedures were performed by the 49,426 ARRT-registered radiologic technologists who also acquired postprimary ARRT mammography certification[2] (Table 4-2).

Table 4-1 MQSA National Statistics

In this section of MQSA Insights, we present the most commonly requested national statistics regarding the MQSA program. These statistics are updated on the first of each month.

[a]Facilities with DBT also have FFDM, so the DBT facilities count is included within the FFDM facilities count.

[b]Based on an analysis of the violation rates for all MQSA citations, the FDA has decided to elevate

the five remaining level 3 citations to level 2 citations. This change took effect on October 27, 2016. Since all level 3 citations, if repeated, could have been elevated to a level 2 with a requirement of a 30-day response to FDA, they should not be viewed as minor in nature, and they should be initially cited as a level 2. As a consequence, the level 3 violation rates will approach zero, and the level 2 violation rates may initially increase but should level off with time.

*c*This number is an aggregate of the total number of procedures performed annually as reported by facilities to their accreditation bodies at the time of their re-accreditation, which takes place once every 3 years. We have aggregated only the numbers reported by MQSA-certified, non-Veterans Hospital Administration facilities. The aggregate number may not reflect the current number of procedures performed at these facilities.

FFDM, full-field digital mammography unit; DBT, digital breast tomosynthesis.

Source: MQSA National Statistics published July 1, 2017. The FDA website, fda.gov, publishes this information on the first of every month. From: http://www.fda.gov

Table 4-2 Certificate Census by Location and Discipline

(Source: American Registry of Radiologic Technologists (ARRT) Census, last updated February 2017. Available at: http://www.arrt.org/about/census. Used with permission from The American Registry of Radiologic Technologists © 2018. The ARRT does not review, evaluate, or endorse publications or other educational materials. Permission to reproduce ARRT copyrighted materials should not be construed as an endorsement of the publication by the ARRT.)

In addition to these credentials, technologists performing mammography in the United States must adhere to strict Federal requirements of the MQSA, as well as State laws that govern the profession of radiologic technologists. Fulfilling these requirements prepares the technologist contemplating a future in breast imaging to understand the technical demands of mammography, as well as the emotional demands of serving a patient population often requiring expressions of genuine empathy and compassion. Needless to say, the challenge to accomplish the arduous task of preparing to join the mammography profession calls to those who do so because they are *motivated* to make a difference in the lives of the patient's who they serve.

The authors agree that the foundation of quality mammography rests on the technologist's ability to demonstrate empathy to the patient and to recognize the correlation of detecting early breast cancer through superior quality imaging. The mammography patient experience and image quality formula is seldom successful when a technologist is required to perform mammography when there is no interest in or desire to work in this discipline.

This chapter takes a closer look at the critical role of the mammography technologist in the breast health care service as she endeavors to meet professional expectations that include her responsibility to the patient and to other members of the patient's breast health care team.

The Technologist Role in the Breast Health Care Team

The mammography technologist is among the team of health care professionals who are responsible for providing breast health services to the patient. In many cases, outside of the patient's primary provider, the technologist may be the first breast health care professional the patient comes in contact with. The expertise provided by the technologist not only is relied upon by the patient but also extends to other members of the patient's breast health care team.

The technologist may be asked to provide services in various situations with the patient as well as other medical professionals: The initial interview between the technologist and the patient documents important health information that is communicated to the radiologist; this information may help verify that appropriate mammography services are rendered to the patient. Providing the service of performing screening or diagnostic procedures requires the technologist to provide educational information about the examination and to answer questions patients may have about surveillance protocols or other breast imaging modalities. Contacting screening mammography patients to schedule additional imaging studies prompts compassionate and knowledgeable explanations by the technologist as she simultaneously searches for the next available appointment. Diagnostic studies may require the technologist to navigate the patient through ancillary breast imaging procedures such as ultrasound or MRI. A typical day for a mammography technologist may begin with performing quality control tests in the early morning before patients arrive, performing mammography throughout the rest of the morning, and providing core biopsy services in the afternoon.

All of these situations describe how the expertise of the technologist impacts the patient experience.

The technologist's performance also contributes to the patient's health care team in providing quality care to their in-common patient. Although the patient's interaction with the technologist during the mammography procedure lasts only a few minutes, the images produced during that short time frame are critical in determining what happens to the patient next. The quality images created by the technologist allow the radiologist, also a member of the patient's health care team, to determine whether the imaging information supports returning to screening mammography or if the imaging information indicates an abnormality.

If an abnormality is detected, the patient's health care team may expand to include the primary provider, an ultrasound technologist, an MRI technologist, the core biopsy team, a nurse navigator, a breast surgeon, a plastic surgeon, an oncologist, a radiation oncologist, and a counselor. Technologists working in association with hospital or outpatient services may also be called upon to assist members of the radiology and surgical team during the needle localization procedure prior to the patient's surgical biopsy.

Members of the patient's health care team may consult the mammography images acquired by the technologist as they determine appropriate treatment for the patient. Each time the patient returns for future breast imaging follow-up services, the valuable archived images are reconstituted for comparison purposes during the radiologist's interpretation of the examination.

According to “Quality Management in the Imaging Sciences,” the customer is defined as, “A person, department, or organization that needs or wants the desired outcome.”[3] The technologist is a significant part of the health care team and is obligated to provide the best quality of care to the primary customer: the patient. It is also true that the breast health care team relies on the information created during the mammography procedure to make decisions on behalf of the patient. They too become the technologist's “customers,” “wanting and needing a desired outcome” of accurate information and superior image quality.

Throughout the process of potential breast health care needs for the patient, the expertise of the technologist is depended upon. Although the patient is directly affected by the *quality of care* she receives from the technologist, other breast health care professionals rely on the *quality performance* of the technologist. The radiologic technologist who is called to be a mammography technologist thrives in a profession that requires strong communication, independent judgment, problem-solving capabilities, working as a team member, and the appreciation of a grateful patient. Documenting Patient Health Information

When a patient visits their health care provider in an outpatient setting, the patient is interviewed first by a nurse or medical assistant prior to the clinician meeting with the patient. The initial interview process provides the clinician with pertinent health information and the reason for the patient's visit. After reviewing the information gathered by the nurse or medical assistant, the clinician interacts with the patient to personally assess the patient and to provide care management.

In a medical imaging setting for screening or diagnostic mammography, it is the mammography technologist who gathers pertinent breast health information from the patient and documents the information in the patient's electronic chart.4 Although practices vary throughout individual health care facilities, typically, screening mammography patients never come face to face with the radiologist who interprets their images. It *is* common practice for diagnostic mammography patients to have the opportunity to meet with the radiologist interpreting their breast imaging studies, but this event frequently occurs at the end of the examination when imaging has been finalized. It is therefore essential that the technologist interviewing the patient prior to performing the mammography procedure give her full attention to the task of gathering pertinent breast health information from the patient. This significant aspect of patient care is addressed by technologist professional organizations: American Society of Radiologic Technologists (ASRT), Mammography Practice Standards, “Mammography technologists are the primary liaison between patients, licensed independent practitioners, and other members of the support team. Mammography technologists must remain sensitive to the needs of the patient through good communication, patient assessment, patient monitoring and patient care skills.”4 American Registry of Radiologic Technologists (ARRT), Standard of Ethics document, Code of Ethics, #6, “The radiologic technologist acts as an agent through observation and communication to obtain pertinent information for the physician to aid in the diagnosis and treatment of the patient…….”.5

The importance of gathering accurate patient health information ensures that the patient receives the correct type of mammography procedure. Indications that determine a screening versus diagnostic mammogram are defined in the ACR Practice Parameter for the Performance of Screening and Diagnostic Mammography6: **Screening Mammogram:** Examination performed annually for women age 40 and older who have an average risk of developing breast cancer Examination performed on women younger than age 40 with various personal health history classifications that are associated with a higher than average risk of developing breast cancer **Diagnostic Mammogram:**

Diagnostic mammography is performed when a problem has been identified by the patient, by her health care provider, or by screening mammography. A patient may present for a diagnostic mammogram when: A clinical finding has been identified, such as a palpable lump, nipple discharge, persistent focal pain, or skin changes Additional imaging is required when abnormal findings have been identified on a screening mammogram A woman reporting for a screening mammogram indicates a breast symptom (requiring a conversion to a diagnostic mammogram following facility protocol) Patients are recommended for short interval follow-ups based on previous imaging Patients have a personal history of breast cancer (women with this history may opt to have screening mammography if offered by the facility)

Screening mammography appointments may be scheduled weeks in advance of the patient's arrival for their procedure. In the interim, breast symptoms may develop that the patient reports to the technologist during documentation of her breast health information. Incorrectly performing a screening mammogram on a patient requiring a diagnostic procedure could delay appropriate patient care or diagnosis. Clinical problems reported to the technologist during the heath information interview with the patient should be reported to the radiologist.7,8 Corroboration of the patient's health information and the procedure order provided by the patient's health care provider should be verified by the technologist. Although this critical process is addressed through triage when the patient schedules her appointment with the facility, and again when the patient arrives at the facility to register for her services, it is the patient breast health interview conducted by the technologist that serves to confirm the type of mammography procedure the patient requires. In the event that a patient scheduled for a screening mammogram reports a symptom, the American College of Radiology (ACR) Practice Parameter For the Performance of Screening and Diagnostic Mammography states “The facility should have a process whereby screening mammography can be converted to diagnostic mammography.”6

The patient health information interview begins with verification by the technologist that the correct patient is having the correct imaging procedure. The Joint Commission recommends that at least two patient identifiers be used for this purpose, such as the patient's name and birthdate.9 The technologist should also verify with the patient that the correct electronic chart has been accessed prior to entering any health information. Establishing an atmosphere of calmness and reassurance helps the patient to focus on the process of answering the questions asked by the technologist and to offer information about breast symptoms that she may be fearful to disclose or embarrassed to discuss.

There are several verbal and nonverbal communication strategies used by the technologist to help enhance the interview process for the patient10: Address the patient by name throughout the interview process. Listen to the patient when she is speaking, without interrupting. Face the patient during the interview. Be aware of your voice tone, speed, and volume. Speak clearly. Be respectful. Accurately document information.

The health history obtained during the patient interview provides vital information to the interpreting radiologist as the patient's mammography images are evaluated. The following information obtained from the patient must be available to the interpreting radiologist (Figure 4-1):

Figure 4-1 The breast health history obtained during the patient interview provides vital information to the interpreting radiologist as she/he evaluates the patient's mammography images. Patient identification Exam identification Documentation of screening versus diagnostic examination Baseline mammogram should be indicated. Information about previous studies Reason for the current examination Reported symptoms Risk factors Personal Family history Gynecological history Hormone history Breast surgical and treatment history Breast implant information

It is important that the technologist gathering information from the symptomatic diagnostic patient elicit specific descriptions about the complaints reported by the patient and to accurately document them for the interpreting radiologist. These descriptors assist the radiologist during their image evaluation and in the decision-making process of managing the patient's care. Information gathered by the technologist for the symptomatic patient should include seven descriptors10,11: Localization: define the location of the reported symptom Chronology: when symptoms began and how often they are noticed Quality: characteristic description of the symptom such as color of nipple discharge or size of breast lump Severity: intensity and extent of the symptom Onset: how the symptoms were made known to the patient Aggravating or

alleviating factors: circumstances that modify or change the intensity of the symptom
Associated manifestations: determining if other complaints the patient may report relate to the symptom

In mammography, an example of using this method to gather symptom specifics depends on the type of breast symptom being reported. For example, reporting breast pain as a symptom may require the technologist to inquire about the timing and frequency of the pain in relation to the menstrual cycle, if the patient is still menstruating, in addition to the more specific questions that describe the location, duration, and persistence of the pain.[7] The example of nipple discharge reported to the technologist also requires careful questioning of the patient to determine the amount, duration, color, and onset. Since there is greater significance to unilateral nipple discharge than bilateral, questions to the patient should include whether or not the discharge is observed in both breasts or is isolated to one breast.[7,12,13]

Physical Inspection

Prior to performing the mammography procedure, the technologist should inspect the skin for the presence of moles, scars, or other skin changes with a potential to be demonstrated on the mammographic image. The locations of these skin conditions are transferred to a breast diagram that accompanies the health history information form Figure 4-2. Additionally, any clinical indications reported by the patient are documented on the breast diagram in the appropriate locations. The decision to use radiopaque breast markers on the skin to indicate moles, scars, or breast lumps is discussed in Chapter 7.

Figure 4-2 Documentation. Note skin changes (e.g., previous biopsies, moles, and scars) on a diagram to correlate with the mammogram.

Risk Factors

The mammography breast health history form includes a section on breast cancer **risk factors** that provides the radiologist with pertinent information about the patient's breast cancer risk. This information is succinctly presented to the radiologist for immediate recognition of which risk factors apply to each patient (Figure 4-1).

A risk factor is anything associated with a greater likelihood of developing the disease. Several reliable resources such as the American Cancer Society, National Cancer Institute, and Susan G. Komen, among many others, provide comprehensive information about breast cancer including breast cancer risk factors. The Centers for Disease Control and Prevention Web site informs women that studies have demonstrated that the risk of developing breast cancer is due to a combination of factors. The CDC includes examples of breast cancer risk factors, shown in Box 4-1. Chapter 21, Breast Cancer Diagnostic Technologies: Today and Tomorrow, focuses on one specific breast cancer risk factor, which has gained increasing attention in the last few years: breast density.

BOX 4-1

What Are the Risk Factors for Breast Cancer?*

Studies have shown that your risk for breast cancer is due to a combination of factors. The main factors that influence your risk include being a woman and getting older. Most breast cancers are found in women who are 50 years old or older.

Some women will get breast cancer even without any other risk factors that they know of. Having a risk factor does not mean you will get the disease, and not all risk factors have the same effect. Most women have some risk factors, but most women do not get breast cancer. If you have breast cancer risk factors, talk with your doctor about ways you can *lower your risk* and about *screening* for breast cancer.

Risk factors include: **Getting older.** The risk for breast cancer increases with age; most breast cancers are diagnosed after age 50. **Genetic mutations.** Inherited changes (mutations) to certain genes, such as BRCA1 and BRCA2. Women who have inherited these *genetic changes* are at higher risk of breast and ovarian cancer. **Early menstrual period.** Women who start their periods before age 12 are exposed to hormones longer, raising the risk for breast cancer by a small amount. **Late or no pregnancy.** Having the first pregnancy after age 30 and never having a full-term pregnancy can raise breast cancer risk. **Starting menopause after age 55.** Like starting one's period early, being exposed to estrogen hormones for a longer time later in life also raises the risk of breast cancer. **Not being physically active.** Women who are not physically active have a higher risk of getting breast cancer. **Not being physically active**. Women who are not physically active have a higher risk of getting breast cancer. **Being overweight or obese after menopause**. Older women who are overweight or obese have a higher risk of getting breast cancer than those at a normal weight. **Having dense breasts**. Dense breasts have more connective tissue than fatty tissue, which can sometimes make it hard to see tumors on a mammogram. Women with dense breasts are more likely to get breast cancer. **Using combination hormone therapy**. Taking hormones to replace missing estrogen and progesterone in menopause for more than 5 years raises the risk for breast cancer. The hormones that have been shown to increase risk are *estrogen* and *progestin* when taken together. **Taking oral contraceptives (birth control pills).** Certain forms of oral contraceptive pills have been found to raise breast cancer risk. **Personal history of breast cancer**. Women who have had breast cancer are more likely to get breast cancer a second time. **Personal history of certain noncancerous breast diseases**. Some noncancerous breast diseases such as atypical hyperplasia or lobular carcinoma in situ are associated with a higher risk of getting breast cancer. **Family history of breast cancer**. A woman's risk for breast cancer is higher if she has a mother, sister, or daughter (first-degree relative) or multiple family members on either her mother's or father's side of the family who have had breast cancer. Having a first-degree male relative with breast cancer also raises a woman's risk. **Previous treatment using radiation therapy**. Women who had radiation therapy to the chest or breasts (like for treatment of Hodgkin's lymphoma) before age 30 have a higher risk of getting breast cancer later in life. **Women who took the drug diethylstilbestrol (DES**), which was given to some pregnant women in the United States between 1940 and 1971 to prevent miscarriage, have a higher risk. Women whose mothers took DES while pregnant with them are also at risk. **Drinking alcohol**. Studies show that a woman's risk for breast cancer increases with the more alcohol she drinks.

Research suggests that other factors such as smoking, being exposed to chemicals that can cause cancer, and night shift working also may increase breast cancer risk.

From: Centers for Disease Control and Prevention (CDC). What are the risk factors for breast cancer? Available at: https://www.cdc.gov/cancer/breast/basic_info/risk_factors.htm.

*The Centers for Disease Control and Prevention (CDC) provides information on risk factors associated with the development of breast cancer.

Risk factors associated with developing breast cancer that are included on the mammography history form are generally known breast cancer risk factors recognized by researchers and medical professionals. The main risk factor for breast cancer is simply being a woman. Age is another important risk factor, as the likelihood of developing breast cancer increases as you get older.14, 15 Risk factors included on the mammography history form address the patient's personal health factors and family history that may increase her chances of developing breast cancer. Having a risk factor, or having several risk factors, does not guarantee that you will develop breast cancer. Some women who have several risk factors may never be diagnosed with breast cancer, while other women with no known major risk factors may develop the disease.14,15

Technologists working in the mammography discipline are continuously asked by their patients about risk factors associated with breast cancer and about mammography surveillance guidelines. It is essential that the technologist be familiar with the current breast cancer screening recommendations for women at average breast cancer risk and the recommendations for women at higher than average risk for developing breast cancer. Patients asking these questions should be directed to their health care provider to discuss what surveillance modalities and intervals are appropriate for them. Providing the patient inquiring about these important issues with information from reliable organizations allows them to be informed and prepared to ask knowledgeable questions prior to meeting with their physician for a better understanding of these subjects. The following organizations provide educational information about all aspects of breast cancer including explanations of breast cancer risk, risk assessment, and screening recommendations for mammography; this information is useful for the mammography technologist as well as her patient: American Cancer Society (ACS) Susan G. Komen MammographySavesLives.org National Cancer Institute Centers For Disease Control and Preventions (CDC) Breast Cancer.org Mastering the Balancing Act: Image Quality and Patient Satisfaction

It is well established that early detection of breast cancer affords the patient the greatest chance of successful treatment and long-term survival. Experts agree that breast cancer awareness and breast cancer screening, particularly utilizing mammography, have impacted the mortality rate associated with the disease. Statistics show a decline in deaths caused by breast cancer since 1989. 14 However, it is also recognized that mammography images are among the most difficult of radiographic images to interpret. Ensuring accuracy of the interpretation requires that the produced images be of high quality.

The consequences of poor image quality in mammography significantly impact the patient in ways that may affect their pocketbook, emotional health,16 and their quality of life. Poor image quality may result in early indications of breast cancer that go undetected by the interpreting physician (IP). This type of report, called a “false negative,” may delay important treatment of the disease, impact the patient's treatment options, or even contribute to a potential loss of life. Poor image quality in mammography may also result in the patient being asked to return for additional imaging when normal breast tissue is interpreted as an abnormality. This type of report, called a “false positive,” may require the patient to undergo additional testing that causes increased anxiety, unnecessary discomfort, and additional cost.17

The significance of mammography image quality is addressed through the MQSA, which regulates mammography services in the United States. MQSA requirements ensure that equipment, personnel, and quality assurance meet established standards safeguarding the delivery of consistent, high-quality mammography to patients no matter where they may live.

There are two foundational components that produce or “create” the mammography image (discussed in detail in the following chapters of this book) that are distinguished in the MQSA standards. To ensure high-quality results for each acquired image, each of these components must perform at the level described by their MQSA standard. Figure 4-3 illustrates the two foundations that “create” the mammography image.

Figure 4-3 The two foundational components that “create” or produce the mammography image: the mammography equipment and the mammography technologist.

Both the equipment used for mammography imaging and the technologist creating the image must be "deemed" properly prepared to function in their ability to deliver high-quality service results. This responsibility does not pose an issue for the mammography equipment. Once the medical physicist approves the equipment for use, the technologist assumes operation for each individual exposure.

The technologist, however, is responsible for balancing two major components of the mammography examination: Producing a high-quality image Providing a positive patient experience

Balancing these two components introduces a conflict that she must learn to master for every patient interaction (Figure 4-4). This conflict may best be appreciated through the philosophy of Arthur C. Nielsen, who is recognized for developing methods to measure the audience of television programs, better known as the "Nielsen ratings." Mr. Nielsen stated simply, "Watch every detail that affects the accuracy of your work." A perceptive mammography technologist understands that the accuracy, or *precision* aspect of the work she creates, relies on the delicate balance between her knowledge and application of technical skills and her interpersonal interactions with the patient. The quality of the mammography examination is dependent on the continuous mingling of technical skills and interpersonal skills occurring simultaneously, not alternately, as illustrated in Figure 4-5.

Figure 4-4 Every patient interaction requires the technologist to carefully balance the responsibilities of ensuring image quality and a positive patient experience. (Modified from Shutterstock, Inc.)

Figure 4-5 The quality of the mammography examination is dependent on the technologist's ability to continuously mingle technical skills and interpersonal skills.

Case Study 4-1

1. Refer to Figure 4-4. Discuss workflow efficiencies and interpersonal skill development that a technologist should master in order to balance the image quality and the patient experience.

The Mammographer's Dilemma

A factor that plays an important role in producing a quality image for the mammography examination is the "patient tolerance" of the procedure.

There is a wide variance of patient tolerance for the positioning maneuvers required to capture adequate breast tissue and for the application of compression required to obtain clarity in a quality image. The agility of the patient, along with their stamina for discomfort, must be considered and continuously monitored throughout the positioning and compression application process of the examination.

To understand the challenge of the technologist, Figure 4-6 illustrates the conflict inherent in the mammography examination. Quality/discomfort must be perfectly balanced with patient satisfaction, which is determined by patient tolerance. To successfully meet this expectation, the technologist must determine for each individual patient the precise point where both patient tolerance and image quality are achieved. The technologist's goal is a challenging one; she must repetitively produce quality mammographic images for a radiographic examination that inherently requires a degree of discomfort to the patient *while repetitively ensuring a positive patient experience.*

Figure 4-6 The technologist's commitment to quality presents a dilemma. The discomfort associated with high-quality mammography requires the technologist to accurately perceive patient tolerance in order to also achieve a satisfactory patient experience.

Unfortunately, and for various reasons (discussed later in this chapter), the equilibrium of quality/discomfort and patient satisfaction may not be achieved. Figure 4-7 illustrates the consequences of a disparity between quality/discomfort and patient satisfaction.

Figure 4-7 Circumstances associated with the examination may interfere with the technologist's ability to achieve equilibrium between quality/discomfort and patient satisfaction. When one factor dominates over the other, one goal of the examination is not met. In the first example, the quality/discomfort portion of the examination is exaggerated, while the patient satisfaction portion is minimized. This indicates that the patient's discomfort exceeded her point of tolerance. The illustration demonstrates that even if the accuracy goal of the examination was met, providing the patient with high-quality images, the patient's experience was less than satisfactory. This negative examination experience may influence the patient's future adherence to screening mammography and may cause the patient to discuss her negative experience with others in the community. In the second example, the patient satisfaction portion of the examination is exaggerated, while the quality/accuracy portion is minimized. Due to a variety of reasons, the examination may be subject to external circumstances that may compromise quality. Examples of this may include the following: the patient informed the technologist that she is unable to tolerate compression, or a patient has been added to the schedule affecting subsequent appointment time allotments. In these instances, consequences of unintentionally omitting breast tissue from the examination or inadequate compression of breast tissue may result due to attempts to appease the patient or remain on time. Although the patient experience may yield a very positive satisfaction result, the images produced during the examination may prohibit the detection of early indications of breast cancer.

These illustrations help reinforce the obligation of the technologist to also serve as an educator to the patient throughout the examination. When the patient is coached by the technologist as the positioning maneuvers are employed, explaining what is happening and why, the patient is invited into a “teamwork” process of reaching the procedure quality goals. The result of establishing a “teamwork” model through effective communication during the positioning/compression process serves to achieve the two goals required for the delivery of quality service:

1. Improving the image quality

2. Providing the patient with a satisfactory mammography experience

The technologist's contact with the mammography patient is approximately 10 to 20 minutes. In addition to serving as an educator to the patient, the technologist assumes the responsibility to simultaneously deliver the following requirements of the mammography procedure (Figure 4-8):

Figure 4-8 The technologist balances a variety of responsibilities during every mammography procedure she performs. The ability of the technologist to tailor the mammography examination to each individual patient and circumstance requires a perception of all factors that influence the procedure. Problem solve Adhere to facility policies Recall individual radiologist's expectations Ensure patient safety Compassionately meet the expectations of the patient

Fulfilling these responsibilities and also meeting expectations to produce superior image quality within the allowable time permitted may be challenging under some examination situations, requiring the technologist to suppress anxiety as she delivers quality patient care. This subject is addressed later in this chapter. Measuring Quality Service

The technologist's ability to successfully balance the expectations of the patient experience and produce high image quality is one component of the mammography service. The mammography procedure serves to gather information providing an accurate representation of patient anatomy for skillful interpretation by the radiologist. The mammography service is completed when the IP provides an assessment to the patient and to the patient's referring health care provider. The entire process of the mammography service can be evaluated using three measurements of service quality (Figure 4-9):

Figure 4-9 Service quality may be evaluated using three levels of measurement: perceived quality, expected quality, and actual quality.

1. **Perceived quality**

Perceived quality is the impression the patient (customer) forms about the service they have received. Customer satisfaction is achieved when the patient feels that the actual quality received surpassed their expectation of quality.18 Perceived quality is very subjective and is difficult to accurately calculate. Service factors such as the registration (check-in) process, how long they waited for the procedure, or their interpretation of how they were treated during the examination influence their perception of quality.3 Perceived quality is a critical measurement of service quality as it represents customer satisfaction.18 It is important for the technologist to understand that their interaction with the patient has the greatest impact on perceived quality. This measure of quality may be more important that the actual quality, as it serves as the determining factor in whether or not customers return to the facility for future imaging services.3

2. **Expected quality**

Expected quality can be influenced by advertisements that the patient is exposed to, by word of mouth in the community, family member experiences, or other outside factors. When the customer has low expectations, they may go elsewhere for their services. In contrast, if the service expectations are too high, it may be difficult for the facility to meet them.18 The customer's expectation of quality of service is formed prior to the service they receive, and therefore, the mammography technologist has minimal control over this measurement of quality.3

3. **Actual quality**

Actual quality is the true service that has been delivered to the customer and is demonstrated through statistical data.18 Points of customer service, such as image quality, the accuracy of radiologist interpretation, and satisfaction of the referring health care provider, are measured through the use of survey results and computer collected data that provide the facility with factual outcomes of actual quality. This information is useful in comparing facility service outcomes to that of their competitors.3

Case Study 4-2

1. Refer to Figure 4-9. Discuss the importance of service quality and the way service can be measured. Describe the significance of each measurement to the mammography facility.

Quality Checks and Balances

Understanding the three measurements of service quality provides valuable information to the facility in establishing mechanisms that ensure service quality determinants are met. The facility, radiologist, senior technologist, and the technologist all play significant roles in ensuring the two critical elements of service: image quality and patient satisfaction are achieved. A closer look at each of these elements of the mammography examination and the specific factors that influence their quality are discussed further.

Quality Factors: Achieving Image Quality

Excluding equipment performance, there are two critical factors that ensure high-quality images are produced during the mammography procedure. The technologist acquiring images must be proficient in her ability to adequately capture breast tissue and to ensure visual clarity of the breast anatomy for accurate interpretation by the radiologist, *and* she must be provided adequate time to create quality images in a variety of patient situations.

Technologist Proficiency

Factors affecting technologist proficiency are influenced by:

Technologist initial mammography education

Radiologist's expectations, oversight, and guidance of image quality (includes ongoing feedback of technologist performance)

Quality and length of time exposed to positioning/compression instruction (number of examinations supervised by qualified instructor)

Imaging instruction and examination management guidance from senior mammography technologists

Ensuring that periodic refresher positioning/compression techniques are included in continuing education

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