Screening mammography: a successful public health initiative

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Suggested citation: Feig SA. Screening mammography: a successful public health initiative. Rev Panam Salud Publica. 2006; 20(2/3):125–33.

SYNOPSIS

This paper reviews the ability of screening mammography to reduce breast cancer death rates, and it discusses methods that maximize benefits and reduce false-positive interpretations in a screening program. The review covers published results from screening mammography programs conducted in Europe and North America, along with quality assurance measures designed to ensure that similar or even better outcomes will be shared by other populations of screened women. Randomized trials in Europe and the United States of America have shown the benefit from screening women ages 40-70 years. Encouraged by the success of these trials, many Scandinavian countries now offer screening mammography to their populations as a public health service. These service screening programs have reduced breast cancer deaths as much as 63% among women who were screened. In the United States, where 61.5% of women age 40 and older report having had a mammogram in the preceding year, death rates from breast cancer have been falling despite an increasing incidence of the disease. The technical quality of mammography in the United States has improved as a result of advances in mammography equipment, including the film-screen systems. Also contributing to the improvement has been the implementation of federally mandated quality control testing at each mammography facility, as required by the Mammography Quality Standards Act (MQSA), which the Congress of the United States approved in 1992. Factors that result in increased detection of early-stage cancers include better technique, use of two mammographic views per breast, annual screening intervals, and improved interpretation. Mammography is one of the 10 major subject categories on the American Board of Radiology examinations. Furthermore, MQSA requires radiologists who practice mammography to obtain continuing medical education credits and to use standard interpretation assessments on every report. Manuals for technical quality control and breast imaging reporting, as well as education and self-assessment materials on interpretation, have been developed by the American College of Radiology. Even though mammography will not detect all breast cancers, it is still the best available screening test. The American Cancer Society recommends that annual screening mammography begin no later than age 40 years.

Key words: breast neoplasms, mammography, mass screening, practice guidelines, program evaluation, United States.

The primary goal of screening mammography is to lower breast cancer mortality rates through reduction in late-stage disease. Early detection also provides a wider choice of therapeutic options such as lumpectomy rather than mastectomy. The relative sensitivity of mammography and clinical examination were assessed by the Breast Cancer Detection

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Demonstration Project, which was conducted at 29 centers throughout the United States of America from 1973 to 1981 (1). Over 280 000 women between the ages of 35 and 74 years were offered five annual screenings with both mammography and clinical examination. Almost 42% of all cancers were detected by mammography alone, 47% by both mammography and clinical examination, and almost 9% by clinical examination alone. The relative performance of mammography was best for earlier cancers such as infiltrative carcinomas measuring less than 1 cm in size and all in situ carcinomas.

RANDOMIZED CLINICAL TRIALS ON SCREENING MAMMOGRAPHY

Seven randomized clinical trials (RCTs) conducted during the past 40 years have compared deaths from breast cancer among study group women ages 40–70 years offered screening mammography and control group women. Six RCTs found that screening reduced breast cancer mortality in the entire range of ages screened. For three RCTs (Health Insurance Plan [HIP], Swedish Two-County, and Edinburgh [Scotland]) there were statistically significant reductions in breast cancer deaths, of 23%, 32%, and 20%, respectively (2–4). The Malmo, Stockholm, and Gothenburg trials in Sweden reported nonsignificant reductions of 19%, 20%, and 14%, respectively (5–7). Only one trial, the National Breast Screening Study of Canada (NBSS), was unable to demonstrate any benefit from screening (8, 9). NBSS results may be explained by poor technical quality and a faulty randomization scheme (10).

At early follow-up, no trial showed much benefit for the subset of women who entered screening between 40 and 49 years of age. Their benefit appeared later because younger women have faster breast cancer growth rates. For these growth rates, screening intervals of two years are excessively long (11, 12). Due to the relatively small number of younger women enrolled and their lower incidence of breast cancer, initial proof of benefit required pooling results from multiple trials to attain statistical significance. In 1997, a meta-analysis of women age 40–49 years at entry into all five Swedish trials found a significant, 30% reduction in breast cancer deaths (13). Subsequent long-term follow-up of three trials (HIP, Gothenburg, and Malmo) each found statistically significant breast cancer mortality reductions, of 24%, 45%, and 36%, respectively, for younger women (14–16). Thus, randomized clinical trials have proven that screening mammography will reduce deaths from breast cancer among women age 40–70 years.

VALIDITY OF SCREENING TRIAL RESULTS

On the basis of results from randomized trials that were conducted over the past quarter of a century and that involved over 500 000 women, there has been consensus in the medical community in favor of screening mammography. In the face of such near unanimous agreement, two articles published by Gotzsche and Olsen, in 2000 (17) and in 2001 (18), made the seemingly incredible claim that none of the trials provided any convincing evidence that screening prevents breast cancer deaths. The arguments and counter-arguments are complex and have been summarized in detail elsewhere (19, 20). Fortunately, the conclusions reached by Gotzsche and Olsen have all been subsequently refuted in the peer-reviewed literature (21–28).

Although the report by Gotzsche and Olsen received considerable publicity in the United States media, no medical organization or government has changed its screening policy. Indeed, after review of the Gotzsche and Olsen papers, 10 leading medical organizations in the United States reaffirmed their support of screening in a full-page advertisement in *The New York Times* on 31 January 2002. (The 10 organizations were the American Academy of Family Physicians, American Cancer Society, American College of Obstetrics and Gynecology, American College of Physicians-American Society of Internal Medicine, American College of Preventive Medicine, American Medical Association, Cancer Research Foundation of America, National Medical Association, Oncology Nursing Society, and the Society of Gynecologic Oncologists.) Also, the National Cancer Institute of the United States and the U.S. Preventive Services Task Force concluded that the results from randomized screening trials were still valid. Many groups outside the United States reached similar conclusions about screening mammography. For example, the Swedish National Board of Health and Welfare, the Danish National Board of Health, the Health Council of the Netherlands, the European Institute of Oncology, and the World Health Organization dismissed the Gotzsche and Olsen arguments and concluded that the evidence for a benefit was convincing (21).

NEGLIGIBLE RADIATION RISK FROM MAMMOGRAPHY

In comparison to the benefits, the risks from screening mammography should be negligible. Potential radiation risk from mammography should be considered, even though no woman has ever been shown to have developed breast cancer as a result of mammography, not even from multiple

examinations over many years at doses much higher than the current dose of 3–4 mGy (0.3–0.4 rad) (29). Some groups of women exposed to radiation have been found to be at increased risk for breast cancer. This has been true for survivors of the atomic bombs dropped on two Japanese cities near the end of World War II and for North American women treated with radiation therapy for benign breast conditions in the 1930s or monitored with multiple chest fluoroscopies during treatment for pulmonary tuberculosis during the same period (29). However, those populations received doses from 100 to over 1 000 rad. Numerous studies have compared the known benefits of screening with the hypothetical risks from low doses of radiation from mammography, using the conservative assumption that the risk per rad remains constant when extrapolated downward from high to low doses. Benefit/risk ratios calculated as either lives saved or years of life saved through screening vs. lives lost or years of life lost as a consequence of mammography indicate that screening mammography is safe (29–34). A 2004 report from the National Council on Radiation Protection and Measurements of the United States concludes that "the risk of radiation-induced mortality, even given a series of 30 annual screenings, is offset by even a minimal benefit in reduced breast cancer mortality from screening as low as one percent" (35).

BENEFITS FROM SERVICE SCREENING

Based on the success shown in the RCTs, all Swedish counties and many counties in Finland now offer screening mammography as a public health service to women age 40 and older. Five studies from Sweden and one from Finland show that this service screening is associated with a reduction in breast cancer mortality often exceeding the reduction found by the RCTs (36). In the counties that participated in the Swedish Two-County Trial, subsequent service screening of women ages 40–74 years reduced breast cancer deaths by 50% among the women offered screening and by 63% among those who agreed to be screened (37). Similar results were found in an expanded study involving seven Swedish counties (38).

SCREENING MAMMOGRAPHY GUIDELINES

Screening mammography beginning at age 40 is advised by the American Cancer Society (ACS), American College of Radiology (ACR), American Medical Association (AMA), National Cancer Institute (NCI), American College of Obstetrics and Gynecology (ACOG), and U.S. Preventive Services Task Force (USPSTF) (39–42). For women ages 40–49, the ACS, ACR, and AMA recommend annual screening; the ACOG, NCI, and USPSTF recommend screening every one to two years. All the organizations advise annual screening for women age 50 and older. The ACS does not stipulate any upper age limit beyond which screening should no longer be performed. Rather, the ACS maintains that screening should continue as long as a woman is in generally good health and has sufficient longevity.

TABLE 1. Breast cancer in the United States of America, with percent diagnosed by stage in 1980 and 2001, and with current five-year relative survival rates by stage at diagnosis as of 2002[a]

Stage	Stage distribution (%) 1980	Stage distribution (%) 2001	Five-year survival (%)
Ductal carcinoma in situ	3	21	100
Stage I	25	42	98
Stage II	45	25	81
Stage III, IV	14	7	26
Unstaged	13	5	56

[a] ***Source:*** National Cancer Institute, SEER database, accessed 20 April 2006. The data on five-year relative survival rates are for the period ending 31 December 2002.

EFFECTS OF INCREASED USE OF SCREENING MAMMOGRAPHY IN THE UNITED STATES

In the United States the use of screening mammography has increased continuously since 1975. Surveys performed by the National Center for Heath Statistics found that the percentage of women ≥ 40 years who reported having undergone a mammogram within the preceding two years was as follows: 28.8% in 1987, 55.8% in 1992, 66.9% in 1998, and 70% in 2000 (43). According to a survey performed in 2002, 61.5% of women in the United States age 40 and older reported that they had had a mammogram within the preceding year (44). As a result of screening mammography there has been a pronounced shift in the stage of diagnosis of breast cancer in the United States (Table 1). Intraductal carcinoma in situ (DCIS), which was rare in the premammography era, now constitutes just over 20% of the recently-diagnosed breast cancers. The proportionate representation of stage I invasive cancer has increased, while that of stages II, III, and IV has decreased.

Analyzing incidence and mortality data that are adjusted to the changes in age representation in the population provides a better assessment of how

breast cancer death rates have fallen as a result of early detection. Adjusted to a single population "standard," the incidence of invasive breast carcinoma in the United States increased by 30.9% between 1980 and 1990, and by 36.8% from 1980 to 1999. Breast cancer mortality increased by 4.4% in the 1980s but fell by 17.0% during the next decade. Based on these figures, Feig calculated that the average woman with invasive cancer in the late 1990s was 39% less likely to die from her disease than was her counterpart in the 1980s (36). If these calculations had assumed that some invasive breast cancers were prevented through mammographic detection of DCIS, the estimated benefit attributed to mammography would be even greater.

MAXIMIZING THE BENEFIT FROM SCREENING

Considering the variability in breast cancer mortality reduction among the studies that this piece has discussed, it should come as no surprise that the benefit from screening women in any country in the world may be greater than, the same as, or less than in any of the randomized trials and service screening programs. Part of the variability may be due to differences in age and risk factors among the screened populations. Most of the variation, however, would be attributable to differences in screening frequency, number of screening rounds, quality of mammography technique, and interpretation.

There is abundant indirect evidence that annual screening should lead to far greater benefit than screening every other year. This is especially true for women screened in their forties (11, 12, 42). For example, screening every two years in the Swedish Two-County Trial decreased breast cancer deaths 18% among women age 40–49 and 39% among women age 50–59. It has been calculated that annual screening for women in each of these age groups would have decreased breast cancer deaths by 36% and 45%, respectively (45).

Most screening trials used a single mediolateral oblique (MLO) view alone on all or most screening rounds. However, we now know that the number of mammographic images per breast will affect screening detection rates. Routine use of both craniocaudal (CC) and MLO views detects 7% more cancers than does an MLO view alone (11).

Overall technical quality of mammography is determined by eight separate factors: breast positioning, breast compression, image exposure, contrast, sharpness, noise, artifacts, and film labeling. Better technical quality allows increased detection rates, detection of earlier-stage disease, and fewer missed cancers (46). To promote good technical quality in the United States, the American College of Radiology has developed a list of recommended specifications for mammography equipment (47). The ACR has also published the *Mammography Quality Control Manual*, which describes: (1) methods for proper positioning and compression of the breast, (2) proper viewbox criteria for assessment of clinical image quality by the radiologist, and (3) quality control tests that need to be performed by the technologist and medical physicist on a regular basis to document proper film processing and equipment functioning (48). The routine performance of these tests is now required by United States law under the Mammography Quality Standards Act (MQSA), which was passed by the United States Congress in 1992; interim regulations became effective in 1994, and final regulations in 1999 (49). Objective data from medical physics inspections have documented improvement in film quality throughout the United States as a result of MQSA (50). Due to improvements in mammographic technique over the past 30 years, modern mammography detects earlier cancers than was possible with the randomized trials that were conducted in the 1970s and 1980s (51). Thus, modern mammography should result in even greater benefit than was shown in studies in earlier decades.

Aside from differences in screening frequency and technique, there are other reasons why randomized trials underestimate the benefit for a woman who now receives annual screening. First, randomized trials measure differences in breast cancer death rates between study group women, who were offered screening, and control group women, who were not offered screening (50). However, not all study group women accepted the offer to be screened, and many control group women obtained screening outside the trials (52). Second, screening trials consist of a limited number of screening rounds, usually three to five. Because benefit does not reach "full throttle" until later rounds, the "average" benefit from the first several rounds underestimates the gain from continual annual screening (23).

Mammography does not detect all breast cancers. Some cancers missed by mammography will be detected by clinical examination (1, 2, 53, 54). There is evidence from RCTs that when women are screened with a combination of mammography and clinical examination, clinical examination makes an independent contribution towards lowering breast cancer mortality (1, 2, 53, 54). The American Cancer Society advises women to obtain an annual mammogram and clinical breast examination beginning at age 40 (41). In addition, the ACS suggests that women should also consider performing monthly breast self-examination (BSE), although the evi-

dence in favor of BSE as a supplementary screening modality is less strong. Unless taught and performed properly, BSE may not be effective (55).

Several studies suggest that early breast cancers missed by mammography may be detected by ultrasound in dense breasts and by magnetic resonance imaging (MRI) in high-risk women (56, 57). These preliminary results need to be confirmed by larger, better-designed multicenter trials before either modality can be considered for routine screening. There are several other reasons why neither ultrasound nor MRI is currently a practical screening method for the general population. Both result in far more false-positive biopsies than mammography does. MRI requires intravenous contrast injection. Although the cost of ultrasound is similar to that of mammography (which costs around US$ 90 per exam), the cost of breast MRI is substantially higher, some US$ 1 000 to US$ 1 500 per examination. The number of MRI and ultrasound units and of adequately–trained technologists and radiologists required for population-wide screening is daunting. The equipment is very expensive, and both studies are extremely time-intensive for technologists and radiologists. Unless high-quality automated ultrasound units can be developed, screening ultrasound will not be practical.

The recent Digital Mammography Imaging Screening Trial, which was conducted by the American College of Radiology Imaging Network, found that digital mammography did not detect any more cancers in the general population than conventional screen-film mammography did (58). However, digital mammography did seem to be more sensitive than conventional mammography for women with radiographically dense breasts and for women below the age of 50 years. The X-ray dose from digital mammography is slightly lower than is the dose with screen-film mammography. However, digital mammography units cost about US$ 500 000, or six times more than conventional mammography units.

Several studies have shown that interpretation of screening mammography by two paired readers may increase detection rates by 5%–15% (59). Results with this double-reading approach vary according to the relative interpretive expertise of the two readers. The potential benefit of double reading must be weighed against increased cost, higher false-positive callback rates, and a shortage of radiologist readers.

In principle, computer-aided detection (CAD) might function as a second reader. Results from CAD studies have varied, showing a 0%–20% increased cancer detection rate (60). There is evidence that the additive value of CAD may depend on the visual skills of the radiologist (61).

Detection of early breast cancer requires a combination of high-quality radiologic interpretation, state-of-the-art equipment, and technical quality assurance programs. In the United States, mammography represents 10% of the questions on the clinical portion of the written section (part I) of the American Board of Radiology (ABR) examination, and it is one of the 10 major categories on the oral portion (part II) of the ABR exam. These examinations are usually given during the fourth year of a radiology residency, which must include three months of experience in breast imaging.

In the United States, to interpret mammograms independently, an interpreting physician must either meet initial requirements or have been grandfathered by qualifying under the interim regulations before 28 April 1999. Initial qualifications specify that the physician must have a state license to practice medicine; must be board-certified in diagnostic radiology by an organization (such as the American Board of Radiology) that is approved by the United States Food and Drug Administration, or have three months of formal training in mammography; and must have 60 category 1 continuing medical education (CME) credits in mammography, with at least 15 obtained in the three years immediately before qualifying as an interpreting physician. In addition, the physician must have interpreted, under direct supervision, 240 mammographic examinations in the six months immediately before qualifying as an interpreting physician. There is an exception for newly-board-certified diagnostic radiologists. Direct supervision means that a supervising MQSA-qualified interpreting physician reviews, discusses, and confirms the diagnosis of the physicians being supervised.

Interpreting physicians must then maintain continuing education by accruing 15 category 1 CMEs over a 36-month period, and maintain a continuing experience of interpreting a minimum of 960 mammograms in 24 months. The physician is also required to maintain a valid state license to practice medicine.

The regulations also stipulate that before independently interpreting digital mammography, a physician must have at least eight hours of training in digital mammography.

The American College of Radiology (ACR) has developed several voluntary self-assessment programs in breast imaging that include images as well as questions and answers on detection, workup, and management. There are several self-assessment syllabi volumes in breast imaging as well as a Mammography Interpretative Skills Assessment (MISA) program in CD-ROM format (62, 63). Many radiologists have found that these learning devices provide unique opportunities to develop and evaluate their own interpretive skills. A medical audit of screening outcomes represents an-

TABLE 2. Recommended results for screening outcome measurements

Parameter	Desirable goal
Positive predictive value 1 (PPV_1)[a]	5%–10%
Positive predictive value 2 (PPV_2)[b]	25%–40%
Tumors found—Stage 0 or 1[c]	> 50%
Tumors found—Minimal cancer[d]	> 30%
Node positivity[e]	> 25%
Cancers found per 1 000 screening examinations	2–10
Prevalent cancers found per 1 000 first-time screening examinations[f]	6–10
Incident cancers found per 1 000 follow-up screening examinations[g]	2–4
Recall rate[h]	≤ 10%

Sources: D'Orsi et al. (65) and Bassett et al. (66).
[a] PPV_1 = cancers/cases recommended for recall or biopsy based on abnormal screening examination.
[b] PPV_2 = cancers/cases recommended for biopsy or surgical consultation; biopsy method may be fine needle aspiration (FNA) cytology, core needle biopsy histology, or excisional biopsy.
[c] Stage 0 = ductal carcinoma in situ; Stage 1 = cancer with no evidence of lymph node metastasis.
[d] Minimal cancer = invasive cancer ≤ 1 cm or ductal carcinoma in situ.
[e] Node positivity = percent of cancers having positive lymph nodes.
[f] Prevalent cancer = cancer detected on screening among women with no prior history of screening.
[g] Incident cancer = cancer detected on screening among women with prior history of screening.
[h] Recall rate = percent of screening patients asked to return for supplementary mammographic views or ultrasound, for further evaluation of a screen-detected finding.

TABLE 3. American College of Radiology (ACR) Breast Imaging Reporting and Data System (BI-RADS) assessment categories: a standardized reporting method to provide unequivocal clinical recommendations and to facilitate imaging outcome audits

Category[a]	Recommendation
0	Need additional imaging evaluation and/or prior mammograms for comparison.
1	Negative.
2	Benign finding(s).
3	Probably benign finding. Initial short interval follow-up suggested.
4	Suspicious abnormality. Biopsy should be considered.
4a	Low suspicion for malignancy.
4b	Intermediate suspicion of malignancy.
4c	Moderate concern but not classic.
5	Highly suggestive of malignancy. Appropriate action should be taken.
6	Known biopsy. Proven malignancy. Appropriate action should be taken.

[a] Category 0 applies only to cases where breast imaging workup is incomplete; categories 1–6 are final assessment categories.

other means of monitoring and improving screening skills (64). A list of desirable goals for medical audits has been developed by the ACR (based on recommendations of the United States Agency for Healthcare Research and Quality), and is shown in Table 2 (65, 66). In some screening programs, such as the one conducted in Canada by the province of British Columbia, potential screening readers are required to take a standardized test in mammography interpretive skills (67). At present there is no similar subspecialty examination required for radiologists who want to begin reading screening mammograms in the United States.

REDUCING FALSE-POSITIVE INTERPRETATION RATES

Achieving the best tradeoff between high detection rates for early cancers and reasonably low false-positive interpretation rates should be a goal for every screening program. High sensitivity should never be achieved with the consequence of low specificity. Nor should a desire for high specificity preclude screening's basic goal of detecting early malignancy.

Formalized training in mammography interpretation can increase detection rates for early disease without any increase in false-positive biopsy rates (68). More experienced mammographers are better at finding early cancers and yet have lower callback rates for additional imaging of screen-detected findings (64). Second opinions on prebiopsy cases have been shown to reduce false-positive biopsy rates (69). Regularly scheduled mammographic-pathologic correlation conferences that review all biopsied cases provide an invaluable means for radiologists to continually improve their own interpretation performance (67). Medical audits allow radiologists to compare their own interpretive outcomes with outcomes for other radiologists in their practice, and with recommended values (66). Desirable goals for audit parameters, such as screening recall rates, detection rates for minimal cancers, and false-positive biopsy rates, are provided in Table 2.

With training, radiologists can learn to confidently identify "probably benign" lesions that have less than a 2% likelihood of malignancy. When such lesions receive short-interval follow-up rather than biopsy, false-positive biopsy rates are reduced. Only a tiny minority of such lesions will ever be biopsied as a result of subsequent change, and they are still detected at a curable stage (70).

Use of standardized assessment categories in mammography reports facilitates record-keeping for medical audits and conveys unequivocal case recommendations to the referring physician. These categories, shown in Table 3, are an integral part of the American College of Radiology Breast Imaging Reporting and Data System (65).

COST-EFFECTIVENESS OF SCREENING MAMMOGRAPHY

A recent study estimated that annual screening mammography beginning at age 40 years and continuing until age 79 years would cost US$ 18 800 per year of life expectancy saved (71). According to this study, the cost-effectiveness of screening mammography is in the same general range as that of other commonly accepted interventions such as screening for cervical cancer and osteoporosis. The cost per year of life gained from annual screening mammography is higher than that of screening for colorectal cancer, but is much lower than that of the use of seat belts and air bags in automobiles.

Although the cost per year of life gained by screening mammography is less than that of renal dialysis or heart transplants, these interventions are needed for only a tiny fraction of the population. Because screening mammography is recommended for all women age 40 and older, its total program cost must also be considered. There are 65 million women aged 40 to 89 in the United States. If every one of these women obtained an annual screening mammogram at a cost of US$ 90, the total cost would come to US$ 5.9 billion per year. The total annual cost for all United States health care expenditures, however, is even more staggering: US$ 1.4 trillion each year. Thus, even if every woman aged 40 to 89 obtained an annual mammogram, the total cost would be only 0.42% of the national expenditure on health care (72).

As a result of mammography and early treatment, most women who develop breast cancer today will not die from the disease. While breast cancer is the most common cancer among women and the second most common cause of cancer death among women, it accounts for only 3.9% of all causes of death among women in the United States (72). Nevertheless, allocation of 0.4% of all national health expenditures (or approximately 0.8% of all national health expenditures for women) to substantially reduce the death rate from a disease that accounts for 3.9% of all deaths among women would seem to be a reasonable policy.

Moreover, early detection will also reduce other health care expenditures, such as treatment of advanced primary cancers, diagnosis and treatment of distant metastases or recurrent disease, loss of work productivity, short-term disability, long-term disability, and terminal care costs.

CONCLUSIONS

There are many reasons to believe that screening mammography is capable of reducing breast cancer mortality around the world. The benefit of screening has been proven in randomized trials, and it has now been documented beyond the trials, in service screening programs. Quality assurance tests and parameters to ensure technical standards have been developed. There are also methods to teach and test interpretive expertise. False-positive interpretations, which result in excessive callbacks and biopsies, can be kept acceptably low. Radiation risks from screening are negligible compared to the known benefits from screening. Finally, screening mammography is also cost-effective.

SINOPSIS

El tamizaje mamográfico: una iniciativa de salud pública que ha dado buenos resultados

En este artículo se examina la capacidad del tamizaje mamográfico para reducir las tasas de mortalidad por cáncer de mama y se exploran los métodos de tamizaje que rinden los mayores beneficios y que reducen el número de interpretaciones positivas falsas en programas para la detección del cáncer mamario. La revisión comprende los resultados ya publicados que se han obtenido mediante los programas de tamizaje mamográfico en Europa y América del Norte, así como algunas medidas de garantía de la calidad orientadas a conseguir resultados iguales o incluso mejores en mujeres sometidas al tamizaje mamográfico en otras partes del mundo. Diversos ensayos clínicos aleatorizados en Europa y Estados Unidos de América han demostrado los beneficios de someter al tamizaje mamográfico a las mujeres entre los 40 y 70 años de edad. Alentados por estos buenos resultados, varios países escandinavos actualmente ofrecen programas de tamizaje mamográfico a toda la población femenina como parte integral de sus servicios de salud, con lo cual han logrado reducir la mortalidad por cáncer de mama hasta en 63% de las mujeres examinadas en esos programas. En los Estados Unidos, donde 61,5% de las mujeres de 40 años de edad o mayores declaran haberse sometido a una mamografía en el transcurso del año anterior, las tasas de mortalidad por cáncer de mama se han venido reduciendo pese a un aumento de la incidencia de la enfermedad. La calidad técnica de la mamografía en los Estados Unidos ha mejorado como resultado de adelantos en los equipos mamográficos, incluidos los sistemas de película y pantalla. Tales mejoras también se deben a que en cada servicio de mamografía se realizan pruebas de garantía de la calidad por exigencia del gobierno federal, conforme la Ley de Estándares de Calidad en Mamografía (Mammography Quality Standards Act), *que el Congreso de los Estados Unidos aprobó en 1992. Ciertos factores han llevado a una mayor detección de cánceres mamarios en etapa temprana: mejores técnicas mamográficas, la toma de dos proyecciones de cada seno, mamografías de tamizaje con periodicidad anual, y mejoras en la interpretación. La mamografía figura entre las 10 principales categorías temáticas comprendidas en los exámenes del Consejo Estadounidense de Radiología* (American Board

of Radiology). *Por otro lado, la MQSA exige que todo radiólogo que realiza mamografías obtenga créditos por asistir a actividades de educación continuada y que aplique criterios de interpretación normalizados en todos sus informes. Asimismo, el Colegio Estadounidense de Radiología* (American College of Radiology) *ha elaborado manuales para la garantía de la calidad técnica de las imágenes mamográficas obtenidas y los informes correspondientes, así como materiales didácticos y de autoevaluación para mejorar la interpretación. Aunque la mamografía no detecta todos los cánceres de mama, sigue siendo la mejor prueba de tamizaje que existe para detectar la enfermedad. La Sociedad Estadounidense contra el Cáncer* (American Cancer Society) *recomienda que el tamizaje mamográfico anual se inicie a más tardar a los 40 años de edad.*

Palabras clave: neoplasias de la mama, mamografía, tamizaje masivo, pautas prácticas, evaluación de programas, Estados Unidos.

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Manuscript received on 14 December 2004. Revised version accepted for publication on 8 August 2005.