

Does This Patient Have Breast Cancer?

The Screening Clinical Breast Examination: Should It Be Done? How?

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CLINICAL SCENARIOS

Case 1

On annual examination of a 64-year-old woman, you note an 8-mm mass in her right breast. She says she never noticed the mass before. Her screening mammogram 7 months ago was normal.

Case 2

A 42-year-old woman comes to see you because she is upset. "I want a breast examination, Doctor. My coworker was just diagnosed with breast cancer." She practices breast self-examination regularly. She has noted no changes in her breasts.

Why Perform a Breast Examination?

The clinical breast examination (CBE), like any part of the physical examination, can be used either for screening (to detect breast cancer in asymptomatic women) or diagnosis (to evaluate breast complaints, primarily to rule out cancer). In primary care, screening CBEs are more commonly performed than diagnostic CBEs; of a total of 14 859 CBEs performed on a cohort of 2400 women over a 10-year period, 73% were for screening and 27% were diagnostic¹ (and J. G. Elmore, MD, MPH, written communication, November 9, 1998). This review concentrates on the screening CBE because most research

Context The clinical breast examination (CBE) is widely recommended and practiced as a tool for breast cancer screening; however, its effectiveness is dependent on its precision and accuracy.

Objective To collect evidence on the effectiveness of CBE in screening for breast cancer and information on the best technique to use.

Data Sources We searched the English-language literature using the MEDLINE database (1966-1997) and manual review of all reference lists, as well as contacting investigators of several published studies for clarifications and unpublished data.

Study Selection and Data Extraction To study CBE effectiveness, we included all controlled trials and case-control studies in which CBE was at least part of the screening modality; for technique, we included both clinical studies and those that used silicone breast models. All 3 authors reviewed and agreed on the studies selected for inclusion in the pooled analyses.

Data Synthesis Randomized clinical trials demonstrated reduced breast cancer mortality rates among women screened by both CBE and mammography. Evidence of CBE's independent contribution was less direct; CBE alone detected between 3% and 45% of breast cancers found that screening mammography missed. The precision of CBE was difficult to determine because of the lack of consistent and standardized examination techniques. Studies on CBE precision reported fair agreement ($\kappa = 0.22-0.59$). Pooling trial data, we estimated CBE sensitivity at 54% and specificity at 94%. The likelihood ratio of a positive CBE result is 10.6 (95% confidence interval [CI], 5.8-19.2), while the likelihood ratio of a negative test result is 0.47 (95% CI, 0.40-0.56). Longer duration of CBE and a higher number of specific techniques used were associated with greater accuracy. The preferred technique for CBE includes proper positioning of the patient, thoroughness of search, use of a vertical-strip search pattern, proper position and movement of the fingers, and a CBE duration of at least 3 minutes per breast. The value of inspection is unproved. Professional and lay examiners improved their sensitivity on silicone breast models after being taught this technique.

Conclusions Indirect evidence supports the effectiveness of CBE in screening for breast cancer. Although the screening clinical examination by itself does not rule out disease, the high specificity of certain abnormal findings greatly increases the probability of breast cancer.

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has been directed to screening rather than for diagnostic CBE. Because the screening CBE involves the search for cancer, there may be legal as well as medical reasons for performing it well. Failure to diagnose breast cancer is a leading reason for malpractice claims, and primary care clinicians account for half the indemnity payments made.² Clinicians who do not perform careful screening may be more liable. Also, some women are more willing to accept screening CBE than mammography,³ in which case screening CBE is particularly important.

Anatomic Basis of the Breast Examination

The female breast consists of glandular and fibrous tissue and fat. Lobules of milk-producing glandular tissue radiate from the nipple centrally supported by fibrous strands. Breast tissue, surrounded by superficial fascia, is attached to both the skin and the pectoral fascia by supporting ligaments. Fat surrounds the lobules of the breast, predominating in the superficial and peripheral portions. Breast tissue extends from the sternum medially to the midaxillary line laterally and from the clavicle superiorly to the "bra line" inferiorly, a rectangular rather than a circular area. The normal breast does not have a homogeneous texture but usually is somewhat lumpy on palpation.

Common distortions of the breast architecture include cysts, which are thought to arise from obstructed collecting ducts, and fibroadenomas, which are caused by an overgrowth of periductal stromal connective tissue within the lobules of the breast. Other benign processes within the ductal system may cause a mass or nipple discharge such as mammary duct ectasia, and intraductal papilloma. Most of these benign lesions carry no increased risk of breast cancer. One pathological lesion, atypical hyperplasia, does increase risk by 3 to 5 times.⁴⁻⁶ Each of these benign processes may cause symptoms or signs that mimic malignancy.

Breast cancer is an unrestrained proliferation of cells arising in tissue of the ducts or lobules. Cancer arising from either type of tissue may be contained

without spreading into surrounding stroma (ductal carcinoma in situ, and lobular carcinoma in situ), or may spread to contiguous tissues, through lymph channels, or hematogenously. While ductal carcinoma in situ is a precursor lesion to invasive cancer, controversy surrounds its prognostic significance.^{7,8} Lobular carcinoma in situ is less common and is understood to be a marker for increased risk of development of invasive cancer, rather than a precursor lesion.⁹ Invasive breast cancer carries a 15.3% 5-year mortality rate¹⁰; advances in screening and treatment have contributed to a decrease in the mortality rate since 1989.^{11,12}

Risk Factors for Breast Cancer

Breast cancer is expected to occur in approximately 12% of American women over their lifetimes.¹³ Breast cancer risk in the general population is most affected by age and family history. The annual incidence at age 70 years (1 in 200) is 20 times higher than that at age 30 years (1 in 4000) (TABLE 1).¹⁴ A woman with 2 first-degree relatives diagnosed as having breast cancer at an early age has a relative risk of more than 4 times that of a woman without such a family history.¹⁵ Other risk factors are related to estrogen exposure (age of menarche, first pregnancy and menopause, parity, and estrogen replacement therapy¹⁵). Gail and colleagues¹⁶ have developed a model to estimate the breast cancer risk of individual women, based on known risk factors. Among a few women, genetic mutations in the *BRCA1* gene and, less commonly, *BRCA2* gene confer very high risk of breast cancer (50%-80% over a lifetime)¹⁷⁻¹⁹; women with these mutations account for only 3% of all breast cancer cases.²⁰

Clinically, strong risk factors affect the likelihood that any abnormality on CBE is cancer. For example, an abnormal finding is more likely to be malignant in an older woman than in a younger woman. The Canadian National Breast Screening Study (NBSS)²¹ reported the positive predictive value for CBE to be twice as high in women from 50 through 59 years than in women from 40 through 49 years. In the Breast Cancer Detec-

Table 1. Incidence of Breast Cancer Within 1 Year for Women at a Given Age*

Age, y	Breast Cancer Incidence
30	1 in 4000
40	1 in 800
50	1 in 400
60	1 in 300
70	1 in 200
80	1 in 200

*Data are from United States and include all races from years 1973-1995.¹⁴

tion Demonstration Project (BCDDP),²² the ratio of benign to malignant biopsy results fell from 16.4 among women from 35 through 39 years to 3.2 for women from 60 through 69 years.

METHODS

We sought articles on effectiveness and test characteristics of the CBE. We identified potential English-language sources from the MEDLINE database for the years 1966 through 1997 using the search terms *physical examination, palpation, breast, breast diseases, diagnosis, diagnostic tests, and sensitivity and specificity*. We reviewed all potentially relevant articles and the reference lists of these articles. In addition, other articles known to us and their references were reviewed. We contacted investigators of several studies for further clarification and in some cases for unpublished data. All authors reviewed and agreed on the studies selected for inclusion in the pooled analysis.

For information on the effectiveness of the CBE, we included all controlled trials and case-control studies in which CBE was at least a part of the screening modality.

Data on CBE techniques included information from both clinical studies and studies using silicone models of the breast. The data synthesis on test characteristics of screening CBE in human populations used the following criteria: (1) CBE performed on asymptomatic population, (2) all screening outcomes reported (ie, total numbers of screens and positive screens), (3) breast cancer outcome determined for all screens, within a defined follow-up period, and (4) all breast cancers had been histologically confirmed.

Table 2. Studies of Breast Cancer Screening That Included Clinical Breast Examination (CBE)*

Study	Years	Examiners	Age of Women at Entry, y	No. of Women		Screening Modality	
				Intervention	Comparison	Intervention	Comparison
Trials Comparing Screening Group With an Unscreened Group							
Randomized controlled trials Health Insurance Plan of New York (HIP) ²⁵	1963-1966	Surgeons	40-64	30 131	30 565	CBE yearly; M yearly	None
Edinburgh randomised trial of breast screening ²⁷	1979-1988	Physicians, nurses	45-64	22 944	21 344	CBE yearly; M alternate years	None
Nonrandomized controlled trial United Kingdom Trial ^{28,29†}	1979-1988	Physicians, nurses	45-64	45 956	127 109	CBE yearly; M alternate years	None
Case-control study The DOM Project ^{30,31}	1974-1981	Medical assistants	50-64	14 796 invited: 54 cases 162 controls	...	CBE yearly; M yearly	None
Trials Comparing 2 Screening Strategies							
Canadian National Breast Screening Study (NBSS 1) ³²	1980-1988	Nurses	40-49	25 214	25 216	CBE yearly; M yearly	CBE 1 time only
NBSS 2 ³³	1980-1988	Nurses	50-59	19 711	19 694	CBE yearly; M yearly	CBE yearly

*Ellipses indicate not applicable; M, mammography; RR, relative risk; and CI, confidence interval.

†United Kingdom (UK) Trial includes data from the Edinburgh randomised trial.

Table 3. Proportion of Cancers Detected by Clinical Breast Examination (CBE) and Mammography Screening

Study	Years	No. of Cancers	Method of Detection, %		
			Both	Mammography	CBE Only
Randomized Controlled Trials					
Health Insurance Plan of New York (HIP) ²⁵	1963-1966	132	22	33	45
Edinburgh randomised trial of breast screening ⁴⁶	1978-1981*	88	71	26	3
Canadian National Breast Screening Study (NBSS 1) ³²	1980-1988	255	36	40	24
NBSS 2 ³³	1980-1988	325	35	53	12
Demonstration Projects					
Breast Cancer Detection Demonstration Project ²²	1973-1981	2045	50	40	9
West London ⁴⁵	1973-1977	29	34	34	31

*Data are from prevalence screen only.

Summary measures for the sensitivity and specificity of the CBE and for likelihood ratios (LRs) of a positive or negative examination used published raw data from the reported trials that met our criteria. A random effects model was used to generate conservative summary measures and confidence intervals (CIs).^{23,24}

EFFECTIVENESS OF CBE

Determining the effectiveness of screening CBE is difficult because no clinical trial has compared CBE alone with no screening. One randomized trial and 1 case-control study compared the combination of screening

CBE and mammography with no screening and demonstrated statistically significant decreased breast cancer mortality rates of 20% and 71%, respectively, in women between the ages of 40 and 64 years^{25,26} (TABLE 2). These results, along with the evidence from randomized trials^{34,35} and case-control studies^{36,37} that screening mammography alone decreases breast cancer mortality rates, make designing a clinical trial in which the control group members receive no screening unethical. It is unlikely that CBE alone will ever be compared with no screening in a randomized trial; therefore, we must use less direct evidence.

Meta-analyses of trials^{25-27,34-38} demonstrated that CBE and/or screening mammography decreases breast cancer mortality rates by about one fourth in women from 50 through 69 years,³⁹ and by 18% in women in their 40s.⁴⁰ In several of these studies, breast cancer was detected using a combination of CBE and mammography²⁵⁻²⁸ (Table 2). These studies that compared a combination screening strategy with no screening are the strongest scientific evidence for an effect of screening CBE.

Other evidence comes from the randomized Canadian NBSSs,³³ in which women from 50 through 59 years were offered either a standardized CBE alone or a CBE and mammography annually for 5 years. The 7-year breast cancer-specific mortality rate for women in these 2 groups was similar,³³ suggesting that mammography may not offer mortality rate advantages over a careful screening CBE, at least for women in their 50s.⁴¹

Additional evidence comes from the Health Insurance Plan (HIP) study,⁴² conducted during mammography's infancy, in which most cancers were found by CBE. Mortality reduction after 10 years in the HIP trial of 29% was similar to a 30% reduction in the Swedish 2-County trial,^{43,44} which used mammography alone. The similarity in the percentage of reduced mortality rates

No. of Rounds	Years Followed Up	Mortality Reduction, RR (95% CI)
4	18	0.77 (0.62-0.97)
7	10	0.82 (0.61-1.11)
7	10	0.86 (0.73-1.01)
4	8	0.29 (0.14-0.62)
5	7	1.36 (0.84-2.21)
5	7	0.97 (0.62-1.52)

found in these 2 approaches, along with the NBSS described above, argues for the effectiveness of carefully conducted CBE.

Finally, we compared the sensitivity of CBE and mammography in the trials that used both methods. In most cases, mammography outperformed CBE (TABLE 3). However, the sensitivity of the combined method was greater than that of mammography alone because CBE detected cancers that had been missed by mammography. The proportion of cancers detected by CBE alone ranged from 3.4% in the Edinburgh trial⁴⁶ to 45% in the HIP Study.²⁵ Proportions of breast cancers found by CBE but missed by mammography in other studies⁴⁷⁻⁵⁸ range from 5.2%⁵⁸ to 29%.⁵¹ In 1 series, among women younger than 35 years, 23% of cancers were reported to be silent on mammography.⁵⁶

The value of detecting breast cancers by CBE that are not detected by mammography is not known. That the combination of CBE and mammography can detect more cancers than either test alone would be important if breast cancer mortality rates would be correspondingly lower. However, there is no evidence on this question. The results of randomized trials using both modalities did not demonstrate improved results over those using only

mammography; however, the many other differences in the trials make comparisons difficult. The mortality rate in women in whom breast cancer is missed by mammography and detected by CBE was higher than that in women whose cancers were detected by mammography.^{25,32,33,59} However, these women still may have benefited compared with women not screened by CBE.

Bottom Line for Effectiveness

The strongest evidence for breast cancer mortality rate reduction after screening CBE comes from studies in which both CBE and mammography were part of breast cancer screening. The individual contribution of CBE cannot be established. In every study, CBE contributed to cancer detection independently of mammography. In 1 randomized trial, the 7-year breast cancer mortality rate was similar among women receiving a standardized CBE and women receiving both CBE and mammography.

Test Characteristics

Summarizing the precision and accuracy of CBE is difficult for several reasons. First, the examination is not well described in the majority of studies, and it is known that conduct of CBE varies widely.⁶⁰ Second, available studies included women differing in age, history of symptoms (symptomatic and asymptomatic), and practice settings (primary care or surgical). Third, the reported test characteristics of CBE were determined sometimes with and sometimes without accompanying mammography screening. The best standardized data come from studies of CBE on silicone models, but the applicability of these studies to women being screened is unknown.

Precision of Examination

Clinical breast examination, even when performed in large-scale studies, has generally not been standardized; only 1 trial (NBSS) reported any description of the examination technique.⁶¹ The lack of attention to a standardized CBE technique may partly ac-

count for the interobserver variation found in studies among clinicians performing CBE.

Thomas et al⁶² compared findings in 103 women screened by 2 nurses and 2 surgeons independently. Agreement between the 2 nurses for any breast abnormality had a κ of 0.22, whereas the 2 surgeons' κ was 0.38. Chamberlain et al⁶³ studied agreement between a nurse and a physician performing independent screening CBE, with a κ of 0.43. Boyd et al⁶⁴ reported that 4 different surgeons found 37 to 74 of 100 women screened to have abnormal findings; in only 25 women did all 4 agree on the findings. The κ value for agreement between any 2 of the 4 surgeons was between 0.34 and 0.59. None of these studies described the CBE technique used by examiners.

Precision varies by the particular physical finding. Ten surgeons examining 242 women had varying indices of agreement (which reflects the chance of agreement using the method of Kendall and Stuart⁶⁵) for specific findings: the index of agreement for nipple discharge was 13.5%; skin findings such as dilated veins, 22.1%; "peau d'orange," 24.2%; ulceration, 61.5%; and visibility of lesion, 68.1%.⁶⁶ For a lump ("saturated nodule") the index of agreement was 59.4%.

Bottom Line for Precision

Clinicians using unstandardized CBE methods have demonstrated moderate degrees of agreement beyond that expected by chance. A standardized examination would likely improve precision.

ACCURACY

To determine its accuracy as a screening test, CBE must be compared with a criterion standard. Mammography cannot be that standard because cancers that are missed by mammography can be found on CBE. Histology alone also cannot be the standard because tissue will never be obtained from all women whose abnormalities are detected by CBE. Even less likely is the histological examination of breasts that

are normal on examination to determine specificity. A compromise criterion standard is to follow up all screened women for a defined period; women diagnosed as having breast cancer must have histologic proof, and all cases of breast cancer among women screened during the follow-up period must be counted. This admittedly imperfect standard nevertheless is so stringent that few studies of breast cancer screening^{22,25,32,33,67,68} meet it.

We defined sensitivity as the number of women who had cancer found on CBE, divided by the sum of screen-detected cancers (found by CBE or mammography), and those interval cancers diagnosed in the year following screening. Specificity was defined as the number of women who had normal CBE results and did not develop breast cancer during follow-up, divided by all the women without cancer at the end of the follow-up period.

The data show that sensitivity of CBE is far from perfect. Pooled data from human studies give an overall estimate for the sensitivity of the CBE of 54% (95% CI, 48%-60%) (TABLE 4). Clinical breast examination sensitivity was above 60%^{32,33,67} when screening rounds included only physical examination but was lower when both CBE and mammography were used in the screening. This difference may reflect the en-

hanced case-finding capacity of mammography. However, 2 of the 3 studies with higher sensitivity also were the only ones using a well-described and standardized method of CBE.^{32,33} It is possible that CBE sensitivity was higher because of superior CBE technique.

The same trials provide data on the specificity of the CBE. Individual trial specificity ranged from 86% to 99%, with a pooled estimated specificity of 94% (95% CI, 90%-97%).

The combined data, pooled using a random effects model to adjust for heterogeneity, indicate that the LR of a positive CBE result is 10.6 (95% CI, 5.8-19.2), while the LR of a negative test is 0.47 (95% CI, 0.40-0.56). The LR positive is more discriminating than the LR negative, which is to say, a positive finding on examination conveys more information about an increased chance of cancer than does the finding of a benign examination offer certainty about the absence of breast cancer. This would be expected given what we know about the frequent discovery by mammography of impalpable cancers.

Clinical breast examination is associated with a relatively high false-positive rate and an even higher false-negative rate. There are no data in the literature on the effect of the false-positive outcomes in terms of subsequent health care use or on women's

psychological status, both of which have been issues for false-positive mammography results.^{1,69,70}

Lumps embedded in silicone breast models provide their own standard. Clinical breast examination sensitivity as measured in silicone models (40%-71%) was similar to that found in population studies.^{60,71-75} On the other hand, specificity measured in models was lower than in population studies (41%-77%).⁷¹⁻⁷⁵

Bottom Line for Accuracy

The sensitivity of the CBE is approximately 54%. The specificity of the examination is about 94%.

Examiner Factors

Studies in humans and silicone models demonstrate several factors, of both examiner and woman, that influence the accuracy of the CBE.

Duration of the Examination. Clinical breast examination duration correlated significantly with lump detection accuracy in experiments involving silicone breast models. In 5 studies mean examination duration was always longer for examiners with higher sensitivity (TABLE 5). The highest recorded sensitivity in human studies (69%) was achieved in the NBSS in which examiners took between 5 and 10 minutes to complete examination of both breasts.²¹

Table 4. Sensitivity and Specificity of Clinical Breast Examination (CBE) in Human Studies*

Study	Years	Ages, y	Screening Modality	No. of Rounds	CBE Sensitivity, %	CBE Specificity, %	LR+ (95% CI)†	LR- (95% CI)†
Health Insurance Plan of New York (HIP) ²⁵	1963-1966	40-64	CBE and M	4	49	99	46.1 (39.0-54.5)	0.51 (0.44-0.59)
United Kingdom Trial ^{67,68}	1979-1988	45-64	CBE only;	3	64	95	14.2 (12.3-16.3)	0.37 (0.29-0.48)
			CBE and M	4	51	...		
Canadian National Breast Screening Study (NBSS 1) ³²	1980-1988	40-49	CBE only;	1	69	86	4.8 (4.2-5.5)	0.36 (0.27-0.49)
			CBE and M	5	48	92		
NBSS 2 ³³	1980-1988	50-59	CBE only;	5	63	94	10.6 (9.6-11.7)	0.39 (0.33-0.46)
			CBE and M	5	40	94		
Breast Cancer Detection Demonstration Project ⁵⁹	1973-1981	35-74	CBE and M	5	52
West London ^{45‡}	1973-1977	≥40	CBE and M	4	56	89
Pooled result (95% CI)					54.1 (48.3-59.8)	94.0 (90.2-96.9)	10.6 (5.8-19.2)	0.47 (0.40-0.56)

*Case definition includes all cancers found at screening (by either method) and interval cancers found within 12 months of screening, except where noted otherwise. Ellipses indicate not applicable; CI, confidence interval; and M, mammography.

†LR+ indicates likelihood ratio of a positive test; LR- is the likelihood ratio of a negative test. An LR is the probability that persons with a disease have a particular test result divided by the probability that persons without the disease have that result. The LR+ is determined by dividing the sensitivity by the probability of an abnormal CBE result among women without breast cancer (1 - specificity). The LR- is calculated as (1 - sensitivity)/specificity.

‡Specificity data based on first round only, with 6 months' follow-up.

Table 5. The Relationship Between Clinical Breast Examination (CBE) Sensitivity and Duration or Techniques Used on Silicone Models*

Study Subjects	No. of Subjects	Median Sensitivity, %	Mean CBE Duration, min		Mean No. of Correct Techniques Used†	
			Sensitivity <Group Median	Sensitivity ≥Group Median	Sensitivity <Group Median	Sensitivity ≥Group Median
Women patients ⁷¹	260	44	1.5	1.9	2.9	3.7
Medical students ⁷⁶	151	100	2.3	2.8	2.7	3.7
Medical residents ⁷²	60	61	1.7	2.5	2.9	3.4
Practicing physicians‡	60	55	1.9	2.4	2.3	2.7
Total§	531		1.8	2.3	2.8	3.6

*In each study, examiners were divided into 2 groups: those with examination sensitivity at or above the group median and those with sensitivity below the group median. Mean values for duration and numbers of correct techniques used are presented for these 2 groups.

†Out of a total of 6 correct techniques: systematic search pattern, thorough examination, varying palpation pressure, 3 fingers, pads of fingers, and small circular motion.

‡R. Harris, MD, MPH, written communication, February 7, 1990.

§P<.001 for pooled differences in both duration and number of techniques.

Technique. The use of correct CBE technique (a systematic search pattern, thoroughness, varying palpation pressure, 3 fingers, finger pads, and circular motion) also correlated with better examination sensitivity in silicone models (Table 5). The number of correct techniques was greater among examiners with higher CBE sensitivity.

Examiner Experience. Previous experience with abnormal breast lumps may be important. Even after controlling for technique differences, medical residents found more lumps in silicone models than lay women did before special training.⁷⁴ Almost none of the women had ever felt either a real or simulated breast lump before the testing session, whereas 77% of the physicians had. Among the residents, previous experience also predicted higher sensitivity. After practice with silicone models containing embedded lumps, the women approached physicians' abilities.⁷¹ However, 2 other studies found no differences in sensitivity across categories thought to correlate with experience.^{60,77}

Bottom Line for Examiner Influence for Accuracy. Spending adequate time on the CBE and using the proper techniques improves breast lump detection.

Patient Factors

Age. On average, younger women have denser breasts that make lump detection more difficult, whereas in older women, the breast becomes more fatty,

making lump detection easier.⁷⁸ In 1 referral population, examiners' sensitivity was 86% among women aged 20 through 49 years and 96% among women aged 50 years and older.⁵⁹ Silicone models simulating postmenopausal breast tissue improved sensitivity over that in models simulating premenopausal breast tissue (64% vs 51%).⁷⁵ Two large trials came to a different conclusion, albeit among women in narrowly defined age ranges. The Breast Cancer Detection Demonstration Project found CBE sensitivity of 53% among women between 40 and 49 years and 48% among women between 50 and 59 years.²² The NBSS⁷⁹ reported higher CBE sensitivity in women 40 through 49 years (68%) compared with those 50 through 59 years (63%), among women receiving both mammography and CBE. Further study is needed on this issue.

Breast Characteristics. Clinical breast examination sensitivity is slightly lower in women with larger breasts.⁸⁰ Women's breasts also vary in the amount of background glandular nodularity that is a normal characteristic of breast tissue.⁸¹ Many women have ill-defined fibrocystic changes that make their breasts feel particularly lumpy; anecdotally, clinicians (and women) find it more difficult to detect breast cancer in lumpy breasts.

Cancer Characteristics. Breast cancers vary in size, hardness, mobility, and location in the breast. Clinical breast examination sensitivity probably varies ac-

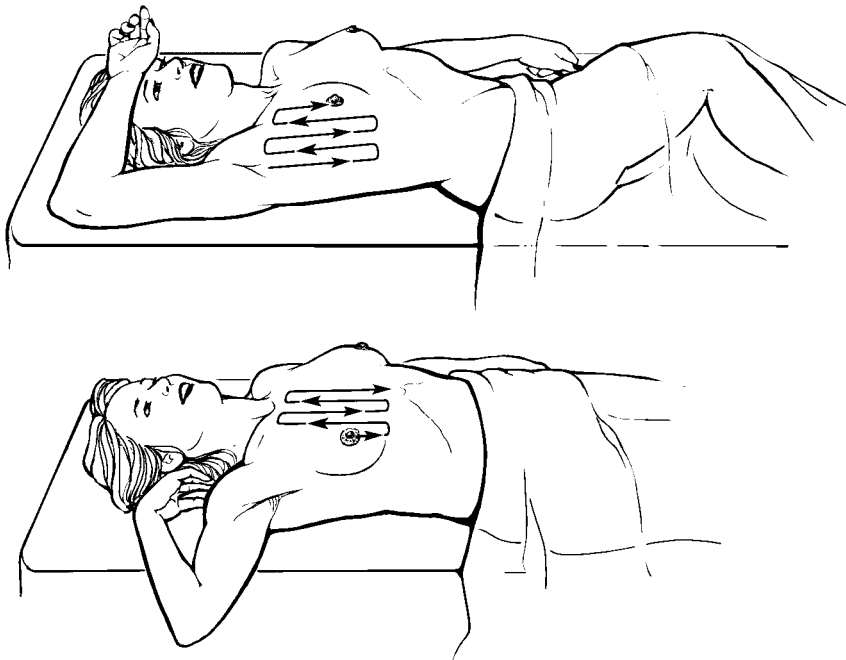
cording to these characteristics of cancers. Prognosis generally follows cancer size at the time of diagnosis, so it is important to determine the accuracy of CBE for small cancers, ie, 2 cm or less. In the Breast Cancer Detection Demonstration Project, sensitivity for non-infiltrating cancers was 35%; for infiltrating cancers smaller than 1 cm in size, 36%; and for infiltrating cancers at least 1 cm in size, 52%.²²

To date, most information about CBE accuracy by lump characteristic comes from experiments carried out on silicone breast models with embedded lumps varying in size, hardness, and placement. These experiments found sensitivity increased with lump size (from 14% for 3-mm lumps to 79% for 1-cm lumps) and hardness (from 42% for 20-durometer lumps to 72% for 60-durometer lumps). Durometers are a measure of hardness; 20 durometers corresponds to a soft-to-medium grape, while a 60-durometer mass is almost as hard as calcified bone. Medium or deep placement of the lump in a model did not alter sensitivity.^{59,72,74}

The Bottom Line for Patient Effects on Accuracy. A woman's age and the size and lumpiness of her breasts may affect the ability of examiners to detect cancer. Size and hardness of breast cancers also affect CBE sensitivity.

Suggested Approach. Many physical diagnosis textbooks give directions for carrying out a breast examination.⁸²⁻⁸⁵ They all involve palpation and inspection, but research has

Figure 1. Position of Patient and Direction of Palpation for the Clinical Breast Examination



Top, The figure shows the lateral portion of the breast and bottom, the medial portion of the breast. Arrows indicate vertical strip pattern of examination. See "Suggested Approach" section for complete description.

Figure 2. Palpation Technique



Pads of the index, third, and fourth fingers (inset) make small circular motions, as if tracing the outer edge of a dime.

stressed palpation. The approach outlined below is derived from a review of the research literature and owes much to the work of Baines and colleagues^{3,21,79,86} and Pennypacker and colleagues⁸⁷⁻⁹¹ because of their work in standardizing the examination. Our recommendation incorporates practices from the Mammacare method, because its components have been validated in independent investigations of CBE technique.^{71,72,92}

Palpation. Variables important in palpating the breast correctly are (1) patient position, (2) breast boundaries, (3) examination pattern, (4) finger position, movement, and pressure, and (5) duration of the examination.

Patient Position. Clinical breast examination requires flattening breast tissue against the patient's chest; she should be supine during the examination. The importance of maneuvers to flatten the breast depends on breast size; they are particularly useful in women with large breasts. To flatten the lateral part of the breast, have the patient roll onto her contralateral hip, rotate her shoulders back into a supine position, and place her ipsilateral hand on her forehead (FIGURE 1). To flatten the medial part of the breast, the woman should lie flat on her back and move her elbow up until it is level with her shoulder (Figure 1).

Breast Boundaries. Breast tissue extends laterally toward the axilla and superiorly toward the clavicle. To be sure that all breast tissue is examined, it is best to cover a rectangular area bordered by the clavicle superiorly, the midsternum medially, the midaxillary line laterally, and the bra line inferiorly.

Examination Pattern. Palpation begins in the axilla and extends in a straight line down the midaxillary line to the bra line (Figure 1). The fingers then move medially, and palpation continues up the chest in a straight line to the clavicle. The entire breast is covered in this manner, going up and down between the clavicle and the bra line. To examine all breast tissue, rows should be overlapping. This vertical strip pattern (or lawnmower tech-

nique) was found to be more thorough than concentric circles or a radial spoke pattern.⁹² In 1 study, two fifths of physicians used no discernible pattern at all.⁶⁰

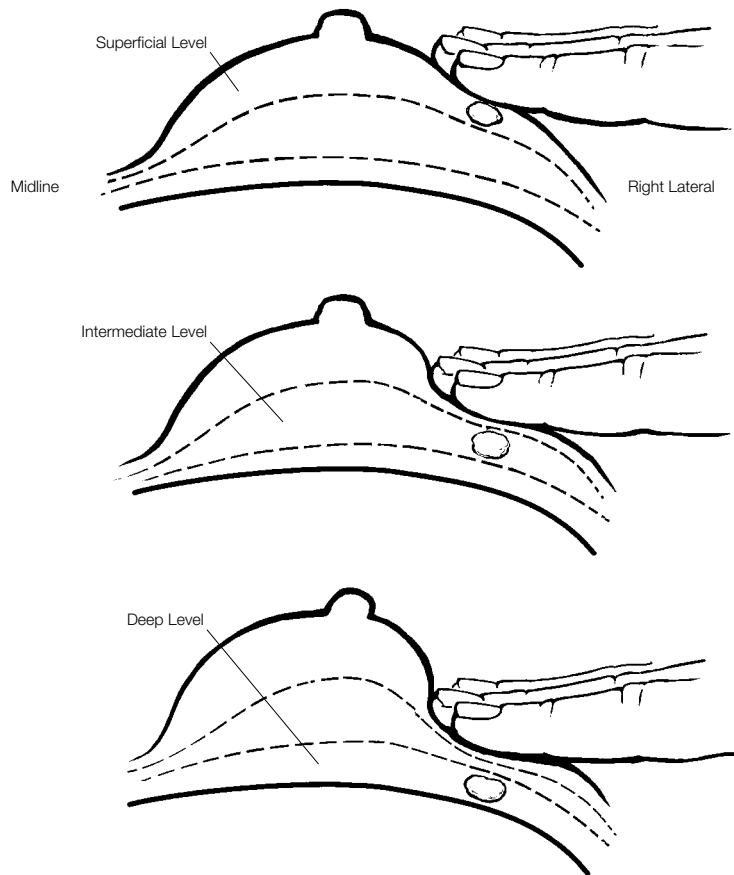
Fingers. Most texts scarcely describe what the fingers should do during palpation, an ironic situation since the fingers must detect and differentiate abnormal lumps in breast tissue. Behavioral psychologists have shown that the finger can detect a soft (20-durometer) 2-mm lump in simulated breast tissue when specific techniques are used.^{88,90,93} These researchers developed a breast palpation technique (the Mammacare Method) combining the vertical strip pattern and specific finger techniques, taught using discrimination skill practice (with the use of silicone breast models) to enhance lump detection. Their method is described below.

The 3 middle fingers are held together, with the metacarpal-phalangeal joint slightly flexed. The pads (not tips) of the fingers (FIGURE 2) are the examining surface. (Confusion regarding the definition of the finger pad exists even among experienced examiners.⁸⁶) Each area is palpated by making small circles as if following the edge of a dime (Figure 2). At each spot, 3 circles using 3 different pressures—light, medium, and deep—are made to ensure palpation of all levels of tissue (FIGURE 3).

Duration. A careful examination of an average-sized breast (brassiere size B) takes at least 3 minutes (6 minutes for both breasts). This is much longer than the average 1.8 minutes physicians spent in 1 study examining both breasts and giving instructions for breast self-examination.⁹⁴ If it seems awkward to spend this amount of time, clinicians should discuss with patients the time needed to do a complete examination and discuss the procedure during the examination.

Other Issues. Palpation of the supraclavicular and axillary regions to detect adenopathy is a standard part of the CBE, though untested. Breast cancer was found in a significant minority of women with isolated axillary lymphadenopathy and normal CBE results in 2 series (12% and 29%, respectively).^{95,96}

Figure 3. Levels of Pressure for Palpation of Breast Tissue Shown in a Cross-Sectional View of the Right Breast



The examiner should make 3 circles with the finger pads, increasing the level of pressure (superficial, intermediate, and deep) with each circle.

Palpation of the nipple area is performed in the same manner as the rest of the breast. Although some texts call for squeezing the nipple to express discharge,^{44,82,83,97} among 448 women complaining of nipple discharge, expression of fluid was not a useful prognostic sign for cancer. Of the women with otherwise normal CBE findings, 3 (2%) of the 151 women with spontaneous discharges were diagnosed as having cancer, while none (0%) of the 178 women with discharges only apparent by expression were diagnosed as having cancer.⁹⁸

Inspection. The importance of inspection is unproved. Most commonly, directions for inspection suggest that the woman face the examiner

with her arms at her side. The breasts are then inspected for nipple abnormalities, dimpling, and retraction or tethering of the skin. No adequate data support recommendations of some authorities^{61,99,100} to examine women in a variety of other positions, such as raising her hands over her head, putting her hands on her hips and bearing down (to contract the pectoral muscles), or leaning forward to allow the breasts to hang out from the chest.

In a series of 296 breast cancers found on breast examination,¹⁰¹ 96% were discovered on palpation, only 1% by retraction alone, and another 3% by visible nipple abnormalities. The women's position when these visual cues were elic-

Table 6. Breast Cancer Probabilities in a 64-Year-Old Woman Assessed After Each of a Succession of Positive Findings*

Prior Probability of Breast Cancer, %	Prior Odds	Finding	Likelihood Ratio Positive†	Successive Posterior Odds‡	Successive Posterior Probability, %
0.35	0.0035	Mass	2.1	0.007	0.73
		Fixed	2.4	0.018	1.74
		Hard	1.6	0.028	2.75
		Irregular	1.8	0.051	4.85
		≥2-cm Lump	1.9	0.097	8.83

*The effect of a particular finding is expressed in the following way: prior odds \times likelihood ratio = posterior odds. Probabilities and odds are interconverted according to these formulae: prior odds = prior probability/(1 - prior probability) and posterior probability = posterior odds/(1 + posterior odds).

†Likelihood ratios are calculated from data on cases diagnosed through June 1970 in the Health Insurance Plan Breast Cancer Screening Study,¹⁰² after Mushlin.¹⁰³

‡The likelihood ratio for each positive finding is applied to the posterior odds from the line above, using an assumption that the findings contribute independently to the odds of breast cancer.

ition was not reported. Inspection and positioning the patient for inspection takes time. Given these facts and given the press of time, we suggest that in asymptomatic women clinicians should concentrate on careful breast palpation, all the while, of course, using their eyes. If the patient is symptomatic, or if an abnormality is discovered during palpation of an asymptomatic patient, careful inspection should be added.

Bottom Line of the Suggested Approach. Use a vertical strip pattern to cover all the breast tissue. Make circular motions with the pads of the middle 3 fingers and examine each breast area with 3 different pressures. Spend at least 3 minutes on each breast.

Teaching the Technique. What is the evidence that using the Mammacare Method improves lump detection abilities and that the technique can be taught?

In 1 study, 20 lay women taught according to the Mammacare Method doubled their detection of known breast lumps in other volunteer women, although they also increased the number of false-positive detections after training.⁸⁹ Three randomized trials using silicone breast models evaluated training of internal medicine residents, graduate nurses, medical students, and women patients.⁷¹⁻⁷³ All showed that training improved CBE sensitivity when measured on silicone models. Pooling the results, the training improved sensitivity by 13 percentage points (95% CI, 10%-16%) from 46% to 59%, while the speci-

ficity declined nonsignificantly by a mean of 4 points (95% CI, -8.9 to 0.7) from 61% to 57%.

Does the effect of teaching persist? In 1 study, 91 patients were taught the Mammacare Method, and 1 year later were able to find more lumps in silicone breast models than women either taught the traditional (circular) CBE pattern, or not taught at all.⁷¹ Similar results occurred in randomized studies using silicone models with medical students and nurses^{72,76} with the effect persisting at least 4 to 6 months. In most cases, sensitivity improved without adverse effects on specificity. However, among medical residents, higher sensitivity was at the expense of specificity in silicone model testing. Reassuringly, a 6-month medical record review of patients cared for by these physicians did not demonstrate any deterioration in CBE specificity in patients.⁷²

Are Lumps Ever Normal? Normal breasts are often lumpy; the clinician's job is to distinguish normal from abnormal (cancerous) lumps. Cancers classically are characterized as hard, fixed, and irregular, while benign breast lumps are the opposite: soft or cystic, movable, and regular. However, many cancers do not conform to the classic picture and benign masses can mimic cancers. Likelihood ratios for the presence of these signs (calculated from HIP data,¹⁰² after Mushlin¹⁰³) are unimpressive except for fixed lesions (LR = 2.4), and lumps greater than 2 cm (LR = 1.9); none of the LRs fall in the range con-

sidered discriminating (TABLE 6). Table 6 also shows the resulting succession of probabilities if a 64-year-old woman had a mass on CBE and if the mass had the listed positive findings. (It is assumed that the findings are independent, although there is not information about the independence of the findings.) In 2400 women undergoing 10 905 screening CBEs in a community setting over a 10-year period, an abnormal CBE result was associated with an LR of 2.1 (J. G. Elmore, MD, MPH, written communication, June 24, 1998). A positive screening CBE in an average-risk woman conveys less risk of cancer than does a woman presenting with a breast lump (LR = 55¹⁰⁴) or an abnormal screening mammogram (LR = 26.3¹⁰⁵).

Because the characteristics of cancerous lumps overlap with those of non-cancerous lumps, clinicians rarely diagnose breast cancer with CBE. Careful CBE can locate abnormalities. Further evaluation with other tests is then required.¹⁰⁶⁻¹⁰⁸

BOTTOM LINE

Screening CBEs should be conducted for women who are at risk for breast cancer and for whom breast cancer screening has been shown effective. Presently, this includes women older than 40 years of age. A well-conducted CBE can detect at least 50% of asymptomatic cancers and may contribute to mortality rate reduction in women screened.

Resolution of Scenarios

The discovery of a breast mass in a 64-year-old patient conveys an increased risk of cancer. Her pretest probability of invasive cancer in the coming year is 0.35% (347 cases per 100 000 women¹⁴). Your finding on CBE gives a post-test probability of 0.73% (Table 6). If the mass is greater than 2 cm and has all the other malignant characteristics the probability of cancer increases to 8.8% (Table 6).

The 42-year-old woman with no breast symptoms has a pretest probability of breast cancer of 0.12%, or 119 per 100 000.¹⁴ A normal CBE would decrease her risk of breast cancer to 0.11%,

but with such a low baseline risk, the difference is hard to appreciate. An explanation of her low pretest probability may suffice; however, the psychological reassurance she may gain from a CBE could increase the value of this maneuver.

Priorities for Research

Standardization of CBE is sorely needed. Numerous studies suggest that the Mammacare Method improves the performance characteristics of CBE on silicone models; further work should be done to determine if the Mammacare technique (or other standardized methods) can improve CBE sensitivity and specificity in patient populations. The contribution of visual inspection has been found to be associated with better outcomes in women who use it as part of breast self-examination.¹⁰⁹ This should be investigated as to its contribution to the CBE.

Screening CBE may be particularly useful in women older than 70 years, because fatty changes in the breast make lump detection easier, and older women do not accept mammography as readily as younger women.¹¹⁰ Comparison of test characteristics of standardized CBE with mammography in older women is needed. At the other end of the age spectrum, because mammography misses substantial numbers of breast cancers in women younger than 50 years, studies are needed to determine if standardized CBE can contribute to decreasing breast cancer mortality rates in this age group.

The cost-effectiveness of CBE screening deserves study if it is to be compared with other maneuvers available for breast cancer screening and compared with other primary care maneuvers that it may displace in a 15-minute visit. Similarly, programs to train providers how to perform the examination should be evaluated as to their cost-effectiveness.

Although some argue that the CBE adds nothing to regular mammography screening, an overall view of the evidence suggests that a carefully performed CBE detects cancers that are potentially curable. If research confirms

that CBE is as effective as mammography in reducing breast cancer mortality rates for older women, then physicians will want to perform CBE regularly and perform it well.

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