

## Concordance of population-based estimates of mammography screening

Denise M. Boudreau<sup>a,b,\*</sup>, Casey L. Luce<sup>a</sup>, Evette Ludman<sup>a,b</sup>,  
Amy E. Bonomi<sup>c</sup>, Paul A. Fishman<sup>a,b</sup>

<sup>a</sup> Group Health Center for Health Studies, Seattle, WA, USA

<sup>b</sup> University of Washington, Seattle, WA, USA

<sup>c</sup> The Ohio State University, Columbus, OH, USA

Available online 17 July 2007

### Abstract

**Objective.** Estimates of adherence to mammography screening guidelines vary, in part, due to lack of consensus on defining adherence. This study estimated adherence to repeat (two successive on-time screenings) and regular screening (three or more successive screenings) and evaluated the impact of varying operational definitions and evaluation periods.

**Methods.** The study included women aged 50–80 without a history of breast cancer who: were on a biennial screening cycle and due for a screening mammogram between 1995 and 1996; underwent screening (index date) in response to a reminder letter; and belonged to Group Health, an integrated health care delivery system in Washington State, for 6 or more years after the index date. Automated records provided information on enrollment, health care utilization, and procedures.

**Results.** Among 1336 women, 67–82% experienced a repeat screen. Adherence to regular screening over the 6-year evaluation period was 42–84%—and higher with longer allowable intervals between screenings, when definitions did not require on-schedule screenings, when intervals were reset after a diagnostic mammogram, and for shorter evaluation periods.

**Conclusion.** Estimates of adherence to screening guidelines varied by the operational definition of “success” and time period of evaluation. Consensus in definitions and terminology is needed to compare evaluations.

© 2007 Elsevier Inc. All rights reserved.

**Keywords:** Mammography; Screening; Breast cancer; Guideline adherence; Methods; Prevalence; Health maintenance organization; Quality indicators

### Introduction

Early detection of breast cancer through mammography reduces morbidity and mortality (Fletcher et al., 1993; Humphrey et al., 2002a,b; Shapiro et al., 1982; Tabar et al., 1989). However, a key to the success of population-based breast cancer screening and evaluating the quality of care associated with early detection is determining whether or not women are screened at regular intervals (Costanza et al., 2000; Davis et al., 1997; Humphrey et al., 2002a,b; King et al., 1994). The Institute of Medicine includes regular mammography screening as a target area to improve the quality of health care. Also, several organizations, including the Agency for Healthcare Research and Quality and the Health Plan Employer Data and Information

Set, deem regular mammography screening a key performance measure. Quality initiatives to improve adherence to screening recommendations abound, as do evaluations of such initiatives.

Researchers have examined rates of mammography adherence and factors related to adherence, using various intervals, definitions, and observation periods. A recent review reported substantial variation in repeat mammography rates (Clark et al., 2003). The authors called for consensus regarding definitions, identifying at least three definitions for successful repeat screening: (1) two or more consecutive, on-schedule mammograms during a given time window (e.g., second mammogram within 24 months of first mammogram); (2) number of mammograms during a given time window (e.g., two mammograms within 5 years); and (3) two or more mammograms as guidelines recommended at the time of the study (Clark et al., 2003). However, variation persists even within each of these definitions. For example, intervals used to define two consecutive mammograms during a given time window have

\* Corresponding author. Group Health Center for Health Studies, 1730 Minor Ave, Suite 1600, Seattle, WA 98101, USA. Fax: +1 206 287 2871.

E-mail address: [boudreau.d@ghc.org](mailto:boudreau.d@ghc.org) (D.M. Boudreau).

Table 1  
Characteristics of study subjects: 1336 women enrolled in Group Health for at least 6 years during March 1, 1995 to February 27, 2003

Characteristics	n=1336
Mean age, years (SD)	63.6 (8.7)
Race, %	
Caucasian	91.9
African American	2.4
Asian/Pacific Islander	4.1
Native American	0.5
Other/unknown	1.1
Education, %	
<12 years	3.9
High school graduate	25.7
At least some college	50.7
Some graduate school	19.7
Household income per year, %	
<\$20,000	14.6
\$20,000–39,999	40.3
\$40,000–49,999	16.7
≥\$50,000	28.4

ranged from 12 months to 3 years (Bobo et al., 2004; Engelman et al., 2004; Rimer et al., 2002; Tatla et al., 2003; Partin et al., 2005). Several studies defined success as receiving a second screen within 2 years, but they varied by whether they allowed an additional time window (e.g., three months) to account for scheduling difficulties (Andersen et al., 2000; Crane et al., 1998; Jepson et al., 1997; Song and Fletcher, 1998; Ulcickas Yood et al., 1999). When repeat and regular screening was defined by number of mammograms received during a given time period, definitions varied by number of mammograms required and length of observation period (Lee and Vogel, 1995; Taylor et al., 1995). Studies also varied by whether diagnostic mammograms and short interval follow-ups were considered.

Substantial value is placed on adherence to mammography screening (Smith et al., 2005; Von Eschenbach, 2002), yet there is little consensus about operational definitions of success. Given the increasing importance of quality measures, standards of comparability are needed. Without such standards, outcomes cannot be compared across studies of different programs and policies. For example, Jepson and colleagues demonstrated within a single study that using an interval of 15–21 months categorized 40% of women as repeat screeners, but relaxing the interval to 21–27 months categorized 70% as repeat screeners (Jepson et al., 1997). Using self-reported data on time since previous mammogram, Partin et al. reported that definitions differing by only one month in screening interval led to differences in adherence as large as 27% (Partin et al., 1998).

Like the lack of consensus on defining screening adherence, terminology is not standardized either. Henceforth, we define “repeat screening” as two consecutive on-schedule screening mammograms and “regular screening” as three or more consecutive screenings (Partin and Slater, 2003).

Our study addresses existing gaps by evaluating how adherence to screening mammography varies by the operational definition used. We conducted this study within a health plan that has explicit screening guidelines and provides mammograms at no out-of-pocket cost, reducing financial barriers to

gaining access to mammography services, which could otherwise bias findings.

## Methods

### Study setting

We conducted the study at Group Health (GH), an integrated delivery system that provides comprehensive health care to approximately 550,000 individuals in Washington State. GH’s Institutional Review Board approved the study. GH’s automated databases record and maintain information on health plan enrollment, health care use, diagnoses, and procedures for all internally provided encounters and reimbursed out-of-plan services (Saunders et al., 2005). GH is located within the geographic reporting region of the western Washington Cancer Surveillance System, a population-based cancer registry and member of the Surveillance, Epidemiology, and End Results (SEER) program (Ries et al., 1975). Computer linkage between the GH population and the local SEER registry provides for complete ascertainment of cancer cases. GH has a population-based Breast Cancer Screening Program (BCSP) that women enrollees age =40 are invited to join (Taplin et al., 1990). Participants complete a breast cancer risk factor questionnaire at program enrollment, and information is updated at each mammogram. Women enrolled in the BCSP are sent reminder letters when they are due for a mammogram. Approximately 85% of women complete the questionnaire and the data are available in automated databases (Taplin et al., 2004). GH recommends yearly screening for high risk women age 40+ years, biennial screening at age =50 for non-high risk women, and no screening for non-high risk women 40–49 years. However, physicians may order screening as part of well care or to evaluate patients with breast symptoms, and women may also self-refer to receive screening. Screening is done at dedicated health care delivery centers within the GH system.

### Study population

Subjects were a random sample of female GH enrollees age 50–80 years without a history of breast cancer as determined by SEER and BCSP, who: (1) were due for a screening mammogram during March 1, 1995 to February 28, 1996; (2) were sent a BCSP reminder letter to schedule a mammogram and; (3) underwent screening (index date) in response to the letter (Taplin et al., 2000). Of this sample (N=1963), women were excluded if they: (1) were not continuously enrolled in GH’s integrated group practice for at least 6 years from index screen or first screen after reminder letter (n=447); or (2) were on an annual screening interval (n=180). Our final sample size was 1336 women.

### Definitions of repeat and regular mammography

To identify common definitions of repeat and regular mammography screening, we searched the literature for studies that evaluated regular and repeat mammography adherence rates alone, in relation to an intervention, or in relation to factors predictive of adherence.

Because GH and other organizations recommended biennial screening for average risk women at the time of data collection, and researchers have defined repeat screening as returning for a second screening mammogram within 24 months, we calculated repeat screening rates according to three operational definitions: within 24, 27, or 30 months of the index screen. We included 27- and 30-month intervals because biennial screenings may not occur exactly at the 24-month cutoff, and researchers commonly extend the window by a few months to

Table 2  
Adherence to repeat mammography screening by various operational definitions among 1336 women enrolled in Group Health for at least 6 years during March 1, 1995 to February 27, 2003

Definition of repeat screening	Percentage adherent, %
Within 24 months of index screen	67.1
Within 27 months of index screen	78.4
Within 30 months of index screen	82.0

account for scheduling difficulties (Clark et al., 2003). Screening mammograms were identified by Current Procedural Terminology (CPT) code 76092 and aggregated at the month level for each subject.

Based on definitions used in published studies, we evaluated regular mammography screening using different operational definitions that varied by time window between screens (e.g., every 24 months vs. every 27 months), schedule of screens (e.g., every 24 months vs. three or more screens in 6 years), whether screening intervals were re-set after receipt of a diagnostic mammogram (CPT codes: 76090, 76091, 76093, 76094, 76095), and time period of evaluation (e.g., 6 vs. 8 years). Study follow-up began at the index screen and continued through February 27, 2003.

### Statistical analysis

We calculated the proportion of women who met each definition of repeat and regular mammography screening. We estimated adherence to repeat mammography screening over a maximum of 30 months from index screen and adherence to regular mammography screening over a maximum of 8 years from index screen.

## Results

### Patient characteristics

Most women included in the study were Caucasian (92%) and had some college education (70%) and earned = \$20,000/year (85%) (Table 1). The mean age at index date was 64 years.

The 1336 women included in the study had a total of 3274 screening mammograms and 828 diagnostic mammograms during the 6-year period. The median number of screening mammograms per woman was three (range 0–6). During the 6-year observation period, 33 women received no screening at all.

Table 3  
Adherence to regular mammography screening by various operational definitions among 1336 women enrolled for at least 6 years in Group Health during March 1, 1995 to February 27, 2003

Definition of regular screening	Percentage adherent, %		
	Over 4 years	Over 6 years	Over 8 years*
Every 24 months	50.8	41.9	31.9
Reset interval after diagnostic mammogram(s)**	60.3	52.9	43.1
Every 27 months	75.2	60.9	51.9
Reset interval after diagnostic mammogram(s)**	80.8	71.4	66.0
Every 30 months	81.0	66.9	58.5
Reset interval after diagnostic mammogram(s)**	85.6	76.0	71.7
Collapse months into years and define as every 2 years	54.3	47.5	41.6
Reset interval after diagnostic mammogram(s)**	63.6	58.8	55.8
Collapse months into years and define as every 3 years	n/a	78.2	73.7
Reset interval after diagnostic mammogram(s)**	n/a	84.4	82.1
≥ 3 over observation period	n/a	55.1	82.5

\* Includes only women enrolled for = 8 years ( $n=1231$ ).

\*\* Subsequent screening due date re-calculated from the diagnostic mammogram.

We performed the 8-year analysis among a subgroup of 1231 women who were enrolled for 8 years.

### Repeat screening

Adherence to repeat screening varied from 67% to 82%, depending on the operational definition used (Table 2). As expected, adherence measures were higher with a longer allowable interval between screenings.

### Regular screening

Adherence to regular screening varied between 42% and 84% of women over the 6-year evaluation period, 51% and 86% of women over the 4-year period, and 32% and 83% of women over the 8-year period, depending on the operational definition used (Table 3). Adherence to regular screening was higher: with longer allowable intervals between screenings; when definitions did not require on-time screenings; and when intervals were reset after a diagnostic mammogram. In most cases, adherence measures were lower for longer evaluation periods.

## Discussion

Adherence to repeat screening depended on the number of months allowed between the two screens, and adherence measures varied by as much as 15%. Different operational definitions also appeared to alter adherence to regular screening. The comparability of studies on regular screening is likely to depend on the definition used to define regular screening, whether diagnostic screenings that occur during the evaluation period are taken into consideration, and the time window during which adherence is evaluated. Within most definitions of regular screening, adherence measures decreased with increasing time window of evaluation. This implies that adherence falls off with time, and time window should be considered when comparing studies.

Using the health plan recommendation of a screening mammogram every 24 months for average-risk women, 67% of women with a prior screening had a repeat screen, 51% were adherent over the 4-year evaluation period, 42% were adherent over 6 years, and 32% were adherent over 8 years. Allowing three extra months to account for any scheduling difficulties resulted in large increases in adherence (11% for repeat, 24% for regular over 4 years, 19% for regular over 6 years, and 20% for regular over 8 years). Expanding the window by an additional three months (i.e., 30 months between screens) increased adherence by 4% for repeat and 6–7% for regular screening, which suggests that adding only a few (e.g., three) extra months to a 24-month period of evaluation is adequate to account for scheduling difficulty.

Our adherence measures for repeat screening are slightly higher than those of most published studies, which report ranges from 32% to 92% (Andersen et al., 2000; Augustson et al., 2003; Barr et al., 2001; Bobo et al., 2004; Calvo-coressi et al., 2004; Carney et al., 2002; Crane et al., 1998; Fox et al., 1998;

Gilliland et al., 2000; Partin et al., 2005; Song and Fletcher, 1998; Ulcickas Yood et al., 1999). Studies report higher adherence when they use less stringent definitions of repeat screening (e.g., second screen within 30 months vs. second screen within 24 months) or comprise women with a history of prior screening (Clark et al., 2003). Measures of regular screening are more difficult to compare because of larger variations between definitions. However, our estimate that 88% of women had at least screens in 6 years is similar to the 85% reported in a study of women age 55–79 on 1- to 2-year screening cycles (Rakowski et al., 2004). Rakowski also found that 74.5% of women report at least three screenings in 6 years (Rakowski et al., 2004) higher than our estimate of 55% among women on a biennial screening cycle. In a study of women age 50–80 years living in Washington State, approximately 50% identified as regular screeners as defined by a self-reported mammogram every 24 months for two cycles plus the intention to undergo screening within 12–24 months of the survey (Rakowski et al., 1997). Using every 24 months to define adherence, the 50% adherence estimate that Rakowski et al. reported resembles our estimate of 42% over 6 years and 51% over 4 years. A study of adherence over an 8-year period within another health plan found lower adherence than our study, with only 16% of women having all the expected screenings (Hansen et al., 1991).

The present study was in a large population with stable membership and complete coverage of medical services. The study also included detailed, unbiased, and complete automated information on the date of mammograms received over time. GH data are considered an accurate and complete source of health care utilization (Saunders et al., 2005), but missed screens are always possible. Few studies have used health plan data to assess adherence to regular screening recommendations over long time periods (Feldstein et al., 2006; Hansen et al., 1991). Because recommended screening intervals did not vary for women included in the study, we likely observed the influence of operational definitions of repeat and regular screening on prevalence estimates. In addition, the lack of out-of-pocket cost to women may have reduced potential bias due to financial barriers to preventive care.

Our results are specific to a population that is older, predominantly Caucasian, insured, and recommended for biennial mammography screening, with comprehensive access and few financial barriers to screening. They are also likely to have a regular provider and reminders for screening. Many of these characteristics are known to increase screening (Calvo-coressi et al., 2005; Lee and Vogel, 1995; Rakowski et al., 2004; Ulcickas Yood et al., 1999). Women in the study had at least one previous mammography screening and, therefore, adherence estimates are likely higher than estimates among women with no prior screening. Small numbers prevented us from evaluating adherence measures among women on annual screening cycles. GH's recommendation for biennial screening of average-risk women differs from recommendations in other settings.

To promote comparability between research studies and evaluations of mammography screening, we encourage stan-

dardized terminology for measures of mammography adherence. We defined repeat screening as two consecutive on-schedule mammograms and regular screening as three or more consecutive screenings. When possible, we recommend that, for populations on biennial screening cycles, research and policy evaluations define repeat mammography screening as occurring within 27 months of index screen, and regular mammography screening as every 27 months. While we recognize that any recommendation for standardization is somewhat arbitrary, we base our recommendations on: (1) the large incremental gain in adherent women when taking scheduling time into account and moving from 24 to 27 months; and (2) making the most of detailed data (e.g., exact month of mammogram) when available. Our recommendation aims to promote comparability across evaluations of screening adherence and does not imply that women should be screened any less than every 24 months. If detailed data are unavailable in cases such as self-report, using every 2 years to define regular screening may be preferred. However, we agree with previous recommendations to find consensus on the specificity of self-report (i.e., month and year vs. interval recall) (Clark et al., 2003). We discourage resetting screening intervals after the receipt of a diagnostic mammogram, because diagnostic mammograms are often unilateral. Because repeated participation in mammography screening over time and at recommended intervals is the key to reducing morbidity and mortality (Fletcher et al., 1993; Humphrey et al., 2002a,b; Tabar et al., 1985; U.S. Preventive Services Task Force, 1996), we suggest that research and quality evaluations focus on adherence to regular screening during numerous years, rather than on one-time measures of repeat screening. Our study results suggest that studies with longer windows of evaluation will report lower adherence rates. Regardless, future research should explicitly describe how repeat and regular mammography screening is defined and operationalized; and such definitions should be considered when comparing results across studies.

Additional studies must: replicate our findings in other settings and among women on annual screening cycles, and evaluate how various definitions of repeat and regular mammography screening affect correlations between factors associated with adherence to screening guidelines.

## Conclusion

Estimates of adherence to mammography screening vary by both the definitions used to define “success” and the time period of evaluation. Consensus in definitions and terminology is needed to make studies and policy evaluations comparable. We defined “repeat screening” as two consecutive on-schedule screening mammograms and “regular screening” as three or more consecutive screenings. When possible, for populations on biennial screening cycles, we recommend defining repeat mammography screening as occurring within 27 months of index screen and regular mammography screening as every 27 months. Recommendation is specific to evaluations of adherence and not a recommendation on how often women should undergo screening.

## Acknowledgments

We thank Deborah Seger and Christine Mahoney for their valuable contributions. NCI grant CA106790 supported this study.

## References

- Andersen, M.R., Yasui, Y., Meischke, H., Kuniyuki, A., Etzioni, R., Urban, N., 2000. The effectiveness of mammography promotion by volunteers in rural communities. *Am. J. Prev. Med.* 18 (3), 199–207.
- Augustson, E.M., Vadaparampil, S.T., Paltoo, D.N., Kidd, L.R., O'Malley, A.S., 2003. Association between CBE, FOBT, and Pap smear adherence and mammography adherence among older low-income women. *Prev. Med.* 36, 734–739.
- Barr, J.K., Franks, A.L., Lee, N.C., Herther, P., Schachter, M., 2001. Factors associated with continued participation in mammography screening. *Prev. Med.* 33 (6), 661–667.
- Bobo, J.K., Shapiro, J.A., Schulman, J., Wolters, C.L., 2004. On-schedule mammography rescreening in the National Breast and Cervical Cancer Early Detection Program. *Cancer Epidemiol. Biomark. Prev.* 13, 620–630.
- Calvocoressi, L., Kasl, S.V., Lee, C.H., Stolar, M., Claus, E.B., Jones, B.A., 2004. A prospective study of perceived susceptibility to breast cancer and nonadherence to mammography screening guidelines in African American and White women ages 40 to 79 years. *Cancer Epidemiol. Biomark. Prev.* 13 (12), 2096–2105.
- Calvocoressi, L., Stolar, M., Kasl, S.V., Claus, E.B., Jones, B.A., 2005. Applying recursive partitioning to a prospective study of factors associated with adherence to mammography screening guidelines. *Am. J. Epidemiol.* 162 (12), 1215–1224.
- Carney, P.A., Harwood, B.G., Weiss, J.E., Eliassen, M.S., Goodrich, M.E., 2002. Factors associated with interval adherence to mammography screening in a population-based sample of New Hampshire women. *Cancer* 95 (2), 219–227.
- Clark, M.A., Rakowski, W., Bonacore, L.B., 2003. Repeat mammography: prevalence estimates and considerations for assessment. *Ann. Behav. Med.* 26 (3), 201–211.
- Costanza, M.E., Stoddard, A.M., Luckmann, R., White, M.J., Spitz Avrunin, J., Clemow, L., 2000. Promoting mammography: results of a randomized trial of telephone counseling and a medical practice intervention. *Am. J. Prev. Med.* 19 (1), 39–44.
- Crane, L.A., Leakey, T.A., Rimer, B.K., Wolfe, P., Woodworth, M.A., Warnecke, R.B., 1998. Effectiveness of a telephone outcall intervention to promote screening mammography among low-income women. *Prev. Med.* 27 (5 Pt 2), S39–S49.
- Davis, N.A., Lewis, M.J., Rimer, B.K., Harvey, C.M., Koplan, J.P., 1997. Evaluation of a phone intervention to promote mammography in a managed care plan. *Am. J. Health Promot.* 11 (4), 247–249.
- Engelman, K.K., Ellerbeck, E.F., Mayo, M.S., Markello, S.J., Ahluwalia, J.S., 2004. Mammography facility characteristics and repeat mammography use among Medicare beneficiaries. *Prev. Med.* 39 (3), 491–497 Sep.
- Feldstein, A.C., Vogt, T.M., Aickin, M., Hu, W.R., 2006. Mammography screening rates decline: a person-time approach to evaluation. *Prev. Med.* 43 (3), 178–182 Sep.
- Fletcher, S.W., Black, W., Harris, R., Rimer, B.K., Shapiro, S., 1993. Report of the International Workshop on Screening for Breast Cancer. *J. Natl. Cancer Inst.* 85 (20), 1644–1656 Oct. 20.
- Fox, S.A., Pitkin, K., Paul, C., Carson, S., Duan, N., 1998. Breast cancer screening adherence: does church attendance matter? *Health Educ. Behav.* 25 (6), 742–758.
- Gilliland, F.D., Rosenberg, R.D., Hunt, W.C., Stauber, P., Key, C.R., 2000. Patterns of mammography use among Hispanic, American Indian, and non-Hispanic White women in New Mexico, 1994–1997. *Am. J. Epidemiol.* 152 (5), 432–437 Sep. 1.
- Hansen, J.P., Knapp, P.A., Newcomb, P.A., 1991. Mammography in a health maintenance organization. *Am. J. Public Health* 81 (11), 1489–1490.
- Humphrey, L.L., Helfand, M., Chan, B.K.S., Woolf, S.H., 2002a. Breast cancer screening: a summary of the evidence for the U.S. Preventive Services Task Force. *Ann. Intern. Med.* 137, 347–360.
- Humphrey, L.L., Helfand, M., Chan, B.K.S., Woolf, S.H., 2002b. Breast cancer screening. Summary of the evidence. *Ann. Intern. Med.* 137, 344–346.
- Jepson, C., Barudin, J., Weiner, J., 1997. Variability in timing of repeat screening mammography. *Prev. Med.* 26, 483–485.
- King, E.S., Rimer, B.K., Seay, J., Balslem, A., Engstrom, P.F., 1994. Promoting mammography use through progressive interventions: is it effective? *Am. J. Public Health* 84, 104–106.
- Lee, J., Vogel, V., 1995. Who used repeat screening mammography regularly? *Cancer Epidemiol. Biomark. Prev.* 4 (8), 901–906.
- Partin, M.R., Slater, J.S., 2003. Promoting repeat mammography use: insights from a systematic needs assessment. *Health Educ. Behav.* 30 (1), 97–112.
- Partin, M.R., Casey-Paal, A.L., Slater, J.S., Korn, J.E., 1998. Measuring mammography compliance: lessons learned from a survival analysis of screening behavior. *Cancer Epidemiol. Biomark. Prev.* 7, 681–687.
- Partin, M.R., Slater, J.S., Caplan, L., 2005. Randomized controlled trial of a repeat mammography intervention: effect of adherence definitions on results. *Prev. Med.* 41 (3–4), 734–740.
- Rakowski, W., Andersen, M.R., Stoddard, A.M., et al., 1997. Confirmatory analysis of opinions regarding the pros and cons of mammography. *Health Psychol.* 16 (5), 433–441.
- Rakowski, W., Breen, N., Meissner, H., et al., 2004. Prevalence and correlates of repeat mammography among women aged 55–79 in the Year 2000 National Health Interview Survey. *Prev. Med.* 39 (1), 1–10.
- Ries, L.A.G., Eisner, M.P., Kosary, C.L., et al., 2004. SEER Cancer Statistics Review, 1975–2001. National Cancer Institute, Bethesda MD.
- Rimer, B.K., Halabi, S., Sugg Skinner, C., et al., 2002. Effects of a mammography decision-making intervention at 12 and 24 months. *Am. J. Prev. Med.* 22 (4), 247–257.
- Saunders, K.W., Davis, R.L., Stergachis, A., 2005. Group Health Cooperative, In: Strom, B. (Ed.), *Pharmacoepidemiology*, 4th edition. John Wiley & Sons, Chichester, pp. 223–239.
- Shapiro, S., Venet, W., Strax, P., Venet, L., Roeser, R., 1982. Ten- to fourteen-year effect of screening on breast cancer mortality. *J. Natl. Cancer Inst.* 69 (2), 349–355.
- Smith, R.A., Cokkinides, V., Eyre, H.J., 2005. American Cancer Society guidelines for the early detection of cancer, 2005. *CA Cancer J. Clin.* 55, 31–44.
- Song, L., Fletcher, R., 1998. Breast cancer rescreening in low-income women. *Am. J. Prev. Med.* 15 (2), 128–133.
- Tabar, L., Fagerberg, C.J.G., Gad, A., et al., 1985. Reduction in mortality from breast cancer after mass screening with mammography. *Lancet* 1, 829–832.
- Tabar, L., Fagerberg, G., Duffy, S.W., Day, N.E., 1989. The Swedish two county trial of mammographic screening for breast cancer: recent results and calculation of benefit. *J. Epidemiol. Community Health* 43 (2), 107–114.
- Taplin, S.H., Thompson, R.S., Schmitzer, F., Anderman, C., Immanuel, V., 1990. Revisions in the risk-based breast cancer screening program at Group Health Cooperative. *Cancer* 66, 812–818.
- Taplin, S.H., Barlow, W.E., Ludman, E., et al., 2000. Testing reminder and motivational telephone calls to increase screening mammography: randomized study. *J. Natl. Cancer Inst.* 92 (3), 233–242.
- Taplin, S.H., Ichikawa, L., Buist, D.S., Seger, D., White, E., 2004. Evaluating organized breast cancer screening implementation: the prevention of late-stage disease? *Cancer Epidemiol. Biomark. Prev.* 13, 225–234.
- Tatla, R.K., Ptasz, L.F., Bondy, S.J., Chen, Z., Chiarelli, A.M., Mai, V., 2003. Socioeconomic status and returning for a second screen in the Ontario breast screening program. *Breast* 12 (4), 237–246.
- Taylor, V.M., Taplin, S.H., Urban, N., White, E., Peacock, S., 1995. Repeat mammography use among women ages 50–75. *Cancer Epidemiol. Biomark. Prev.* 4 (4), 409–413.
- U.S. Preventive Services Task Force, 1996. Guide to clinical preventive services, 2nd ed. Williams and Wilkins, Baltimore, p. xxvi.
- Ulcickas Yood, M., McCarthy, B.D., Lee, N.C., Jacobsen, G., Johnson, C.C., 1999. Patterns and characteristics of repeat mammography among women 50 years and older. *Cancer Epidemiol. Biomark. Prev.* 8 (7), 595–599.
- Von Eschenbach, A.C., 2002. NCI remains committed to current mammography guidelines. *Oncologist* 7, 170–171.