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Concordance of population-based estimates of mammography screening

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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 six 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 six 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.

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, 1993;Humphrey, 2002;Shapiro, 1982;Tabar, 1989] However, a key to the success of population-based breast cancer screening and evaluating the quality of care associated with

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Précis: Estimates of adherence to mammography screening varies by operational definition used to define “success” and time period of evaluation. We recommend terminology and standard definitions to promote comparability between studies.

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early detection is determining whether or not women are screened at regular intervals. [Costanza, 2000; Davis, 1997; Humphrey, 2002; King, 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, 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 five years); and 3) two or more mammograms as guidelines recommended at the time of the study. [Clark, 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 ranged from 12 months to three years. [Bobo, 2004; Engelman, 2004; Rimer, 2002; Tatla, 2003; Partin, 2005] Several studies defined success as receiving a second screen within two years, but they varied by whether they allowed an additional time window (e.g., three months) to account for scheduling difficulties. [Andersen, 2000; Crane, 1998; Jepson, 1997; Song, 1998; Ulcickas, 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, 1995; Taylor, 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, 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, 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, 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, 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, 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, 2004] 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, 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, 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, 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 six 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 account for scheduling difficulties.[Clark, 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 six 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., six versus eight 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 eight years from index screen.

Results

Patient characteristics

Most women included in the study were Caucasian (92%) and, had some college education (70%) and earned $\geq \$20,000/\text{year}$ (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 six-year period. The median number of screening mammograms per woman was three (range 0–6). During the six-year observation period, 33 women received no screening at all. We performed the 8 year analysis among a subgroup of 1231 women who were enrolled for eight 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 six year evaluation period, 51% and 86% of women over the four year period, and 32% and 83% of women over the eight 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 four year evaluation period, 42% were adherent over six years, and 32% were adherent over eight years. Allowing three extra months to account for any scheduling difficulties resulted in large increases in adherence (11% for repeat, 24% for regular over four years, 19% for regular over six years, and 20% for regular over eight 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, 2000; Augustson, 2003; Barr, 2001; Bobo, 2004; Calvoressi, 2004; Carney, 2002; Crane, 1998; Fox, 1998; Gilliland, 2000; Partin, 2005; Song, 1998; Ulcickas-Yood, 1999;] Studies report higher adherence when they use less stringent definitions of repeat screening (e.g., second screen within 30 months versus second screen within 24 months) or comprise women with a history of prior screening. [Clark, 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 six years is similar to the 85% reported in a study of women age 55–79 on one- to two-year screening cycles. [Rakowski, 2004] Rakowski also found that 74.5% of women report at least three screenings in six years, [Rakowski, 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, 1997] Using every 24 months to define adherence, the 50% adherence estimate that Rakowski et al. reported resembles our estimate of 42% over six years and 51% over four years. A study of adherence over an eight year period within another health plan found lower adherence than our study, with only 16% of women having all the expected screenings. [Hansen, 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 is considered an accurate and complete source of health care utilization, [Saunders, 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, 2006; Hansen, 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. [Calvoressi, 2005; Lee, 1995; Rakowski, 2004; Ulcickas-Yood, 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 standardized 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 two 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 versus interval recall).[Clark, 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, 2006; Humphrey, 2002; Tabar, 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. Our recommendation is specific to evaluations of adherence and not a recommendation on how often women should undergo screening.

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References

- Andersen MR, Yasui Y, Meischke H, Kuniyuki A, Etzioni R, Urban N. The effectiveness of mammography promotion by volunteers in rural communities. *Am J Prev Med* 2000;18(3):199–207. [PubMed: 10722985]
- Augustson EM, Vadaparampil ST, Paltoo DN, Kidd LR, O’Malley AS. Association between CBE, FOBT, and Pap smear adherence and mammography adherence among older low-income women. *Prev Med* 2003;36(6):734–9. [PubMed: 12744918]
- Barr JK, Franks AL, Lee NC, Herther P, Schachter M. Factors associated with continued participation in mammography screening. *Prev Med* 2001;33(6):661–7. [PubMed: 11716664]
- Bobo JK, Shapiro JA, Schulman J, Wolters CL. On-schedule mammography rescreening in the National Breast and Cervical Cancer Early Detection Program. *Cancer Epidemiol Biomarkers Prev* 2004;13:620–630. [PubMed: 15066928]
- Calvocoressi L, Kasl SV, Lee CH, Stolar M, Claus EB, Jones BA. 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 Biomarkers Prev* 2004;13(12):2096–105. [PubMed: 15598767]
- Calvocoressi L, Stolar M, Kasl SV, Claus EB, Jones BA. Applying recursive partitioning to a prospective study of factors associated with adherence to mammography screening guidelines. *Am J Epidemiol* 2005;162(12):1215–24. [PubMed: 16221800]
- Carney PA, Harwood BG, Weiss JE, Eliassen MS, Goodrich ME. Factors associated with interval adherence to mammography screening in a population-based sample of New Hampshire women. *Cancer* 2002;95(2):219–27. [PubMed: 12124819]
- Clark MA, Rakowski W, Bonacore LB. Repeat mammography: prevalence estimates and considerations for assessment. *Ann Behav Med* 2003;26(3):201–11. [PubMed: 14644696]
- Costanza ME, Stoddard AM, Luckmann R, White MJ, Spitz Avrunin J, Clemow L. Promoting mammography: results of a randomized trial of telephone counseling and a medical practice intervention. *Am J Prev Med* 2000;19(1):39–4. [PubMed: 10865162]
- Crane LA, Leakey TA, Rimer BK, Wolfe P, Woodworth MA, Warnecke RB. Effectiveness of a telephone outcall intervention to promote screening mammography among low-income women. *Prev Med* 1998;27(5 Pt 2):S39–49. [PubMed: 9808823]
- Davis NA, Lewis MJ, Rimer BK, Harvey CM, Koplan JP. Evaluation of a phone intervention to promote mammography in a managed care plan. *Am J Health Promo* 1997;11(4):247–9.
- Engelman KK, Ellerbeck EF, Mayo MS, Markello SJ, Ahluwalia JS. Mammography facility characteristics and repeat mammography use among Medicare beneficiaries. *Prev Med* 2004 Sep;39(3):491–7. [PubMed: 15313088]
- Feldstein AC, Vogt TM, Aickin M, Hu WR. Mammography screening rates decline: a person-time approach to evaluation. *Prev Med* 2006 Sep;43(3):178–82. [PubMed: 16675004]
- Fleiss JL. Measuring agreement between two judges on the presence or absence of a trait. *Biometrics* 1977;31:651–659. [PubMed: 1174623]
- Fletcher SW, Black W, Harris R, Rimer BK, Shapiro S. Report of the International Workshop on Screening for Breast Cancer. *J Natl Cancer Inst* 1993 Oct 20;85(20):1644–56. [PubMed: 8105098]
- Fletcher SW, Black W, Harris R, Rimer BK, Shapiro S. Report Of The International Workshop On Screening For Breast cancer. *J Natl Cancer Inst* 1993;85:1644–56. [PubMed: 8105098]
- Fox SA, Pitkin K, Paul C, Carson S, Duan N. Breast cancer screening adherence: does church attendance matter? *Health Educ Behav* 1998;25(6):742–58. [PubMed: 9813745]
- Gilliland FD, Rosenberg RD, Hunt WC, Stauber P, Key CR. Patterns of mammography use among Hispanic, American Indian, and non-Hispanic White women in New Mexico, 1994–1997. *Am J Epidemiol* 2000 Sep 1;152(5):432–7. [PubMed: 10981456]
- Hansen JP, Knapp PA, Newcomb PA. Mammography in a health maintenance organization. *Am J Public Health* 1991;81(11):1489–90. [PubMed: 1951811]
- Humphrey LL, Helfand M, Chan BKS, Woolf SH. Breast cancer screening: a summary of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med* 2002;137:347–60. [PubMed: 12204020]
- Humphrey LL, Helfand M, Chan BKS, Woolf SH. Breast cancer Screening. Summary of the Evidence. *Ann Intern Med* 2002;137:344–6. [PubMed: 12204019]
- Jepson C, Barudin J, Weiner J. Variability in timing of repeat screening mammography. *Preventive Medicine* 1997;26:483–85. [PubMed: 9245670]
- King ES, Rimer BK, Seay J, Balshem A, Engstrom PF. Promoting mammography use through progressive interventions: is it effective? *Am J Public Health* 1994;84:104–6. [PubMed: 8279593]
- Lee J, Vogel V. Who used repeat screening mammography regularly? *Cancer Epidemiol Biomarkers Prev* 1995;4(8):901–6. [PubMed: 8634664]
- Partin MR, Casey-Paol AL, Slater JS, Korn JE. Measuring mammography compliance: lessons learned from a survival analysis of screening behavior. *Cancer Epidemiol Biomarkers Prev* 1998;7:681–687. [PubMed: 9718220]
- Partin MR, Slater JS. Promoting repeat mammography use: insights from a systematic needs assessment. *Health Educ Behav* 2003;30(1):97–112. [PubMed: 12564670]

- Partin MR, Slater JS, Caplan L. Randomized controlled trial of a repeat mammography intervention: effect of adherence definitions on results. *Prev Med* 2005;41(3–4):734–40. [PubMed: 16043216]
- Rakowski W, Andersen MR, Stoddard AM, Urban N, Rimer BK, Lane DS, et al. Confirmatory analysis of opinions regarding the pros and cons of mammography. *Health Psychol* 1997;16(5):433–41. [PubMed: 9302540]
- Rakowski W, Breen N, Meissner H, Rimer BK, Vernon SW, Clark MA, et al. Prevalence and correlates of repeat mammography among women aged 55–79 in the Year 2000 National Health Interview Survey. *Prev Med* 2004;39(1):1–10. [PubMed: 15207980]
- Ries, LAG.; Eisner, MP.; Kosary, CL., et al. SEER Cancer Statistics Review, 1975–2001. Bethesda, MD: National Cancer Institute; 2004.
- Rimer BK, Halabi S, Sugg Skinner C, Lipkus IM, Strigo TS, Kaplan EB, et al. Effects of a mammography decision-making intervention at 12 and 24 months. *Am J Prev Med* 2002;22(4):247–57. [PubMed: 11988381]
- Saunders, KW.; Davis, RL.; Stergachis, A. Group Health Cooperative. *Pharmacoepidemiology*. 4. Strom, B., editor. Chichester: John Wiley & Sons; 2005. p. 223–39.
- Shapiro S, Venet W, Strax P, Venet L, Roeser R. Ten- to fourteen-year effect of screening on breast cancer mortality. *J Natl Cancer Inst* 1982;69(2):349–55. [PubMed: 6955542]
- Smith RA, Cokkinides V, Eyre HJ. American Cancer Society guidelines for the early detection of cancer, 2005. *CA Cancer J Clin* 2005;55:31–44. [PubMed: 15661685]
- Song L, Fletcher R. Breast cancer rescreening in low-income women. *Am J Prev Med* 1998;15(2):128–33. [PubMed: 9713668]
- Tabar L, Fagerberg CJG, Gad A, Baldetorp L, Holmberg LH, Grøntoft O, Ljungquist U, Lundström B, Manson JC, Eklund G, et al. Reduction in mortality from breast cancer after mass screening with mammography. *Lancet* 1985;1:829–32. [PubMed: 2858707]
- Tabar L, Fagerberg G, Duffy SW, Day NE. The Swedish two county trial of mammographic screening for breast cancer: recent results and calculation of benefit. *J Epidemiol Community Health* 1989;43(2):107–14. [PubMed: 2512366]
- Taplin SH, Barlow WE, Ludman E, MacLehos R, Meyer DM, Seger D, et al. Testing reminder and motivational telephone calls to increase screening mammography: randomized study. *J Natl Cancer Inst* 2000;92(3):233–42. [PubMed: 10655440]
- Taplin SH, Ichikawa L, Buist DS, Seger D, White E. Evaluating organized breast cancer screening implementation: the prevention of late-stage disease? *Cancer Epidemiol Biomarkers Prev* 2004;13:225–34. [PubMed: 14973097]
- Taplin SH, Thompson RS, Schnitzer F, Anderman C, Immanuel V. Revisions in the risk-based breast cancer screening program at Group Health Cooperative. *Cancer* 1990;66:812–818. [PubMed: 2386908]
- Tatla RK, Paszat LF, Bondy SJ, Chen Z, Chiarelli AM, Mai V. Socioeconomic status & returning for a second screen in the Ontario breast screening program. *Breast* 2003;12(4):237–46. [PubMed: 14659307]
- Taylor VM, Taplin SH, Urban N, White E, Peacock S. Repeat mammography use among women ages 50–75. *Cancer Epidemiol Biomarkers Prev* 1995;4(4):409–13. [PubMed: 7655338]
- U.S. Preventive Services Task Force. Guide to clinical preventive services. 2. Baltimore: Williams and Wilkins; 1996. p. xxvi
- Ulcickas Yood M, McCarthy BD, Lee NC, Jacobsen G, Johnson CC. Patterns and characteristics of repeat mammography among women 50 years and older. *Cancer Epidemiol Biomarkers Prev* 1999;8(7):595–9. [PubMed: 10428196]
- Von Eschenbach AC. NCI remains committed to current mammography guidelines. *Oncologist* 2002;7:170–1. [PubMed: 12065784]

Table 1

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

Characteristics	<i>n</i> = 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

Table 2

Adherence to repeat mammography screening by various operational definitions among 1336 women enrolled in Group Health for at least six 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

Table 3

Adherence to regular mammography screening by various operational definitions among 1336 women enrolled for at least six 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