Follow-up Among Women With an Abnormal Mammogram in an HMO: Is It Complete, Timely, and Efficient?

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Abstract

Objective: **To describe the extent to which women with seriously abnormal mammograms complete indicated follow-up, the timeliness of this follow-up, and variations in the pattern of use of diagnostic procedures.**

Study Design: **Retrospective chart review.**

Patients and Methods: **Ninety-two women enrolled in a single urban health maintenance organization (HMO) with an abnormal index mammogram (mass or suspicious calcifications) during 1995 or 1996 were identified by review of all HMO mammography reports. Data were abstracted from medical records concerning all clinical services received over the 11 months after the date of the abnormal mammogram. Procedure costs were estimated based on 1997 Medicare relative-value units. Logistic regression and a multivariate accelerated failure-time model were used to evaluate the association between predictor variables and the occurrence and timing of completion of follow-up.**

Results: **Follow-up was not completed by 31 (34%) of the 92 study women and was delayed beyond 60 days for another 32 (35%). In adjusted analysis, factors associated with completion within 60 days included age less than 50 years and inclusion of a specific follow-up recommendation in the mammogram report. Completion by the end of the study (a minimum of 11 months after the index mammogram) was associated only with the presence of a specific follow-up recommendation. The follow-up process (ie, the diagnostic procedures used) was highly variable but almost always included surgical evaluation. The average cost among those completing follow-up was about $1900 (in 1997 dollars).**

Conclusions: **Incomplete follow-up after a potentially seriously abnormal mammogram constitutes an important barrier to breast cancer control efforts in the study HMO, but its explanation remains incompletely understood. The follow-up process itself is highly variable, and improvement in its efficiency and timely completion will require a better understanding of its determinants.**

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The effectiveness of appropriately targeted screening mammography as a method to reduce breast cancer-related mortality is well established.[1] Incomplete use of mammography among eligible women constitutes an important impediment to breast cancer control programs, and considerable attention has been focused on methods to increase use of mammography.[2-10] However, completion of screening mammography is not an end in itself. Reduction in breast cancer mortality requires that abnormal mammograms be followed by a process that leads to definitive diagnosis and treat-

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ment. Previous research has suggested that this follow-up process may be incomplete or delayed, particularly among women of lower socioeconomic status.[11-14]

Among such women, relevant barriers to follow-up could include issues of access to healthcare, patterns of care delivered by providers, and other social, economic, and personal factors.[13-16] Enrollment in a health maintenance organization (HMO) would be expected to reduce some of the follow-up barriers related to healthcare coverage. We previously demonstrated the effectiveness of interventions promoting the use of screening mammography among women enrolled in an HMO serving a predominately African-American, Medicaid-eligible population in Detroit, Michigan.[17-19] In order to better understand the pattern of care that follows an abnormal screening mammogram, we conducted a retrospective review of the medical records of women with a mammogram report that indicated a potentially serious abnormality. We were specifically interested in the completeness and timeliness of follow-up, the process of follow-up (selection and sequencing of diagnostic procedures), factors associated with timely follow-up, and the economic costs related to the follow-up process.

··· METHODS ···

Study Population

The study setting includes 3 practice sites of a staff-model HMO that serves a predominately Medicaid-eligible (90%) population of minority women (90% African American) in Detroit, Michigan. During the study period, 20 physicians provided primary care at the study sites (2 family physicians, 9 internists, and 9 gynecologists). Individual patients are not assigned to specific physicians and thus may receive care from multiple providers.

From 1989 to 1996 these sites participated in a series of clinical trials that investigated the effectiveness of alternative mammography reminder systems.[18,19] As a component of these investigations, the original radiology reports for all available 1995 and 1996 mammograms (n = 3131) were reviewed by a study investigator (a medical oncologist), who classified each mammogram based on the radiologist-provided interpretation and recommendation. This report focuses on mammogram reports that indicated a "potentially suspicious" mass or calcification or that specifically recommended consideration of diagnostic ultrasonography or surgical evaluation.

We identified 92 women with mammograms classified as "seriously abnormal," and these women are the subjects of this report. Although predating the final American College of Radiology (ACR) classification system, the mammograms we identified as seriously abnormal would correspond to ACR class 4 or 5. The distribution of results (and equivalent ACR class) for the entire sample of 3131 mammograms is as follows: (1) 53% normal (ACR 1), (2) 24% minor abnormality with routine follow-up recommended (ACR 2), (3) 20% with a repeat mammogram recommended at a 3- to 6-month interval (ACR 3), and (4) 3% potentially serious abnormality (ACR 4 or 5, the study cohort). Approval for this study was obtained from the institutional review board of Wayne State University and the participating HMO.

Data Collection

Data concerning the study participants and the follow-up process were obtained from administrative data and review of medical records. Electronic administrative data provided information concerning age, insurance type (Medicaid, commercial, or Medicare), HMO visit history, and visit-specific diagnoses. Proxy measures for years of education and household income were constructed based on census tract block data from the 1990 Census of Population and Housing.[20,21]

Medical records were reviewed independently by each of 2 trained medical record abstractors. Discrepancies were resolved by consultation with a study investigator (medical oncologist). Record review occurred a minimum of 11 months after the date of the index mammogram (median interval was 19 months). Data collected from the medical records included content of visits to primary care providers (clinical breast examination defined as normal, not normal, or not done, and indication of any follow-up result or plan); results of follow-up procedures (surgical consultation, repeat or diagnostic mammography, ultrasound examination, and breast biopsy [needle localization, ultrasound-guided core, fine needle aspiration or excisional]); and documentation of any telephone or mail contact with women concerning follow-up.

Two of the study investigators (medical oncologist and general internist) reviewed the abstracted data concerning all diagnostic procedures used during follow-up. Follow-up was classified for each woman as complete if a satisfactory biopsy was performed, an ultrasound examination documented an uncomplicated cyst, or surgical evaluation recommended no additional diagnostic procedure. There were no differ-

ences between the reviewers in the coding of follow-up as complete or not.

Each diagnostic procedure was classified by the pathway reviewers as appropriate (either recommended or optional to promote a favorable clinical outcome) or potentially redundant (neither necessary nor likely to be useful). Differences in the classification of procedure appropriateness were resolved by consensus (required in 8 of 92 cases). We classified the first primary care visit after an index mammogram as an appropriate follow-up procedure since it provided the opportunity to inform the woman of the result and initiate follow-up. Since we did not have information about the content of subsequent primary care visits (ie, whether they addressed follow-up or other clinical issues), these visits were not considered further.

Cost Data

Costs were ascertained for each follow-up procedure including the first primary care visit, all surgical evaluations, and each diagnostic procedure. The cost of each type of biopsy included all related facility and professional fee components as specified by the hospital finance department providing the service. For example, the final cost of a needle localization biopsy included costs for the needle placement mammogram, facility charges (ambulatory surgery, recovery room, and anesthesia), and professional components (radiologist, surgeon, and pathologist). Professional components of cost were based on 1997 Medicare relative-value units and payment modified by the local geographic modifier.[22] The costs for hospital services were based on the 1997 outpatient hospital cost-charge ratio for the participating referral hospital. Our estimated costs for each procedure included facility plus professional components and were as follows: primary care visit, $100.08 (established patient, level 3 visit); surgical evaluation, $89.58 (consultation, level 2); mammogram, $83.58; ultrasonography, $72.66; fine needle aspiration, $305.01; needle localization biopsy, $2171.19; and ultrasound core biopsy, $587.48.

The cost analyses presented focus on only the direct costs of providing medical care to women with an abnormal mammogram and exclude any costs associated with a subsequent diagnosis of breast cancer. Also excluded are the HMO's costs to implement follow-up (notification of women regarding abnormal results or pending appointments) and the direct and indirect costs incurred by women in attending follow-up appointments (transportation, child care, lost wages, time).

Statistical Methods

Standard descriptive statistics were used to characterize the study population. The primary study outcome was completion of follow-up within 60 days (consistent with the Health Employer Data and Information Set [HEDIS] 3.0 criterion). Secondary outcomes of interest are completion of follow-up as of the end of the study period (a minimum of 342 days for completion at any time) and the time to completion. Study variables include age (<50 years of age or older), insurance (Medicaid or other), median family income (<$20,000 or greater), primary care visits and number of chronic illness diagnoses in the year before the index mammogram, year and follow-up recommendation of the index mammogram, clinical breast examination result, and occurrence of any follow-up procedure or primary care visit within 60 days of the index mammogram (not included in the analysis of follow-up within 60 days). The unadjusted odds ratio describing the association of each study variable with completion of follow-up was estimated by logistic regression. Multivariate logistic regression analyses were used to provide adjusted estimates of association.[23] Variables were included in the multivariate analysis if their unadjusted odds ratio exceeded 1.5 or if they were significant in the unadjusted analyses at the .10 level. PROC LOGISITC in SAS[23] was used to fit logistic regression models. A multivariate accelerated failure-time model was used to evaluate the time to completion.[23] PROC LOGISTIC in SAS[23] was used to fit the failure-time model.

··· RESULTS ···

Study Population

Characteristics of the 92 study women are presented in Table 1. Nearly 40% of the study women were less than 40 years of age and more than 80% were enrolled through Medicaid. The majority of these women visited the HMO regularly (nearly 60% 3 or more times in the preceding year), and three quarters remained continuously enrolled in the HMO during the year after their index mammogram (93% remained continuously enrolled for at least 3 months). Based on census block of residence, more than half of the study households had annual family incomes under $20,000 (1995 dollars). (Of 28 study women contacted by telephone, 15 reported an annual income of less than $18,000.)

Information concerning the index mammogram is included in Table 1. Of the 92 abnormal mammo-

grams, 75 (82%) indicated a mass either alone or in combination with another abnormality. A specific follow-up recommendation was included by the radiologist in the mammogram report for 87 (95%) of the 92 index mammograms. Surgical evaluation was recommended for 22 (24%) women, ultrasound examination for 26 (28%), and the option of a repeat mammogram if no other diagnostic procedure was completed was recommended for 39 (42%). A final diagnosis of breast cancer was established among 10 of the 61 women who did complete follow-up (16%). Among women not completing follow-up, there were no cases of subsequently diagnosed breast cancer at the time of chart review, but follow-up beyond 1 year was not available.

Results concerning clinical breast examinations performed by the primary care physician in association with the index mammogram were available for 84 women. The examination was considered normal for 26 women and not normal for 58 (data concerning the specific type of abnormality were not available). Notation of an abnormal clinical breast examination was more likely among women under the age of 40 compared with those 40 years of age or older (75% vs 55%; $P = .057$).

Completion of Follow-up

Table 2 presents results concerning completion of follow-up within 60 days or by conclusion of the study follow-up period (a minimum of

Table 1. Characteristics of Women with Abnormal Mammograms in 1995 and 1996

Characteristic	No.	Percentage
Total	92	
Age (y)		
Under 40	36	39
40-49	25	27
50 or older	31	34
Insurance		
Medicaid	76	83
Other	16	17
Continuing insurance eligibility (postindex mammogram)		
3 or more months	86	93
Less than 3 months	6	7
Median family income		
Less than $10,000	10	11
$10,000-$19,999*	37	40
$20,000-$29,999	18	20
$30,000 or more	27	29
Education		
No high school	3	3
Grades 9-12, no degree*	59	64
High school graduate	29	32
College, no degree	1	1
Chronic illnesses		
None	56	61
1 or more	36	39
Primary care visits in the previous year†		
None	19	21
1-2	19	21
3 or more	54	59
Year of index mammogram		
1995	69	75
1996	23	25
Follow-up recommendation with index mammogram		
Interval mammogram	39	42
Surgical evaluation	22	24
Ultrasonography	26	28
Not specified	5	5
Preindex clinical breast exam		
Not normal	58	63
Normal/not done‡	34	37
Postindex primary care visits		
None	27	29
1	31	34
2 or more	34	37
Postindex event within 60 days		
Yes (procedure or primary care visit)	76	83
No	16	17

* There was 1 missing result.
†These visits included primary care and obstetrics/gynecology.
‡Clinical breast exams were not done in 8 cases.

Table 2. Completion of Follow-up: Unadjusted Odds Ratios

Characteristic	Completion Within 60 Days			Completion by End of Study		
	Rate (%)	Odds Ratio	*P*	Rate (%)	Odds Ratio	*P*
Age (y)						
Under 50	38	2.52	.08	69	1.40	.47
50 or older*	19	1.00		61	1.00	
Insurance						
Medicaid	33	1.47	.54	67	1.22	.72
Other*	25	1.00		63	1.00	
Continuing insurance eligibility (postindex mammogram)						
3 or more months	33	2.41	.43	66	0.98	.98
Less than 3 months*	17	1.00		67	1.00	
Median family income						
Less than $19,999*,†	26	1.00		62	1.00	
$20,000 or more	38	1.77	.21	71	1.53	.34
Education						
Less than high school graduate*,†	32	1.00		65	1.00	
High school graduate or higher	30	0.90	.83	70	1.28	.60
Chronic illnesses						
None*	36	1.00		63	1.00	
One or more	25	0.60	.28	72	1.56	.34
Primary care visits in the previous year‡						
None*	26	1.00		53	1.00	
One or more	33	1.37	.58	70	2.09	.16
Year of index mammogram						
1995*	25	1.00		64	1.00	
1996	52	3.34	.02	74	1.61	.38
Follow-up recommendation with index mammogram						
Procedure	44	3.50	.01	79	3.47	.01
No procedure*	18	1.00		52	1.00	
Preindex clinical breast exam						
Not normal	28	0.62	.29	62	0.59	.26
Normal/not done§	38	1.00		74	1.00	
Postindex event within 60 days	NA‖	NA‖	NA‖			
Yes (procedure or primary care visit)				68	1.69	.35
No*				56	1.00	

*Reference category.
†There was 1 missing result.
‡These visits included primary care and obstetrics/gynecology.
§Clinical breast exams not done in 8 cases.
‖By definition all had an event within 60 days.

342 days after the index mammogram). Within 60 days, only one third (29 of 92) of the study women completed follow-up. By the end of the study, 66% (61 of 92) of the women had completed follow-up. Thus, one third of women never completed follow-up and two thirds failed to do so in a timely fashion (that is, within 60 days).

Factors most closely associated with completion of follow-up within 60 days included age less than 50 years, index mammogram completed during 1996 (compared with 1995), and inclusion of a specific follow-up recommendation by the radiologist in the index mammogram report. These factors are each associated with a 2- to 3-fold increase in the odds of completing follow-up within 60 days. The only factor associated with completion of follow-up by the end of the study period is the presence in the index mammogram report of a specific follow-up procedure recommendation.

Table 3 presents results for the multivariate analyses of completion within 60 days or ever. The only factors independently associated with completion within 60 days are age less than 50 years and inclusion of a procedure recommendation in the index mammogram. In the analysis of completion by end of study, the effect of age is no longer statistically significant, and only the presence of a procedure recommendation in the index mammogram report remains independently associated with completion.

The Figure presents results indicating the cumulative probability of follow-up completion over time for subgroups of women characterized by age (top panel) and the presence or absence of a follow-up recommendation in the index mammogram report (bottom panel). The results of the survival analysis for time to completion were similar to those observed in the logistic regression analyses. Factors independently associat-

Table 3. Completion of Follow-up: Adjusted Odds Ratios and 95% Confidence Intervals

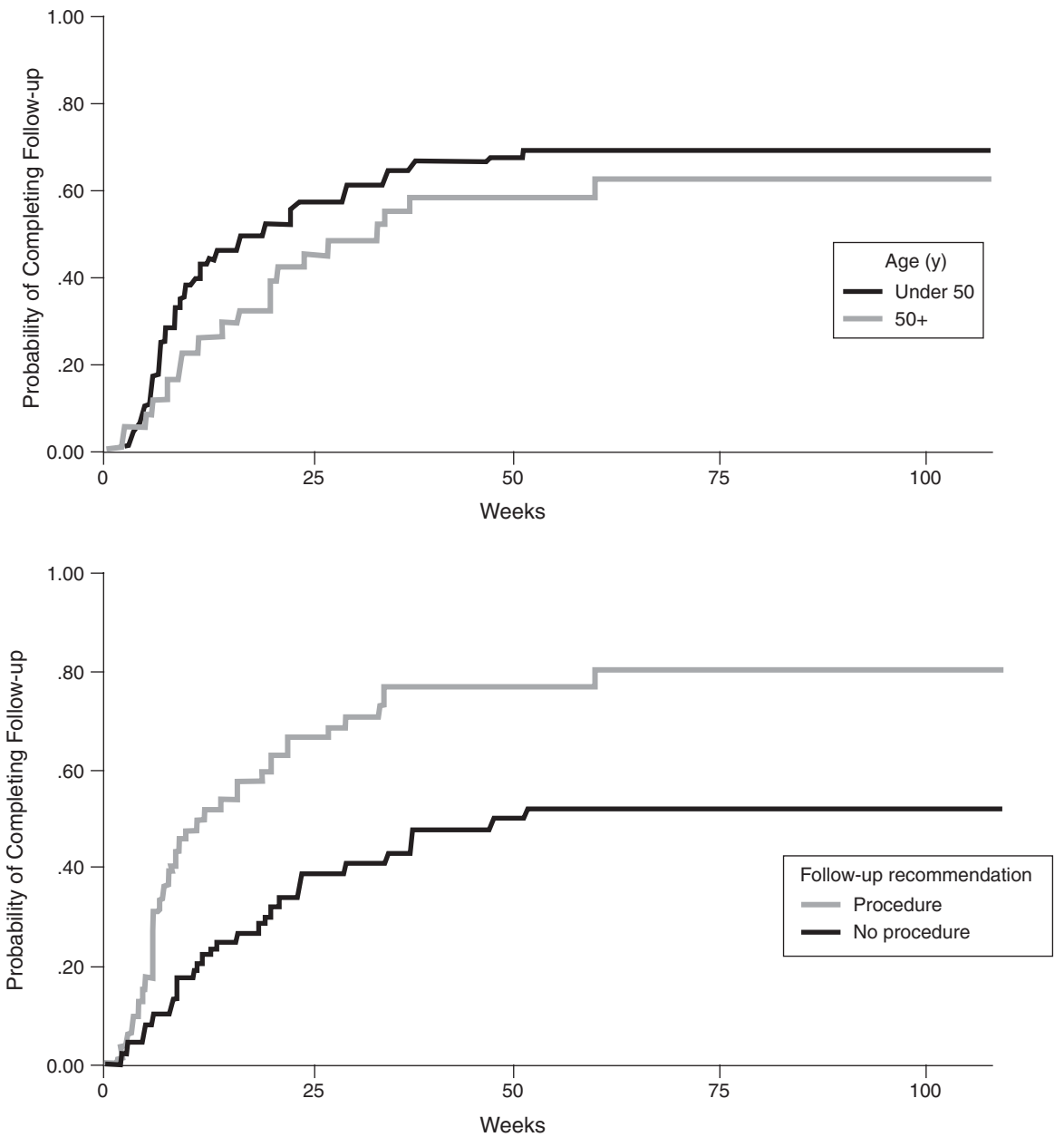
	Completion Within 60 Days		Completion by End of Study	
Characteristic	**Odds Ratio**	**95% CI**	**Odds Ratio**	**95% CI**
Age (y)				
Under 50	3.61	(1.04, 12.48)	2.55	(0.81, 8.03)
50 or older*	1.00		1.00	
Insurance				
Medicaid	1.45	(0.35, 6.03)	1.17	(0.31, 4.35)
Other*	1.00		1.00	
Median family income				
Less than $19,999*,†	1.00		1.00	
$20,000 or more	1.85	(0.68, 5.04)	1.41	(0.54, 3.70)
Chronic illnesses				
None*	1.00		1.00	
One or more	0.70	(0.22, 2.28)	1.99	(0.61, 6.55)
Primary care visits in the previous year‡				
None*	1.00		1.00	
One or more	1.66	(0.42, 6.51)	1.67	(0.47, 5.93)
Year of index mammogram				
1995*	1.00		1.00	
1996	2.20	(0.57, 8.54)	0.59	(0.14, 2.49)
Follow-up recommendation with index mammogram				
Procedure	3.55	(1.14, 11.04)	4.58	(1.54, 13.62)
No procedure*	1.00		1.00	
Preindex clinical breast exam				
Not normal	0.70	(0.20, 2.41)	0.45	(0.14, 1.49)
Normal/not done*,§	1.00		1.00	
Postindex event within 60 days				
Yes (procedure or primary care visit)	NA‖	NA‖	1.37	(0.38, 5.00)
No*	NA‖		1.00	

CI = confidence interval.
*Reference category.
†There was 1 missing result.
‡These visits included primary care and obstetrics/gynecology.
§Clinical breast exams were not done in 8 cases.
‖By definition all had an event within 60 days.

ed with time to completion are age (adjusted coefficient = -1.00 for women under the age of 50 years) and inclusion of a procedure recommendation in the index mammogram report (adjusted coefficient = -1.37).

HMO efforts to contact women after an abnormal mammogram were successful among all 31 women who nevertheless subsequently failed to complete follow-up. More than three quarters of these women

Figure. Cumulative Probability of Completing Follow-up Over Time According to Age (Top Panel) and Presence of a Procedure Recommendation in the Index Mammogram Report (Bottom Panel)



(n = 25) visited a primary care provider, 19 were contacted by telephone, and 22 were sent either postcards or certified letters. A similar pattern of contact was used to notify the 61 women who eventually did complete follow-up.

Patterns of Procedure Use in Completing Follow-up

Information concerning procedures used during follow-up is presented in Table 4. The most common follow-up procedure was surgical evaluation, which was completed by more than 90% of study women (86 of 92) during follow-up. More than two thirds of women (65 of 92) had one or more primary care visits during follow-up. Ultrasound examinations were completed by 29 women (32%), and 50 women (54%) underwent breast biopsy. The mean number of diagnostic procedures among women completing follow-up was 2.4 (3.6 when primary care visits were included). Among women not completing follow-up, the mean number of diagnostic procedures was 1.5 (2.7 when primary care visits were included).

As would be expected, the pattern of procedure use differed between those completing and not completing follow-up. Among the 61 women completing follow-up, the final diagnostic procedure was biopsy in 49 (80%) cases, surgical evaluation supported by an ultrasound exam and/or repeat mammogram in 11 cases, and repeat mammography alone in 1 case. The most common diagnostic pathway among women completing follow-up was surgical evaluation followed by biopsy (36 of 61 [59%]). An additional 12 women underwent surgical evaluation, ultrasonography, and then biopsy (20%); and 12 women did not require biopsy for diagnosis.

Among women not completing follow-up, all entered the follow-up process. Twenty-seven of the 31 (87%) women completed at least 1 diagnostic procedure, 14 (45%) completed 2 or more, and 4 only visited a primary care provider. A total of 45 diagnostic procedures were completed by the 31 women who did not subsequently complete follow-up.

Relatively few diagnostic procedures were classified as potentially redundant. These included 5 surgical evaluations (3 among completors and 2 among noncompletors), 4 ultrasound examinations (2 among completors and 2 among noncompletors), and 2 mammograms (among completors only). Sixty-five of the 92 women visited a primary care physician during follow-up (109 total visits). Since the available data do not allow us to determine whether initial or subsequent primary care visits were necessary to communicate results, encourage follow-up, or provide other services, none are classified as potentially redundant or unnecessary.

Costs Associated With Follow-up

Table 5 provides the estimated total cost for follow-up (in 1997 dollars) among all study women, excluding the costs of primary care visits after the first visit. The aggregate total is $126,363 (mean cost per woman of $1374); and as would be expected, the mean cost was higher among women completing follow-up compared with those not completing follow-up ($1934 among completors vs $271 among noncompletors). Costs for the 61 women completing follow-up are further examined in Table 5 by factors related to the index mammogram, the follow-up pathway, and the final diagnosis. The largest contributor to the cost of follow-up was the breast biopsy.

Table 4. Diagnostic Procedures Used for Follow-up

	Completors (n = 61)		Noncompletors (n = 31)		Total (n = 92)	
Procedure	Women	Occurrences	Women	Occurrences	Women	Occurrences
Surgical evaluation	60	67	26	30	86	97
Biopsy	49	53	1	1	50	54
Ultrasonography	17	17	12	12	29	29
Mammogram	11	12	2	2	13	14

Among women undergoing biopsy the average cost was approximately $2331 ($2571 if the final diagnosis was malignant versus $2270 if the final diagnosis was benign) as compared to $311 if no biopsy was required. While some differences in cost were noted in association with the type of recommendation included in the index mammogram by the radiologist and with the first procedure used during follow-up, it appears that these differences were predominately attributable to the occurrence or absence of a subsequent biopsy.

The economic efficiency of follow-up reflects the extent to which procedures used were classified as necessary or "potentially unnecessary." Among the 61 women completing follow-up, 7 diagnostic procedures (3 surgical evaluations, 2 ultrasound examinations, and 2 mammograms) were classified as potentially unnecessary at a cost of $581. Since the total cost of follow-up among these women was $117,963, only about 0.5% of the follow-up costs can be considered as inefficient or potentially unnecessary. Among the 31 women not completing follow-up, the total cost of follow-up was $8400, all of which might be considered an inefficient use of resources to the extent that clinical resolution was not reached. Thus, the total economic cost for follow-up was $126,363, of which $8981 appears as a potentially unnecessary or inefficient expense (7.1% of the total).

Table 5. Follow-up Costs

Variable	No.	Average cost per woman
Overall	92	$1373.51
Follow-up complete	61	$1933.82
Follow-up not complete	31	$270.96
Year of index mammogram		
1995	44	$1909.67
1996	17	$1996.32
Follow-up recommendation after index mammogram		
None	4	$2379.02
Interval mammogram	19	$1817.96
Surgical evaluation	17	$2230.76
Ultrasonography	21	$1713.46
Initial step in pathway		
Primary care visit	22	$1818.97
Surgical evaluation	34	$2106.66
Ultrasonography	5	$1263.86
Final diagnosis		
Biopsy result benign	39	$2269.93
Biopsy result malignant	10	$2570.84
No biopsy	12	$310.61

··· DISCUSSION ···

In this population of predominately Medicaid-eligible women served by a single HMO, we noted that only one third were able to complete follow-up within 60 days of the occurrence of a potentially seriously abnormal mammogram. Another one third subsequently completed follow-up over a period as long as a year, and the remaining one third were never successful in coming to clinical resolution. The implications of absent or delayed follow-up for these women and their healthcare organization are clear. Without successful follow-up, the potential benefit of programs focusing on increased use of screening mammography cannot accomplish their goal of reducing breast cancer-associated mortality.

Our results contrast with previous reports that note higher rates of completed follow-up. For example, Kerlikowske examined time to a first diagnostic procedure among women in 5 breast cancer control programs and noted that more than two thirds of women initiated follow-up within 8 weeks.[12] Furthermore, nearly three quarters of women in the California Breast and Cervical Cancer Control Project completed follow-up within 8 weeks (vs 32% in this study).[12] However, in contrast with these studies, our population was restricted to women with seriously abnormal mammograms and did not include women whose follow-up required only a repeat mammogram. In another study conducted in an HMO, McCarthy et al reported that

only 7.2% of women requiring "immediate follow-up" failed to complete follow-up compared with our observed failure rate of 34%.[13] This variance may reflect substantial differences in the 2 study populations, although differences in the providers or healthcare organization also may contribute. In a small group of women more similar to ours, Rojas et al reported failure to complete follow-up among 3 of 13 women (23%) with "suspicious" mammograms.[14]

Factors Associated with the Timeliness and Completion of Follow-up

We explored multiple potential factors as explanations for absent or delayed follow-up. We noted that failure to identify the abnormal mammogram or to contact the woman was not an important contributor to absent follow-up, nor was disenrollment from the study HMO. In other studies women more likely to experience delays in follow-up included those who were older, nonwhite, and economically disadvantaged.[11,12] Given the relative homogeneity of our study population, we cannot assess the relationship of race/ethnicity or socioeconomic status to follow-up.

We did observe that women under the age of 50 years were more likely to complete follow-up within 60 days. Our ability to explain this observation is limited by the absence of data concerning many potentially relevant age-associated factors, socioeconomic factors, health beliefs, attitudes, and social support. One potential contributing factor may be the observation that abnormal breast exams were more commonly noted among women under the age of 40 than among those 40 years of age or older (75% vs 55%; $P = .057$). However, we did not observe a statistically significant association between the presence of an abnormal breast examination and time to follow-up. On the other hand, the factor most strongly associated with follow-up completion both at 60 days and by the end of the study was inclusion by the radiologist of a follow-up procedure recommendation in the mammogram report. The presence of this recommendation could serve as an indicator of severity, thus prompting a more timely response by physicians or by women. However, the presence of such a recommendation was not associated with age and thus does not provide an explanation for more prompt follow-up among younger women. Patient perception of severity and physician remain important areas for future investigation.

Follow-up Pathway

Considerable variation in the follow-up process was apparent. Among the 61 women completing follow-up, 7 different combinations of individual procedures were used and the number of permutations based on sequence was considerably greater. However, surgical evaluation was central to the process and not unexpected given the level of severity of mammogram abnormality required for study inclusion. This pattern could change in the future as advances in ultrasonography or magnetic resonance imaging for diagnosis or assisted biopsy influence the management of women with abnormal mammograms.[24]

Costs of Follow-up

Estimating the cost of a screening mammogram program based on the cost of the mammograms themselves will result in a substantial underestimation. Others have reported that up to one third of the costs of a screening program arise from follow-up-related assessments.[25,26] In our study setting, a total of 3131 screening mammograms were reviewed to identify 92 women (3%) with serious abnormalities. The total cost of the screening mammograms was $261,689. We estimated the direct costs of follow-up among the 92 study women to be $126,363; thus, follow-up resulted in an additional cost of approximately 50% over and above the cost of the screening mammograms themselves (not including the costs associated with follow-up among women with lesser degrees of mammography abnormality). From the perspective of efficiency, we noted use of relatively few potentially unnecessary diagnostic procedures. We estimate that no more than 0.5% of costs incurred in the follow-up of the study women completing follow-up might be considered inefficient (up to 7% if the procedures used during the care of women not completing follow-up are included as inefficient).

Limitations

Several limitations of this work must be acknowledged. While our data do reinforce previous concerns about incomplete follow-up among women with seriously abnormal mammograms, our small relatively homogeneous sample and dependence on proxy measures of income and education limit our ability to explain this problem. In addition, our results may not apply to other populations or other healthcare settings.

As we did a retrospective study of follow-up based on review of medical records, the information available to us was limited. Explanations of decision making or barriers to follow-up from the perspective

of the women or their physicians were not available, and we could not evaluate the content of the follow-up advice given by physicians to their patients. We believe that our data concerning the occurrence of follow-up procedures are relatively complete and accurate since all study women were enrolled in a staff-model HMO with significant restrictions on out-of-plan care. We did accept as evidence of completion a surgical opinion (without biopsy) that no further evaluation was required. The effect of this potential misclassification would be to underestimate the extent to which follow-up was truly incomplete.

Our cost estimates are specific to a single managed care organization. Different estimates would be expected among different healthcare organizations, and estimates would differ according to variance over time in practices, particularly the choice of biopsy type. However, others interested in projected costs can substitute local, contemporary values for biopsy as well as other indicated procedures. Finally, our method of classification of procedures as necessary or potentially redundant has not been validated. While 2 reviewers representing 2 different clinical disciplines came to a consensus for each procedure, these decisions were made retrospectively and may differ from those that would be reached prospectively by clinicians caring for women.

··· CONCLUSION ···

Our major observation is that completion of follow-up among this population of economically disadvantaged women with seriously abnormal screening mammograms is seriously limited by factors that have not yet been completely identified. The impact of failed follow-up may be considerable. Cancer was diagnosed in 16% of study women completing follow-up; and if this same proportion applies to the 31 women not completing follow-up, 5 cases of breast cancer could have been missed in this cohort of 92 women. Furthermore, the delay in diagnosis associated with untimely follow-up further compromises the opportunity for early intervention that should accompany screening mammography. The failure of follow-up we observed is even more notable for its occurrence within a managed care organization that strives to remove many of the barriers potentially affecting economically disadvantaged women. While we note relatively little economic inefficiency in the follow-up process, the aggregate costs of follow-up are considerable and must be considered in projecting the cost of a breast cancer control program (or any other screening activity). Furthermore, any intervention targeting women at risk for delayed or incomplete follow-up could add substantially to these costs.

Based on our observations, we think it critical that healthcare organizations establish ongoing monitoring procedures to assess the timely occurrence of follow-up. Linked to monitoring must be effective interventions tailored to the specific barriers encountered by women in a given setting. Logistic impediments to care including difficulty scheduling appointments or with transportation contribute to but do not fully explain incomplete follow-up.[13] Identification of the relevant barriers and development of targeted interventions constitute the next challenge in translating the promise of screening mammography into improved outcomes.

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