Methods

Using Medicare Data to Estimate the Prevalence of Breast Cancer Screening in Older Women: Comparison of Different Methods to Identify Screening Mammograms

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Objectives. To compare different methods for defining screening mammograms with Medicare claims and their impact on estimates of breast cancer screening rates.

Methods. Medicare outpatient facility and physician claims for 61,962 women in 1993 and 59,652 women in 1998 were reviewed for evidence of receipt of screening mammography. We compared the estimates of screening mammography use derived from CPT (Current Procedure Terminology) codes to categorize mammograms as screening or diagnostic versus using an algorithm that uses CPT codes plus breast-related diagnoses in the prior two years. We also compared estimates obtained from review of physician claims alone, facility claims alone, or the combination of the two sources of claims.

Results. Use of physician claims alone produced estimates of screening rates similar to rates calculated from use of both physician and outpatient (facility) claims. In 1993, the CPT code for screening mammography underestimated the rate of screening compared to estimates generated by using the algorithm (8.3 percent versus 18.0 percent prevalence, $p < 0.001$). By 1998, the screening prevalence rate generated from using the CPT code for screening mammography more closely approximated the rate generated by the algorithm (23.0 percent versus 25.1 percent). By all methods of estimating screening mammography with Medicare claims, its prevalence increased substantially between 1993 and 1998.

Conclusion. Providers increased their use of the screening mammography code in their charges to Medicare during the 1990s. This has improved the claims' ability to distinguish screening from diagnostic mammograms, but screening rates computed with claims continue to fall below those generated from self-reports of mammography use among general populations of older women.

Key Words. Mammography, Medicare, breast cancer

A screening mammogram is a mammogram performed on an asymptomatic woman for the early detection of breast cancer. Most authorities recommend

yearly screening mammography in women beginning at age 50, but differ at what age to stop (American Cancer Society 2001; AGS Clinical Practice Committee 1999; U.S. Preventive Services Task Force 1996). While the American Cancer Society and the National Cancer Institute pose no upper age limit for annual mammography, the American Geriatrics Society recommends screening every one to two years up to age 75. After age 75 it recommends screening every two to three years for women with an estimated life expectancy of at least four years. There are several ways to assess compliance with recommendations for screening mammography, including medical record review, patient self-report, physician report, and review of administrative datasets such as billing data (Montano and Phillips 1995; Anonymous 1995; Blustein 1995; Preston et al. 1997; Blustein and Weiss 1998; May and Trontell 1998; Parker et al. 1998; Welch and Fisher 1998; Parker, Sabogal, and Gebretsadik 1999; Smith-Bindman et al. 2000; Breen et al. 2001; Degnan et al. 1992; Blackman, Bennett, and Miller 1999; Burns et al. 1996; Breen and Kessler 1994).

For older women in particular, the Institute of Medicine has targeted a number of important breast cancer screening issues that could be initially addressed with Medicare claims data. These include monitoring trends in the use of screening mammography, examining geographic variations in screening incidence and studying the outcomes of routine screening in terms of follow-up procedures (Lohr 1990). However, it has not been clear whether the limitations of the claims will allow for the generation of valid information on these topics. In particular, even though separate codes on the claims are used for billing purposes, it is uncertain how well the Current Procedure Terminology (CPT) codes reflect the intent of the mammogram—for screening or diagnostic purposes.

Previous investigations using Medicare data have used three different approaches to identifying claims for screening mammograms: (1) any

The National Cancer Institute (RO1-CA72076) and the Department of the Army (BC990990) provided funding for this study. Additional funding was provided through a Training Grant from the National Institute on Aging (T32-AG00270).

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mammogram claim—CPT codes 76090 (mammography, unilateral), 76091 (mammography, bilateral), and 76092 (screening mammography, bilateral); (2) any bilateral mammogram claim—CPT codes 76091, and 76092; and (3) any screening mammogram claim—CPT code 76092 (Anonymous 1995; Blustein 1995; Preston et al. 1997; Blustein and Weiss 1998; May and Trontell 1998; Parker et al. 1998; Welch and Fisher 1998; Parker, Sabogal, and Gebretsadik 1999; Smith-Bindman et al. 2000). These approaches have been limited by problems in distinguishing claims for screening mammograms from those for diagnostic mammography. Before 1991, Medicare did not cover screening mammography. This led to actual screening mammograms being billed under a diagnostic code. This practice of billing for screening mammograms under a diagnostic code continued after 1991 (Anonymous 1995; Blustein 1995; Parker, Sabogal, and Gebretsadik 1999), which meant that using only the CPT code for screening mammography would underestimate actual screening mammography prevalence, while use of both the screening and diagnostic codes would overestimate the prevalence.

This study compares different approaches for defining screening mammograms with Medicare claims and their impact on estimates of breast cancer screening rates. Of interest is the extent to which estimates of prevalence rates vary across these methods and whether the variation has changed over time. In other words, is there evidence that the screening CPT code has become more widely used, particularly in 1998 when Medicare began reimbursing for annual mammography? In addition, we propose a fourth approach to defining a screening mammogram: any bilateral mammogram claim with no evidence of a previous mammogram performed in the prior 11 months and with no evidence of a breast-related diagnosis in the prior 24 months.

METHODS

The study utilizes Medicare claims and enrollment data that were provided by the Centers for Medicare and Medicaid Services (formerly, the Health Care Financing Administration, or HCFA) as part of the SEER (Surveillance, Epidemiology and End Results) Medicare data linkage project (Potosky et al. 1993; Reynolds 1994). Eligible subjects were selected from the summarized denominator (SUMDENOM) file, which includes demographic and Medicare entitlement information for a 5 percent sample of Medicare beneficiaries residing in SEER areas who have never had a diagnosis of cancer reported to

any of the registries. For each woman, screening mammography use was determined with claims from two sources: the Hospital Outpatient Standard Analysis File (SAF) (Facility Claims), and the National Claims History (NCH) 100 percent Physician/Supplier data file (Physician Claims) (U.S. Department of Health and Human Services 1995). The facility claims represent bills for facility-based outpatient services. Diagnoses are coded with the International Classification of Disease—Clinical Modification (ICD-9-CM) codes (U.S. Public Health Service and the Health Care Financing Administration 1998). Procedures are coded with the ICD-9-CM and also with the HCFA Common Procedure Coding System (HCPCS) that includes CPT codes and other codes assigned by the HCFA local carriers (*Physicians' Current Procedural Terminology—CPT 94* 1993; HCPCS 1997 National Level II Medicare Codes: *Health Care Financing Administration Common Procedures Coding System* 1997). The physician claims file contains the claims for physician and other provider services. Diagnoses are coded in ICD-9-CM and procedures in HCPCS.

We compare screening rates for the years 1993 and 1998. For each year, the study population consisted of females residing in SEER areas who were at least 67 years old on January 1 of the study year and who were alive on December 31 of the study year (83,213 women in 1993 and 91,641 women in 1998). We excluded women who were not enrolled in Medicare Parts A and B for the study year and the two previous years (7,867 women in 1993 and 6,806 women in 1998). We selected women aged 67 and older with complete Medicare coverage for the two prior years because the algorithm for screening mammography uses diagnoses in Medicare records in the two years prior to mammography. Women enrolled in a health maintenance organization (HMO) at any time during those three years were excluded because there may be less than complete billing data in the Medicare files for HMO patients (13,384 women in 1993 and 25,183 women in 1998). This yielded 61,962 eligible women in 1993 and 59,652 in 1998.

We defined a screening mammogram by four different methods:

1. Any claim for mammography (CPT 76090, 76091, 76092).
2. Any claim for bilateral mammography (CPT 76091, 76092).
3. Any claim for screening mammography (CPT 76092).
4. An algorithm, defined below.

The algorithm for defining a screening mammogram is diagrammed in Figure 1. For mammogram claims with a screening mammography CPT code (76092),

there had to be:

1. A screening diagnosis code in the physician's claim (V16.3, V10.3, V72.5, V15.89 in 1993 and V16.3, V76.12, V15.89 for 1998);
2. No previous diagnosis of breast cancer (174xx) or breast mass (61172) in the two years prior to the date of mammography in the physician outpatient or inpatient claims; and
3. No mammogram claim in the 11 months prior to the date of mammography in the physician claims.

For mammogram claims with a bilateral diagnostic CPT code (76091), there had to be 2 and 3 above. No mammograms with a unilateral mammography CPT code (76090) were considered to be screening.

Analyses

Prevalence rates of screening mammography were generated from the physician claims, the facility claims, and both sources combined. Each mammogram was defined as either screening or diagnostic based on each of the four definitions. Dichotomous variables were then created for each woman in the study as to whether she had at least one screening mammogram for that study year based on each definition. These variables were summed to generate the numerators for the prevalence rates, and the denominator was the number of eligible women for the given study year ($n = 61,962$ for 1993 and $n = 59,652$ for 1998). Contingency tables were generated and tested using likelihood ratio χ^2 tests. All computations and data management were done using the statistical application SAS[®] version 6.12 (SAS Institute 1997).

RESULTS

Comparison of Estimates of Screening Mammography by Source of Claims

We first investigated how different sources of Medicare claims data might affect the estimates of mammography use. Table 1 shows prevalence rates for mammography based on data from the physician file, facility file, and both sources combined. The physician claims produced estimates of mammography use that were about twice as large as the facility claims. Combining the two sources increased the prevalence rates estimated by the physician claims alone by less than 1 percent. Because physician claims alone produced estimates very close to those generated by using both sources of claims, in the remaining analyses we used physician claims alone.

Table 1: Percentage of Female Medicare Beneficiaries with at Least One Claim for Mammography (CPT 76090, 76091, 76092) in 1993 and 1998, Using Different Sources of Medicare Claims^a

<i>Source of Claims</i>	<i>1993 (N= 61,962)</i>	<i>1998 (N= 59,652)</i>
Physician claims only	24.2%	31.9%
Facility claims only	10.2%	17.6%
Both sources combined	25.0%	32.8%

^a Percentages in this table were generated by dividing the number of women with at least one mammography claim (in the given source or database of claims) by the number of eligible women during that study year (n), multiplied by 100 percent. For example, the number of women in 1993 with a least one claim for a mammogram (a claim with a CPT code of 76090, 76091, or 76092) in the physician claims database divided by the total number of eligible women in 1993 (61,962) and multiplied by 100 percent is 24.2 percent. For the "Both sources combined" row the numerator is the number of women with at least one mammogram claim in either the physician claims database or the facility claims database for the given year. The denominator is again the number of eligible women for that same year.

Note: The likelihood ratio χ^2 tests show that prevalence rates across the claim sources are significantly different ($p < 0.0001$) within each year.

Comparison of Different Definitions of Screening Mammography

Table 2 presents estimates of screening mammography use generated using four different methods of defining screening mammography: any mammogram claim, any bilateral mammogram claim, any screening mammogram claim, and an algorithm which defines a screening mammogram as any bilateral mammogram in a woman who had not undergone mammography in the prior 11 months and who did not have a diagnosis of breast disease in the prior 24 months (Figure 1).

We wish to make several points about this table. First, regardless of how screening mammography is defined, there was a marked increase in the percentage of women using screening mammography between 1993 and 1998 ($p < 0.0001$ for all comparisons). Second, in 1993, use of the screening mammography CPT code (76092) as a method to identify screening mammograms produced estimates of screening mammography use substantially lower than did the other methods; for example, an 8.3 percent estimate using the screening mammography CPT code versus an 18.0 percent estimate using the algorithm ($p < 0.0001$). However, between 1993 and 1998 there was a marked increase in the use of the screening code. In 1993 the estimate of screening mammography utilization derived from using only screening mammography claims is less than half that generated by the algorithm

Table 2: Percentage of Female Medicare Beneficiaries with at Least One Screening Mammogram in 1993 and 1998, by Different Definitions of a Screening Mammogram^a

<i>Definition of a Screening Mammogram User</i>	<i>1993 N= 61,962</i>	<i>1998 N= 59,652</i>
Any mammogram claim (CPT 76090,76091,76092)	24.2 (14,968)	31.9 (19,047)
Any bilateral mammogram claim (CPT 76091, 76092)	23.3 (14,434)	30.8 (18,380)
Any screening mammogram claim (CPT 76092)	8.3 (5,129)	23.0 (13,727)
Any screening mammogram by algorithm definition	18.0 (11,148)	25.1 (14,946)

^a Claims found in Physician Medicare Part B claims.

Note: Definitions were significantly different within each year ($p < 0.0001$) and prevalence differed significantly across the two years within each definition ($p < 0.0001$).

definition (8.3 percent versus 18.0 percent), while in 1998 the two estimates are much closer (23.0 percent versus 25.1 percent).

Another way of looking at the change in use of mammography CPT codes between 1993 and 1998 is shown in Figure 1. In 1998 more mammograms were given the CPT code for screening mammography than in 1993 (13,805 in 1998 versus 5,158 in 1993) while there were fewer mammograms with the CPT code for bilateral diagnostic mammography (4,911 in 1998 versus 9,550 in 1993). Hence, the distribution of screening versus diagnostic mammograms also changed. In 1993, 67 percent of all mammograms were coded as diagnostic (CPT codes 76090 or 76091) compared to 33 percent in 1998. Using the algorithm's definition, 29 percent were identified as diagnostic in 1993 and 28 percent in 1998.

DISCUSSION

The results of these analyses can be summarized as follows. First, use of the screening mammography code (CPT 76092) to estimate screening mammography rates with claims data substantially underestimated the percentage of older women receiving screening mammograms through the Medicare

Figure 1: Algorithm Used to Classify Mammograms as Screening or Diagnostic

Outline of algorithm defining screening mammography. The algorithm starts with 15,629 mammograms in 1993 and 20,549 mammograms in 1998 and then stratifies by CPT codes defining diagnostic unilateral mammography (CPT 76090), diagnostic bilateral mammography (CPT 76091), and screening mammography (CPT 76092). The number of cases in 1993 and in 1998 in each category is given in parentheses. All mammograms coded with the unilateral diagnostic CPT code (CPT 76090) were considered to be diagnostic. For mammograms coded with either bilateral diagnostic (CPT 76091) or screening (CPT 76092) CPT codes, the mammograms were considered to be diagnostic if there was a diagnosis of breast cancer or breast mass in the 24 months prior to the date of the incident mammogram (not including the actual date of the incident mammogram). Next, the mammogram was considered diagnostic if another mammogram had been performed in the 11 months prior to the date of the incident mammogram. The number of mammograms included and excluded at each step for 1993 and 1998 are given in parentheses.

program in 1993. However, by 1998 use of the screening code was more widespread and appeared to better approximate the actual percentage of beneficiaries provided screening through Medicare. Increased use of the screening code also appeared to improve the claims' ability to distinguish screening from diagnostic mammograms. Second, estimates of the overall use of screening mammography were substantially higher in 1998 compared to 1993.

The small difference in the estimates (~ 1 percent) of mammography use generated using the physician claims alone versus both physician and facility claims together indicate that very few claims are found in the facility claims files that do not have a corresponding physician claim. The facility claims alone were inadequate for assessing mammography use.

As mentioned above, use of the screening code alone appeared to substantially underestimate the use of screening mammography in 1993. This problem has also been identified by other studies using claims data to assess prevalence of mammography in elderly women (Anonymous 1995; Blustein 1995; Parker, Sabogal, and Gebretsadik 1999). One approach to compensating for underutilization of the screening code is to count any mammogram as a screening mammogram. This method produces overestimates of use, because mammography claims are a mix of both screening and diagnostic mammograms. We compensated for this overestimation with an algorithm, which counts all bilateral mammograms and then subtracts those where the woman had other mammography in the prior 11 months or a diagnosis of breast cancer or breast mass in the prior 24 months. These adjustments became less important by 1998, because the estimates using only the screening code better approximated those generated by the algorithm (Table 2).

Regardless of how screening mammography rates are measured with claims, estimates are lower than those produced through national surveys of self-reported use, even after adjusting for differences in screening interval (i.e., having a mammogram in the past year versus in the past two years) (Breen et al. 2001). For example, May and Trontell's systematic comparison of screening mammography rates generated from the 1992 National Health Interview Survey to rates generated from Medicare claims found that the differences are explained by a combination of factors related to different populations (defined by age, HMO membership, and institutionalized residence), errors in self-report of mammography use, errors in recalling the time of the last mammogram, and missing claims (May and Trontell 1998). After adjustments for these factors, estimated rates from the two sources fell within 2.7 to 3.9 percentage points of each other.

Direct comparisons of self-report survey methods to review of mammography facility records (Degnan et al. 1992), physician report (Montano and Phillips 1995), chart audits (Elmore et al. 1994), or billing data (May and Trontell 1998) have also found that mammography rates generated by self-report may be inflated. Discrepancies among the different sources used to estimate mammography use illustrate the challenge in obtaining accurate estimates of screening rates and lead one to question: "Which rate is right?" Physicians and patients tend to overestimate the use of screening mammography, charts may be inaccurate or incomplete, and screening mammography services provided to Medicare beneficiaries may be mislabeled as diagnostic or missing from the claims database. Each source clearly has its unique advantages and limitations, depending on the use for such information.

Using Medicare claims to estimate screening mammography rates in older women is considerably easier, faster and less expensive and than the more commonly used methods of self-report via telephone or in-person interviews. The major disadvantage is the exclusion of HMO members. Women belonging to Medicare HMOs were excluded from our study because of incomplete Medicare billing data. This represented approximately 27 percent of women in 1998. Since women enrolled in HMOs are more likely to receive screening mammography (Degnan et al. 1992), their exclusion would tend to underestimate the overall screening rate. Use of Medicare claims would also miss women who received screening mammograms from programs that do not bill Medicare, such as Veteran's Administration Hospitals and some community-based screening programs.

Nevertheless, as the IOM (Institute of Medicine) recommends, the claims may be used to track trends in mammography use at national, state, and local levels. For example, published studies have used the claims to examine the impact of Medicare reimbursement for screening mammography on screening rates (Blustein 1995; Preston et al. 1997), variation in screening by hospital service areas in Connecticut (Preston et al. 1997), differences in screening by population characteristics (Preston et al. 1997; Parker et al. 1998), and adherence to screening guidelines (Parker, Sabogal, and Gebretsadik 1999).

Another potential use for identifying women who receive screening mammography is in quality control of mammography services in the community. Investigators have shown considerable variation among radiologists in quality indicators such as sensitivity and specificity (Elmore et al. 1994; Beam, Layde, and Sullivan 1996; Feldman et al. 1995; Elmore, Wells,

and Howard 1998). For example, in one study, investigators had 10 radiologists experienced in mammography read 150 mammograms. Sensitivity ranged from 77 to 100 percent; false positive rates ranged from 20 to 68 percent. The radiologists also varied in what threshold they used for recommending biopsy, with most radiologists recommending biopsy when their suspicion of cancer was 2–6 percent.

Thus, there is a clear need for monitoring quality, but it is uncertain how such monitoring should be conducted. Chart audits are expensive. The IOM has recommended that investigators examine the feasibility of using administrative data to generate quality indicators of breast cancer care (Institute of Medicine 2000). For example, screening mammograms can be identified in Medicare data, and then subsequent diagnostic testing (breast ultrasound, additional mammograms, breast biopsies) can be assessed (Welch and Fisher 1998) as well as subsequent diagnoses of breast cancer (Freeman et al. 2000). By this process, specificity of screening mammography can be assessed across different patient groups. In addition, since approximately 20 percent of all mammograms are obtained in women older than age 65, the Medicare data would allow for robust estimates of specificity of screening mammography at the level of the individual mammographer.

In the context of these potential uses of Medicare data, one might reasonably question the importance of differentiating screening mammography from diagnostic mammography with the claims. We would argue that such a distinction is important in certain situations. For example, mislabeling as screening mammography a mammogram performed for evaluation of a lump found by a physician or by self-exam would bias estimates of the number of breast cancer cases discovered by screening mammography, and it would interfere with estimates of sensitivity and positive predictive value of screening mammography in the community.

The question of what represents a true screening versus a diagnostic mammogram, however, is more complex now than when mammography was first introduced. Given the substantial false positive rate, a cohort of women undergoing regular screening mammography will over time include an increasing percentage of women who have received diagnoses and procedures related to those false positive mammograms. Thus, for example, Elmore et al. (1998) estimated that the risk of a biopsy after 10 yearly mammograms among women who do not have cancer is 18.6 percent. What should bilateral mammograms obtained one year after an abnormal screening mammogram that resulted in a negative breast biopsy be termed? Is it screening or diagnostic?

Also problematic, are mammograms performed for surveillance purposes after the diagnosis of breast cancer. The Agency for Healthcare Research and Quality (formerly the Agency for Health Care Policy and Research, or AHCPR [1994]) has published clinical practice guidelines for mammography. They recommend diagnostic mammography for women with breast implants and for women who were treated with breast conserving surgery. For postmastectomy patients, they recommend screening mammography in the contralateral breast. Imaging the postmastectomy side with diagnostic mammography is considered “controversial.”

Thus, the definition originally used to define a screening mammogram—a bilateral mammogram performed on an asymptomatic woman to detect early breast cancer—is no longer as well defined as it was before mammography was introduced into routine clinical practice. Hence, depending on the use of the claims data, mammography performed after abnormal mammograms or after cancer treatment may be considered screening or diagnostic. Our algorithm categorizes such mammograms as diagnostic. This conservative approach would be appropriate for examining outcomes of screening mammography.

A limitation of the study was the source of Medicare claims. This population was derived from a 5 percent noncancer sample drawn from SEER areas. As none of the women in the sample had a prior history of any type of cancer reported to a SEER registry, this sample does not give us an accurate indication of the screening habits of women with a cancer history.

In conclusion, we have presented a method of estimating screening mammography use in older women using Medicare claims data. This method compensates for underestimation of screening mammography use that results if only the CPT code for screening mammography is used, and also for the overestimation if all mammography claims are counted as screening mammography. Increased use of the screening code in 1998 compared to 1993 has improved the claims’ ability to distinguish screening from diagnostic mammography. Medicare data provide an important way of monitoring use of screening mammography in older women.

ACKNOWLEDGMENTS

This study used the Linked SEER-Medicare Database. The interpretation and reporting of these data are the sole responsibility of the authors. The authors acknowledge the efforts of the Applied Research Program, NCI; the Office of

Information Services, and the Office of Strategic Planning, HCFA; Information Management Services (IMS), Inc.; and the Surveillance, Epidemiology, and End Results (SEER) Program tumor registries in the creation of the SEER-Medicare database.

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