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Predisposing, Enabling, and Reinforcing Factors Associated with Mammography Referrals in U.S. Primary Care Practices

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Abstract

Objective—We examined how predisposing, enabling and reinforcing factors influence mammography referrals by primary care physicians (PCPs).

Methods—Using the 2001–2003 National Ambulatory Medical Care and National Hospital Ambulatory Medical Care Surveys, we identified visits to office (n=8,756) and outpatient (n=17,067) PCPs by women≥40 without breast symptoms or breast cancer. We examined mammography referrals by predisposing (age, race, ethnicity, education, chronic problem), enabling (income, payer, visits within 12 months, time with physician), and reinforcing factors (physician age, gender, specialty/clinic, PCP status, region, MSA, solo/group practice). Gender, specialty, physician age, time with physician and solo/group were only in NAMCS. Clinic type was only in NHAMCS. We fitted logistic regression models adjusted for all factors and year.

Results—Office-based referrals were more likely during visits: for preventive or chronic care; with private payer *vs* self/uninsured; by women with no visit within 12 months *vs*≥3; lasting≥15 minutes; to female PCPs; to PCPs aged ≥45; to gynecologists. Outpatient referrals were more likely during visits: by Hispanics; for preventive or chronic care; by women with no visit within 12 months; to one's own PCP; to gynecologic clinics; in the Northeast or Midwest.

Conclusions—Reinforcing factors, in addition to predisposing and enabling factors, are associated with mammography referral. Interventions to increase referrals should consider provider factors and aspects of the healthcare environment, and recognize differences between settings. Efforts to facilitate referrals during chronic care visits or outpatient visits to non-PCP providers may provide opportunities to increase screening. Efforts are needed to ensure that uninsured women are receiving appropriate referrals.

Keywords

Mammography referral; breast cancer; primary care

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INTRODUCTION

Breast cancer is the most commonly diagnosed cancer among women in the United States and the second leading cause of cancer death in women of all racial groups [1]. Screening reduces breast cancer mortality [2], although recent national estimates indicate that approximately 30% of U.S. women did not report having a recent mammogram [3]. Lack of physician recommendation for mammography is one of the most commonly reported reasons why women do not undergo mammography, and has a powerful influence on screening use [4,5]. Many patient factors have been associated with breast cancer screening, including age, breast cancer risk, having health insurance, higher income, greater education, and longer duration of residence in the United States [6–10]. Having a usual source of health care and continuity of health care also facilitate adherence to screening [6,11]. Less is known about the influence on screening of factors related to healthcare providers and the healthcare environment. Findings suggest that some physician characteristics may be associated with screening practices [7,9,12–15]. A recent meta-analysis of factors associated with mammography utilization found that physician specialty was associated with mammography use, but concluded that due to the relatively low number of studies and the lack of recent evidence, further investigation in this area was needed [4]. Other physician, healthcare system, and access factors such as age, gender, practice structure and time spent with physician were not reported.

Moreover, few studies have examined factors associated with mammography screening using a conceptual framework to examine the contributions of patient characteristics and factors related to the healthcare environment. To better understand the influence of various factors on mammography referrals in clinical practice, we employed a conceptual framework based on the systems model of clinical preventive care [16] and the behavioral model of health services use [17]. The first model focuses on the patient-physician interaction and details categories of factors that promote or inhibit preventive care. The second model was developed to help understand the use of health services and measure equitable access to health care. Our conceptual framework includes predisposing, enabling, and reinforcing factors. Predisposing factors are those associated with the individual receiving care, such as demographics or burden of illness. Enabling factors are those that relate to healthcare access and the affordability and availability of screening, such as higher income and health insurance coverage. Reinforcing factors relate to the provider and the healthcare system or environment and may include physician characteristics, practice structure, geographic region, or residence in a metropolitan statistical area (MSA). The purpose of this study was to examine the relationship of predisposing, enabling, and reinforcing factors with mammography referrals provided in primary care practices in the United States.

MATERIALS AND METHODOLOGY

We combined visit-level data from the 2001 to 2003 National Ambulatory Medical Care Survey (NAMCS) [18] and the National Hospital Ambulatory Medical Care Survey (NHAMCS) [19], which are national, annual probability sample surveys supplying information about care in ambulatory settings. In NAMCS, information about patient visits to non-federally employed, office-based physicians is abstracted by providers or office staff on a random sample of visits. Provider and practice information were also obtained [18]. In the NHAMCS, information is collected on visits to hospital emergency and outpatient departments in non-institutional general and short-stay hospitals, excluding federal, military, and Veterans Administration hospitals. Hospital outpatient department staff completes standard data forms similar to those used in NAMCS during a randomly selected period. Sample data must be weighted to obtain national estimates of ambulatory care.

We identified visits to primary care practices in office settings (NAMCS) by women aged 40 years or older. For hospital outpatient departments (NHAMCS), we subsetted visits to general medicine and gynecology clinics by women in this age group. This age threshold was chosen to be consistent with recommendations for initiating mammography screening [2]. We excluded visits by women presenting with breast symptoms or with a recorded breast cancer history.

Our dependent variable was provider referral for mammography, defined using the survey item that asked of providers/practice staff whether a mammogram was "ordered or provided" during the visit. Independent variables were selected according to our conceptual model. Predisposing factors included patient age, race, Hispanic ethnicity, education, and chronic illness visits. We excluded race groups other than white, black, and Asian/Pacific Islander due to small numbers. Education information was based on 2000 U.S. Census data regarding the proportion of adults with more than a high school education residing within a woman's residential zip code. We considered women to have a chronic illness visit if the major reason for the visit was "chronic problem, routine" or "chronic problem, flare-up." Other visit types included preventive care and acute care (acute problems or peri-operative care). We considered all visit types, not just preventive visits, because evidence suggests that a large proportion of mammograms are ordered outside of visits for general medical or gynecologic exams [20].

Enabling variables reflect access to and availability of health care and providers, and included household income, expected payment source, number of visits during the preceding 12 months, and time spent with the physician. Income information was obtained from 2000 U.S. Census data regarding the median income in the patient's residential zip code. Visit number consisted of visits by the woman to any provider in that practice (NAMCS) or clinic (NHAMCS) during the preceding 12 months, using the survey-defined categories of none, 1–2 visits, 3–5 visits, and ≥6 visits.

Reinforcing variables included physician factors (age, gender, primary care specialty, PCP status) and healthcare environment factors. We defined primary care specialty as internal medicine, general/family practice, or gynecology in NAMCS and defined clinic type as general medicine *vs* gynecology in NHAMCS. PCP status was determined by a survey item which asked, for each sampled visit, "Are you the patient's primary care physician?" Healthcare environment factors included practice region (Northeast, Midwest, South, West) and MSA status (MSA *vs* non-MSA) as well as practice environment factors such as practice structure (solo *vs* group) and setting (e.g., hospital-based outpatient department *vs* office-based). Physician age, gender, primary care specialty, practice structure, and time spent with the patient were available only from NAMCS.

We stratified analyses by setting (hospital-based outpatient *vs* office-based), because we anticipated that factors related to referrals might vary by practice setting, possibly due to differences in patient populations [21]. Referral percentages were calculated by predisposing, enabling, and reinforcing factors; with 95% confidence intervals calculated using a logit transformation. Statistical testing for discrete variables was performed using the Pearson chi-square test. Because chi-square tests examine overall associations and do not indicate which categories differ significantly, interpretations of where differences lay were made based on comparing confidence intervals between groups. Continuous variables included education and income, and represent the median income and the proportion of adults with at least a high school education in a patient's zip code of residence. We presented the median values for these variables with 25^{th} and 75^{th} percentiles. Statistical testing for unadjusted differences in the distribution of continuous variables by mammography referral was performed using linear regression models with the ranks of the

continuous variable of interest as the dependent variable and mammography referral as the independent variable. We modeled the ranks because non-parametric testing procedures are not implemented in statistical software packages that handle complex sample survey analyses.

Multivariable logistic regression models were created to determine characteristics associated with mammography referral in office-based and hospital outpatient-based settings, after adjusting for all factors and survey year. With the exceptions described above for physician age, gender, specialty, practice structure and time spent with physician, variables were defined in the same way for both models. Restricted cubic spline functions were used to assess the linearity assumption between continuous independent variables (education, income) and mammography referral [22]. P-values presented in the modeling table are for simultaneously testing that all beta coefficients associated with a given variable are equal to 0. Statistical testing for all models was performed using the Wald chi-square test. Results are presented as adjusted odds ratios with 95% confidence intervals. All statistics were generated using SUDAAN version 9.0 (Research Triangle Institute, Research Triangle Park, NC) and SAS version 9.1 (SAS Institute Inc., Cary, NC). All data were weighted to account for the complex survey design and nonresponse. P-values <.05 were considered significant.

We used data imputed by NCHS when available. Missing data items were imputed by NCHS by randomly assigning a value from a patient record with similar characteristics (specialty, region (or state for ethnicity), and ICD-9-CM diagnosis codes) [18]. Item nonresponse rates for the overall surveys were 5% or less for all data items with the exception of race, ethnicity, prior visits, and time spent with physician. Birth year, sex, and race were imputed in both NAMCS and NHAMCS for all years. Ethnicity and number of prior visits in the last 12 months were imputed only in 2003 for both datasets. Time spent with physician, available from NAMCS only, was imputed for all years. We created missing data indicator variables for factors missing ≥5% of data in our samples (Hispanic ethnicity, PCP status, number of visits) because casewise deletion would have resulted in a significant reduction in sample size and a corresponding loss of statistical power. The *p*-values presented in the modeling tables for these variables are based on linear contrasts of the beta coefficients excluding the missing indicator coefficient.

In 2003, the National Center for Health Statistics (NCHS) revised the method of adjustment for non-response in NAMCS to account for practice size and variability in the number of weeks per year that physicians practiced [18]. To be consistent across years, we applied the 2003 revised estimators to each survey year in our sample. Because estimates with a relative standard error (RSE) >30% may be unreliable, we have footnoted these estimates to caution the reader.

RESULTS

Overall, 8,756 office-based visits and 17,067 hospital-based outpatient visits were included in our sample. Visit characteristics are shown in Table 1. Table 1 presents the raw sample sizes and weighted national estimates of the percent distributions of predisposing, enabling, and reinforcing factors for physician office and outpatient clinic visits. Percentiles of income and education by setting are shown in Table 2.

In unadjusted analyses (Tables 2 and 3), mammography referrals during office visits were positively associated with being younger than 70 *vs* 70 or older. Referrals were also more likely among women aged 50–59 years *vs* 60–69. Other factors associated with referrals included being non-Hispanic, residence in areas where a greater proportion of adults had at least a high school education, and visits for chronic and particularly preventive care

(predisposing factors); residence in areas with a higher median income, expected payment from private insurance, fewer than 3 visits within the previous 12 months or new patient visits, and at least 15 minutes spent with physician (enabling factors); and female providers, non-PCP status, gynecologic specialty, and MSA residence (reinforcing factors). For hospital-based outpatient practices, we observed positive associations for visits by women in their forties *vs* women aged 70 or older, Hispanic ethnicity, chronic and particularly preventive care visits (predisposing factors), no visits within the previous 12 months (enabling factors), and for visits to gynecology clinics, in MSA areas, and in the Northeastern *vs* Western regions (reinforcing factors).

Results from adjusted analysis are shown in Tables 4 and 5. Office-based referrals (Table 4) were more likely given during visits for chronic and particularly preventive care *vs* acute care (predisposing factors); by women with private expected source of payment *vs* self/uninsured women, by women with no visits within the preceding 12 months *vs* ≥3 visits, where at least 15 minutes were spent with the physician *vs* less than 15 minutes (enabling factors); visits to female *vs* male PCPs, to physicians at least 45 years old, and to gynecologists *vs* internal medicine or general/family practitioners (reinforcing factors). Hospital-based outpatient referrals (Table 5) were more likely given during visits by Hispanic *vs* non-Hispanic women, for chronic and particularly preventive care *vs* acute care (predisposing factors); by women with no visits within the preceding 12 months *vs* new patient visits or ≥3 visits (enabling factors); to a woman's own PCP *vs* another PCP, to gynecology *vs* general medicine clinics, and in the Northeast or Midwest *vs* the West (reinforcing factors).

DISCUSSION

Physician recommendation is one of the strongest predictors of breast cancer screening participation [4,23–27]. Given the importance of recommendation, understanding factors that influence screening recommendation or referral is important to maximize adherence with screening guidelines [24]. Our findings from national surveys of care provided during primary care visits suggest that mammography referral can be understood as interplay between predisposing factors associated with individuals receiving care, enabling factors relating to healthcare access, and reinforcing factors associated with providers or the healthcare environment. This is consistent with other evidence indicating that predisposing and enabling factors are related to breast cancer screening [6–9,24,28]. Some evidence suggests that several reinforcing factors may play a role [7,10,23,24,28–30]. One study reported that physician and practice factors may explain more of the variation in mammography referral practices than patient or health service utilization factors [31]. Our findings support that provider and healthcare system factors are important determinants of physician referrals. We found this to be so in both office-based and hospital-based outpatient settings, and after controlling for patient and access or availability factors. Future studies and conceptual models for referrals should examine further aspects of the healthcare environment and patient-physician interactions in addition to those examined in the present study.

Our study also contributes to the literature by examining several reinforcing factors not previously well-studied, including physician age, PCP status and solo *vs* group practice structure. Few studies of mammography screening have examined the role of physician age. Some have reported no significant or meaningful association [29,32], while others concluded that older physicians were less likely to screen [7,24]. We found that physicians aged 45 or older were more likely to refer for mammography than younger physicians. Further study using more current data is needed to confirm this finding, and to examine this relationship in hospital-based outpatient practices.

We also found that solo/group practice status was not associated with referrals in office settings, although we did find an association of PCP status in hospital outpatient clinics. Visits to a woman's own PCP were more likely to result in referral than visits to other providers. Other providers may defer screening decisions to the PCP, or visits to non-PCP providers may represent visits for acute problems, during which preventive care may be less likely to be addressed. However, this finding persisted after adjusting for visit reason and other factors. Women may also be more comfortable discussing breast cancer screening with their own PCP. Some evidence suggests that women may be less likely to adhere to screening recommendations from providers who are not their personal PCP [7]. It is uncertain why we did not find this association in office settings. This may be due to the inclusion of gynecologists in our sample. Gynecologists were less likely to be the PCP and had much higher referral rates. Furthermore, the proportion of gynecologists was more than twice as high in NAMCS compared with NHAMCS. We did find that PCP status was associated with increased referrals in NAMCS when gynecologists were excluded.

Furthermore, we found that determinants of screening referrals vary somewhat between office-based and hospital-based outpatient settings. Differences between settings may reflect differences in patient populations [21] or in access barriers. For example, minority women have a higher likelihood of receiving care from hospital outpatient departments [21] and may be less up-to-date with mammography screening [33], including Hispanic women. This could explain the increased referral rates among Hispanic women in hospital outpatient settings, although why this was not true in office settings is less clear. Differences between settings in office systems to promote screening, such as reminders, could minimize differences in referrals by ethnicity. Variations between settings also may reflect differences in providers who practice in these settings or in the healthcare environment. Findings also could stem from differences in populations sampled in these two datasets, although systematic random sampling of visits was used [18,19].

We observed no differences in referral rates by race in unadjusted or adjusted analyses. Differences in referral by ethnicity were significant in hospital outpatient settings, with visits by Hispanic women more likely to include referral. These findings raise the question of whether lower mammography use by race or ethnicity reported in some previous studies and reports [6,33,34] may reflect differences in other factors such as access and availability of screening or adherence to recommendations and referrals, rather than differences in physician referral. However, we were unable to examine completed mammography use in this study. The lack of difference in referrals between black and white women is consistent with findings from previous research concerning mammography recommendation rates (i.e., tests recommended but not necessarily ordered) [24,28,35,36].

Our findings indicate that in office settings, visits by uninsured women, who have consistently been shown to experience disparities in mammography use [6,37,38], were substantially less likely to include referral than visits by privately insured women. Although caution is needed in interpreting this finding because information about whether women were due for screening was not available, this finding is consistent with previous evidence about the influence of insurance on physician recommendation or referral for mammography [24,28,30,36]. In one study, the relationship of insurance to screening completion was found to operate through provider recommendation [24]. Further research is needed to determine why referrals are less likely to be provided during visits by uninsured women to these practices. No differences in referrals by expected payer were observed in hospital outpatient settings.

Mammography referrals were much more likely to be given during visits for preventive care than during visits for acute or chronic health problems, consistent with assertions that the

type of visit influences whether preventive care will be addressed [39]. However, only about 17% of office visits and 12% of outpatient visits in these national surveys were for preventive care. Other studies have found that mammography recommendations were associated with visits for “annual exams,” compared with visits for routine chronic care [10,40], and that visits for urgent issues were less likely to be associated with mammography recommendations [10]. As in our study, longer visit duration has also been associated with referrals [28], although we found that visit reason remained a strong predictor of referral after adjusting for time spent with the physician. Women seen for visits dedicated to preventive care may differ from women without such visits, or providers who encourage preventive care visits may differ from other providers. These findings also could reflect competing demands during visits and/or the probability of women being due for screening exams. Visits for chronic problems also were more likely to lead to referrals than visits for acute problems. However, the association for preventive care visits was the strongest in both settings.

The time spent with the physician also remained significantly associated with referral in regression analysis, as in a study of visits to office-based physicians of many specialties [28]. Our findings add to these by describing this association for PCPs, who frequently provide cancer screening services to patients, and by demonstrating the persistence of this relationship after controlling for visit reason. Longer duration of visits involving referral may reflect time needed to discuss screening with women [28].

The number of visits to a practice or clinic within the preceding 12 months also was strongly associated with mammography referrals, even after adjusting for predisposing and reinforcing factors. Visits by women with no visits within the preceding 12 months were more likely to involve a referral. This finding is not surprising given that these women may more likely be due for screening and less likely to have already received a recommendation at a recent visit. The lower likelihood of referral among women with more visits could reflect referral at a previous visit or could be due perhaps to comorbidities leading to an increased number of visits.

Our results related to provider gender are consistent with previous literature suggesting that female providers are more likely to screen for breast cancer [10,14,15,24,31], and to provide preventive services than male providers [14,29]. Reasons for this are uncertain and may partly reflect differences in patient populations [14,15,28], although we found a persistent difference by provider gender after controlling for patient age, race, ethnicity, education, income, and insurance. Patients of male and female providers have been found to be similar in attitudes toward mammography [14]. However, female providers may have more positive attitudes toward [14] or score higher on tests of preventive care [31]. Measures of care availability, comprehensiveness, continuity of care, and communication have been suggested to influence preventive care [41]. Evidence that female physicians may provide more health maintenance visits [42] or spend more time with patients [14,15] may suggest differences in the process of primary care that may influence preventive care delivery. However, our finding was independent of time spent with physician. Finally, male providers may refer patients to other providers for screening (e.g., gynecologists). We did not have information about referrals to other providers to examine this possibility. Information about provider gender was available only for office providers.

Some evidence suggests that primary care specialty is related to mammography offering or recommendation [7,23,30], although some have not found this to be true [32]. Our findings support that primary care specialty is related to referrals, with gynecologists more likely to refer during visits than general/family practitioners. We found this to be true in both office-based and hospital-based outpatient settings. Others have found that the obstetrics/

gynecology specialty may be related to mammography screening [28,29,43,44]. Potential differences by primary care specialty may reflect differences in training, differing recommendations by clinical organizations, how patients seek care from providers [9], or other factors. Patient populations cared for by different primary care specialties may vary as well [7]; however, our findings regarding specialty persisted after controlling for many of these factors.

Some prior studies have noted geographic variation in mammography screening or recommendation [7,35]. Our results support that geographic variation in screening may exist, and further suggest that findings may vary by setting. Additional studies are needed to confirm and explore potential reasons for this finding. One possible explanation might be differing use of reminder systems, flow sheets, or other healthcare system interventions to increase routine mammography use. However, information about reminder systems or other interventions to promote routine mammography was not available. Future versions of NAMCS data will contain information about reminders, which could be considered for future analyses.

NAMCS and NHAMCS data used in this study were abstracted from medical records, and therefore not subject to the problems inherent to self-reported data. However, findings need to be interpreted in light of several limitations. Data were cross-sectional and at visit level, not patient level. Therefore, there may be some bias towards women who more frequently utilize care. Patient-level identifiers are not collected in the NAMCS/NHAMCS surveys, thus individual patients cannot be tracked in the data. The visit sample is selected independently, without regard to patient. It is theoretically possible that some clustering of visits by specific patients could occur during the reporting period or by the same patients across different sampled visits to other physicians. However, the sample design is intended to yield estimates of visits without regard to either persons or patients. Furthermore, we did not have information about whether screening referrals were completed or recommended but not ordered. However, provider recommendation for mammography is an important determinant of screening completion [23,24]. We were also unable to ascertain which women were due or overdue for screening and which were up-to-date. Also, we were unable to account for the variability associated with imputed values. As a result, the standard errors for these variables will be biased low, yielding test statistics somewhat too large and associated *p*-values too small. However, given the large proportion of missing data for some variables, we chose to use the imputed values rather than lose this important information. Finally, some clinical practices are excluded from NAMCS and NHAMCS, such as federally-employed physicians and federal, military, and Veterans Administration hospitals.

CONCLUSION

In summary, reinforcing factors, in addition to predisposing and enabling factors, are associated with mammography referral in primary care, an important determinant of breast cancer screening participation. Interventions to increase referrals should consider provider factors and aspects of the healthcare environment, in addition to patient and access factors, and should recognize differences between settings. Furthermore, efforts to facilitate referrals during chronic care visits or outpatient visits to non-PCP providers may provide an opportunity to increase breast cancer screening. Finally, efforts are needed to ensure that uninsured women are receiving appropriate referrals.

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Table 1

Characteristics of Visits to Office-Based Primary Care Physicians and Hospital Outpatient General Medicine and Gynecology Clinics by Women Ages 40 Years and Older, National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey, 2001–2003

	Visits to Office-Based Primary Care Physicians		Visits to Hospital Outpatient Clinics	
	n[a]	%[a]	n[a]	%[a]
Total	8,756	100	17,067	100
Predisposing Factors				
Patient Age (yrs)				
40–49	2,464	26.9	5,456	31.1
50–59	2,136	24.1	4,504	26.0
60–69	1,544	17.7	3,389	19.5
≥ 70	2,612	31.3	3,718	23.4
Patient Race				
White only	7,694	86.3	12,529	76.6
Black only	802	10.4	3,912	20.1
Asian/Pacific Islander only	260	3.3	626	3.3
Patient Ethnicity				
Hispanic	537	8.1	2,154	12.6
Not Hispanic	6,879	75.7	13,182	77.5
Missing	1,340	16.2	1,731	9.9
Reason for visit				
Chronic problem	3,533	41.3	7,829	45.1
Acute problem	3,378	37.6	6,043	38.6
Preventive care	1,510	16.9	2,265	11.7
Missing	335	4.3	930	4.6
Enabling Factors				
Expected source of payment				
Medicare	2,846	33.4	4,735	28.5
Medicaid	466	5.0	3,357	16.3
Private	4,585	52.4	5,255	35.1
Other	217	2.3	825	4.4
Self/uninsured	395	4.1	1,999	10.9
Missing/unknown	247	2.9	896	4.7
# of visits in prior 12 mos[b]				
New patient	484	5.5	2,119	10.7
0	573	6.6	852	4.5
1–2	2,235	25.3	3,943	23.3
3–5	2,674	30.4	3,988	24.0
≥ 6	2,360	26.9	4,651	28.9

	Visits to Office-Based Primary Care Physicians		Visits to Hospital Outpatient Clinics	
	n[a]	%[a]	n[a]	%[a]
Missing	430	5.2	1,514	8.6
Time spent with physician			NA	
< 15 minutes	2,030	24.1		
15–<30 minutes	5,213	59.4		
≥ 30 minutes	1,513	16.5		
Reinforcing Factors				
Physician age (yrs)			NA	
< 45	3,146	36.3		
45–54	3,393	38.5		
≥ 55	2,217	25.2		
Physician gender			NA	
Male	6,604	75.3		
Female	2,152	24.7		
PCP status				
PCP for that patient	6,508	75.7	6,962	46.1
Not PCP for that patient	1,777	18.9	8,319	43.4
Missing	471	5.4	1,786	10.5
Physician specialty			NA	
Internal Medicine	2,534	39.6		
General/family practice	4,734	45.2		
Obstetrics and gynecology	1,488	15.1		
Clinic type	NA			
General Medicine			14,492	93.1
Obstetrics and gynecology			2,575	6.9
Solo *vs* group practice			NA	
Solo	3,313	39.2		
Group	5,443	60.8		
MSA[c]				
MSA	6,914	81.7	14,733	77.5
Non-MSA	1,842	18.3	2,334	22.5
Geographic region				
Northeast	1,760	24.5	4,930	25.8
Midwest	2,185	21.1	5,205	25.8
South	2,873	33.1	4,461	37.2
West	1,938	21.3	2,471	11.1

[a]Percentages were calculated using weighted national survey estimates. Ns are unweighted. Unweighted data from the NAMCS and NHAMCS are not nationally representative and are included merely as indicators of sample size.

[b]Does not include index visit.

[c] MSA = metropolitan statistical area.

NA = not available.

Table 2

Education and Income Distributions[a] by Practice Setting and Mammography Referral

Characteristic	Total	Mammography Referral	No Mammography Referral	p-Value[b]
Office-based primary care practices	n=8,330	n=733	n=7,597	
% with at least high school education[c]	83.3 (74.1, 89.6)	85.8 (78.3, 90.8)	83.2 (73.9, 89.4)	<0.001
Median household income[c] ($)	41026 (33359, 54521)	46521 (35759, 60672)	40723 (33197, 54045)	<0.001
Hospital outpatient departments	n=16,255	n=1,031	n=15,224	
% with at least high school education[c]	78.5 (69.2, 85.8)	78.0 (69.2, 84.8)	78.5 (69.2, 85.8)	0.464
Median household income[c] ($)	35946 (28804, 45993)	36590 (27964, 47044)	35915 (28804, 45961)	0.881

[a] Distributions of the proportion of adults with at least a high school education and of the median household income in a patient's zip code of residence are presented as medians (25^{th} percentile, 75^{th} percentile).

[b] P-value from linear regression models with ranks of continuous income or education variable as the dependent variable and mammography referral as the independent variable.

[c] Based on zip code level data from the 2000 Census.

Table 3

Bivariate Associations of Predisposing, Enabling, and Reinforcing Factors with Mammography Referrals According to Setting, National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey, 2001–2003

	Visits to Office–Based Primary Care Physicians			Visits to Hospital Outpatient Clinics		
	n[a]	%[a] of Visits with Mammography Referrals	CI	n[a]	%[a] of Visits with Mammography Referrals	CI
Predisposing Factors						
Patient Age (yrs)		p<.001			p=.009	
40–49	2,464	9.4	7.9–11.2	5,456	5.8	4.7–7.1
50–59	2,136	11.2	9.5–13.2	4,504	5.6	4.5–6.9
60–69	1,544	7.5	6.0–9.4	3,389	5.4	4.0–7.3
≥ 70	2,612	3.7	2.9–4.7	3,718	3.4	2.5–4.7
Patient Race		p=.686			p=.053	
White only	7,694	7.9	6.9–8.9	12,529	4.7	3.8–5.7
Black only	802	6.6	4.3–9.9	3,912	6.8	5.3–8.8
Asian/Pacific Islander only	260	7.3	4.4–12.0	626	5.5	3.7–8.2
Patient Ethnicity		p=.040			p=.022	
Hispanic	537	5.1	3.4–7.6	2,154	7.2	5.4–9.6
Not Hispanic	6,879	8.2	7.2–9.3	13,182	4.9	4.1–6.0
Reason for visit		p<.001			p<.001	
Chronic problem	3,533	3.6	2.8–4.5	7,829	3.5	2.7–4.6
Acute problem	3,378	2.1	1.6–2.7	6,043	1.9	1.4–2.5
Preventive care	1,510	31.9	28.1–35.9	2,265	22.9	18.6–27.8
Enabling Factors						
Expected source of payment		p<.001			p=.182	
Medicare	2,846	4.4	3.6–5.3	4,735	4.2	3.2–5.6
Medicaid	466	3.1[b]	1.6–6.0	3,357	5.5	4.3–7.0
Private	4,585	10.8	9.4–12.4	5,255	4.7	3.5–6.3
Other	217	7.0[b]	3.3–14.3	825	5.0	3.0–8.1
Self/uninsured	395	3.6	2.0–6.4	1,999	7.3	5.4–9.8

	Visits to Office–Based Primary Care Physicians			Visits to Hospital Outpatient Clinics		
	n[a]	%[a] of Visits with Mammography Referrals	CI	n[a]	%[a] of Visits with Mammography Referrals	CI
# of visits to practice[c]		p<.001			p<.001	
New patient	484	12.5	9.0–17.1	2,119	4.1	2.8–5.9
0	573	28.4	23.7–33.6	852	15.3	9.4–23.9
1–2	2,235	10.6	8.8–12.7	3,943	6.8	5.6–8.3
3–5	2,674	4.5	3.6–5.6	3,988	4.5	3.5–5.8
≥ 6	2,360	3.0	2.1–4.2	4,651	3.1	2.3–4.2
Time spent with physician		p<.001			NA	
< 15 minutes	2,030	4.4	3.2–6.1			
15–<30 minutes	5,213	7.5	6.4–8.9			
≥ 30 minutes	1,513	13.1	10.3–16.6			
Reinforcing Factors						
Physician gender		p<.001			NA	
Male	6,604	6.4	5.4–7.5			
Female	2,152	11.8	9.5–14.6			
Physician age (yrs)		p=.194			NA	
< 45	3,146	6.6	5.4–8.0			
45–54	3,393	8.0	6.5–9.8			
≥ 55	2,217	9.0	6.6–12.0			
PCP status		p<.001			p=.201	
PCP for that patient	6,508	4.8	4.1–5.7	6,962	5.6	4.4–7.1
Not PCP for that patient	1,777	18.5	15.6–21.8	8,319	4.4	3.3–5.9
Physician specialty		p<.001			NA	
Internal Medicine	2,534	3.7	2.7–5.1			
General/family practice	4,734	4.4	3.6–5.4			
Obstetrics and gynecology	1,488	28.1	24.3–32.2			
Clinic type		NA			p<.001	
General Medicine				14,492	4.2	3.4–5.2
Obstetrics and gynecology				2,575	17.0	14.1–20.4

	Visits to Office–Based Primary Care Physicians			Visits to Hospital Outpatient Clinics		
	n[a]	%[a] of Visits with Mammography Referrals	CI	n[a]	%[a] of Visits with Mammography Referrals	CI
Solo *vs* group practice		p=.122			NA	
Solo	3,313	6.7	5.2–8.4			
Group	5,443	8.4	7.2–9.8			
MSA[d]		p<.001			p=.037	
MSA	6,914	8.6	7.6–9.7	14,733	5.7	4.7–6.8
Non-MSA	1,842	3.8	2.7–5.4	2,334	3.3	1.8–5.8
Geographic region		p=.931			p=.019	
Northeast	1,760	8.1	6.2–10.7	4,930	6.9	5.5–8.7
Midwest	2,185	7.5	6.0–9.2	5,205	5.8	4.3–7.6
South	2,873	7.4	6.0–9.0	4,461	3.9	2.6–5.8
West	1,938	8.0	6.1–10.4	2,471	3.7	2.5–5.5

[a]Percentages were calculated using weighted national survey estimates. Ns are unweighted. Unweighted data from the NAMCS and NHAMCS are not nationally representative and are included merely as indicators of sample size.

[b]Estimates should be interpreted with caution due to relative standard error ≥ 30%.

[c]Does not include index visit.

[d]MSA = metropolitan statistical area.

NA = not available.

Note: Statistical testing for differences in mammography referral across levels of predisposing, enabling, and reinforcing factors performed using the Pearson chi-square test.

Table 4

Adjusted Associations of Predisposing, Enabling and Reinforcing factors with mammography referrals by office-based primary care physicians, National Ambulatory Medical Care Survey 2001–2003

	Office-Based Primary Care Physicians		
	Odds Ratio[a]	**95% CI**	**p-Value[b]**
Predisposing Factors			
Patient Age (yrs)			0.066
40–49	1.00	Reference	
50–59	1.38	1.05–1.81	
60–69	1.31	0.89–1.93	
≥ 70	0.92	0.52–1.64	
Patient Race			0.931
White only	1.00	Reference	
Black only	1.03	0.65–1.64	
Asian/Pacific Islander only	1.12	0.61–2.05	
Patient Ethnicity			0.246
Hispanic	0.74	0.44–1.24	
Not Hispanic	1.00	Reference	
Education[c]			0.934
Per 10% increase in high school graduates	0.99	0.86–1.15	
Reason for visit			<0.001
Chronic problem	2.18	1.53–3.12	
Acute problem	1.00	Reference	
Preventive care	13.79	9.81–19.38	
Enabling Factors			
Income[c]			0.662
Per $10,000 increase in median income	1.02	0.93–1.12	
Expected source of payment			0.039
Medicare	2.30	0.86–6.17	
Medicaid	1.66	0.63–4.42	
Private	2.86	1.30–6.28	
Other	3.35	0.99–11.33	
Self/uninsured	1.00	Reference	
# of visits in prior 12 months[d]			<0.001
New patient	0.66	0.42–1.02	
0	1.00	Reference	
1–2	0.77	0.53–1.12	
3–5	0.50	0.32–0.78	
≥ 6	0.34	0.21–0.57	

	Office-Based Primary Care Physicians		
	Odds Ratio[a]	**95% CI**	**p-Value[b]**
Time spent with physician			<0.001
< 15 minutes	1.00	Reference	
15–<30 minutes	1.80	1.27–2.54	
≥ 30 minutes	2.26	1.49–3.44	
Reinforcing Factors			
Physician gender			0.021
Male	0.62	0.42–0.93	
Female	1.00	Reference	
Physician age (yrs)			0.022
< 45	1.00	Reference	
45–54	1.47	1.03–2.11	
≥ 55	1.69	1.12–2.56	
PCP status			0.380
PCP for that patient	1.19	0.80–1.77	
Not PCP for that patient	1.00	Reference	
Physician specialty			<0.001
Internal Medicine	0.69	0.44–1.09	
General/family practice	1.00	Reference	
Obstetrics and gynecology	2.76	1.64–4.65	
Solo *vs* group practice			0.330
Solo	1.18	0.84–1.65	
Group	1.00	Reference	
MSA[e]			0.281
MSA	1.27	0.82–1.98	
Non-MSA	1.00	Reference	
Geographic region			0.070
Northeast	1.00	Reference	
Midwest	1.65	1.12–2.41	
South	1.33	0.88–2.01	
West	1.18	0.80–1.74	
Year			0.405
2001	1.00	Reference	
2002	0.89	0.62–1.29	
2003	0.74	0.48–1.15	

[a] Adjusted for factors in the table.

[b] P-values presented in the modeling table are for simultaneously testing that all beta coefficients associated with a given variable are equal to 0. Statistical testing for all models was performed using the Wald chi-square test.

[c] Based on zip code level data from the 2000 Census.

[d] Does not include index visit.

[e] MSA = metropolitan statistical area.

Table 5

Adjusted Associations of Predisposing, Enabling and Reinforcing Factors with Mammography Referrals in Hospital Outpatient General Medicine and Gynecology Clinics, National Hospital Ambulatory Medical Care Survey 2001–2003

	Hospital Outpatient Clinics		
	Odds Ratio[a]	**95% CI**	**p-Value[b]**
Predisposing Factors			
Patient Age (yrs)			0.379
40–49	1.00	Reference	
50–59	0.95	0.71–1.28	
60–69	1.20	0.88–1.64	
≥ 70	0.76	0.46–1.24	
Patient Race			0.457
White only	1.00	Reference	
Black only	1.18	0.85–1.66	
Asian/Pacific Islander only	1.19	0.70–2.04	
Patient Ethnicity			0.024
Hispanic	1.57	1.06–2.34	
Not Hispanic	1.00	Reference	
Education[c]			0.427
Per 10% increase in high school graduates	1.08	0.89–1.31	
Reason for visit			<0.001
Chronic problem	1.95	1.29–2.94	
Acute problem	1.00	Reference	
Preventive care	11.73	7.78–17.66	
Enabling Factors			
Income[c]			0.162
Per $10,000 increase in median income	0.92	0.82–1.04	
Expected source of payment			0.465
Medicare	0.83	0.47–1.46	
Medicaid	0.70	0.46–1.08	
Private	0.75	0.48–1.17	
Other	0.64	0.31–1.30	
Self/uninsured	1.00	Reference	
# of visits to practice[d]			0.001
New patient	0.44	0.21–0.93	
0	1.00	Reference	
1–2	0.55	0.28–1.08	
3–5	0.35	0.17–0.72	

	Hospital Outpatient Clinics		
	Odds Ratio[a]	**95% CI**	**p-Value[b]**
□□≥ 6	0.26	0.13–0.54	
Reinforcing Factors			
PCP status			0.014
PCP for that patient	1.71	1.11–2.61	
Not PCP for that patient	1.00	Reference	
Clinic type			0.002
General Medicine	1.00	Reference	
Obstetrics and gynecology	2.06	1.31–3.22	
MSA[e]			0.435
MSA	1.28	0.68–2.41	
Non-MSA	1.00	Reference	
Geographic region			0.007
Northeast	1.96	1.19–3.21	
Midwest	2.19	1.33–3.63	
South	1.21	0.64–2.28	
West	1.00	Reference	
Year			0.598
2001	1.00	Reference	
2002	0.97	0.64–1.46	
2003	0.80	0.51–1.25	

[a] Adjusted for factors in the table.

[b] P-values presented in the modeling table are for simultaneously testing that all beta coefficients associated with a given variable are equal to 0. Statistical testing for all models was performed using the Wald chi-square test.

[c] Based on zip code level data from the 2000 Census.

[d] Does not include index visit.

[e] MSA = metropolitan statistical area.