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## Delivery of Cancer Screening:

### How Important Is the Preventive Health Examination?

**Joshua J. Fenton, MD, MPH, Yong Cai, PhD, Noel S. Weiss, MD, DrPH, Joann G. Elmore, MD, MPH, Roy E. Pardee, JD, MA, Robert J. Reid, MD, PhD, and Laura-Mae Baldwin, MD, MPH**

Department of Family and Community Medicine, University of California, Davis, Sacramento (Dr Fenton); Departments of Family Medicine (Drs Cai and Baldwin), Epidemiology (Drs Weiss and Elmore), and Medicine (Dr Elmore), University of Washington, Seattle; and Center for Health Studies (Mr Pardee and Dr Reid) and Department of Preventive Medicine (Dr Reid), Group Health Cooperative, Seattle

### Abstract

**Background**—Patients and physicians strongly endorse the importance of preventive or periodic health examinations (PHEs). However, the extent to which PHEs contribute to the delivery of cancer screening is uncertain.

**Methods**—In a retrospective cohort study, we determined the association between receipt of a PHE and cancer testing in a population-based sample of enrollees in a Washington State health plan who were aged 52 to 78 years and eligible for colorectal, breast, or prostate cancer screening in 2002–2003 (N = 64 288). Outcomes included completion of any colorectal cancer testing (fecal occult blood testing, sigmoidoscopy, colonoscopy, or barium enema), screening mammography, and prostate-specific antigen testing.

**Results**—More than half (52.4%) of the enrollees received a PHE during the study period. After adjusting for demographics, comorbidity, number of outpatient visits, and historical preventive service use before January 1, 2002, receipt of a PHE was significantly associated with completion of colorectal cancer testing (incidence difference, 40.4% [95% confidence interval (CI), 39.4%–41.3%]; relative incidence, 3.47 [95% CI, 3.34–3.59]), screening mammography [incidence difference, 14.2% [95% CI, 12.7%–15.7%]; relative incidence, 1.23 [95% CI, 1.20–1.25]), and prostate-specific antigen testing (incidence difference, 39.4% [95% CI, 38.3%–40.5%]; relative incidence, 3.06 [95% CI, 2.95–3.18]).

**Conclusions**—Among managed care enrollees eligible for cancer screening, PHE receipt is associated with completion of colorectal, breast, and prostate cancer testing. In similar populations, the PHE may serve as a clinically important forum for the promotion of evidence-

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**Correspondence:** Joshua J. Fenton, MD, MPH, Department of Family and Community Medicine, University of California, Davis, 4860 Y St, Suite 2300, Sacramento, CA 95817 (Joshua.fenton@ucdmc.ucdavis.edu).

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based colorectal cancer and breast cancer screening and of screening with relatively less empirical support, such as prostate cancer screening.

The preventive health examination (PHE) has been part of medical practice since at least the mid-19th century.<sup>1</sup> Traditionally, PHEs have included a history and general physical examination, which in modern practice may be accompanied by screening, counseling, or immunizations. Such “well visits,” “health maintenance visits,” or “general medical examinations” have been regarded skeptically in recent decades, as experts and physician organizations have emphasized the opportunistic delivery of selected preventive services across all health encounters rather than periodic visits dedicated to prevention.<sup>1</sup> In clinical practice, however, time constraints may make opportunistic delivery of indicated preventive services impractical.<sup>2</sup> Meanwhile, patients and physicians strongly endorse preventive visits as a means of improving health and building trust.<sup>3,4</sup> Perhaps reflecting these values, the general medical examination remains the most common reason for outpatient visits in the United States.<sup>5</sup>

The PHE may be an auspicious time to promote cancer screening. The PHE may afford primary care physicians the opportunity to discuss and recommend cancer screening when indicated,<sup>3,6</sup> and physicians’ recommendations have been consistently associated with timely cancer screening.<sup>7–9</sup> Although previous studies have observed associations between PHEs and cancer testing,<sup>10–16</sup> these studies are limited by patient self-report,<sup>12</sup> lack of adjustment for the total number of visits,<sup>10–13,15,16</sup> or performance in the early 1990s, before recent colorectal cancer (CRC) and prostate cancer testing recommendations were widely promulgated.<sup>13–16</sup>

We determined the association between receipt of a PHE and completion of cancer testing in enrollees in a prepaid health plan who were eligible for CRC, breast cancer, or prostate cancer screening. We examined CRC and breast cancer screening because each is associated with reduced cancer mortality and is widely recommended.<sup>17</sup> Although the effectiveness of prostate cancer screening is uncertain, we also examined prostate-specific antigen (PSA) screening because it is recommended by some public health agencies and is widely practiced.<sup>18</sup> Medicare recently extended coverage for dedicated PHEs for new enrollees (the “Welcome to Medicare” examination),<sup>19</sup> so the present analyses are timely and may suggest whether this policy is likely to increase cancer screening in older Americans.

## METHODS

### SETTING AND PATIENTS

Study participants were enrolled in Group Health Cooperative, a mixed-model health plan that serves approximately 450 000 enrollees in Washington State. Data sources to determine eligibility and study variables included automated health care and pharmacy data and mammography and regional tumor registries, which have been used extensively for research. Because the plan provides comprehensive health services to a closed population, the health care data provide a relatively complete account of patients’ health care use and differentiate the types of outpatient visits received (ie, primary care vs specialty visits). The study methods were approved by the Group Health Cooperative human subjects review committee.

We identified 3 population-based cohorts of enrollees aged 52 to 78 years on January 1, 2002, who were eligible for CRC, breast cancer, or prostate cancer screening in 2002–2003 based on health care data from previous enrollment years. The specific eligibility criteria for the 3 study cohorts are given in Table 1, including relevant diagnostic and procedural codes. Generally, patients had no previous cancer in the target organ and lacked diagnostic

indications for surveillance or diagnostic cancer testing (eg, previous colonic polyps or abnormal mammograms). We excluded patients who received no primary care visits during the study period because we sought to compare testing outcomes in patients with similar numbers of primary care visits, and patients who had PHEs had, by definition, at least 1 primary care visit.

The health plan periodically issues evidence-based recommendations regarding cancer screening to providers and patients. During the study period, plan recommendations regarding CRC, breast cancer, and prostate cancer screening were similar to the 2002 recommendations of the US Preventive Services Task Force.<sup>17</sup> The plan recommends that enrollees older than 50 years receive a PHE every 2 years but does not prompt enrollees to attend preventive visits. The specific content of PHEs is neither standardized nor dictated by the plan. For example, although the plan did not recommend prostate cancer screening during the study period, physicians and patients could opt for screening at their discretion. During the 2002–2003 study period, PHEs did not count toward enrollees' deductibles and were usually free of copayments (for 75%–80% of enrollees).

Since the mid-1980s, the health plan has operated an innovative population-based breast cancer screening program. Independent of primary care, the program sends mailed reminders to eligible women encouraging self-referral for screening mammography at regional breast health centers. No similar centralized programs promote CRC or prostate cancer screening among enrollees.

## CANCER TESTING OUTCOMES

In each cohort, we ascertained completion of cancer testing in 2002–2003. For patients eligible for CRC screening, we used automated laboratory data to ascertain completion of fecal occult blood testing and *Current Procedural Terminology* codes from outpatient and inpatient encounters to identify receipt of sigmoidoscopy, colonoscopy, and double-contrast barium enema (Table 1). We ascertained receipt of screening mammography using the health plan's mammography registry, which receives regular data quality monitoring.<sup>20</sup> We queried automated laboratory data to identify PSA tests. Although the mammography registry reliably distinguishes screening from diagnostic mammograms, we could not definitively classify CRC or PSA tests as screening vs diagnostic.

## RECEIPT OF A PHE

A PHE was defined as any outpatient encounter in 2002–2003 having either (1) an evaluation and management code indicating “initial evaluation” (codes 99386-7) or “reevaluation and management of a healthy individual” (codes 99396-7) or (2) an *International Classification of Diseases, Ninth Revision, Clinical Modification*, code signifying either a general medical (code V700 or V708-9) or a gynecologic (code V723) examination. In a representative sample of US outpatient encounters, similar codes accurately identified visits during which women reported that the visit purpose was to receive a PHE.<sup>21</sup>

## COVARIATES

We computed an automated form of the Charlson comorbidity index that has been validated in health plan enrollees.<sup>22</sup> We determined counts of outpatient visits in 2002–2003 to account for opportunities for cancer screening promotion outside of PHEs (including primary care and medical and surgical specialty encounters but not mental health visits). We determined whether men had an *International Classification of Diseases, Ninth Revision, Clinical Modification*, diagnosis of benign prostatic hyperplasia between January 1, 2000,

and December 31, 2003 (code 600.xx), because men with obstructive urinary symptoms may have received PSA testing for diagnostic purposes rather than for screening.

We compiled 2 measures of historical preventive services use (during 2000–2001) because research<sup>12,23</sup> suggests that these would correlate with patient attitudes and beliefs that may predispose patients to cancer screening. In particular, we determined whether patients received a PHE in 2000–2001, and within each cohort we determined counts of target organ cancer tests received during 2000–2001 (ie, fecal occult blood tests for patients eligible for CRC screening, screening mammograms for women eligible for mammography screening, and PSA tests for men eligible for prostate cancer screening). We did not count historical use of lower endoscopy or barium enema testing because these were exclusion criteria for the CRC cohort.

To develop a proxy for socioeconomic status, we used a health plan database of US Census data (compiled for active enrollees in January 2005) to identify participants' census block-group median household income.

## STATISTICAL ANALYSES

We performed bivariate analyses to identify patient characteristics associated with PHE receipt during the study period and to compare the incidence of cancer testing among patients who did and did not receive a PHE. To account for covariates that were associated with PHE receipt and cancer testing, we used multivariate logistic regression to estimate adjusted incidence differences and relative incidences of testing in patients who did and did not receive a PHE. In adjusted models, we set covariates to sample means to enable model-based equivalents to direct adjustment and estimated confidence intervals (CIs) using bootstrap procedures.<sup>24</sup>

For enrollees eligible for each cancer test, we modeled completion of testing as a function of PHE receipt while adjusting for age (5-year categories), sex (for CRC testing), comorbidity (Charlson comorbidity index score of 0, 1, 2, or 3), number of outpatient visits (quintiles), baseline PHE receipt, baseline number of target organ cancer tests (0, 1, or 2), benign prostatic hyperplasia diagnosis in 2000–2003 (for prostate cancer testing), and significant interactions between PHE receipt and covariates as identified by likelihood ratio tests ( $P < .05$ ). We also used the models to estimate adjusted cancer testing incidences among participants who did and did not receive a PHE stratified by age, sex (for CRC testing), and the number of outpatient visits. For CRC testing, we separately analyzed fecal occult blood testing and then a composite outcome of any invasive testing (sigmoidoscopy, colonoscopy, or barium enema). Because results were similar, we report results for a combined outcome of either fecal occult blood testing or invasive CRC testing.

Because of health plan disenrollment or death before census linkage in January 2005, US Census block-group median household income was unavailable for 2872 (4.5%) of 64 288 participants. We, therefore, conducted the analyses with and without adjustment for household income. We also repeated the analyses using generalized estimating equations to correct standard errors for correlation of cancer test outcomes in primary care provider practices. Because point estimates and standard errors were not substantively changed with income adjustment or using generalized estimating equations, we report the logistic regression results in the entire study sample without income adjustment. Hypothesis tests were 2-tailed, with  $\alpha = .05$ .

## RESULTS

### SAMPLE DESCRIPTION

We identified 64 288 continuously enrolled adults who attended 1 or more primary care visits in 2002–2003 and who were eligible for 1 or more of the cancer screening tests, including 39 475 patients eligible for CRC screening, 31 379 women eligible for breast cancer screening, and 28 483 men eligible for prostate cancer screening. More than half (52.4%) received a PHE in 2002–2003 (Table 2). Receipt of a PHE was significantly associated with younger age, female sex, slightly higher household income, and less comorbidity. Patients who did not receive a PHE in 2002–2003 were more likely to have attended relatively few (1–5) outpatient visits and were less likely to have received a PHE in 2000–2001. Similarly, in each cohort, patients who did not receive a PHE in 2002–2003 were significantly less likely to have received target organ cancer testing in 2000–2001 ( $P < .001$ ).

### CANCER TESTING

Of enrollees eligible for CRC screening, 37.5% received CRC testing in 2002–2003 (Table 3). Of those who received a PHE in 2002–2003, however, 57.2% received CRC testing, whereas 17.2% of patients who did not receive a PHE completed CRC testing. The incidence of CRC testing was more than 3 times higher in patients who received PHE vs those who did not (adjusted relative incidence, 3.47; 95% CI, 3.34–3.59;  $P < .001$ ).

Two thirds (66.6%) of eligible women received screening mammography in 2002–2003 (Table 3). However, 74.1% of women who received a PHE completed screening mammography vs 55.9% of women who did not (adjusted incidence difference, 14.2%; 95% CI, 12.7%–15.7%;  $P < .001$ ). Receipt of a PHE was significantly associated with screening mammography receipt, although the association was not as strong as with CRC testing (adjusted relative incidence, 1.23; 95% CI, 1.20–1.25;  $P < .001$ ).

More than one third (38.2%) of eligible men received PSA testing (Table 3). Among eligible men, 58.8% who received a PHE completed PSA testing compared with 21.1% who did not. The strong association between PHE receipt and PSA testing was similar in magnitude to the association between PHE receipt and CRC testing (adjusted relative incidence, 3.06; 95% CI, 2.95–3.18;  $P < .001$ ).

### SUBGROUP ANALYSES

If patients often receive opportunistic prevention outside of preventive visits, one might expect the association between PHE receipt and cancer testing to weaken in patients with more outpatient visits. However, in analyses stratified by the number of outpatient visits, there remained substantial differences in adjusted cancer testing incidences between patients who did and did not receive PHEs, even among those in the highest quintile of visits (Figure). For enrollees eligible for CRC and PSA testing, incidence differences ranged from more than 40% in patients with relatively few visits to approximately 32% in patients with 24 or more visits in 2002–2003. For women eligible for screening mammography, incidence differences ranged from 23% in women with 1 to 5 visits to 9% in women with 24 or more visits. Cancer testing incidences in patients who received a PHE were similar regardless of the total number of outpatient visits.

In separate age- and sex-stratified analyses, PHE receipt was associated with similar differences in adjusted cancer testing incidences in all age groups (52–54, 55–59, 60–64, 65–69, 70–74, and 75–78 years) and in men and women eligible for CRC screening.

## COMMENT

Among health plan enrollees eligible for cancer screening, receipt of a PHE was significantly associated with completion of CRC testing, screening mammography, and PSA testing. Receipt of a PHE was particularly strongly associated with CRC and PSA testing. The association between PHE receipt and cancer testing was substantial regardless of patient age, sex, or outpatient visit frequency.

Although patients and physicians believe that PHEs are of proven value,<sup>3,4</sup> there has been relatively little empirical support for the efficacy of the PHE in health promotion or disease prevention. Whereas other investigators<sup>10–16,25</sup> have observed an association between preventive visits and cancer testing, the present study provides timely confirmation and quantification of the association between PHEs and completion of CRC, breast cancer, and prostate cancer testing in population-based cohorts with confirmed eligibility for screening. Moreover, this analysis adjusts for a range of important confounding factors, including comorbidity and previous preventive services use. Finally, these large samples allow us to stratify by outpatient visit frequency and to estimate the impact of PHE on patients with varying opportunities for cancer screening promotion outside of the PHE.

An association between the PHE and cancer screening could arise if patients schedule PHEs to request the desired screening. The PHE, on the other hand, may afford physicians the opportunity to counsel patients regarding the methods, benefits, and risks of cancer screening, whereas physicians may find it difficult to thoroughly discuss cancer screening during time-restricted illness visits.<sup>6</sup> In a recent survey, nearly all primary care physicians (97%) reported recommending CRC screening during PHEs, whereas few reported recommending CRC screening during other visits.<sup>26</sup> In population-based surveys, “receiving a physician’s recommendation” has been strongly associated with receipt of CRC,<sup>7</sup> breast cancer,<sup>8</sup> and prostate cancer<sup>9</sup> screening. Thus, the strong associations between PHE receipt and CRC and PSA testing in the present study may have arisen because health plan physicians frequently recommend those tests during PHEs.

Some researchers<sup>1,27</sup> have urged physicians and policymakers to emphasize the opportunistic delivery of preventive services outside of dedicated well visits. In patients in the present study who did not receive PHEs, adjusted testing incidences gradually increased with an increasing number of outpatient visits (Figure), suggesting that physicians sometimes order cancer testing outside of preventive visits. In no case, however, did the testing incidences in patients who did not receive a PHE reach the levels of patients who did. Indeed, the adjusted incidences of CRC and PSA testing were 30% greater in PHE recipients compared with nonrecipients even in patients who received 24 or more outpatient visits during the 2-year study period. Meanwhile, adjusted testing incidences in patients who received a PHE were similar regardless of the number of outpatient visits. Thus, in a population that has received a PHE, screening rates may reach a ceiling beyond which subsequent opportunistic recommendations may have little impact.

The present findings suggest that the PHE may promote evidence-based screening, such as CRC and breast cancer screening, and screening with less empirical support, such as PSA testing. Although neither the health plan nor the US Preventive Service Task Force recommends PSA screening, we observed comparable population incidences of PSA and CRC testing and similarly large incidence differences associated with PHE receipt. In a national sample, eligible men reported more frequent receipt of PSA screening than CRC screening, which may be attributable to the relative ease of completing a blood test.<sup>18</sup> During PHEs, physicians probably order other blood and urine tests that lack strong evidential support.<sup>3,4</sup>

Mammography screening incidences were relatively high in this population, and incidence differences associated with PHE were relatively lower, which may be attributable to the plan's population-based breast cancer screening program. Although the PHE was associated with incrementally higher mammography screening rates, population-based screening programs may hold promise for the promotion of other evidence-based cancer screening, such as CRC testing.

We did not ascertain the presence of cancer symptoms, and some CRC and PSA tests may have been performed for diagnostic purposes rather than for screening. If such symptoms led some enrollees to seek a "preventive" examination, and if physicians responded by ordering tests to diagnose cancer, then the results would overstate to some extent the impact of the PHE on cancer screening. In addition, misclassification of some covariates (eg, benign prostatic hyperplasia diagnoses) may have allowed residual confounding.

Unmeasured differences between patients who do and do not receive PHEs may partly explain the observed differences in cancer screening. However, we adjusted for baseline preventive services use to account for attitudes and beliefs that may predispose patients to seek cancer screening or adhere to provider recommendations independently from the PHE. Still, randomized studies could allow more accurate quantification of the association between PHE receipt and cancer screening and potentially explore the association between PHEs and other preventive services, such as health behavior counseling. In addition, these study findings may not be generalizable to uninsured populations or fee-for-service settings. Finally, these findings for CRC and breast cancer screening may not be comparable with publicly reported quality measures (such as the Health Plan Employer Data and Information Set) because of differences in patient sampling, observation periods, and screening test definitions.<sup>28</sup>

In a managed care population, receipt of a PHE was significantly associated with screening for CRC, breast cancer, and prostate cancer. The associations were particularly strong for CRC and prostate cancer, for which the health plan provides no centralized screening program. In similar populations, the PHE may serve as a clinically important forum for the promotion of evidence-based CRC and breast cancer screening and of prostate cancer screening, which is not universally recommended. Experimental studies could confirm the efficacy of the PHE in health promotion, elucidate the ideal content of PHEs, and guide the development of interventions to help physicians make the most of PHEs.

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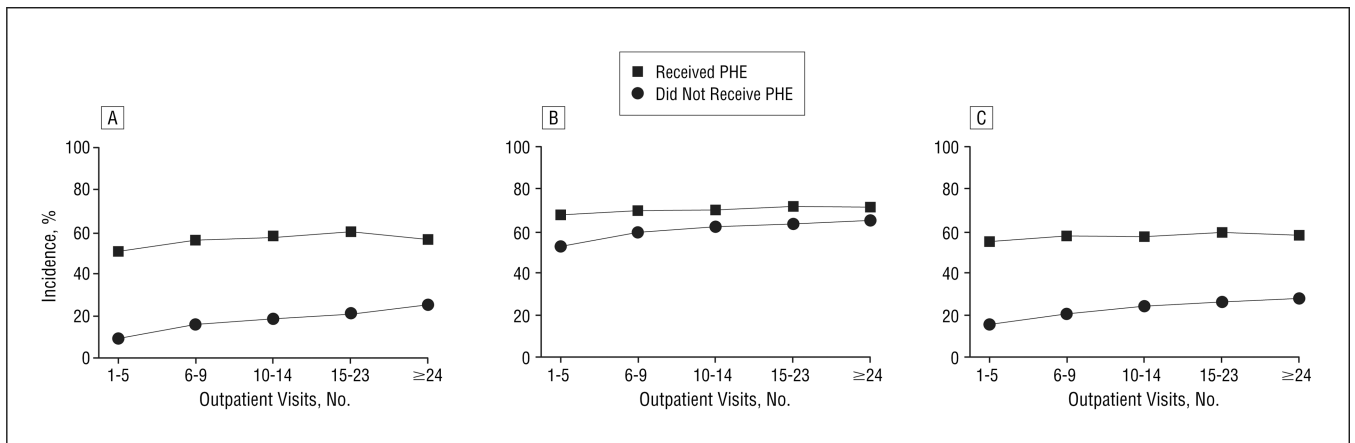
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**Figure.**

Adjusted incidence of any colorectal cancer tests (A), screening mammography (B), and prostate-specific antigen tests (C) in patients who did and did not receive preventive health examinations (PHEs) by the total number of outpatient visits (2002–2003). Incidence is adjusted for age (5-year categories), sex (for colorectal cancer testing), comorbidity (Charlson comorbidity index score of 0, 1, 2, or 3), historical PHE receipt (in 2000–2001), number of target organ cancer tests in 2000–2001 (0, 1, or 2), benign prostatic hyperplasia diagnosis in 2000–2003 (for prostate-specific antigen testing), and significant interactions between PHE receipt and the listed covariates ( $P < .05$ ). For each cancer test, likelihood ratio tests of the interaction between PHE receipt and the number of outpatient visits were significant ( $P < .001$ ).

**Table 1**

## Criteria for Cohorts Eligible for Cancer Testing Outcomes

Criterion	Colorectal Cancer Testing	Breast Cancer Screening	Prostate Cancer Testing
Age	52–78 y on January 1, 2002		
Cancer status	No personal history of target organ cancer (identified by linkage with the regional Surveillance, Epidemiology, and End Results registry)		
No. of visits	1 Primary care visits, 2002–2003		
Health plan enrollment	1997–2003	2000–2003	2000–2003
Sex	Male and female	Female	Male
Exclusion criteria	Sigmoidoscopy, colonoscopy, or barium enema, 1997–2001 <sup>*</sup>	Abnormal mammogram results, 2000–2001 <sup>†</sup>	Serum prostate-specific antigen >4 ng/mL, 2000–2001 <sup>†</sup>
	Any positive fecal occult blood test results, 1997–2001 <sup>†</sup>		Prostate biopsy, 2000–2001 <sup>§</sup>
	Known indications for surveillance colonoscopy, 1997–2001 <sup>‡</sup>		

<sup>\*</sup> Sigmoidoscopy was identified by *Current Procedural Terminology (CPT)* codes 45300, 45303, 45305, 45308-09, 45315, 45317, 45320, 45330-34, and 45338-39. Colonoscopy was identified by *CPT* codes 45378-85 and by *Healthcare Common Procedure Coding System (HCPCS)* codes G0105 and G0121. Barium enema was identified by *CPT* codes 74270 and 74280 and by *HCPCS* codes G0105, G0120, and G0122.

<sup>†</sup> Previous test results or conditions requiring diagnostic testing or surveillance rather than screening. Mammogram results were defined as “abnormal” if given a Breast Imaging Reporting and Data System classification of 0, 3 with a recommendation for immediate further evaluation, 4, or 5.

<sup>‡</sup> Indications for surveillance colonoscopy included *International Classification of Diseases, Ninth Revision, Clinical Modification*, diagnoses of inflammatory bowel diseases (codes 555-6) or colorectal polyps (code V12.72).

<sup>§</sup> Prostate biopsies were identified by *CPT* codes 55700-05.

**Table 2**

Demographic and Clinical Characteristics of Patients Eligible for Cancer Screening Tests, 2002–2003

Characteristic *	Preventive Health Examination <sup>†</sup>		Total Sample <sup>‡</sup> (N = 64 288)
	Yes (n = 33 708)	No (n = 30 580)	
Age, y			
52–54	21.0	18.6	19.9
55–59	27.7	24.0	25.9
60–64	17.5	15.2	16.4
65–69	13.3	14.2	13.7
70–74	12.3	15.5	13.8
75–78	8.3	12.5	10.3
Female, %	60.1	47.0	53.8
Household income, mean, \$ <sup>‡</sup>	57 950	55 260	56 680
Charlson comorbidity index score			
0	78.1	66.0	72.4
1	14.3	20.3	17.2
2	5.0	8.4	6.6
3	2.6	5.3	3.9
No. of outpatient visits			
1–5	17.7	24.3	20.9
6–9	21.2	18.2	19.8
10–14	20.3	17.0	18.7
15–23	20.6	18.6	19.7
24	20.1	21.9	21.0
Historical preventive services use, 2000–2001			
1 Preventive health examinations	66.1	44.0	55.6
No. of fecal occult blood tests (n = 39 475)			
0	67.3	78.0	72.5
1	29.0	20.1	24.6
2	3.8	2.0	2.9
No. of screening mammograms (n = 31 379 women)			
0	28.0	40.8	33.3
1	61.4	52.4	57.7
2	10.6	6.8	9.0
No. of prostate-specific antigen tests (n = 28 483 men)			
0	61.7	70.8	66.7
1	26.2	21.4	23.6
2	12.1	7.8	9.7

\* All the patient characteristics are significantly associated with preventive health examination receipt ( $P < .001$ ). Percentages may not total 100% because of rounding.

<sup>†</sup>Unless indicated otherwise, values are given as percentages.

<sup>‡</sup>US Census block-group median household income. Values are missing for 2872 enrollees (4.5%) owing to either health plan disenrollment or death before census linkage in 2005.

**Table 3**  
Incidence of Cancer Testing by Receipt of a Preventive Health Examination (PHE), 2002–2003

Cancer Test	Unadjusted Incidence, %			Incidence Difference, %		Adjusted Relative Incidence (95% CI)*
	Overall	PHE	No PHE	Unadjusted	Adjusted (95% CI)*	
Any colorectal cancer screening (n = 39 475)	37.5	57.2	17.2	40.0	40.4 (39.4–41.3)	3.47 (3.34–3.59)
Screening mammography (n = 31 379)	66.6	74.1	55.9	18.2	14.2 (12.7–15.7)	1.23 (1.20–1.25)
Prostate-specific antigen (n = 28 483)	38.2	58.8	21.1	37.7	39.4 (38.3–40.5)	3.06 (2.95–3.18)

Abbreviation: CI, confidence interval.

\* Adjusted for age (5-year categories), sex (for colorectal cancer testing), comorbidity (Charlson comorbidity index score of 0, 1, 2, or 3), historical PHE receipt (in 2000–2001), number of target organ cancer tests in 2000–2001 (0, 1, or 2), benign prostatic hyperplasia diagnosis in 2000–2003 (for prostate-specific antigen testing), and significant interactions between PHE receipt and the listed covariates ( $P < .05$ ). All adjusted incidence differences and relative incidences are significant ( $P < .001$ ).