Predictors of Screening for Breast, Cervical, Colorectal, and Prostatic Cancer Among Community-Based Primary Care Practices

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Background: **As we enter the year 2000, it is worth looking at whether primary care practices are reaching the goals established *in Healthy People 2000* for breast, cervical, colorectal, and prostatic cancer screening. The objectives of this study were (1) to determine the current rates of cancer screening; and (2) to determine which factors predict completion of a single screening test, of all tests for each cancer, and of all procedures for age and sex.**

Methods: **Medical records of 200 eligible patients (100 men and 100 women) from each of 24 community-based primary care practices were abstracted for cancer-screening events.**

Results: **We audited 5125 charts. A Papanicolaou smear was documented for 63.8% of women with an intact cervix within 3 years of the audit.. We found that 46.8% of women had documentation of ever having a discussion of breast self-examination. For breast cancer screening, 41.8% of the women had a clinical breast examination within 1 year, 48.2% aged 40 to 49 years had a mammogram within 2 years, and 38.5% aged 50 years and older had a mammogram within 1 year. Only 29% of women aged 40 to 49 years and 17% of women 50 years and older were current for all breast cancer-screening tests. Among patients 50 years and older, 33% of men and 38% of women had a digital rectal examination within 1 year, 26% of men and 28% of women had a fecal occult blood test within 1 year, and 22% of men and 16.8% of women had a flexible sigmoidoscopy within 5 years. Of all men 28.7% had a prostate-specific antigen test within 1 year. Completion of all tests relevant for age and sex were documented for 8.6% of women aged 40 to 49 years, 3% of women 50 years and older, and 5% of men 50 years and older. The single most significant predictor of documented cancer screening was a health maintenance visit.**

Conclusions: **This sample of primary care clinicians has not reached the goals set in *Healthy People 2000* for cancer screening. Interventions aimed at increasing the percentage of patients who schedule a health maintenance visit could serve to increase cancer screening and help us reach goals set for the year 2010. (J Am Board Fam Pract 2000;13:1–10.)**

In 1998 an estimated 564,800 Americans died from cancer.[1] The deaths from breast (43,900), cervical (4900), colorectal (56,500), and prostatic (39,200) cancers account for 26% of the total estimated cancer deaths.[1] These deaths are potentially avoidable, because these cancers are amenable to early detection, and the prognosis is favorable if the patient has early treatment. For each of these cancers, there are early detection regimens supported by various medical and professional organizations. In addition, a number of studies have investigated the efficacy and effectiveness of each regimen in reducing mortality from the related cancer.

The evaluation of physicians' implementation of regimens for early cancer detection has been done primarily through self-report methods. The 1984 and 1989 national survey of physicians (internists, general practitioners and family physicians, obstetricians and gynecologists) by the American Cancer Society regarding early cancer detection in asymptomatic people found that physicians placed greater emphasis on early cancer detection in 1989 compared with 1984.[2,3] The greatest changes in emphasis were for early detection of breast (39% to 61%) and colorectal (31% to 40%) cancer. More than 95% of these physicians reported ever per-

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forming digital rectal examination, breast physical examination, mammogram, Papanicolaou smear, or prostate examination on asymptomatic people. The use of stool blood test was 89%, and the least frequent procedure was proctoscopic examination at 49%. In contrast, the range of physicians who follow or exceed the American Cancer Society guidelines with all patients was much lower, ranging from 23% for proctoscopic examination to 78% for breast examination. Other surveys have found different levels of use for various early detection regimens.[4–11] Several investigators have questioned the validity of physician self-report studies of provision of cancer prevention services.[12,13]

Another source of data on physicians' practice of early cancer detection is from studies using chart audits. Dietrich and Goldberg[14] found no difference between generalists and subspecialists in performance of any individual prevention service, but they did note wide variation within each group. Significantly lower compliance with the regimens is found with chart audits than in the self-report data.[15–20] Others have explored the practice of cancer screening among primary care practices with an intent to increase the screening rates. Three recent examples of these studies reported relatively little impact on screening rates after resource-intense interventions.[21–23] The percentages of women in these studies having received screening tests for breast or cervical cancer in the past 2 years were 28% to 52% for clinical breast examination, 24% to 59% for mammogram, and 19% to 56% for Papanicolaou smears.[21–23] All percentages were consistently well below the target for the year 2000. The performance for colorectal screening tests fell substantially below the target of 40%.[21–23] The methodologic problems associated with data from chart audits that have been previously documented[24–26] need to be considered, however. Other studies[27–30] have shown larger and sustained increases in the delivery of cancer preventive services. In contrast to the studies reporting minimal increase in preventive services, the studies reporting substantive increases in preventive services have been limited to either single-practice sites of highly committed practitioners[27,28] observed for only a short time, such as 12 months,[30] or sites that lacked community-based primary care practices[29,31]

In summary, certain subsets of the population are not receiving adequate early detection regimens for breast, cervical, colorectal, and prostatic cancer. One goal of *Healthy People 2000*[32] is to eliminate these gaps in cancer screening. One source of this problem is partially attributable to the failure of physicians and their practices to provide consistently adequate early cancer-detection regimens. Studies are lacking, however, that evaluate the delivery of screening procedures for all four of these cancers among a large sample of community-based primary care offices. Focusing on one disease or one screening test does not represent the actual setting in which physicians and patients interact with respect to early cancer detection or any medical issue.[33,34] The objectives of our study were (1) to determine the current rates of screening for each of these cancers in community-based, primary care offices; and (2) to determine the patient factors that predict completion of a single cancer-screening test, of all tests for cancers that have more than one screening procedure (breast, colorectal, and prostate), and of all cancer-screening procedures for age and sex.

Methods

Population

Practices were recruited from the Michigan Research Network, practices previously participating in the research projects organized from the University of Michigan, practices receiving the departmental newsletter, and practices participating in an influenza-monitoring study. Practices were eligible to participate in this study if both of the following two criteria were met: (1) the practice provided nonsubspecialty care or medical care not restricted to a specific disease, organ system, or sex; and (2) the practice served adults (older than 18 years). Practices were excluded if they (1) provided primarily acute or urgent care (50% or more of office visits) rather than continuous care, (2) excluded patients because of older age or race, (3) saw fewer than 10 patients per day more than 4 days per week, or (4) had less than 50% of the physicians in the practice agreeing to participate.

Data Collection

Medical records from 1993 to 1994 of patients from each practice were abstracted if the patient (1) was aged 40 years and older, (2) did not have cancer of any type previously diagnosed, and (3) was active in the practice (defined as having been seen at least twice in the previous 2 years). Approximately 200

eligible charts (100 men and 100 women) were selected randomly from all available records. If a practice did not have 100 charts that met the eligibility criteria for either sex, then all eligible charts were audited.

During chart audits, the data were abstracted from only the current version of each chart using all the information in that version, including hospital notes, laboratory reports, radiologic reports, and consultation letters. The data abstracted included demographic information and completion of the specific cancer-screening procedures. The demographic variables were age, sex, year of first visit to the practice, number of visits in last 24 months, height, weight, race, marital status, smoking status, alcohol use, insurance types, and chronic illnesses or problems. For women, information was also collected on whether the patient was under the care of an outside gynecologist, had a hysterectomy, or was taking oral contraceptives or hormone replacement.

The date and results were collected for each of the cancer-screening procedures (clinical breast examination, mammogram, Papanicolaou smear, digital rectal examination, fecal occult blood test, prostate-specific antigen, and flexible sigmoidoscopy). The auditors determined whether the most recent screening procedure was part of a health maintenance examination or other type of encounter. If the patient had received more than one of any of the screening procedures, then the dates of the previous two were collected. For breast self-examination, auditors looked for any documentation of recommending, reviewing, or teaching breast self-examination. Colonoscopies and air-contrast barium enemas were grouped with flexible sigmoidoscopies, because the study physicians would determine when and whether another imaging procedure would be recommended for screening. None of the study physicians recommended routine use of either colonoscopies or air-contrast barium enemas in screening for colorectal cancer.

Analysis

Initially we calculated frequencies and summary statistics on all variables. Age was dichotomized at 40 to 49 years vs 50 years and older. Next, bivariate associations between the screening procedure (ie, each cancer-screening test) and the age classification were determined using chi-square tests. Screening indexes were created for each cancer that had more than one screening procedure (ie, breast, colorectal, and prostate). The breast cancer screening index that was created for each female patient consisted of any discussion of breast self-examination, a clinical breast examination (2 years for age $<$ 40 years; every year for age $\geq$ 50 years) and a mammogram (2 years for age $<$ 40 years, every year for age $\geq$ 50 years). The colorectal cancer-screening index was created for all patients aged 50 years and older and consisted of digital rectal examination in 1 year, fecal occult blood test in 1 year, and flexible sigmoidoscopy in 5 years. The prostate cancer screening index was created for men aged 50 years and older and consisted of digital rectal examination in 1 year and prostate-specific antigen test in 1 year. In a similar fashion screening indexes were created for each sex and age group ($<$ 50 years and $\geq$50 years) consisting of all screening procedures relevant for age and sex (ie, women $\geq$ 50 years: Papanicolaou smear in 3 years, breast self-examination ever, a clinical breast examination in 1 year, mammogram in 1 year, digital rectal examination in 1 year, fecal occult blood test in 1 year, and flexible sigmoidoscopy in 5 years).

To explore the impact of the patient variables on completion of the screening procedures and screening indexes, we calculated bivariate associations using chi-square, *t* tests, and Mann-Whitney U tests, where appropriate. Lastly, we used logistic regression analysis (using the backward stepwise procedure) to assess which combination of patient variables had the strongest effect on patient screening participation for each screening procedure individually and each screening index. We did not develop logistic models for those screening variables with less than 20% of the cases in one of the screen–no screen categories.

Results

The population of practices from which study participants were recruited consisted of 88 community-based primary care offices. After the recruitment effort was completed, 30 practices were eligible and agreed to participate in the study. Of the remaining 58 practices, 5 were not eligible (all provided only urgent care), 5 were no longer in practice or had moved their practice, 5 declined to participate, and 33 did not respond to any of the recruitment contacts. Of the 30 practices agreeing

to participate, 6 did not allow data collection to be completed. The data reported represent 24 community-based primary care practices.

The 24 practices were equally distributed between urban and rural location and small (3 or fewer providers) and large (more than 3 providers). No significant relation existed between the size of practice as measured by number of providers and rural or urban location. The mean opening year of the practices was 1984, and there was no difference between rural and urban or small and large practices.

The charts of 5125 patients were audited. The demographic features of these patients are displayed in Table 1. Among women aged 40 to 49 years compared with women 50 years and older, a significantly higher proportion used an outside gynecologist (16% vs 11%, $P < .0001$), a lower proportion reported a hysterectomy (22% vs 29%, $P < .0001$), a higher proportion used oral contraceptive use (7% vs 1%, $P < .0001$), and a lower proportion used hormone replacement therapy (19% vs 35%, $P < .0001$). Differences between rural and urban practices were significant on only a few demographic variables. Rural practices had significantly more charts with no race identification (41.1% vs 34.0%, $P = .00001$), a lower proportion of patients insured through managed health care (22.5% vs 39.3%, $P = .00001$), fewer charts documenting alcohol use (47.4% vs 60%, $P = .00001$), fewer charts documenting patient use of a gynecologist (6.6% vs 20.4%, $P = .00001$), and higher patient use of estrogen replacement (31.9% vs 25.3%, $P = .0003$). Small practices (3 or fewer providers) had significantly more charts with no race identification (49.8% vs 26.6%, $P = .00001$), a lower proportion of patients insured through managed health care (22.9% vs 37.8%, $P = .00001$), and fewer charts with documented alcohol use (48% vs 58.5%, $P = .0001$).

Displayed in Figure 1 are the proportion of women's charts with documentation that each individual procedure was done within the defined time interval, stratified by the age groups of 40 to 49 and 50 and older. Logistic regression models were developed for each of the following outcomes: Papanicolaou smear in last 3 years, self-breast examination reviewed ever, clinical breast examination in last year and 2 years, mammogram in the last year and 2 years. The odds ratio for the significant predictors in each logistic regression model are summarized in Table 2. Possible variables considered in each model, but not found to be significant predictors, were number of chronic problems, body mass index, smoking status, alcohol use, years as a patient in the practice, and race.

The proportion of women aged 40 to 49 years with documentation of breast self-examination discussion ever, clinical breast examination in the past

Table 1. Demographic Features of Patients from 5125 Chart Audits.

Variable	Value
Age (mean years)	55
Race (%)	
White	60
Other	2
Unknown	38
Sex (% women)	50
Marital status (%)	
Married	73
Single, widowed, separated	20
Insurance status (%)	
Health maintenance organization	30
Other private	49
Medical, Medicaid	16
None	2
Smoking status (%)	
Current	20
Never	45
Former	18
Not documented	18
Body mass index (kg/m^2) (mean)	28.3
Years as a patient (mean)	5.3
Visits in past 24 months (No.)	6.3
Alcohol use (%)	
Yes	37
None	32
Not documented	31
Chronic medical problems (% none)	78.2
Women's issues	
Currently use estrogen (%)	27
Currently use oral contraceptives (%)	3
See a gynecologist (%)	
Yes	9
No	62
Not documented	29
Have had a hysterectomy (%)	
Yes	24
No	66
Not documented	10

Note: some variables total less than 100% because of missing data.

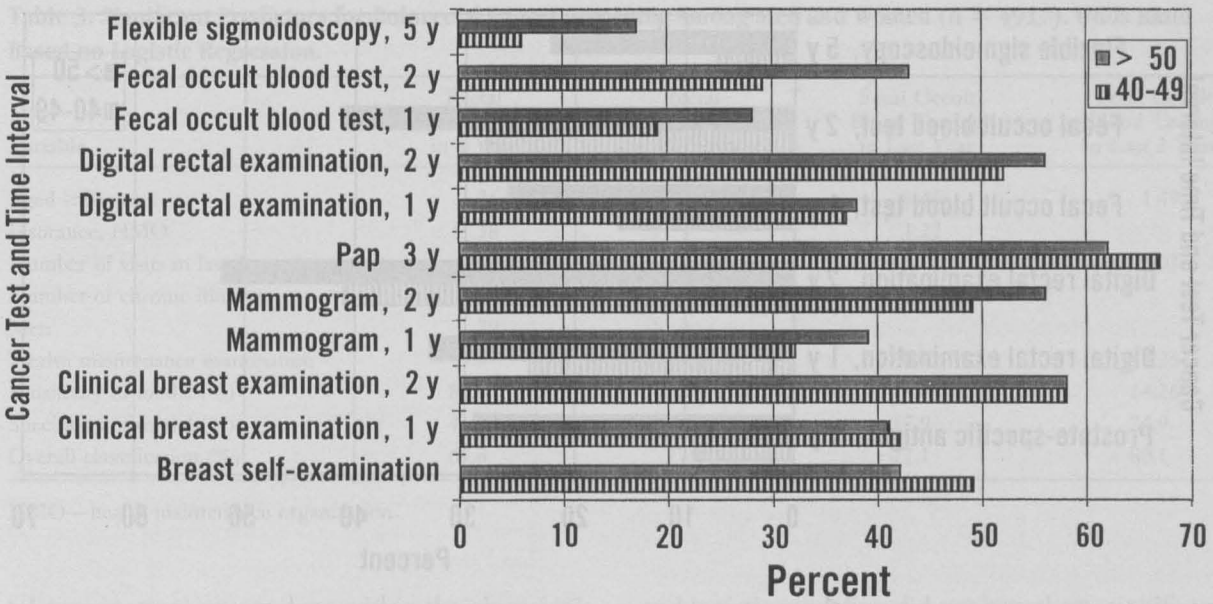

Figure 1. Proportion of women receiving individual screening procedure within a defined time interval by age-group. Significant differences ($P < .0001$) exist between age groups for self-breast examination review ever, mammogram in 1 year or 2 years, fecal occult blood test in 1 year or 2 years, and flexible sigmoidoscopy in 5 years.

2 years, and mammography in the past 2 years was 29%. The proportion of women aged 50 years and older with documentation of breast self-examination discussion ever, clinical breast examination in the past year, and mammography in the past year was 17%. The proportion of women aged 50 years and older with a digital rectal examination in the past year, fecal occult blood test in the past year, and flexible sigmoidoscopy in the past 5 years was 5.8%. Only 8.6% of women aged 40 to 49 years had documentation of their receiving a Papanicolaou smear in the past 3 years (with an intact cervix), breast self-examination discussion ever, clinical breast examination in the past year, and

Table 2. Significant Predictors for Cancer Test Among Women (n = 2228). Odds Ratios Based on Logistic Regression.

Variable	Papanicolaou Smear in Last 3 Years	Breast Self-Examination Review Ever*	Clinical Breast Examination in Last Year	Clinical Breast Examination in Last 2 Years	Mammogram in Last Year	Mammogram in Last 2 Years
Aged ≥50 years	.64	.78				1.40
Hormone replacement	2.15	1.56	1.69	2.25	1.88	2.46
Insurance, HMO	1.49	1.63		1.35	1.56	1.65
Number of visits in last 2 years	1.03			1.02	1.02	1.03
Years as patient		1.03				
Married				1.29	1.30	1.05
Health maintenance examination	28.53		10.02	18.97	5.09	10.06
Sensitivity of model (%)	81.6	42.5	56.3	72.6	80.9	78.0
Specificity of model (%)	86.4	71.7	89.2	88.3	50.0	74.5
Overall classification (%)	84.7	58.5	69.7	81.8	69.8	76.2

HMO—health maintenance organization.
* Data not collected to determine whether breast self-examination review or education given as part of a health maintenance examination or other type of encounter.

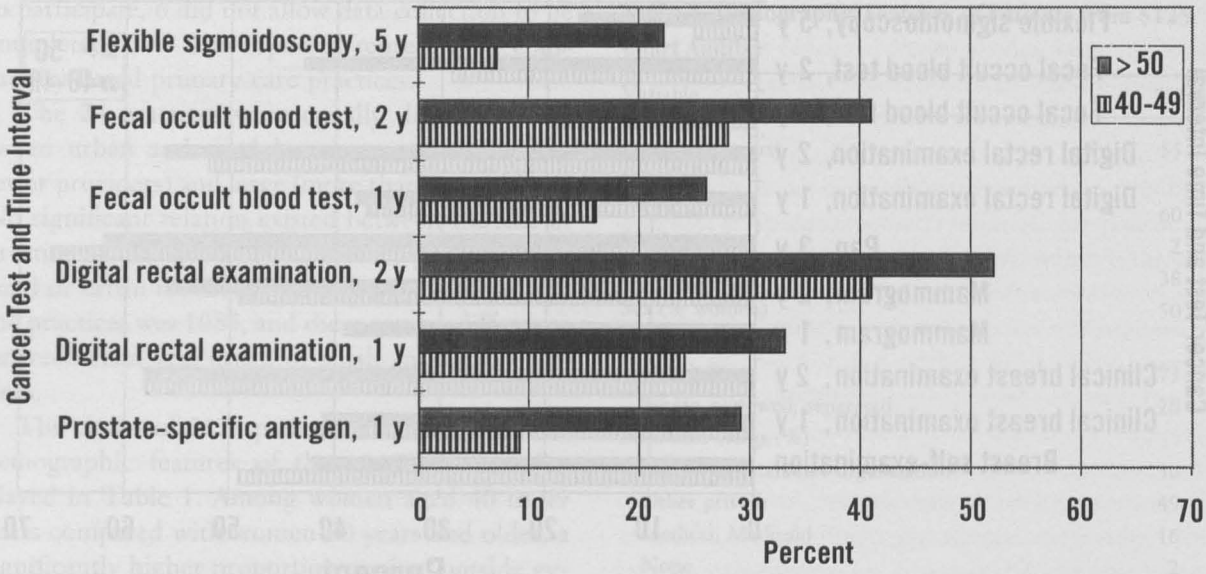

Figure 2. Proportion of men receiving individual screening procedure within a defined time interval by age-group. Significant differences ($P < .0001$) exist between age groups for prostate-specific antigen test in 1 year, digital rectal examination in 1 year and 2 years, fecal occult blood test in 1 year or 2 years, and flexible sigmoidoscopy in 5 years.

mammography in the past 2 years (or all cancer-screening procedures for their age and sex). Only 3% of women aged 50 years and older had documentation of receiving a Papanicolaou smear in the past 3 years (with an intact cervix), breast self-examination discussion ever, a clinical breast examination in the past year, a mammography in the past year, a digital rectal examination in the past year, a fecal occult blood test in the past year, and a flexible sigmoidoscopy in the past 5 years (or all cancer-screening procedures for their age and sex). These proportions were so small that we could not develop logistic regression models.

Displayed in Figure 2 are the proportion of men's charts with documentation that each individual procedure was done within the defined time interval by age groups of 40 to 49 years and 50 years and older. The proportion of men receiving a prostate-specific antigen test in the past year did not meet our criteria for logistic regression analysis. The proportion of men aged 50 years and older having had a digital rectal examination in the past year and a prostate-specific antigen test was 4.3%. The proportion of men aged 50 years and older having had a digital rectal examination in the past year, fecal occult blood test in the past year, and flexible sigmoidoscopy in the past 5 years was 5%. Only 5% of men 50 years and older had documentation of receiving a digital rectal examination in the past year, a fecal occult blood test in the past year, a flexible sigmoidoscopy in the past 5 years, and a prostate-specific antigen test in the last year (or all cancer-screening procedures for their age and sex). The proportion of men completing all cancer-screening procedures for colorectal cancer, prostatic cancer, and both was so small that we could not develop logistic regression models.

No significant differences existed between men and women in the same age-group on colorectal cancer screening procedures. Logistic regression models for digital rectal examination in the last year and last 2 years, along with fecal occult blood testing within 1 year and 2 years, are summarized in Table 3. The proportion of men and women getting a flexible sigmoidoscopy did not meet our criteria for logistic regression analysis.

Discussion

The single most consistent predictor of documented cancer screening among men and women aged 40 years and older seen in primary care settings was the patient coming in for a health maintenance visit. This was found to be true regardless of whether the screening test was part of the examination (clinical breast examination and digital rec-

Table 3. Significant Predictors for Colorectal Cancer Screening Among Men and Women (n = 4917). Odds Ratio Based on Logistic Regression.

Variable	Rectal Examination in 1 Year	Rectal Examination in 2 Years	Fecal Occult Blood Testing in Last Year	Fecal Occult Blood Testing in Last 2 Years
Aged ≥50 years	1.26	1.26	1.45	1.49
Insurance, HMO	1.38		1.22	
Number of visits in last 2 years		1.02	1.02	1.03
Number of chronic illnesses	1.28			
Men	.79			
Health maintenance examination	5.9	11.43	8.42	14.26
Sensitivity of model (%)	81.6	76.0	8.41	14.26
Specificity of model (%)	46.7	78.4	17.9	74.9
Overall classification (%)	69.8	77.2	77.1	80.1

HMO—health maintenance organization.

tal examination) or was done within the physician's office at the time of the visit (prostate-specific antigen), or whether the patient was referred to another site (mammogram). This finding was true regardless of whether the patient was seen in a rural or urban site practice or the patient was seen in a large practice (more than 3 providers) or small practice (3 or fewer providers). It was true for well-accepted procedures (Papanicolaou smears, mammograms in women aged 50 years and older) and for controversial procedures (prostate-specific antigen test). For each screening procedure, other variables also made significant contributions in predicting documentation of receiving the test.

Among women, the other variables that contributed to the logistic regression models were age, hormone replacement therapy, insurance type, number of visits in the last 2 years, years as a patient, and marital status. The nature of the relations was as most physicians would predict. Variables of interest with no apparent relation to documentation of receiving a cancer-screening procedure were race, smoking status, number of chronic illnesses, alcohol use, and body mass index. Even after considering all these variables, it was still impossible to determine significant predictors of women getting sigmoidoscopy, all screening procedures for breast and colorectal cancers, or all procedures for age. So few women have documentation of all cancer-screening procedures relevant to their age that bivariate analysis and logistic modeling either could not be done, or they revealed insignificant predictors. This issue was even more pronounced among men, because bivariate analysis and logistic modeling did not reveal any significant difference among men getting prostate-specific antigen tests, sigmoidoscopy, or all screening procedures for colorectal cancer, or all tests relevant for age.

With respect to cancer-screening procedures relevant to both women and men, there were similar findings of other variables contributing to logistic regression models. These included age, insurance type, number of visits in last 2 years, and marital status. The only difference between the sexes was that men were less likely than women to get a rectal examination in the past year. This finding is somewhat difficult to explain given the dual possible reasons for digital rectal examinations among men (colorectal and prostatic cancer). Women might more routinely receive a rectal examination, however, as part of the requested Papanicolaou and pelvic examination.

There are several limitations to these findings. First, charts audits were used as the source of demographic and cancer-screening data. Some would argue that some screening is occurring that was not captured by this data source. For example, women could be obtaining Papanicolaou smears, breast examinations, and even mammograms in settings other than their primary care office, such as by gynecologists. Our data suggest, however, that the proportion of women getting care at sites other than their primary care offices is extremely small (only 9% were documented as seeing a gynecologist) and would have very little impact on the conclusions.

Second, the population of these practices contained minimal numbers of minorities. Thus, our insights are not generalizable to practices with more diverse patient populations. Third, the findings of this study depend on the beliefs of the physicians regarding cancer-screening intervals and specific procedures. The consensus of the study physicians was to follow the American Cancer Society 1993–94 guidelines. No practice had written or documented policies or protocols for cancer screening, however. In addition, with each office beliefs varied among physicians and staff regarding specific screening procedures and intervals. Thus, these findings might not generalize to other groups of physicians who have different beliefs.

Fourth, the variables considered in this study reflect only one sphere of influence over behavior—the patient. Other possible spheres of influence[33] include the patient's environment, the physician (beliefs, knowledge, priorities, and attitudes), and the physician's environment. Because we addressed only a limited number of variables in this study, it is not possible to gain complete insight into all the influences on behavior.

As noted by Preisser and colleagues,[35] fewer than one third of patients older than 40 years have annual health maintenance examinations. Yet, this annual examination is the single most influential predictor of getting individual cancer-screening procedures. Even so, it does not explain why so few men and women have received all the cancer-screening procedures relevant to their age. Yet, the promotion of an annual visit to a health care provider to focus of preventive services is likely to increase the screening recommendations provided to patients and subsequent delivery of preventive services. It still remains unclear which interventions are successful in increasing the proportion of a primary care practice that will regularly request such a visit.

In general, our understanding of physician's behaviors can best be described as a black box. There are numerous theories,[33,34,36–39] physician-described barriers and facilitators,[40–45] and many proposed tools to change physician practices[20,21,46–55] There is, however, inadequate in-depth analysis of physician practices, especially that focused on preventive services including all relevant spheres of influence. As a result, investigators are beating on a black box (physician behavior) with a variety of tools to modify the delivery of preventive services. The result is only marginal changes or no change. Before we can intervene successfully in physician behavior, we need a far more basic understanding of physician's practice behaviors.

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