Screening Men for Prostate and Colorectal Cancer in the United States: Does Practice Reflect the Evidence?

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Screening Men for Prostate and Colorectal Cancer in the United States

Does Practice Reflect the Evidence?

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Context The debate about the efficacy of prostate-specific antigen (PSA) screening for prostate cancer has received substantial attention in the medical literature and the media, but the extent to which men are actually screened is unknown. If practice were evidence-based, PSA screening would be less common among men than colorectal cancer screening, a preventive service of broad acceptance and proven efficacy.

Objective To compare the prevalences of PSA and colorectal cancer screening among US men.

Design, Setting, and Population The 2001 Behavioral Risk Factor Surveillance System, an annual population-based telephone survey of US adults conducted by the Centers for Disease Control and Prevention, was used to gather data on a representative sample of men aged 40 years or older from all 50 states and the District of Columbia (n=49315).

Main Outcome Measures Proportions of men ever screened and up to date on screening for prostate cancer (with PSA testing) and colorectal cancer (with fecal occult blood testing, flexible sigmoidoscopy, or colonoscopy).

Results Overall, men are more likely to report having ever been screened for prostate cancer than for colorectal cancer; 75% of those aged 50 years or older have had a PSA test vs 63% for any colorectal cancer test (risk ratio [RR], 1.20; 95% confidence interval [CI], 1.18-1.21). Up-to-date PSA screening is also more common than colorectal cancer screening for men of all ages. Among men aged 50 to 69 years (those for whom there is the greatest consensus in favor of screening), 54% reported an up-to-date PSA screen, while 45% reported up-to-date testing for colorectal cancer (RR, 1.19; 95% CI, 1.16-1.21). In state-level analyses of this age group, men were significantly more likely to be up to date on prostate cancer screening compared with colorectal cancer screening in 27 states, while up-to-date colorectal cancer screening was more common in only 1 state.

Conclusion Among men in the United States, prostate cancer screening is more common than colorectal cancer screening. Physicians should ensure that men who choose to be screened for cancer are aware of the known mortality benefit of colorectal cancer screening and the uncertain benefits of screening for prostate cancer.

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THE PROSTATE-SPECIFIC ANTIgen (PSA) test has been the subject of great hope and controversy since it was first approved for use in 1986 by the US Food and Drug Administration.[1] Although some believe that screening with PSA carries the promise of reducing deaths due to the second most lethal cancer among men, others are concerned that the overall effect of widespread PSA screening will be more prostate cancer diagnoses and potentially harmful therapy without any improvement in outcomes.[2-8] To our knowledge, there is no valid evidence from randomized controlled trials to help settle this debate,[9-13] and professional societies are sharply divided in their recommendations.[14-17]

Colorectal cancer screening, on the other hand, is advocated for adults 50 years or older by all major professional medical societies and guideline-issuing organizations.[18-22] This unanimity is based on the results of several randomized controlled trials, all of which have shown substantial reductions in colorectal cancer mortality among individuals invited to periodic screening with the fecal occult blood test (FOBT).[23-25] Flexible sigmoidoscopy and colonoscopy, as yet unproven in randomized trials, are believed to confer an even greater mortality benefit than FOBT, based on results of well-conducted case-control trials.[26,27]

Population-based estimates of colorectal cancer screening rates have been widely reported.[28] However, although surveys suggest that ordering PSA

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Box. Survey Questions From the 2001 Behavioral Risk Factor Surveillance System of the Centers for Disease Control and Prevention

Prostate Cancer Screening

1. A prostate-specific antigen test, also called a PSA test, is a blood test used to check men for prostate cancer. Have you ever had a PSA test?
   Yes
   No
   Don't know/not sure
   Refused

2. How long has it been since you had your last PSA test?
   Within the past year (anytime <12 months ago)
   Within the past 2 years (≥1 year but <2 years)
   Within the past 3 years (≥2 years but <3 years)
   Within the past 5 years (≥3 years but <5 years)
   5 or more years ago
   Don't know/not sure
   Refused

3. A digital rectal examination is an examination in which a doctor, nurse, or other health professional places a gloved finger into the rectum to feel the size, shape, and hardness of the prostate gland. Have you ever had a digital rectal examination?
   Yes
   No
   Don't know/not sure
   Refused

4. How long has it been since your last digital rectal examination?
   Within the past year (anytime less than 12 months ago)
   Within the past 2 years (≥1 year but <2 years ago)
   Within the past 3 years (≥2 years but <3 years ago)
   Within the past 5 years (≥3 years but <5 years ago)
   5 or more years ago
   Don't know/not sure
   Refused

5. Have you ever been told by a doctor, nurse, or other health professional that you had prostate cancer?
   Yes
   No
   Don't know/not sure
   Refused

Colorectal Cancer Screening

1. A blood stool test is a test that may use a special kit at home to determine whether the stool contains blood. Have you ever had this test using a home kit?
   Yes
   No
   Don't know/not sure
   Refused

2. How long has it been since you had your last blood stool test using a home kit?
   Within the past year (anytime <12 months ago)
   Within the past 2 years (≥1 year but <2 years ago)
   Within the past 5 years (≥2 years but <5 years ago)
   5 or more years ago
   Don't know/not sure
   Refused

3. Sigmoidoscopy and colonoscopy are examinations in which a tube is inserted in the rectum to view the bowel for signs of cancer or other health problems. Have you ever had either of these examinations?
   Yes
   No
   Don't know/not sure
   Refused

4. How long has it been since you had your last sigmoidoscopy or colonoscopy?
   Within the past year (anytime <12 months ago)
   Within the past 2 years (≥1 year but <2 years ago)
   Within the past 5 years (≥2 years but <5 years ago)
   Within the past 10 years (≥5 years but <10 years ago)
   10 or more years ago
   Don't know/not sure
   Refused

screening is routine practice for many physicians,[29-31] it is unknown how many US men are undergoing PSA testing. Therefore, we sought to describe and compare the prevalence of PSA and colorectal cancer screening among men in the United States. If practice were evidence-based, fewer men would undergo PSA screening than colorectal cancer screening.

METHODS

Data Source

We used data from the 2001 Behavioral Risk Factor Surveillance System (BRFSS), an annual cross-sectional, population-based, random-digit-dialed telephone survey conducted by the Centers for Disease Control and Prevention. The BRFSS collects data on health care use, risk behaviors, and demographics from a representative sample of civilian noninstitutionalized adults (≥18 years) in each of the 50 states and the District of Columbia.[32]

Study Population

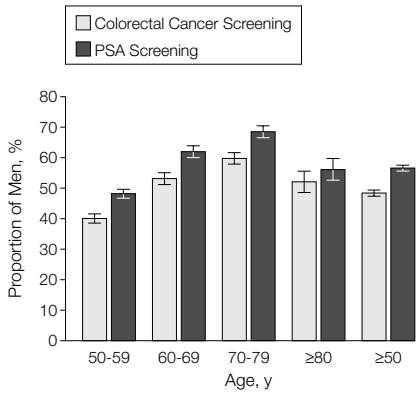
In 2001, for the first time, every state included questions about prostate and colorectal cancer screening in the BRFSS survey. We included 49 315 men aged

Table 1. Proportion of Men Undergoing Screening for 2 Cancers, According to Decade of Age*

Age Group, y	No. of Respondents	Weighted %: Prostate-Specific Antigen	Colon Cancer: Fecal Occult Blood Test	Colon Cancer: Lower Endoscopy†	Colon Cancer: Either Test
		Ever Tested			
40-49	17 301	34			
50-59	13 850	67	36	38	53
60-69	9151	80	48	52	68
70-79	6636	86	55	60	75
≥80	2377	82	50	58	71
Men ≥50	32 014	75	44	48	63
		Up-to-Date Screening Test‡			
		Within 1 Year	Within 1 Year	Within 5 Years	Either Test
40-49	17 264	22			
50-59	13 680	48	18	31	40
60-69	8686	62	26	43	53
70-79	5886	69	30	49	60
≥80	1995	56	25	43	52
Men ≥50	30 247	57	23	39	48

*Number of respondents in each age group is lower for questions on up-to-date screening than for those on ever having been tested because respondents with a history of prostate cancer have been excluded. Weighted percentages refer to the US male population, not the interviewed sample of 49 315 men. Men aged 40 to 49 years were not asked about colorectal cancer screening.
†Flexible sigmoidoscopy or colonoscopy.
‡Screening prostate specific antigen tests only. Men with known prostate cancer are excluded from the analysis of up-to-date screening for both cancers. For colorectal cancer screening tests, we were unable to distinguish screening examinations from those performed for known disease (eg, cancer) or the evaluation of symptoms; colorectal cancer screening data are likely overestimates of screening.

Figure 1. Proportion of US Men Who Are Up to Date on Prostate-Specific Antigen (PSA) and Colorectal Cancer Screening, According to Decade of Age



Error bars represent 95% confidence intervals.

40 years or older who responded to at least 1 prostate or colorectal cancer question. Median annual response rate for the 50 states and the District of Columbia, based on persons estimated to be eligible to participate was 51%.[33]

Outcomes

Prostate Cancer Screening. All men aged 40 years or older were asked whether they had ever had a PSA test (BOX). Those men who responded yes were asked about the timing of the most recent test. Men were also asked whether they had ever been told they had prostate cancer. We report the proportion of men ever tested for prostate cancer (those who reported at least 1 lifetime PSA test) and the proportion up to date on screening. To be up to date, a man had to report a PSA test within the previous year. We considered men with known prostate cancer ineligible for screening and excluded them from the analysis of up-to-date screening (for both prostate and colorectal cancers).

Colorectal Cancer Screening. For colorectal cancer screening, respondents aged 50 years or older were asked whether and how recently they had had an FOBT and a sigmoidoscopy or colonoscopy. We report the proportions of men ever tested for colorectal cancer (with any of the 3 tests) and up to date on testing. We considered a man up to date if he reported an FOBT within 1 year or a lower endoscopy (sigmoidoscopy or colonoscopy) within 5 years. Respondents were not asked about the indication for colorectal cancer tests or about personal history of colorectal cancer.

Analysis

Each state's yearly BRFSS data file is weighted to the respondent's probability of selection and the age-specific, sex-specific, and race-specific population from the most current census data (or intercensal estimates) for each state. These weights adjust for differences in probability of selection and nonresponse, and may also partially correct for any bias caused by lack of telephone coverage. Because the poststratification weights reflect the size of the underlying stratum-specific population, we were able to combine data from each state into summary measures (weighted estimates) representing the combined population of the country.

Men who did not respond to questions about ever having had a test (eg, PSA) were excluded from the analysis of that test. Men who reported having had a test but did not respond about the timing of the test were considered not up to date with respect to that test. Item nonresponse rates ranged from 2% to 9% for PSA questions and 0% to 7% for colorectal cancer testing questions.

We analyzed responses based on decade of age, using 5 age categories from 40 to 49 years to 80 years or older. For men aged 50 years or older, we report the risk ratio (RR) of prostate cancer screening compared with colorectal cancer screening using Fisher exact test to calculate 95% confidence intervals (CIs). All analyses were performed using STATA version 7.0 (Stata Corp, College Station, Tex). All reported P values are based on 2-sided tests; $P<.05$ is considered significant.

RESULTS

In the 50 states and the District of Columbia, 75% of men aged 50 years or

older had undergone PSA testing at least once. The likelihood of ever having been tested increased with age until 80 years (TABLE 1). Eighty-six percent of men aged 70 to 79 years had had at least 1 PSA test. Prostate-specific antigen testing was not uncommon among younger men: 34% of men aged 40 to 49 years had been tested at least once. Up-to-date PSA screening was also common. Fifty-seven percent of men aged 50 years or older reported an up-to-date screening PSA. Elderly men were most likely to be up to date on screening: 69% of men aged 70 to 79 years had an up-to-date PSA. Although rates declined modestly after 80 years, PSA screening remained common with 56% of men 80 years or older reporting an up-to-date screening test.

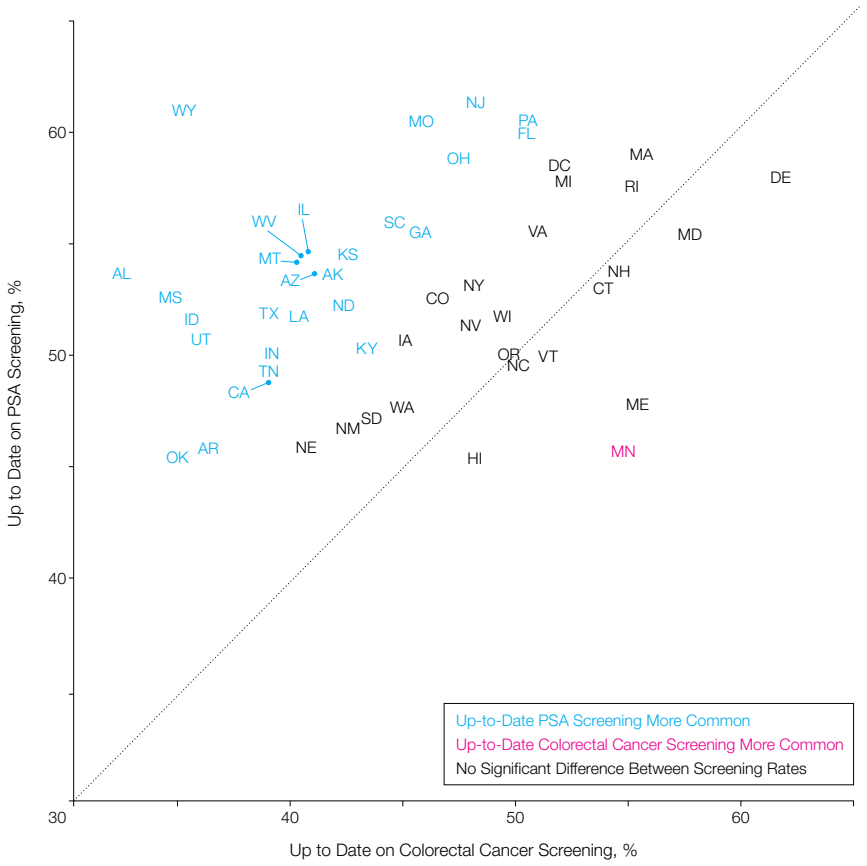
In contrast with PSA testing, 63% of men aged 50 years or older had undergone colorectal cancer screening using either FOBT or lower endoscopy. As was the case for prostate cancer screening, rates of ever having been tested and of up-to-date screening increased with age until 80 years (Table 1). Lower endoscopy was more common than FOBT as a means of up-to-date colorectal cancer screening among men of all ages.

More men aged 50 years or older had ever been tested for prostate than for colorectal cancer (75% vs 63%; RR, 1.20; 95% CI, 1.18-1.21). Men were also more likely to be up to date on prostate cancer screening than colorectal cancer screening (57% vs 48%; RR, 1.19; 95% CI, 1.17-1.21). Among men aged 50 to 69 years, the age group for which there is the greatest consensus in favor of screening for both cancers,[14-22] 54% of men were up to date on PSA screening compared with 45% for colorectal cancer testing (RR, 1.19; 95% CI, 1.16-1.21). FIGURE 1 demonstrates the comparison between rates of up-to-date PSA and colorectal cancer screening according to decade of age. Men aged 50 to 59 years were 20% more likely to be up to date on PSA than colorectal cancer screening (RR, 1.20; 95% CI, 1.17-1.24). Up-to-date prostate cancer screening was also significantly

Table 2. Prostate and Colorectal Cancer Screening in the 50 US States and the District of Columbia, 2001

State	Ever Tested, % (Men ≥50 y)			Up-to-Date Screening, % (Men 50-69 y)		
	Prostate Cancer	Colorectal Cancer	*P* Value	Prostate Cancer	Colorectal Cancer	*P* Value
Alabama	76	54	<.001	54	32	<.001
Alaska	78	62	<.001	54	42	<.001
Arizona	76	63	<.001	54	41	<.001
Arkansas	71	59	<.001	46	36	.01
California	74	58	<.001	49	39	.004
Colorado	77	68	.01	53	46	.20
Connecticut	74	70	.02	53	54	.74
Delaware	86	73	<.001	58	62	.34
District of Columbia	79	70	.01	59	52	.15
Florida	77	65	<.001	60	50	.003
Georgia	78	63	<.001	56	45	.003
Hawaii	67	70	.20	45	48	.42
Idaho	73	58	<.001	52	35	<.001
Illinois	73	55	<.001	55	40	.002
Indiana	75	62	<.001	50	39	.001
Iowa	72	64	.003	51	45	.11
Kansas	77	62	<.001	55	42	<.001
Kentucky	73	59	<.001	50	43	.003
Louisiana	74	55	<.001	52	40	<.001
Maine	67	67	>.99	48	55	.06
Maryland	77	72	.03	56	58	.51
Massachusetts	79	71	<.001	59	56	.15
Michigan	79	71	.001	58	52	.08
Minnesota	71	72	.60	46	55	.008
Mississippi	71	49	<.001	53	34	<.001
Missouri	82	64	<.001	61	45	<.001
Montana	76	59	<.001	54	40	<.001
Nebraska	69	58	<.001	46	40	.14
Nevada	72	62	<.001	51	48	.32
New Hampshire	76	71	.03	54	54	.80
New Jersey	77	65	<.001	61	48	<.001
New Mexico	72	61	<.001	47	42	.18
New York	72	65	.01	53	48	.13
North Carolina	75	66	<.001	50	50	.95
North Dakota	77	60	<.001	52	42	.02
Ohio	78	64	<.001	59	47	.002
Oklahoma	73	52	<.001	45	35	<.001
Oregon	76	68	.01	50	50	.90
Pennsylvania	79	68	<.001	61	50	.002
Rhode Island	77	69	.002	58	55	.43
South Carolina	78	62	<.001	56	44	.002
South Dakota	72	59	<.001	47	43	.19
Tennessee	69	53	<.001	49	39	.02
Texas	76	55	<.001	52	39	<.001
Utah	78	56	<.001	51	36	<.001
Vermont	71	71	.88	50	51	.69
Virginia	76	66	<.001	56	51	.21
Washington	75	69	.03	48	45	.40
West Virginia	73	56	<.001	55	40	<.001
Wisconsin	76	69	.02	52	49	.49
Wyoming	82	59	<.001	61	35	<.001

Figure 2. Relationship Between Up-to-Date Prostate-Specific Antigen (PSA) and Colorectal Cancer Screening Among Men Aged 50 to 69 Years by State



Prostate-specific antigen (PSA) screening is more common than colorectal cancer screening in the portion of the graph above the dotted line. The color of the state abbreviation shows the statistical relationship between the state's PSA and colorectal cancer screening rates.

more common among men aged 60 to 69 years (RR, 1.17; 95% CI, 1.14-1.20), 70 to 79 years (RR, 1.15; 95% CI, 1.12-1.18), and 80 years or older (RR, 1.08; 95% CI, 1.02-1.14).

In 47 states, men were significantly more likely to have ever had a PSA test than to have ever been tested for colorectal cancer. In Hawaii, Maine, Minnesota, and Vermont, the proportions were similar (TABLE 2). Rates of up-to-date testing also favored PSA screening. Among men aged 50 to 69 years, for whom consensus in favor of screening is greatest, the median percentage with an up-to-date PSA screen was 53% (range, 45%-61%) compared with 45% (range, 32%-62%) for an up-to-date colorectal cancer test. FIGURE 2 demonstrates the relationship between rates of up-to-date PSA and colorectal cancer screening within each state. Up-to-date PSA screening was significantly more common than colorectal cancer testing in 27 states. Colorectal cancer testing was more common only in Minnesota; in the remainder, there was no significant difference (Table 2).

COMMENT

We found that PSA testing was common in the United States: 75% of men aged 50 years or older had had a PSA test and 57% were up to date on screening. Prostate-specific antigen screening was particularly common among elderly men, with 69% of men aged 70 to 79 years and 56% of men 80 years or older reporting PSA screening in the past year. If practice were in accordance with evidence of screening-related benefits, colorectal cancer screening would be more common than prostate cancer screening among US men. However, we found this to be the case in only 1 state. Nationally, men in each age group from 50 to 79 years were 15% to 20% more likely to be up to date on PSA screening than colorectal cancer screening.

Although prostate and colorectal cancers are responsible for comparable numbers of deaths among US men each year (in 2002, an estimated 30 200 deaths from prostate cancer and 27 800 from colorectal cancer),[34] colorectal cancer is responsible for the large majority of premature deaths among the 2 malignancies (accounting for 2 ½ times as many years of potential life lost before age 75 years as prostate cancer).[35-37] Furthermore, evidence for a benefit from screening is vastly different for the 2 cancers. Deaths from colorectal cancer were decreased by 14% to 33% in the screening (FOBT) groups of 3 randomized controlled trials involving 250 000 participants in 3 countries.[18,23-25] In contrast, no valid randomized controlled trial evidence exists regarding the efficacy of prostate cancer screening.[8-13,38,39] In accordance with the evidence, professional societies are divided regarding PSA screening recommendations but uniformly endorse colorectal cancer screening, most commonly FOBT and flexible sigmoidoscopy, for adults aged 50 years or older.[14-22]

There are several possible explanations for our findings that screening practices among US men are discordant with evidence about screening benefits. First, men may be more accepting of a simple blood test (PSA) than the more inconvenient or invasive testing involved in colorectal cancer screening. Second, although media messages have promoted colorectal cancer screening in recent years, these messages have been eclipsed by those of the PSA screening movement, with messages to men to "Get the [PSA] test" from sources as varied as the media,

public personalities, and the US Postal Service, in the form of a postage stamp.[40,41] Lastly, men may perceive themselves to be more vulnerable to prostate than to colorectal cancer. Because the prevalence of prostate cancer is more than 3 times that of colorectal cancer among men older than 40 years[34] (in part due to PSA testing), men are more likely to know other men with prostate cancer than with colorectal cancer and to perceive themselves to be at heightened risk of the disease.

It is likely that physicians' ordering practices are influenced by all of these factors, in addition to pressures to adhere to perceived standards of care, meet patient demands, and avoid malpractice liability.[31] Despite findings that most physicians are unsure about the benefits of PSA testing, the large majority routinely order the test on their male patients.[26,31] On the other hand, although most physicians are aware of strong evidence in favor of colorectal cancer screening, many refrain from recommending testing, primarily because of anticipated patient resistance.[42-44]

There are several limitations in our study. First, some may argue with our criterion for an up-to-date colorectal cancer test. Although we allowed an up-to-date FOBT or lower endoscopy to qualify as up to date on screening, FOBT alone is supported by solid evidence and most professional organizations recommend both tests. Had we strengthened our standard for up-to-date colorectal cancer testing by requiring an up-to-date FOBT or required that both tests be up to date (FOBT and lower endoscopy), the proportion of men in each age group meeting the requirement would have decreased by half. Thus, our use of a liberal standard inflated the estimates of up-to-date colorectal cancer testing, narrowing the gap between colorectal and PSA screening rates.

On the other hand, we may have underestimated the extent of up-to-date colorectal cancer testing, because our data do not allow us to count men with a single colonoscopy more than 5 years ago as up to date on colorectal cancer screening (as many authorities recommend). Data from another national survey, however, enable us to predict that if we were able to count a single lifetime colonoscopy as an up-to-date screen, our estimate of the proportion of men with an up-to-date colorectal cancer screening test would increase by 3%.[45]

Third, because it is a less widely agreed on screening modality, we did not include digital rectal examination as a prostate cancer screening test in our analyses. Including digital rectal examination, which was about as common as PSA screening among men of all ages, would have resulted in a larger disparity favoring prostate cancer screening over colorectal cancer screening. Sixty-six percent of men 50 years or older were up to date on prostate cancer screening based on a PSA test or digital rectal examination within 1 year (compared with 57% with PSA alone).

Lastly, our estimates are based on patient self-reports. Although self-reports of screening behavior have consistently been found to overestimate the extent of actual screening by 20% to 50%,[46-49] recent evidence suggests lower rates of inaccuracy (10%-30%) for recall of PSA testing[50,51] and colorectal cancer testing.[52,53] Moreover, because men are more likely to be aware of and recall having had a do-it-yourself (FOBT) or invasive (lower endoscopy) examination compared with a simple blood test (PSA), the use of self-reported data would be expected to overstate the extent of colorectal cancer screening relative to screening for prostate cancer. Our results may further overstate the extent of colorectal cancer screening, because although we were able to distinguish between screening and surveillance PSA tests in men with known prostate cancer, we were not able to do so for colorectal cancer tests and therefore considered each test a screening test. Another limitation imposed by reliance on self-reported data is that the proportion of men reporting screening may be higher in our study than in actual practice, if those not responding to the survey are less likely to be screened. Thus, we may have overestimated both PSA and colorectal cancer screening rates.

Our study suggests that, despite widespread efforts to improve adherence to colorectal cancer screening guidelines,[54] such screening is still considerably less common among US men than prostate cancer screening, for which benefits have never been demonstrated. We recommend that physicians ensure that men who choose to be screened for cancer are aware of the known mortality benefit of colorectal cancer screening and the uncertainty about screening for prostate cancer. In addition, given the high rates of PSA screening among elderly men, physicians should ensure that elderly men (those who are least likely to benefit and who may well be harmed by screening) make a well-informed decision about PSA screening.

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Analysis and interpretation of data: Sirovich, Schwartz, Woloshin.
Drafting of the manuscript: Sirovich, Schwartz, Woloshin.
Critical revision of the manuscript for important intellectual content: Sirovich, Schwartz, Woloshin.
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REFERENCES

1. Hankey BF, Feuer EJ, Clegg LX, et al. Cancer Surveillance Series: interpreting trends in prostate cancer, part I: evidence of the effects of screening in recent prostate cancer incidence, mortality, and survival rates. *J Natl Cancer Inst.* 1999;91:1017-1024.
2. Brawer M. Prostate-specific antigen: current status. *CA Cancer J Clin*. 1999;49:264-281.
3. Catalona WJ, Ramos CG, Carvalhal GF, Yan Y. Lowering PSA cutoffs to enhance detection of curable prostate cancer. *Urology*. 2000;55:791-795.
4. Donovan JL, Frankel SJ, Neal DE, Hamdy FC. Screening for prostate cancer in the UK: seems to be creeping in by the back door. *BMJ*. 2001;323:763-764.
5. Hahn DL. Lack of knowledge regarding prostate-specific antigen screening: is ignorance bliss? *J Fam Pract*. 1999;48:679-681.

6. Labrie F. Screening and early treatment of prostate cancer are accumulating strong evidence and support. *Prostate.* 2000;43:215-222.
7. Mettlin C. Public health impact of prostate cancer early detection. *Prostate*. 1997;31:71-73.
8. Barry MJ. Early detection and aggressive treatment of prostate cancer: groping in the dark. *J Gen Intern Med*. 2000;15:749-751.
9. Labrie F, Candas B, Dupont A, et al. Screening decreases prostate cancer death: first analysis of the 1988 Quebec prospective randomized controlled trial. *Prostate*. 1999;38:83-91.
10. Boer R, Schroder FH. Quebec randomized controlled trial on prostate cancer screening shows no evidence for mortality reduction [letter]. *Prostate*. 1999; 40:130-131.
11. Labrie F, Candas B. Various statistical analyses indicate a marked reduction of prostate cancer death in the Quebec trial. *Prostate*. 1999;40:132-134.
12. Alexander FE, Prescott RJ. Reply to Labrie et al: results of the mortality analysis of the Quebec randomized/controlled trial (RCT). *Prostate.* 1999;40:135-137.
13. Labrie F, Candas B. The Quebec study shows a 69% decrease in prostate cancer death [letter]. *Prostate.* 1999;40:137.
14. American College of Physicians. Screening for prostate cancer. *Ann Intern Med*. 1997;126:480-484.
15. US Preventive Services Task Force. Screening for prostate cancer. In: *Guide to Clinical Preventive Services.* 2nd ed. Baltimore, Md: Williams & Wilkins; 1996: 119-134.
16. Smith RA, Cokkinides V, von Eschenbach AC, et al. American Cancer Society guidelines for the early detection of cancer. *CA Cancer J Clin*. 2002;52:8-22.
17. Carroll P, Coley C, McLeod D, et al. Prostate-specific antigen best practice policy, part I: early detection and diagnosis of prostate cancer. *Urology*. 2001; 57:217-224.
18. Ransohoff DF, Sandler RS. Clinical practice: screening for colorectal cancer. *N Engl J Med*. 2002;346: 40-44.
19. Eddy DM. Screening for colorectal cancer. *Ann Intern Med.* 1990;113:373-384.
20. US Preventive Services Task Force. Screening for colorectal cancer. In: *Guide to Clinical Preventive Services.* 2nd ed. Baltimore, Md: Williams & Wilkins; 1996:89-103.
21. Winawer SJ, Fletcher RH, Miller L, et al. Colorectal cancer screening: clinical guidelines and rationale. *Gastroenterology*. 1997;112:594-642.
22. Rex DK, Johnson DA, Lieberman DA, et al. Colorectal cancer prevention 2000: screening recommendations of the American College of Gastroenterology. *Am J Gastroenterol.* 2000;95:868-877.
23. Mandel JS, Bond JH, Church TR, et al. Reducing mortality from colorectal cancer by screening for fecal occult blood. *N Engl J Med.* 1993;328:1365-1371.
24. Kronborg O, Fenger C, Olsen J, et al. Randomised study of screening for colorectal cancer with faecal-occult-blood test. *Lancet.* 1996;348: 1467-1471.
25. Hardcastle JD, Chamberlain JO, Robinson MHE, et al. Randomised controlled trial of faecal-occult-blood screening for colorectal cancer. *Lancet.* 1996; 348:1472-1477.
26. Fowler FJ, Bin L, Collins MM, et al. Prostate cancer screening and beliefs about treatment efficacy: a national survey of primary care physicians and urologists. *Am J Med*. 1998;104:526-532.
27. Selby JV, Friedman GD, Quesenberry CP Jr, Weiss NS. A case-control study of screening sigmoidoscopy and mortality from colorectal cancer. *N Engl J Med*. 1992;326:653-657.
28. Müller AD, Sonnenberg A. Prevention of colorectal cancer by flexible endoscopy and polypectomy: a case-control study of 32,702 veterans. *Ann Intern Med.* 1995;123:904-910.
29. Trends in screening for colorectal cancer—United States, 1997 and 1999. *MMWR Morb Mortal Wkly Rep*. 2001;50:162-166.
30. Hoffman RM, Papenfuss MR, Buller DB, Moon TE. Attitudes and practices of primary care physicians for prostate cancer screening. *Am J Prev Med.* 1996; 12:277-281.
31. Voss JD, Schectman JM. Prostate cancer screening practices and beliefs: a longitudinal physician survey. *J Gen Intern Med*. 2001;16:831-837.
32. Centers for Disease Control and Prevention. *Behavioral Risk Factor Surveillance System Overview 2001.* Atlanta, Ga: US Dept of Health and Human Services; 2002. Available at: http://www.cdc.gov/brfss/surveydata/2001/overview_01.rtf. Accessed October 28, 2002.
33. Centers for Disease Control and Prevention. *2001 Behavioral Risk Factor Surveillance System Summary Data Quality Report.* Atlanta, Ga: US Dept of Health and Human Services; 2002.
34. Ries LAG, Eisner MP, Kosary CL, Hankey BF, Miller BA, Clegg L, Edwards BK, eds. *SEER Cancer Statistics Review, 1973-1999.* Bethesda, Md: National Cancer Institute; 2002. Available at: http://seer.cancer.gov/csr/1973_1999/. Accessed May 25, 2002.
35. National Center for Health Statistics. NCHS definitions: an alphabetical listing of many terms used at NCHS: years of potential life lost. Available at: http://www.cdc.gov/nchs/datawh/nchsdefs/yearsofpotentiallifelost.htm. Accessed September 18, 2002.
36. Surveillance, Epidemiology, and End Results. *SEER Incidence and US Mortality Statistics.* Bethesda, Md: National Cancer Institute; 1999. Available at: http://seer.cancer.gov/canques/. Accessed September 18, 2002.
37. Population Estimates Program, Population Division. *Annual Population Estimates by Age Group and Sex, Selected Years from 1990 to 2000.* Washington, DC: US Census Bureau; 2001. Available at: http://eire.census.gov/popest/data/age.php. Accessed September 18, 2002.
38. Standaert B, Denis L. The European Randomized Study of Screening for Prostate Cancer: an update. *Cancer*. 1997;80:1830-1834.
39. Prorok PC, Andriole GL, Bresalier RS, et al. Design of the Prostate, Lung, Colorectal and Ovarian (PLCO) Cancer Screening Trial. *Control Clin Trials*. 2000;21:273S-309S.
40. Farrell MH, Murphy MA, Schneider CE. How underlying patient beliefs can affect physician-patient communication about prostate-specific antigen. *Eff Clin Pract*. 2002;5:91-94.
41. Woloshin S, Schwartz LM. The US Postal Service and cancer screening: stamps of approval? *N Engl J Med*. 1999;340:884-887.
42. Hawley ST, Levin B, Vernon SW. Colorectal screening by primary care physicians in two medical care organizations. *Cancer Detect Prev*. 2001;25:309-318.
43. Schroy PC 3rd, Geller AC, Crosier Wood M, et al. Utilization of colorectal cancer screening tests: a 1997 survey of Massachusetts internists. *Prev Med*. 2001;33:381-391.
44. Pignone M, Harris R, Kinsinger L. Videotape-based decision aid for colon cancer screening: a randomized controlled trial. *Ann Intern Med.* 2000;133:761-769.
45. National Center for Health Statistics. *National Health Interview Survey Data.* Hyattsville, Md: Division of Health Interview Statistics, National Center for Health Statistics; 2000.
46. McGovern PG, Lurie N, Margolis KL, Slater JS. Accuracy of self-report of mammography and Pap smear in a low-income urban population. *Am J Prev Med*. 1998;14:201-208.
47. Suarez L, Goldman DA, Weiss NS. Validity of Pap smear and mammogram self-reports in a low-income Hispanic population. *Am J Prev Med*. 1995; 11:94-98.
48. Whitman S, Lacey L, Ansell D, et al. Do chart reviews and interviews provide the same information about breast and cervical cancer screening? *Int J Epidemiol.* 1993;22:393-397.
49. Bowman JA, Redman S, Dickinson JA, et al. The accuracy of Pap smear utilization self-report: a methodological consideration in cervical screening research. *Health Serv Res*. 1991;26:97-107.
50. Volk RJ, Cass AR. The accuracy of primary care patients' self-reports of prostate-specific antigen testing. *Am J Prev Med*. 2002;22:56-58.
51. Jordan TR, Price JH, King KA, et al. The validity of male patients' self-reports regarding prostate cancer screening. *Prev Med.* 1999;28:297-303.
52. Mandelson MT, LaCroix AZ, Anderson LA, et al. Comparison of self-reported fecal occult blood testing with automated laboratory records among older women in a health maintenance organization. *Am J Epidemiol.* 1999;150:617-621.
53. Baier M, Calonge N, Cutter G, et al. Validity of self-reported colorectal cancer screening behavior. *Cancer Epidemiol Biomarkers Prev.* 2000;9:229-232.
54. Vernon SW. Participation in colorectal cancer screening: a review. *J Natl Cancer Inst.* 1997;89:1406-1422.