

Trends in Prostate-Specific Antigen Testing From 1995 Through 2004

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Background: The utility of the prostate-specific antigen (PSA) test to screen for prostate cancer has been widely debated for several years. Whether PSA testing rates have changed during this period of controversy is not well known.

Methods: We examined the National Ambulatory Medical Care Survey (1995-2004) of visits to primary care providers by healthy men aged 35 years or older. We examined visits by calendar year and compared the years 2000 through 2004 with the years 1995 through 1999. We also examined visits by men in the overall population and in particular subgroups.

Results: Primary care physicians ordered PSA tests in 4.7% of all visits in 1995 and in 7.0% of all visits in 2004 ($P = .03$). In multivariate analysis, the odds of a primary care physician ordering a PSA test during any clinic visit

increased 8% (odds ratio [OR], 1.08; 95% confidence interval [CI], 1.04-1.12; $P < .001$) per year from 1995 through 2004. The increase was more pronounced among men making visits for general medical examinations (11.2% in 1995 vs 32.3% in 2004; $P = .003$). Comparing the period 2000-2004 with the period 1995-1999, the odds of PSA testing increased in nearly all subgroups but most dramatically in black men (OR, 2.3; 95% CI, 1.4-3.8; $P = .002$) and in men 35 through 49 years of age (OR, 1.8; 95% CI, 1.3-2.6; $P = .001$).

Conclusion: In a nationally representative sample, we found that despite the lack of clear evidence of benefit, PSA testing for prostate cancer screening has increased dramatically, especially among black men and younger men.

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PROSTATE CANCER IS THE MOST commonly diagnosed cancer in men in the United States.¹ It has been estimated that more than 200 000 new cases of prostate cancer will have been diagnosed by the end of 2007. However, only about 12% of these men will die of their disease. The discrepancy between the large numbers of men diagnosed as having prostate cancer and the smaller number of men who die of prostate cancer have led some investigators to suggest that aggressive screening using the prostate-specific antigen (PSA) test is unwarranted.² An alternative view is that aggressive screening leads to early diagnosis of prostate cancer and thereby to reduced mortality.³ As a result of this uncertainty, most major scientific and medical groups do not recommend routine PSA testing for prostate cancer⁴⁻⁶; however, some authors suggest that it might be appropriate in men with an estimated life expectancy of at least 10 years.⁷⁻⁹ Two large trials that may help answer these questions are still ongoing.¹⁰

Previous studies have indicated that physicians often use the PSA test to screen

for prostate cancer and may continue to do so even among men who are least likely to benefit, such as those older than 75 years or those with significant comorbidities and short life expectancy.^{11,12} However, we do not really know whether testing patterns have changed in recent years. It is possible that the controversy surrounding the benefits might have led physicians to curtail their use of the PSA test as a screening test until the benefits are clearer. It is also possible that despite the uncertain benefits, physicians might be increasing their use of this screening modality as a response to some of the guidelines that advocate for testing. Understanding how physicians have responded can shed some light on how physicians' behavior changes in the context of uncertainty. Therefore, we used data from the National Ambulatory Medical Care Survey (NAMCS) from 1995 through 2004 to answer 2 questions: Were primary care physicians more likely to order PSA testing over time? If the frequency of PSA testing changed, what particular characteristics of patients and providers were associated with the largest change?

METHODS

We used the NAMCS, a nationally representative survey administered by the Ambulatory Care Statistics Branch of the Centers for Disease Control and Prevention National Center for Health Statistics (NCHS).¹³ The NAMCS collects information on patient visits to non-federally funded, community, office-based physician practices throughout the United States. It has a 3-stage sampling design, with sampling based on geographic location, physician practices within a geographic location (stratified by physician specialty), and visits within individual physician practices. Physicians who are selected to participate in the NAMCS during a particular calendar year are not eligible to be selected again for at least another 3 years.

Patient, physician, and clinical information is collected at each selected visit and is recorded on patient record forms by participating physicians, office staff, or US Census Bureau representatives. Patient information includes demographic data and insurance status. Race and ethnicity are classified by the person filling out the patient record form, according to an office's usual practice for collecting such information. Physician information includes self-identified specialty, geographic region, and whether the practice is located within a rural area. Clinical characteristics include up to 3 reasons for the visit (coded using the Reason for Visit Classification [RVC]), 3 diagnoses (1 primary diagnosis and 2 secondary diagnoses, coded using the *International Classification of Diseases, Ninth Revision, Clinical Modification* [ICD-9-CM]), and whether or not a PSA test was ordered. The NCHS weights each visit to allow extrapolation to national estimates for all aspects of the surveys. The visit weight accounts for selection probability, adjustment for non-response, and other adjustments to reflect the universe of ambulatory visits in the United States.

STUDY POPULATION

Because we were interested in analyzing how often a PSA test is ordered for men who are most likely to be screened for prostate cancer, we only included men who visited a family practice/general medicine physician or an internal medicine physician office. We began with the most recently available data (2004) and obtained the previous 9 years of annual NAMCS data to create a 10-year sample. No data are available in the NAMCS regarding why a PSA test was ordered. Because we were interested in orders for the PSA test for prostate cancer screening and not for diagnosing other prostate-related diseases or prostate cancer monitoring, we excluded men who presented with prostate-related symptoms (RVC codes 17100, 17101, 17102, 45290, and 45300) or diagnoses (ICD-9-CM codes 098.12, 098.32, 131.03, 601.0X, 601.1X, 601.4X, 601.9X, and 600.XX) as well as those with a known history of prostate cancer (ICD-9-CM codes 185.X, 2334.X, 2365.X, and V1046). Because we expected few primary care physicians to screen men younger than 35 years for prostate cancer, we excluded these men. We examined frequency rates for all primary care clinic visits and visits for general medical examinations (RVC code 31000 and ICD-9-CM codes V70.0X and V70.9X) to better focus on visits during which PSA tests are more likely to be ordered for prostate cancer screening. After these exclusions, our data are nationally representative of men 35 years of age or older without a recorded prostate-related disease who visited primary care physicians located in nonfederal health care facilities in the period from 1995 through 2004.

STATISTICAL ANALYSIS

We calculated visit-based rates of PSA testing for both overall primary care clinic visits and visits for general medical exami-

nations. We used the number of visits by eligible men at which a primary care physician ordered a PSA test during a given year as the numerator and the total number of visits to primary care physicians by eligible men for that year as the denominator. We compared the patient and physician characteristics of visits at which primary care physicians ordered a PSA test with visits at which primary care physicians did not order a PSA test for eligible men during the entire 10-year period. We used the χ^2 test to determine whether there were differences between the frequencies of PSA ordering by categorical variables over the 10-year period. We also investigated predictors of an order for a PSA test in the cohort using multivariable logistic regression models. In these models, we controlled for the following covariates: calendar year (1995-2004); age (35-49, 50-74, and ≥ 75 years); urban vs rural location; geographic region (Northeast, Midwest, South, and West); ethnicity (Hispanic or non-Hispanic); race (white or black); physician specialty (internal medicine or family practice/general medicine physician) and insurance status (private, Medicare, or other).

To examine trends for PSA testing among prespecified subgroups over time, we pooled visits into 2 time periods—1995 through 1999 and 2000 through 2004—because of limitations from small sample sizes. We then examined changes in the frequency of PSA ordering between these 2 periods within prespecified subgroups, which were defined by characteristics of the patients (age groups, insurance status, and race/ethnicity) as well as those of the providers (specialty, geographic region, and urban vs rural location). We used multivariate models to determine if the likelihood of a PSA order changed within these subgroups from one time period to the other.

All analyses were performed with SAS version 9.1 (SAS Institute Inc, Cary, North Carolina) and SAS-callable SUDAAN version 9.0.1 (Research Triangle Institute, Research Triangle Park, North Carolina) to account for the complex sampling design of the NAMCS as recommended by the NCHS. All *P* values were 2-tailed, and *P* < .05 was considered significant. Only estimates based on 30 or more sample records and estimates with a relative standard error (the standard error divided by the estimate itself) of less than 30% are reported except where otherwise noted. Estimates based on fewer than 30 sample records or with a relative standard error of greater than 30% may be unreliable according to the NCHS.

RESULTS

In the period from 1995 through 2004, there were approximately 100 million annual clinic visits to outpatient primary care physicians by men aged 35 years or older without prostate-related symptoms or a diagnosis of prostate cancer. Over the entire period, primary care physicians ordered the PSA test more frequently for men between 50 and 74 years of age than for men younger than 50 years or older than 74 years (**Table 1**). Physicians in urban areas ordered PSA tests more frequently than physicians in rural areas, and internists were more likely to order PSA tests than were family or general medicine practitioners. Primary care physicians ordered PSA tests for men with private insurance more frequently than for men with other forms of insurance.

Physicians ordered a PSA test in 4.7% of visits in 1995 and in 7.0% of visits in 2004, an increase of nearly 50% (*P* = .03). Over this 10-year period, the odds of having a PSA test ordered during a clinic visit increased 8% (odds ratio [OR], 1.08; 95% confidence interval [CI],

Table 1. Cohort Characteristics and Visit-Based Rates of Prostate-Specific Antigen (PSA) Testing, 1995 Through 2004

Variable	Percentage			P Value
	Overall	PSA Testing	No PSA Testing	
Age, y				
35-49	33.1	3.2	96.8	<.01
50-74	50.3	8.0	92.0	
≥75	16.6	5.3	94.7	
Location				
Rural	22.5	4.2	95.8	<.01
Urban	77.5	6.5	93.5	
Region				
Northeast	19.9	6.7	93.3	.46
Midwest	24.1	6.0	94.1	
South	33.3	5.4	94.6	
West	22.7	6.2	93.8	
Ethnicity				
Non-Hispanic	93.0	6.0	94.0	.42
Hispanic	7.0	5.2	94.8	
Race				
White	86.2	5.9	94.1	.60
Black	9.3	6.9	93.2	
Specialty				
FP/GP	54.4	4.9	95.1	<.01
IM	45.6	7.2	92.8	
Insurance				
Private	50.3	6.7	93.3	<.01
Medicare	29.4	6.1	93.9	
Other	20.2	4.0	96.0	

Abbreviations: FP, family practice; GP, general medicine practice; IM, internal medicine.

1.04-1.12; $P < .001$) per year after adjustment for other factors. Among visits for a general medical examination, the frequency of visits in which a physician ordered a PSA test nearly tripled from 11.2% in 1995 to 32.2% in 2004 ($P = .003$) (**Figure**). Over this 10-year period, the odds of having a PSA test ordered during a visit for a general medical examination increased 14% (OR, 1.14; 95% CI, 1.08-1.21; $P < .001$) per year after adjustment for other factors.

When we examined PSA testing frequencies among prespecified subgroups of men in the 2000-2004 period and compared the rates with those of the 1995-1999 period, we found that the likelihood of a primary care physician ordering a PSA test during any clinic visit increased significantly in almost every subgroup (**Table 2**). For example, men aged 35 through 49 years had 82% higher odds of receiving a test during 2000-2004 than they did during 1995-1999 (OR, 1.82; 95% CI, 1.27-2.60; $P = .001$). The likelihood of a physician ordering a PSA test increased significantly among all ethnic and racial groups, with the most pronounced increase among black men (OR, 2.27; 95% CI, 1.37-3.77; $P = .002$) and Hispanic men (OR, 4.35; 95% CI, 1.99-9.50; $P < .001$), although the CI among Hispanic men was wide. During 2000-2004, physicians were 63% more likely to order a PSA test for men with private insurance (OR, 1.63; 95% CI, 1.27-2.10; $P < .001$) and 59% more likely to order a PSA test for men with Medicare (OR, 1.59; 95% CI, 1.15-2.18; $P = .005$). The increase among men with other forms of insurance was smaller and not statistically significant (OR, 1.22; 95% CI, 0.78-1.89; $P = .39$).

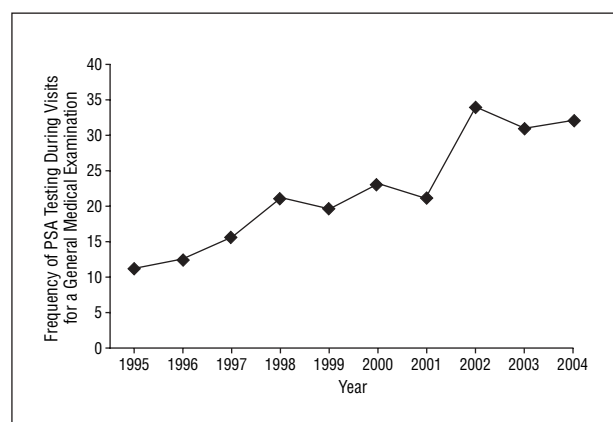


Figure. Frequency of prostate-specific antigen (PSA) testing during visits for a general medical examination among American men, 1995 through 2004.

Limiting clinic visits to those for a general medical examination, we found that physicians were much more likely to order PSA tests among nearly all subgroups of patients in the 2000-2004 period than they were in the 1995-1999 period (**Table 3**). For example, men aged 35 through 49 years had more than a 3-fold increase in their odds of receiving a PSA test in the 2000-2004 period than in the 1995-1999 period (OR, 3.26; 95% CI, 1.70-6.25; $P < .001$). The frequency of PSA testing during visits for a general medical examination increased in all regions of the country, among all racial and ethnic groups, and among men with private or Medicare insurance. These trends in PSA testing during a general medi-

Table 2. Frequency of Prostate-Specific Antigen (PSA) Testing by Primary Care Physicians in 2000-2004 Compared With 1995-1999

Variable	Percentage		OR (95% CI) ^a	P Value
	PSA Testing 1995-1999	PSA Testing 2000-2004		
Age, y				
35-49	2.1	4.2	1.82 (1.27-2.60)	.001
50-74	6.3	9.4	1.50 (1.20-1.89)	<.001
≥75	4.5	5.9	1.33 (0.89-2.01)	.17
Location				
Rural	3.0	5.4	1.80 (1.13-2.89)	.01
Urban	5.0	7.6	1.50 (1.20-1.88)	<.001
Region				
Northeast	4.5	8.3	1.74 (1.09-2.77)	.02
Midwest	3.7	7.7	1.98 (1.33-2.93)	<.001
South	5.0	5.7	1.09 (0.78-1.53)	.61
West	4.6	7.6	1.74 (1.12-2.69)	.01
Ethnicity				
Hispanic	1.9 ^b	7.1	4.35 (1.99-9.50)	<.001
Non-Hispanic	4.7	7.4	1.46 (1.19-1.81)	<.001
Race				
White	4.5	7.0	1.51 (1.21-1.87)	<.001
Black	3.8	9.5	2.27 (1.37-3.77)	.002
Specialty				
FP/GP	3.6	6.0	1.56 (1.20-2.03)	.001
IM	5.6	8.5	1.52 (1.09-2.11)	.01
Insurance				
Private	5.0	7.9	1.63 (1.27-2.10)	<.001
Medicare	4.6	7.2	1.59 (1.15-2.18)	.005
Other	3.7	4.4	1.22 (0.78-1.89)	.39

Abbreviations: CI, confidence interval; FP, family practice; GP, general medicine practice; IM, internal medicine; OR, odds ratio.

^aMultivariable model for each individual variable included each of the following variables: age (35-49, 50-74, and ≥75 years); metropolitan status (rural or urban); geographical region (Northeast, Midwest, South, or West); ethnicity (Hispanic or non-Hispanic); race (white or black); physician specialty (FP/GP or IM); and insurance status (private, Medicare, or other).

^bThis subpopulation is based on fewer than 30 sample records and therefore may be unreliable.

cal examination are shown in greater detail in Table 3 and broadly mirrored the results for trends in PSA testing during all visits.

COMMENT

We found that between 1995 and 2004, orders for a PSA test by primary care physicians increased nearly 50% among all clinic visits and nearly tripled among clinic visits for a general medical examination. Although the likelihood of a physician ordering a PSA test increased in nearly all groups, the most dramatic increases were among men aged 35 through 49 years, among black men, and among men with private and Medicare insurance.

During a period with little evidence but with significant debate regarding the use of the PSA test for prostate cancer screening, it might be surprising that PSA testing rates increased 8% per year during all primary care visits and 14% per year during visits for general medical examinations. Prostate cancer screening has been found to be more common than colorectal cancer screening,¹⁴ although the evidence for prostate cancer screening practice is much weaker. Possible explanations regarding why physicians are ordering PSA tests more frequently may include increasing patient awareness,¹⁵ increasing requests for prostate cancer screening, and increasing belief among physicians and patients that the PSA test is a

viable screening modality for prostate cancer.^{16,17} Physicians may also be ordering more PSA tests because of perceived protection from malpractice suits.¹⁸

Our results are consistent with those of previous studies that found that physicians frequently ordered PSA tests for older men.^{11,12} However, we are not aware of studies that have examined trends in PSA testing in a nationally representative sample or that have focused on the frequency of PSA testing among younger men. Although the absolute rates of testing were lower among men aged 35 through 49 years than among men aged 50 through 74 years, the likelihood of a physician ordering a PSA test increased most rapidly in the latter age group. Some evidence from a retrospective analysis suggests that men aged 40 through 49 years with a PSA level above the age-range median PSA level may be at greater risk for developing prostate cancer¹⁹; therefore, biennial PSA testing starting at age 40 years rather than annual PSA testing starting at age 50 years may be a more effective screening strategy.²⁰ National guidelines from the National Comprehensive Cancer Network recommend a baseline PSA test at age 40 years for all average-risk men who choose prostate cancer screening.⁹ The American Cancer Society and the American Urological Society recommend a PSA test for men younger than 50 years if they have defined risk factors such as being black or having a first-degree relative with prostate cancer.^{7,8} These results and

Table 3. Likelihood of Prostate-Specific Antigen Testing in 2000-2004 Compared With 1995-1999 Among Men Attending a Visit for a General Medical Examination

Variable	OR (95% CI) ^a	P Value
Age, y		
35-49	3.26 (1.70-6.25)	<.001
50-74	1.93 (1.35-2.74)	<.001
≥75	0.91 (0.40-2.09)	.82
Location		
Rural	2.65 (1.07-6.56)	.03
Urban	1.96 (1.36-2.81)	<.001
Region		
Northeast	1.34 (0.71-2.55)	.37
Midwest	3.36 (1.79-6.30)	<.001
South	1.98 (1.14-3.42)	.01
West	1.78 (0.78-4.05)	.17
Ethnicity		
Hispanic	8.81 (1.90-40.8)	.005
Non-Hispanic	1.74 (1.26-2.41)	<.001
Race		
White	1.70 (1.22-2.37)	.002
Black	9.29 (2.11-40.8)	.003
Specialty		
FP/GP	1.87 (1.21-2.90)	.005
IM	1.91 (1.20-3.04)	.007
Insurance		
Private	2.07 (1.40-3.08)	<.001
Medicare	1.62 (0.97-2.71)	.06
Other	1.95 (0.91-4.17)	.09

Abbreviations: CI, confidence interval; FP, family practice; GP, general medicine practice; IM, internal medicine; OR, odds ratio.

^aMultivariable model for each individual variable included each of the following variables: age (35-49, 50-74, and ≥75 years); metropolitan status (rural or urban); geographical region (Northeast, Midwest, South, or West); ethnicity (Hispanic or non-Hispanic); race (white or black); physician specialty (FP/GP or IM); and insurance status (private, Medicare, or other).

recommendations may be affecting physicians' decisions to increasingly order PSA tests for younger men. However, the evidence for testing younger men remains weak, and whether screening this age group reduces morbidity and mortality is unknown.^{10,21}

In our study, the likelihood of a physician ordering a PSA test for black men increased dramatically, perhaps because of patient or physician awareness that black men have an increased risk for prostate cancer.¹ This finding contrasts with studies that have found that the rates of other preventive care measures among black men have stayed flat or even decreased over time.²² Prostate-specific antigen testing is one of the few areas of preventive care in which blacks are more likely to receive a service than whites.²³ Given that blacks have a higher risk of prostate cancer, our findings may seem reassuring. However, since it is unknown whether PSA testing is useful, it is equally likely that blacks may be receiving unnecessary testing.

We found that rates of testing among men with private insurance or Medicare increased much more dramatically than rates of testing among uninsured men or among men with Medicaid. Insurance status has been shown to be associated with high rates of PSA testing in the past.²⁴ In 2000, Medicare began coverage of prostate

cancer screening by PSA testing, and many private insurers followed Medicare's lead, which may explain the significant increase in the frequency of ordering of PSA tests for men with private insurance and Medicare but not for men with other forms of insurance. Not only are men with private or Medicare insurance more likely to receive PSA testing, the gap in testing frequency between men with private or Medicare insurance and men with Medicaid or the uninsured appears to be widening as well. It is unlikely that changes in the pattern of the disease would explain this expanding gap in testing rates.

There are limitations to our study. First, although our study is nationally representative of community-based ambulatory care visits in the United States over a 10-year period, it does not capture patients who receive care in federal facilities (such as the Veterans Affairs Health Administration). Second, the cross-sectional sampling scheme limits our ability to make conclusions about the reason for the changes in the frequency of physician orders for PSA tests. Third, we did not have clinical data regarding why a PSA test was ordered. Therefore, it is possible that some PSA tests were ordered for the evaluation of conditions related to the prostate other than prostate cancer. We attempted to limit this possibility by excluding men who presented with potential prostate-related conditions, but our exclusions may not have been complete. Finally, the translation of physician diagnoses into ICD-9-CM codes is imperfect. The NAMCS only captured the first 3 diagnosis codes of a clinic visit. Therefore, it may have been possible that men with known prostate cancer did not carry an ICD-9-CM diagnosis of prostate cancer in the NAMCS data set.

In summary, while the evidence that underlies PSA testing for prostate cancer screening remains tenuous, primary care physicians were more likely to order PSA testing in 2004 than in 1995. The increases were most dramatic for visits by black men and younger men. In an era of increasing health care costs, understanding how to optimize preventive services as well as how to ensure evidence-based care remains critically important.

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Author Contributions: Dr Farwell had full access to all of the data in this study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Farwell and Jha. Acquisition of data: Farwell, Linder, and Jha. Analysis and interpretation of data: Farwell and Linder. Drafting of the manuscript: Farwell. Critical revision of the manuscript for important intellectual content: Farwell, Linder, and Jha. Statistical analysis: Farwell and Linder. Obtained funding: Farwell, Linder, and Jha. Administrative, technical, or material support: Linder and Jha. Study supervision: Linder and Jha.

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