The incidence of prostate cancer has increased substantially since the introduction of prostate-specific antigen (PSA) testing in the late 1980s (1). It has been predicted that the increasing number of prostate cancer cases that are diagnosed earlier in the course of disease as a result of PSA testing may change the risk profile of patients with prostate cancer. Previous studies have documented the changing risk profile of prostate cancer in the United States (2–5); however, most of those studies were conducted in a selected population or had limited data on important prognostic factors. Population-based studies of prostate cancer patients that are representative of the US population are lacking. We undertook a nationwide study of newly diagnosed prostate cancer across the United States using 2004–2005 data from the Surveillance, Epidemiology, and End Results (SEER) Program. Following its expansion in 2001, SEER now collects cancer incidence data from registries that cover approximately 26% of the US population and has 98% completeness in case ascertainment (6,7). Individual PSA values and Gleason scores at diagnosis were first available in the SEER public dataset starting in 2004: The PSA value recorded in SEER is the highest PSA laboratory value before the diagnostic biopsy or treatment. We used SEER data to provide a contemporary risk profile of prostate cancer in the United States. There were 98,486 newly diagnosed prostate cancer cases in 2004–2005 in the SEER database. Subjects who were aged 24 years or younger at diagnosis or for whom age at diagnosis was missing (n = 67), whose race was listed as other than black or white (n = 8432), or who had missing PSA values, Gleason score, or clinical stage (n = 7446) were excluded from these analyses. After these exclusions, 82,541 cases were eligible for this study and they were stratified by the patient's age at diagnosis (25–54, 55–64, 65–74, ≥75 years), self-reported race in the medical record (black, white), and cancer features (PSA level, Gleason score, and cancer stage).

The cutpoints for age at diagnosis were chosen because 65 years is the starting age of enrollment of Medicare. We categorized the patients’ ages into 10-year groups for ease of presentation. Patients were categorized into three risk groups on the basis of the American Joint Committee on Cancer clinical stage (8,9), PSA level, and Gleason score, as was done in previous studies (10,11): low risk (stage T2a or lower, a PSA level ≤10 ng/mL, and a Gleason score of 6 or lower), intermediate risk (stage T2b or a PSA level from 10.1 to 20 ng/mL or a Gleason score of 7), and high risk (stage T2c or higher or a PSA level >20 ng/mL or a Gleason score of 8 or higher). We compared the proportions of prostate cancer patients stratified by age at diagnosis, PSA level, Gleason score, and cancer stage between whites and blacks. We also examined temporal trends in age at prostate cancer diagnosis, cancer grade, and tumor stage from 1988 to 2004 using data from the SEER 9 registries, which include Atlanta, Connecticut, Detroit, Hawaii, Iowa, New Mexico, San Francisco–Oakland, Seattle–Puget Sound, and Utah. We restricted our trend analysis to the area covered by SEER 9 to ensure that patients were from the same catchment area so that these trends would be comparable over time. Furthermore, we compared the characteristics of men in the...
2004–2005 SEER database with those of men enrolled in the Scandinavian Prostate Cancer Group 4 (SPCG-4) (12) to provide insight about the generalizability of the result of this trial in the US population. The independence of distributions in these factors between blacks and whites was tested using χ² tests. Secular trends in the proportions for blacks and whites were evaluated separately by using the asymptotic Kruskal–Wallis test (13). Trends in the PSA distribution for patients in 2004–2005 SEER database and for patients in SPCG-4 was tested by an ordered χ² test. All statistical tests were two-sided and were performed by using SAS version 9.0 (SAS Institute, Cary, NC).

This study was approved by the institutional review board of University of Medicine and Dentistry of New Jersey.

We first examined descriptive and tumor characteristics of this cohort of 82,541 patients who were diagnosed with prostate cancer during 2004–2005 (Table 1). Among all patients, the mean age at diagnosis was 67.1 years (67.5 years in whites and 64.7 years in blacks, difference = 2.7 years, 95% confidence interval [CI] = 2.5 to 2.9 years, P < .001). Among all patients, 41% were aged 64 years or younger at diagnosis (25% of whites and 16% of blacks). Among all patients, 94% were diagnosed with localized (ie, stage T1 or T2) prostate cancer (94% of whites and 93% of blacks). Almost half of the patients (47% of whites and 44% of blacks) had a biopsy Gleason score of 6 or lower. Thirty-six percent of patients had a biopsy Gleason score of 7 (36% of whites and 38% of blacks), 25% had primary pattern 3 and secondary pattern

### Table 1. Clinical characteristics of prostate cancer patients, Surveillance, Epidemiology, and End Results (2004–2005)*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All patients, N = 82,541</th>
<th>White, n = 71,346</th>
<th>Black, n = 11,195</th>
<th>P†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at diagnosis, y</td>
<td>Mean (SD)</td>
<td>67.1 (9.75)</td>
<td>67.5 (9.72)</td>
<td>64.7 (9.68)</td>
</tr>
<tr>
<td>25–54, %</td>
<td>10</td>
<td>9</td>
<td>15</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>55–64, %</td>
<td>31</td>
<td>30</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>65–74, %</td>
<td>36</td>
<td>36</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>≥75, %</td>
<td>24</td>
<td>25</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>PSA level, ng/mL</td>
<td>Median (range)</td>
<td>6.7 (0.1–99.0)</td>
<td>6.6 (0.1–99.0)</td>
<td>7.4 (0.1–99.0)</td>
</tr>
<tr>
<td>≤2.5, %</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>2.6–4, %</td>
<td>7</td>
<td>7</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>4.1–6.9, %</td>
<td>35</td>
<td>35</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>7–10, %</td>
<td>17</td>
<td>17</td>
<td>16</td>
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<tr>
<td>10–12, %</td>
<td>14</td>
<td>14</td>
<td>16</td>
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<tr>
<td>&gt;20, %</td>
<td>12</td>
<td>12</td>
<td>17</td>
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<tr>
<td>Unknown</td>
<td>10</td>
<td>10</td>
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<td></td>
</tr>
<tr>
<td>Gleason score, %</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2–6†</td>
<td>46</td>
<td>47</td>
<td>44</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>7</td>
<td>36</td>
<td>36</td>
<td>38</td>
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</tr>
<tr>
<td>3+4‡</td>
<td>25</td>
<td>25</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>4+3§</td>
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<td></td>
</tr>
<tr>
<td>8–10</td>
<td>15</td>
<td>15</td>
<td>16</td>
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<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Tumor stage, %</td>
<td></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>T1#</td>
<td>51</td>
<td>50</td>
<td>53</td>
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</tr>
<tr>
<td>T2#</td>
<td>43</td>
<td>44</td>
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<td>T3**</td>
<td>3</td>
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<td></td>
</tr>
<tr>
<td>T4**</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

* For some categories, the percentages do not total 100 because of rounding. PSA = prostate-specific antigen.
† χ² test (two-sided) was used to test independence of distributions between blacks and whites.
‡ Gleason score 2–4 accounted for 2% of Gleason score 2–6.
§ Primary pattern 3, secondary pattern 3.
¶ Primary pattern 4, secondary pattern 3.
† T1c accounted for 95% of T1.
# T2a accounted for 12% of T2.
** 30% of T3 and T4 cancers were classified as distant cancers.

### From the Editors

Prior knowledge

The increasing number of prostate cancer cases that are diagnosed earlier in the course of disease as a result of prostate-specific antigen testing may change the risk profile of patients with prostate cancer. However, population-based studies of contemporary prostate cancer patients that are representative of the US population are lacking.

### Study design

Surveillance, Epidemiology, and End Results Program data for 2004–2005 were used to generate a contemporary profile of prostate cancer patients and to compare the characteristics of the 2004–2005 patient population with those of patients diagnosed in 1988–1989 and 1996–1997 and with those of participants in a randomized trial of radical prostatectomy vs watchful waiting that showed better survival for patients aged 65 years or younger in the radical prostatectomy group.

### Contribution

Patients diagnosed in 2004–2005 were younger and had earlier stage cancers than patients diagnosed in earlier years. The incidence of stage T3 or T4 cancer at diagnosis has decreased in both blacks and whites and the racial disparity in cancer stage at diagnosis has decreased over time. Compared with patients in the trial, patients in the Surveillance, Epidemiology, and End Results population had a lower prostate-specific antigen level and earlier cancer stage at diagnosis.

### Implications

It remains to be determined whether more patients being diagnosed at earlier stages ultimately results in a decreased mortality and whether the narrowing of the racial disparity in the presentation of advanced prostate cancer is ultimately accompanied by similar trend in mortality.

### Limitations

Changes in prostate-specific antigen level at diagnosis of prostate cancer patients over time could not be directly compared. A more refined classification of Gleason scores before 2004 was not possible.
4, and 10% had primary pattern 4 and secondary pattern 3 (14,15). The median serum PSA level at diagnosis was 6.7 ng/mL (6.6 ng/mL in whites and 7.4 ng/mL in blacks, difference = 0.8 ng/mL, 95% CI = 0.63 to 0.97 ng/mL, *P* < .001). Approximately 13% of patients had a PSA level of 4 ng/mL or less. Among these patients, 46% had PSA level of 2.5 ng/mL or less.

Overall, older age at diagnosis was associated with a higher PSA level (Supplementary Figure 1, available online) and with a higher biopsy Gleason score (Supplementary Figure 2, available online) in both blacks and whites. Within each age stratum, blacks had a higher median PSA level and a slightly higher proportion of biopsy Gleason score of 7 or higher compared with whites. We examined the distribution of risk groups by race and age at diagnosis (Figure 1). The proportion of patients who exhibited intermediate- or high-risk disease at diagnosis increased with increasing age at diagnosis in blacks and in whites. In each age-at-diagnosis stratum, blacks were more likely than whites to have intermediate- or high-risk cancers.

We examined temporal trends in age at prostate cancer diagnosis, cancer grade, and tumor stage from 1988 to 2005 in SEER 9 area (Supplementary Table 1, available online). The average age of patients at diagnosis decreased from 72.2 years in 1988–1989 to 69.2 years in 1996–1997 to 67.2 years in 2004–2005. In general, the incidence of stage T3 or T4 prostate cancer among newly diagnosed patients increased with increasing age at diagnosis in blacks and whites. In each age stratum, blacks had a higher PSA level at diagnosis than whites, with a difference of 7.4 ng/mL in blacks and 6.7 ng/mL in whites (6.6 ng/mL in whites and 7.4 ng/mL in blacks, difference = 0.8 ng/mL, 95% CI = 0.63 to 0.97 ng/mL, *P* < .001). Approximately 13% of patients had a PSA level of 4 ng/mL or less. Among these patients, 46% had a PSA level of 2.5 ng/mL or less.

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References

Funding
National Cancer Institute (ROI CA 116399), Cancer Institute of New Jersey core grant (NCI CA-72720-10), and Robert Wood Johnson Foundation (60624).

Notes
The sponsors had no role in the study design, the collection and analysis of the data, the interpretation of the results, the preparation of the manuscript, or the decision to submit the manuscript for publication.
We thank Thanusha Puvananayagam, MPH, Cancer Institute of New Jersey assistant staff, for outstanding administrative and technical assistance.
Manuscript received January 22, 2009; revised July 1, 2009; accepted July 14, 2009.