Risk Adjustment and the Assessment of Disparities in Dialysis Mortality Outcomes

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ABSTRACT
Standardized mortality ratios (SMRs) reported by Medicare compare mortality at individual dialysis facilities with the national average, and are currently adjusted for race. However, whether the adjustment for race obscures or clarifies disparities in quality of care for minority groups is unknown. Cox model-based SMRs were computed with and without adjustment for patient race for 5920 facilities in the United States during 2010. The study population included virtually all patients treated with dialysis during this period. Without race adjustment, facilities with higher proportions of black patients had better survival outcomes; facilities with the highest percentage of black patients (top 10%) had overall mortality rates approximately 7% lower than expected. After adjusting for within-facility racial differences, facilities with higher proportions of black patients had poorer survival outcomes among black and non-black patients; facilities with the highest percentage of black patients (top 10%) had mortality rates approximately 6% worse than expected. In conclusion, accounting for within-facility racial differences in the computation of SMR helps to clarify disparities in quality of health care among patients with ESRD. The adjustment that accommodates within-facility comparisons is key, because it could also clarify relationships between patient characteristics and health care provider outcomes in other settings.


The Standardized Mortality Ratio (SMR), which compares mortality at each dialysis facility to the overall mortality of United States patients on dialysis, is reported in the annual US Dialysis Facility Reports and as a public measure on the Centers for Medicare and Medicaid Services (CMS) Dialysis Facility Compare website. These reports are used by government agencies and dialysis facilities with the goal of improving the quality of health care to more than half a million United States patients treated with dialysis.

Our purpose in this paper is to explain the rationale for the inclusion of race in the SMR model. In 2011, the rationale led to the National Quality Forum’s approval of this race-adjusted measure despite that organization’s standing policy and general concern about adjustments that obscure disparities in outcomes for disadvantaged populations.

The SMR for a given facility is computed as the ratio of the observed number of deaths at that facility to the number of deaths expected under a national norm, where the expectation is adjusted to reflect characteristics of that facility’s patients. Risk adjustment is performed using a two-stage Cox regression model. Race and ethnicity are included as adjustments in the model. A key feature of our approach is that we assess risk factors by comparing outcomes of patients with varying race and ethnicity attributes, within facilities. Applying these within-facility adjustments in the SMR then allows comparison of outcomes between facilities. This approach avoids confounding between patient characteristics and facility effects.

Adjustment for race can potentially mask racial disparities when racial minorities tend to receive poorer health care, leading to poorer outcomes, on average, than other patients. Some authors have suggested that black patients undergoing dialysis tend to have better survival outcomes than white patients and other racial groups. At least in these cases, not adjusting for within-facility racial differences may conceal underlying disparities in care provided by specific health care providers.

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with a careful analysis of the race adjustment in the SMR for dialysis facilities and discuss implications for data interpretation and policy in the Discussion section.

RESULTS

Our research uses CMS national data on patients being treated with dialysis to evaluate dialysis facilities with respect to patient survival. Table 1 summarizes demographic characteristics for the population of patients included in these comparisons. The comorbidity index is computed for each patient based on comorbidities reported at the onset of dialysis. The index is described in detail in the Dialysis Facility Reports.

Comparisons among facilities are based on the SMRs for the calendar year 2010. The analyses were performed with and without race and ethnicity adjustments. However, we concentrate here on the differences in SMRs between facilities related to the proportion of blacks in the facility. Facilities were grouped into deciles according to their percentage of black patients. Figure 1 displays the combined SMRs for each decile, with and without adjustment for within-facility differences in race and ethnicity. Figure 2 gives a similar display of SMRs, adjusted for within-facility differences in race and ethnicity, but separately for black patients and non-black patients.

As noted, and in contrast to many other health care settings, black patients undergoing dialysis have better survival rates than non-black patients. When SMRs are unadjusted for the racial composition of patients in the facility, facilities with more black patients tend to have observed mortality rates lower than the expected mortality from the predictive model. Overall, mortality at the 10% of facilities with the highest percentage of black patients was approximately 7% lower than expected (SMR=0.93 for the decile) and the SMRs generally decreased as the percentage of black patients increased (Figure 1, dashed line).

When SMRs are adjusted for the within-facility effect of race, expected mortality is based on the race of each patient. With this adjustment, facilities treating higher percentages of black patients have observed mortality rates higher than the expected mortality. Overall, mortality at the 10% of facilities with the largest percentages of black patients was approximately 6% higher.

Table 1. Patient demographics of 514,357 patients with ESRD who contribute to the comparisons of SMRs for the year 2010

<table>
<thead>
<tr>
<th>Patient Characteristics</th>
<th>Percentages/Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients by age group, years (%)</td>
<td></td>
</tr>
<tr>
<td>&lt;18</td>
<td>0.5%</td>
</tr>
<tr>
<td>18–64</td>
<td>55.9%</td>
</tr>
<tr>
<td>65+</td>
<td>44.6%</td>
</tr>
<tr>
<td>Female patients (%)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>57.1%</td>
</tr>
<tr>
<td>Black</td>
<td>35.6%</td>
</tr>
<tr>
<td>Asian/Pacific Islander</td>
<td>4.8%</td>
</tr>
<tr>
<td>Native American</td>
<td>1.4%</td>
</tr>
<tr>
<td>Other</td>
<td>1.1%</td>
</tr>
<tr>
<td>Patients by Hispanic ethnicity (%)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>15.2%</td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>83.2%</td>
</tr>
<tr>
<td>Unknown</td>
<td>1.6%</td>
</tr>
<tr>
<td>Average incident comorbidity index</td>
<td>0.23</td>
</tr>
<tr>
<td>Diabetes as cause of ESRD (%)</td>
<td>44.1%</td>
</tr>
<tr>
<td>Patients by duration of ESRD (%)</td>
<td></td>
</tr>
<tr>
<td>&lt;1 year</td>
<td>34.0%</td>
</tr>
<tr>
<td>1–2 years</td>
<td>14.9%</td>
</tr>
</tbody>
</table>

Figure 1. Comparison of 2010 SMRs from models adjusted and unadjusted for race and ethnicity. The x axis is the percentage of black patients at facilities grouped into deciles. Plotted points are the estimated SMR versus the average percentage of blacks for the decile. Shaded areas are 95% confidence intervals.
than expected (SMR=1.06 for the decile; Figure 1). These changes occur because the expected mortality at these facilities differs markedly based on the inclusion or exclusion of patient race in the predictive model. The race- and ethnicity-adjusted SMRs of both black and non-black patients generally increased as the proportion of black patients in the facility increased (Figure 2), even more so for non-black patients. Similar analyses showed no important effects relating a facility’s ethnic composition to SMR.

Table 2 compares several facility characteristics of the 10% of facilities with the highest proportion of black patients with all other facilities. Those with the highest proportions of black patients had a lower average for median household income in the zip code of residence by about $11,000. Other less marked differences lay in average age, time since onset of ESRD and percent of rural facilities.

DISCUSSION

The observation that black patients treated with dialysis tend to have better survival outcomes than non-black patients has been noted in the literature and reported in the US Renal Data System. The reasons are not entirely clear. Some studies suggest that underlying genetic and biologic differences may determine kidney disease pathways in blacks compared with other race and ethnic groups. Similarly, specific biologic or genetic factors may provide protective benefits for certain clinical outcomes, when compared with whites or other race groups. For example, some have observed an association with high body mass index and better nutritional status, which may account for the survival advantage among blacks. Others have postulated that blacks with CKD who progress to ESRD tend to be healthier and therefore start chronic dialysis with a survival advantage.

In the results unadjusted for race (Figure 1), it is unclear whether lower mortality at facilities with greater percentages of black patients occurs because black dialysis patients have lower mortality, or because these facilities tend to provide better care. However, the analysis adjusted for race and ethnicity indicates that facilities with a higher percentage of black patients tend to have higher mortality than would be expected given their case mix including race. Further, as Figure 2 illustrates, this elevation in mortality is observed for both black and non-black patients. This may be the result of an underlying relationship with socioeconomic status or other environmental variables.

Our objective is to clearly identify facilities whose outcomes are below the national average. With this approach, the race-adjusted analyses do not obscure disparities in health care, but tend to clarify the disparities. Without adjustment, we may erroneously conclude that those facilities with a high concentration of black patients have outcomes better than the national norm. As demonstrated, when taking ac-

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Table 2. Average facility characteristics for the 10% of facilities in 2010 with the highest percentage of black patients and for the remaining 90%

<table>
<thead>
<tr>
<th>Facility Characteristics</th>
<th>Lowest 90% of percentages</th>
<th>Highest 10% of percentages</th>
<th>( p ) Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>((n=5328))</td>
<td>((n=592))</td>
<td></td>
</tr>
<tr>
<td>Average age</td>
<td>61.2</td>
<td>58.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Average incident comorbidity index</td>
<td>0.24</td>
<td>0.21</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Average income(b)</td>
<td>$50K</td>
<td>$39K</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>In nursing home the previous year</td>
<td>7.4%</td>
<td>6.3%</td>
<td>0.001</td>
</tr>
<tr>
<td>Diabetes as cause of ESRD</td>
<td>44.3%</td>
<td>38.6%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Female patients</td>
<td>43.9%</td>
<td>47.0%</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Average duration of ESRD (years)</td>
<td>3.6</td>
<td>4.3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Rural facility(c)</td>
<td>22.4%</td>
<td>17.4%</td>
<td>0.005</td>
</tr>
</tbody>
</table>

*Test for difference based on independent samples t tests for all except rural facility characteristic, which was based on a chi-squared test.

\(b\) Average income for each facility was based on the median household income for each patient’s zip code of residence (income data source: American Community Survey 2007–2011, Social Explorer, and US Census Bureau; if a patient was missing zip code of residence he/she was assigned the facility’s zip code).

\(c\) Table reports the percentage of facilities in the “percentage of black patients” category that are rural.
count of facility level racial composition, this does not appear to be the case.

As a general principle, serious consideration should be given to the potential role of patient race and other sociodemographics when evaluating quality of care. When typically disadvantaged minorities appear to have better outcomes at the patient-level, adjustment for these demographic variables may be particularly important as in the example discussed in this paper. However, even if minority outcomes are associated with poorer facility performance, it may still be informative to estimate and adjust for within-facility effects, and then evaluate between facility differences for potential disparities.

Socioeconomic factors may play an important role in explaining the differences between facilities based on racial composition (Table 2). They may relate, for example, to insufficient resource allocation to facilities with a high proportion of black patients. Alternatively, because facilities with many black patients tend to have a higher proportion of patients with low socioeconomic status, these facilities work with a population that has more resource-intensive chronic conditions due to limited access to health care, in turn resulting in poorer outcomes. However, this may only be a partial explanation. We considered an alternative model that adjusts for patient socioeconomic status measured at the zip-code level but this had negligible impact on the results for race.

CONCISE METHODS

In our study, we used 2007–2010 CMS ESRD data along with mortality data from the Social Security Death Master File. The SMR is based on a two-stage survival model applied to 4 years of data. At Stage 1, a Cox model with facility-defining strata is fitted to estimate the coefficients of patient-level covariates, including age, race, etc., as well as two-way interactions. Stratification by facility has the advantage of allowing estimation of covariate effects, while controlling for facility differences. This effectively accounts for any confounding that might occur between facility effects and the covariates. At Stage 2, the estimated log relative risk for each patient from the first stage is used as an offset to estimate a national average (across-facilities) baseline hazard rate. At this stage, the model also adjusts for variations in state-wide mortality rates. Combining the predicted relative risk from the first stage and the national baseline hazard rate from the second stage, we can estimate the expected number of deaths for each patient. More details are given in the Online Supplemental Material and in the Dialysis Facility Reports.

The estimated model is then used to obtain SMRs for each of 5920 dialysis facilities during calendar year 2010. In Figures 1 and 2, the SMRs for a given decile are computed by summing the observed numbers of deaths in 2010 for each of the facilities in that decile and dividing that by the corresponding sum of the expected numbers of deaths. In Figure 2, an SMR is computed in this way for blacks and non-blacks separately.

There has been discussion relating the SMR and facility characteristics in the literature. There has also been a critical review and a response. Other methods of computing SMRs were discussed and compared in Kalbfleisch and Wolfe.

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The University of Michigan Kidney Epidemiology and Cost Center (UM-KECC) produces the Dialysis Facility Reports (DFR) under contract to the Centers for Medicare and Medicaid Services (CMS). Information regarding this report is available at: https://dialysisdata.org/content/methodology. Before September 2014 this documentation was available at http://www.dialysisreports.org, which previously supported preview of DFR and DFC data to facilities. Centers for Medicare and Medicaid Services (CMS) Dialysis Facility Compare: Available at: http://www.medicare.gov/dialysisfacilitycompare/search.html


DISCLOSURES

The authors do not have financial conflicts of interests to disclose.

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1. The University of Michigan Kidney Epidemiology and Cost Center (UM-KECC) produces the Dialysis Facility Reports (DFR) under contract to the Centers for Medicare and Medicaid Services (CMS). Information regarding this report is available at: https://dialysisdata.org/content/methodology. Before September 2014 this documentation was available at http://www.dialysisreports.org, which previously supported preview of DFR and DFC data to facilities.


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