Anemia is associated with mortality in patients receiving maintenance dialysis. The period immediately after hemodialysis (HD) initiation, which is associated with high rates of mortality and substantial economic costs, is often characterized by efforts to increase low hemoglobin (Hb) levels that developed during the predialysis period.

However, it is not fully understood how effectively hemoglobin levels are managed in the predialysis period. In particular, how anemic patients may respond to erythropoiesis-stimulating agents (ESAs) prior to HD initiation is understudied.

We examined ESA administration and associated Hb levels in the period before and after initiation of HD, focusing on potentially “undertreated” individuals.

**Methods**

- **USRDS ESRD and pre-ESRD standard analytical files** for patients initiating HD between 4/1/12 and 6/30/13 were used.
- The dates were selected since they occurred after CMS revised the Prospective Payment System (January 2011) and the Food and Drug Administration changed the ESA label (June 2011). In April 2012, CMS began requiring the reporting of Hb levels for all HD patients via CROWNWeb.
- Patients were required to have:
  - Continuous Medicare Parts A and B insurance (with no enrollment in a HMO) during the 6-month predialysis period.
  - Alive and an HD patient on the first day of the follow-up period (which began 90 days after HD initiation)
  - Survived an additional 3 months;
  - 1 Hb measurement in the month of HD initiation or a Hb value recorded on the Medical Evidence Report upon HD initiation;
  - ≥2 Hb measurements in the 3 months immediately after HD initiation;
  - Aged 65 years or older at initiation (to permit assessment of Medicare claims in the pre-dialysis period).
- Patients who had a blood transfusion during the baseline period were excluded.
- We grouped patients into 4 major groups:
  - Those with predialysis Hb <9 g/dL who did not receive ESAs in the 3 months before dialysis initiation
  - Those with predialysis Hb <9 g/dL who did not receive ESAs in the 3 months before dialysis initiation
  - Those with predialysis Hb <9 g/dL who did not receive ESAs in the 3 months before dialysis initiation
  - Those with predialysis Hb <9 g/dL who did not receive ESAs in the 3 months before dialysis initiation

- **Predialysis** defined as the 3 months before HD initiation.
- **Post-hemodialysis** defined as the 3 months after HD initiation.

**Introduction**

Anemia is associated with mortality in patients receiving maintenance dialysis. The period immediately after hemodialysis (HD) initiation, which is associated with high rates of mortality and substantial economic costs, is often characterized by efforts to increase low hemoglobin (Hb) levels that developed during the predialysis period. However, it is not fully understood how effectively hemoglobin levels are managed in the predialysis period. In particular, how anemic patients may respond to erythropoiesis-stimulating agents (ESAs) prior to HD initiation is understudied.

We examined ESA administration and associated Hb levels in the period before and after initiation of HD, focusing on potentially “undertreated” individuals.

**Methods**

- **USRDS ESRD and pre-ESRD standard analytical files** for patients initiating HD between 4/1/12 and 6/30/13 were used.
- The dates were selected since they occurred after CMS revised the Prospective Payment System (January 2011) and the Food and Drug Administration changed the ESA label (June 2011). In April 2012, CMS began requiring the reporting of Hb levels for all HD patients via CROWNWeb.
- Patients were required to have:
  - Continuous Medicare Parts A and B insurance (with no enrollment in a HMO) during the 6-month predialysis period.
  - Alive and an HD patient on the first day of the follow-up period (which began 90 days after HD initiation)
  - Survived an additional 3 months;
  - 1 Hb measurement in the month of HD initiation or a Hb value recorded on the Medical Evidence Report upon HD initiation;
  - ≥2 Hb measurements in the 3 months immediately after HD initiation;
  - Aged 65 years or older at initiation (to permit assessment of Medicare claims in the pre-dialysis period).
- Patients who had a blood transfusion during the baseline period were excluded.
- We grouped patients into 4 major groups:
  - Those with predialysis Hb <9 g/dL who did not receive ESAs in the 3 months before dialysis initiation
  - Those with predialysis Hb <9 g/dL who did not receive ESAs in the 3 months before dialysis initiation
  - Those with predialysis Hb <9 g/dL who did not receive ESAs in the 3 months before dialysis initiation
  - Those with predialysis Hb <9 g/dL who did not receive ESAs in the 3 months before dialysis initiation

- **Predialysis** defined as the 3 months before HD initiation.
- **Post-hemodialysis** defined as the 3 months after HD initiation.

**Results**

Table 1. Baseline characteristics and comorbidity by initial Hb value

<table>
<thead>
<tr>
<th>Initial Hb</th>
<th>Hb &lt; 9.0</th>
<th>9.0 ≤ Hb &lt; 10.0</th>
<th>10.0 ≤ Hb &lt; 11.0</th>
<th>Hb ≥ 11.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Hb (g/dL)</td>
<td>8.2 (0.3)</td>
<td>9.0 (0.3)</td>
<td>9.9 (0.3)</td>
<td>10.9 (0.3)</td>
</tr>
<tr>
<td>Age (year)</td>
<td>76.4</td>
<td>75.6</td>
<td>75.6</td>
<td>75.6</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>54.2</td>
<td>54.2</td>
<td>54.2</td>
</tr>
<tr>
<td>Female</td>
<td>45.8</td>
<td>45.8</td>
<td>45.8</td>
<td>45.8</td>
</tr>
<tr>
<td>White</td>
<td>39.0</td>
<td>39.0</td>
<td>39.0</td>
<td>39.0</td>
</tr>
<tr>
<td>Black</td>
<td>31.9</td>
<td>31.9</td>
<td>31.9</td>
<td>31.9</td>
</tr>
<tr>
<td>Primary cause of ESRD</td>
<td>Diabetes</td>
<td>56.2</td>
<td>56.2</td>
<td>56.2</td>
</tr>
<tr>
<td>Hypertension</td>
<td>23.4</td>
<td>23.4</td>
<td>23.4</td>
<td>23.4</td>
</tr>
<tr>
<td>Other</td>
<td>20.4</td>
<td>20.4</td>
<td>20.4</td>
<td>20.4</td>
</tr>
<tr>
<td>Mean days of total hospitalizations (STE) during baseline</td>
<td>12.5 (6.7)</td>
<td>12.5 (6.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length of total hospitalizations during baseline</td>
<td>12.5 (6.7)</td>
<td>12.5 (6.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charlson index</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Comorbid conditions</td>
<td>Diabetes</td>
<td>50.4</td>
<td>50.4</td>
<td>50.4</td>
</tr>
<tr>
<td>Hypertension</td>
<td>48.0</td>
<td>48.0</td>
<td>48.0</td>
<td>48.0</td>
</tr>
<tr>
<td>Cardiovascular disease</td>
<td>46.4</td>
<td>46.4</td>
<td>46.4</td>
<td>46.4</td>
</tr>
<tr>
<td>Other</td>
<td>46.4</td>
<td>46.4</td>
<td>46.4</td>
<td>46.4</td>
</tr>
</tbody>
</table>

**Conclusions**

- Overall, about one-quarter of patients who initiated HD had a predialysis Hb level <9.0 g/dL.
- Of these with Hb levels <9.0 g/dL, only one-quarter received predialysis ESAs.
- Over 9 in 10 patients with low predialysis Hb levels proved responsive to ESAs after HD initiation (with Hb levels increasing, on average, from 8.2 to 10.9 g/dL).
- Many untreated patients later proved to be treatment responsive after HD initiation, suggesting possible undertreatment of anemia in the predialysis period - a critically important finding given the association of anemia with mortality in dialysis patients.

- 76.7% had predialysis Hb levels > 9.0 g/dL, 25.0% of whom were treated were ESAs predialysis.
- 23.7% had predialysis Hb levels > 9.0 g/dL, of whom only 26.6% received ESAs predialysis.
  - ESA-treated mean predialysis Hb level: 8.2 ± 0.7 g/dL
  - Non-ESA-treated mean predialysis Hb level: 8.2 ± 0.8 g/dL
- Of patients with predialysis Hb levels > 9.0 g/dL, 91.9% received ESAs post-initiation, with a mean increase in Hb from 8.2 ± 0.8 to 10.9 ± 1.2 g/dL.