Timely notification of chronic hypoxemia in an academic adult pulmonary function laboratory

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Background
Oxygen is a vital component of all cellular activity and is, therefore necessary to sustain life.1 Supplemental oxygen is thought to play an important role in the treatment of many chronic illnesses including COPD, interstitial lung disease, heart disease, and pulmonary hypertension.2,3 Moreover, delays in the diagnosis and treatment of hypoxia carry the potential for significant morbidity and mortality.1 The pulmonary fellows at UCSF recognized that patients often present to the pulmonary function testing (PFT) laboratory with hypoxia (SpO2 <89%) in the absence of acute illness and without a prescription for supplemental oxygen. However, the epidemiology of hypoxia in a U.S. outpatient setting has not been explored.

We hypothesized that the delayed management of hypoxia and treatment with supplemental oxygen may be due, in part, to the lack of timely notification to the referring provider regarding the chronically hypoxic patient.

Therefore, our project objectives were to:
1. Quantify the prevalence of the untreated hypoxic patient presenting for PFTs we identified target patients by:
   a. Self-report from the pulmonary fellows assigned to the PFT rotation each month;
   b. Regular review of the PFT laboratory database; and
   c. Patient monitoring logs maintained by the PFT technicians and staff.
2. Our initial quality improvement interventions included:
   a. A detailed protocol for the timely notification of referring and primary care providers;
   b. The creation of a templated notification letter using the established electronic medical record system (Apex); and
   c. A requirement that notification be sent to providers within 48 hours.
3. The ability to electronically follow the frequency and speed of the notification process.

Methods
Prior to our project, a protocol was in place for the direct notification of referring providers when patients were found to be hypoxic in the PFT lab. According to the original protocol, PFT technicians contacted the fellow or attending physicians assigned to the Pulmonary Function Lab rotation. This physician was asked to evaluate the patient and also provide notification to referring providers regarding procurement of home supplemental oxygen therapy. However, there are no established guidelines on the format, timing, or follow-up of these notifications.

To quantify the prevalence of the untreated hypoxic patient presenting for PFTs we identified target patients by:
1. Self-report from the pulmonary fellows assigned to the PFT rotation each month;
2. Regular review of the PFT laboratory database; and
3. Patient monitoring logs maintained by the PFT technicians and staff.

Our initial quality improvement interventions included:
1. Guidance to the referring provider on choice of appropriate supplemental oxygen therapies and the correct format for home oxygen therapy prescriptions.
2. Instructions to our fellows on how to electronically route completed letters to the appropriate providers ensuring timely notification.
3. The ability to electronically follow the frequency and speed of the notification process.

Target Patient ID and Provider Notification

<table>
<thead>
<tr>
<th>Fellow Notified</th>
<th>PFT Technician</th>
<th>Provider</th>
<th>Notification sent</th>
<th>Supplemental oxygen prescribed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary Fellow</td>
<td>PFT Technician</td>
<td>Primary Care Provider</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>PFT Technician</td>
<td>Pulmonary Fellow</td>
<td>Primary Care Provider</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Pulmonary Fellow</td>
<td>PFT Technician</td>
<td>Home Care Provider</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Results
• During a one month observation period 2 hypoxic patients were identified as having:
  a. An O2 sat of <89% on room air
  b. Hypoxia was thought to be associated with their referring diagnosis, i.e. severe pulmonary hypertension and COPD.
  c. No obvious cause of acute pulmonary dysfunction
  d. No need for urgent evaluation or treatment

• During a 6 month intervention period 3 hypoxic individuals were identified. In all three cases:
  a. The standardized letter was used to notify referring providers.
  b. Notifications took place within 48 hours.

Limitations
• The discrepancy between the observational and interventional periods may be due to changes in reporting during each period, PFT technician versus pulmonary fellow reports, respectively.
• The study period was limited by barriers to the creation of a standardized electronic notification letter, and the need to train a new pulmonary fellow monthly on a monthly basis.

Conclusions
• More data is required to assess the prevalence of untreated hypoxia in the outpatient setting and to understand the consequences.
• Findings from the observational period suggest that untreated outpatient hypoxia may be a relatively prevalent problem.
• A standardized reporting system may improve the event capture of adverse findings discovered in the outpatient setting.
• A templated letter within an electronic medical record system can aid in the timely communication between multiple providers.
• A streamlined approach to reporting and notification may aid with the adherence and compliance of a quality improvement initiative.

References