Medication Adherence Patterns in Chronic Obstructive Pulmonary Disease*

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While medical treatment of COPD has advanced, the failure to adhere to regimens for medication poses a significant barrier to effective management. Furthermore, no data are available regarding adherence for patients within the United States. Data from this investigation indicate that 78 outpatients from a medical center in the southeastern region of the United States were prescribed an average of 6.26 medications with both various dosing schedules and different modes of administration. Adherence was poor, with 42 patients (54 percent) underutilizing medications, 39 patients (50 percent) overutilizing medications during periods of respiratory distress, and 24 patients (31 percent) employing ineffective inhaler dosing techniques. Prescription patterns and adherence were not associated with demographic variables; however, adherence was related to classes of medication and situational variables.

(Chesl 1991; 99:837-41)

MAS = medication adherence scale; IAS = inhaler adherence scale; MDIC = metered-dose inhaler checklist.

A dherence to pharmacologic therapy has been reported to be low among patients with COPD and related to poor prognosis. This is a distressing finding, considering that pharmacologic therapy may be considered the backbone of management of COPD in both comprehensive rehabilitation programs and ambulatory settings. Currently, little is known about the extent and management of adherence problems among patients with chronic bronchitis and emphysema. A recent review of the literature identified only six studies which examined this important issue, and only three of these studies investigated adherence to pharmacologic treatment. Taylor et al reported that 41.3 percent (26) of their sample of 63 patients with COPD did not adhere to prescribed theophylline levels over a brief seven-day period. Adherence in this study was measured by plasma theophylline levels and pill counts. Chryssidis et al reported overcompliance with inhaled medication therapy as measured by canister weight in a sample of 114 patients with COPD. James et al also examined patterns of medication by using a questionnaire in 185 patients with either asthma or COPD (chronic bronchitis and emphysema). The results indicate that both groups displayed poor adherence and that patients with COPD displayed significantly lower adherence levels than asthmatic subjects. The group with COPD was observed to adhere to their maintenance regimen 47 percent of the time and to their full regimen only 19 percent of the time. It is interesting to note that James et al also observed overutilization of inhaled medications among many of their patients.

This investigation reports on patterns of medication utilization and factors related to poor adherence among patients with COPD seen in an ambulatory outpatient setting within an urban medical center located in the southeast region of the United States.

Materials and Methods

Participants

Participants in this investigation were 78 patients seen through the Division of Pulmonary Medicine outpatient clinics at UAB. Patients from the Veterans Affairs Medical Center's pulmonary clinics were not included in this investigation. The Division of Pulmonary Medicine's ambulatory clinics manage over 800 cases of COPD annually, with approximately 150 new cases of COPD being seen each year. Criteria for inclusion into the study were: (1) diagnosis of either emphysema or chronic bronchitis, (2) presence of shortness of breath, and (3) willingness to participate (informed consent). Patients were randomly selected across the 16 physician clinics to ensure a representative sample. No patient refused to participate. The mean age for this sample of patients was 64.5 years (range 37 to 79 years). The distribution of ages is as follows: 4 patients (5 percent) between 35 and 44 years; 5 patients (6 percent) between 45 and 54 years; 20 patients (26 percent) between 55 and 64 years; 37 patients (46 percent) between 65 and 74 years; and 12 patients (15 percent) over 75 years of age. Fifty-five patients (71 percent) were men, and 53 patients (68 percent) were white. The mean FEV1 for this sample was 1.32 L/sec (range, 0.34 to 3.54 L/s).

Measures

Medication Adherence Measures. Two brief 6-item self-report scales, the MAS and the IAS, were used to measure patients' adherence to recommended regimens. These scales are based on...
Table 1—MAS and IAS Scale Items and Scoring

MAS
(no = 1; yes = 0; scale score equals sum of "no" responses.)
A. During the last 3 months, have you at times been careless about taking your breathing medications?
B. During the last 3 months, have you ever forgotten to take your breathing medicine because you felt better?
C. During the last 3 months, have you ever stopped taking your breathing medicine because you felt better?
D. During the last 3 months, have you ever taken less of your breathing medicine than the doctor prescribed because you felt better?
E. During the last 3 months, have you ever stopped taking your breathing medicine because you felt worse?
F. During the last 3 months, have you ever taken more of your breathing medicine than the doctor prescribed because you felt you were having breathing problems.

IAS
(no = 1; yes = 0; scale score equals sum of "no" responses.)
A. During the last 3 months, have you at times been careless about using your inhaler or nebulizer?
B. During the last 3 months, have you ever forgotten to use your inhaler or nebulizer?
C. During the last 3 months, have you ever stopped using your inhaler or nebulizer because you felt better?
D. During the last 3 months, have you ever used your inhaler or nebulizer less than the doctor prescribed because you felt better?
E. During the last 3 months, have you ever stopped using your inhaler or nebulizer because you felt worse?
F. During the last 3 months, have you ever used your inhaler or nebulizer more than the doctor prescribed because you felt you were having breathing problems?

the prototypic scales described by Moriskey and associates® and have been successfully used with adult asthmatic patients (see Table 1 for scale items). These scales have acceptable Cronbach alpha reliability coefficients of 0.76 and 0.69, respectively, and have been observed to correspond to outcome measures in the UAB adult asthma study which support their construct and discriminative validity. In addition, a structured interview was also used to obtain information regarding the patient's medication regimen (ie, theophylline, various inhaled agents, steroids, and antibiotics) and their daily dosing schedule.

Inhaler Dosing Technique. Since patients may adhere to their inhaler dosing schedule but still use their inhaler improperly,® a ten-item behavioral checklist was additionally used. The MDIC has a Cronbach alpha reliability coefficient of 0.73.®

Barriers to Adherence. Variables related to poor adherence were assessed through a structured interview in which patients were queried about problems they encounter in using their medications. Areas that were assessed included lack of social and family support, social inconvenience to taking medications, lack of financial resources, family instability, side effects of medication, and inconvenience of medical treatment.

Procedures

Potential participants were identified initially through a review of the medical records of patients scheduled for pulmonary outpatient visits. Individuals who appeared to meet the initial criteria were then approached at the time of their clinic visit for inclusion in the study. Patients who fit our criteria were asked to participate in a study which was "seeking to determine what type of problems, if any, patients encountered with their prescribed regimens." After informed consent was obtained, each participant was interviewed following a structured format to collect information about their utilization of medications and any problems which they encountered with their regimen. The two six-item adherence scales and the MDIC were administered as part of this interview. Chart review was used to verify prescribed regimens.

RESULTS

Psychometric Properties of Measures

The two adherence scales used in this study, while having been developed with a pulmonary population, have not previously been used with patients with COPD. Therefore, the psychometric properties of these scales are important. Data from this investigation indicate that these measures have acceptable reliability coefficients when used with patients with COPD. The MAS and the IAS were observed to have Cronbach reliability coefficients® of 0.96 and 0.80, respectively.

Characteristics of Prescribed Medication Regimens

Medication regimens were observed to be complex, with 77 percent of the sample (60 patients) receiving two or more oral time-contingent medications, 18 percent (14 patients) receiving one oral time-contingent medication, and only 5 percent (four patients) receiving no oral time-contingent medications. In addition, 32 percent (25 patients) were receiving two or more inhaled time-contingent medications, 45 percent (35 patients) were receiving one inhaled time-

Table 2—Average Number of Medications by Race and Gender

<table>
<thead>
<tr>
<th>Race</th>
<th>Gender</th>
<th>Group</th>
<th>N</th>
<th>Oral Medications</th>
<th>Inhaled Medications</th>
<th>Total Medications</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>women</td>
<td>19</td>
<td></td>
<td>4.26</td>
<td>1.37</td>
<td>5.63</td>
</tr>
<tr>
<td></td>
<td>men</td>
<td>35</td>
<td></td>
<td>3.06</td>
<td>1.17</td>
<td>4.23</td>
</tr>
<tr>
<td>Black</td>
<td>women</td>
<td>4</td>
<td></td>
<td>4.25</td>
<td>0.75</td>
<td>5.00</td>
</tr>
<tr>
<td></td>
<td>men</td>
<td>20</td>
<td></td>
<td>3.50</td>
<td>1.10</td>
<td>4.60</td>
</tr>
</tbody>
</table>

Table 3—Distribution of Oral and Inhaled Medications by Race and Gender*

<table>
<thead>
<tr>
<th>Race</th>
<th>Gender</th>
<th>Oral Medications</th>
<th>Inhaled Medications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2 or more</td>
<td>One</td>
</tr>
<tr>
<td>White</td>
<td>women</td>
<td>19</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>men</td>
<td>35</td>
<td>64</td>
</tr>
<tr>
<td>Black</td>
<td>women</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>men</td>
<td>20</td>
<td>85</td>
</tr>
</tbody>
</table>

*Table data are percentages of group.
contingent medication, and 23 percent (18 patients) were receiving no inhaled time-contingent medications. The mean numbers of prescribed oral time-contingent and inhaled time-contingent medications were 3.53 and 1.17, respectively; however, an additional 31 percent of the sample (24 patients) had prescribed oral p.r.n. medications and 17 percent (13 patients) had inhaled p.r.n. medications. Overall, the average number of time-contingent and p.r.n. medications per patient was 6.26 (range, 1 to 16). A two-factor analysis of variance failed to reveal any significant race (F[1,74] = 0.050; p = 0.819), gender (F[1,74] = 0.74; p = 0.394), or race × gender interactions (F[1,74] = 0.550; p = 0.462) for the overall number of medications. Tables 2 and 3 provide a summary of the distribution by gender and race.

For patients who had recently undergone spirome-
try, values for FEV1 were used to estimate the severity
of disease. The sample was divided into those with an
FEV1 less than 1 L/s (N = 26) and those with FEV1
equal to or greater than 1.0 L/s (N = 28). The total
mean numbers of prescribed medications for the two
groups were 6.15 and 5.18, respectively. No significant
differences in the total number of medications were observed between these two groups (F[1,52] = 1.834; p = 0.181).

Adherence to Prescribed Regimens

Self-reported adherence to regimens was observed
to be low in this investigation (see Table 4 for reports
by race and gender). Overall, 42 patients (53.8 percent
[men = 27, women = 15]) reported stopping their medica-
tions periodically over the last three months, 37
patients (47.4 percent [men = 26, women = 11]) noted
forgetting doses over the last three months, and 34
patients (43.6 percent [men = 23, women = 11]) ac-
cnowledged being "careless" in taking their medica-
tions. Furthermore, 39 patients (50 percent [men = 25, women = 14]) reported using more medication than
was prescribed in times of distress. When a patient's
dosing technique was actually observed and rated with
the MDIC, it was noted that 31 percent (24 patients)

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Table 4—Reported Adherence Problems during Last Month by Race and Gender*

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Forgot</th>
<th>Stopped</th>
<th>Careless</th>
<th>Used More than Prescribed</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>women</td>
<td>19</td>
<td>47.4</td>
<td>68.4</td>
<td>47.4</td>
<td>63.1</td>
</tr>
<tr>
<td>White</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>men</td>
<td>35</td>
<td>45.7</td>
<td>45.7</td>
<td>37.1</td>
<td>42.8</td>
</tr>
<tr>
<td>Black</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>women</td>
<td>4</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
<td>50.0</td>
</tr>
<tr>
<td>Black</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>men</td>
<td>20</td>
<td>50.0</td>
<td>55.0</td>
<td>50.0</td>
<td>50.0</td>
</tr>
</tbody>
</table>

*Table data are percentages of group.

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Table 5—Adherence Measure Scores by Race and Gender*

<table>
<thead>
<tr>
<th>Group</th>
<th>MAS</th>
<th>IAS</th>
<th>MDIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>White women</td>
<td>4.08±2.72</td>
<td>3.54±2.40</td>
<td>8.54±1.98</td>
</tr>
<tr>
<td>White men</td>
<td>2.20±2.63</td>
<td>1.68±1.82</td>
<td>8.24±1.76</td>
</tr>
<tr>
<td>Black women</td>
<td>3.00±4.24</td>
<td>4.50±0.71</td>
<td>9.50±0.71</td>
</tr>
<tr>
<td>Black men</td>
<td>2.75±2.73</td>
<td>3.75±2.01</td>
<td>7.67±2.31</td>
</tr>
</tbody>
</table>

*Table data are means (± SD).

(38 percent [21] of the men; 12 percent [3] of the
doctors) used their inhaled medications with unsatis-
factory technique.

The means and standard deviations for the adher-
ence measures are presented in Table 5. A significant
effect for race was observed (F[3,46] = 4.026; p = 0.013); however, no significant gender or
race × gender interactions were noted. Follow-up
univariate F-tests indicated a trend for black patients
to report being more adherent on the IAS
(F[1,48] = 3.257; p = 0.07). No differences were found
between races on either the MAS or the MDIC. In
addition, patients with an FEV1 of less than 1 L/s were
also noted to be more adherent on the MAS
(F[1,48] = 4.832; p = 0.03) but not the IAS or MDIC.

The class of medication was also observed to be
related to reported adherence. Patients were spe-
cifically asked how many times during the last month
they missed each of their medications. Forty-six per-
cent of those receiving an inhaled anticholinergic
agent (13/28 patients), 39 percent of those receiving
inhaled sympathomimetics (24/62), 32 percent of those
receiving theophylline preparations (23/71), and 10
percent of those receiving steroids or antibiotics (3/
30) reported nonadherence at least once during the
last month. Only three patients were found to be
collecting cromolyn sodium, and none reported adher-
ence problems with this medication. The average
number of episodes of nonadherence during the last
month were 15.22 times per month (range, 1 to 31)
for those receiving inhaled sympathomimetics, 9.15
(range, 1 to 30) for those receiving an inhaled anticho-
linergic agent, 6.17 (range, 1 to 30) for those receiving
theophylline preparations, and 4.00 (range, 1 to 9) for
those receiving steroids or antibiotics.

Factors Related to Poor Adherence

Forgetting or deciding not to dose were noted to be
the most common causes of poor adherence (see Table
6). Forgetting was reported by 51 percent of the
sample (40 patients). Furthermore, 31 percent of the
sample (24 patients) reported consciously deciding not
to dose. The top two reasons cited for missing medica-
tions were either forgetting or deciding not to dose.
due to feeling good; however, forgetting to dose due to interruptions or changes in normal routines, not dosing due to side effects, or running out of medications were also frequently noted causes of poor adherence.

**DISCUSSION**

Adherence to pharmacologic regimens was observed to be poor in this investigation. More than half of this sample of patients with COPD reported missing or skipping doses of their medication. In addition, approximately half of the patients reported using more than the prescribed amount of medications during times of distress. When observed inhaling medication, 31 percent of the sample (24 patients) displayed a technique which delivered an inadequate dose of medication. These data are consistent with studies conducted in other countries3,5 and suggest that both underutilization of medications during periods of good function and overutilization of medications during respiratory distress are significant problems for patients with COPD in the United States.

These data also highlight the complexity of medication regimens which are frequently prescribed for patients with COPD. When examining time-contingent medications, 77 percent (60/78) of the patients were prescribed two or more oral medications, and 32 percent (25/78) were prescribed two or more inhaled medications. In addition, 31 percent (24) of the sample were prescribed oral or inhaled p.r.n. medications to supplement their maintenance medications. It is also noteworthy that many of these medications had different dosing schedules. Thus, it was quite common for patients in our sample to be prescribed a combination of five to eight oral and inhaled time-contingent and p.r.n. medications, with many medications requiring different dosing patterns.

Overall, these data failed to reveal any particularly strong severity, race, or gender effects in medication prescription or adherence patterns. None of the variables investigated was observed to be related to prescription patterns. Demographic variables and disease severity were similarly not strongly associated with adherence to regimens. There was a weak trend for black patients to be somewhat more adherent with inhaled medications, and some suggestion that patients with more severe airways disease were more adherent; however, due to the inconsistent pattern of results and the small sample sizes, these trends should be considered tentative at present.

Interestingly, the class of medication appeared to be associated with adherence. Although the sample size was small for the number of patients prescribed specific classes of medications, there was a noticeable pattern for patients to report better adherence with steroids and antibiotics than with theophylline, inhaled sympathomimetics, and inhaled anticholinergic agents. Unfortunately, the underlying causes of these differences are impossible to determine due to the manner in which these data were collected. It is possible that one or more dimensions of the medication classes such as the ability to produce quick relief of symptoms or the side effect profiles could underlie class differences. One speculation that fits the data is that patients may adhere to regimens of steroids and antibiotics more frequently because these medications are typically prescribed for short periods of time to deal with acute symptoms and therefore may be perceived as more necessary, urgent, or manageable.

Among the strongest findings of this investigation was the association between poor adherence and situational factors. Forgetting to dose was the most common problem reported. Forgetting was associated most often with feeling good, interruptions or changes to normal routines, and inconvenience of dosing. It is also important to note that 31 percent (24) of the sample reported missing prescribed doses of medication because they deliberately decided not to dose. The decision not to dose was most frequently associated with feeling good but was also related to concerns about side effects, beliefs that the medication was not effective, concerns that they would become immune to the medication, and confusion about actual dosing schedules. Insufficient funds and the presence of personal or family problems were reported in less than 4 percent (3) of the patients; however, this low prevalence may reflect a patient’s reluctance to discuss financial and personal matters. Overall, situational factors were more strongly associated with poor adherence than demographic or medication class variables.

The data from this investigation indicate that patients with COPD are frequently prescribed complex
medication regimens and that adherence to these regimens is poor; however, several methodologic limitations should be considered in interpreting these findings. First, the data from this investigation, with the exception of the observation of MDI use, was based on self-reports from patients. Therefore, it is possible that reports of missing medications were exaggerated; however, most investigations of the reliability of self-reports indicate that patients bias information in a positive direction, suggesting that it is more likely that adherence may have been overestimated in this investigation. Secondly, these data failed to reveal any strong disease severity, gender, or race effects, but the variability of the measures was high and the sample size small. It is therefore possible that more pronounced severity or race effects may emerge with larger samples. Finally, these data reflect the medication patterns of only one urban medical center in the southeastern United States and therefore may not be generalizable to other areas of the country; however, the consistency of these data with both other studies conducted outside the United States and general clinical lore strengthen our confidence in the data.

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