



## The Quality of Obstructive Lung Disease Care for Adults in the United States as Measured by Adherence to Recommended Processes\*

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**Background:** The extent to which patients with obstructive lung disease receive recommended processes of care is largely unknown. We assessed the quality of care delivered to a national sample of the US population.

**Methods:** We extracted medical records for 2 prior years from consenting participants in a random telephone survey in 12 communities and measured the quality of care provided with 45 explicit, process-based quality indicators for asthma and COPD developed using the modified Delphi expert panel methodology. Multivariate logistic regression evaluated effects of patient demographics, insurance, and other characteristics on the quality of health care.

**Results:** We identified 2,394 care events among 260 asthma participants and 1,664 events among 169 COPD participants. Overall, participants received 55.2% of recommended care for obstructive lung disease. Asthma patients received 53.5% of recommended care; routine management was better (66.9%) than exacerbation care (47.8%). COPD patients received 58.0% of recommended care but received better exacerbation care (60.4%) than routine care (46.1%). Variation was seen in mode of care with considerable deficits in documenting recommended aspects of medical history (41.4%) and use of diagnostic studies (40.1%). Modeling demonstrated modest variation between racial groups, geographic areas, insurance types, and other characteristics.

**Conclusions:** Americans with obstructive lung disease received only 55% of recommended care. The deficits and variability in the quality of care for obstructive lung disease present ample opportunity for quality improvement. Future endeavors should assess reasons for low adherence to recommended processes of care and assess barriers in delivery of care.

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**Key words:** asthma; pulmonary disease, chronic obstructive; quality indicators, health care; quality of health care; therapeutics, standards

**Abbreviations:** CI = confidence interval; HMO = health maintenance organization

Obstructive lung disease affects an estimated 12 to 50 million Americans, with estimates that vary by data source; 8.5% of the population report having lung diseases compared to 6.8% based on lung function data and 3 to 5% from administrative or medical record review data.<sup>1–4</sup> Chronic lower respiratory tract disease is the fourth-leading cause of death in the nation, is increasing in prevalence and mortality worldwide, and causes significant human

suffering and decreased quality of life.<sup>2–3,5</sup> Appropriate disease management has been demonstrated to decrease the morbidity and mortality associated with asthma and COPD, and multiple guideline statements have set standards for the quality of care for patients with obstructive lung disease.<sup>2–3,6–12</sup> However, the extent to which patients receive recommended processes of health care for obstructive lung disease is largely unknown.

Although previous studies have documented quality deficits for obstructive lung disease, they are limited by the population studied and the scope of evaluation. Most studies have assessed a particular aspect of COPD or asthma care,<sup>13–15</sup> evaluated a small number of indicators of quality in a small geographic area,<sup>16–18</sup> evaluated persons with a particular type of insurance coverage or relied on administrative data sets,<sup>14,19–26</sup> relied on provider or patient self-report or survey,<sup>27–30</sup> or focused on quality improvement with a pre-post design.<sup>29–31</sup> The studies<sup>14,19,22,29,32–33</sup> that explored the process of health care delivered by providers mostly relied on administrative databases.

Our objective was to measure quality across the continuum of care delivered to an adult sample of the US population with obstructive lung disease. We report results from medical record review in the Community Quality Index, a collateral study of the Community Tracking Survey,<sup>34–35</sup> assessing the extent to which recommended processes of health care are delivered for obstructive lung disease.

## METHODS AND MATERIALS

Participants were sampled from 12 communities randomly selected to represent the national population living in metropolitan areas with > 200,000 people in 1995.<sup>35</sup> Between October 1998 and August 2000, we obtained written permission from adult participants to obtain copies of medical records from all providers seen in the previous 2 years. Of the 20,158 persons in the starting sample, 2,091 persons (10%) were ineligible because they had moved out of the area, died, or became incapacitated. Of the 17,937 adults who were eligible for the study, 13,275 patients (74%) completed the telephone survey. 12,412 patients (69%) reported that they had at least one health-care visit and 863 patients (7%) had no visits in the 2-year study period. Among those with a visit, 10,404 patients (84%) verbally agreed to

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provide access to their medical records and 7,528 patients (61%) returned signed consent forms. We obtained at least one record for 6,712 consenting respondents (89%). Patients were included in this analysis if the provider documented asthma or COPD and if care events met criteria for one or more quality indicators for process of care provided for these disorders. No exclusions were made on the basis of site or system of care in this population study.

The indicators of quality used were derived from the RAND Quality Assessment Tools System.<sup>35–36</sup> Indicators were drawn from established national guidelines and the medical literature. Using the modified Delphi method, a nine-member panel of experts nominated by the relevant specialty societies reviewed the evidence and rated the validity of proposed indicators.<sup>37–38</sup> The quality indicators and their characteristics are described in the on-line data supplement (supplemental Table 1); 25 indicators evaluated asthma care (9 for routine care and 16 for exacerbation management) and 20 indicators evaluated COPD care (8 for routine and 12 for exacerbation). A subset of indicators was assembled for a sensitivity analysis based on recent evidence-based guidelines to explore whether quality assessments would be significantly different based on updated data on recommended care.

Twenty trained registered nurses who underwent a 2-week training program used computer-assisted abstraction software to manually abstract data from medical records. Average interrater reliability was assessed using a 4% sample of total records for three aspects of agreement and found to be substantial with the following  $\kappa$  statistics: whether the patient had a particular condition ( $\kappa = 0.83$ ), whether the patient was eligible for an indicator ( $\kappa = 0.76$ ), and whether the patient received indicated care ( $\kappa = 0.80$ ).

The unit of analysis is a care event defined as any part of a health-care encounter that constitutes care provided for obstructive lung disease and meets a denominator criteria for an operationalized quality indicator. For each care event quality assessment, we specified the combination of variables necessary to determine whether each respondent was eligible for (yes/no) and received (yes/no or proportion) the recommended care. To produce aggregate scores, we divided all instances in which recommended care was delivered for a given eligibility event by the number of eligibility events within the category. The aggregate scores can be interpreted as the proportion of recommended care that is received. We used the bootstrap method to directly estimate SEs for aggregate scores and for adjusted rates.

Multivariate logistic regression was used to evaluate the effect of patient demographics, insurance, self-reported health status, chronic conditions, and community on quality of health care delivered for obstructive lung disease. Adjusted rates obtained from multivariate logistic modeling assess patient, insurance, and community effects on obstructive lung disease quality. We adjusted the scores for nonresponse, weighting participants to be representative of the population from which they were drawn using the Community Tracking Survey data. Since patients were eligible for multiple indicators, all results were adjusted for clustering at the patient level. The study was approved by the RAND Institutional Review Board.

## RESULTS

We obtained 84% of the total records from consented care visits. Of the 6,712 adult patients in the study, 260 patients were eligible for at least one asthma indicator (2,394 eligible events) and 169 adults were eligible for at least one COPD indicator (1,664 eligible

events). Of patients eligible for at least one indicator, the average patient was eligible for 10.3 indicators (SD, 12.0). Compared to patients with COPD, patients with asthma were younger at the time of study enrollment; more likely to be female and better educated; had higher income; were less likely to be insured through Medicare and more likely to have health maintenance organization (HMO) insurance coverage; were less likely to report being in fair/poor health; were less likely to be hospitalized; and had fewer chronic disease diagnoses ( $p < 0.05$ ) [Table 1].

Overall, participants received 55.2% (95% confidence interval [CI], 51.2 to 59.1%) of recommended care for obstructive lung disease (Table 2). In sensitivity analysis, patients received 52.0% (95% CI, 48.7 to 55.2%; 3,483 events) of care based on the subset of indicators most supported by recent guidelines; this quality level was not statistically different than the complete analysis at the  $\alpha = 0.05$  level. The associations in the restricted models remained in the same directions, but due to sample size, a few of the relationships were without statistical significance.

Patient gender, age, self-reported health status, and utilization were not related to quality scores (see supplemental Table 2 for complete model). Controlling for

patient demographics, insurance, self-reported health status, chronic conditions, and geographic location, African Americans received better care than all other race categories (Table 3). Lower-income participants received lower quality of care, and enrollees in HMOs received lower quality care than those in Medicaid. We identified significant variation in the quality of care between communities with scores ranging from 38 to 59% for asthma and from 40 to 77% for COPD.

Participants with asthma received 53.5% (95% CI, 49.8 to 57.3%) of recommended care (Table 2). Asthma patients received better routine care (67%) than exacerbation care (48%) [ $p < 0.05$ ]. Performance was lowest for documentation of history (34%), use of lab and radiologic studies (40%) and specific interventions at time of encounter (11%). Sensitivity analysis restricted to indicators consistent with National Asthma Education and Prevention Program guidelines<sup>9</sup> revealed a quality score of 51.4% (95% CI, 48.8 to 54.0%; 2,206 events) that was not statistically different than the complete analysis at the  $\alpha = 0.05$  level.

Participants with COPD received 58.0% (95% CI, 51.7 to 64.3%) of recommended care (Table 2). In contrast to asthma, COPD patients trended toward better exacerbation care (60% of recommended care) than routine care (46%). Adherence to recommended medication prescribing was lower in COPD than in asthma (56%, compared to 81% of recommended care received). Sensitivity analysis restricted to indicators consistent with Global Initiative for Chronic Obstructive Lung Disease<sup>2-3</sup> and American Thoracic Society/European Respiratory Society<sup>7-8</sup> guidelines revealed a quality score 53.1% (95% CI, 46.3 to 60.0%; 1,277 events) that was not statistically different than the complete analysis at the  $\alpha = 0.05$  level.

**Table 1—Patient Characteristics\***

Characteristics†	All Obstructive		
	Pulmonary Patients	Asthma (n = 260)	COPD (n = 169)
Age at enrollment, yr	50‡	44‡	61‡
Male gender	37	28	49
White race	82	79	86
African-American race	8	8	8
Hispanic	7	8	4
Other race	3	5	3
College/graduate education	46	55	31
High school graduate	36	33	41
Less than high school education	17	12	28
Income > \$50,000/yr	29	35	15
Income \$15,000 to \$50,000/yr	39	38	44
Income < \$15,000/yr	32	27	41
No insurance	5	6	3.6
Medicare insurance	28	19	44
Medicaid insurance	10	8	13
HMO insurance	27	31	17
Private insurance	30	34	23
Reporting fair or poor health	33	26	47
No hospitalization	71	78	56
One hospitalization	18	15	22
Two or more hospitalization	12	7	21
Fewer than 11 outpatient visits	48	51	40
11 to 20 outpatient visits	32	30	32
More than 20 outpatient visits	21	19	27

\*Data are presented as % of group unless otherwise indicated.

†Some multilevel categories do not sum to 100% due to rounding error.

‡SD  $\pm$  1 year.

## DISCUSSION

Overall, participants in a national sample of obstructive lung disease patients received approximately 55% of recommended care processes. These deficits have important implications for the health of Americans with obstructive lung disease. These data provide a measure of the quantity of the problem of poor quality of care received by the chronically ill,<sup>39</sup> and emphasize that patients who suffer from common forms of lung disease are in no way better off than Americans with other conditions.<sup>35</sup>

Quality deficits were particularly large in certain areas of care. We identified disparity between routine care in asthma (67%) and exacerbation management (48%). This finding suggests that national efforts over the last 2 decades in the United States to improve the routine care for asthma have been successful but that deficits in exacerbation manage-

**Table 2—Quality of Health Care Delivered for Obstructive Lung Disease Patients\***

Process Indicator	All Obstructive Lung Disease Care, 4,058 Eligible Events	Asthma Care, 2,394 Eligible Events	COPD Care, 1,664 Eligible Events
Overall	55.2 (51.2–59.1)	53.5 (49.8–57.3)	58.0 (51.7–64.3)
Sensitivity subset†	52.0 (48.7–55.2)	51.4 (48.8–54.0)	53.1 (46.3–60.0)
Type of care			
Routine	61.9 (57.6–66.2)	66.9 (62.7–71.1)	46.1 (36.8–55.3)
Exacerbation	52.9 (47.7–58.1)	47.8 (41.4–54.1)	60.4 (53.8–67.0)
Mode of care‡			
History	41.4 (36.7–46.1)	33.8 (29.7–37.8)	51.6 (43.6–59.7)
Physical examination	80.2 (75.7–84.8)	90.4 (86.0–94.9)	75.1 (68.1–82.0)
Immunization	60.9 (52.3–69.5)	60.9 (52.3–69.5)	No indicator data
Laboratory/radiology	40.1 (26.5–53.6)	40.1 (25.9–54.4)	39.8 (24.1–55.5)
Medication	77.7 (72.3–83.1)	81.4 (76.4–86.5)	56.4 (45.8–67.1)
Encounter	29.0 (19.5–38.5)	11.2 (1.7–20.6)	43.5 (32.0–55.0)
Function§			
Diagnosis	59.0 (52.3–65.6)	34.4 (22.6–46.3)	60.3 (53.5–67.1)
Treatment	54.0 (49.9–58.0)	54.5 (50.3–58.8)	47.9 (40.0–55.9)

\*Data are presented as unadjusted % of recommended care delivered (95% CI).

†Sensitivity analysis was done with subsets of quality indicators that are consistent with the Global Initiative for Chronic Obstructive Lung Disease and American Thoracic Society/European Respiratory Society Task Force guidelines for evaluation of COPD care and the National Asthma Education and Prevention Program (National Heart, Lung, and Blood Institute) guidelines for the diagnosis and management of asthma 1997 report and the 2002 update for evaluation of asthma care (details in Supplemental Web-based Table 1). Quality rates are not different than the unrestricted analysis at the  $\alpha=0.05$  level.

‡Mode of care categorization of indicators refers to predominant aspects of care delivery as follows: history as documentation of prior aspects of care or disease, physical examination as objective evaluation, immunization as provision of vaccine, laboratory/radiology as ordered evaluation, medication as prescriptions, or encounter as specific response to needed care indicated at a specific care interaction; further details are available at: [http://www.rand.org/health/mcglynn\\_appa.pdf](http://www.rand.org/health/mcglynn_appa.pdf).

§Function of care categorization refers to indicators that evaluate for recommended diagnostic interventions (diagnosis) or evaluate for provision of a recommended therapy (treatment); further details are available at: [http://www.rand.org/health/mcglynn\\_appa.pdf](http://www.rand.org/health/mcglynn_appa.pdf).

ment remain. Additional investigation of exacerbation care for asthma and comprehensive quality improvement is needed. In contrast, in COPD, we found worse routine care (46%). This quality shortfall, especially with increasing evidence for benefit through chronic routine management,<sup>2–3,7–8,40</sup> suggests that increased focus on routine management of COPD care is warranted.

We also identified variation in quality by mode (how the care was administered). History taking had lower scores than other modes of care, with obstructive lung disease patients receiving 41%, and asthma care receiving 34% of recommended care. History taking is time consuming, and a portion of this deficit may be due to increasing demands on providers' time. Also noteworthy, the use of laboratory and radiologic studies in evaluation and management of both asthma and COPD was documented in only 40% of the instances in which it was recommended. Failure to assess lung function by peak flow and/or pulmonary function testing accounts for most of the diagnostic shortfalls. Guidelines emphasize functional testing,<sup>2–4</sup> and our data suggest that this should be a focus of quality improvement efforts.

Guidelines also underline the importance of education and involving patients in the management of

chronic obstructive lung diseases, consistent with common models of quality improvement in chronic disease,<sup>2–4,7–8,41–42</sup> yet we found shortfalls in this area as well. We found particularly poor scores for the use of spacers with metered-dose inhalers (11% for asthma and 32% for COPD).

In our sample of patients with at least some access to care, different sociodemographic subgroups had small differences in levels of quality. After adjusting for other covariates, African Americans received better overall care than all other race categories (67%), and Latinos with COPD received worse care (37%). Most prior published studies using indicators such as specialist referral and follow-up have demonstrated worse obstructive lung disease care for racial minorities,<sup>23</sup> although one study in veterans<sup>20</sup> did not find differences in processes of care between races. The racial variation we identified may be different from prior study,<sup>43</sup> in that we were able to control for a wider range of sociodemographic, health status, and utilization covariates. Also, disparities in prior studies may be partially explained by access limitations, whereas our evaluation included only participants who received at least some medical care. Small variation was also seen between different insurance types with Medicaid patients achieving statistically higher quality of care than HMO

**Table 3—Significant Associations for Adjusted Quality of Care Rates by Patient Characteristics\***

Characteristic	All Obstructive Lung Disease Patients	Asthma	COPD
<b>Race</b>			
White	51.6 (48.4–54.8)	48.7 (44.8–52.6)†	54.9 (51.3–58.6)†
African American	67.2 (59.7–74.6)‡	64.0 (56.3–71.6)†	79.5 (68.4–90.6)‡
Hispanic (Latino)	47.9 (40.3–55.5)	48.9 (41.8–55.9)	36.8 (26.0–47.5)†
Other	51.0 (44.2–57.8)	53.5 (44.3–62.7)	49.6 (37.3–61.9)
<b>Income, per yr</b>			
< \$15,000	50.8 (48.0–53.6)§	49.7 (46.9–52.5)†	55.3 (50.1–60.5)
\$15,000 to 50,000	57.5 (53.9–61.1)	54.0 (50.0–58.0)	60.4 (55.7–65.1)
> \$50,000	60.7 (56.1–65.3)	59.5 (55.2–63.8)†	59.4 (49.6–69.3)
<b>Health status</b>			
Excellent	57.9 (50.8–65.1)	57.5 (51.2–63.8)	71.7 (58.0–85.4)†
Very good	53.0 (48.8–57.3)	51.6 (46.5–56.7)	55.3 (47.6–62.9)
Good	58.4 (54.9–91.9)	55.9 (52.1–59.6)	63.7 (58.3–69.2)
Fair/poor	53.2 (50.1–56.2)	51.8 (48.0–55.6)	53.5 (49.8–57.1)†
<b>Insurance coverage</b>			
None	51.2 (43.9–58.6)	47.7 (39.0–56.4)	56.3 (43.5–69.1)
Medicaid	61.6 (56.2–67.0)†	61.0 (55.2–66.7)†	63.6 (56.0–71.1)†
Medicare	57.6 (50.6–64.5)	59.9 (49.4–70.4)	61.3 (54.8–67.9)
HMO	48.7 (43.8–53.6)†	46.6 (42.2–50.9)†	60.7 (51.2–70.2)
Private	53.7 (48.5–58.9)	52.3 (48.3–56.2)	46.8 (38.2–55.5)†
<b>Two or more hospital stays</b>			
	58.9 (53.9–63.9)	50.9 (46.0–55.8)	68.6 (62.3–74.9)‡

\*Data are presented as adjusted rate in % of recommended care (95% CI); adjusted rates modeling quality of care received on patient characteristics, insurance status, and community covariates (for complete model see Supplemental Web Table 2).

†Significant difference between individually identified categories of variable at  $p < 0.05$  level.

‡Value higher in comparison with all other categories of variable ( $p < 0.05$  within adjusted model).

§Value lower in comparison with all other categories of variable ( $p < 0.05$  within adjusted model).

enrollees. The variation between sociodemographic groups is dwarfed by the overall quality deficits; further exploration of the magnitude and reasons for variation requires different methodologies.

Variation by geographic location in the quality of health care has been documented in many prior studies<sup>44</sup> and suggest fertile ground for quality improvement and further research. We demonstrated regional variation across the 12 communities with quality scores ranging from 46 to 63% overall. The better geographic regions for asthma care were generally the better regions for COPD care. However, when examined with the larger lens of our previous analysis across 30 health conditions, overall effectiveness of care was not uniformly better in any region.<sup>45</sup> Participants in the lowest income bracket, even after controlling for insurance status and other demographic, community, and participant characteristics, received lower quality of care and warrant targeted interventions. In regards to the differences in quality by characteristics or region or demographics, we emphasize that variation between groups is generally much less than the overall deficits we documented in the quality of care.

Our study has a number of limitations. First, the study relied on medical record review for quality assessment, and some of the quality shortfall may be due to underdocumentation. Our indicators were developed with explicit instructions to the Delphi panel

participants to include the importance of chart documentation as a criterion for rating the validity indicators. Previous studies<sup>46–48</sup> have found that chart abstraction underestimates quality by at most 10% as compared to direct observation, and may even overestimate quality in some instances. Although underdocumentation may explain some of our findings, it is hard to explain the considerable quality shortfalls we identified for obstructive lung disease purely on the basis of poor documentation. Second, our response rate of 37% of all those eligible introduces the potential for bias. The low prevalence of obstructive lung disease in our sample (3.9% for asthma and 2.5% for COPD) may reflect a younger population relative to national demographics and the reliance on provider diagnosis for inclusion. Our 2-year sampling frame may also lead to underrepresentation of patients with milder disease and infrequent health-care visits. The direction of bias from these limitations is unclear, but as our sampling frame favored users of the health-care system, our sample may be biased toward underestimation of quality deficits by missing underuse of recommended medical care.

Our study does not evaluate more complex quality standards, nor does it evaluate care based on recent innovations or the changing science in the management of obstructive lung disease. If we had been able to evaluate complex care processes or care indicated by

recent innovations, our estimate of quality would likely have been even lower. Despite the rigor of the modified Delphi panel, indicators were based mostly on the available evidence base of the 1990s, which relied heavily on descriptive and expert opinion levels of evidence. However, our sensitivity analysis of the most updated evidence base suggests that most indicators remain relevant and the quality of care evaluation remained robust.

While it is difficult to know the extent of the excess morbidity and mortality that the deficits we documented for obstructive lung disease might engender, we can estimate excess mortality that might result from failure to provide care specified in individual indicators. For example, only 32% of COPD patients with baseline hypoxia received home oxygen for routine management. From estimates of the numbers of hypoxic patients in the United States and the mortality reduction demonstrated from the Nocturnal Oxygen Therapy Trial, 27,000 to 54,000 annual deaths may have been reduced by appropriate oxygen use.<sup>1,4,11</sup> Similarly, only 56% of hospitalized asthmatic patients received systemic steroids, which may lead to excess mortality estimates that approach 2,000 per year.<sup>12</sup>

In summary, Americans with asthma and COPD received approximately 55% of recommended care in our evaluation. The deficits and variability in processes of care for patients with obstructive lung disease present ample opportunity for improvement in obstructive lung disease management. To begin to improve the deficits identified in this study, broad-based and widely available evaluation of health-care processes is required. The reasons for lack of adherence to recommended care processes may relate to the complexity and diversity of the health care system.<sup>35,44,49-50</sup> Our study does not directly suggest strategies to improve care, but these may include increasing the use of information technology, increasing quality improvement and continuous assessment, better chronic disease management, improved care coordination, establishing performance measures with active monitoring, and linking quality performance to reimbursement, among others.<sup>49-50</sup> Whatever strategies are employed, national efforts combined with local innovation aimed at system change will be required to realize the potential of translating novel data from basic science and clinical trials into comprehensive chronic disease management and improved patient care and outcomes. The data from this study should be a resounding call for quality improvement efforts and further understanding of the deficits in processes of care for obstructive lung disease.

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