

# Confidence in correct inhaler technique and its association with treatment adherence and health status among US patients with chronic obstructive pulmonary disease

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**Background:** Improper use of bronchodilators is associated with poor disease control, nonadherence to long-term therapy, and poor clinical outcomes. Our current understanding of factors associated with correct inhaler use and adherence is limited. We measured physician- and patient-reported confidence in device usage and associations with treatment adherence and COPD-related health status.

**Methods:** This was an analysis of a US observational, point-in-time survey of physicians and patients. Physicians who met study eligibility criteria completed surveys for 5 consecutive, eligible patients who were then invited to respond to questionnaires. We assessed patient demographics, type of prescribed inhaler device(s), device training, COPD severity, comorbidities, physician- and patient self-reported confidence in device usage, treatment adherence, and health status.

**Results:** Completed questionnaires for 373 patients were provided by 134 physicians. Complete confidence in device usage was observed for 22% and 17% of patients as reported by patients and physicians, respectively. Greater confidence was associated with higher self-reported adherence to inhaler usage. Physicians were more likely than patients to report lower levels of patient confidence in device usage. High physician- and patient-reported confidence were associated with more favorable health status. Predictors of confidence in device usage included fewer comorbidities, no depression, and higher education levels.

**Conclusion:** Low confidence in inhaler usage was associated with lower adherence and poor COPD-related health status. Choice of inhaler device tailored to patients' ability to use specific devices and ongoing education to support optimal inhaler usage may improve patient confidence and enhance both adherence and health status.

**Keywords:** chronic obstructive pulmonary disease, inhaler technique, adherence, health status, patient satisfaction

## Introduction

COPD is a progressive condition associated with chronic morbidity, reduced quality of life, and premature mortality.<sup>1,2</sup> COPD was the third leading cause of mortality in the USA in 2011,<sup>3</sup> and imposes a substantial economic burden with total medical costs estimated at US\$50 billion and 60% attributed to direct expenditures.<sup>4</sup> Despite the significant morbidity and mortality associated with it, COPD is a treatable condition,<sup>5,6</sup> with medical therapies tailored to individual patients based on symptom severity, risk for exacerbations, and response to therapy.<sup>7</sup> Traditional management of COPD exacerbation, however, has been reactive instead of proactive.<sup>8</sup>

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Bronchodilators are the mainstay of treatment and have established efficacy for symptom control, reduced risk of complications, and prevention of exacerbations.<sup>5-7,9</sup> The effectiveness of inhaler therapies depends on device type,<sup>10</sup> patients' ability to use devices correctly,<sup>10,11</sup> device reliability for medication delivery,<sup>12,13</sup> and patient adherence with prescribed timing, dosage, and frequency.<sup>7,14,15</sup> The most frequently observed types of nonadherence are underuse and improper use of inhaled therapies, with the majority of patients unable to properly use inhalers.<sup>16-19</sup>

A systematic review of studies directly observing patients' inhaler use technique reported an overall prevalence of 31% (95% CI: 27%–36%) for poor technique, 41% (95% CI: 36%–47%) acceptable technique, and 31% (95% CI: 28%–35%) correct usage in patients with asthma or COPD. Error rates were higher for pressurized metered-dose inhalers (MDIs), with 38% of patients demonstrating poor technique compared to 23% of those using dry-powder inhalers (DPIs). Acceptable usage was reported for 37% and 44% of users of MDIs and DPIs, respectively.<sup>20</sup>

Poor inhaler technique and inadequate inhaler instruction contribute to suboptimal control of COPD,<sup>9,21</sup> nonadherence, and poor clinical outcomes.<sup>18,21,22</sup> We lack an understanding of factors that contribute to incorrect inhaler usage,<sup>23</sup> although research suggests higher error rates in patients who self-educate on usage and those who are female, older, and have fewer years of education.<sup>11,18,24,25</sup>

A greater understanding of relationships between patient characteristics and inhaler technique may facilitate efforts to identify patients at risk for incorrect inhaler usage. This information can guide clinicians' efforts to prescribe the device type that is most likely to be used correctly. The objectives of this analysis were to: 1) quantify the level of concordance between physician and patient ratings of confidence in device usage, 2) assess the association of treatment adherence with physician-perceived and patient self-reported confidence in patients' ability to correctly use inhaler(s), 3) identify patient characteristics associated with low confidence in inhaler usage, and 4) assess associations between inhaler technique and COPD-related health status.

## Methods

### Study design

This was a prospective analysis of the 2013 Adelphi Respiratory Disease Specific Program, a large, multinational, observational, cross-sectional survey that collects real-world data from physicians and patients.<sup>26</sup> Physicians were identified from publicly available lists and contacted by telephone to determine if they met the eligibility criteria for the survey.

Eligible, consenting primary care physicians and pulmonologists practicing in the US completed surveys for the next five consecutive, eligible patients who were consulting for any reason and were compensated at fair market rates for their participation.

Patients for whom their physician completed a survey were invited to respond to a questionnaire, which was voluntarily and independently completed with no input or direction from clinicians. Patients provided written informed consent before participation. No tests, treatments, or investigations were performed as part of this survey. The survey was conducted as a market research survey adhering to the ICC/ESOMAR International code on observational research and performed in full accordance with the rules of the US Health Insurance Portability and Accountability Act 1996.<sup>27</sup> IRB approval was not necessary or sought.

### Subjects

Physicians eligible for participation included those who completed medical training in the last 5–35 years, were personally responsible for treating patients with COPD, and treated at least 3 COPD patients per week. Patient eligibility criteria were age  $\geq 40$  years, a physician-confirmed diagnosis of COPD, a history of tobacco use, and a prescription for  $\geq 1$  inhaled medication. Patients with asthma were ineligible and those who declined to complete a questionnaire despite availability of a physician-completed survey were excluded from all analyses.

### Assessments

Physicians reported patient demographics, type of prescribed inhaler(s), provision of device training, severity of COPD, and comorbid health conditions. They assessed patients' confidence in the use of inhaler device(s) on a 5-point Likert scale ranging from 1 (not at all confident) to 5 (completely confident) in response to the question, "How confident are you that your patient is using their inhaler correctly". Completion of each survey took ~20 minutes, with compensation provided for each completed survey.

The patient-completed survey included items comparable to the physician instrument, with confidence in use of inhalers assessed by the question, "How confident are you that you are using your inhaler correctly" and responses recorded on a 5-point Likert scale. Physician- and patient-reported confidence ratings were used as a proxy for correct inhalation technique.

Patients also completed the EuroQoL 5 (EQ-5D-3L) including the graduated visual analog scale (VAS) and five dimensions of health,<sup>28</sup> and the COPD assessment test

(CAT)<sup>29</sup> to assess the impact of COPD on their health status. Patient-reported treatment adherence was assessed with the 8-item Morisky Medication Adherence Scale (MMAS-8),<sup>30</sup> with low adherence validated for MMAS-8 scores ranging from 0 to <6, medium for scores of 6 to <8, and high for scores of 8. Completion of the patient survey and standardized questionnaires required about 15 minutes and no compensation was provided.

## Statistical analysis

Percent responses were calculated for categorical variables and means and standard deviations for continuous variables. Spearman correlation evaluated the relationship between confidence in the use of inhaler(s) and adherence. Wilcoxon and weighted kappa ( $\kappa$ ) statistics<sup>31</sup> determined the degree of concordance between physician and patient ratings of confidence in correct inhaler usage. Kappa values <0 were equal to poor concordance, 0.0–0.20 slight, 0.21–0.40 fair, 0.41–0.60 moderate, 0.61–0.80 substantial, and 0.81–1.00 almost perfect concordance.<sup>32</sup> Ratings of not at all, slightly, and moderately confident were summed to represent low confidence, while ratings of completely and very confident indicated high confidence in device usage.

Stepwise logistic regression identified relationships between high versus low confidence in inhaler technique and patient demographic and clinical characteristics. Patients receiving their COPD medication by nebulizers alone were excluded due to very small sample size. Standard errors were adjusted for a possible correlation between patients consulting the same physician. Multiple linear regression evaluated relationships between high versus low confidence in inhaler usage and measures of health status. Logistic regression analysis assessed relationships between confidence in the use of inhaler(s) and patient-reported treatment satisfaction. Covariates included age, COPD severity, person providing inhaler education, number of comorbidities, education level, adherence, and concomitant nebulizer use. Kruskal–Wallis tests were performed to determine the significance of relationships between confidence in use of inhaler(s) and treatment adherence. All statistical analyses were performed with Stata/SE version 12.1.<sup>33</sup>

## Results

A total of 76 (56.7%) primary care physicians and 58 (43.3%) pulmonologists completed questionnaires for 373 patients. The median patient age was 67.0 years, with 171 (45.8%) indicating high school as their highest level of educational attainment (Table 1). More than half of patients were prescribed DPIs and MDIs together; 44 (11.8%) were prescribed nebulized medications plus a DPI or MDI. Almost all patients

indicated they received inhaler training from a health care professional.

## Physician versus patient-reported confidence in the correct use of inhaler device(s)

Complete confidence in device usage was observed for 22% and 17% of patients, whereas 33% and 41% of patients indicated moderate, slight, or no confidence in correct use of inhaler(s) as reported by patients and physicians, respectively (Figure 1). Low confidence was reported by 91 (37%) patients for DPIs and 86 (33%) for MDIs. Physicians reported 104 (42%) and 112 (43%) patients had low confidence in the use of DPIs and MDIs, respectively. Evaluation of concordance between physician- and patient-reported confidence ratings for inhaler use resulted in  $\kappa=0.397$ , equivalent to fair agreement.<sup>32</sup>

Physicians overestimated confidence in inhaler usage in 18% of patients compared with patient ratings, while 30% of patients overestimated confidence relative to physician ratings. Significantly more patients with low confidence had comorbid depression, anxiety, and congestive heart failure compared to those with high confidence (Figure 2; Table 2).

## Association of treatment adherence with physician- and patient-reported confidence in device usage

High confidence ratings by physicians and patients were associated with the highest levels of treatment adherence, with 33% and 38% of patients with high confidence ratings by both physicians and patients demonstrating high and medium adherence, respectively (Figure 3). Low adherence was reported for 64% of patients with low confidence ratings by physicians and patients compared to 30% of patients with high physician and patient confidence ratings ( $P<0.0001$ ).

## Patient characteristics associated with physician- and patient-reported confidence in device usage

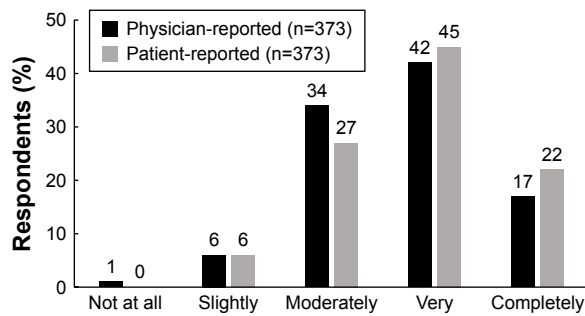
Complete covariate data for the stepwise logistic regression analysis of predictors of confidence in inhaler use were available for 289 patients. Lack of physician diagnosis of depression and college education were significantly associated with high patient-reported confidence in device usage (Table 3). Fewer comorbidities, and training provided by self or family members were significantly associated with high physician-reported confidence in inhaler use (Table 3). Patient age, physician-reported severity of COPD, and use of one or more types of hand-held inhaler devices (MDI

**Table 1** Demographic and clinical characteristics of patients

Characteristics	Total (n=373)	PCP patients (n=193)	Pulmonologist patients (n=174)
<b>Age, median, years</b>	67.0	67.5	67.0
<65, n (%)	145 (38.9)	65 (37.4)	76 (39.4)
65–74, n (%)	141 (37.8)	71 (40.8)	68 (35.2)
≥75, n (%)	87 (23.3)	38 (21.8)	49 (25.4)
<b>Level of educational attainment, n (%)</b>			
Some high school	32 (9.0)	10 (6.0)	19 (10.4)
High school graduate	163 (45.8)	79 (47.3)	82 (44.8)
Trade school	13 (3.7)	7 (4.2)	6 (3.3)
Some college	53 (14.9)	26 (15.6)	26 (14.2)
College graduate	73 (20.5)	37 (22.2)	36 (19.7)
Graduate school	22 (6.2)	8 (4.8)	14 (7.7)
<b>Time since COPD diagnosis, mean (SD), months</b>	72.7 (62.5)	74.8 (66.7)	70.5 (66.7)
<b>Severity of COPD based on physician subjective assessment, n (%)</b>			
Mild	80 (21.7)	42 (24.6)	37 (19.4)
Moderate	200 (54.3)	101 (59.1)	96 (50.3)
Severe/very severe	88 (23.9)	28 (16.4)	58 (30.4)
<b>Exacerbation in last 12 months, mean (SD)</b>	1.3 (1.9)	1.4 (2.1)	1.2 (1.6)
<b>Smoking status based on physician report, n (%)</b>			
Current smoker	116 (31.3)	70 (40.2)	45 (22.0)
Former smoker	240 (64.7)	95 (54.6)	143 (74.9)
Never smoked	15 (4.0)	9 (5.2)	42 (22.0)
<b>Comorbid health conditions affecting ≥5% of patients in total, n (%)</b>			
Allergic rhinitis	33 (9.0)	16 (9.3)	17 (8.9)
Anxiety	67 (18.2)	33 (19.2)	33 (17.4)
Anxiety or depression	106 (28.8)	51 (29.7)	54 (28.4)
Arthritis	104 (28.3)	58 (33.7)	46 (24.2)
Cardiac arrhythmias	22 (6.0)	11 (6.4)	11 (5.8)
Cardiovascular conditions (total)	285 (77.4)	144 (83.7)	136 (71.6)
Congestive heart failure	30 (8.2)	13 (7.6)	17 (8.9)
Coronary artery disease	45 (12.2)	25 (14.5)	20 (10.5)
Depression	58 (15.8)	27 (15.7)	31 (16.3)
Diabetes	47 (12.8)	23 (13.4)	23 (12.1)
Elevated cholesterol/hyperlipidemia	158 (42.9)	92 (53.5)	65 (34.2)
Gastroesophageal reflux disease	78 (21.2)	39 (22.7)	38 (20.0)
Hypertension	243 (66.0)	129 (75.0)	109 (57.4)
Obesity	33 (9.0)	16 (9.3)	17 (8.9)
Osteoporosis	32 (8.7)	24 (14.0)	8 (4.2)
Peripheral vascular disease	35 (9.5)	23 (13.4)	11 (5.8)
Prostate disorder	39 (10.6)	19 (11.0)	20 (10.5)
Sleep apnea	29 (7.9)	9 (5.2)	18 (9.5)
<b>Inhaler device type currently prescribed, n (%)</b>			
Dry-powder inhaler only	51 (15.4)	26 (17.0)	24 (13.6)
Metered-dose inhaler only	70 (21.2)	44 (28.8)	26 (14.8)
Dry-powder inhaler and metered-dose inhaler	171 (51.7)	71 (46.4)	99 (56.3)
Nebulizer with other inhaled devices	39 (11.8)	12 (7.8)	27 (15.3)
<b>Source of device training reported by patient, n (%)</b>			
Self or family member	26 (7.4)	11 (6.5)	15 (8.4)
Health care practitioner	327 (92.6)	158 (93.4)	163 (91.5)
Physician	288 (81.6)	138 (81.7)	144 (80.9)
Nurse	39 (11.0)	20 (11.8)	19 (10.7)
<b>MMAS-8 score, n (%)</b>			
Low adherence	166 (44.5)	74 (42.5)	90 (46.6)
Medium adherence	118 (31.6)	60 (34.5)	55 (28.5)
High adherence	89 (23.9)	40 (23.0)	48 (24.9)

**Notes:** Missing data for main treating physician type for 6 patients. Use of the ©MMAS-8 is protected by the US copyright laws. Permission for use is required. A license agreement is available from: Donald E Morisky, ScD, ScM, MSPH, Professor, Department of Community Health Sciences, UCLA School of Public Health, 650 Charles E Young Drive South, Los Angeles, CA 90095-1772; dmorisky@gmail.com.

**Abbreviations:** MMAS-8, Morisky Medication Adherence Scale; PCP, primary care physicians; SD, standard deviation.



**Figure 1** Physician- and patient-reported confidence in correct usage of inhaler device(s).

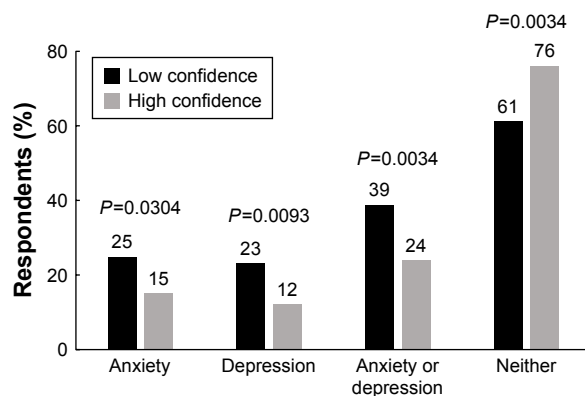
only, DPI only, or both) were not significant predictors of physician- or patient-reported confidence.

### Association of physician- and patient-reported confidence with health status

High physician-reported confidence in inhaler usage was significantly associated with lower CAT scores, higher EQ-5D VAS, and greater overall patient satisfaction with inhaler treatment. Similar results were found for patient-reported confidence in device usage for CAT scores and inhaler satisfaction (Table 4).

### Discussion

This real-world study of community-based, US primary care physicians and pulmonologists and their patients demonstrated that both physicians and patients expressed low confidence in patients' ability to correctly use inhaler(s). Notably, physicians reported lower confidence in patients' ability to use inhalers than patients' self-reported confidence, and the level of agreement between their responses was only fair suggesting that patients may overestimate their ability to correctly use inhaler(s). Alternatively, physicians might underestimate patients' proficiency in the use of inhalers.

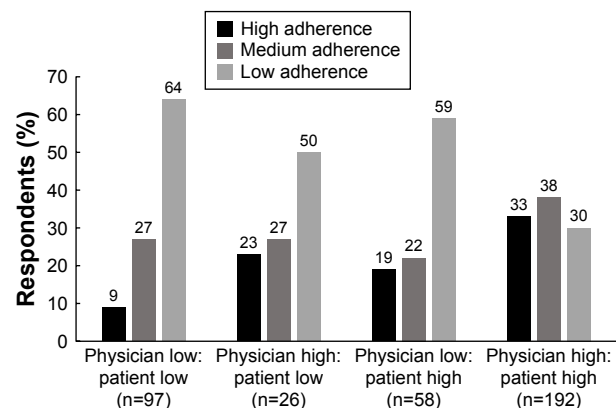


**Figure 2** Anxiety and depression in patients reporting low and high confidence in correct usage of inhaler device(s).

**Table 2** Characteristics of patients reporting low and high confidence in correct usage of inhaler device(s)

Characteristics, %	Confidence level		P-value
	Low (n=123)	High (n=250)	
Depression	23.1	12.1	0.009
Anxiety	24.8	15.0	0.030
Arthritis	31.4	26.7	0.389
Cardiovascular conditions, any	83.5	74.5	0.063
Congestive heart failure	12.4	6.1	0.044
Coronary artery disease	15.7	10.5	0.176
Peripheral vascular disease	12.4	8.1	0.191
Cerebrovascular disease and/or stroke	5.0	2.0	0.188
<b>Smoking status</b>			
Current	35.8	29.0	0.193
Former	62.6	65.7	0.566
Never	1.6	5.2	0.159

Our objective was to determine if confidence was significantly associated with patient-reported outcomes, including adherence. We found that physician- and patient-reported ratings of confidence in device usage were significantly associated with overall self-reported treatment adherence. The lowest adherence was evident in patients who reported low confidence and were perceived to be the least confident in device usage by their physicians. These results suggest that physician recognition of the factors associated with patient confidence in inhaler usage may help to identify patients who are likely to benefit from additional education or choose a different inhaler device that would suit their needs. Interestingly, we did not find an association between confidence and age or physician-reported COPD severity although previous research suggests the existence of an association between older age<sup>34</sup> and confidence. Additional research to identify other factors that influence confidence may improve patient outcomes.



**Figure 3** Association of treatment adherence with physician- and patient-reported confidence in correct usage of inhaler device(s).

**Table 3** Logistic regression model for predictors of physician and patient perceptions of high self-reported confidence in correct usage of inhaler device(s)

Patient characteristics (n=289)	Physician-reported high confidence in correct usage of inhaler OR (95% CI)	Patient-reported high confidence in correct usage of inhaler OR (95% CI)
Highest level of education, college or trade school	1.68 (1.00, 2.83)	1.98 (1.08, 3.63) <sup>a</sup>
Self-taught use of inhaler device(s)	3.34 (1.20, 9.31) <sup>a</sup>	3.33 (0.89, 12.48)
Comorbidities, number	0.85 (0.75, 0.96) <sup>a</sup>	0.92 (0.82, 1.03)
Current use of DPI versus use of both DPI and MDI	0.96 (0.49, 1.86)	0.57 (0.30, 1.07)
Current use of MDI versus use of both DPI and MDI	0.79 (0.38, 1.63)	1.14 (0.59, 2.17)
<b>Patient age, years</b>		
<65 versus ≥75	0.69 (0.31, 1.54)	1.02 (0.47, 2.20)
65–74	1.13 (0.56, 2.29)	0.94 (0.43, 2.03)
<b>COPD severity</b>		
Mild	1.37 (0.61, 3.04)	0.91 (0.39, 2.16)
Moderate versus severe	1.08 (0.57, 2.05)	1.13 (0.59, 2.17)
Depression	0.75 (0.36, 1.55)	0.46 (0.22, 0.97) <sup>a</sup>
Anxiety	1.33 (0.64, 2.76)	0.68 (0.33, 1.39)

Note: <sup>a</sup>P<0.05.

Abbreviations: CI, confidence interval; DPI, dry-powder inhaler; MDI, metered-dose inhaler; OR, odds ratio.

Self-education or training provided by family members were associated with significantly higher physician-reported confidence levels, which might suggest some benefit of training both patients and caregivers. These results, however, should be interpreted cautiously given the low proportion of patients who did not also receive training from a person other than a health professional. The important findings of this study lie in the fact that the report of low confidence in inhaler usage is seen despite receipt of training by the patient. However, the extent of training received by the patient could not be ascertained in this research and can be perceived as a limitation that precludes from making any strong conclusion about the role of education. Other characteristics significantly associated with greater confidence in device usage were fewer comorbidities, the absence of depression, and higher

education levels. Overall, these results suggest that, clinicians may need to consider patient characteristics in inhaler device selection for patients at risk of having low confidence to avoid subsequent non adherence. Other factors, such as medication costs and higher cost sharing by patients, are also likely to influence adherence and should be considered when prescribing inhaler devices.

Approximately 75% of patients in our study used more than one inhaler, further highlighting the importance of device instruction and education. Previous research suggests that patients' ability to properly use inhalers is improved by instruction from clinicians in the proper use of inhaler(s), regular follow-up assessment of inhaler technique, and remedial training.<sup>9,11,21,35–39</sup>

Interestingly, literature suggests that even health professionals require training in the use of inhaler devices before they can effectively educate their patients,<sup>37</sup> with many clinicians not optimally informed about the appropriate use of inhaler devices and effective patient education strategies.<sup>10,12,17</sup> One study reported that only 14% of >1,500 physicians had adequate knowledge of inhaled therapy, <50% knew correct inhalation maneuvers required for DPI inhalers, and only 25% checked patients' inhalation technique before prescribing new device(s) or drug combinations.<sup>40</sup>

Typically, observation, oral instructions, and demonstration are essential for effective education on optimal device usage.<sup>25,37,39,41</sup> Successful device training reduces the frequency of exacerbations and dyspnea and improves quality of life.<sup>42</sup> Repeated instruction in inhalation techniques increases adherence and improves patients' health status<sup>43</sup> because patients are likely to forget what has been taught as time elapses from the point of training.<sup>12</sup>

**Table 4** Association of physician-reported and patient-reported confidence in correct usage of inhaler device(s) with health status and patient satisfaction with inhaler device

Patient-reported outcome	Coefficient or odds ratio (95% CI) <sup>a</sup>	P-value
<b>Physician-reported patient level of confidence (high versus low)</b>		
EQ-5D-3L, coefficient	0.028 (–0.014 to 0.070)	0.185
EQ-5D-VAS, coefficient	6.49 (1.92, 11.05)	0.006
CAT, coefficient	–2.49 (–4.65 to –0.323)	0.025
Inhaler satisfaction, OR	4.18 (1.94, 8.97)	<0.0001
<b>Patient-reported confidence (high versus low)</b>		
EQ-5D-3L, coefficient	0.015 (–0.025 to 0.055)	0.465
EQ-5D-VAS, coefficient	2.72 (–1.99, 7.43)	0.255
CAT, coefficient	–3.09 (–5.18 to –1.00)	0.004
Inhaler satisfaction, OR	7.47 (3.78, 14.77)	<0.0001

Note: <sup>a</sup>Coefficient is for the effect of high confidence in correct inhaler usage.

Abbreviations: CAT, COPD assessment test; CI, confidence interval; EQ-5D-3L, EuroQoL 5; OR, odds ratio; VAS, visual analog scale.

Choice of inhaler device tailored to the individual patient's ability to use a particular type of device as well as patient needs and preferences can also enhance patients' confidence and maintain long-term treatment adherence.<sup>9,24,25,36</sup> Patient preferences and their ability to generate the appropriate level of inspiratory flow for inhaler(s) are critical factors to consider when prescribing device(s).<sup>37,44</sup> Patients with spontaneous breathing, good dexterity, and poor inspiratory flow may benefit from a pressurized MDI, while those with inadequate coordination but sufficient inspiratory flow may do well with a DPI or a pressurized MDI with a spacer.<sup>37</sup> Nebulizers are an alternative to pressurized MDIs plus a spacer and DPI, particularly for elderly patients, those with severe disease and frequent exacerbations, and those with physical or cognitive limitations.<sup>45</sup> Many patients, particularly those with moderate or severe COPD, have difficulty achieving the minimum inhalation rate required for a DPI.<sup>44</sup> Patients with severe airflow obstruction may only achieve the full benefits of inhaled therapy by using a spacer<sup>37</sup> or a nebulizer.<sup>37,45</sup> Spacer devices and nebulized medications may benefit patients for whom low confidence is related to diminished inspiratory flow or difficulties using inhalers due to impaired cognitive function, manual dexterity, or hand strength.<sup>25</sup>

The results of this observational survey must be considered within the context of several limitations that are inherent to all surveys – selection bias, potential lack of generalizability, and recall bias. The data source was a cross-sectional survey meaning adherence could only be measured by one-time patient self-report through validated questionnaire and not monitored longitudinally. The use of a single-item question about confidence in device usage could be perceived as another limitation. However, several validated instruments including the CAT, MMAS-8, and the EQ-5D-3L were used in the study, and the direction of association between confidence, adherence and health status had the expected trend. These findings suggest high concurrent validity with our results about patient confidence in device usage. The list of patient characteristics was not an exhaustive list of all factors that might affect confidence, such as cognitive abilities and motor coordination. Furthermore, this study was unable to assess whether HCPs were accurate in their instructions to patients for correct inhaler technique, which if incorrect could have undermined the benefits and, therefore, confidence the inhaler was being used correctly. Finally, confidence in device usage was not always specific to a single inhaler because a high percentage of patients used multiple inhalers. Despite these limitations, the findings of the study suggest that considering various patient factors for inhaler selection and training can help increase patient's

confidence in correct inhaler usage. This may, in turn, help achieve better outcomes for COPD patients.

## Conclusion

Our results indicate that 1 in 3 COPD patients have low confidence in correct usage of inhaler devices and further poor inhaler confidence is associated with lower COPD-related health status. These findings may motivate a more individualized approach by health care professionals when considering inhaler delivery mechanisms and patient education to ensure better patient outcomes.

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## Disclosure

ANA is on the speaker's bureau for Sunovion Pharmaceuticals Inc. VG is an employee of Sunovion Pharmaceuticals Inc. AR is an employee of Adelphi Real World. MS is an employee of Adelphi Real World. The authors report no other conflicts of interest in this work.

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