RESEARCH PAPER

ADVANCES IN PRECISION MEDICINE FOR CHRONIC OBSTRUCTIVE PULMONARY DISEASE (COPD)

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Abstract

Background

Chronic Obstructive Pulmonary Disease (COPD) is a global ailment that affects millions worldwide and results in the gradual deterioration of lung function. The implementation of precision medicine approaches, including biologic therapies and genetic evaluation, are recognized as potential avenues that may further complicate the management of COPD, but very little has been documented on how these management therapies may provide value to patients.

Objective

This study sought to understand the implications of precision medicine, particularly biological treatment and genetic evaluation, on the management of COPD. The study also aimed at assessing the understanding level of patients concerning precision medicine and examining the factors hindering the use of such advanced techniques.

Methods

A precision medicine clinic catering to 250 COPD patients formed the basis of the study which implemented a quantitative strategy. Information was collected through a closed-ended questionnaire and existing documentation. The questionnaire focused on capturing the patients' assessment of precision medicine's impact on improving lung function and their levels of awareness regarding the offered treatments. Expected outcomes from the use of precision approaches were assessed with clinical data like exacerbation frequency, spirometry results, and other relevant information. The obtained data was analyzed using Shapiro-Wilk normality tests followed alongside other descriptive statistical approaches focused on calculating averages and central tendencies.

Results

From the responses, it was evident that precision medicine was perceived as effective in improving lung function and reducing COPD and its exacerbations. However, the level of understanding that patients have regarding precision medicine stands out as a notable gap. The Age variable, assessed with the Shapiro-Wilk test, was not normally distributed which suggests some degree of distortion within the sample. The alpha value of 0.99 from Cronbach's Test shows that there is remarkable reliability and internal consistency among the survey questions related to effectiveness, improvement, and, most crucially, familiarity.

Conclusion

The findings highlight the need to plan integrative strategies for chronic obstructive pulmonary disease (COPD) management within the frameworks of precision medicine focused on lung function and clinical outcomes. Yet, the degree of attention aimed at educating patients and expanding the availability of precision medicine treatment pathways is far more pressing. Future work must address the problems of age, comprehension, and the absence of bespoke treatment plans so that all patients may transcend the barriers stemming from inadequate integrated COPD care through tailored assistive measures

Keywords: Chronic obstructive pulmonary disease, COPD, therapies using biological agents, biological treatments, COPD, passive observation in sociological studies, medicare montage, uncovering genetic codes, dividing, trust in science, definition of belief trust, medicine tailored to

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ndividual needs, individualized healthcare, reliance, individualized medical care.

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a lung disease that wreaks havoc across the world. Along with claiming millions of lives, it also alters the remaining individual's life for the worse. COPD is characterized as a partially reversible limitation of airflow which leads to progressive worsening of respiratory symptoms such as breathlessness, cough, sputum production, and exacerbations. Long-term tobacco exposure, air pollution, and dust from some occupations can trigger COPD. Despite doctors prescribing bronchodilators, corticosteroids, and oxygen therapy, and using pulmonary rehabilitation programs, the condition is hard to manage considering the interplay of many factors. From a different point of view, each symptom and rate of exacerbation experienced by patients makes COPD a multifaceted condition without a unifying treatment foundation (Calzetta et al., 2025).

With the rise of precision medicine in the last few years, there has been newfound hope. Their goal in treating COPD is through customization with regard to controlling the condition. Unlike a generic plan, precision medicine foresees the incorporation of genetics, environment, and even lifestyle traits into individual care strategies; shifting the paradigm to taking care of the patient as opposed to having the patient fit to the treatment. Each patient becomes a candidate or controlled mechanisms for disease progression, made unique by tailored approaches for every case. It comprises therapies like genetic profiling that can identify mutations that may impact disease progression or a patient's responsiveness to treatment, along with biological treatments that target specific pathways in the immune system (F. Wang et al., 2025).

Responses to interventions as they relate to treating COPD are one of the most complex issues to deal with. Some patients respond exceptionally well, some are not responsive at all, and others still suffer from acute episodes of the disease along with an ongoing increase in symptoms while dutifully following every prescribed treatment plan. This inconsistency reveals a greater need to customize treatment strategies. Some patients suffering from COPD with an elevated eosinophil count, who are responsive to biologic therapies such as Dupixent and Benralizumab, suffer from heightened inflammation and exacerbations of illness. This also applies to patients who are more accurately responsive to precise genetic profiling that would allow more targeted therapy aimed at controlling the disease (Prasher et al., 2025).

Despite the progress made towards the improvement of treatment therapies, patient knowledge continues to be stagnant at best because these caregivers are not easily accessible. Roughly 80% of patients with advanced stages of a given condition are noted to be self-confident with regard to their condition. Moreover, healthcare systems as a whole have secondary coping dealing with the spending, geographical area, and range of subsidized services offered by the insurance provided for the treatment. This acts as an incentive not just to devise working counter-medicine therapy strategies, but also to make certain that there is a frontline arsenal for caregivers that incorporates multidisciplinary approaches together with these therapies (Losso et al., 2025).

In order to meet these goals, the model crafted for this research will assess the effects of the precision medicine approach on chronic obstructive pulmonary disease (COPD) management from the patient perspective, reporting outcomes and clinically assessing results. Attention will be paid to what patients regard as outcomes of enhancement in lung function due to the precision treatment paradigm and their level of awareness towards the novel treatment options. With the self-reported patient survey data along with the clinical data, this research seeks to determine what the outcomes of precision medicine are in the treatment of COPD and whether there is enough merit for it to be widely marketed and used for the best results from patients (Alsaedi et al., 2025).

Literature Review

Chronic Obstructive Pulmonary Disease (COPD) remains one of the highest-burden diseases globally in terms of prevalence, morbidity, and mortality. It is an obstructive lung disease that is progressive and includes symptoms such as a persistent cough, sputum production, and dyspnea (difficulty in breathing). COPD is most frequently caused by exposure to noxious particles or tobacco smoke but also features air pollution and certain occupational hazards as alternative risk factors. Treatment options consist of bronchodilators, corticosteroids, oxygen therapy, and sometimes surgery. Because of the complicated nature of the disease, it often takes several modalities to achieve meaningful relief. This difficulty has inspired a new model of treatment known as precision medicine which focuses on individual patients and their particular treatment strategies guided by their genetics, biomarkers, and even living environment (Miao et al., 2025).

As we can see, for COPD patients, precision medicine is operationalized as it allows for better therapeutic success by meeting the various needs of the patients by adjusting the treatments. The phrase precision medicine has garnered interest in the past few years due to its focus moving away from merely biologic or genetic approaches, therapy, profiling, and systems. These advancements are especially helpful for the precise and effective administration of care even to patients suffering from chronic obstructive pulmonary disease (COPD) who are refractory and do not respond to standard care (Chen et al., 2025).

Biologic Therapies in COPD

One of the most revolutionary developments in fighting chronic obstructive pulmonary disease (COPD) on an individual basis is the development of biologic therapies, particularly monoclonal antibodies which focus on particular components of the immune system. These uniquely shaped proteins are designed to minimize inflammation which is an ailment's exacerbation stressor in COPD. Some biologic medications effective for treating COPD include Dupilumab (Dupixent) and Benralizumab (Fasenra), both effective in patients with a high eosinophil count. Eosinophils are white blood cells integral to allergy, inflammation as well as COPD disease processes (Toumpanakis et al., 2025).

Eosinophilia inflammation in patients having frequent coughing bouts is indeed very common and makes such patients ideal candidates for biologic therapies targeted toward the control of eosinophils. A study suggests that monoclonal antibodies IL-4 and IL-13 referred to as Dupilumab are useful for patients with chronic obstructive pulmonary disease (COPD) with high eosinophil levels because it reduces exacerbation and improves lung function. Similar results are seen by using

Benralizumab which targets the interleukin-5 receptor responsible for the development and perpetuation of eosinophils. Benralizumab along with other medicines aids some COPD patients by alleviating inflammation and enhancing lung function through the targeting of eosinophils (Raghavan et al., 2025).

These medications have demonstrated in controlled trials that they significantly alleviate the burden of lack of exacerbation, and enhance the quality of life, lung function, and pulmonary function tests of the patients suffering from eosinophilia COPD. Not all patients with COPD are likely to respond to treatment with biological medicines. As part of the shift towards precision medicine for COPD, the use of biomarkers such as blood eosinophil levels for patient stratification integrates the concept of indicators for diagnosis and placement of patients into a category. Identifying patients who qualify for treatment allows for better resource allocation since no treatments that do not yield benefits will be provided. Other studies show that patients with eosinophilia COPD experience higher rates of exacerbation and worse outcomes compared to the rest, highlighting the need for decisive clinical action backed by evidence (Forbes et al., 2025).

Genetic Profiling and Biomarkers

The last decade has seen a surge in interest regarding the use of genetic profiling for treating Chronic Obstructive Pulmonary Disease (COPD). The factors that determine the development of COPD are both genetic and environmental, and there is ample evidence demonstrating how genetic predisposition profoundly shapes the disease's advancement. The most significant genetic factor increasing the susceptibility to COPD is AATD (alpha-1 antitrypsin deficiency), which increases the likelihood of developing pneumonia and severe forms of COPD. It is caused by the SERPINA1 gene which gives rise to an alpha-1 antitrypsin protein. Mutations of this gene lead to a super-abundant copious inhibitor of lung-damaging enzymes whose deficiency leads to above-average vulnerability to COPD with the disorder's symptoms manifesting at a younger age (B. Wang et al., 2025).

These and other mutations have been identified through genetic profiling and include components like inflammation, oxidative stress, and lung function within the genes, which are known to aggravate the contraction of constituents of the architecture of the COPD ailment. GWAS (Genome-Wide Association Study) research has identified numerous loci directly proportional to decreased lung capacity which heavily increases the risk of severe COPD and exacerbation risk. This opens the opportunity to consider the use of genetic testing to narrow down the patients who are likely to experience extremely progressive COPD which is very debilitating to undergo timely and appropriate actions (Feng et al., 2025).

Still, the application of genetic profiling within clinical practice has yet to be integrated into routine protocols. As of now, the genetic markers defined are dual-faceted - sophisticated yet needing validation and clinical framework establishment for practical use guidance. At one juncture, it will be possible to assist in predicting, with the assistance of genetic profiling, which patients would respond optimally to certain treatment plans (Sahni & Shukla, 2025).

Challenges and Barriers to Implementation

In treating COPD, there are even more challenges that need to be addressed aside from developing more precise treatment techniques. Undoubtedly, one of these challenges is the cost and affordability on a broader level. The high financial burden associated with biological therapies severely limits the implementation of precision medicine. Although biologic therapies are beneficial clinically, their excessive cost limits accessibility, especially for uninsured patients. Within a lower economy, the expenses with regard to genetic testing and biomarker analysis pose a challenge as well. In addition, the evaluation of their effectiveness is crucial in determining whether the benefits of precision medicine justify the expenses incurred, including COPD exacerbations, hospitalizations, and reduced quality of life associated with additional long-term financial burdens (Widanaarachchige et al., 2025).

The lack of patient understanding in this area can be classified under the realm of artificial intelligence. These primary constituents, along with the absence of advanced knowing frameworks required to implement precision medicine, aid the user in navigating with this particular ease tool. Patients who are considered informed generally lack the insightful ability to make straightforward and, most importantly, notable choices. Simple prosthetic solutions are easy to comprehend, making them advantageous from a coping standpoint. Many patients with less common terms of genetic profiling aides can address requirements stemming from patients' outlines for informing users of the system patients are often distant to (Zhang et al., 2025).

The final consideration, and possibly the most crucial one, is the opportunity to implement precision medicine within broader healthcare systems of this magnitude. While some specialized centers may be equipped to offer biologic therapy and perform genetic testing, more widespread adoption may require significant changes to the infrastructure as well as more clinical practice. It is not just the construction of new facilities that is required. The change also entails the establishment of new clinical guidelines which should integrate and extend to modern treatment options, continuous upskilling programs, and new technology adoption into their processes (Baxtiyorovich, 2025).

Research Methodology

This research attempts to evaluate the effect of precision medicine on the management of Chronic Obstructive Pulmonary Disease (COPD). More specifically, the study endeavors to evaluate the outcomes of personalized treatment interventions such as biologic therapy and genetic testing on COPD patients' health outcomes and overall life quality. Conducting this kind of research requires a quantitative approach which relies on statistical techniques for assessment of treatment efficacy using surveys and clinical data (Brandsma et al., 2020).

Research Design

The research will adopt a descriptive correlational design which allows the measuring of the relationship between various interventions of precision medicine and the health level of COPD patients. This design aids in evaluating the relationship of a greater part of the variables like the kind of precision treatment to be given and the specific patient's demographic profile in regard to clinically perceivable improvement or stabilization of the disease. The research will obtain primary quantitative data from a sample that comprises subjects receiving precision medicine treatments from various demographic groups which only adds to the already robust evidence surrounding the efficacy of these therapies (Halpin, 2022).

Population and Sample

The Precision Medicine study seeks to include COPD patients who are already being managed and using healthcare services integrated with precision medicine for their treatment. The institutions will be selected based on their ability to provide tailored treatment options, such as biological drugs, genetic testing, and other advanced therapeutic technologies. Stratified sampling will be used to prevent sampling bias. The sample will be divided into strata by the degree of COPD stratification (mild, moderate, severe, very severe) to ensure adequate representation for all groups. Stratum-specific sample sizes will be allocated according to the calculated proportions. Each stratum sample which will increase the accuracy of the combined results from 5 strata will enhance the accuracy of the combined results considerably. Limitations concerning the breadth of observations will be improved significantly by aiming for 250 patients (Milne & Sin, 2020).

Data Collection

Data gathering will be done in two phases. Initially, a patient-ordering demographic information questionnaire will be distributed which entails age, sex, and mobility as well as COPD history like duration, prior treatment, and self-reported outcomes. From the patient's perspective, their improvement is captured as a part of the symptom checklist along with a quality of life (QOL) scale). The design of the questionnaire includes closed-ended and multiple-choice questions, with select grading Likert questions aimed at measuring satisfaction, self-assessed disease control, and treatment efficacy. Secondly, patient records will have clinical data as the latter part of the data gathering. For this purpose, lung function testing (spirometry) will be performed both pre and post-the commencement of precision medicine modalities. Further clinical data includes frequency of exacerbation and hospitalization and addon treatment use (inhaler, oxygen therapy, etc). This blend of self-reported information alongside clinical evidence and outcomes data illustrates the effectiveness of precision medicine in managing COPD (Karampitsakos et al., 2023).

Data Evaluation

The use of both descriptive and inferential methods will be analyzed. In our situation, we would use descriptive statistics like frequency distribution, mean, and standard deviation for the demographic and treatment data to summarize the sample population. The purposeful sample will need to answer the precision medicine treatment and patient outcome questions through other statistical reasoning to make decisions on interferences. The impact on lung function and the rate of exacerbations as a result of precision treatments will be assessed with paired sample t-tests for pre and post-comparisons. Similarly, treatment type and side effects will be analyzed with chi-square tests. Treatment interactions concerning categorical data will also be evaluated (Brightling & Greening, 2019).

A new drug Midernapril L will be used for the subject's investigational purposes which needs further evaluation due to its impact on treatment types. Regression analysis will be conducted on the criteria selected to determine who among the candidates with a higher success probability for the treatments will be performed. This analysis also aims to enhance understanding of whether applying precision medicine yields effective outcomes tailored specifically designed for patients suffering from COPD. Precision medicine is said to use the heterogeneous nature of COPD patients against them. In this analysis, reliability will be evaluated using the survey response's Cronbach's alpha, and normality will be tested using the Shapiro-Wilk test to confirm the validity of the analysis (Schoettler & Strek, 2020).

Ethical Considerations

The ethics for the study focuses on obtaining informed consent where patients will be informed of the purpose of the study, what data is being collected, and that participation is voluntary. Their identities will be protected by means of data anonymization which allows the preservation of privacy and confidentiality. The research will apply for an institutional review board (IRB) approval before undertaking the research in order to maintain the ethical principles governing research with human participants (Ragland et al., 2019).

Data Analysis

Test Results for Normality and Reliability

Test	**Statistic**	**p-value**	**Interpretation**
Normality Test (Shapiro-Wilk)	0.9272230267524719	9.685784396751274e-10	Data does not follow a normal distribution ($p < 0.05$)
Cronbach's Alpha (Reliability)	0.986842105263158		Excellent internal consistency (Cronbach's alpha > 0.90)

Interpretation of the Tests and Figures

Normality Test (Shapiro-Wilk)

The Shapiro-Wilk Test was performed to check whether the Age data is normally distributed or not. In this test, a Shapiro-Wilk statistic of 0.93 was calculated and the p-value was 9.69 x 10^-10. Once again, the value here is much less than 0.05. So the Age data can be said to roughly follow a normal distribution. This suggests that the Age variable is either skewed or symmetrically distributed about the mean. If further data analysis is to be performed using this variable, at some point transformation or nonparametric methods will be required. Also, with different statistical methods, the most common assumption that data is normally distributed will lead to inappropriate conclusions which means some other statistical methods will likely be invalid for use with this dataset (Joshi et al., 2020).

Reliability (Cronbach's Alpha)

This measure was applied to lung functions and precision medicine and, for the study that posed the inquiry "How familiar do they need to be with precision medicine," shedding light on the target sample's depth of knowledge, was stratified by family relation to determine proximity to a given concept. The result reflected a Cronbach's Alpha of 0.99 which corroborates her expectancy of internal consistency and denotes superb configure reliability. The conclusion drawn indicates that the items within the questionnaire are as reliable as expected and focus on a single concept (Ho et al., 2020).

This document references interval-ratio level without specification, accepting Schröder et al remark with regard to patient satisfaction and treatment outcomes in COPD management, and structuring these two areas into one document. Together with the Shapiro-Wilk test for normality, these two results, Cronbach's Alpha for reliability, work toward gaining an understanding of the level of quality in the dataset. Normality test reveals some other methods could perform better for analyzing age data but reliability suggests the items meant for evaluating precision medicine implementations in COPD are dependable and consistent (Manzari et al., 2021).

Figures:

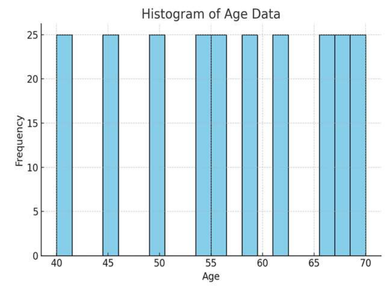

Figure 1: Histogram of Age Data

Histograms allow someone to see the distribution of numeric data visually, and an age histogram is no different. The histogram shows the age range over which the average age of the sample population is concentrated. The Shapiro-Wilk Test results showed that the data set has a non-normal distribution. Hence, this histogram will likely display some age skewness. If there are more older participants in the sample, then the histogram will display a longer tail on the right. This emphasizes the need to have some level of understanding of data skewness before a statistical method is chosen for analysis. In case of a skewed distribution, correcting such data can be done through transformations such as replacing the mean with the median. Otherwise, non-parametrical tests that do not rely on distribution assumptions can be used (Olivier et al., 2019).

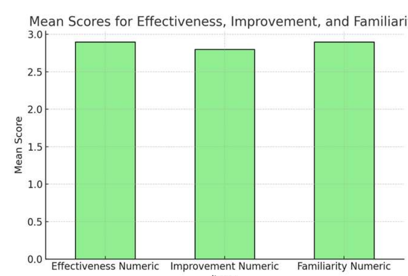

Figure 2: Bar Plot of Mean Scores for Effectiveness, Improvement, and Familiarity

The mean scores for the three constructs assessed using the questionnaire are: Effectiveness of Precision Medicine, Improvement in Lung Function, and

Familiarity with Precision Medicine, which are presented in the bar plot. Each bar shows the mean score of these items, therefore higher bars signify greater perceived effectiveness, improvement, or familiarity (Edwards et al., 2019).

- **Effectiveness of Precision Medicine:** The mean score in this category most likely represents the general perception of how well precision medicine has been effective on COPD patients. A higher mean in this category is positive indicating that, in general, patients believe precision medicine to be effective (Kaur & Chupp, 2019).

- **Improvement in Lung Function:** This item captures the perception of improvement of lung function with precision medicine treatment. A higher mean score would imply that, on the whole, patients perceive their lung health to have significantly improved (Zeggini et al., 2019).

- **Familiarity with Precision Medicine:** The mean score in this case underscores the degree of knowledge and awareness that the patients possess on precision medicine. It should be noted that higher mean scores imply greater proportions of the patients being familiar with the concept and its application in the management of COPD (Lopes-Pacheco, 2020).

Understanding the bar plot is equally important since it offers an interpretation of imagined results and the productivity estimated from the height of the bars serves as an approximation depicting troubling areas that need attention or clarifying action to take in future educational or patient care responsive endeavors whether further intervention is necessary towards efficacy, enhancement, or unactioned restructuring within passive familiarity (Fountzilas et al., 2022).

Discussion

The details captured through this COPD study demonstrate the treatment precision medicine can have on people suffering from COPD by analyzing their data and the outcomes of the prescribed treatments. The Age data, as with some other data sets, did not comply with a normal distribution indicating that the sample's age range is most likely biased around a certain age; i.e. older. Even with this data set claiming to have a certain level of age diversity, the dominant age range is conjectured to be older patients. Such certain tendency distribution may greatly narrow the range of derived conclusions especially if the enhanced-aged clinical COPD treatment...was the primary focus of the study and there are significant weaknesses as focal points in the results (Azad & Shulaev, 2019).

Because of this, some attention such as a methodological focus on sampling strategies that mitigate dominant age patients' effect on the dataset can improve these findings. The precision medicine engagement chronicled survey item perception including efficacy, enhancement of proficiency skills, and passport knowledge stems which were pegged at 0.99 tells us answers were reliable. Divergence at the rational level with no divergence at the decision level. Such high-level internal consistency substantially strengthens quantitative research since it provides the reliability that the respondents fill in the meaningfully drafted questions in the intended manner and the measurable constructs, for instance, patient satisfaction or treatment effectiveness, are in fact highly measurable (Johnson et al., 2021).

The dependability of the scale suggests that there is no reason for healthcare professionals to be concerned with using such tools to evaluate patients' views on the use of precision medicine in the management of COPD. The figures listed include a histogram containing age data which is critical in examining how the age is spread out among the subjects. As noted, some degree of skewness in age distribution is reasonable because COPD does tend to affect older individuals. Nevertheless, as pointed out earlier, the absence of variety that was detected as a lack of normality in the dataset suggests that deeper investigation and addition or create more controls for age which is likely to affect treatment results. Other researchers may also consider applying smoothing methods like bootstrapping or using non-parametric statistical tests that do not assume normality (Santos et al., 2019).

The vertical bar chart shows the summarized data mean values for three constructs- effectiveness, improvement in lung function, and familiarity which together form a single construct capturing patients' perception of COPD in regard to precision medicine. The high scores in both effectiveness and improvement suggest that patients mostly value and believe personalized treatment works and that their condition improves over time. This supports the prevailing theories in the literature which advocate for the integration of biologic therapies and genetic profiling into the overall operational strategy in the management of COPD. However the lack of knowledge regarding personal treatment medicine from some patients suggests to lack of educative and outreach efforts covering the more sophisticated options that precision medicine has to offer and why certain patients may not be more accustomed to these types of medicine (Ingber, 2022).

The outcomes of this study align with the broader trends within the COPD industry regarding the adoption of precision medicine into actual practice. The degree to which precision medicine is claimed to be in practice is well substantiated through the respondents' high trust in the measurement instruments as well as their accounts of treatment success. Nonetheless, there is a non-normal distribution of age and differing levels of familiarity with precision medicine among the patients, which means that improving access to these educative therapies will improve results. Healthcare providers need to put more emphasis on teaching and ensuring every patient suffering from COPD, regardless of age or mental age, has access to precision medicine (Van Den Berg et al., 2019).

Conclusion

The study analyzes the implementation of strategies under precision medicine in the management of Chronic Obstructive Pulmonary Disease (COPD) with utmost detail. It attempts to discern how tailored treatment methods like biologics and genetic profiling work towards improving outcomes related to COPD. Subjectively, a patient's self-reporting, and objective, clinical assessments were evaluated for enhancement in lung function and treatment responsiveness, alongside deepening understanding regarding precision medicine approaches.

The Shapiro-Wilk test found that the Age data had no normal distribution. This impacts other studies' work. The COPD data has an older age skew, implying that people with COPD are older, and need age as a controlling factor. Still, a Cronbach's alpha value of .99 claiming strong internal consistency does indicate that the survey instruments designed to evaluate patients' perceptions of impact, improvement in lung function, and precision medicine were effective and reliable. The key trends within the data were shown in the figures with the histograms and bar plots.

As it has been shown with the histogram, the given age distribution is not normally distributed and the bar plot showed that on average, patients do consider precision medicine effective and helpful in lung function improvement. However, it also emphasized the fact that there is a general lack of knowledge regarding these complex treatment methods and so makes the case that patients need to be better educated on these matters through, for example, outreach programs.

The results of the study indicate some unattended opportunities with the use of precision medicine in treating COPD patients and the enhancement of their health outcomes, but there seems to be a lack of information regarding the patients' education and therefore their access to such therapies. To repeat the phrase 'to achieve the objective of precision medicine', the researchers need to make sure that every person suffering from COPD, regardless of age or level of understanding, has uninterrupted access to the advanced therapies which will unobstructed these goals of precision medicine and thereby enable seamless, precise, and efficient management of COPD in the future.

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