

Cost-Effectiveness Analysis of Tiotropium + Olodaterol Fixed-Dose Combination for Patients with Moderate-to-Very Severe Chronic Obstructive Pulmonary Disease in China

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Abstract

Chronic Obstructive Pulmonary Disease (COPD) is a kind of chronic progressive respiratory disease with considerable effect on patients and society. The launch of tiotropium + olodaterol Fixed-Dose Combination (FDC) provides a new choice for patients with moderate-to-very severe COPD in China. The purpose of this study is to evaluate the cost-effectiveness of tiotropium + olodaterol FDC compared with tiotropium for the treatment of patients with moderate-to-very severe COPD from the perspective of the Chinese healthcare system. A Markov model was developed. The cycle length was 3 months. Patient characteristics and treatment effects from DYNAGITO and TOnado studies were entered into the model. The mortality rates from Chinese life tables were adjusted by hazard ratios. The time-to-treatment-discontinuation curve was first used to calculate the discontinuation rate of different therapies over a model cycle. Costs were obtained from official government documents and published cost-effectiveness analyses of the maintenance treatment of COPD in China. Uncertainty was assessed by one-way and probabilistic sensitivity analysis. The base case analysis reveals that tiotropium + olodaterol FDC was cost-effective, compared to tiotropium, with an incremental cost-effectiveness ratio of CNY108140.11 per quality-adjusted life year (QALY) gained. Results are robust in one-way and probabilistic sensitivity analyses. Tiotropium + olodaterol FDC is a cost-effective alternative compared to tiotropium for patients with moderate-to-very severe COPD in China under three times China's gross domestic product (GDP) per capita threshold.

Keywords: Chronic obstructive pulmonary disease; Tiotropium + olodaterol fixed-dose combination; Cost-effectiveness analysis; Discontinuation.

Introduction

The Global initiative for chronic Obstructive Lung Disease (GOLD) strategy report defines chronic obstructive pulmonary disease (COPD) as a common treatable disease, characterized by persistent airflow limitation that is due to airway and/or alveolar abnormalities [1,2]. The persistent airflow limitation and symptoms such as shortness of breath, cough, and expectoration are typical features of COPD. The economic burden of COPD is extensive for both the individual and society. In China, COPD was the third leading cause of death [3]. In 2015, 99.9 million Chinese adults aged 20 years or older have been diagnosed with COPD [3]. The direct medical cost of COPD even reached 3565 dollars, accounting for 118.09% of the local average annual income [4]. In addition, patients with COPD tend to report the quality of life reduced [5].

Inhaled bronchodilator treatment is the backbone of maintenance therapy for COPD [6]. The results of completed clinical trials suggested that long-acting muscarinic antagonists (LAMAs) and long-acting β_2 -agonists (LABAs) in combination could reduce the risk of exacerbation, delay the disease progression, ameliorate lung function and the symptom of dyspnea, and improve the quality of life [7-10]. Dual LAMA/LABA bronchodilator therapy is recommended for patients with severe dyspnea, airflow obstruction, and excessive inflation [2-11].

Tiotropium + olodaterol FDC is a once-daily fixed-dose dual bronchodilator that combines the LAMA tiotropium and the LABA olodaterol. This FDC has been approved for the maintenance treatment of COPD and entered the Chinese market in 2018. Tiotropium + olodaterol FDC reduced COPD exacerbation rates [12], significantly improved pulmonary function [13,14], and enhanced health-related quality of life [13]. The cost-effectiveness of tiotropium + olodaterol FDC is still unknown in China though the effectiveness and safety of that have been proven. Therefore, this study evaluated the cost-effectiveness of tiotropium + olodaterol FDC for patients with moderate-to-very severe COPD from the perspective of the Chinese healthcare system, aiming to explore whether it is worth getting tiotropium + olodaterol FDC into Chinese health insurance.

Materials and methods

Model design

It is necessary to build a prolonged model for COPD because of the chronic and progressive features of COPD. According to the China Guidelines for Pharmacoeconomic Evaluations 2020 [15] and published literature [16,17], a Markov model was constructed to assess the lifetime cost-effectiveness of the tiotropium + olodaterol FDC in Microsoft Excel 2016. The model schematic is shown in Figure 1.

The Markov states were classified according to the severity of airflow limitation. The rationale of the classification was according to GOLD (moderate: $50\% \leq FEV_1 < 80\%$ predicted; severe: $30\% \leq FEV_1 < 50\%$ predicted; very severe: $FEV_1 < 30\%$ predicted (FEV_1 : Forced Expiratory Volume in One Second)). The mild state was excluded from the model because moderate-to-very severe COPD is recommended to be treated with LABA/LAMA combination by GOLD and is the indication of LABA/LAMA combination treatment approved by the National Medical Products Administration [1,18]. Hence, only the states of moderate COPD, severe COPD, very severe COPD, and death were taken into account in the model. Meanwhile, COPD is considered irreversible [19], thus the patient in a severer state

could not go back to a milder one. That is to say, a patient may stay in the current state, progress to a severer state, or enter the state of death during each cycle. A patient could enter the model from one of the three states: moderate, severe, or very severe COPD. During each cycle, patients could experience an exacerbation or remain event-free which means no exacerbation. In other words, the exacerbation was a tunnel state, which did not affect a patient's health state. Mirror states were designed for all health states to represent the disease progression of individuals who stopped their medications. Then the patient could stay in the present state, progress into the next disease state, go into the corresponding discontinuation state or enter into the death state.

Adverse events were ignored in this study for the reason that there was no difference in the number of adverse events between the tiotropium group and the tiotropium + olodaterol FDC group in the DYNAGITO study (NCT02296138).

The analysis was conducted from a Chinese healthcare system perspective. Therefore, only direct medical costs were considered. According to the recommended intervals for follow-ups in GOLD 2023 and clinical practice in China, a model cycle length of 3 months was set which is also consistent with the DYNAGITO study. A lifetime horizon was set for the model [20-22].

Clinical inputs

Baseline characteristics

The baseline characteristics of the COPD patients were derived from the DYNAGITO study [12]. DYNAGITO study is a 52-week, randomized double-blind, phase III trial, which included Asian participants. The impact of tiotropium + olodaterol FDC 5 μ g/5 μ g and tiotropium 5 μ g on the annual rate of exacerbations for patients with moderate-to-very severe COPD was investigated in the DYNAGITO study. Eligible patients were diagnosed with COPD, with a smoking history of more than 10 pack-years and a postbronchodilator FEV_1 /forced vital capacity (FVC) less than 0.7, etc. The details are listed in Table 1. Accordingly, 35.62% of the patient population began in the moderate COPD state, 51.68% began in the severe COPD state, and the remaining 12.70% began in the very severe COPD state. The height and weight that were not collected in the DYNAGITO study were taken from the Report on Chinese Resident's Chronic Disease and Nutrition 2020 [23] and the fifth bulletin on national physical fitness monitoring [24].

Comparators

Tiotropium was chosen as a comparator for tiotropium + olodaterol FDC because it is one of the recommended first-line maintenance treatments for patients with moderate-to-very severe COPD and one of the most commonly used long-acting bronchodilators for treating COPD patients in China [1,25]. In addition, tiotropium has been used as a comparator in the published economic evaluation of LABA/LAMA FDC [21,26-28]. What's more, in DYNAGITO study and TOnado study, tiotropium was selected as a comparator [12,13]. TOnado study (Study 1237.5: NCT01431274; Study 1237.6: NCT01431287) investigated the efficacy and safety of tiotropium + olodaterol FDC compared with tiotropium or olodaterol in patients with moderate-to-very severe COPD.

Transition probabilities

The transition between each Markov state of the patient is based on the method described by Spencer et al [16]. In brief,

the inverse of patients' average time in each health state was estimated as transition probabilities. The calculation formula for duration average time was reported before, which will not be mentioned here [16].

Disease progression of COPD is dependent on the annual rate of decrease in FEV₁ and the initial FEV₁% prediction of patients. The formula of normal people in eastern China was reported [21]:

$$FEV_1 = 0.04283 \times Height - 0.0185 \times Age + 0.39424 \times Gender + 0.009228832 \times Weight - 4.04947$$

Notes: Height is measured in centimeters; Weight is measured in kilograms; Gender equals 1 for males and 0 for females

The decline rate of normal people was estimated at 18.5 ml/year according to the above formula, while that of COPD patients was estimated at 42 ml/year [29]. Once the treatment starts, the improvement of trough FEV₁ would be added to the baseline FEV₁. Patients will progress into the next states when the FEV₁ predicted reduces to the critical point of the next state. The improvement of trough FEV₁ was obtained from the TONado study, and the values were listed in Table 2.

COPD exacerbation

COPD exacerbations have a negative impact on health states, rates of hospitalization and re-admission, and disease progression, which makes COPD exacerbations non-negligible in the management of COPD. A COPD exacerbation is defined as an acute worsening event of respiratory symptoms that requires additional treatment [1,12]. An important goal in the treatment of COPD is to reduce the risk of exacerbation. The risk of exacerbations increases with the progression of disease symptoms and the deterioration of lung function.

According to GOLD 2023, COPD exacerbations are categorized as mild (treated with short-acting bronchodilators only), moderate (treated with short-acting bronchodilators plus antibiotics and/or oral corticosteroids), and severe (patients require hospitalization or emergency care). Mild exacerbation was ignored in this model due to its low incidence and minor influence on healthcare costs and health outcomes [30]. In accordance with the DYNAGITO study [12], a moderate exacerbation was defined as those leading to oral corticosteroids or antibiotics or both treatments and severe exacerbation was defined as those requiring hospitalization or an emergency room visit.

The incidence of moderate and severe exacerbation per cycle was calculated based on the rate of different exacerbation events during the year in the DYNAGITO study.

Discontinuation rate

Discontinuation rates were retrieved from the DYNAGITO study, by picking up points in the time-to-treatment-discontinuation curve in GetData Graph Digitizer [12]. Assuming patients receive medication guidance from clinical pharmacists every three months (a cycle) in every follow-up, the discontinuation rate will go back to the initial level after each follow-up. For the convenience of calculation, the mean discontinuation rate of the first 90 days was taken into calculation. Patients may discontinue their treatment due to poor efficacy and/or the occurrence of intolerable adverse reactions and/or poor adherence. No matter what reason for discontinuation, only the impact after discontinuation will be taken into account. The clinical im-

pact of drug discontinuation was reflected in the input of clinical efficacy parameters. Patients who discontinued therapy will no longer benefit from improvements in trough FEV₁ and thus had a higher probability of disease progression and a higher risk of exacerbation. Exacerbation rates after discontinuation were adjusted by the relative risk for tiotropium versus placebo (0.86, 95% CI: 0.81-0.91) in the UPLIFT study [29]. Patients who discontinued their treatment with inhaled medications were assumed to continue maintenance therapy.

Mortality

Death may be the result of severe exacerbation or a cause related to the severity of COPD. The mortality rate resulting from severe exacerbation was 1.24%, according to a multi-center, retrospective, observational study conducted in China [31]. The mortality related to the severity of COPD was calculated by age and sex all-cause mortality life table [32] and mortality risk ratios for different disease states, which were derived from previous studies [33]. To avoid double counting mortality due to severe exacerbations, the hazard ratio of 0.7 mentioned in the previous study was used to adjust for all-cause mortality [21].

Cost and utility inputs

Cost: From the perspective of the Chinese healthcare system, only direct medical costs are included. Therefore, only drug acquisition costs, maintenance costs stratified by COPD severity and exacerbation management costs were taken into account. Adverse management costs were ignored because of the non-significant difference between the two treatments in the DYNAGITO study.

The costs of tiotropium and tiotropium + olodaterol FDC were derived from the public resource trading platform of Jiangsu Province [34]. The costs of drug acquisition in a cycle were calculated by unit price and quantity. Maintenance costs which contained outpatient visits, spirometry, chest imaging examinations and influenza vaccinations were obtained from a previous expert survey [22]. Moderate exacerbation management costs included drug cost, test costs and outpatient visit costs. Severe exacerbation management costs included drug cost, test costs, nursing costs and inpatient ward costs. Exacerbation management costs were also obtained from the previous expert survey [22]. And all costs were inflated to 2021 CNY using the Chinese Consumer Price Index for Healthcare [35]. Both QALYs and costs were discounted at a rate of 5% in the base case analysis, according to the China Guidelines for Pharmacoeconomic Evaluations 2020 [15].

Utilities: The utility values for each Markov state were obtained from a Chinese health-related quality-of-life study published in 2015 [36]. The annual utility decrements were 0.010 and 0.042 for the moderate exacerbation state and severe exacerbation state [37].

Scenario and sensitivity analyses

As a lifetime horizon was performed in the base case analysis, lifetime costs and effects were discussed. In order to investigate the short-term cost-effectiveness of tiotropium + olodaterol FDC compared with tiotropium, a five-year time horizon scenario analysis performed.

A one-way sensitivity analysis (OWSA) was conducted to test the robustness of the base case results. In OWSA, only one specific parameter changes in a test. The OWSA results for each input were ranked from the most sensitive to the least sensi-

tive, and the tornado diagram showed the top ten parameters that had the greatest impact on the final result. The range of the improvements in FEV₁ was retrieved from the previous studies [13]. The upper and lower limits of exacerbation rate [12], the relative risk for Tiotropium versus placebo [29], and the hazard ratio of all-cause mortality rate [21] were retrieved from 95% confidence intervals of published literature. The discount rate varied between 0% and 8% per annum, according to the China Guidelines for Pharmacoeconomic Evaluations 2020 [15]. Other parameters fluctuated ±20% around the base case value in OWSA. The specific values of the parameters used in OWSA are shown in Table 2.

In addition, a Probabilistic Sensitivity Analysis (PSA) was conducted to estimate the uncertainty associated with costs and health outcomes. In the PSA, all parameters varied in ranges at the same time. 1000 times sampling and calculation were performed, and the results were presented in a scatter plot. In the scatter plot, each dot represented a result of once different input. The normal distribution is used for FEV₁ improvement and utility decrements [21]. Log-normal distribution was applied to the relative risk for tiotropium vs. placebo and hazard ratios. Beta distribution was used for exacerbation rate, discontinuation rate, mortality of severe exacerbation, and utility. Gamma distribution was applied for costs. The 1000-times Monte Carlo simulation was performed for PSA.

Model output

Model outputs include total costs, lifeyears, quality-adjusted life years (QALYs), and incremental cost-effectiveness ratios (ICERs). To calculate the cost-effectiveness of two different COPD maintenance treatments, ICER is calculated by dividing the incremental cost of the two intervention strategies by the incremental effectiveness. In this study, the willingness-to-pay (WTP) threshold is set to three times China’s (GDP) per capita in 2021 [15], i.e., CNY 242928 [35]. The tiotropium + olodaterol FDC can be considered a more cost-effective strategy for Chinese patients with moderate-to-very severe COPD compared with tiotropium when the ICER is lower than the WTP threshold.

Results

Base case analyses

Base-case analyses, using best estimates for each input variable, were performed first. As shown in Table 3, tiotropium + olodaterol FDC gains additional 0.0846 life-years and additional 0.0296 QALYs compared to tiotropium with extra CNY 3201.50 costs. As a result, the ICER is CNY 108140.11 per QALY gained, which is lower than the WTP threshold. This results in tiotropium + olodaterol FDC being a more cost-effective strategy.

Scenario and sensitivity analyses

In the scenario analysis (Table 3), tiotropium + olodaterol FDC gained extra 0.0397 lifeyears. Tiotropium + olodaterol FDC produced an incremental effectiveness of 0.0208 QALYs with an additional cost of CNY3463.69. As a result, the ICER of tiotropium + olodaterol FDC versus tiotropium was CNY166455.45 per QALY, which was still lower than the WTP. However, compared to base case analysis, it seems that COPD patients will benefit more from tiotropium + olodaterol FDC in the long run.

The results of the OWSA are shown in the tornado diagram in Figure 2. The parameters that have the greatest impact on the results are the cost of tiotropium + olodaterol FDC, the cost of tiotropium and the discontinuation rate. However, the result

of the OWSA is relatively stable. When the cost of tiotropium + olodaterol FDC is at its highest value, the of ICER is CNY235082, which is still lower than the WTP. What’s more, the ICER is negative when the cost of tiotropium + olodaterol FDC is at its lowest value, which indicates tiotropium + olodaterol FDC is a dominant alternative. In conclusion, tiotropium + olodaterol FDC is a more cost-effective strategy compared to tiotropium under the WTP threshold, though the parameters have varied within a set range.

The results of the PSA are shown in Figure 3. Tiotropium + olodaterol FDC results in an increase in QALYs versus tiotropium in all simulations, and tiotropium + olodaterol FDC is more cost-effective than tiotropium in 93.8% of simulations (Figure 4).

The cost-effectiveness acceptability curve (Figure 5) indicates that tiotropium + olodaterol FDC has a probability over 98% of being cost-effective when the WTP threshold is over CNY 300000.

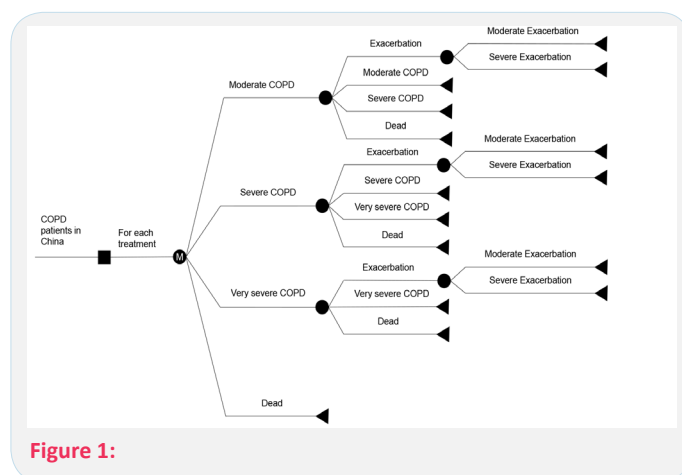


Figure 1:

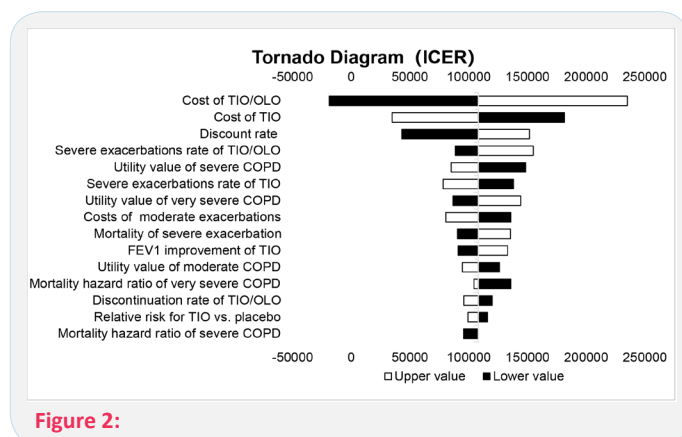


Figure 2:

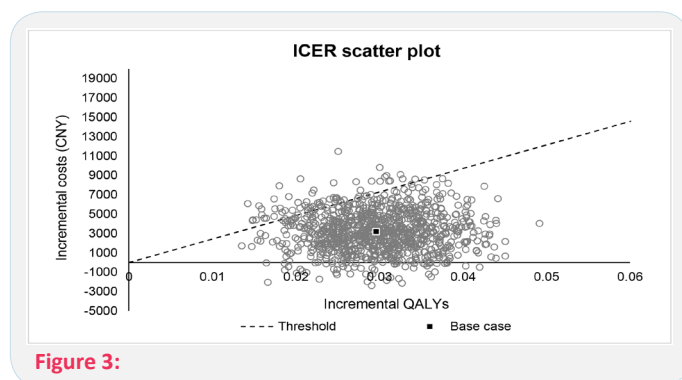


Figure 3:

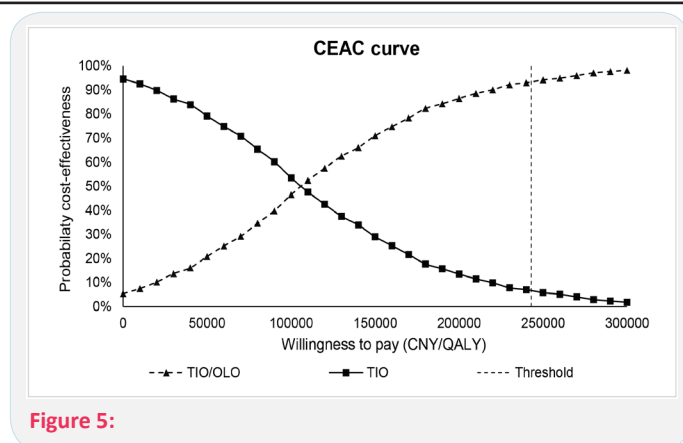
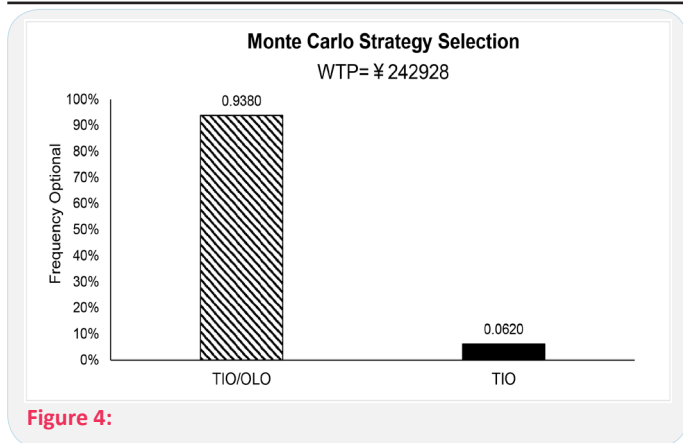


Table 1: Baseline characteristics of the target population.

Baseline characteristics	value	Reference
Age	66.5	¹²
Gender (male)	71.00%	¹²
Height (male, cm)	169.7	²³
Height (Female, cm)	158.0	²³
Weight (male, kg)	67.35	²⁴
Weight (female, kg)	59.23	²⁴
Initial distribution of disease state		
Moderate COPD	35.62%	¹²
Severe COPD	51.68%	¹²
Very severe COPD	12.70%	¹²

Abbreviations: cm: centimeter; kg: kilogram; COPD: Chronic Obstructive Pulmonary Disease; FDC: Fixed-Dose Combination; QALY: Quality-Adjusted Life-Year.

Table 3: Base case and Scenario analyses results.

	Base case analysis			Scenario analysis		
	TIO/OLO	TIO	difference	TIO/OLO	TIO	difference
LYs	18.7782	18.6936	0.0846	14.1567	14.1170	0.0397
Costs (CNY)	66065.55	62864.04	3201.50	58747.33	55.283.65	3463.69
QALYs	7.2995	7.2699	0.0296	6.5073	6.4865	0.0208
ICER, CNY/QALY	108140.11			166455.45		

Notes: All costs are presented in CNY (2021).

Abbreviations: TIO/OLO: Tiotropium + Olodaterol Fixed-Dose Combination; TIO: Tiotropium; Lys: Lifeyears; FDC: Fixed-Dose Combination; QALY: Quality-Adjusted Life-Year; ICER: Incremental Cost-Effectiveness Ratios.

Table 2: Model inputs for base-case and sensitivity analyses.

Parameters	Base-case value	OWSA value		Distribution	Source
		Lower limit	Upper limit		
Trough FEV₁ improvement					
TIO/OLO	0.1405	0.1360	0.1450	Normal	¹³
TIO	0.0805	0.0650	0.0950	Normal	¹³
Hazard ratio of all-cause mortality rate					
Moderate COPD	1.466	1.19	1.48	Log-normal	³³
Severe COPD	3.025	1.97	2.97	Log-normal	³³
Very severe COPD	5.256	2.75	5.76	Log-normal	³³
Exacerbations rate					
TIO/OLO					
Moderate	0.2364	0.2149	0.2538	Beta	¹²
Severe	0.0663	0.0602	0.0757	Beta	¹²
TIO					
Moderate	0.2599	0.2308	0.2792	Beta	¹²
Severe	0.0757	0.0694	0.0853	Beta	¹²
Relative Risk for Tiotropium vs. Placebo	0.86	0.81	0.91	Log-normal	²⁹
Mortality rate of severe exacerbation	0.0124	0.0112	0.0136	Beta	²⁹
Discontinuation rate					
TIO/OLO	0.0207	0.0167	0.0248	Beta	¹²
TIO	0.0740	0.0369	0.0553	Beta	¹²

Cost (per cycle)					
Drug acquisition					
TIO/OLO	2168.76	1735.01	2602.51	Gamma	38,39
TIO	1560.00	1248.00	1872.00	Gamma	38,39
Maintenance					
Moderate COPD	1547.87	1238.29	1857.44	Gamma	21
Severe COPD	2109.30	1687.44	2531.16	Gamma	21
Very severe COPD	3189.41	2551.53	3827.29	Gamma	21
Exacerbation management (per episode)					
Moderate exacerbation	2056.19	1644.95	2467.43	Gamma	21
Severe exacerbation	18875.20	15100.16	22650.24	Gamma	21
Utility					
Moderate COPD	0.734	0.587	0.881	Beta	36
Severe COPD	0.691	0.553	0.829	Beta	36
Very severe COPD	0.675	0.540	0.810	Beta	36
Moderate exacerbation	0.010	0.008	0.012	Normal	21,37
Severe exacerbation	0.042	0.034	0.050	Normal	21,37

Notes: All costs are presented in CNY (2021).

Abbreviations: OWSA: One-Way Sensitivity; FEV₁: Forced Expiratory Volume In One Second; TIO/OLO: Tiotropium + Olodaterol Fixed-Dose Combination; TIO: Tiotropium, COPD: Chronic Obstructive Pulmonary Disease; QALY: Quality-Adjusted Life-Year.

Discussion

This analysis is the first to investigate the cost-effectiveness of tiotropium + olodaterol FDC and tiotropium for Chinese patients with moderate-to-very severe COPD. The result revealed that tiotropium + olodaterol FDC was more cost-effective for patients with moderate-to-very severe COPD than tiotropium from the Chinese healthcare system perspective, which reduced the risk of exacerbation and improved the quality of life. Scenario analysis revealed that tiotropium + olodaterol FDC was still an economic alternative over five years, notwithstanding a higher ICER than that of base case analysis. In the OWSA, the costs of tiotropium + olodaterol FDC and tiotropium had the greatest impact on the results. The model used in this study was based on previously reported models [16,17] and adjusted based on the Chinese healthcare system. This study was conducted by the China Guidelines for Pharmacoeconomic Evaluations 2020. We first made use of the time-to-treatment-discontinuation curve to calculate the discontinuation rate over three months.

In the TONADO study, tiotropium + olodaterol FDC was shown to improve lung function and quality of life and reduce dyspnea compared with tiotropium [13]. The DYNAGITO study found that the tiotropium + olodaterol FDC reduced the annual rate of total exacerbations ($P < 0.05$) in comparison with tiotropium, and has no significant difference in safety [12].

In terms of pharmacoeconomic evaluation, Selya-Hammer et al [38] evaluated the cost-effectiveness of tiotropium + olodaterol FDC and tiotropium from the perspective of the Italian National Health Service and the result showed that tiotropium + olodaterol FDC was a more economical option compared to tiotropium. van Boven et al [26] conducted a cost-versus-effectiveness analysis of tiotropium + olodaterol FDC and tiotropium from the perspective of Dutch healthcare payers and the results similarly showed that tiotropium + olodaterol FDC was a cost-effective therapeutic regimen compared to tiotropium. All results are consistent with the results of this study.

Several economic evaluations of dual LAMA/LABA bronchodilators have been conducted in China [21,39]. However, the lack of head-to-head randomized clinical trials of available dual LAMA/LABA bronchodilators limits the cost-effective assessment of all available dual LAMA/LABA bronchodilators based on direct high-quality evidence. Further head-to-head randomized clinical trials need to be carried out.

This study also has limitations due to data and methodological deficiencies. Populations of different ethnic backgrounds may exhibit variability in response to tiotropium + olodaterol FDC. Though the clinical on which this study is based included 14.77% of Asians, individual data were not available for a subgroup of the Chinese population and the subgroup analysis was not performed. Therefore, the results may be inaccurate. However, according to a published study [40], tiotropium + olodaterol FDC is more effective in the Chinese population relative to the overall population, with similar safety. Therefore, it is reasonable to suppose that tiotropium + olodaterol FDC would be more cost-effective in the Chinese population. Similar to other cost-effectiveness analyses based on clinical trials, the results may be different in the real world because of the strict inclusion and exclusion criteria and process management of the clinical trial.

The control drug used in the DYNAGITO study was tiotropium bromide inhalation spray, therefore, tiotropium bromide inhalation spray was also used as the comparator in this analysis. There are two dosage forms of tiotropium inhalation formulations in China, one is tiotropium bromide inhalation spray (2.5 µg, 60 sprays, two sprays, QD) and the other is tiotropium bromide powder for inhalation (18 µg/capsule, one capsule, QD). Among them, a generic version of tiotropium bromide spray is not yet available in China and therefore tiotropium bromide inhalation spray has a higher price, while tiotropium bromide powder has been marketed in China in a variety of generics. It has been shown that the two different dosage forms of tiotro-

pium inhalation formulations are bioequivalent [41]. However, only the cost of tiotropium bromide inhalation spray was considered in the study because the market share of these two dosage forms in China was not available, and tiotropium bromide inhalation spray is used in randomized controlled trials [12,13].

Conclusion

To sum up, from the perspective of the Chinese healthcare system, tiotropium + olodaterol FDC could be considered as a cost-effective alternative of maintenance treatment for moderate-to-very severe COPD patients, when compared to tiotropium. This economic evaluation of tiotropium + olodaterol FDC may provide policy basis for health authorities.

Declarations

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Availability of data and material: All data generated or analyzed during this study are included in this published article.

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