

FACTORS ASSOCIATED WITH ADHERENCE OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE TREATMENT

Fajar Wira Perdana Kesuma¹, Andika Pradana², Pandiaman Pandia²

¹Department of Pulmonology and Respiratory Medicine, Faculty of Medicine, University of North Sumatera, Medan, Indonesia

²Asthma and COPD Division, Department of Pulmonology and Respiratory Medicine, Faculty of Medicine University of North Sumatera, Medan, Indonesia

ARTICLE INFO

Corresponding author :

Andika Pradana
Asthma and COPD Division,
Department of
Pulmonology and
Respiratory Medicine,
Faculty of Medicine
University of North
Sumatera, Medan,
Indonesia

Email:

andikapradana@usu.ac.id

Kata kunci:

Penyakit Paru Obstruktif
Kronis
Adherensi Pengobatan

Keywords:

Chronic Obstructive
Pulmonary Disease
Treatment Adherence

Original submission:

December 2, 2025;

Accepted:

March 26, 2026;

Published:

September 20, 2026

ABSTRAK

Penyakit Paru Obstruktif Kronis (PPOK) merupakan salah satu penyebab utama kematian dan disabilitas di dunia, dengan tingkat kepatuhan terhadap pengobatan yang masih rendah. Penelitian ini bertujuan menganalisis faktor-faktor yang berhubungan dengan adherensi pengobatan pasien PPOK di Poliklinik Paru RS Pendidikan Prof. Dr. Chairudin P. Lubis USU. Penelitian menggunakan desain cross-sectional pada pasien PPOK stabil yang berobat selama Januari–Mei 2025. Data karakteristik demografi, sosial ekonomi, klinis, dan adherensi dikumpulkan menggunakan kuesioner terstruktur dan MMAS-8, kemudian dianalisis menggunakan uji chi-square. Sebagian besar responden berusia >50 tahun (79,1%), laki-laki (76,9%), berpendidikan SMA/ sederajat (49,5%), dan memiliki status ekonomi tinggi (70,3%). Sebanyak 80,2% pasien memiliki kepatuhan pengobatan yang baik. Terdapat hubungan signifikan antara usia, pendidikan, status ekonomi, jarak ke fasilitas kesehatan, derajat obstruksi (GOLD), preferensi device inhaler, pengetahuan, kepuasan terhadap fasilitas kesehatan, dukungan keluarga, dan grup PPOK GOLD dengan adherensi pengobatan ($p < 0,05$). Adherensi pengobatan pada PPOK berhubungan dengan faktor demografi, sosial ekonomi, klinis, pengetahuan, preferensi inhaler, kepuasan layanan, dan dukungan keluarga.

ABSTRACT

Factors Associated with Adherence of Chronic Obstructive Pulmonary Disease Treatment. Chronic Obstructive Pulmonary Disease (COPD) is a leading cause of death and disability worldwide, with suboptimal treatment adherence. This study aimed to analyze factors associated with treatment adherence among COPD patients at the Lung Polyclinic of Prof. Dr. Chairudin P. Lubis Universitas Sumatera Utara Hospital. A cross-sectional study was conducted among patients with stable COPD treated between January and May 2025. Demographic, socioeconomic, clinical, and adherence data were collected using a structured questionnaire and the MMAS-8, and analyzed using the chi-square test. Most respondents were aged >50 years (79.1%), male (76.9%), high school graduates (49.5%), and had high economic status (70.3%). Good treatment adherence was observed in 80.2% of patients. Significant associations were found between adherence and age, education, economic status, distance to health facilities, degree of obstruction (GOLD), preferred inhaler device, knowledge, satisfaction with health facilities, family support, and COPD GOLD group ($p < 0.05$). COPD treatment adherence was associated with demographic, socioeconomic, clinical, knowledge, inhaler preference, healthcare satisfaction, and family support factors.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death worldwide, causing approximately 3 million deaths globally in 2019.¹ Data from the Global Burden of Disease 2019 study, which covered 204 countries and territories, identified 212.3 million global cases of COPD associated with 74.4 million disabilities and 3.3 million deaths.^{2,3}

Inhalation therapy is the cornerstone treatment for this chronic respiratory disease. Long-term adherence to inhaled therapy is essential for effective management. However, adherence rates in patients with COPD tend to be lower than those with other chronic diseases.⁴ Currently, adherence to treatment in COPD patients is just over 60%.⁵

Several factors influence patient adherence, including inadequate inhaler technique, patient perceptions, and beliefs.⁴ A major challenge in assessing adherence to COPD therapy and evaluating methodologies to improve the accuracy of a single assessment approach. A wide range of factors are associated with adherence to COPD therapy, including patient demographics; specific diseases and comorbidities; medication regimen, polypharmacy, satisfaction, and side effects; social and family support; cultural and socioeconomic factors; and health literacy levels.⁶ The aim of the current study was to identify factors associated with medication adherence in COPD patients.

METHODS

This research is an observational analytical study with a cross-sectional design conducted at Department of Pulmonology and Respiratory Medicine at Pulmonary Polyclinic of Prof. Dr. Chairudin P. Lubis Universitas Sumatera Utara Hospital from January to May 2025 after obtained permission from Research Ethics Committee of Faculty of Medicine, Universitas Sumatera Utara.

The research sample was stable COPD patients at Pulmonary Polyclinic of Prof. Dr. Chairudin P. Lubis Universitas Sumatera Utara Hospital who met the inclusion and exclusion criteria. The inclusion criteria were patients who received treatment using Social Security Administration Bodies health insurance, patients who had received treatment for at least 3 months, patients diagnosed with stable COPD, patients who were willing to be examined and filled out an informed consent form. Patients who experienced an exacerbation during hospitalization period, did not sign an informed consent or refused to be a research subject, or had incomplete data were excluded from this research. The diagnosis of stable COPD was made according to the latest GOLD guidelines. Sample collection used consecutive sampling, with a total of 91 patients.

The validity of the instrument (questionnaire) was tested by comparing the Corrected Item-Total Correlation value with the table r value of 0.361. The validity test used Pearson Product Moment, then tested using SPSS, examining the interpretation and correlation index. If the calculated r value is greater than the table r value, the data is considered valid, and vice versa.⁷

After measuring validity, it is necessary to measure data reliability. This reliability is measured using the Cronbach's Alpha formula. If the r value is greater than the table r value, the data is considered reliable. Questions are considered reliable if respondents' answers to the questions (questionnaires) are consistent or stable over time.^{8,9}

The data obtained are primary data, then will be analyzed and presented with statistical analysis using SPSS. Bivariate analysis was conducted to assess correlation between independent variables (Age, Gender, Education Level, Economic Status, Ethnicity, Distance to Health Facilities, Marital Status, Degree of Obstruction (Fev1) GOLD, Preferred Inhaler Device Type, Type of inhaler device ever used, Level of Satisfaction with Health Facilities, Patient Knowledge Level, COPD Group

based on GOLD 2024, Family Support) with dependent variables (COPD treatment adherence). Categorical data will be analyzed using the chi-square test.

RESULTS

The research results showed most of the patients were aged >50 years (79.1%), male (76.9%), high school graduates (49.5%), high economic status (70.3%), Javanese (35.2%) and all were married (100%).

Table 1. Patient Characteristics

Characteristics	n	%
Age (years old)		
<40	7	7,7
40-50	12	13,2
>50	72	79,1
Gender		
Male	70	76,9
Female	21	23,1
Education Level		
Elementary School	2	2,2
Junior High School	10	11,0
Senior High School	45	49,5
Bachelor	32	35,2
Higher Level	2	2,2
Economic Status		
Low	2	2,2
Moderate	25	27,5
High	64	70,3
Ethnicity		
Bataknese	30	33,0
Karo	24	26,4
Minangkabau	1	1,1
Javanese	32	35,2
Malay	4	4,4
Martial Status		
Married	91	100

Bivariate analysis with chi square test in this research found that age ($p=0.001$), education level ($p=0.001$), economic status ($p=0.001$), distance to health facilities ($p=0.001$), degree of COPD obstruction ($p=0.022$), preferred inhaler device type ($p=0.044$), patient knowledge level ($p=0.001$), level of satisfaction with health facilities ($p=0.001$), family support ($p=0.001$), and COPD Group based on GOLD 2024 ($p=0.001$) had a significant correlation with the level of treatment adherence in COPD patients at Pulmonary Polyclinic of Prof. Dr. Chairuddin. P. Lubis Universitas Sumatera Utara Hospital in 2024 ($p<0.05$).

Table 2. Correlation between Patient Characteristics and COPD Treatment Adherence

Characteristics	COPD Treatment Adherence						P value	RP (95%CI)
	Low		Good		Total			
	n	%	n	%	n	%		
Age (years old)								
<40	7	100,0	0	0	7	7,7	0,001	1,400
40-50	10	83,3	2	16,7	12	13,2		(0,444-
>50	1	1,4	71	98,6	72	79,1		4,441)
Gender								
Male	15	21,4	55	78,6	70	76,9	0,471	1,500
Female	3	14,3	18	85,7	21	23,1		(0,387- 5,817)
Education Level								
Elementary School	1	50,0	1	50,0	2	2,2	0,001	3,333
Junior High School	8	80,0	2	20,0	10	11,0		(0,817-
Senior High School	5	11,1	40	88,9	45	49,5		13,067)
Bachelor	4	12,5	28	87,5	32	35,2		
Higher Level	0	0	2	100,0	2	2,2		
Economic Status								
Low	1	50,0	1	50,0	2	2,2	0,001	0,821
Moderate	16	64,0	9	36,0	25	27,5		(0,619-
High	1	1,6	63	98,4	64	70,3		0,975)
Ethnicity								
Bataknese	4	13,3	26	86,7	30	33,0	0,231	1,600
Karo	4	16,7	20	83,3	24	26,4		(0,326-
Minangkabau	1	100,0	0	0	1	1,1		4,541)
Javanese	8	25,0	24	75,0	32	35,2		
Malay	1	25,0	3	75,0	4	4,4		
Distance to Health Facilities								
Near	8	11,6	61	88,4	69	75,8	0,001	1,550
Moderate	9	50,0	9	50,0	18	19,8		(0,345-
Far	1	25,0	3	75,0	4	4,4		5,654)
Marital Status								
Married	18	19,8	73	80,2	91	100,0	-	-
Degree of Obstruction								
A (Mild)	5	35,7	9	64,3	14	15,4	0,022	1,645
B (Moderate)	8	28,6	20	71,4	28	30,8		(0,332-
C (Severe)	3	17,6	14	82,4	17	18,7		6,766)
D (Very Severe)	1	3,1	30	96,9	31	35,2		
Preferred Inhaler Device Type								
Respimat	16	25,4	47	74,6	63	69,2	0,044	4,063
Breezhaler	2	7,1	26	92,9	28	30,8		(0,862- 19,153)
Type of inhaler device ever used								
All Types of Inhalers	18	19,8	73	80,2	91	100,0	-	-
Patient Knowledge Level								
Good	1	1,4	73	98,6	74	81,3	0,001	0,001
Low	17	100,0	0	0	17	18,7		(0,000- 0,015)

Table 2. Correlation between Patient Characteristics and COPD Treatment Adherence

Level of Satisfaction with Health Facilities								
Satisfied	8	9,9	73	90,1	81	89,0	0,001	0,012 (0,001-0,109)
Not Satisfied	10	100,0	0	0	10	11,0		
Family Support								
Yes	0	0	73	100,0	73	80,2	0,001	5,244 (0,664-8,332)
No	18	100,0	0	0	18	19,8		
COPD Group based on GOLD 2024								
A	9	75,0	3	25,0	12	13,2	0,001	3,223 (0,231-6,775)
B	9	33,3	18	66,7	27	29,7		
E	0	0	52	100,0	52	57,1		

DISCUSSION

Adherence to treatment tends to be stronger in older samples. This finding reflects the differences in managing chronic illness and emotional maturity.¹⁰ Therefore, older patients tend to have developed more effective coping strategies and have a better insight into the importance of adherence to treatment based on life experiences. These findings align with previous research, which found that older patients with chronic conditions often have higher levels of adherence.¹¹ In this study, treatment adherence among women was nearly the same as among men. For age groups, treatment adherence was higher in those aged >50 years. This is likely because those aged >50 years are considered elderly; therefore, COPD begins to interfere with productivity. This condition must be addressed immediately by sufferers. In this research, there was a significant correlation between age and treatment adherence in COPD patients ($p < 0.05$). Meanwhile, Gillisen stated that pediatric and adolescent patients tend to be less adherent than adults. In this research, the research population was adults, and it did not assess adherence in children.

Education level is often associated with medication behavior. A high level of education will indicate good medication behavior. These results indicate a difference in adherence by education level ($p < 0.05$). The results are in line with Apter et al.'s study, who reported a correlation between total years of formal education (<12 years) and medication adherence in COPD patients. Bauman et al. and Horne) stated that the higher the level of education, the higher the patient's adherence to treatment, especially for COPD patients. A higher level of education results in a better understanding of the patient's disease.¹¹ In addition, those with a high level of education tend to be quicker and more ready to make behavioral changes. Aspects of poor treatment adherence stem from forgetfulness and laziness in seeking care. These factors can be minimized if patients are aware and have a comprehensive understanding of the disease and its treatment.¹²

Horne stated that medication adherence is related to the income level of asthma patients. In this research, it was found that patients with high incomes had the highest medication adherence (80.8%), while those with medium and low incomes had the lowest adherence. Statistically, there was a difference in medication adherence based on income level. This is in line with Apter et al. study which found a significant correlation ($p = 0.002$) between income and medication adherence in COPD patients.¹³ This may be because not all COPD patients covered their medication costs. Some patients covered by civil servant health insurance, such as patients receiving treatment at Pirngadi Hospital in Medan.

Ethnic differences are often associated with differences in treatment adherence. In this research, treatment adherence was high among the Batakese patient and low among the Javanese patient.

Statistically, there was no correlation between ethnicity and treatment adherence. This is inconsistent with research by Wells et al., which reported a correlation between ethnicity and treatment adherence. Wells et al. found differences in Treatment Adherence Behavior and Its Relation to Quality of Life among Asthma Patients in Medan.¹⁴ Similarly, research by Apter et al. found a correlation between adherence in the Spanish group. This is likely due to the unequal ethnic variation in this correlation. In Indonesia, there are many ethnic groups, especially in Medan, a very heterogeneous city where the Batakese people dominate.

A correlation between patient knowledge level and treatment adherence was found in this study. Low knowledge and negative attitudes among patients regarding their disease, health priority factors in patients' lives, health beliefs, previous experiences, difficulties during consultations, understanding of the disease, and self-efficacy. Problems other than management, such as poorly understood doctors' instructions, dissatisfaction with health workers, not meeting expectations, lack of supervision from doctors and families, incorrect estimates of disease risk, cultural problems, incorrect stigmatization, forgetfulness, religious/belief problems, and sociodemographic factors. Treatment adherence begins with a proper understanding of the disease and its treatment. The treating physician is the most competent person to provide this understanding. Adherence is distinguished from compliance because adherence emphasizes the physician's strong role in supporting the patient, particularly by providing understanding of the disease and asthma treatment. Bauman et al. stated that among the causes of poor patient adherence to treatment are forgetfulness and laziness. This can be minimized if patients use reminders to take their medication, such as a mobile phone, a communication device that almost everyone owns.¹¹

A correlation between the preferred inhaler device type and COPD treatment adherence was found in this study. This result is thought to occur because of majority age group of 40-50 years which is elderly group commonly uses breezhalers. In a study comparing the peak inspiratory flow (PIF) achieved by patients with moderate to severe COPD who used Breezhaler, patients achieved inhalation with the lowest inspiratory effort and produced the highest average PIF readings compared to the other two inhalers; this results regardless of COPD severity, patient age, or gender.¹⁵ The internal resistance of Breezhaler device is lower than Diskus, Turbuhaler, and Handihaler, allowing greater flow rates to be achieved with less inspiratory effort, which may be beneficial for elderly patients and patients with moderate to severe respiratory disease who have difficulty generating the inspiratory flow required to achieve efficient drug delivery from a dry powder inhaler (DPI).¹⁶ Patients find low-resistance DPIs more acceptable than high-resistance devices. In elderly patients, regardless of whether they have COPD, there is a reduced ability to generate inspiratory flow with a DPI.¹⁷

Based on these research results, all patients had used four types of inhalers, namely respimat, turbuhaler, discuss, and breezhaler, with an adherence rate of 80.2. The study found no significant correlation between the type of inhaler device ever used and treatment adherence among patients with COPD. This is because the data obtained were constant data, the same data as marital status data. A large observational study involving 3811 primary care patients receiving inhaled medications either through a pressurized metered-dose inhaler (pMDI) or through one of four DPIs (Aerolizer, Automated breathing device, Diskus or Turbuhaler) found that the most common errors made by patients were independent to device used which included failure to exhale before activating the device and not holding the breath for a few seconds after inhaling. It was found that, 76% of patients made at least one error with a pMDI compared to 49–55% with a DPI. Critical errors (defined as errors that could significantly affect drug delivery to the lungs) were made by only 11–12% of patients treated with the Aerolizer, Automated Respirator, or Discus compared with 28% and 32% of patients treated with the pMDI and Turbuhaler, respectively. In the same study, critical errors

with DPI included blowing into the device before inhaling, failing to insert the capsule, and failing to press and release the two buttons (Aerolizer). It was concluded that, among other factors, improper use of the delivery device had a significant negative effect on COPD adherence.¹⁸

Correlation between the degree of COPD obstruction and treatment adherence in this research. Most respondents (50%) had a severe pulmonary obstruction (FEV1). The high number of severe obstruction cases indicates that patients were not identified in the early stages of the disease; most COPD patients do not seek treatment without moderate and severe degrees of clinical symptoms. Symptoms that arise in COPD sufferers with severe obstruction include more frequent exacerbations, shortness of breath grade 3-4 (shortness of breath occurs when walking 100 meters or after a few minutes, shortness of breath when bathing or dressing), FEV1/FVC ratio <70%, and values showing FEV1 between 30-50% of the predicted value. The results are in accordance with Firdausi's study results, conducted at RSUD Dr. Soedarso Pontianak, found that the most common degree of pulmonary obstruction (FEV1) of COPD patients was in the severe category (41.2%). Shamara and Fachri studied at the Jakarta Islamic Hospital, Sukapura, and also showed that the degree of pulmonary obstruction (FEV1) of COPD patients was mostly in the severe category (67.4%).¹⁹

A correlation between satisfaction with Healthcare Facilities and Treatment Adherence was also found in this research. Many factors contribute to patient adherence to treatment, including the quality of healthcare services. Compliance is driven by the correlation between patient satisfaction and dissatisfaction with perceived quality of healthcare services, which can influence patients' willingness to seek repeat treatment at the same institution.¹⁹ This is consistent with Ahmar's research, which found that the quality of inpatient pharmacy services, based on the tangible evidence dimension, was good (53.9%), with high compliance (65.8%), and a significance value of 0.019, indicating a correlation between tangible evidence and patient adherence.²⁰ Responsiveness and medication adherence were significantly related, with a low strength and a positive direction. This means that higher-quality responsiveness results in higher patient treatment adherence.²¹

Based on the research results, there is a significant correlation between the COPD group and treatment adherence in COPD patients. Patients in COPD group E have better adherence than those in COPD groups A and B. In COPD group E, clinical symptoms such as moderate persistent asthma, no dengue fever, controlled symptoms, and electrolyte malnutrition are present.¹¹

There is a significant correlation between distance to a health facility and treatment adherence among COPD patients. Researchers assume that the shorter the distance traveled to receive treatment, the better the treatment adherence. According to Prasetyo, although hospital infrastructure is good and treatment costs are covered by insurance, the difficult access to the hospital makes transportation costs high, even higher than the cost of treatment itself. Research by Kharisma also found that distance from home to the hospital shows a significant correlation with non-compliance with treatment ($p = 0.000.19$). Research by Primadiah shows the same, where patients with a distance of more than 5 km from home tend to experience default ($p = 0.001$).¹⁰ Research by Adriati also found a correlation between the distance from home to the hospital and treatment compliance ($p = 0.000$). Different results were obtained in Rian's research (2010) where there was no correlation between the distance from home to hospital and default occurrence.²²

The high proportion of patients with good adherence indicates that the use of various inhaler devices is not a major barrier to treatment adherence in patients with COPD. This may reflect the effectiveness of education provided by healthcare professionals regarding inhaler use, as well as the possibility of selecting a device that aligns with the patient's abilities and preferences. However, 19.8% of patients still have low adherence. This situation suggests the need for further evaluation of factors influencing low adherence, such as patient understanding of inhaler use, perceptions of

therapy benefits, and support from family or surroundings. Improving education, monitoring inhaler use, and individualizing approaches could be strategies to improve adherence in this group. Overall, these results emphasize the importance of education and selecting the right inhaler device in supporting successful COPD therapy. With the majority of patients demonstrating good adherence, hopefully disease control and quality of life for COPD patients will continue to improve.

CONCLUSION

Age, education level, economic status, distance to health facilities, degree of COPD obstruction, preferred inhaler device type, patient knowledge level, level of satisfaction with health facilities, family support, and COPD Group based on GOLD 2024 had a significant correlation with the level of treatment adherence in COPD patients at Pulmonary Polyclinic of Prof. Dr. Chairuddin. P. Lubis Universitas Sumatera Utara Hospital in 2024.

REFERENCES

1. Tamondong-Lachica DR, Skolnik N, Hurst JR, et al. GOLD 2023 update: implications for clinical practice. *Int J Chron Obstruct Pulmon Dis*. Published online 2023:745-754.
2. Parums D V. Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2023 guidelines for COPD, including COVID-19, climate change, and air pollution. *Med Sci Monit Int Med J Exp Clin Res*. 2023;29:e942672-1.
3. Safiri S, Carson-Chahhoud K, Noori M, et al. Burden of chronic obstructive pulmonary disease and its attributable risk factors in 204 countries and territories, 1990-2019: results from the Global Burden of Disease Study 2019. *bmj*. 2022;378.
4. Ma J, Sun X, Wang X, Liu B, Shi K. Factors affecting patient adherence to inhalation therapy: an application of SEIPS model 2.0. *Patient Prefer Adherence*. Published online 2023:531-545.
5. Moradkhani B, Mollazadeh S, Niloofar P, Bashiri A, Oghazian MB. Association between medication adherence and health-related quality of life in patients with chronic obstructive pulmonary disease. *J Pharm Heal care Sci*. 2021;7(1):40.
6. Ladner J, El Badrawy M, Nofal A, Saba J, Audureau E. A cohort study of medication adherence among patients with chronic obstructive pulmonary disease in Egypt. *NPJ Prim care Respir Med*. 2020;30(1):31.
7. Hidayat AA. *Menyusun Instrumen Penelitian & Uji Validitas-Reliabilitas*. Health Books Publishing; 2021.
8. Riwidikdo H. Statistik penelitian untuk kesehatan dengan aplikasi program R dan SPSS. *Yogyakarta: Pustaka Rihana*. Preprint posted online 2009.
9. Riyanto A. Aplikasi metodologi penelitian kesehatan. Published online 2022.
10. Yulisetyaningrum Y, Hidayah N, Yuliarti R. Hubungan Jarak Rumah Dengan Kepatuhan Minum Obat Pada Pasien Tbc Di Rsi Sunan Kudus. *J ilmu keperawatan dan kebidanan*. 2019;10(1):248-255.
11. Samodra G, Octaviani P. Hubungan Kepatuhan Minum Obat Dengan Kualitas Hidup Pada Pasien Geriatri Penyakit Paru Obstruktif Kronik (Ppok) Di Rsud Banyumas. *J Nurs Heal*. 2022;7(3):289-295.
12. Kirana SS, Ramdini DA, Sayoeti MFW, Pardilawati CY, Damayanti E. Faktor-Faktor yang Mempengaruhi Kepatuhan Pengobatan pada Pasien Penyakit Paru Obstruktif Kronik (PPOK) di Low and Middle Income Countries (LMICs): A Literature Review. *J Ris Kesehat Mod*.

2025;7(2).

13. Versita R, Yustisia N, Rachmawati S, Nengsih CF. The Relationship between Demographic Characteristics and Patient Compliance Undergoing Tuberculosis (Tbc) Treatment at the Bintuhan Health Center, Kaur Regency, Bengkulu Province. *ANJANI J (Medical Sci Healthc Stud.* 2021;1(2).
14. Oktaviyani H. Hubungan Perceived Benefits dan Perceived Barriers dengan Kepatuhan Minum Obat dan Kualitas Hidup pada Pra-Lansia Penderita Hipertensi di Wilayah Kerja Puskesmas Kalianget. *Universitas Wiraraja*. Preprint posted online 2026.
15. Yadav A, Subedi B. Factors Associated with Medication Adherence Among Chronic Obstructive Pulmonary Disease Patients. *J Adv Intern Med.* 2026;15(1):6-11.
16. Molimard M, Kottakis I, Jauernig J, Lederhilger S, Nikolaev I. Performance Characteristics of Breezhaler® and Aerolizer® in the Real-World Setting: M. Molimard et al. *Clin Drug Investig.* 2021;41(5):415-424.
17. Quinet P, Young CA, Heritier F. The use of dry powder inhaler devices by elderly patients suffering from chronic obstructive pulmonary disease. *Ann Phys Rehabil Med.* 2010;53(2):69-76.
18. Molimard M, Raherison C, Lignot S, Depont F, Abouelfath A, Moore N. Assessment of handling of inhaler devices in real life: an observational study in 3811 patients in primary care. *J aerosol Med.* 2003;16(3):249-254.
19. Mustofa S, Hasanah FA, Puteri FD, Surya SR, Soemarwoto RAS. Penurunan kesadaran disebabkan gagal nafas tipe ii pada pasien penyakit paru obstruktif kronis (ppok) eksaserbasi akut: laporan kasus. *J Ilmu Kedokt dan Kesehat.* 2023;10(6):2194-2203.
20. Ahmar SB, Ridwan BA. Hubungan Kualitas Pelayanan Apotek Rawat Inap Rs TKIV Dr R. Ismoyo Kendari Terhadap Tingkat Keputusan Pasien. *J Pharm Mandala Waluya.* 2022;1(4):174-187.
21. Fitriarahmah G, Peranginangin JM, Keswara YD. Hubungan Pelayanan Farmasi dengan Kepatuhan Pengobatan Pasien Penyakit Paru Obstruktif Kronik (PPOK). *MPI (Media Pharm Indones.* 2023;5(2):146-155.
22. Insel KC, Reminger SL, Hsiao CP. The negative association of independent personality and medication adherence. *J Aging Health.* 2006;18(3):407-418.