



IJPPR

INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals

ISSN 2349-7203




Human Journals

Research Article


May 2024 Vol.:30, Issue:5

© All rights are reserved by K. Nithyapriya et al.

Assessment of Medication Usage and Prescribing Trends in COPD Patients with Cardiovascular Disease



IJPPR
INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals



ISSN 2349-7203

K. Nithyapriya^{*1}, F. Lebor Frank², R. Jasmiya clives², B. Akash², R. Rajamurugan²

1-Department of pharmaceuticals, 2-Department of pharmacy practice

SSM College of pharmacy, Jambai, Erode. India.

Submitted: 22 April 2024
Accepted: 28 April 2024
Published: 30 May 2024



HUMAN JOURNALS

ijppr.humanjournals.com

Keywords: Chronic obstructive pulmonary disease, cardiovascular diseases, Corticosteroids, Essential drugs, Prescription pattern, Drug use evaluation

ABSTRACT

Background: Cardiovascular diseases are the leading cause of death in the world. Most common comorbidities related to cardiovascular diseases include COPD. In healthcare systems worldwide, the problem of improper and unreasonable prescription practices is a significant hurdle, especially in developing countries. **Aim:** Aim of this study is to analyze prescribing practices and drug utilization to enhance the management of clinical symptoms in patients with COPD and cardiovascular comorbidities. **Material and methods:** Study design: Retrospective study. Sample size: 270 patients were included in this study. Study duration: Period of six months starting from January to June 2023 Study place: Department of Pulmonology and cardiology in Sudha Institute of Medical science, Erode Statistical analysis: Mean median, mode and percentage **Results:** The study comprised 70.37% male participants, with 60.37% falling in the 61-75 age bracket. Among them, 63.33% were of normal weight, while 40.74% were smokers and 35.58% drank alcohol. A majority (67.4%) were hospitalized for less than a week. Of the participants, 53 had COPD with comorbid hypertension. The study involved 2401 drugs, with steroids being the most commonly used. The prevalent antibiotics were Amoxicillin + Clavulanic acid upon discharge and Piperacillin + Tazobactam during hospitalization. Around 66% of the prescribed drugs were part of the national essential drug list. **Conclusion:** The primary treatment strategy focused on administering a blend of corticosteroids and cardiovascular drugs to address the dual challenges of COPD and cardiovascular conditions. Moreover, a considerable number of patients were given various antibiotics both during their hospital stay and upon discharge. Remarkably, more than half of the prescribed medications adhered to the National List of Essential Medicines (NLEM).

INTRODUCTION:

Cardiovascular diseases are the leading cause of death in the world ⁵. Comorbidities related to cardiovascular diseases include diabetes mellitus, obesity, COPD, HTN, CAD, CVA, arrhythmia, OA, thyroid disease, hyperlipidemia, renal dysfunction and anemia. COPD poses significant challenges globally, causing a considerable impact on health and societal aspects with rising morbidity and mortality rates. It currently stands as the fourth major cause of death worldwide and is anticipated to rank third by the year 2020 in terms of mortality ⁴. In healthcare systems globally, the issue of inappropriate and irrational prescription practices stands out as a major challenge, particularly in developing nations ¹. Such practices not only adversely affect individual health but also have significant economic repercussions at both the personal and societal levels, resulting in resource wastage and widespread health risks ². Drug utilization research plays a crucial role in examining and understanding the impact of drugs within society, providing valuable insights for informed healthcare decisions based on socio-medical and health economic considerations. Despite the intricate nature of drug utilization, the World Health Organization (WHO) has developed, standardized, and assessed various indicators to address this complexity ³. A drug utilization study serves as a robust investigative tool for assessing the current landscape of drug usage and the appropriateness of prescriptions ⁶. It evaluates the safety and rationality of drug therapy, making a positive impact on prescribing physicians by enhancing their prescribing patterns. This study aids physicians in modifying treatment strategies as needed, enabling them to identify and make appropriate decisions for safe and cost-effective therapy ⁷. The main aim of this study is to analyze prescribing practices and drug utilization to enhance the management of clinical symptoms in patients with COPD and cardiovascular comorbidities, adhering to the guidelines outlined in the National List of Essential Medicines (NLEM), with the ultimate goal of improving quality of life.

OBJECTIVES:

- To ascertain the demographic attributes of patients.
- To evaluate the range of drug categories prescribed during hospitalization and discharge.
- To analyze antibiotic prescriptions during hospitalization and discharge.
- To calculate the percentage of prescribed medications listed in the National List of Essential Medicines (NLEM).

Methodology:

Study design: Retrospective study.

Sampling method and sample size: Simple random sampling and 270 patients were included in this study.

Study duration: Period of six months starting from January to June 2023

Study place: Department of Pulmonology and cardiology in Sudha Institute of Medical science, Erode.

Study criteria:

Both male and female patients diagnosed with chronic obstructive pulmonary disease (COPD) alongside cardiovascular comorbidities were eligible for inclusion in this study, provided they were between 25 and 80 years of age. However, pregnant and lactating women were excluded from participation.

Ethical consideration:

The study is approved by the Institutional Ethical Committee (IEC) for ethical approval.

Data collection:

Data for the research was collected from patient profiles and drug therapy plans using custom-designed forms. These forms included demographic details such as age, gender, height, weight, social background, as well as information on the planned drug therapy throughout the treatment process and upon discharge.

Statistical analysis:

Mean, median, mode and percentage

Results:

COPD often leads to chronic hypoxia (low oxygen levels) due to impaired lung function. Hypoxia can cause vasoconstriction in pulmonary arteries, leading to pulmonary hypertension. Chronic hypoxia also triggers a cascade of events that can affect the heart, such as increasing sympathetic nervous system activity and stimulating the release of vasoactive substances that impact blood pressure and heart function.

In this study, the data shows a predominance of male participants (70.37%) as depicted in Figure 1. Table 1 reveals that the majority (60.37%) of participants fall within the age range of 61-75 years. Additionally, Table 2 indicates that 63.33% of participants were classified as having normal weight.

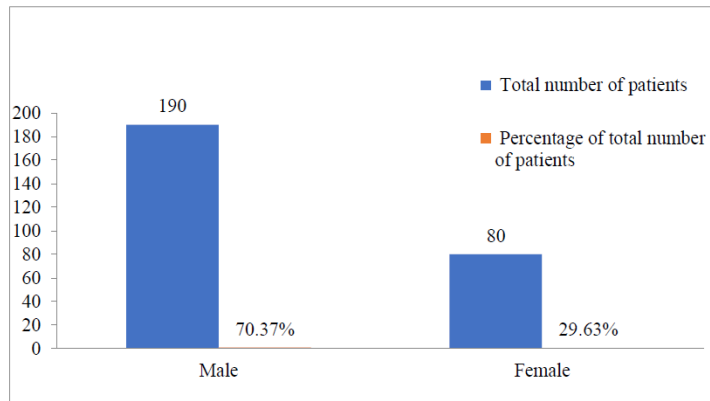


Figure 1: Gender wise distribution of patients

Table 1: Age wise distribution of patients

S.NO	Age category	Total Number of Patients	Percentage of total number of patients
1	61-75	163	60.37%
2	46-60	74	27.41%
3	76-90	25	9.26%
4	30-45	8	2.96%
	Total	270	100.00%

Table 2: Distribution of patients based on BMI

S.NO	BMI class	Total number of patients	Percentage
1	Normal weight (18.5-24.9)	171	63.33%
2	Over weight (25.0-29.9)	63	23.33%
3	Under weight(Below 18.5)	32	11.85%
4	Class I obesity (30-34.9)	4	1.48%
	Total	270	100.00%

Among the participants, 40.74% were smokers and 35.58% used alcohol, as shown in Table 3. Table 4 demonstrates that 67.4% of participants were hospitalized for treatment for less than 7 days. Regarding comorbidities, Table 5 shows that a larger number of patients (53)

had COPD with hypertension compared to only 4 patients having COPD with Angina and Asthma.

Table 3: Distribution of patients based on their smoking status

Patients	Non-smoking patients	Smoking patients	Smoking withdrawal	Non-alcoholic patients	Alcoholic patients	Alcoholic withdrawal patients
Total patients	116	110	44	157	96	17
Percentage	42.96%	40.74%	16.30%	58.15%	35.56%	6.30%

Table 4: Duration of hospital stay of study participants

Sl.No	Duration of hospital stay	No of patient	Percentage of patient
1.	<7 Days	182	67.4%
2.	7-10 Days	78	28.8%
3.	>10 Days	10	3.8%
	TOTAL	270	100%

Table 5: Distribution of patient based on their co-morbidity conditions

S.NO	Co-morbidities	No of patients with co-morbidities	Percentage of patients with co-morbidities
1	COPD + HTN	53	19.63%
2	COPD + Angina	37	13.71%
3	COPD + HTN + DM	35	12.96%
4	COPD + MI	26	9.63%
5	COPD + Angina + Asthma	13	4.81%
6	COPD + HTN + TB	10	3.70%
7	COPD + Angina + DM	9	3.33%
8	COPD + RV failure + HTN	8	96%
9	COPD + MI + Asthma	6	2.22%
10	COPD + Angina + HTN	5	1.85%
11	COPD + Angina + HTN + DM + Asthma	5	1.85%
12	COPD + HTN + DM + Corpulmonale + Kidney failure + respiratory failure	5	1.85%
13	COPD + HTN + Head trauma + DM	5	1.85%
14	COPD + HTN + DM+ TB	5	1.85%
15	COPD + Angina + Stroke	5	1.85%
16	HTN + Hyperlipidemia + Depression	5	1.85%
17	COPD + HTN + DM + Seizure disorder	5	1.85%
18	COPD + Angina + DM + Asthma	5	1.85%
19	COPD +RV failure	4	1.48%
20	COPD + HTN + DM + TB + Seizure	4	1.48%
21	COPD +MI + Osteoarthritis	4	1.48%
22	COPD +HTN + Acute pulmonary edema	4	1.48%
23	COPD + MI + HTN + DM	4	1.48%
24	COPD + HTN + Angina + Acute pulmonary edema	4	1.48%
25	COPD + Angina + Asthma	4	1.48%
	Total	270	100.00%

A total of 2401 drugs were utilized for treating patients with COPD and Co-Morbidities, as indicated in Table 6. Table 6 highlights that corticosteroids were the most commonly used drug (11.70%) among patients during hospitalization, while Antacids were the least commonly used (0.17%).

Table 6: List of common drug categories employed during treatment period

S.N O	Drug classification	No. of drugs for patients	Percentage of drugs for patients
1	Corticosteroids	281	11.70
2	Penicillin Antibiotics	196	8.16
3	Methylxanthines	151	6.29
4	Proton pump inhibitors	125	5.21
5	Diuretics	112	4.66
6	Anticholinergics	103	4.29
7	Corticosteroids + Beta 2 sympathomimetics	102	4.25
8	Beta 2 sympathomimetics	96	4.00
9	Beta 2 sympathomimetics + Anticholinergics	96	4.00
10	Calcium channel blockers	83	3.46
11	Antiplatelet	79	3.29
12	Analgesics & Antipyretics	78	3.25
13	Cephalosporin antibiotics	67	2.79
14	Vitamins	64	2.67
15	HMG CoA reductase inhibitors	50	2.08
16	Laxative	44	1.83
17	Macrolide antibiotics	39	1.62
18	Electrolyte	38	1.58
19	Biguanide	32	1.33
20	Methylxanthines + mucolytics	30	1.25
21	H2 blockers	29	1.21
22	Mucolytics	27	1.12
23	Antihistamine	26	1.08

24	Serotonin 5-HT3 receptor antagonists	25	1.04
25	Lincosamide antibiotic	25	1.04
26	Leukotriene receptor antagonists + Antihistamine	22	0.92
27	Beta blockers	21	0.87
28	Triazole Antifungals	18	0.75
29	Calcium + Vitamins	18	0.75
30	HMG CoA reductase inhibitors + Antiplatelet	17	0.71
31	Opioid analgesics	15	0.62
32	Antidepressant	15	0.62
33	ACE inhibitors	14	0.58
34	NSAIDs	13	0.54
35	Leukotriene receptor antagonists	13	0.54
36	Antitussive + Nasal decongestants + Antihistamines	13	0.54
37	D2 receptor antagonist	12	0.50
38	Opioid analgesics + Antihistamine	10	0.42
39	Protectants	10	0.42
40	Anticoagulants	10	0.42
41	Fatty acid oxidation inhibitors	10	0.42
42	Anticonvulsants	10	0.42
43	Selective serotonin reuptake inhibitors	10	0.42
44	Nitrates	9	0.37
45	Beta 2 sympathomimetics + mucolytics + Expectorants	8	0.33
46	Fluroquinolone antibiotic	8	0.33
47	Beta 2 sympathomimetics + Mucolytics	8	0.33
48	Antifibrinolytics	5	0.21
49	Proton pump inhibitors + Antiemetic	5	0.21
50	Alpha blockers	5	0.21
51	Alkalinizing agent	5	0.21
52	Iron exchange resins	5	0.21
53	Meglitinide	5	0.21

54	Iron replacement products	5	0.21
55	Laxative + Electrolytes	5	0.21
56	Anticonvulsants + Antidepressants + Vitamins	5	0.21
57	Anti-diarrheal	5	0.21
58	Dipeptidyl Peptidase-4 inhibitors	5	0.21
59	Sulfonylurea	5	0.21
60	Anthelmintics	5	0.21
61	Supplement	5	0.21
62	Nitroimidazole antibiotics	5	0.21
63	Rifamycin antibiotic	5	0.21
64	Sedative-hypnotics	5	0.21
65	Benzodiazepines	5	0.21
66	Angiotensin receptor blockers	5	0.21
67	Cephalosporin + Beta lactam antibiotics	4	0.17
68	leukotriene receptor antagonists + Antihistamine + Mucolytics	4	0.17
69	Angiotensin receptor blockers + Diuretics	4	0.17
70	Aminoglycoside Antibiotic	4	0.17
71	Tetracycline Antibiotic	4	0.17
72	Antacid	4	0.17
	Total	2401	100%

During hospitalization, Table 7 indicates that 29.55% of patients received the combination of piperacillin + Tazobactam antibiotics, whereas Table 8 shows that 31.23% received the combination of Amoxicillin + Clavulanic acid antibiotics upon discharge.

Table 7: List of antibiotics prescribed to the patients during treatment period

S.NO	Antibiotic drugs	No of patients	Percentage of patients
1	Piperacillin+ Taxobactam	99	29.55%
2	Amoxicillin + Clavulanic acid	80	23.88%
3	Clindamycin	25	7.46%
4	Ceftriaxone	22	6.57%
5	Cefoperazone+Sulbactam	22	6.57%
6	Azithromycin	18	5.37%
7	Clarithromycin	17	5.07%
8	Cefuroxime sodium	10	2.99%
9	Cefotaxime	8	2.39%
10	Cefixime	5	1.49%
11	Rifaximin	5	1.49%
12	Erythromycin	4	1.19%
13	Doxycycline	4	1.19%
14	Levofloxacin	4	1.19%
15	Moxifloxacin Hydrochloride	4	1.19%
16	Gentamicin	4	1.19%
17	Cefotaxime + Clavulanic acid	4	1.19%
	Total	335	100.00%

Table 8: List of antibiotics prescribed to the patients during discharge

S.NO	Antibiotic drugs	No of patients	Percentage of patients
1	Amoxicillin + Clavulanic acid	89	31.23%
2	Cefuroxime Sodium	74	25.96%
3	Amoxicillin	44	15.44%
4	Ciprofloxacin	35	12.28%
5	Clindamycin	18	6.32%
6	Levofloxacin	10	3.51%
7	Rifaximin	5	1.75%
8	Faropenem Sodium	5	1.75%
9	Piperacillin + Tazobactam	5	1.75%
	Total	285	100.00%

Furthermore, Table 9 reveals that 46.8% of patients received oral treatment during their hospital stay. Regarding medication categorization, Table 10 demonstrates that 66.76% of drugs used during hospitalization were essential, and a similar percentage (66.04%) of essential drugs was prescribed at discharge.

Table 9: Distribution of patients on the route of administration of drug during treatment period

S.NO	Route of administration	No. of patients	Percentage of patients
1	Oral	1125	46.8%
2	Intravenous	795	33.11%
3	Nasal	427	17.7%
4	Inhalation	39	1.67%
5	Rectal	10	0.44%
6	Transdermal	5	0.27%
	TOTAL	2401	100%

Table 10: Categorization of drugs based on NLEM during hospitalization and during discharge

Sl.NO	Types of drugs	During hospitalization		During discharge	
		Number of drugs	% of drugs	Number of drugs	% of drugs
1	Essential drugs	1603	66.76%	1118	66.04%
2	Non-Essential drugs	798	33.24%	575	33.96%
	Total	2401	100%	1693	100%

Discussion:

A significant proportion, specifically 60%, of patients diagnosed with COPD also had comorbid Cardiovascular Disease (CVD). COPD is characterized by chronic airway inflammation, which releases pro-inflammatory mediators systemically. These mediators can contribute to endothelial dysfunction, plaque formation, and thrombosis in blood vessels,

thereby increasing the risk of CVD. Inflammation also promotes atherosclerosis, narrowing blood vessels and reducing oxygen supply to tissues, exacerbating both COPD symptoms and cardiovascular complications⁸. Johnson et al. reported 2.44% COPD prevalence among rural women of Tamil Nadu⁹.

In our study, predominance of male participants aligns with existing research showing a higher prevalence of COPD in males, possibly due to differences in smoking habits and occupational exposures. Another study results suggested that Males were more commonly affected with CVS disease and COPD than female¹⁰⁻¹¹. In our study, age distribution with a majority in the 61-75 years range reflects the typical age profile of COPD patients, highlighting the disease's association with aging. Another study results also similar to our study those 61 – 70 years patients were more commonly affected with COPD and CVD¹¹⁻¹². Ageing is usually considered one of the most important risk factors for developing COPD, like other non-communicable diseases¹³.

The high percentage of normal-weight participants is noteworthy, as COPD is often associated with weight loss and malnutrition, suggesting potential variations in disease severity or management among different weight categories. Srikala et al. conducted a study in COPD patients concluded that 73.42% of patients were in the normal weight category¹⁴.

Smoking and Alcohol use habits were less common in patients with COPD and CVD patients. Srikala et al. conducted a study in COPD patients concluded that alcoholic habits were less and smoking habit were high among COPD patients¹⁴.

Smoking causes airway inflammation and structural damage, which subsequently causes COPD¹⁵. Roy reported that smokeless tobacco consumption was independently associated with COPD-related deaths among Indians¹⁶.

The relatively short hospitalization duration for most participants indicates either milder disease exacerbations or effective management strategies that allow for shorter hospital stays. Rangapriya et al. 2021, conducted a study in cardiovascular patients concluded that 54% of patients admitted for less than 7 days in hospital¹¹.

The usage of corticosteroids as the most common drug during hospitalization reflects their established role in managing COPD exacerbations, while the low usage of Antacids suggests a lesser focus on gastrointestinal complications during hospital treatment. Salwan P et al.

study concluded that corticosteroids (67.85%) were most prescribed class of drugs in the management of COPD ¹².

Corticosteroids can decrease airway edema (swelling) by reducing vascular permeability and inhibiting the migration of inflammatory cells into the airway tissues. This action helps alleviate airway narrowing and improves lung function. Corticosteroids have potent anti-inflammatory effects by inhibiting the production and release of pro-inflammatory cytokines (such as interleukins and tumor necrosis factor-alpha) and mediators involved in the inflammatory response. In COPD, chronic inflammation in the airways contributes to bronchial constriction, mucus production, and airway remodeling. Corticosteroids help reduce this inflammation, leading to improved airflow and symptom control ¹⁷.

The distribution of comorbidities, particularly COPD with hypertension, highlights the common occurrence of multiple chronic conditions in COPD patients, necessitating comprehensive management approaches. Veetil SK et al. 2014 study concluded that hypertension is most commonly noted co-morbid condition in COPD patients ¹⁸.

The use of specific antibiotic combinations during hospitalization and discharge indicates tailored treatment strategies, possibly guided by the presence of respiratory infections or exacerbations. In our study, 31.23% received the combination of Amoxicillin + Clavulanic acid antibiotics upon discharge. Another study conducted by srikala et al. concluded that an Amoxicillin + Clavulanic acid antibiotic was most commonly prescribed among COPD patients ¹⁴.

Our study concluded that 46.8% of the drugs were given in the oral route of administration. In contrast to result of our study, Jyothi et al. 2020 concluded that inhalation route (36.95%) was the most preferred route of drug administration in this study ¹⁰.

Overall, these findings contribute to understanding the clinical profile of COPD patients with CVD, emphasizing the need for personalized, multidisciplinary approaches to optimize outcomes and quality of life for these individuals.

Conclusion:

The study revealed that COPD and CVD, being intricate diseases often seen together, are linked with significant complications. The predominant treatment approach involved prescribing a combination of corticosteroids and cardiovascular medications to manage these

concurrent conditions. Additionally, a substantial portion of patients received multiple antibiotics both during their hospitalization and at discharge. Notably, over half of the prescribed drugs were in line with the National List of Essential Medicines (NLEM), indicating adherence to NLEM guidelines in treating COPD alongside cardiovascular complications.

Limitation:

The study did not evaluate potential drug-drug interactions within the patient's medication regimen. Additionally, because it was conducted at a single center with a limited sample size, the findings may vary from those derived from a larger, multicenter population study.

Further recommendation:

Our upcoming study aims to assess the likelihood of drug interactions within the therapeutic regimens administered to patients.

Conflict of interest: Nil

Acknowledgement: Nil

References:

1. Enato EFO, Madadi P, Souny AA. Assessment of disease profiles and drug prescribing patterns of healthcare facilities in Edo state, Nigeria. *J Public Health Africa*. 2012;e25:101–106.
2. Ghimire S, Nepal S, Bhandari S, et al. A prospective surveillance of drug prescribing and dispensing in a teaching hospital in western Nepal. *J Pak Med Assoc*. [Internet] 2009 [cited 2019 Jul 9];10:726-731. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/19813695>. [PubMed]
3. Ghei P. How to investigate drug use in health facilities. Selected drug use indicators. *Health Policy*. [Internet] 2004;1:73. Available from: <https://apps.who.int/iris/handle/10665/60519>.
4. Murray CJ, Lopez AD. Alternative projections of mortality and disability by cause 1990-2020: Global Burden of Disease Study. *Lancet*. 1997;349:1498–504.
5. Naliganti C, Valupadas C, Akkinapally RR, Eesam S. Evaluation of drug utilization in cardiovascular disease at a teaching and referral hospital in Northern Telangana. *Indian Journal of Pharmacology*. 2019; 51(5): 323-329.
6. Jyothi D, Kumar VS, Undrakonda A, Bhargavi N et.al. Assessment and Drug Utilization Pattern on Antiplatelet Agents in Cardiovascular Patients - A Prospective Study in Tertiary Care Hospital. *International Journal of Pharmacy and Pharmaceutical Research*. 2019; 14 (2): 109-119.
7. Fardan M, Manjari S, Periasamy S. Study of drug utilization in cardiovascular emergency at a rural teaching hospital in Tamilnadu, India. *International Journal of Basic & Clinical Pharmacology*. 2019; 8(7): 1587-1593.
8. Gupta, A.S., Rajesh, V. & James, P. Cardiovascular comorbidities associated with patients with chronic obstructive pulmonary disease – a hospital-based study. *Egypt J Bronchol* 13, 591–595 (2019). https://doi.org/10.4103/ejb.ejb_64_19
9. Johnson P, Balakrishnan K, Ramaswamy P, Ghosh S, Sadhasivam M, Abirami O, et al. Prevalence of chronic obstructive pulmonary disease in rural women of Tamilnadu: Implications for refining disease burden assessments attributable to household biomass combustion *Glob Health Action* 2011 4 7226

10. Jyothi DB, Prasad SV, Vangoori Y, Bharatha A. A Prospective Study on Prescription Pattern in Chronic Obstructive Pulmonary Disease. *Maedica (Bucur)*. 2020 Mar;15(1):37-44. doi: 10.26574/maedica.2020.15.1.37.
11. Rangapriya M, Kurian M, P.M N, Reji MK, Sinha N. A study on drug utilization pattern and cardiovascular disease prevalence in a tertiary care hospital. *International Journal of Pharmaceutical Sciences Review and Research*. 2021 May 15;68(1). doi:10.47583/ijpsrr.2021.v68i01.007
12. Salwan P, Singla J, Salwan S. Prescription pattern in the management of chronic obstructive pulmonary disease patients in a tertiary hospital: An observational study. *International Journal of Basic & Clinical Pharmacology*. 2020 Sept 22;9(10):1578. doi:10.18203/2319-2003.ijbcp20204100
13. Brandsma CA, de Vries M, Costa R, Woldhuis RR, Königshoff M, Timens W Lung ageing and COPD: Is there a role for ageing in abnormal tissue repair? *Eur Respir Rev* 2017 26 1 15.
14. Srikala T SL, V S, Babu K R, Eswaraiyah M C. Assessment of prescription pattern among COPD patients in departments of General Medicine Ward and pulmonology in tertiary care hospitals of Khammam Region. *International Journal of Research in Pharmaceutical Sciences*. 2020 Apr 14;11(2):1798–806. doi:10.26452/ijrps.v11i2.2083
15. Ghosh A, Boucher RC, Tarran R Airway hydration and COPD *Cell Mol Life Sci* 2015 72 3637 52.
16. Roy MP Socio-demographic factors of COPD mortality in India *Clin Epidemiol Glob Heal* 2020 doi:10.1016/j.cegh.2020.02.028
17. Tripathi K. *Essentials of Medical Pharmacology*. New Delhi: Jaypee; 2010.
18. Veettil SK, Rajiah K, Kumar S. Study of drug utilization pattern for acute exacerbation of chronic obstructive pulmonary disease in patients attending a government hospital in kerala, India. *J Family Med Prim Care*. 2014 Jul;3(3):250-4. doi: 10.4103/2249-4863.141622.