

## Prescribing Pattern and Cost Analysis of Corticosteroids and Bronchodilators in Pulmonology Department in a Tertiary Care Hospital

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### ABSTRACT

Bronchodilators and Corticosteroids are two common types of medications used to manage respiratory conditions, particularly Asthma and COPD. These medications are often used in combination to provide comprehensive care for respiratory conditions. The primary objective of our study was to evaluate the prescribing pattern of bronchodilators and corticosteroids among the inpatients. The study also focuses on analyzing the cost of the treatment provided. Across-sectional study was conducted among 300 patients in a tertiary care hospital in Bangalore. The study included adult and geriatric inpatients receiving corticosteroids, bronchodilators, or both as medications. The data were collected from patient case profile, prescription and Jan Aushadhi Sugam App and noted in a self-designed data collection form. SPSS and MS Excel applications were used to do statistical analysis on the acquired data. Among 300 patients, 21.3% were in the age group between 61-70 years of age. By 65%, male patients outnumbered female patients. COPD and asthma were the most common diagnosis. Out of 300 patients, 173 patients had comorbidities and the most common comorbidity was HTN (93), DM (41) and PTB (21). Most commonly used combination therapy was ipratropium bromide and levosalbutamol (219) and budesonide as monotherapy (228). Inhalational route (478) of

drug administration was the preferred route as compared to other routes. Cost analysis study revealed that mean average cost of generic drug (287.54) is much less than the mean average cost branded drugs (1011.75). This study provides adequate insights into the overall pattern of bronchodilators and corticosteroids used among various respiratory diseases. Patients must be provided with adequate information and knowledge in order to improve the medication adherence. Physicians should be encouraged to increase generic prescribing in order to minimize the financial burden on patients.

**KEYWORDS:-** Bronchodilators, Corticosteroids, prescribing pattern, Cost analysis and Branded drugs.

### I. INTRODUCTION

The term "Pulmonology" originates from the Latin language. In Latin, "pulmo" means "lungs," and "logos" means "study," therefore it is the study of lungs. Pulmonology is an Internal Medicine sub-specialty that focuses on the health of the respiratory tract. Especially, the health of the lower airway, lungs, and breathing control in, as well as their influence on the oxygen supply to the blood.<sup>1</sup>

## BRONCHODILATORS

A Bronchodilator is a type of medications that are used to relieve mainly the symptoms of Asthma, COPD, Emphysema and other lung conditions. They do this by relaxing the muscles and widening the airways. Bronchodilators additionally help in the removal of mucus from the airways. Mucus flows more freely as the airways expand, allowing you to cough it out of the body with less effort. Bronchodilators are mostly available as inhalers and nebulizer solutions.<sup>2</sup>

There are two forms of Bronchodilators:

**Short-acting Bronchodilators :** Short-acting bronchodilators are also called as “rescue inhalers” or “fast-acting inhalers” as they treat symptoms such as wheezing, shortness of breath, and chest tightness that come suddenly. They’re effective for 3-6 hours. Another term for a short-acting bronchodilator is a rescue inhaler. Short-acting bronchodilators begin to function within a few minutes. The therapeutic effects typically only last 4-5 hours, despite the fact that they operate quickly. People don’t need to use short-acting bronchodilators while they are symptom-free because they treat unexpected symptoms. Common short-acting bronchodilators include: albuterol, levalbuterol, pirbuterol etc.

**Long-acting Bronchodilators:** Long-acting bronchodilators are not as effective in relieving acute or abrupt symptoms as short-acting bronchodilators are. People take them regularly to avoid symptoms from developing as the effects can last up to 24 hours. Common long-acting bronchodilators include salmeterol, formoterol, tiotropium etc.<sup>3</sup>

## SIDE EFFECTS OF BRONCHODILATORS

Common side effects of beta-adrenergic bronchodilators include Ear infections (otitis media), Bronchitis, Cough, Allergic reactions (rash, hives, itching), Nervousness, Tremor. Possible serious side effects of  $\beta$ -adrenergic bronchodilators include: Bronchospasm (worsening of asthma), Serious allergic reactions (anaphylaxis), Low potassium and Abnormal heart rhythm (palpitations).

Common side effects of anticholinergic bronchodilators include: Dry mouth, Cough, Headache, Nausea, Dizziness. Possible serious side effects of anticholinergic bronchodilators include: Life-threatening bronchospasms, Serious allergic reactions involving the closure of the airways., Worsening symptoms of benign prostatic

hyperplasia and Worsening symptoms of narrow-angle glaucoma.

Common side effects of xanthines include:- Nausea, Vomiting, Diarrhea and Headaches. Other side effects of xanthine include: Diuresis, Restlessness, Tremor and Insomnia. Possible serious side effects of xanthine include: Seizures, Shock and Heart arrhythmias.<sup>4</sup>

## CORTICOSTEROIDS

Corticosteroids are drugs that mimic the hormone cortisone, which is synthesized by the adrenal glands in the body. The body requires cortisone to fight damage, infection, and other disorders. Corticosteroids have an anti-inflammatory effect and are used to treat a variety of inflammatory illnesses. For instance, they may be used to treat inflammation in the lungs (asthma and other lung disorders), the joints (arthritis), the skin (dermatitis), and the bowel (colitis). The most common lung ailment for which corticosteroids are prescribed is asthma, which is brought on by inflammation of the airways. They can occasionally be beneficial in treating chronic obstructive pulmonary disease (COPD), which includes emphysema and chronic bronchitis. Other lung illnesses including sarcoidosis and chronic inflammatory diseases like alveolitis (inflammation of the lung tissue itself) can be effectively treated with corticosteroids.

Corticosteroids taken by mouth are called oral corticosteroids such as Prednisolone, dexamethasone. Inhaled corticosteroids are preferred for COPD and asthma because they have fewer side effects and act directly on the airways, these include fluticasone, budesonide, beclomethasone, ciclesonide.<sup>5</sup>

Side effects from oral Corticosteroids may include: skin and muscle atrophy, mood or behavioral changes, osteoporosis, glaucoma and diabetes. Long-term use of oral corticosteroid is associated with: weight gain, facial swelling or puffiness (fluid retention) and depression.

## PRESCRIBING PATTERN

Prescription pattern monitoring studies are population-based drug utilization studies that are primarily concerned with the rational use of medications. The definition states that "patients receive medications relevant to their medical needs, in doses which satisfy their own specific needs, for a sufficient amount of time, and at a price that is affordable to them and their community. The WHO core indicators assist to improve patterns of

prescribing and, as a result, safer utilization of drugs in a healthcare setting. Periodic prescription audits can be used to test practitioners' rational prescribing skills.<sup>6</sup>

#### COST MINIMIZATION ANALYSIS

Cost Minimization Analysis (CMA) compares the costs of two or more alternatives without taking the outcome into account. When the outcomes of two or more therapies are nearly comparable, CMA looks for the least expensive choices. CMA involves evaluating drug costs in order to identify the least expensive medicine or treatment modality. A patient has access to various brands of the same medication as alternatives, with the same anticipated therapeutic result. The phenomena of "inter-brand price variation," which can place a heavy financial burden on patients and raise moral and ethical questions, can be identified through analysis of their costs.<sup>7</sup>

## II. MATERIALS AND METHODS

### SOURCES OF DATA AND MATERIALS

1. Patient case sheet.
2. Drug-drug interaction forms.
3. Adverse drug reaction forms.
4. Patient counseling forms.
5. Prescribing indicator form.

### METHOD OF COLLECTING DATA

This is a cross-sectional study in which patients who met the inclusion criteria were enrolled using a patient consent form. Every patient admitted to the ward was evaluated on a daily basis. Patients with known symptoms were interviewed and enrolled if they matched the research requirements, which included open-ended questions about their past medical history. Name, age, gender, education level, lifestyle, economic position, occupation, date of admission, reasons for admission, history of previous illness, and social history were collected from patients.

Vital signs (blood pressure, temperature, pulse rate, and respiratory rate), laboratory data (hematological tests, blood sugar tests, liver function tests, urine analysis, renal function tests such as serum creatinine, blood urea, and so on), final diagnosis, current treatment drug regimen, and other relevant data were also collected from

patient case sheets. The patient data collecting form will be filled out with the information stated above. Interviews with patients or those who are responsible for their care will be conducted to get demographic information. The outcomes of the data collection will be examined using descriptive inferential statistics, and frequencies, percentages, and mean values will be computed.

### STATISTICAL ANALYSIS

The data was collected and entered in Microsoft Excel software 2019 and interpreted by descriptive statistics that were presented to analyze and express the report as counts and percentages in the form of tables, charts, and graphs. The statistical analysis of the collected data was performed using IBM SPSS version 26 statistical software.

### ETHICAL CONSIDERATION

Confidentiality was maintained throughout the study with Written informed consent was obtained from all the participants. And There is no physical harm to the participants, as there is no intervention.

### ETHICAL CLEARANCE

The study was submitted for ethical clearance to the ethical committee of the Saphthagiri Institute of Medical Sciences and Research Center. This study was based on the analysis of approved surveillance data

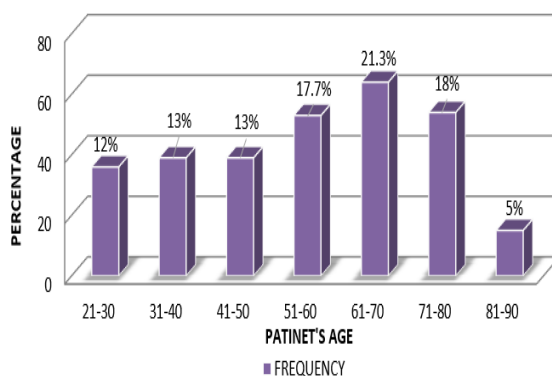
## III. RESULTS

### PATIENT AGE CATEGORIZATION

The data provided represents the age distribution of a group of 300 patients. The majority of patients fall into the age groups of 51-60 years and 61-70 years, with 17.7% and 21.3% of the total, respectively. The age groups 31-40 years and 41-50years each account for 13% of the patients, while the 71-80 years age group represents 18% of the total. Patients between 21-30years and 81-90 years old make up 12% and 5% of the total, respectively. In summary, the patient population is fairly evenly distributed across different age ranges, with the highest concentration in the 61-70 years age groups.

**Table 1:-** Category of Patients age.

PATIENT'S AGE	FREQUENCY	PERCENTAGE (%)
21-30	36	12.0
31-40	39	13.0
41-50	39	13.0
51-60	53	17.7
61-70	64	21.3
71-80	54	18.0
81-90	15	5.0
<b>Grand Total</b>	<b>300</b>	<b>100.0</b>



**Figure 1:-** Patient Age Distribution

**GENDER ENUMERATION**

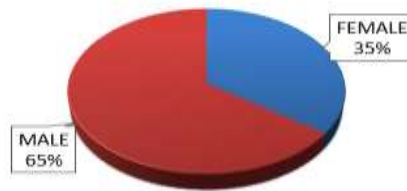
The data provided shows the gender distribution among a total of 301 individuals. Among them, 105 are female, and 196 are male.

This data indicates a higher representation of males in the group, accounting for approximately two-thirds of the total population, while females make up the remaining one-third.

**Table 2:-** Gender and Frequency of patients.

GENDER	FREQUENCY
FEMALE	104
MALE	196
<b>Grand Total</b>	<b>300</b>

### GENDER ENUMERATION



**Figure 2 :** Percentage of Gender enumeration

### FINAL DIAGNOSIS

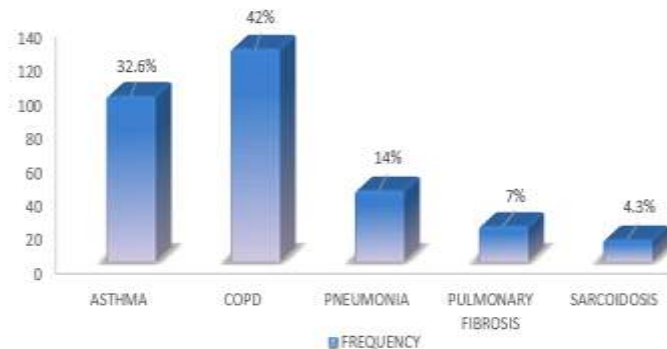
This data provided represents the distribution of diagnoses among a group of 300 patients. Among these patients, the most prevalent diagnosis is Chronic Obstructive Pulmonary Disease (COPD), which accounts for 42% of the cases. Asthma is the second most common diagnosis, with a frequency of 98 patients, representing 32.67% of the total. Pneumonia is

diagnosed in 14% of the patients, totaling 42 cases. Pulmonary Fibrosis is seen in 7% of the patients, with 21 cases, while Sarcoidosis is the least common diagnosis, at 4.33%, affecting 13 patients. In summary, COPD is the most frequent diagnosis, followed by asthma, with pneumonia, pulmonary fibrosis, and sarcoidosis being less prevalent among the patient group.

**Table 3 :-** Diagnosis and Frequency

DIAGNOSIS	FREQUENCY	PERCENTAGE %
ASTHMA	98	32.67
COPD	126	42.00
PNEUMONIA	42	14.00
PULMONARY FIBROSIS	21	7.00
SARCOIDOSIS	13	4.33
<b>Grand Total</b>	<b>300</b>	<b>100.00</b>

### FINAL DIAGNOSIS



**Figure 3 :** Final Diagnosis

### CO MORBIDITIES

This data provides insights into the comorbidities associated with a group of 173 patients based on their primary diagnoses. Hypertension (HTN) is the most prevalent comorbidity, affecting 93 patients, while Type 2 Diabetes Mellitus (T<sub>2</sub>DM) is the second most common, found in 41 patients. Pulmonary

Tuberculosis (PTB) is present in 21 patients, while Acute Gastroenteritis (ACUTE GE) and ischemic heart disease (IHD) have lower prevalence, each affecting 9 patients. This information underscores the varying degrees of comorbidity within the patient group, with hypertension being the most frequently observed comorbidity.

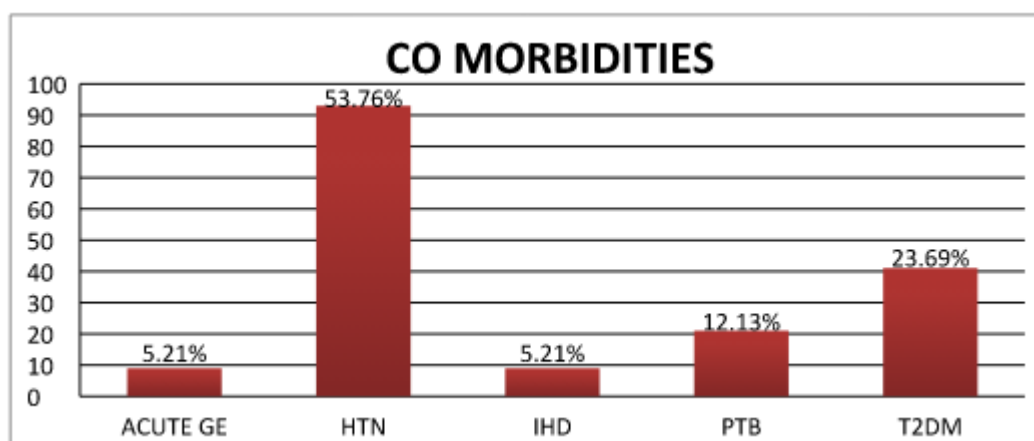


Figure 4 : Co morbidities associated with respiratory disorders.

### COMBINATION THERAPY

This data provides the utilization of various combined drug formulations within a group of 363 patients. Among these combinations, the most frequently prescribed is Ipratropium bromide + Levosalbutamol administered to 219 patients. Ambroxol + Levosalbutamol + Guaiphenesine is also commonly prescribed to 65 patients. Other combinations include Acebrophylline + Terbutaline

+ Guaiphenesin (29 patients), Guaiphenesin + Terbutaline + Bromhexin (25 patients), Budesonide + formoterol (13 patients), Etophylline + Theophylline (11 patients), and Fluticasone furoate + Formoterol (1 patient). This data highlights the varying usage of these combined drug formulations within the patient population, with Ipratropium bromide + Levosalbutamol being the most commonly administered combination.

Table 4 : Combination drug and count of drugs.

COMBINATION DRUGS	COUNT OF DRUGS	PERCENTAGE(%)
Acebrophylline+Terbutaline+Guaiphenesine	29	7.9
Ambroxol +Levosalbutamol+ Guaiphenesine	65	17.9
Budesonide + Formoterol	13	3.5
Etophylline+Theophylline	11	3
Fluticasone Furoate+ Formoterolfumarate	1	0.27
Guaifenesin+ Terbutaline+ Bromhexine	25	6.8
Ipratropium Bromide +Levosalbutamol	219	60.5
<b>Grand total</b>	<b>363</b>	<b>100</b>



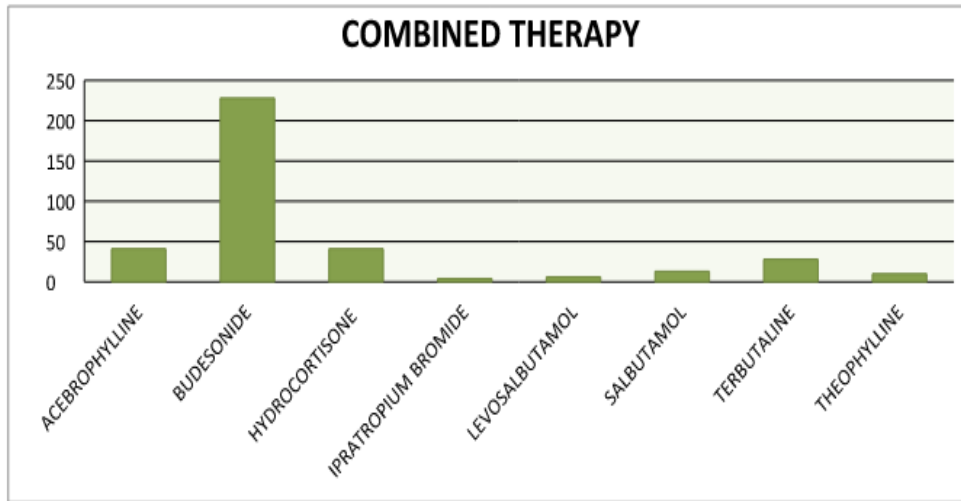


Figure 5 :- Combination drugs used in bronchodilators and corticosteroids.

#### MONOTHERAPY DRUGS

The data provided illustrates the frequency of different generic drug names prescribed to a total of 371 patients. Among these prescriptions, Budesonide is the most commonly administered drug, with 228 patients receiving it. Acebrophylline is given to 41 patients, as is Hydrocortisone. Ipratropium Bromide is prescribed to 4 patients,

while Levosalbutamol is used for 6 patients. Salbutamol is administered to 13 patients, Terbutaline to 28 patients, and Theophylline to 10 patients. This data highlights the varied utilization of these generic drug names within the patient population, with Budesonide being the most frequently prescribed.

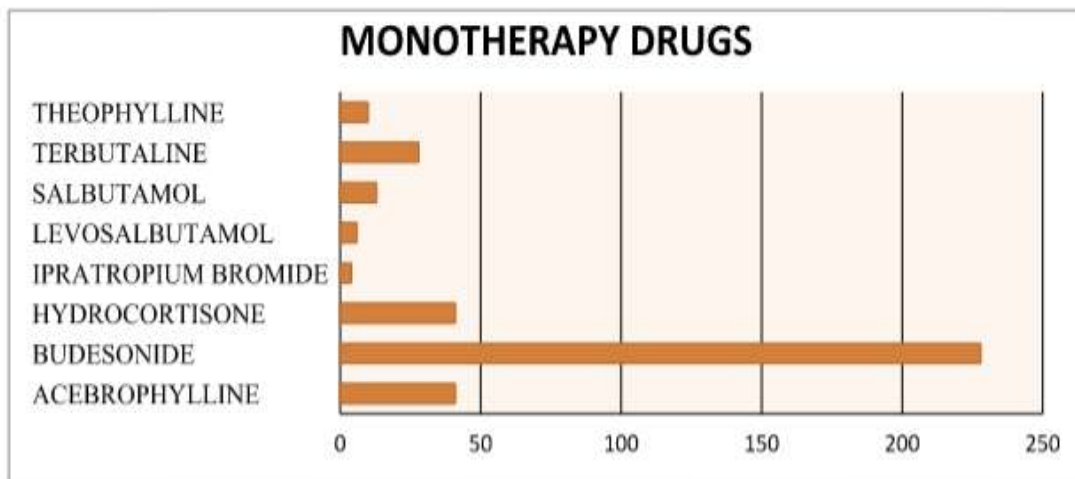


Figure 6 :- Monotherapy Drugs in the prescription pattern of bronchodilators and corticosteroids

#### COUNT OF CORTICOSTEROIDS

The data provided presents the count of corticosteroid drugs administered within a group totaling 268 individuals. Among these corticosteroids, Neb.Budecort is the most frequently prescribed, used by 228 patients.

Inj.H.Cort, on the other hand, is administered to 40 patients. This data demonstrates the distribution of corticosteroid usage within the patient group, with Neb.Budecort being the more commonly prescribed corticosteroid.

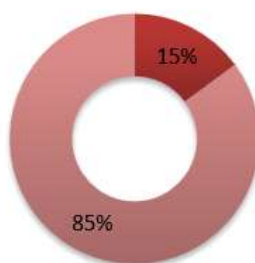
**Count of Corticosteroids**

**Table 5 :- Count of corticosteroids**

DRUGS	COUNT OF CORTICOSTEROIDS
INJ.H.CORT	40
NEB.BUDECORT	228
<b>Grand Total</b>	<b>268</b>

**CORTICOSTEROIDS**

■ INJ.H.CORT ■ NEB.BUDECORT



**Figure 7 :- Percentage count of corticosteroids.**

**COUNT OF BRONCHODILATORS**

The data provided outlines the usage of various brand names and their associated generic drugs in a total of 541 prescriptions. The most frequently prescribed bronchodilator drug is Neb.Duolin, which is administered to 219 patients. Syp.Ascoril Ls and Syp.Ascoril SF are also

commonly prescribed, with 65 and 25 patients receiving them, respectively. Other drugs, like Neb.Asthalin, Syp.Pulmoclear, and Tab.Abevia N, are given to 13, 29, and 55 patients, respectively. Various other brand-name and generic drug combinations are prescribed to different numbers of patients, reflecting the diversity of treatments within the patient group.

**Table 6 : Count of Bronchodilators.**

BRAND NAME	GENERIC NAME	COUNT OF DRUGS	PERCENTAGE (%)
Ih.Formoflo	Fluticasone Furoate+ Formoterol Fumarate	1	0.18
Inj.Salbutamol	Salbutamol	6	1.1
Neb.Asthalin	Levosalbutamol	13	2.4
Neb.Duolin	Ipratropium + Levosalbutamol	219	40.4
Neb.Foracort	Formoterol + Budesonide	13	2.4
Neb.Ipravent	Ipratropium Bromide	4	0.73
Syp.Ascoril	Terbutaline	28	5.17



Syp.Ascoril LS	Ambroxol+		12
	Levosalbutamol+	65	
	Guaphenesine		
Syp.Ascoril SF	Guaiifenesin +Terbutaline+	25	4.62
	Bromhexine		
Syp.Pulmoclear	Acebrophylline+		5.3
	Terbutaline+	29	
	Guaiifenesine		
Tab.Abevia N	Acebrophylline+		10.1
	Acetylcysteine	55	
Tab.Abevia SR	Acebrophylline	7	1.2
Tab.Abflo N	Acebrophylline +	2	0.36
	Acetylcysteine		
Tab.Abflo SR	Acebrophylline	3	0.55
Tab.Abphylline N	Acebrophylline +	9	1.6
	Acetylcysteine		
Tab.Abphylline SR	Acebrophylline	31	5.73
Tab.Deriphylline	Etophylline +Theophylline	11	2.03
Tab.Pulmoclear	Acebrophylline +	10	1.8
	Acetylcysteine		
Tab.Theophylline	Theophylline	10	1.8
<b>Grand Total</b>		<b>541</b>	<b>100</b>

**COUNT OF ROUTE OF ADMINISTRATION**

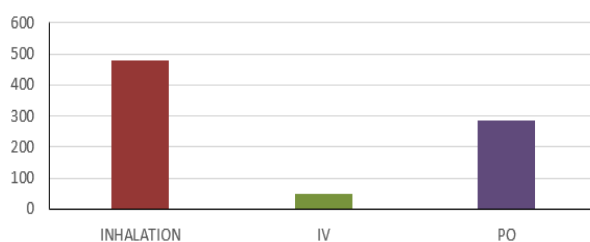
The data provided represents the routes of administration for medications among a total of 810 cases. Inhalation is the most common route, with 478 cases, indicating that a significant portion of patients receive medication through inhalation.

Intravenous (IV) administration is used in 47 cases, and oral (PO) administration is prevalent in 285 cases. This data illustrates the diverse methods of medication delivery within the patient group, with inhalation being the most frequently employed route.

**Table 7:** Count of administration.

ROUTES	Count of ROUTE
INHALATION	478
IV	47
PO	285
<b>Grand Total</b>	<b>810</b>

ROA



**Figure 8 :**Count of Route of administration .

#### COST MINIMIZATION ANALYSIS

##### Comparison of Generic Costs and Brand Costs.

The data provided give insight regarding the cost of both generic and branded medications per prescription. The average cost of generic drugs is around ₹287.54, while the average cost of branded drugs is approximately ₹1011.75.

##### Comparison of Cost of Bronchodilators and Corticosteroids.

The mean expense of prescribed corticosteroids is roughly ₹43.82, whereas the mean cost of bronchodilators is approximately ₹225.91. The total cost, including bronchodilators and corticosteroids, is approximately ₹351.77.

Bronchodilators and corticosteroids are key drugs in the treatment of pulmonary diseases. These drugs are effective as both long-term and short-term therapies. A short-acting bronchodilator (rescue inhaler) should be used first. Inhaled steroids, long-acting bronchodilators, and combination inhalers are regarded as maintenance medications, despite playing a significant role in the treatment strategy for asthma or chronic obstructive pulmonary disease (COPD). In other words, they are regularly used to avert acute symptom flare-ups and attacks rather than to cure them.

The study by Zainabath Sazm<sup>8</sup> revealed that the mean average age of people suffering from the condition was 61.4, with more male patients than female ones. Men outnumbered women in our study, which revealed that the majority of patients were between the ages of 61 and 70. The most frequent comorbidity in their analysis was HTN. The most prevalent co-morbid conditions among our study participants were hypertension and diabetes. In the study we conducted, COPD, as well as asthma and pneumonia, were the most frequent diagnosis. According to a study by DB Jyothi<sup>10</sup>, the inhalational mode of medicine delivery was shown to be the most favoured one. In our study, the majority of the patients favoured inhalation medicine delivery over oral and intravenous methods.

In the research done by Dr Usha DS<sup>9</sup>, the bronchodilator that was recommended the most commonly was levosalmolol (53.1%), followed by acebrophylline (30.8%). In our study, 219 individuals received the most Ipratropium bromide and Levosalbutamol prescriptions, while Budesonide was most commonly used corticosteroid as a monotherapy.

The highest cost difference was identified in the research conducted by Billu Payal<sup>10</sup> between respules budesonide high expensive branded generic and least costly branded generic drugs and generic versus high expensive branded generic. According to the findings of this study, moving from branded to generic anti-asthmatics and COPD treatments can result in possible cost savings for patients. In our study, it was discovered that the price of branded medications used to treat pulmonary disorders is significantly greater than the price of generic medications.

#### IV. CONCLUSION :

Rational use of drugs is a significant factor that must be addressed to maximize the benefit of drug therapy in patient care. A wide range of socio-cultural elements influence how medicines are utilised. The primary causes for failing to provide most effective health services are poor education, the use of multiple health care systems, drug advertising and promotion, the dispensing of prescription drugs without a prescription, competition in the healthcare and pharmaceutical companies, and a lack of drug information. Inappropriate drug use also results in higher healthcare costs, adverse effects, and patient mortality.

Our study was on the prescribing pattern and cost analysis of bronchodilators and corticosteroids in a tertiary care hospital. In our study, we found that majority of the patients were between the age group 61-70. Male patients dominated females. Hypertension and Diabetes mellitus were the most common comorbidity among the 300 patients. Majority of the patients were suffering with COPD, asthma and pneumonia. Combination of Ipratropium bromide and Levosalbutamol was most commonly used bronchodilator and budesonide was the commonly used corticosteroid.

When comparing the costs of bronchodilators and corticosteroids, it was discovered that the use of generic medications would have a lower financial burden on patients than the use of branded drugs with the same effectiveness.

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