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Original Article

Drug Utilization and Evaluation of Proton Pump Inhibitors at Tertiary Care Hospital of Southern Rajasthan

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ABSTRACT

Introduction: Proton Pump Inhibitors (PPIs) are among the most frequently prescribed drugs for the management and prevention of acid-related gastrointestinal disorders. Although PPIs are effective and well tolerated, their widespread and often empirical use has raised concerns regarding inappropriate prescribing, prolonged therapy, polypharmacy, and potential adverse effects. Drug utilization studies play a crucial role in evaluating prescribing trends and promoting rational use of PPIs in hospital settings. **Materials and Methods:** A prospective observational study was conducted over six months in the Department of General Medicine of a tertiary care teaching hospital. A total of 170 adult inpatients aged 18-60 years who were prescribed proton pump inhibitors were included. Data on socio-demographic characteristics, prescribing patterns, dosing frequency, number of drugs per prescription, and concomitant medications were collected using a structured data collection form. Utilization of PPIs was assessed using World Health Organization prescribing indicators and the Anatomical Therapeutic Chemical/ Defined Daily Dose (ATC/DDD) methodology, expressed as defined daily dose per 100 bed-days (DDD/100 bed-days). Descriptive statistical methods were applied for data analysis. **Results:** Most patients belonged to the 47-60 years age group, with a predominance of male patients. Pantoprazole was the most frequently prescribed proton pump inhibitor, followed by rabeprazole. Once-daily dosing was commonly observed. Polypharmacy was prevalent, with the majority of patients receiving six or more medications during hospitalization. Antibiotics, antiemetics, and non-steroidal anti-inflammatory drugs were the most commonly co-prescribed drug classes. Utilization analysis revealed higher DDD/100 bed-days for pantoprazole compared to other PPIs. **Conclusion:** The study demonstrates extensive use of proton pump inhibitors among hospitalized patients, with frequent polypharmacy and concurrent drug use. Regular prescription audits and adherence to evidence-based guidelines are essential to ensure rational PPI use and improve patient safety.

Keywords: Define Daily Dose (DDD), Drug utilization study, Polypharmacy, Proton-Pump Inhibitors (PPIs), Rational drug use, Zollinger-Ellison Syndrome (ZES).

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INTRODUCTION

Proton-Pump Inhibitors (PPIs) are a class of medications that cause a profound and prolonged reduction of stomach acid production. PPIs are the most potent inhibitors of acid secretion (Patil *et al.*, 2015). proton pump inhibitors are one of the most prescribed categories of drugs that causes pronounced and long-lasting suppression of gastric acid production by inhibiting the hydrogen potassium adenosine triphosphate enzyme (H+/K+ ATPase) system. In the past few decades, PPIs have eclipsed Histamine type-2 Receptor Antagonist (H_2RA) as the most prescribed agents (Asl *et al.*, 2020). PPIs work by irreversibly blocking an enzyme called H+/K+ ATPase which controls acid production. H+/k+ ATPase enzyme is also known as the proton pump and is found in the parietal cells of the stomach wall. PPIs treat conditions that are caused by either an overproduction of stomach acid or exacerbated by stomach acid (HCL) (Liu *et al.*, 2020).

Recommend indications for prescribing PPIs on the management of Gastro-Esophageal Reflux Disease (GERD) and upper gastrointestinal bleeding (including varices), in the management of Barrett's Oesophagus, Zollinger-Ellison Syndrome (ZES), ulcer healing, Helicobacter pylori eradication, prophylaxis of Peptic Ulcer Disease (PUD) for patients taking Non-steroidal Anti-inflammatory Drugs (NSAIDs) / aspirin/steroid, prophylaxis for patients taking anticoagulants, second-line agent for non-ulcer dyspepsia (i.e., dyspeptic symptoms with normal

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endoscopic findings) and prophylaxis of stress ulcers. Six types of PPIs are approved by the Food and Drug Administration (FDA) (Torres-Bondia *et al.*, 2022). Current guidelines recommend empiric therapy with proton pump inhibitors for patients suspected of having gastrointestinal related disorders. WHO[5] PPIs are generally safe especially when they are used for short term purposes, but recent literature shows an adverse sequelae of long term PPI use including osteoporosis with increased risk of bone fractures, clostridium difficile associated diarrhoea, community - acquired pneumonia, hypomagnesemia, iron deficiency, vitamin B12deficiency, acute interstitial nephritis, hypergastrinemia, and chronic atrophic gastritis (Forgacs *et al.*, 2008). PPIs are routinely prescribed for the prevention of gastrointestinal bleeding in patients receiving Dual Antiplatelet Therapy (DAPT) (Aspirin and Clopidogrel) after myocardial infarction or percutaneous coronary interventions and stenting (Heidelbaugh *et al.*, 2012). According to The World Health Organization (WHO) defines Drug Utilization Research (DUR) as "the marketing, distribution, prescription and use of drugs in a society, with special emphasis on the resulting medical, social and economic consequences" (Florentin *et al.*, 2008). Especially in the community medicine setting, Drug utilization review plays a key role for pharmacist (WHO, 2003). In addition, The World Health Organization (WHO) regards drug utilization as 4 phases of drugs in society. These four phases are marketing, distribution, prescription and usage (Sudhakar *et al.*, 2016). Define daily dose are assigned for medicine given at ATC code. The DDDs are allocated to the drug by WHO collaborating centre in also, working in association with The WHO international working group on drug statics methodology (Nousheen *et al.*, 2014). The ATC code of PPIs (A02BC), The ATC code of omeprazole (A02BC01), Pantoprazole (A02BC02), Lansoprazole (A02BC03), Rabeprazole (A02BC04), Esomeprazole (A02BC05), Dexlansoprazole (A02BC06). York guidelines (Marita D'Souza, *et al.*, 2026).

MATERIALS AND METHODS

Study design and duration

A prospective observational study was conducted over a period of six months.

Study site

The study was carried out in the Department of General Medicine, Geetanjali Medical College and Hospital, Udaipur.

Sample size

A total of 170 adult inpatients prescribed proton pump inhibitors were included in the study.

Study Inclusion criteria

- Adult inpatients aged 18-60 years,
- Patients prescribed any proton pump inhibitor,
- Patients admitted under the Department of General Medicine.

Study Exclusion criteria

- Patients from departments other than General Medicine,
- Outpatients and follow-up cases,
- Patients below 18 years or above 60 years,
- Pregnant, lactating, or breastfeeding women.

Ethical approval

Ethical approval was obtained from the Institutional Ethics Committee of Geetanjali University (Ref No: GUHREC/EC/2022/2036). Written informed consent was obtained from all participants.

Data collection

Data were collected using a pre-designed patient proforma, which included socio-demographic details, clinical history, current medication details, number of drugs prescribed, dosing frequency, and concurrent medications.

Drug utilization analysis

Prescribing patterns were evaluated using WHO prescribing indicators. PPI utilization was quantified using the ATC/DDD system, expressed as DDD per 100 bed-days.

Statistical analysis

Descriptive statistics such as frequency and percentage were used to summarize data.

RESULTS

Age wise distribution of patients on proton pump inhibitors

In Table 1, age-wise distribution showed that 100 patients belonged to the 47-60 years age group, followed by 44 patients in the 33-46 years age group. The 18-32 years age group included 26 patients.

Socio-Demographic Details of Patient

In Table 2, socio-demographic characteristics showed that 119 patients were male and 51 patients were female. Most patients were married (*n*=158), while 12 patients were unmarried. With respect to residence, 146 patients belonged to rural areas and 24 patients were from urban areas.

Distribution of patients according to their education

In Table 3, educational status showed that 66 patients had education up to the 5th standard, followed by 43 patients educated up to the 6th-10th standard. Education up to the 11th-12th standard was reported by 17 patients. A smaller proportion of patients

were graduates (*n*=9) and postgraduates (*n*=2), while 34 patients were illiterate.

Distribution of patients according to their occupation

In Table 4, occupational status showed that the majority of patients were farmers (*n*=80), followed by patients engaged in private jobs (*n*=36) and housewives (*n*=26). Patients without occupation accounted for 19 cases, while drivers comprised 9 patients.

Distribution of patients according to their social habits

In Table 5, social habits showed that 34 patients reported alcohol consumption, while 136 patients reported no alcohol use. Smoking was reported by 68 patients, whereas 102 patients were non-smokers.

Anatomical Therapeutic Classification Code and Daily Defined Dose of Proton Pump Inhibitors

In Table 6, Utilization of proton pump inhibitors was assessed using the defined daily dose per 100 bed-days (DDD/100 bed-days) methodology. Pantoprazole (ATC code: A02BC02) demonstrated a DDD/100 bed-days of 50.83 for oral formulation and 99 for parenteral formulation, with a WHO-assigned DDD value of 40 mg. Rabeprazole (ATC code: A02BC04) showed a DDD/100 bed-days of 64.44 for oral formulation and 45.55 for parenteral formulation, with a WHO-assigned DDD value of 20 mg.

Distribution of PPIs frequency administration

In Table 7, dosing frequency showed that once-daily administration was prescribed in 128 patients, while 42 patients received twice-daily dosing.

Total number of drugs prescribed per patient (polypharmacy)

In Table 8, total number of drugs prescribed showed that 86 patients received 6-8 drugs, followed by 30 patients receiving

Table 1: Age-wise distribution.

Sl. No.	Age Group (Years)	No. of patients (*n*=170)	Percentage (%)
1.	18-32	26	15.3
2.	33-46	44	25.9
3.	47-60	100	58.8

Table 2: Socio-demographic characteristics.

Sl. No.	Study Parameter	Number of patients	Percentage (%)
1.	Gender		
	Male	119	70
	Female	51	30
2.	Marital status		
	Married	158	92.9
	Unmarried	12	7.1
3.	Residence		
	Rural	146	85.9
	Urban	24	14.1

Table 3: Educational status.

Sl. No.	Educational Status	Number of Patients (*n*=170)	Percentage (%)
1.	Illiterate	34	20
2.	Up to 5th standard	66	39
3.	6th-10th standard	42	25
4.	11th-12th standard	17	10
5.	Graduate	9	5
6.	Postgraduate	2	1

Table 4: Occupational status.

Sl. No.	Occupation	Number of Patients (*n*=170)	Percentage (%)
1.	Farmer	80	47
2.	Private Job	36	21
3.	Housewife	26	15
4.	None	19	12
5.	Driver	9	5

Table 5: Social habits.

Sl. No.	Social Habits	Number of Patients (*n*=170)	Percentage (%)
1.	Alcohol Use		
	Yes	34	20
	No	136	80
2.	Smoking Status		
	Smoker	68	40
	Non-Smoker	102	60

Table 6: Anatomical Therapeutic Classification Code and Daily Defined Dose of Proton Pump Inhibitors.

Sl. No.	Drug Name	ATC code	WHO DDD Value (mg)	DDD/100 Bed/Day
1.	Pantoprazole (Oral)	A02BC02	40	50.83
2.	Pantoprazole (Parenteral)	A02BC02	40	99
3.	Rabeprazole (Oral)	A02BC04	20	64.44
4.	Rabeprazole (Parenteral)	A02BC04	20	45.55

Table 7: Frequency of PPI administration.

Sl. No.	Frequency	Number of Patients (*n*=170)	Percentage (%)
1.	Once Daily (OD)	128	75.3
2.	Twice Daily (BD)	42	24.7

9-10 drugs and 32 patients receiving more than 10 drugs. A smaller number of patients received 4-5 drugs (*n*=18) and 1-3 drugs (*n*=4).

Distribution of class of concurrent drug prescribed

In Table 9, concurrent drug classes showed that antibiotics were prescribed in 129 patients, followed by antiemetics in 98 patients and NSAIDs in 93 patients. Other prescribed drug classes included respiratory drugs (*n*=52), antidepressants (*n*=50), antihypertensives (*n*=33), and antidiabetic drugs (*n*=22).

DISCUSSION

The present prospective observational study evaluated the prescribing pattern and utilization of Proton Pump Inhibitors (PPIs) among inpatients in a tertiary care teaching hospital. Drug utilization research is essential for assessing prescribing trends and promoting rational drug use, particularly for frequently prescribed drug classes such as PPIs (Patil *et al.*, 2015; WHO, 2003). In the present study, PPI use was predominantly observed among patients aged 47-60 years, a finding consistent with earlier studies by (Patil *et al.*, 2015; Sudhakar *et al.*, 2026; D'souza *et al.*, 2026), which reported higher PPI utilization among middle-aged and elderly populations. Similar age-related increases in PPI consumption have also been documented in international studies conducted in China and Europe (Liu *et al.*, 2020; Torres-Bondia *et al.*, 2022). Male predominance observed in this study aligns with findings reported by (Patil *et al.*, 2015; Mathew *et al.*, 2015; and Kunwar *et al.*, 2026), suggesting higher hospitalization rates and greater exposure to risk factors among males. The predominance of patients from rural areas is comparable to reports by (Sudhakar *et al.*, 2026; Kunwar *et al.*, 2026), reflecting the catchment population of tertiary care teaching hospitals in India. Educational status analysis revealed that a substantial proportion of patients had lower levels of formal education, similar to observations reported by (Nousheen *et al.*, 2014; D'souza *et al.*, 2026), highlighting the importance of patient education regarding rational medication use. Occupational distribution showed farmers as the largest group of PPI users, which is consistent with findings from Indian studies by (Sudhakar *et al.*,

Table 8: **Total number of drugs prescribed per patient (polypharmacy).**

Sl. No.	Number of Drugs	Number of patients (*n*=170)	Percentage (%)
1.	1-3	4	2.4
2.	4-5	18	10.6
3.	6-8	86	50.6
4.	9-10	30	17.6
5.	>10	32	18.8

Table 9: **Concurrent drug classes.**

Sl. No.	Drug Class	Number of drugs prescribed in patients (*n*=477)	Percentage (%)
1.	Antibiotics	129	75.9
2.	Antiemetics	98	57.6
3.	NSAIDs	93	54.7
4.	Antidepressants	50	29.4
5.	Respiratory drugs	52	30.6
6.	Antihypertensives	33	19.4
7.	Antidiabetics	22	12.9

2026; Mathew *et al.*, 2015). A proportion of patients reported alcohol consumption and smoking, findings that are comparable with previous studies by (Kunwar *et al.*, 2026; Nousheen *et al.*, 2016), where lifestyle factors were commonly observed among PPI users. Pantoprazole was the most frequently prescribed PPI in the present study, a trend consistently reported in multiple drug utilization studies from India and other countries (Asl *et al.*, 2020; D'souza *et al.*, 2026; Machado-Alba *et al.*, 2013). Utilization analysis using the ATC/DDD methodology demonstrated higher DDD/100 bed-days for pantoprazole compared to rabeprazole, supporting findings reported by (Patil *et al.*, 2015; Machado-Alba *et al.*, 2026), and reaffirming the utility of the WHO ATC/DDD system for standardized drug utilization assessment (WHO, 2003). Polypharmacy was commonly observed in the present study, similar to reports by (Sudhakar *et al.*, 2026; Mathew *et al.*, 2015), with frequent co-prescription of PPIs alongside antibiotics, NSAIDs, and antiemetics. Concerns regarding overutilization and safety of long-term PPI therapy, including risks of hypomagnesemia and infections, have been highlighted in previous studies (Florentin *et al.*, 2012; de Jager *et al.*, 2012), emphasizing the need for periodic review of PPI therapy and adherence to evidence-based guidelines (Forgacs *et al.*, 2008; Heidelbaugh *et al.*, 2012; York guidelines, 2026).

CONCULSION

The present study highlights the prescribing pattern and utilization of proton pump inhibitors among inpatients in a tertiary care teaching hospital. Proton pump inhibitors were predominantly prescribed to middle-aged and older adults, with pantoprazole being the most frequently utilized agent. Once-daily dosing was commonly practiced, and a high degree of polypharmacy with concurrent use of antibiotics, NSAIDs, and antiemetics was observed. Utilization assessment using the WHO ATC/DDD methodology demonstrated higher consumption of pantoprazole compared to other PPIs. These findings underscore the need for continuous monitoring of PPI prescribing practices, adherence to evidence-based guidelines, and periodic drug utilization reviews to promote rational use and enhance patient safety.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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