

# Appropriateness Analysis of Proton Pump Inhibitor Use among General Medicine Inpatients of a Secondary Care Hospital: A Hospital Based Cross-Sectional Study

Aswathy Melel Somarajan<sup>1</sup>, Balaiahgari Mani Raja Rao<sup>1</sup>, Donthula Pushpa<sup>1</sup>, Anke Sai Kumar<sup>1</sup>, Goruntla Narayana<sup>2</sup>, Venkata Ramana<sup>3</sup>, Akkiraju Sudheer<sup>1,\*</sup>

<sup>1</sup>Department of Pharmacy Practice, Raghavendra Institute of Pharmaceutical Education and Research, Anantapur, Andhra Pradesh, INDIA.

<sup>2</sup>Department of Clinical Pharmacy and Pharmacy Practice, School of Pharmacy, Kampala International University, Western Campus, Ishaka, UGANDA.

<sup>3</sup>Department of General Medicine, General Medicine, Rural Development Trust Hospital, Bathalapalli, Andhra Pradesh, INDIA.

## ABSTRACT

**Background:** Proton pump inhibitors are used for suppressing gastric acid secretion. They are among the most routinely prescribed drugs globally due to their excellent efficacy and low risk of side effects, yet they are frequently used inappropriately. Although extensive studies are available in Western countries on proton pump inhibitor appropriateness, such data from India is still very limited. **Materials and Methods:** This is a hospital-based cross-sectional study where 402 patients participated, and appropriateness was assessed using standard guidelines (Food and Drug Administration, National Institute for Health and Care Excellence, and American College of Gastroenterology) and the Medication Appropriateness Index tool (among proton pump inhibitor users). **Results:** Logistic regression was performed, and strong relationships between the appropriateness of proton pump inhibitor usage and gender and comorbidity were observed. According to standard guidelines, appropriate usage of proton pump inhibitors was recorded as highest during hospitalization (33%), and least during discharge (8%). **Conclusion:** This study explored the appropriateness of proton pump inhibitor prescriptions among general medicine inpatients at a secondary care referral hospital in Andhra Pradesh. Inappropriate proton pump inhibitor usage is still more prevalent in our country, and it is imperative to enhance appropriate proton pump inhibitor prescription, particularly with regard to minimizing misuse, to attain a noteworthy reduction in healthcare expenses and anticipate a decreased occurrence of possible unfavorable outcomes.

**Keywords:** Proton pump inhibitor, Food and Drug Administration, National Institute for Health and Care Excellence, American College of Gastroenterology, Medication appropriateness index, Appropriateness.

## Correspondence:

**Dr. Akkiraju Sudheer**

Head of Department, Department of Pharmacy Practice, Raghavendra Institute of Pharmaceutical Education and Research, Anantapur, Andhra Pradesh, INDIA.

Email: sudeerlegend@gmail.com

**Received:** 04-03-2024;

**Revised:** 01-04-2024;

**Accepted:** 09-06-2024.

## INTRODUCTION

Proton Pump Inhibitors (PPIs) are a class of drugs that were developed in the 1980s for suppressing gastric acid secretion by acting on the hydrogen-potassium ATPase enzyme. They are regarded as the primary choice for treating acid-related diseases. The most commonly used PPIs are omeprazole, esomeprazole, lansoprazole, pantoprazole, and rabeprazole. These are majorly indicated for treating and managing acid-related diseases such as Peptic Ulcer Disease (PUD), Gastro-Oesophageal Reflux Disease (GERD), Gastrointestinal (GI) bleeding, and Helicobacter pylori infection, as well as for preventing gastric ulcers in patients

taking Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), glucocorticoids, anti-platelet agents, and anti-coagulants. PPIs are among the most widely prescribed drug families all over the world, as they have high efficacy and a low risk of side effects. However, they are frequently used improperly. A few instances of improper PPI use include: (a) prescribing PPIs without a valid reason (e.g., ulcer prophylaxis in patients without risk factors); (b) treating functional dyspepsia excessively and failing to cease medication when necessary.

International research on PPI usage in hospital patients from Spain, Italy, and Germany revealed that a significant proportion didn't meet their nations recommended standards for PPI use (74%, 80%, and 52%, respectively). A recent community-based study found that 30% of PPI users lacked appropriate treatment durations.<sup>1-4</sup> In Nigeria, 73.3% of patients at a tertiary teaching hospital had improper PPI prescriptions, with 52.1% having



DOI: 10.5530/jyp.2024.16.98

### Copyright Information :

Copyright Author (s) 2024 Distributed under Creative Commons CC-BY 4.0

Publishing Partner : Manuscript Technomedia. [www.mstechnomedia.com]

a shorter duration and 33.3% having a higher frequency than recommended.<sup>5</sup> Additionally, a study in the Netherlands noted that 56% of PPI prescriptions had inappropriate indications.<sup>6</sup>

Taking Asian nations into account, it was observed that PPI usage spiked significantly during 2004-2013, expanding by over 10.4 times in one of the biggest teaching hospitals in Southwest China.<sup>7</sup> Additionally, a regional study in Jordan exhibited that 70% of hospitalized patients were prescribed PPIs without clear rationale, and current practice standards were not being followed.<sup>2</sup> Furthermore, the projected annual cost of inappropriate Intravenous PPIs at a Saudi Arabian academic medical hospital was \$156,044.18.<sup>2</sup>

Acid-peptic diseases are prevalent in India as well, due to changing lifestyles and dietary habits. A survey of 1,000 Indian clinicians revealed a high prevalence of non-ulcer dyspepsia (25.2%), peptic ulcer disease (37.1%), and GERD (39.2%), with over half of the patients requiring an immediate endoscopy.<sup>8</sup> The PPIs that are available in India are rabeprazole, pantoprazole, omeprazole, esomeprazole, lansoprazole, dexlansoprazole, dexrabeprazole, and ilaprazole. Due to a lack of standard national guidelines, physicians often face difficulty choosing PPIs appropriately, which ultimately leads to huge variation in PPI selection.<sup>9</sup> However, the escalation of acid-related illnesses and the expansion of their therapeutic uses alone cannot account for the dramatic rise in PPI use. Anisha Marita D'souza *et al.*, (2019) carried out a hospital-based observational prospective study and found that on the first day of hospitalization, patients with COPD, viral fever, hyperparathyroidism and bronchial asthma were prescribed PPIs for which there was no reliable documented evidence. Additionally, according to a cross-sectional multi-departmental observational study carried out in a sizable tertiary care teaching hospital in Delhi, India, 7.39% of PPIs were used appropriately and 91% inappropriately.<sup>10</sup> In Western countries, PPI appropriateness has been the subject of substantial research; nevertheless, there is still a dearth of evidence in this regard from India.

## MATERIALS AND METHODS

The study design used was a hospital-based cross-sectional study that received approval from the Institutional Ethics Committee (RDTH/BTP/ETHICS/2022/23) and was performed over a duration of six months (October 2022 to March 2023) in the General Medicine Department of a seven-bedded secondary care referral hospital (Rural Development and Trust Hospital) in Andhra Pradesh, India. The study purpose was explained thoroughly to the participants, and the confidentiality of their identities was ensured. In accordance to the pilot study conducted on 30 patients, the sample size was calculated to be 376 by using simple random sampling, and a total of 402 samples were collected. Participants who met the inclusion criteria-general medicine in patients who are  $\geq 18$  years old-were allowed to participate in the study. Those who met the exclusion criteria, including

outpatients, patients who are  $< 18$  years old and admitted to other departments such as paediatrics, OBG, ICU, and casualty and those who did not provide consent, were excluded from the study. The study tool consisted of a data collection form along with an Informed Consent Form (ICF) and a MAI (Medication Appropriateness Index) form (Figure 1).

## The data collection form consists of three forms

### Form I

Contained data collected during hospital admission. It included the following data: date of admission, provisional diagnosis, PPI use, dose and duration of PPI therapy, Route of Administration (ROA) of PPI therapy, generic name and indication of the PPI used, planned withdrawal, comorbidities, concomitant medications, and MAI score.

### Form II

Compiled from information obtained after 72 hr of admission. It included details on how PPI therapy had changed from Form I (initiation, stopping, and dose adjustments), the rationale behind the changes, whether they were suitable in light of accepted standards (appropriateness of the changes), and the MAI score.

### Form III

Contained information at discharge, including the date of discharge, primary and secondary diagnoses and modifications to PPI therapy compared to Form 2 (initiation, withdrawal, and dosage adjustments), justifications for the modifications, planned withdrawal, appropriateness of the changes, concomitant medications, mortality during hospitalization, and MAI score.

Based on data from the patient's medical charts, all forms were filled out. Two techniques were employed

- Agreement between the use of PPIs or not using them and the availability of the right indication. The FDA and other accepted recommendations for the treatment of adult acid-related illnesses were used to identify the lists of suitable indications.<sup>11-15</sup>
- Only in the instance of PPI users was MAI evaluation carried out. It was used for comparing its results with those obtained from the guidelines-based method.

MAI is a questionnaire tool with nine questions. This tool is employed to evaluate the appropriateness of any drug. Questions on indication and effectiveness receive a score of 3, dose, correct directions, practical directions, and drug-drug interactions receive a score of 2, and drug-disease interactions, cost, duplication, and duration receive a score of 1. An option called 'Don't Know' (DK), which receives a score of nine, can be chosen if further information is needed to respond to a question.<sup>16-19</sup>

**The following are the categories for MAI scores**

- Appropriate (MAI=0-10).
- Marginally appropriate (MAI=11 to 20).
- Inappropriate (MAI>20).

**Note**

The MAI score can be calculated according to the PPI prescriptions. The following indications of PPI use are deemed appropriate for both approaches

- GERD
- Gastric/duodenal ulcers.
- Erosive esophagitis.
- Helicobacter pylori eradication.
- Chronic use of NSAIDs and aspirin in high-risk individuals [age >65, history of ulcers, or concurrent anti-coagulant medication].
- Hyper-secretory conditions such as Zollinger-Ellison syndrome.<sup>11-14</sup>

**Medication Appropriateness Index**

*For assessing the MAI, circle the appropriate score for each question.*

Drug Name:	Unique Serial ID:				
1. Is there an indication for the drug? Comments:	-	1 (Y)	2 (PY)	3 (N)	*9
2. Is the medication effective for the condition? Comments:	-	1 (Y)	2 (PY)	3 (N)	*9 (DK)
3. Is the dosage correct? Comments:	-	1 (Y)	2 (N)	-	*9 (DK)
4. Are the directions correct? Comments:	-	1 (Y)	2 (N)	-	*9 (DK)
5. Are the directions practical? Comments:	0 (Y)	1 (N)	-	-	*9 (DK)
6. Are there clinically significant drug-drug interactions? Comments:	-	1 (N)	2 (Y)	-	*9 (DK)
7. Are there clinically significant drug-disease/ condition interactions? Comments:	-	1 (N)	2 (Y)	-	*9 (DK)
8. Is there unnecessary duplication with other drug(s)? Comments:	0 (N)	1 (Y)	-	-	*9 (DK)
9. Is the duration of therapy acceptable? Comments:	0 (Y)	1 (N)	-	-	*9 (DK)
Total Score					

**Abbreviations:**

\*Y- Yes    \*PY- Partially yes    \*N- No    \*DK- Don't Know

**Figure 1:** Medication Appropriateness Index questionnaire.

The statistical data analysis was done by using descriptive analysis for all the forms and a logistic regression model for the evaluation of the association between the usage of PPI and appropriate therapeutic indications.

## RESULTS

In total, 402 patients participated in the study. Among the 402 patients, 196 were male and 206 were female. The patients who participated were mostly of age <65. In addition, the participants with prescriptions of drugs ≤five were 402 and >five were 188. Moreover, 104 patients had comorbidities, and 298 patients were without any comorbidity (Table 1).

The appropriateness of PPI use was assessed using standard guidelines such as FDA, NICE, and ACG guidelines. Variables such as gender, age, number of concomitant drugs, and presence of comorbidities were taken into account for assessing PPI appropriateness. Appropriate usage of PPI was recorded highest during hospitalization (33%), followed by admission (10%), and least during discharge (8%). However, inappropriate usage of PPI was observed to be highest during admission (76%), followed by discharge (55%), and hospitalization (52%). In addition, appropriate lack of PPI was highest during discharge (35%), and least during admission and hospitalization (i.e., 14% each). Moreover, inappropriate lack of PPI was recorded highest during discharge (2%) followed by admission (1%) but no such lack was observed during hospitalization (Table 2).

Based on the MAI assessment, the highest appropriateness of PPI therapy was noted during admission (66%), followed by hospitalization (65%), and the lowest during discharge (28%). In addition, marginally appropriate use of PPI therapy was noted to be highest during discharge (67%), followed by hospitalization (35%), and lowest during admission (34%). However, inappropriate use of PPI was observed only during discharge (5%) (Table 3).

## The logistic regression analysis results depict a

Strong association between appropriateness of PPI use in relation with gender ( $p$  value: 0.0046) and comorbidity ( $p$  value: 0.0045).

Significant appropriateness association in relation to age ( $p$  value: 0.0056).

However, in relation to the odds ratio, the appropriateness association among people with PPI therapy was observed in relation to age (OR: 2.5), concomitant therapy (OR: 1.2), and comorbidity (OR: 2.0), whereas among patients without PPI therapy, the association was found to be with gender male (OR: 1.005) (Table 4).

## DISCUSSION

This study was performed in the RDT hospital, Anantapur district, Andhra Pradesh, India, in order to assess the appropriateness of PPI prescriptions using the FDA and other standard guidelines among general medicine inpatients. This evaluation is crucial, as PPIs are widely used and often over-prescribed, which may lead to potential adverse effects and increased healthcare costs.

**Table 1: Distribution of demographic characteristics of the subjects participated (n=402).**

Variables	N
Total patients	402
Male	196
Female	206
Age ≥65	40
Age <65	362
Concomitant drugs >5	188
Concomitant drugs ≤5	402
Patients without comorbidities	298
Patients with comorbidities	104

**Table 2: Appropriateness of PPI use based on FDA, NICE, and ACG guidelines.**

Form	Appropriate Use of PPI		Inappropriate Use of PPI		Appropriate lack of PPI		Inappropriate lack of PPI	
	N	%	N	%	N	%	N	%
Admission	40	10%	302	76%	56	14%	2	1%
Hospitalization	14	33%	22	52%	6	14%	0	0%
Discharge	28	8%	188	55%	118	35%	8	2%

**Table 3: Distribution of the appropriateness of PPI therapy based on MAI.**

Form	Appropriate		Marginally appropriate		Inappropriate		Total
	N	%	N	%	N	%	
Admission	226	66%	116	34%	0	0%	342
Hospitalization	22	65%	12	35%	0	0%	34
Discharge	60	28%	144	67%	10	5%	214

**Table 4: Logistic regression for the appropriateness of PPI use.**

Variables	With PPI therapy			Without PPI therapy		
	OR	CI 95%	p-value	OR	CI 95%	p-Value
Age ≥ 65Y	2.522	(1.331, 4.623)	*0.005593	0.9748	(0.521, 1.818)	0.9370
Gender Male	0.4887	(0.2915, 0.8053)	**0.004614	1.005	(0.7066, 1.43)	0.9763
Concomitant therapy (>5 drugs)	1.195	(0.7626, 1.844)	0.4261	0.7192	(0.5012, 1.019)	0.06408
Comorbidity	2.033	(1.25, 3.288)	**0.004479	1.023	(0.6837, 1.52)	0.9065

Note: Results with an OR >1 imply higher appropriateness.\*p value <0.05 is statistically significant.\*\*p value <0.005 is statistically strongly significant.

Our findings highlight significant differences compared to similar studies. In accordance with an Italian-based cohort study conducted among general medicine inpatients, the percentage of appropriate PPI therapy was highest during hospitalization and discharge (22% each) and lowest during admission (21%).<sup>20</sup> However, in our study, the percentage of appropriate PPI use among general medicine inpatients was highest during hospitalization (33%), followed by admission (10%), and lowest during discharge (8%). These discrepancies could be attributed to variations in clinical practice, patient demographics, and adherence to guidelines between different healthcare settings.

Moreover, our findings differ from those of Abukhalil *et al.*, where 67.5% of patients were discharged with appropriate PPI prescriptions, and from Anisha Marita D'Souza *et al.*, where 64% of the patients were found to have appropriate PPI use. Such differences underscore the need for localized assessments and interventions tailored to specific hospital settings to improve prescription practices.

An interesting aspect of our study is the strong association we found between gender, comorbidity, and the appropriateness of PPI use. Specifically, our statistical results indicated that gender and comorbidity strongly influenced the appropriateness of PPI prescriptions, while age showed a significant association. This contrast with the Italian-based cohort study, which found that age ≥65 years was significantly associated with appropriate PPI use and inappropriate omitted use, but gender was not significantly associated.<sup>20</sup> These findings suggest that demographic and clinical factors may interact differently in various populations, affecting prescription appropriateness.

The strengths of our study include a robust sample size suitable for evaluating PPI usage appropriateness in a clinical setting and a study duration of six months, which aligns with other studies of this nature. Additionally, our methodology involved assessing PPI appropriateness at three different points in time: during admission, hospitalization, and discharge. This comprehensive approach provides a detailed view of prescription practices over the course of patient care. We also employed the MAI tool to

compare its results with standard guideline-based appropriateness assessments, enhancing the reliability of our findings.

However, our study has several limitations. Firstly, being confined to a single department of a secondary hospital in Anantapur, our findings cannot be extrapolated to other clinical settings without caution. The local practices and patient population characteristics might significantly differ from those in other regions or healthcare institutions. Secondly, the study did not include outpatient data, which is a significant limitation as it excludes a substantial portion of PPI usage. Over-The-Counter (OTC) PPI use, which is common and can contribute to inappropriate PPI consumption, was also not accounted for due to a lack of patient information regarding OTC medications.

Future research should aim to address these limitations by including multiple hospital departments and settings, as well as outpatient and OTC PPI use. Such studies would provide a more comprehensive understanding of PPI prescription practices and their appropriateness. Additionally, interventions targeted at improving PPI prescription practices, such as clinician education and guideline dissemination, should be evaluated for their effectiveness in enhancing prescription appropriateness.

In short, our study sheds light on the appropriateness of PPI prescriptions in a specific hospital setting in India, revealing significant differences compared to other international studies. The findings highlight the importance of continuous monitoring and evaluation of prescription practices to ensure optimal and appropriate use of PPIs. Addressing the identified gaps and limitations in future research will be crucial for developing effective strategies to improve PPI prescription practices and patient outcomes.

## CONCLUSION

In this study, we found that a higher proportion of PPI prescriptions did not follow any appropriate standard guidelines. However, while considering off-label PPI usage, a larger percentage of PPI prescriptions were observed to be marginally

appropriate. Moreover, we also observed a strong association between the appropriateness of PPI use in relation to gender male and comorbidity and a significant appropriateness association in relation to age  $\geq 65$ . Furthermore, among non-PPI users, the percentage of inappropriate lack of PPI therapy was negligible and, a higher proportion of prescriptions were assessed with an appropriate lack of PPI. Thus, inappropriateness was more observed in PPI users than in non-PPI users.

Even though PPIs are considered to be considerably safe, there are many studies that have revealed that PPIs can cause many short-term and long-term side effects. Still, inappropriate usage of PPI is more prevalent in our country, which can lead to unnecessary economic expenditure for patients. Henceforth, it is important to enhance the appropriateness of PPI prescriptions, particularly with regard to lowering overuse. By encouraging appropriate prescribing of PPIs, we can achieve a significant decrease in healthcare costs and expect a reduction in the incidence of potential adverse events. Therefore, it is necessary to create awareness among physicians and other healthcare professionals regarding the appropriate use of PPI by committing to standard clinical guidelines such as the FDA, ACA, NICE, or any other appropriate standard guidelines which ultimately helps in improving the appropriateness of PPI prescription regimens, preventing complications, and reducing health care costs.

## ACKNOWLEDGEMENT

We are thankful to the Principal and Correspondent of the Raghavendra Institute of Pharmaceutical Education and Research (RIPER), Anantapur, Andhra Pradesh, for their unwavering support during the course of the investigation that led to the successful completion of this work. We would also like to thank the Rural Developmental Trust (RDT) hospital for giving us a wonderful platform to conduct this work. We are extremely grateful to the health care workers of the respective hospital for helping us obtain the data.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

## ABBREVIATIONS

**ACG:** American College of Gastroenterology; **CI:** Class interval; **COPD:** Chronic Obstructive Pulmonary Disease/Disorder; **FDA:** Food and Drug Administration; **GERD:** Gastro-Esophageal Reflux Disease; **GI:** Gastro Intestinal; **ICF:** Informed Consent Form; **ICU:** Intensive Care Unit; **IV:** Intravenous; **MAI:** Medication Appropriateness Index; **NICE:** National Institute for Health and Care Excellence; **NSAID:** Non-Steroidal

Anti-Inflammatory Drugs; **OBG:** Obstetrics and Gynaecology; **OR:** Odds Ratio; **OTC:** Over The Counter; **PPI:** Proton Pump Inhibitors; **PUD:** Peptic Ulcer Disease; **RDT:** Rural Development Trust; **ROA:** Route of Administration.

## REFERENCES

- Ahrens D, Behrens G, Himmel W, Kochen MM, Chenot JF. Appropriateness of proton pump inhibitor recommendations at hospital discharge and continuation in primary care. *Int J Clin Pract.* 2012;66(8):767-73. doi: 10.1111/j.1742-1241.2012.02973.x, PMID 22805269.
- Zalloom N, Abu Farha R, Awwad O, Samara N. Inappropriate prescribing of proton pump inhibitors among patients in two Jordanian tertiary health facilities. *Trop J Pharm Res.* 2016;15:489.
- Pasina L, Urru SA, Mandelli S, Giua C, Minghetti P, SGCP Investigators. Evidence based and unlicensed indications for proton pump inhibitors and patients' preferences for discontinuation: a pilot study in a sample of Italian community pharmacies. *J Clin Pharm Ther.* 2016;41(2):220-3. doi: 10.1111/jcpt.12371, PMID 26931180.
- Mohzari YA, Alsaegh A, Basheeruddin Asdaq SM, Al Shanawani SN, Albraiki AA, Bagalb A. The pattern of intravenous proton-pump inhibitor utilization at an academic medical center in Riyadh, Saudi Arabia. *J Res Pharm Pract.* 2020;9(3):151-4. doi: 10.4103/jrpp.JRPP\_20\_62, PMID 33489984.
- Okoro RN, Abdullahi K, Dayar DA. Assessment of proton-pump inhibitor use at a tertiary teaching hospital in Nigeria. *Med Access Point Care.* 2021;5(5):23992026211062729. doi: 10.1177/23992026211062729, PMID 36204491.
- Koggel LM, Lantinga MA, Büchner FL, Drenth JP, Frankema JS, Heeregrave EJ, *et al.* Predictors for inappropriate proton pump inhibitor use: observational study in primary care. *Br J Gen Pract.* 2022;72(725):e899-906. doi: 10.3399/BJGP.2022.0178, PMID 36127156.
- Zeng W, Finlayson AE, Shankar S, de Bruyn W, Godman B. Prescribing efficiency of proton pump inhibitors in China: influence and future directions. *BMC Health Serv Res.* 2015;15:11. doi: 10.1186/s12913-014-0638-6, PMID 25609265.
- Rai RR, Gangadhar A, Mayabhate MM. Clinical profiling of patients with Acid Peptic Disorders (APD) in India: a cross-sectional survey of clinicians. *Int J Basic Clin Pharmacol.* 2016;6(1):194-202. doi: 10.18203/2319-2003.ijbcp20164779.
- Singh P, Sawhney H, Kaur P. Clinical practice of prescribing proton pump inhibitors by physicians: an Indian perspective. *Indian J Gastroenterol.* 2018;37(6):481-91.
- Verma N, Tayal V, Roy V. Proton pump inhibitors: prescribing practices, appropriateness of use, and cost incurred in a tertiary care, public, teaching hospital in New Delhi, India. *MAMC J Med Sci.* 2019;5(3):113. doi: 10.4103/mamcjms.mamcjms\_40\_19.
- Moe HW, Sharma S, Sharma AK. An evaluation of medication appropriateness in pregnant women with coexisting illness in a tertiary care hospital. *Perspect Clin Res.* 2021;12(1):21-6. doi: 10.4103/picr.PICR\_22\_19, PMID 33816205.
- Katz PO, Dunbar KB, Schnoll-Sussman FH, Greer KB, Yadlapati R, Spechler SJ. ACG clinical guideline for the diagnosis and management of gastroesophageal reflux disease. *Am J Gastroenterol.* 2022;117(1):27-56. doi: 10.14309/ajg.0000000000001538, PMID 34807007.
- Ali Khan M, Howden CW. The role of proton pump inhibitors in the management of upper gastrointestinal disorders. *Gastroenterol Hepatol (N Y).* 2018;14(3):169-75. PMID 29928161.
- Dylan Ren W. Appropriate use and stewardship of proton-pump inhibitors. *Uspharmacist.com*; 2022.
- Ramirez E, Lei SH, Borobia AM, Piñana E, Fudio S, Muñoz R, *et al.* Overuse of PPIs in patients at admission, during treatment, and at discharge in a tertiary Spanish Hospital. *Curr Clin Pharmacol.* 2010;5(4):288-97. doi: 10.2174/157488410793352067, PMID 20925644.
- Hanlon JT, Schmader KE, Samsa GP, Weinberger M, Uttech KM, Lewis IK, *et al.* A method for assessing drug therapy appropriateness. *J Clin Epidemiol.* 1992;45(10):1045-51. doi: 10.1016/0895-4356(92)90144-c, PMID 1474400.
- Nousheen, Tadvil NA, Shareef SM. Use of proton pump inhibitors in general practice: is its rationale? *Int J Med Res Health Sci.* 2014;3(1):37-42. doi: 10.5958/j.2319-5886.3.1.008.
- Hanlon JT, Schmader KE. The medication appropriateness index: A clinimetric measure. *Psychother Psychosom.* 2022;91(2):78-83. doi: 10.1159/000521699, PMID 35158365.
- Hanlon JT, Schmader KE. The medication appropriateness index at 20: where it started, where it has been, and where it may be going. *Drugs Aging.* 2013;30(11):893-900. doi: 10.1007/s40266-013-0118-4, PMID 24062215.
- Lodato F, Poluzzi E, Raschi E, Piccinni C, Koci A, Olivelli V, *et al.* Appropriateness of proton pump inhibitor prescription in patients admitted to hospital: attitudes of general practitioners and hospital physicians in Italy. *Eur J Intern Med.* 2016;30:31-6. doi: 10.1016/j.ijem.2016.01.025, PMID 26926561.

**Cite this article:** Aswathy MS, Mani Raj B, Pushpa D, Sai Kumar A, Narayana G, Ramana V, *et al.* Appropriateness Analysis of Proton Pump Inhibitor Use among General Medicine Inpatients of a Secondary Care Hospital: A Hospital Based Cross-Sectional Study. *J Young Pharm.* 2024;16(4):781-6.