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Original Research Article

A study on assessment of inappropriate prescribing of proton pump inhibitors at a teaching hospital

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ABSTRACT

Background: Proton pump inhibitors (PPI's) are amongst the most extensively utilized therapies for conditions characterized by excessive gastric-acid production, making them highly susceptible to inappropriate long-term use predisposing individuals to a higher risk of side effects. This study seeks to evaluate the prevalence and patterns of inappropriate PPI prescribing in both in-patients and out-patients, with a focus on adherence to clinical guidelines regarding indications, dosage, frequency, and duration of therapy by using National Institute for Health and Care Excellence (NICE) guidelines.
Methods: Appropriateness of PPI prescriptions was prospectively assessed in 120 in-patients during their hospitalization and at discharge, and 50 out-patients with regard to the indication, dosage, frequency and duration of therapy for their compliance with NICE guidelines. The required data for the study was noted in a suitably designed data collection form.
Results: Among 120 in-patients, 56 (46.67%) were males and 64 (53.33%) were females. Pantoprazole 40 mg was the commonly prescribed PPI, accounting 115 (95.83%) IV and 5 (4.17%) oral prescriptions among In-patients whereas 94 (93.07%) prescriptions account for pantoprazole 40 mg and 7 (6.93%) with rabeprazole 20 mg during discharge, all through an oral route. On assessing the appropriateness of prescription, it was revealed that 80 (66.67%) were appropriate, while 40 (33.33%) were inappropriate in IPD. In 35 inappropriate indications, 14 (40%) are due to prophylaxis in low-risk patients with concomitant use of NSAIDs and 1 (2.86%) with corticosteroids. Twenty (57.15%) prescriptions had no indications. Four (10%) prescriptions had inappropriate frequency and 1 (2.50%) had inappropriate duration. Among the out-patients, 32 (64%) were males and 18 (36%) females. Pantoprazole 40 mg was prescribed in 5 (10%) through an IV route and 32 (64%) were oral prescriptions whereas 13 (26%) were given rabeprazole 20 mg orally. Inappropriateness was seen in 14 (77.78%) due to prophylaxis in low-risk patients co-prescribed with NSAIDs and 4 (22.22%) prescriptions had no clear indications. Three (14.29%) accounted for inappropriate frequency.
Conclusions: The study concludes that, the rate of inappropriate prescribing of PPIs is relatively low in both in-patients during hospitalization, at discharge, and in outpatients. Pharmacists can work closely with prescribers to ensure the proper indication, dose, frequency and duration of therapy.

Keywords: Proton pump inhibitors, Appropriateness, NICE guidelines, Prophylaxis, Concomitant use

INTRODUCTION

The escalating global prevalence of PPI's poses a significant threat to public health necessitating their rigorous monitoring and underscoring the need for evidence-based guidelines. PPIs are a class of potent drugs frequently used in the management of acid related gastrointestinal disorders, and are the most effective inhibitors of gastric acid because they block the secretion

of hydrogen ions, thereby reducing the amount of gastric pH levels, hence permanently inactivating the proton pumps in parietal cells (H-K-ATPase) of the gastric lumen, which is activated during the final phase of acid release.[1]

PPIs are activated in an acidic environment, since they are prodrugs, they demand acid secretion for their activation and subsequent action.[2] These medications are among the highly effective therapies for conditions characterized by excessive stomach acid production, and because they bind to the proton pump irreversibly, this yields a longer lasting effect than that of other acid-reducing agents, such as H2 receptor antagonists (H2RA).[1]

The acid dissociation constant (pKa) value of PPIs varies from 3.9 to 5.0, they get concentrated, particularly in the extremely-acidic secretory canaliculus of the parietal cell, after which they are transformed into active sulfonamide forms and interact with the outer surface of H-K-ATPase, resulting in covalent inhibition of the enzyme and a long-lasting gastric acid suppression. The timing of administration of PPIs is very crucial. Generally, PPIs are highly functional after a meal when the cells are activated, but the quantity of H-K-ATPase in the parietal cells is maximum after an extended fast, therefore, PPIs are ideally administered before breakfast in patients with once-daily dosing, or before the evening meal in those with a twice-daily regimen. The elimination half-life of PPIs varies from 0.5 to 2 hours and the effect of single dose on acid secretion extends up to 2-3 days. The acid-suppressing effect of PPIs is suboptimal initially as they inhibit only active pumps in the canalicular membrane, but improves greatly with recruitment of inactive enzymes over consequent administration of the drug. Owing to this, acid suppression may be therapeutically inadequate and unsatisfactory if PPIs are used on an 'as needed' basis.[1]

PPIs are majorly eliminated by the hepatic route and cytochrome P450 (CYP450) system. Polymorphic CYP2C19 and CYP3A4 are the key enzymes involved in their metabolism.[3] The emergence of PPIs in the 1990s marked significant therapeutic breakthrough, by targeting severe acid-related disorders such as Zollinger-Ellison syndrome and gastro-esophageal reflux disease (GERD) along with erosive esophagitis. As clinical experience and evidence emerged, PPIs subsequently became widely adopted in 2000s for management of ailments, including GERD, peptic ulcer disease, and *H. pylori* eradication.[4]

Omeprazole, a benzimidazole derivative, was the first PPI introduced into clinical practice in the US in 1988 and is widely used due to its efficacy and availability, both over-the-counter and by prescription.[3] Lansoprazole, also a benzimidazole derivative, was introduced in 1995, followed by rabeprazole in 1999.[5,6] Later, pantoprazole, another benzimidazole, introduced in 2000, emerged amongst the most widely used PPI due to its unique pharmacokinetic profile and lower potential for drug interactions and still remains the mainstay in majority of the prescriptions in India.[7]

Esomeprazole, an S-enantiomer of omeprazole, introduced in 2001, followed by dexlansoprazole**,** which is an R-enantiomer of lansoprazole, was introduced in 2009, and features a unique dual delayed-release formulation for extended acid suppression.[8,9] PPIs are typically administered as enteric-coated tablets or capsules and passed through the stomach unaltered, allowing them to be absorbed in the proximal small intestine and delayed release for prolonged action.[1]At present, pantoprazole, omeprazole, esomeprazole and less commonly rabeprazole and lansoprazole are available in intravenous forms in settings were oral administration is not feasible.[10]

Globally, the use of PPIs is on rise, with variations in prescription practices influenced by local healthcare systems, disease prevalence, and physician practices. A hospital-based study in India reported that 45% of PPI prescriptions were inappropriate. A significant portion of these inappropriate uses was observed in patients aged 50-70 years.[11]Similarly, these drugs represent a notably prevalent prescribed category of medications in the Western nations, with nearly 30% of the French population utilizing PPIs in 2015, and a sharp rise of PPI consumers was recorded from 2% to 15%, in the UK amidst 1990 and 2014 at a primary care center.[12]

PPI's became one of the best-selling drugs globally, ranking about fifth worldwide and third largest category of medications sold in the USA in 2009.[13] However, inpatient studies from countries like Australia, UK, Greece, Ireland, Netherlands, reveals a considerable amount are administering PPIs, without complying to their country's predefined criteria for prescribing PPIs. Research carried out in the Ireland and Italy revealed that, about 71% and 66% of PPI prescriptions were initiated at the hospital, and about 51% of the prescriptions in the UK accounted for inappropriate indications. This has emerged as a significant economic strain for the healthcare sectors across the globe.[14]

In addition, the established indications, PPIs serve as crucial adjunct for stress ulcer prevention in critically ill patients who are concomitantly treated with medications of ulcerogenic potential. Injudicious use of PPIs is largely driven by their prophylactic use in stress-related mucosal damage in patients who do not meet high risk criteria. Since most gastric-acid related conditions necessitate prolonged treatment, the risk for significant adverse drug interactions in patients co-prescribed with a PPI alongside other medications increases considerably. This does not imply that every prescription should reflexively include a PPI without first critically evaluating the indication; rather, it emphasizes the necessity for careful judgment, ensuring that the use of PPIs is both justified and aligned with the patient's specific clinical needs.

Prolonged and inappropriate PPI utilization is associated with marked risk of *Clostridium difficile* infections, chronic kidney disease, and osteoporosis-related fractures.[15] Studies have highlighted a potential link

between long-term PPI use and nutritional deficiencies such as hypomagnesemia and vitamin B12 deficiency.[16]

The development of clinical guidelines for PPIs has evolved as these drugs became a cornerstone in the management of acid-related disorders. The NICE was established in 1999 in the UK to provide national guidance in promoting good health and the prevention and treatment of ill health. Over the years, NICE has issued comprehensive, evidence-based guidelines for the use of PPIs, particularly focusing on managing conditions like dyspepsia, GERD, and peptic ulcer disease (PUD).

In September 2014, NICE revised and updated the dyspepsia guideline to CG184. This update focused on reducing unnecessary long-term PPI use, stressing regular reassessment of patients on PPIs and advising that they must be prescribed at the lowest effective dose for shortest duration possible, depending on indication. The guideline also recommends alternative management strategies such as H2RAs and alginate therapy in specific cases.[17]

In an emerging country like India, surpassing the availability of over five hundred patented formulations of PPI, the odds of abuse and misuse escalates exponentially.[18] Therefore, multiple elements must be accounted before initiating proton pump inhibitor in the prescription: (i) dosage, duration of therapy accompanied by an assessment of clinically appropriate indication; (ii) how frequently patients prescribed with a proton pump inhibitor for GERD were simultaneously being co-prescribed with medications that can potentially worsen or result in GERD.[19]

Furthermore, information by GPs to patients, particularly regarding treatment duration and dose titration, needs improvement. Interventions are necessary to promote the review of PPI prescribing in both hospitals and the community.[20] The growing trend of inappropriate PPI use poses risks that may outweigh its benefits, compromising patient safety. In the view of above facts, in the present study, assessment for inappropriateness in prescribing of PPI's was done by using NICE guidelines. These guidelines are also used by researchers to carry out drug utilization studies for PPI's. This makes them efficient to follow during practice and prevent any unforeseen risks due to long term use, adverse reactions/ drug interactions.

METHODS

Study design and setting

This was a prospective, observational study conducted at the general medicine department in Basaveshwar Teaching and General Hospital, Kalaburagi.

Study population

The study population included patients admitted to the general medicine department and those visiting the out-patient department in Basaveshwar Teaching and General Hospital within a period of 6 months (March-2024 to August-2024), who were prescribed with PPI's.

Inclusion criteria

Patients of either gender, over the age of >18 years, admitted or visiting the OPD, diagnosed with or without co-morbidities, and who received PPI's and willing to participate were included in the study.

Exclusion criteria

Patients who are terminally ill, pregnant and lactating women or those discharged against medical advice were excluded from the study.

Data collection

The required data for the study was noted in a duly designed data collection form, by attaining consent from them, who fits into the study criteria. The assessment of collected data was done by following NICE guidelines. The prescribed PPI's were evaluated for their appropriateness with regard to their indications, dosage form, dose and frequency. Data was collected from in-patient records during their admission, at discharge, and from OPD cards of the patients visiting the out-patient clinic.

RESULTS

A total of 170 patients were enrolled in the study, comprising 120 in-patients and 50 out- patients who received PPI therapy. In the in-patient group (n=120), all patients were evaluated during hospitalization, and 101 patients were further assessed at the time of discharge for continuation or modification of PPI use. Similarly, in the out-patient group (n=50), prescriptions were reviewed at the point of care in the outpatient department. The study population represented individuals prescribed PPIs for both therapeutic and prophylactic indications, with data systematically recorded to evaluate prescribing patterns and adherence in compliance with NICE clinical guidelines (Figure 1).

It summarizes the demographic characteristics of the study participants, including age and gender distribution, alongside the pattern of PPI use in both inpatients and outpatients. It highlights the commonly prescribed PPIs, their route of administration, and frequency of dosing during hospitalization, at discharge, and in the outpatient setting.

Pantoprazole 40 mg was the most frequently prescribed PPI in all groups, with intravenous administration predominant in inpatients. Rabeprazole 20 mg was less commonly used, primarily in outpatients, and oral administration was the main route at the discharge (Table 1).

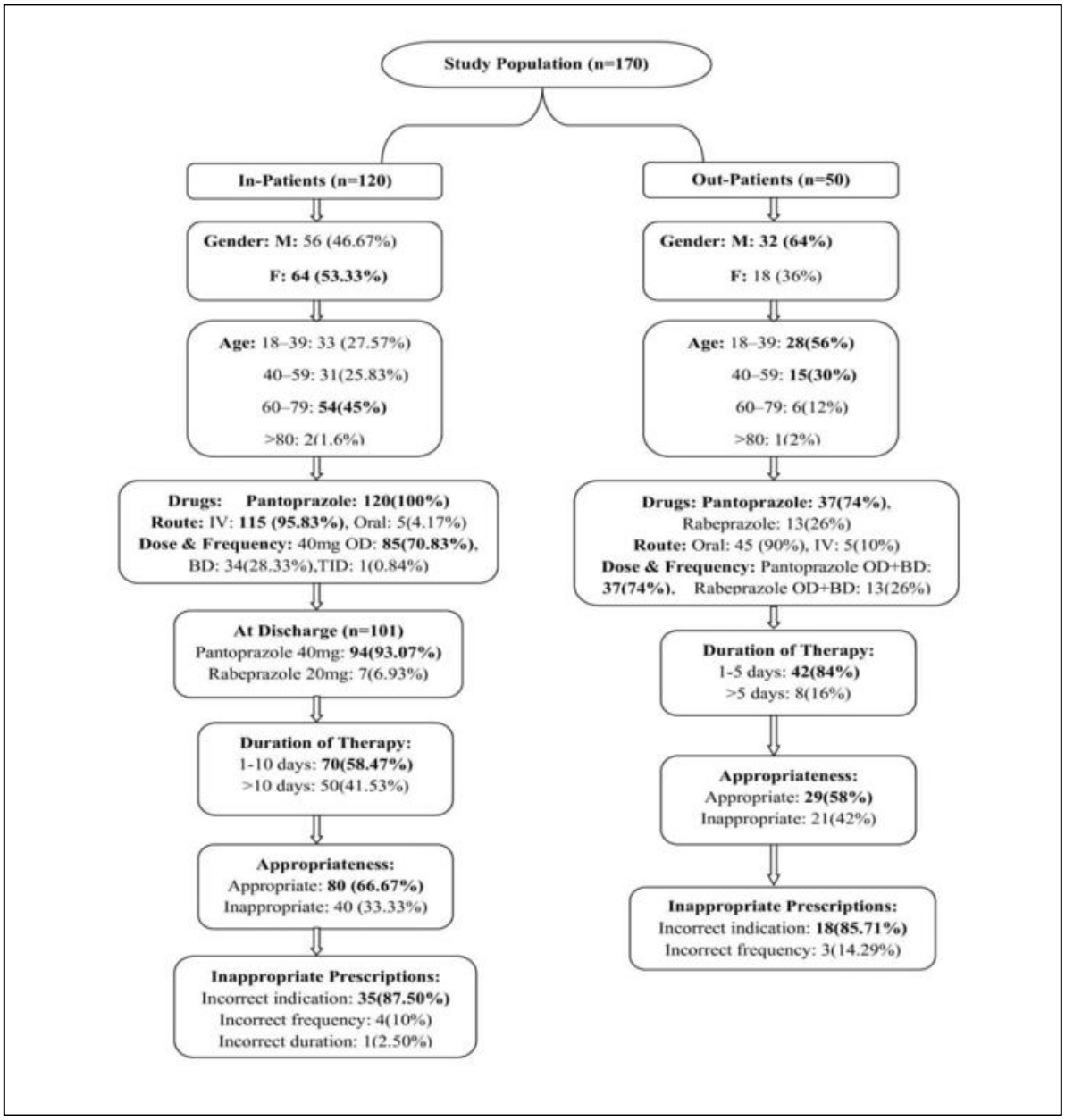

Figure 1: Study overview: PPI utilization and appropriateness.

It presents the distribution of PPI therapy duration among in-patients and out-patients. It shows that most in-patients received PPIs for a period ranging between 6-15 days, reflecting short-term hospital-based management. In contrast, the majority of out-patients used PPIs for less than five days, indicating brief courses for acute conditions. Very few patients in either group continued therapy beyond 15 days, suggesting general adherence to recommended treatment durations (Table 2).

It summarizes the various clinical diagnoses for which PPIs were prescribed among in- patients and out-patients. In-patients predominantly received PPIs for gastrointestinal, neurological, and respiratory disorders, often as part of prophylactic therapy. The most common in-patient diagnoses included acute gastroenteritis, neurological and lung disorders, and viral diseases. Among out-patients, prescriptions were largely associated with functional gastrointestinal disorders such as dyspepsia, gastritis, and abdominal pain, as well as systemic conditions like fever and anemia. The data highlight a broader prophylactic use in hospitalized patients and more indication-specific use in the outpatient setting (Table 3).

It summarizes the distribution of appropriately prescribed PPIs based on clinical indications and risk factors. In-patients most frequently received PPIs for valid gastrointestinal conditions such as GERD, gastric ulcers, and non-ulcer dyspepsia, as well as for prophylaxis against stress ulcers in high-risk patients co-prescribed with NSAIDs, corticosteroids, anti-coagulant or anti-platelet

agents. Among out-patients, the majority of appropriate prescriptions were for dyspepsia and GERD. Overall, appropriate prescribing was higher in in-patients than in out-patients, reflecting better adherence to clinical guidelines during hospitalization (Table 4).

It summarizes the extent and nature of inappropriate PPI prescriptions. The most common cause of inappropriateness in both groups was prophylactic use in low-risk patients or the absence of a valid indication. A smaller proportion of errors involved incorrect frequency or duration of therapy. Pantoprazole was frequently prescribed in multiple daily doses without clinical justification in contrast with rabeprazole. The findings emphasize the need for improved guideline adherence and pharmacist-led interventions to minimize unnecessary PPI exposure (Table 5).

Table 1: Demographic characteristics and pattern of PPI use among inpatients and outpatients.

Parameters	Inpatients (n=120)	At discharge (n=101)	Outpatients (n=50)
Gender	Males: 56 (46.67%)	Males: 46 (45.55%)	Males: 32 (64%)
	Females: 64 (53.33%)	Females: 55 (54.45%)	Females: 18 (36%)
Age distribution (in years)	18-39: 33 (27.57%)	18-39: 28 (27.72%)	18-39: 28 (56%)
	40-59: 31 (25.83%)	40-59: 27 (26.73%)	40-59: 15 (30%)
	60-79: 54 (45%)	60-79: 44 (43.56%)	60-79: 6 (12%)
	≥80: 2 (1.60%)	≥80: 2 (1.99%)	≥80: 1 (2%)
PPI used	Pantoprazole 40 mg, 120 (100%)	Pantoprazole 40 mg: 94 (93.07%)	Pantoprazole 40 mg: 37 (74%)
		Rabeprazole 20 mg: 7 (6.93%)	Rabeprazole 20 mg: 13 (26%)
Route of administration	IV: 115 (95.83%)	Oral: 101 (100%)	Pantoprazole IV: 5 (10%)
	Oral: 5 (4.17%)		Pantoprazole oral: 32 (64%)
			Rabeprazole oral: 13 (26%)
Pantoprazole frequency	OD: 85 (70.83%)	OD: 84 (83.17%)	OD: 33 (66%)
	BD: 34 (28.33%)	BD: 9 (8.91%)	BD: 4 (8%)
	TID: 1 (0.84%)	TID: 7 (0.99%)	
Rabeprazole frequency	-	OD: 6 (5.94%)	OD: 6 (12%)
		BD: 1 (0.99%)	BD: 7 (14%)

Table 2: Duration of PPI use among in-patients and out-patients.

Duration (days)	In-patients	Out-patients
1-5	30 (25.17%)	42 (84%)
6-10	40 (33.30%)	7 (14%)
11-15	38 (31.60%)	1 (2%)
16-20	10 (8.33%)	-
>20	2 (1.60%)	-

Table 3: Diagnoses of patients prescribed with PPI.

Diagnosis (In-patients)	N (%)	Diagnosis (Out-patients)	N (%)
GERD	1 (0.83%)	Gastric ulcers	1 (2%)
Peptic ulcer disease	1 (0.83%)	Acute gastroenteritis	2 (4%)
Acute gastroenteritis	13 (10.83%)	Acidity (dyspepsia/non-ulcer dyspepsia)	5 (10%)
Acute enteritis	9 (7.5%)	Abdominal pain	3 (6%)
Gastric ulcers	2 (1.67%)	Body pain	8 (16%)
Anaemia	6 (5%)	Fever	14 (28%)
Sepsis	2 (1.67%)	Fever + nausea	4 (8%)
Dysphagia	1 (0.83%)	Anaemia	1 (2%)
Hypothyroidism	3 (2.5%)	Pharyngitis	4 (8%)
Diabetic complications	7 (5.83%)	Viral diseases	4 (8%)
Neurological disorders	27 (22.5%)	Arthritis	2 (4%)
Liver disorders	6 (5%)	Accidents	2 (4%)
Lung disorders	23 (19.17%)	-	-
Viral diseases	5 (4.17%)	-	-
Others	14 (11.67%)	-	-

Table 4: Appropriate indications among in-patients and out-patients.

Variables	In-patients (n=85) (%)	Out-patients (n=32) (%)
Appropriate indications		
Peptic ulcer disease	1 (1.18)	-
GERD	4 (4.70)	5 (15.62)
Gastric ulcers with *H. Pylori* -ve	4 (4.70)	1 (3.12)
Stress ulcer prophylaxis for sepsis	2 (2.35)	-
Non-ulcer dyspepsia	13 (15.30)	13 (40.62)
Sub-total	24 (28.23)	19 (59.37)
Gastrointestinal risk due to co-prescription		
NSAIDs	11 (12.96)	7 (21.88)
Corticosteroids	4 (4.70)	1 (3.12)
Anti-platelet agents	2 (2.35)	-
Anti-coagulant agent	3 (3.52)	-
NSAIDs and corticosteroids	5 (5.88)	-
NSAIDs and anti-platelet agents	6 (7.06)	-
Anti-coagulant and anti-platelet agents	2 (2.35)	-
Sub-total	32 (38.82)	8 (25.00)
Prophylaxis against stress ulcers in high-risk patients		
NSAIDs	5 (5.88)	4 (12.51)
Corticosteroids	7 (8.27)	1 (3.12)
Anti-platelet agents	2 (2.35)	-
NSAIDs and corticosteroids	5 (5.88)	-
NSAIDs and anti-platelet agents	4 (4.70)	-
NSAIDs and anti-coagulants	2 (2.35)	-
NSAIDs, anti-coagulants and anti-platelet agents	3 (3.52)	-
Sub-total	28 (32.95)	5 (15.63)

Table 5: Inappropriate prescriptions among in-patients and out-patients.

Inappropriate prescriptions	In-patients (n=40)	Out-patients (n=21)
Incorrect indication	35 (87.5%)	18 (85.71%)
Prophylaxis against stress ulcers in low risk patients co- prescribed with NSAIDs	14 (40%)	14 (77.78%)
Prophylaxis against stress ulcers in low-risk patients co-prescribed with corticosteroids	1 (2.86%)	-
No indication	20 (57.15%)	4 (22.22%)
Incorrect frequency	4 (10%)	3 (14.29%)
Pantoprazole BD	2 (50%)	1 (33.33%)
Pantoprazole TID	1 (25%)	-
Rabeprazole BD	1 (25%)	2 (66.67%)
Incorrect duration	1 (2.5%)	-

DISCUSSION

In this study, the demographic profile of 120 in-patients receiving PPI therapy showed a slight female predominance with 56 (46.67%) were males and 64 (53.33%) were females.

Age distribution showed 33 (27.57%) patients between 18-39 years, 31 (25.83%) between 40-59 years, and 54 (45%) between 60-79 years, with 2 (1.60%) patients aged 80 and above. All the 120 (100%) were prescribed with pantoprazole as PPI during their hospital stay. It was noted that in 115 (95.83%) patients, PPI prescription was commenced through intravenous (IV) route and 5 (4.17%) through an oral route of administration. The findings are similar to the study conducted by Shivani et al wherein 138 (72%) of the study participants were prescribed PPIs through IV route and in only 54 (28%) cases an oral route was favored. Pantoprazole was the most frequently prescribed PPI in 112 (58%) patients.[21] The number of oral prescriptions in our findings is four times lesser than in this study.

The 85 (70.83%) patients were given pantoprazole 40 mg, once a day (OD), 34 (28.33%) patients, twice a day (BD), and 1 (0.84%) was prescribed thrice a day (TID). Four prescriptions accounted for inappropriate frequency, 2 (50%) were due to prescribing pantoprazole twice a day

(BD) and 1 (25%), thrice a day (TID). In Rabeprazole, 1 (25%) prescription had inappropriate frequency i.e., twice a day (BD). Similar to the study carried out by Verma et al where in most of the cases pantoprazole was prescribed at a standard dose of 40 mg once daily but, in 37 (33%) prescriptions it was prescribed 40 mg twice daily, which has no rational basis and is not a recommended dose.[22]

Out of 101 patients prescribed oral PPI's at discharge, 94 (93.07%) patients were prescribed with pantoprazole 40 mg, and 7 (6.93%) patients were prescribed with rabeprazole 20 mg respectively. The duration of PPI prescription including in-hospital stay and at discharge was 30 (25.17%) patients between the range of 1-5 days, 40 (33.30%) patients, between the range of 6-10 days, 38 (31.60%) patients, between the range of 11-15 days, 10 (8.33%) fall between the range of 16-20 days, and 2 (1.60%) were prescribed for more than 20 days.

In a study of 120 patients prescribed PPIs, the diagnoses included 1 patient (0.83%) with GERD, 1 (0.83%) with peptic ulcer disease, 13 (10.83%) with acute gastroenteritis, and 9 (7.50%) with acute enteritis. There were 2 patients (1.67%) with gastric ulcers, 6 (5%) with anemia, 2 (1.67%) with sepsis, and 1 (0.83%) with dysphagia. Additionally, 3 patients (2.50%) had hypothyroidism, 7 (5.83%) had diabetic complications, 27 (22.50%) had neurological disorders, 6 (5%) had liver disorders, 23 (19.17%) had lung disorders, 5 (4.17%) had viral diseases, and 14 (11.67%) labelled as "others." The diagnoses are similar to study done by Sukaina et al where disease distribution included 34 (19.8%) with gastrointestinal disease, 29 (16.9%) with pulmonary disease, and 24 (14.0%) with infectious disease. Cardiac disease affected 18 (10.5%), renal disease 15 (8.7%), and hepatic disease 14 (8.1%). Neurological disease was found in 12 (7.0%), endocrine disease in 10 (5.8%), and both haematological disease and "others" in 8 (4.7%) patients each.[23]

Among 120 prescriptions evaluated for appropriateness, 80 (66.67%) were appropriate, while 40 (33.33%) were inappropriate with respect to indication, frequency, and duration. The 85 (70.83%) prescriptions were compliant to indications for appropriate PPI prescription, whereas 35 (29.17%) prescriptions were not compliant. The findings are consistent with the study done by Saad et al where PPI therapy was prescribed for approved indications in 32 (66.6%) patients but for 16 (33.3%) the indication was unapproved or unknown.[24] The ratio of findings in our study is similar to that of this study.

Among 85 appropriate indications, 1 (1.18%) account for peptic ulcer disease (PUD), 4 (4.70%) accounts for GERD (Gastro esophageal reflux disease), 4 (4.70%) accounts for gastric ulcers with -ve for *H. pylori*, 2 (2.35%) for stress ulcer prophylaxis in sepsis, and 13 (15.30%) were due to non-ulcer dyspepsia (Functional dyspepsia). Patients with low risk for stress ulcers (<65 years) who had gastrointestinal risks were prescribed with PPI's for their co-prescriptions with; NSAIDs in 11 (12.96%), corticosteroids in 4 (4.70%), anti-platelet agents in 2 (2.35%), anti-coagulants in 3 (3.52%), NSAIDs paired with corticosteroids account for 5 (5.88%) and with anti-platelet agents account for 6 (7.06%). Anti-platelets and anti-coagulants given in combination accounts for 2 (2.35%).

Patients with high risk for stress ulcers were those above 65 years of age, and they were prescribed PPI's mostly for their concomitant with drugs that have the tendency to cause GI bleed, dyspepsia, reduced renal function, ulcers or polypharmacy. Among the concomitantly used drugs, NSAIDs accounts for 5 (5.88%), corticosteroids account for 7 (8.27%), anti-platelet agents account for 2 (2.35%). Patients with concomitant use of NSAIDs with Corticosteroids account for 5 (5.88%), with anti-platelet agents account for 4(4.70%), with anti-coagulants for 2 (2.35%), and both anti-coagulants and anti-platelet agents account for 3 (3.52%). Our findings align with those of Giannini et al where 93 (65.0%) patients were prescribed for GERD, 42 (91.3%) and 2 (16.7%) received treatment for dyspepsia.[12] Shivani et al had similar indications where 51 (48.57%) patients received ulcer prophylaxis for NSAID use, and 33 (31.43%) for anti-platelets or anti-coagulants. Dyspepsia was diagnosed in 5 (4.76%), 1 (0.95%) had a peptic ulcer with *H. pylori*, 5 (4.76%) had upper gastrointestinal bleeding.[21] This study shows significantly lower rates of PPI prescriptions for GERD, NSAID-related ulcer prophylaxis, and anti-platelet/anti-coagulant-related prophylaxis compared to the studies by Giannini et al and Shivani et al.[12] Out of 35 inappropriate indications, 14 (40%) accounts for prescribing as prophylaxis against stress ulcers in low risk patients concomitantly with NSAIDs, 1 (2.86%) due to co-prescription with corticosteroids. Notably, 20 prescriptions (57.15%) had no indication for PPI use. This finding is consistent with the study carried out by Marie et al where main non-conform PPI's indications were prevention of hemorrhagic risk of anti-platelet agent (16.4%), anticoagulant (16.4%), steroids (13.4%) or non-steroid anti-inflammatory therapy without any risk factor (9%).[25] The results in this study are four times lesser to our findings. In 1 (2.32%) patient, despite correct indication PPI was not discontinued even after withdrawal of medication (anti-coagulant) that had caused dyspeptic symptoms.

In 50 out-patients (OPD) enrolled into the study, there are 32 (64%) males and 18 (36%) females. Age distribution of patients showed 28(56%) patients between age group of 18-39, 15 (30%) patients of age group 40-59, 6 (12%) patients of age group 60-79 and 1 (2%) patient of age above 80 years. The findings are similar to a study by Basyal et al where the age of the patients ranged from 18 to 86 years. The majority of patients were in age groups of less than 30 (30.78%) while 2.14% were above 80 years.[26] Thirty-seven (74%) patients were prescribed pantoprazole 40 mg, with 5 (10%) receiving it intravenously and 32 (64%) orally. Additionally, 13 (26%) were prescribed

rabeprazole 20 mg, all through the oral route. Pantoprazole was prescribed once a day (OD) in 33 (66%) patients and twice a day (BD) in 4 (8%) patients. Rabeprazole was prescribed once a day (OD) in 6 (12%) patients and twice a day (BD) in 7 (14%) patients.

The duration of 42 (84%) patients falls in the range of 1-5 days, 7 (14%) patients in the range of 6-10 days, 1 (2%) patient in the range of 11-15 days. The final diagnoses were, 1 (2%) with ggastric ulcers, 2 (4%) with acute gastroenteritis, 5 (10%) with acidity (dyspepsia), 3 (6%) with abdominal pain, 8 (16%) with body pain, 14 (28%) with fever, 4 (8%) with fever and nausea, 1 (2%) with anaemia, 4 (8%) with pharyngitis, 4 (8%) with viral diseases, 2 (4%) with arthritis and 2 (4%) with accidents. It was observed that 29 (58%) prescriptions were appropriate and 21 (42%) prescriptions were inappropriate. Incorrect indications accounted for 18 (85.71%) of the inappropriate prescriptions, and incorrect frequency for 3 (14.29%). Overall, 32 (64%) prescriptions followed appropriate PPI indications, while 18 (36%) did not. Out of 32 appropriate indications, 5 (15.62%) accounts for GERD, 1 (3.12%) for gastric ulcers with -ve for *H. pylori* and 13 (40.62%) for nonulcer dyspepsia. Gastrointestinal risks due to co-prescription with NSAIDs accounts for 7(21.88%), and with corticosteroids accounts for 1 (3.12%). Prophylaxis against stress ulcers in high-risk patients due to concomitant use of NSAIDs accounts for 4 (12.51%) and with corticosteroids account for 1 (3.12%) respectively. Inappropriateness was noted in 14 (77.78%) prescription due to prophylaxis for stress ulcers among low risk patients co-prescribed with NSAIDs and about 4 (22.22%) prescriptions had absolutely no indication for PPI prescription. Frequency of 1 (33.33%) prescription was inappropriate due to prescription of pantoprazole 40 mg twice a day (BD), and 2 (66.67%) accounted for prescribing rabeprazole 20 mg twice a day (BD).

The results are consistent with the study carried out by Awanish et al where acceptable reason for PPI use was found to be dyspepsia in 41 (27.7%) patients, followed by GERD in 36 (24.3%), stress ulcer prophylaxis in 29 (19.6%), peptic ulcer disease in 24 (16.2%) and others in 18 (12.2%). Among the patients who were advised PPI without a valid indication, the most common primary disease was anaemia 51 (24.6%) followed by NSAIDs 29 (14%) and corticosteroids therapy alone 26 (12.6%).[27]

This comparison highlights some similarities but also key differences, particularly in the rates of PPI prescriptions for GERD, dyspepsia, and stress ulcer prophylaxis.

Limitations

This study has a few limitations. It was conducted in a single tertiary-care hospital, which may limit the wider applicability of the findings. The assessment depended on the accuracy of medical records, so incomplete documentation may have influenced the results. In addition, the study did not include follow-up after discharge, which prevents evaluation of long-term outcomes related to PPI use. Larger, multi-centre studies are needed to confirm these observations.

CONCLUSION

This 6-month observational study convincingly demonstrates that majority of the PPI prescriptions adhered to guidelines, with low rates of inappropriate prescribing among both in-patients (during hospitalization and at discharge) and out-patients. The key concerns were injudicious prescriptions for indications namely stress-ulcer prophylaxis among low-risk patients and unclear indications followed by inappropriate frequency.

To address this, strict adherence to clinical guidelines is crucial to ensure that PPIs are prescribed only after recognition of patients for whom prescription is truly warranted. This significantly minimizes the risk of unjustified medication utilization, adverse effects, long-term complications and declines the economic burden of patients.

Therefore, it is imperative that, implementing national guidelines or hospital-specific protocols in addition to targeted interventions and stewardship initiatives can promote rational use and ensure appropriate choice of PPI therapy in the long run.

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REFERENCES

1. Boparai V, Rajagopalan J, Triadafilopoulos G. Guide to the use of proton pump inhibitors in adult patients. Drugs. 2008;68(7):925-47.
2. Shin JM, Kim N. Pharmacokinetics and pharmacodynamics of the proton pump inhibitors. J Neurogastroenterol Motility. 2013;19(1):25.
3. Yu LY, Sun LN, Zhang XH, Li YQ, Yu L, Yuan ZQ, et al. A review of the novel application and potential adverse effects of proton pump inhibitors. Adv Ther. 2017;34(5):1070-86.
4. Katz PO, Gerson LB, Vela MF. Guidelines for the diagnosis and management of gastroesophageal reflux disease. J Am College Gastroenterol| ACG. 2013;108(3):308-28.
5. Barradell LB, Faulds D, McTavish D. Lansoprazole: a review of its pharmacodynamic and pharmacokinetic properties and its therapeutic efficacy in acid- related disorders. Drugs. 1992;44(2):225-50.
6. Fuhr U, Jetter A. Rabeprazole: pharmacokinetics and pharmacokinetic drug interactions. Die Pharmazie. 2002;57(9):595-601.
7. Jungnickel PW. Pantoprazole: a new proton pump

inhibitor. Clin Ther. 2000;22(11):1268-93.
8. Andersson T, Hassan-Alin M, Hasselgren G, Röhss K, Weidolf L. Pharmacokinetic studies with esomeprazole, the (S)-isomer of omeprazole. Clin Pharmacokinetics. 2001;40(6):411-26.
9. Wittbrodt ET, Baum C, Peura DA. Delayed release dexlansoprazole in the treatment of GERD and erosive esophagitis. Clin and Exp Gastroenterol. 2009:117-28.
10. Shung DL, Laine L. Upper gastrointestinal bleeding–review of current evidence and implications for management. Aliment Pharmacol Ther. 2024;59(9):1062-81.
11. Gupta Y, Bhandari S, Govil A, Gupta R, Goyal J, Goyal B, et al. Use and inappropriate use of proton pump inhibitors in hospitalized patients. Intl J Basic Clin Pharmacol. 2019;8(11):2490.
12. Giannini EG, Crespi M, Djahandideh A, Demarzo MG, Moscatelli A, Bodini G, et al. Appropriateness of proton pump inhibitors treatment in clinical practice: prospective evaluation in outpatients and perspective assessment of drug optimisation. Dig Liv Dis. 2020;52(8):862-8.
13. Rakesh TP. Proton pump inhibitors: use, misuse and concerns about long-term therapy. Clin J Gastroenterol. 2011;4(2):53-9.
14. Kunwar N, Kumaraswamy M, Shrestha S, Paudel S, Kafle B, Pokharel T, et al. A study on proton pump inhibitors in the general medicine unit of a tertiary care teaching hospital. World J Pharm Res. 2015;4(6):1519-34
15. Forgacs I, Loganayagam A. Overprescribing proton pump inhibitors. BMJ. 2008;336(7634):2-3.
16. Lam JR, Schneider JL, Zhao W, Corley DA. Proton pump inhibitor and histamine 2 receptor antagonist use and vitamin B12 deficiency. JAMA. 2013;310(22):2435-42.
17. Dyspepsia and gastro-oesophageal reflux disease: investigation and management. NICE Clinical Guideline [CG184]. 2014.
18. Atkins AM, Sekar MC, Ph R. Proton pump inhibitors: Their misuse, overuse and abuse. IOSR J Pharm. 2013;3(2):25-9.
19. Naunton M, Peterson GM, Bleasel MD. Overuse of proton pump inhibitors. J Clin Pharm and Ther. 2000;25(5):333-40.
20. Grant K, Al-Adhami N, Tordoff J, Livesey J, Barbezat G, Reith D. Continuation of proton pump inhibitors from hospital to community. Pharm World Sci. 2006;28(4):189-93.
21. Juneja S, Rana P, Manoj SV, Kalia R, Singh RP. Appropriateness of Proton Pump Inhibitor Use in Hospitalized Patients: A Cross-Sectional Study in a Tertiary Care Hospital in North India. J Pharm Care 2023;11(2):61-5.
22. 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):113-20.
23. Damji SS, Rabbani SA, Rao PG, Butt AU. Proton pump inhibitor use and appropriateness analysis: a snapshot from a secondary care hospital. J Pharm Health Services Res. 2021;12(2):206-12.
24. Mat Saad AZ, Collins N, Lobo MM, O'connor HJ. Proton pump inhibitors: a survey of prescribing in an Irish General Hospital. Intl J Clin Pract. 2005;59(1):31-4.
25. Marie I, Moutot A, Tharrasse A, Hellot MF, Robaday S, Hervé F, et al. Validity of proton pump inhibitors' prescriptions in a department of internal medicine. La Revue de Med Interne. 2006;28(2):86-93.
26. Basyal B, Marasine NR, Sankhi S, Lamichhane R, Uprety BN. Prescribing pattern of proton pump inhibitors among patients visiting the outpatient general medicine clinic in a tertiary care teaching hospital in Nepal. J Health Res. 2022;36(5):946-53.
27. Awanish K, Gyan BR, Ashish KS, Vandana K. How appropriately are adults being prescribed proton pump inhibitors-experience of a tertiary care centre. Intl J Health Clin Res. 2021;4(7):238-41.

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