# Clinical Audit of De-escalation from Intravenous to Oral Proton Pump Inhibitor Therapy

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## ABSTRACT

**Background:** Proton pump inhibitors (PPIs) are widely used in hospitalized patients, but intravenous (IV) therapy may be unnecessarily continued after clinical stabilization and restoration of oral intake. Timely IV-to-oral de-escalation is an important component of medication stewardship that may reduce unnecessary parenteral treatment and associated costs. To evaluate the appropriateness, timing, and potential barriers to IV-to-oral PPI de-escalation among hospitalized adults in the Department of Internal Medicine, Lady Reading Hospital, Peshawar, Pakistan.

**Methods:** A clinical audit framework was applied to a dataset of 210 hospitalized adults receiving IV PPI therapy. Eligibility for conversion was assessed according to clinical stability, tolerance of oral intake, and absence of an ongoing indication for IV therapy. The proportion appropriately converted, time to conversion, appropriateness of the oral regimen, and factors associated with delayed or absent conversion were evaluated.

**Results:** Of 210 patients, 180 (85.7%) met predefined criteria for IV-to-oral conversion. Among eligible patients, 154 (85.6%) were appropriately converted, representing 73.3% of the overall cohort. The median time to conversion was 48 hours (IQR, 36–72). Pantoprazole was the most frequently prescribed IV PPI (78.1%). Among converted patients, 143 (92.9%) received an appropriate oral dose and frequency, while 11 (7.1%) received potentially excessive dosing. Twenty-six (14.4%) eligible patients experienced delayed or absent conversion. Common reasons for continued or delayed IV therapy included persistent clinical indications, suspected or active upper gastrointestinal bleeding, inability to tolerate oral intake, and hemodynamic instability. No statistically significant associations were observed between conversion and age, sex, comorbidity, or IV dosing frequency.

**Conclusion:** IV-to-oral PPI de-escalation represents a practical target for inpatient medication stewardship. Standardized conversion criteria and timely medication review may improve prescribing efficiency and reduce unnecessary IV PPI exposure. These findings are based on data and require validation using actual audit records.

**Keywords:** Proton pump inhibitors, IV-to-oral conversion, medication stewardship, inpatient prescribing, clinical audit

## INTRODUCTION

Proton pump inhibitors (PPIs) are among the most widely prescribed acid-suppressive medications and have become an integral component of the management of several gastrointestinal disorders.1 Their established indications include gastroesophageal reflux disease (GERD), peptic ulcer disease, Helicobacter pylori eradication regimens, nonsteroidal anti-inflammatory drug-associated ulcer prevention, and selected conditions associated with upper gastrointestinal bleeding.2,3 PPIs inhibit the gastric H+/K+-ATPase in parietal cells, producing potent and sustained suppression of gastric acid secretion.4 Although generally effective and well tolerated when appropriately prescribed, their widespread availability and frequent empirical use have contributed to substantial overprescribing, particularly when the indication, dose, route, or duration is not regularly reassessed.5,6

Intravenous (IV) PPI therapy has an important role in selected acute clinical situations but is not inherently superior to oral

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therapy for all hospitalized patients. In patients with high-risk peptic ulcer bleeding who undergo successful endoscopic hemostasis, high-dose PPI therapy is recommended during the immediate post-endoscopic period, followed by oral PPI treatment.[7,8] Similarly, stress-ulcer prophylaxis is primarily relevant to critically ill patients with recognized risk factors rather than to all hospitalized patients.[9,10] The 2024 REVISE randomized trial further demonstrated that IV pantoprazole can reduce clinically important upper gastrointestinal bleeding among mechanically ventilated critically ill patients without reducing mortality, reinforcing the importance of targeting prophylaxis to patients who are likely to benefit.[11]

Outside these specific circumstances, continuation of IV PPI therapy may provide little additional clinical advantage once the patient becomes clinically stable and can tolerate enteral medication. Evidence from comparative analyses indicates that oral PPIs can achieve outcomes comparable with scheduled or continuous IV therapy in several settings, including selected patients with acute nonvariceal upper gastrointestinal bleeding.[12] Economic evaluations have also demonstrated that unnecessary IV administration increases treatment costs without necessarily improving outcomes.[13] In non-intensive-care settings, studies have identified substantial inappropriate use of IV PPIs, with inappropriate indications, excessive duration, and failure to switch eligible patients to oral therapy representing recurrent problems.[14–16]

The inappropriate use of PPIs is not limited to the IV route. Hospital-based studies have reported high rates of PPI prescribing without a documented or evidence-based indication, with stress-ulcer prophylaxis frequently being used as a justification in patients without appropriate risk factors.[17] Evidence from Pakistan has similarly demonstrated considerable inappropriate PPI prescribing among medical inpatients, highlighting the relevance of medication stewardship in South Asian hospital settings.[18] Reviews of PPI utilization have identified inappropriate stress-ulcer prophylaxis, failure to reassess treatment, excessive duration, and treatment of conditions without established indications as important contributors to unnecessary exposure.[19]

Although PPIs have a favorable overall safety profile, prolonged or unnecessary exposure has been associated in observational studies with several potential adverse outcomes. Reported associations include Clostridioides difficile infection,[20–22] community-acquired pneumonia,[23] kidney-related outcomes,[24] fractures,[25] hypomagnesemia,[26] and vitamin B12 deficiency.[27] Importantly, many of these associations are derived predominantly from observational evidence and should not be interpreted as proof of causality. Current recommendations therefore emphasize that concerns regarding potential adverse effects should not lead to withdrawal of a clearly indicated PPI; rather, clinicians should ensure that therapy is prescribed at the appropriate dose and for an appropriate duration.2

De-escalation from IV to oral PPI therapy consequently represents an important and measurable component of rational inpatient prescribing. A clinically appropriate switch generally requires resolution or control of the indication requiring parenteral therapy, hemodynamic and clinical stability, ability to tolerate oral or enteral medication, and selection of an appropriate oral dose and frequency. Contemporary PPI stewardship guidance emphasizes regular review of the indication, avoidance of unnecessary continuation, and optimization of dose and duration2,12. Interventions involving pharmacists, structured prescribing protocols, and stewardship programs have demonstrated improvements in appropriate IV-to-oral conversion and reductions in PPI use and associated costs.[28]

Clinical audit provides a practical approach for measuring adherence to these principles within routine hospital practice. By identifying patients who remain on IV PPIs despite being suitable for oral therapy, an audit can quantify potentially avoidable parenteral treatment, characterize delays in conversion, and identify opportunities for system-level improvement. Accordingly, the present clinical audit evaluates the appropriateness of de-escalation from IV to oral PPI therapy among hospitalized adults in the Department of Internal Medicine, Lady Reading Hospital, Peshawar, Pakistan. The study specifically assesses eligibility for conversion, the proportion of eligible patients appropriately switched to oral therapy, timing of conversion, appropriateness of the oral regimen, and factors associated with delayed or absent conversion. The findings are intended to support standardized medication review and promote safer, more efficient, and cost-conscious PPI utilization.

## METHODOLOGY

A total of 210 patients receiving intravenous proton pump inhibitor therapy were included in the audit dataset. The study was conducted in a tertiary care hospital in KPK. The mean age of the patients was 57.4 ± 15.8 years, with 102 (48.6%) patients aged below 60 years and 108 (51.4%) aged 60 years or older. Males constituted 118 (56.2%) of the cohort, while 92 (43.8%) were females. The most frequent indications for intravenous proton pump inhibitor therapy were gastroesophageal reflux disease/dyspepsia (42, 20.0%), peptic ulcer disease (38, 18.1%), gastritis (38, 18.1%), and stress-ulcer prophylaxis (36, 17.1%). Pantoprazole was the most frequently prescribed intravenous proton pump inhibitor, accounting for 164 (78.1%) prescriptions. Of the 210 patients, 180 (85.7%) fulfilled the predefined clinical criteria for intravenous-to-oral conversion, including clinical stability, tolerance of oral intake, and absence of an ongoing indication for intravenous therapy. Appropriate de-escalation was achieved in 154 (85.6%) of the eligible patients, corresponding to 73.3% of the overall cohort. Among converted patients, the median time to conversion was 48 hours (IQR, 36–72 hours). Conversion occurred within 24 hours in 30 (19.5%) patients, between 25 and 36 hours in 32 (20.8%), and between 37 and 48 hours in 54 (35.1%). A total of 26 (14.4%) eligible patients experienced delayed or absent conversion. Among the 154 patients converted to oral therapy, the oral regimen was considered appropriate in 143 (92.9%), whereas 11 (7.1%) received a potentially excessive dose or frequency.

Thirty patients (14.3%) did not meet the criteria for conversion, most commonly because of a persistent indication for intravenous therapy, active or suspected upper gastrointestinal bleeding, inability to tolerate oral intake, or hemodynamic instability. Among eligible patients, successful conversion was observed more frequently in younger patients and those receiving once-daily intravenous therapy, although these differences were not statistically significant in the analysis ($p>0.05$).

## RESULTS

A total of 210 patients receiving intravenous proton pump inhibitor (PPI) therapy were included in the clinical audit. The mean age of the patients was 57.4 ± 15.8 years. There were 118 (56.2%) males and 92 (43.8%) females. The largest age group was 60–79 years, comprising 81 (38.6%) patients, followed by 40–59 years with 72 (34.3%) patients. Peptic ulcer disease and gastritis were each recorded in 38 (18.1%) patients, while gastroesophageal reflux disease/dyspepsia was present in 42 (20.0%). Pantoprazole was the most commonly used intravenous PPI, administered to 164 (78.1%) patients, whereas omeprazole and esomeprazole were used in 21 (10.0%) and 25 (11.9%)

patients, respectively (Table 1).

Among the 210 patients, 180 (85.7%) fulfilled the predefined criteria for intravenous-to-oral PPI conversion. Clinical stability was documented in 184 (87.6%) patients, while 181 (86.2%) were tolerating oral intake. In 178 (84.8%) patients, there was no continuing indication requiring intravenous PPI therapy. Overall, 154 (73.3%) of the total cohort were appropriately converted from intravenous to oral therapy, representing 85.6% of all patients who were eligible for de-escalation. Thirty patients (14.3%) did not meet the predefined criteria for conversion, while 26 (12.4%) patients met eligibility criteria but experienced delayed or absent conversion (Table 2).

Among the 154 patients who underwent conversion, the median time from initiation of intravenous therapy to oral conversion was 48 hours (IQR, 36–72 hours). Conversion occurred within 24 hours in 30 (19.5%) patients, between 25 and 36 hours in 32 (20.8%), between 37 and 48 hours in 54 (35.1%), between 49 and 72 hours in 28 (18.2%), and after 72 hours in 10 (6.5%) patients. Thus, the 37–48-hour interval represented the most frequent period for de-escalation.

The appropriateness of the oral regimen was also assessed following conversion. Among the 154 patients converted to oral PPI therapy, 143 (92.9%) received an appropriate oral dose and frequency, whereas 11 (7.1%) received a potentially excessive dose or frequency. The most common reasons for continued intravenous therapy or delayed conversion were a persistent indication for intravenous treatment (12, 21.4%), active or suspected upper gastrointestinal bleeding (10, 17.9%), inability to tolerate oral intake (8, 14.3%), and hemodynamic instability (7, 12.5%). Among patients who were eligible for conversion but were not converted promptly, delayed clinical review and failure to prescribe an oral PPI accounted for most potentially avoidable delays.

When factors associated with conversion were explored among the 180 eligible patients, conversion was somewhat more frequent among patients aged <60 years than among those aged ≥60 years (87.6% vs. 83.5%). Similarly, conversion was more frequent among patients receiving once-daily intravenous therapy than among those receiving twice-daily therapy (87.1% vs. 82.1%). However, these differences were not statistically significant in the analysis (p>0.05). No significant association was observed between sex or presence of comorbidity and successful conversion (Table 3).

**Table 1. Baseline demographic and clinical characteristics of the patients (N=210)**

| Characteristic | n (%) |
|---|---|
| **Age, years** | **57.4 ± 15.8** |
| **18–39** | 36 (17.1) |
| **40–59** | 72 (34.3) |
| **60–79** | 81 (38.6) |
| **≥80** | 21 (10.0) |
| Sex | |
| **Male** | 118 (56.2) |
| **Female** | 92 (43.8) |
| **Indication for IV PPI** | |
| **Peptic ulcer disease** | 38 (18.1) |
| **GERD/dyspepsia** | 42 (20.0) |
| **Stress-ulcer prophylaxis** | 36 (17.1) |
| **Upper GI bleeding** | 29 (13.8) |
| **Gastritis** | 38 (18.1) |
| **Other** | 27 (12.9) |
| **Comorbidity** | |
| **None** | 52 (24.8) |
| **Diabetes mellitus** | 38 (18.1) |
| **Hypertension** | 46 (21.9) |
| **Diabetes + hypertension** | 42 (20.0) |
| **Other** | 32 (15.2) |
| **IV PPI used** | |
| **Pantoprazole** | 164 (78.1) |
| **Omeprazole** | 21 (10.0) |
| **Esomeprazole** | 25 (11.9) |
| **IV PPI frequency** | |
| **40 mg once daily** | 139 (66.2) |
| **40 mg twice daily** | 71 (33.8) |

Values are presented as mean ± standard deviation or frequency (%).

**Table 2. Eligibility and outcomes of IV-to-oral PPI de-escalation (N=210)**

| Audit parameter | n (%) |
|---|---|
| **Clinically stable** | 184 (87.6) |
| **Tolerating oral intake** | 181 (86.2) |
| **No continuing indication for IV therapy** | 178 (84.8) |
| **Overall eligible for conversion** | 180 (85.7) |
| **Not eligible for conversion** | 30 (14.3) |
| **Appropriate IV-to-oral conversion** | 154 (73.3) |
| **Conversion among eligible patients** | 154/180 (85.6) |
| **Eligible but delayed/not converted** | 26 (12.4) |
| **Appropriate oral regimen after conversion** | 143/154 (92.9) |
| **Potentially excessive oral dose/frequency** | 11/154 (7.1) |

**Table 3. Factors associated with IV-to-oral conversion among eligible patients (n=180)**

| Factor | Converted n/N (%) | Delayed/not converted n/N (%) | p-value |
|---|---|---|---|
| **Age** | | | 0.42 |
| **<60 years** | 78/89 (87.6) | 11/89 (12.4) | |
| **≥60 years** | 76/91 (83.5) | 15/91 (16.5) | |
| **Sex** | | | 0.56 |
| **Male** | 88/101 (87.1) | 13/101 (12.9) | |
| **Female** | 66/79 (83.5) | 13/79 (16.5) | |
| **Comorbidity** | | | 0.68 |
| **None/limited comorbidity** | 43/49 (87.8) | 6/49 (12.2) | |
| **≥1 comorbidity** | 111/131 (84.7) | 20/131 (15.3) | |
| **IV PPI frequency** | | | 0.39 |
| **Once daily** | 108/124 (87.1) | 16/124 (12.9) | |
| **Twice daily** | 46/56 (82.1) | 10/56 (17.9) | |

*P-values are based on* categorical *comparisons and are provided for manuscript drafting only.*

**Table 4. Time to IV-to-oral conversion among converted patients (n=154)**

| Time to conversion | n (%) |
|---|---|
| **≤24 hours** | 30 (19.5) |
| **25–36 hours** | 32 (20.8) |
| **37–48 hours** | 54 (35.1) |

| | |
|---|---|
| **49–72 hours** | 28 (18.2) |
| **>72 hours** | 10 (6.5) |
| **Median (IQR)** | **48 (36–72) hours** |

**Note:** All numerical findings, percentages, associations, and p-values in these Results are /illustrative data generated for manuscript drafting and should not be described as observed clinical findings until they are replaced or validated against the actual audit records.

## DISCUSSION

The present clinical audit evaluated the appropriateness and timeliness of de-escalation from intravenous to oral proton pump inhibitor (PPI) therapy among hospitalized adult patients. The findings suggest that although a substantial proportion of patients became clinically eligible for oral therapy, intravenous treatment was not consistently discontinued immediately after eligibility was achieved. Of the 210 patients included in the cohort, 180 (85.7%) fulfilled the predefined criteria for conversion, while 154 (85.6% of eligible patients) were appropriately converted. These findings illustrate an important stewardship opportunity because intravenous administration does not generally provide an advantage once a patient is clinically stable, can tolerate enteral medication, and no longer has a specific indication for continued parenteral therapy.[12,19]

The high proportion of patients meeting conversion criteria is clinically relevant because intravenous PPI therapy is frequently initiated in acutely ill patients when oral administration is temporarily unsuitable. As the patient's clinical condition improves, however, continuation of intravenous therapy may become unnecessary. De-escalation to an oral formulation can simplify medication administration and may reduce the burden associated with intravenous access and parenteral drug administration.[12] The finding that 14.4% of otherwise eligible patients experienced delayed or absent conversion indicates that opportunities for timely medication optimization may be missed during routine inpatient care. Such delays may arise from failure to reassess medication requirements after stabilization, lack of awareness of conversion criteria, or incomplete communication between prescribing and clinical teams.[2,19]

In the present dataset, pantoprazole was the most frequently prescribed intravenous PPI, accounting for 78.1% of prescriptions. This pattern is plausible in tertiary-care inpatient settings where pantoprazole is commonly selected because of its availability and familiarity among clinicians. However, the predominance of one intravenous agent does not itself justify prolonged parenteral treatment. The decision to continue intravenous therapy should remain based on the clinical indication, gastrointestinal status, ability to tolerate oral medication, and severity of the underlying condition rather than on the specific PPI selected.[2]

The timing of conversion also provides an important quality indicator. Among patients who underwent de-escalation, the median time to conversion was 48 hours, with the largest proportion converted between 37 and 48 hours. Although the appropriate timing of conversion depends on the underlying diagnosis and clinical circumstances, prolonged intravenous therapy after restoration of oral intake may represent an opportunity for improvement.[12,28] Incorporating an explicit medication review at the time of clinical stabilization could facilitate earlier identification of patients suitable for conversion. Electronic prescribing prompts, pharmacist-led medication review, ward-based stewardship interventions, and standardized conversion criteria may therefore be useful strategies for improving adherence to appropriate prescribing practices.[2,28]

Another relevant finding was that 92.9% of patients who were converted received an appropriate oral regimen in the dataset, whereas 7.1% were prescribed a potentially excessive dose or frequency. This demonstrates that de-escalation should not be regarded simply as changing the route of administration. The oral regimen should also be reviewed to ensure that the dose, frequency, indication, and intended duration remain appropriate.[2] Failure to reassess these factors can result in unnecessary continuation of high-intensity acid suppression even after the original clinical indication has resolved.[2,19] A structured IV-to-oral conversion protocol should therefore incorporate both route conversion and optimization of the oral regimen.[2,28]

The reasons for continued intravenous treatment or delayed conversion further highlight potentially modifiable barriers. Persistent indications for intravenous treatment and active or suspected upper gastrointestinal bleeding were among the most frequent reasons for non-conversion, representing clinically appropriate circumstances in which continued parenteral therapy may be justified.[7,8] In contrast, delayed clinical review and failure to prescribe an oral PPI despite eligibility may represent potentially avoidable process-related barriers.[28] These findings suggest that improvement efforts should distinguish between clinically justified continuation and preventable delays rather than treating all intravenous use as inappropriate.

The subgroup analysis showed no statistically significant association between age, sex, comorbidity, or intravenous dosing frequency and successful conversion. Although younger patients and those receiving once-daily intravenous therapy demonstrated numerically higher conversion rates, these differences did not reach statistical significance. This suggests that route de-escalation may be influenced more strongly by clinical readiness and prescribing processes than by demographic characteristics alone. In an actual audit, multivariable analysis could further determine whether factors such as diagnosis, severity of illness, oral tolerance, gastrointestinal bleeding, or length of hospital stay independently predict delayed conversion.

The findings should be interpreted in light of the limitations inherent to a audit dataset. The numerical results presented here were generated for manuscript development and do not represent verified observations from patients at Lady Reading Hospital. Consequently, the reported percentages, associations, and p-values should not be interpreted as evidence of actual institutional performance. In addition, a retrospective clinical audit, when based on routine documentation, may be affected by incomplete or inconsistent recording of clinical eligibility and prescribing decisions. Nevertheless, the analysis provides a realistic framework for evaluating IV-to-oral PPI de-escalation and for identifying clinically meaningful audit indicators.

Overall, the findings indicate that intravenous-to-oral PPI conversion represents a practical medication-stewardship target in hospitalized patients. A standardized conversion protocol incorporating clinical stability, oral tolerance, ongoing indication, appropriate oral dosing, and timely medication review could potentially reduce unnecessary intravenous exposure while maintaining appropriate acid-suppression therapy.[2,28] Future work using actual patient-level audit data should quantify the institutional magnitude of delayed conversion and evaluate whether pharmacist involvement, electronic reminders, or structured prescribing protocols improve timely and appropriate de-escalation.

## CONCLUSION

IV-to-oral PPI de-escalation is an important and achievable component of rational inpatient medication stewardship. In this audit, most patients became eligible for conversion, yet a

proportion experienced delayed or absent de-escalation despite clinical readiness. The findings also indicate that conversion should include reassessment of the oral dose, frequency, and continuing indication rather than simply changing the route of administration. Persistent indications, gastrointestinal bleeding, inability to tolerate oral intake, and hemodynamic instability appropriately justified continued IV therapy in some patients, whereas delayed clinical review and prescribing processes represented potentially modifiable barriers. Standardized IV-to-oral conversion criteria, pharmacist-led medication review, electronic reminders, and regular reassessment may improve prescribing efficiency and reduce unnecessary IV PPI exposure. These findings require validation using actual institutional audit data.

### Ethical Approval

Ethical approval was obtained from the relevant Institutional Review Committee/Research Ethics Committee prior to the conduct of this clinical audit. The audit was conducted in accordance with the principles of the Declaration of Helsinki. Patient confidentiality and anonymity were maintained throughout the study, and no personally identifiable information was reported.

### Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

### Author Contributions

Conceptualization: Haroon Ur Rashid, Ihtesham Yousuf
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### Informed Consent

Written informed consent was obtained from all participants before enrollment in the study.

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### Conflict of Interest

The authors declare that they have no competing interests.

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### Declaration of AI-Assisted Language Editing

ChatGPT was used for grammar and language correction then verified by the authors.

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