Outcomes From a Pharmacist - led Proton Pump Inhibitor Stewardship Program at a Single Institution

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Abstract

Background: Proton pump inhibitors (PPIs) are effective medications for acid-related disorders; however, they are also overused and may be associated with several adverse effects. A PPI stewardship program was implemented at one institution to combat the overuse of PPIs. **Objective:** The purpose of this study is to evaluate the effectiveness of an inpatient PPI stewardship program in reducing PPI use, both during hospitalization and upon discharge. **Methods:** This was a retrospective cohort study of all patients admitted to an internal medicine service at a single institution from March 14, 2016, to August 14, 2016, with an intervention by the PPI stewardship team. The primary objective was to determine the percentage of patients who tolerated inpatient and outpatient PPI discontinuation, or dose de-escalations upon discharge. Secondary objectives included the identification of risk factors for intolerance of PPI discontinuation, the occurrence of gastrointestinal (GI) complications after PPI discontinuation, and the percentage of patients who required “as needed” acid suppressive therapy (AST) with an antacid or histamine-2 receptor antagonist (H2RA) to control their symptoms while hospitalized. **Results:** During the study time period, 537 patients with an active outpatient prescription for a PPI were admitted to an internal medicine team with 41.0% (n = 220) not meeting criteria for inpatient continuation. Of these patients, 95.9% (n = 211) tolerated inpatient PPI discontinuation, with 83.4% (n = 176) not requiring any “as needed” AST during hospitalization. Upon discharge, 57.1% patients (n = 24 of 42) tolerated PPI discontinuation at 3 months, while 81.8% patients (n = 18 of 22) tolerated PPI dose de-escalations at 3 months. Risk factors for intolerance of inpatient PPI discontinuation were a higher body mass index (BMI) (33.7 vs 30.3 kg/m², P = .046) and longer length of stay (7.0 vs 4.0 days, P = .03), while longer duration of PPI use (9.0 vs 5.5 years, P = 0.03) was identified as a risk factor for intolerance of outpatient PPI discontinuation. One patient experienced reflux esophagitis 2 months after PPI discontinuation. **Conclusion:** A PPI stewardship program at a single institution resulted in the reduction of inappropriate PPI use in both the inpatient and outpatient settings.

Keywords

gastrointestinal agents, physician prescribing, drug/medical use evaluation

Background

Proton pump inhibitors (PPIs) are useful medications for the treatment of acid-related disorders. However, PPIs are overused, with various studies finding 46% to 61% of patients lack an evidence-based indication for therapy.^{1–3} Moreover, as follow-up appointments to specifically evaluate the continued need for PPIs are uncommon, PPI therapy is rarely discontinued once initiated.³ Recent studies suggest there are several risks associated with prolonged PPI therapy, including pneumonia, fractures, hypomagnesemia, *Clostridium difficile* infection (CDI), and spontaneous bacterial peritonitis, as well as some retrospective studies suggesting a link between PPIs and mortality in the elderly.^{4–10} With increasing knowledge about the risks associated with PPI therapy, there is a greater awareness of the need to limit the use of unnecessary PPIs.

Several studies have described efforts to de-prescribe PPIs without evidence-based indications with success rates ranging from 14% to 64%.¹¹ Due to the various modalities studied, with differing success rates, the optimal method for PPI discontinuation remains unclear. Lifestyle modification alone, including weight loss, has proven efficacious in some patients, particularly those with nonerosive gastric reflux.¹² Patient education and pharmacist-led gastroesophageal

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Table 1. Criteria for Inpatient Continuation of Proton Pump Inhibitor (PPI).

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- UGIB, erosive esophagitis, ulcer diagnosed in the last 8 weeks, or longer than 8 weeks ago, but with documented persistent symptoms of GERD
 - Barrett esophagus
 - Esophageal strictures secondary to acid reflux
 - Hypersecretory disorder
 - Gastric malignancy or previous esophageal or gastric surgery (excluding total gastrectomy)
 - Treatment for *Helicobacter pylori* infection
 - PPI initiated by VA gastroenterologist^a
 - Current inpatient diagnosis includes an acid-related disorder on the differential
 - Documentation of failed previous attempts at PPI weaning/discontinuation
 - Chronic kidney disease IV or V^a
 - Active cancer^a
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Note. UGIB = upper gastrointestinal bleed; GERD = gastroesophageal reflux disease; VA = Veterans Affairs.

^aNot a true indication for PPI therapy; however, the PPI stewardship team deferred decisions on PPI discontinuation in these patients to the facilities' gastroenterologists, nephrology pharmacist, and oncology pharmacist.

reflux disease (GERD) or heartburn clinics have also enjoyed varying degrees of success in the outpatient setting.¹³⁻¹⁵ In the inpatient setting, effective discontinuation strategies have included provider education, medication reconciliation tools, and the implementation of institution-specific guidelines for appropriate PPI use.^{1,16-18}

One barrier to successful PPI discontinuation is the phenomenon of rebound hyperacidity in which acid-related symptoms develop when PPI treatment is stopped.^{19,20} Symptoms are most prevalent in the first 2 weeks after discontinuation but may persist for several weeks.^{19,21,22} To combat this, studies have used many strategies, ranging from PPI tapering to abrupt withdrawal, with step-down therapy appearing to be more successful than abrupt discontinuation at reducing the risks of symptom reoccurrence.¹¹

Previously, we described the development and implementation of a PPI stewardship program at our facility.²³ This is a pharmacist-led program whereby all patients admitted to a medicine service in our facility are evaluated by a pharmacist on the PPI stewardship team to determine whether they have an appropriate indication for PPI continuation in the hospital. Table 1 lists the criteria for inpatient continuation of PPIs. It was established based on available published evidence regarding appropriate PPI indications, with input from one of the facility's hospitalists and gastroenterologists, and approved by the facility's acute care committee and pharmacy and therapeutics committee.²⁴⁻²⁶ Although chronic kidney disease and active cancer are not indications for PPI therapy, these patients were excluded from this program, and decisions regarding PPI therapy were deferred to the nephrology or oncology pharmacists.

The process for implementation the PPI stewardship program (Figure 1) was created with pharmacist and hospitalist collaboration. Daily pharmacist reviews are performed on all medicine patients with a home prescription for a PPI. If no proper indication is found for inpatient continuation, the inpatient PPI order is discontinued and replaced by "as needed"

acid suppressive therapy (AST), including antacids and histamine-2 receptor antagonists (H2RA). The hospitalists and gastroenterologist are occasionally contacted with questions or clarifications in complicated patients; however, medication changes are made by the pharmacists practicing under a scope of practice, previously established by the facility. The attending physician is notified of any medication changes by a note entered into the chart (Figure 2). PPIs may be resumed at the medical team's discretion or per patient request, particularly if symptoms are uncontrolled with "as needed" AST.

In addition to the inpatient component of the PPI stewardship program, the stewardship team also evaluates patients' indications for outpatient resumption of their PPI upon hospital discharge. If patients meet any of the criteria from Table 2, they are instructed to resume their PPI upon discharge, as there is evidence to support the long-term benefits of PPI therapy for these indications.^{24,27-30} Of note, the PPI stewardship team recognized corticosteroid and anticoagulant use alone is not an indication for long-term PPI use; however, internal analyses prior to the implementation of this program found that many of our veterans receiving these agents also possessed other risk factors placing them at higher risk for bleeding, such as history of peptic ulcers, age greater than 65 years, or concomitant use of nonsteroidal anti-inflammatory drug (NSAID) therapy, so the criteria were broadened to allow these patients to remain on long-term PPI therapy.²⁴

Therefore, for some patients admitted to our facility, PPI interruption is relatively brief. The rationale for this novel approach is based on the PPI stewardship team's hypothesis that stopping PPI therapy in the inpatient setting, even for brief periods, may provide benefits such as a decrease in the risk of CDI.³¹ As the risk of gastrointestinal (GI)-related complications with brief interruptions of therapy was felt by the PPI stewardship team to be minor for all PPI indications, other than those specified in Table 1, the potential benefits of this practice were felt to outweigh the risks, although this practice has not yet been studied to confirm this hypothesis.

Figure 1. Proton pump inhibitor (PPI) stewardship program flowchart.

Conversely, patients who do not meet the criteria in Table 2 are counseled by medication reconciliation pharmacists upon hospital discharge to attempt a trial of PPI discontinuation and are offered a prescription for “as needed” antacids to treat symptoms of rebound hyperacidity.

Finally, for those patients who meet criteria for outpatient PPI use (ie, erosive esophagitis) but are on a higher than standard PPI dose without a documented reason for this dose (eg, persistent symptoms on a lower dose, or recent gastrointestinal bleeding [GIB]), the stewardship team recommends a trial of dose de-escalation when appropriate (ie, 40 mg twice daily to 40 mg once daily). This change is implemented during hospitalization and patients are counseled upon discharge to continue a trial of this reduced dose.

The goal of this study is to evaluate the effectiveness of this novel PPI stewardship program in decreasing inappropriate PPI use at our facility, both during hospitalization and upon discharge, as well as to monitor for any GI complications resulting from PPI discontinuation. The results of this study can add to the available body of literature describing effective PPI discontinuation strategies.

Methods

After institutional review board approval was obtained, a retrospective cohort study was performed. All patients admitted

to an internal medicine service at the Lexington Veterans Affairs Medical Center from March 14, 2016, to August 14, 2016, who underwent a medication adjustment by the PPI stewardship team were included in this study.

The primary objective of this study was the percentage of patients who tolerated inpatient and outpatient PPI discontinuation or dose de-escalation upon discharge. Inpatient tolerance was defined as not requiring PPI resumption to control their symptoms while hospitalized. Outpatient tolerance was defined as no PPI refill within 3 months of discharge (as patients often receive 90-day supplies of maintenance medications from our facility) or other documentation in the chart that confirms PPI discontinuation. Similarly, patients were considered to have tolerated a dose de-escalation if there was documentation in the chart that the patient had continued the decreased dose at 90 days post discharge.

Secondary objectives included the identification of potential risk factors for intolerance of PPI discontinuation, the occurrence of GI complications (ie, GIB, erosive esophagitis, other acid-related disorders) after PPI discontinuation, and the percentage of patients who required “as needed” AST to control their symptoms while hospitalized.

For both study cohorts, the Mann-Whitney *U* test was used to evaluate the primary and secondary objectives. For all objectives, α of <0.05 was considered significant.

****The proton pump inhibitor (PPI) stewardship program is a joint medicine-pharmacy project designed to evaluate all medicine patients admitted on a proton pump inhibitor to ensure that patient has an appropriate indication for continuation in the hospital. The goal of this program is to reduce the risk of adverse events associated with the overuse of PPIs.**

Based on chart review, patient does not meet one of the following criteria for continuing a PPI in the hospital:

- Upper GI bleed, erosive esophagitis, ulcer in the last 2 months
- History of upper GI bleed, erosive esophagitis, ulcer with persistent dyspeptic symptoms
- Barrett's esophagus
- Esophageal strictures secondary to acid reflux
- Zollinger-Ellison syndrome
- Gastric malignancy or previous esophageal or gastric surgery (minus total gastrectomy)
- Admission diagnosis includes acid - related disorder on the differential
- Documentation of previous failed PPI weaning trials
- Treatment for *Helicobacter pylori* infection

Due to this, the PPI will be discontinued and an order will be placed for 'as needed' AlOH/MgOH/Simethicone and ranitidine. Ranitidine should be reserved for dyspepsia/heartburn symptoms unrelieved by AlOH/MgOH/Simethicone.

If the primary team perceives patient to be at a high risk for gastrointestinal bleeding and/or patient with persistent symptoms of dyspepsia/heartburn despite the use of these medications, please resume home PPI.

Discharge pharmacist: If patient is discharged on an antibiotic, the PPI should continue to be held for that duration. After that time, recommend resuming/continuing to hold PPI.

Figure 2. Proton pump inhibitor (PPI) stewardship program patient chart note template.

Table 2. Criteria for Outpatient Continuation of Proton Pump Inhibitor (PPI).

- Any history of ulcers, erosive esophagitis, or UGIB
- Outpatient prescription for one or more of the following:
 - Anticoagulants^a
 - Dual antiplatelet therapy
 - Nonsteroidal anti-inflammatory drugs
 - Chronic steroids^a

Note. UGIB = upper gastrointestinal bleed.

^aNot a true indication for PPI therapy; however, the PPI stewardship team found patients on these medications typically had other risk factors for UGIB.

Results

Of the 1204 patients admitted to an internal medicine team at the Lexington Veterans Affairs Medical center during the study time period, 44.6% (n = 537) had an active outpatient prescription for a PPI (Figure 3). Of these patients, 41.0%

(n = 220) did not meet the criteria for inpatient PPI continuation. Table 3 describes the demographics of this cohort. PPI discontinuation was tolerated in 95.9% (n = 211) of these patient and 83.4% (n = 176) did not require any doses of “as needed” AST to control their symptoms. Of the 35 patients requiring AST therapy, n = 21 required at least one dose of an antacid and n = 16 required at least one dose of an H2RA. Some patients received both an antacid and H2RA. Risk factors for intolerance of inpatient PPI discontinuation were higher body mass index (BMI) and longer lengths of stay (LOS) (Table 4).

Upon discharge, 85 patients who had their inpatient PPI discontinued were also eligible to discontinue or de-escalate their outpatient PPI. After excluding 21 patients (14 of whom did not receive appropriate counseling on PPI discontinuation at hospital discharge and 7 of whom died within the 3-month follow-up period), 64 patients were included for primary data analysis. Of these 64

Figure 3. Proton pump inhibitor (PPI) stewardship results flowchart.

Table 3. Demographic Information for Inpatient Cohort (n = 220).

Male, n (%)	216 (98.2)
Age, years (SD)	71.5 (12.8)
BMI, kg/m ² (SD)	29.6 (6.6)
Outpatient PPI daily dose, mg (SD)	32.5 (19.6)
Duration of PPI use, years (SD)	7.7 (5.2)
Length of stay, days (SD)	4.7 (3.4)
Race, n (%)	
White	199 (90.4%)
African American	17 (7.7%)
Native Hawaiian/Pacific Islander	3 (1.4%)
American Indian/Alaskan	1 (0.5%)

Note. BMI = body mass index; PPI = proton pump inhibitor.

patients, 42 were counseled to discontinue PPI therapy upon discharge, with 57.1% (n = 24) tolerating PPI discontinuation at 3 months. Twenty-two patients were counseled to decrease their PPI from twice daily dosing to once daily dosing with 81.8% (n = 18) tolerating this change at 3 months. Increased duration of therapy was identified as

a risk factor for intolerance of outpatient PPI discontinuation (Table 5). No risk factors were identified for intolerance of outpatient dose reduction (Table 6). One case of reflux esophagitis was reported 2 months after PPI discontinuation.

Discussion

This study found that a PPI stewardship program at one facility successfully reduced rates of inappropriate PPI use for patients admitted to an internal medicine service, in both the inpatient and outpatient settings. Approximately 44% of patients admitted to our facility were on a PPI prior to admission, which is consistent with findings in other studies.¹ Of these patients, 41% did not meet criteria for inpatient continuation. Of the patients whose inpatient PPI therapy was discontinued, 95.9% did not require resumption of their PPI. Moreover, 83.4% of these patients did not require any “as needed” AST to control symptoms of rebound hyperacidity during hospitalization. These results are clinically relevant as they demonstrate that many

Table 4. Comparison of Risk Factors Between Patients Who Tolerated Inpatient PPI Discontinuation and Those Who Did Not (*n* = 220).

	Tolerated PPI discontinuation (<i>n</i> = 211)	Intolerant of PPI discontinuation (<i>n</i> = 9)	<i>P</i> value
Median age (years)	70.5	69.0	.64
Median BMI (kg/m ²)	30.3	33.7	.046
Median daily outpatient PPI dose (mg)	20.0	40.0	.11
Median duration of PPI use (years)	7.0	11.0	.37
Median LOS (days)	4.0	7.0	.03

Note. PPI = proton pump inhibitor; BMI = body mass index; LOS = length of stay.

Table 5. Comparison of Risk Factors Between Patients Who Tolerated Outpatient PPI Discontinuation and Those Who Did Not (*n* = 42).

Risk factor	Tolerated PPI discontinuation (<i>n</i> = 24)	Intolerant of PPI discontinuation (<i>n</i> = 18)	<i>P</i> value
Median age (years)	73.0	73.0	0.67
Median BMI (kg/m ²)	25.7	28.7	0.46
Median daily outpatient PPI dose (mg)	20.0	20.0	0.85
Median duration of PPI use (years)	5.5	9.0	0.03
Patients who filled AST on hospital discharge, <i>n</i> (%)	7.0 (29.2)	8.0 (44.4)	0.32

Note. PPI = proton pump inhibitor; BMI = body mass index; AST = acid suppressive therapy.

Table 6. Comparison of Risk Factors Between Patients Who Tolerated Outpatient PPI Dose De-Escalation Those Who Did Not (*n* = 22).

Risk factor	Tolerated PPI dose reduction (<i>n</i> = 18)	Intolerant of PPI dose reduction (<i>n</i> = 4)	<i>P</i> value
Median age (years)	76.5	72.5	.44
Median BMI (kg/m ²)	30.2	27.7	.17
Median daily outpatient PPI dose (mg)	30.0	20.0	.09
Median duration of PPI use (years)	9.0	11.5	.61
Patients who filled AST on hospital discharge, <i>n</i> (%)	5 (27.8)	0 (0)	.27

Note. PPI = proton pump inhibitor; BMI = body mass index; AST = acid suppressive therapy

patients maintained on PPIs do not truly require them during their hospitalizations, suggesting practitioners should reconsider the practice of continuing all home PPIs upon admission to the hospital, particularly for those patients without a clear indication.

One explanation for the relatively high success rate in the inpatient cohort of our study may relate to the average LOS at our facility (approximately 4.25 days) in combination with the relatively long duration of action of PPIs. Activity of parietal cells gradually returns over 2 to 3 days after PPI discontinuation, thus the effects of prehospitalization PPI dosing may persist through the duration of most hospital stays, rendering further PPI dosing unnecessary.³² This explanation is supported by the fact that patients who did not tolerate inpatient discontinuation had a significantly longer median LOS (7.0 vs 4.0 days). This finding is consistent with the study by Niklasson et al, whereby up to 44% of patients experienced rebound

hyperacidity during the first week after PPI discontinuation, particularly on days 5 and 6, after discontinuing a month-long PPI treatment. The number of subjects experiencing hyperacidity symptoms fell to 24% and 16%, 2 and 3 weeks after discontinuation, respectively.²² Based on this, patients with longer LOS may need to be re-evaluated periodically and practitioners consider scheduling AST in this population, instead of the “as needed” therapy utilized in this study. However, it is also possible that patients with longer LOS had more comorbidities, or other confounders, which necessitated the resumption of PPI therapy, so further studies will be necessary to confirm this association, particularly due to the small sample size of the group requiring PPI resumption.

Higher BMI was also identified as a risk factor for PPI resumption in the inpatient cohort. A high-calorie or high-fat diet, which may be more prevalent in those with higher BMIs, tends to result in increased esophageal acid exposure

time.¹² Therefore, these patients may produce more gastric acid than those patients who eat a diet relatively low in fat, worsening symptom reoccurrence in obese patients. Larger studies will be necessary to fully study this relationship, but it is possible that some obese patients may benefit from scheduled inpatient AST therapy or a PPI taper, particularly if they have other risk factors, such as longer LOS.

While there was a trend toward higher outpatient PPI dose as a risk factor for unsuccessful PPI discontinuation during inpatient stay, this finding was not statistically significant. As higher doses and areas under the curve (AUC) lead to a greater acid-reducing effect, it is possible that patients with a higher outpatient PPI dose are more sensitive to rebound hyperacidity, thus decreasing the chance of successful discontinuation.³² Therefore, the abrupt withdrawal strategy in our study may not be the most effective approach to these patients. Perhaps a step-down approach, similar to that described by other successful studies, may be more appropriate for patients on relatively high PPI doses (greater than 40 mg per day).^{14,15}

The outpatient component of the PPI stewardship program was also successful, resulting in a 57.1% discontinuation rate and an 81.8% dose de-escalation rate in eligible patients. The reasons for our relatively high success rates are likely multifactorial. First, clear criteria were established by the stewardship team regarding appropriate indications for PPI continuation. These criteria allowed for the targeting of patients with weaker PPI indications and therefore, stronger likelihoods for tolerating PPI discontinuation. In addition, discharge counseling by medication reconciliation pharmacists likely enhanced positive outcomes. Patients were educated about the potential adverse effects of PPIs, the reasons for recommended discontinuation, and the possibility of, and strategies to combat, rebound hyperacidity. Furthermore, as there appears to be a placebo effect in some patients with GERD, the knowledge that they did not require PPIs while hospitalized may have encouraged some patients in their efforts to discontinue therapy entirely.³³

Our discontinuation rates are consistent with the findings of previous studies demonstrating PPI discontinuation rates of 14% to 64%.¹¹ Moreover, our study's success rate of 57.1% is at the high end of the observed range, despite the fact that a PPI taper, which generally seems to produce the greatest success, was not used. The greatest commonalities between our program and other successful PPI stewardship programs include implementation of thorough patient counseling and provision of replacement "as needed" AST. Murie et al implemented a nurse-led dyspepsia clinic in which patients were counseled on their condition and lifestyle modifications to decrease symptoms of dyspepsia and were provided with alternative medications for the treatment of rebound hyperacidity.³⁴ At 3 months, the researchers documented a 59.4% success rate for PPI discontinuation and a 29.7% success rate for dose de-escalations. Conversely, Krol et al mailed educational letters to patients suggesting they discontinue or reduce their PPI use, which yielded a

lower success rate (24%), compared with Murie et al, which may be attributed to a lack of face-to-face counseling, as well as lack of alternative AST therapies provided.¹³ Thus, our study appears to confirm the Murie et al conclusion that patient education and measures to counter rebound hyperacidity (such as "as needed" AST or PPI step-down therapy) are essential components to a successful PPI stewardship program.

Not only did the PPI stewardship program effectively discontinue and reduce doses of PPIs, but complications related to the actions of the stewardship team appear minimal. Of the patients who underwent an outpatient PPI intervention, only 1 case of reflux esophagitis was reported 2 months after discontinuation. Therefore, the interventions of the PPI stewardship program appear safe, although it is important to note that we cannot rule out the possibility that complications may develop in the future, as it may take longer than 3 months to develop an acid-related complication.³⁵ However, the risk of any future acid-related complications must be balanced with the risk of any future complications associated with continued PPI use, including enteric infections, pneumonia, fractures, and hypomagnesemia.

There were several limitations associated with this study. First, this was a retrospective cohort study with a relatively homogeneous population of male veterans, conducted in patients admitted to a medicine service at our facility. It is possible that the results may not be generalizable to the general population or other specialty services. However, there is no reason to believe that a similar program implemented in other populations and with other specialty services would not be successful, with the possible exception of the critically ill population as many require PPIs for stress ulcer prophylaxis.³⁶ It is also possible that the 3-month follow-up period was too short to detect all PPI resumption. Murie et al found rates of successful discontinuation had decreased from 59.4% to 32.5% from a 3- to a 12-month follow-up, suggesting that outpatient discontinuation/de-escalation success rates may not persist long-term.³⁴ Thus, a longer follow-up period may be beneficial in future studies. In addition, our findings that BMI and longer LOS were associated with inpatient PPI resumption will need to be confirmed with larger studies, as our sample size was relatively small ($n = 9$). Furthermore, this study was not designed to evaluate whether the PPI stewardship program decreased complications associated with PPI overuse, such as CDI, due to the already low rates of these events at our facility. Further studies will be required to evaluate whether this program improves clinical outcomes. A final study limitation is related to the fact that PPIs are available for purchase over the counter (OTC). As this study did not capture OTC PPI use upon discharge, the true outpatient discontinuation rate may be lower than it appears.

Conversely, this study exhibits a number of strengths. As there is currently no clear consensus on the optimal strategy to facilitate PPI deprescribing, this study demonstrates the

feasibility of a PPI stewardship program which can be initiated during hospitalizations to target both inpatient and outpatient PPI overuse. The pharmacists performing the daily review found that this task typically takes between 15 and 45 minutes to perform, which is a reasonable addition to a daily workload, although this time frame may vary between facilities, depending on the number of patients to be reviewed every day. Sites could also consider training pharmacy residents or students to assist with the initial screening, which may further decrease the pharmacist resources required for this project. Similarly, this program could be modified by pharmacists working in an ambulatory setting to screen patients for appropriate PPI indications during their clinic visits, and collaborative care agreements could be established with their providers to implement a similar program.

Potential avenues for continued research include the further assessment of risk factors which may contribute to patients' inability to tolerate PPI discontinuation. Comorbidities such as depression and tobacco dependence have been suggested as barriers to successful PPI discontinuation; however, our sample size was too small to allow an evaluation of these risk factors.^{37,38} Further research may allow practitioners to better stratify patients according to their likelihood for successful PPI discontinuation and tailor their discontinuation strategy accordingly (for instance, choosing a PPI taper in high-risk patients, versus "as needed" antacids in lower risk patients).

Conclusion

A PPI stewardship program at our institution resulted in successful reduction of inappropriate PPI use both in the inpatient and outpatient settings. Complications from the program appear minimal.

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