Improving Proton Pump Inhibitor Deprescribing Behaviors in Home-Based, Primary Care

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On my honor, I pledge that I have neither given nor received any unauthorized assistance on this paper. March 26, 2023
Abstract

Objective: This quality improvement project sought to evaluate the effect of a 12-week intervention including clinician education, evidence-based algorithm and EMR chart audit with notification on clinician proton pump inhibitor deprescribing behaviors, clinician knowledge and to determine the overall feasibility of continued use of the intervention.

Methods: This project utilized a 1-group pretest-posttest design to compare the number of PPI’s prescribed before and after the intervention, as well the overall knowledge, attitudes and behaviors score of clinician participants pre and post intervention. The intervention included clinician education on use of an evidenced based deprescribing algorithm and daily electronic medical record audits with notifications.

Results: A total of 4 clinician participants were recruited for the intervention. There was a significant decrease in the median ± SD number of PPI’s prescribed pre and post intervention (Pre: $M_{1.00}$, SD 0 vs Post: $M_{0.8155}$, SD .38976, Diff: $M_{-0.1845}$, SD .38976). While there was an increase in overall clinician knowledge score, the increase was not statistically significant ($\alpha = 0.05$, $V = 3.00$, $z = 0.00$, $p = 1.000$).

Conclusions: This quality improvement study found that clinician education and EMR chart audits with notifications are an effective means of reducing inappropriate PPI prescriptions and improving clinician deprescribing behaviors. These interventions do not result in statistically significant changes in clinician overall knowledge or attitudes regarding PPIs but remain a feasible intervention in the future.

Implications: Implementation of clinician education, clinical decision support tools and EMR chart audits are an effective means of reducing overall amounts of inappropriately prescribed PPI medications in small practices with little support staff. Large scale implementation could be
achieved with automated EMR tools and multi-disciplinary support. More research and a larger sample size is needed to determine if this is an effective method of increased clinician PPI knowledge.
Improving Proton Pump Inhibitor Deprescribing Behaviors in Home-Based, Primary Care

Introduction

Proton pump inhibitors (PPIs) are a widely prescribed class of medications used in the treatment of gastric related disorders such as gastroesophageal reflux disease, peptic ulcer disease, Zoller-Ellison Syndrome, Helicobacter pylori infections and gastrointestinal bleeding (Maes et. Al, 2017). More than 113 million prescriptions for PPIs are written each year, contributing to 13 billion dollars in healthcare spending (Laferty, 2020). While it varies by region, as many as 71.4% of PPI prescriptions are prescribed without an appropriate indication (Hotiet et al., 2020). Rampant overuse has contributed grossly to polypharmacy and increased risk of adverse events, such as recurrent enteral infections, increased risk of cardiovascular death, hospital acquired pneumonia, chronic kidney disease, and interstitial nephritis (Dharmarajan, 2021; Frary, 2015; Jaynes & Kumar, 2018; Lafferty, 2020). Lack of knowledge and adherence to national recommendations are significant barriers to reducing the harmful effects and excessive spending caused by inappropriate PPI use.

The purpose of this quality improvement project was to increase clinician deprescribing behaviors through education and electronic medical records chart audits. The project specifically aimed to (1) determine the impact of a 12-week, evidenced-based PPI education program and electronic medical record (EMR) chart audit on clinician deprescribing behaviors, (2) compare whether the 12-week, evidenced based PPI education program and EMR chart edit results in increased clinician knowledge in deprescribing habits using a pre-test, post-test model, and (3) evaluate the feasibility of the 12-week, evidenced based PPI education program and EMR chart audit using a post-intervention feasibility survey.
Background

Prescribers often overlook inappropriate use of PPIs and fail to deprescribe them when no clear indication exists. To reduce the risk of adverse events, treatment with a PPI is typically indicated for a maximum of 8 weeks, at the lowest effective dose, for the shortest period of time possible (Ahmed & Clarke, 2021). Many clinicians are unaware of protocols and best practice guidelines for reducing and discontinuing PPIs. Furthermore, varying guidelines exist regarding length of PPI therapy depending on the specific etiology of the diagnoses (Dharmarajan, 2021). Complicating the issue further, PPIs are often initiated during hospitalizations and due to lack of medical records, outpatient clinicians have difficulty discerning whether an appropriate indication exists for continued therapy (Dharmarajan, 2021). In some cases, support staff are tasked with renewing prescriptions in outpatient settings, reducing recognition by clinicians. Lack of deprescribing secondary to these issues increases the risk of adverse events and poor patient outcomes.

While PPI overuse is both a global and national problem, preliminary chart reviews at the project site indicate that most providers are not engaging in active deprescribing behaviors that would discontinue or decrease the dose of PPIs. Lack of adherence to national recommendations contributes to an increased risk of adverse events in community dwelling adults over the age of 50 at this site. The primary care panel at the project site includes approximately 300 patients. Of those patients, an estimated 50% are prescribed a PPI. Length of therapy is unclear is many of these patients. It is estimated that at least 100 patients have questionable indications for continued PPI use and could benefit from providers reducing or discontinuing the medication. Implementing clinician education and EMR chart audits will assist clinicians in identify inappropriate PPI prescriptions and reduce the overall risk of adverse events.
Review of Literature

Evidence consistently suggests that in the absence of diagnoses requiring long term PPI treatment, these medications should be prescribed at the lowest effect dose for the shortest period of time, typically no longer than eight weeks (Dharmarajan, 2021; Farrell et al., 2017). Judicious initial dosing of PPIs coupled with frequent and timely reassessment of prescription appropriateness is associated with reductions in PPI usage (Gawron et al., 2015; Naunton et al., 2018). Unfortunately, while many PPI prescriptions are initiated appropriately, lack of reassessment causes more than 35% percent of PPI prescriptions to eventually qualify as inappropriate simply as result of long-term use (Gawron et al., 2015; Mafi et al., 2019; Naunton et al., 2018).

In 2021, a thorough review of the literature was undertaken and found that educating primary care providers on best practice guidelines for deprescribing PPIs and providing algorithms to taper or discontinue PPIs is an effective strategy for reducing inappropriate PPI prescriptions (Bowman, 2020; Walsh, 2016). Evidenced-based algorithms exist to aid clinicians in determining whether continued use is indicated, and where it is not, how to taper or discontinue safely (Farrell et al., 2017). Prompting clinicians to evaluate PPI usage via electronic medical record (EMR) and providing evidence based deprescribing algorithms is associated with increased rates of deprescribing behaviors (Bowman, 2020; Walsh et al., 2016).

Translation Framework

This DNP scholarly project utilized the Knowledge -to-Action (KTA) model, which is a framework developed by Dr. Ian Graham that describes a two-part process of knowledge creation and knowledge application or action cycles (White et al., 2016). KTA is perceived as a funnel beginning with the wide end where new knowledge is obtained through research then
gradually filtered down to the narrower end, in the same way that knowledge is filtered for relevancy, synthesized then finally, adapted to fit its end users and purpose (White et al., 2016). The KTA model includes seven phases: problem identification, local context adaption, assessment of barriers, tailoring of interventions, monitoring of knowledge use, evaluating outcomes of knowledge use and sustaining knowledge use (White et al., 2016). Stakeholder involvement in preparing the action cycle is of the utmost importance in this model, making KTA effective for a wide range of users because the producer can tailor the interventions at each step to fit the intended audience (Field et al., 2014).

The KTA model is particularly applicable to this scholarly project as it took place with a small group of practitioners that function independently of each other without broad guidelines or structures (See Appendix A). Following this seven-step model, discussion with the supervising physician led to identification of the problem being high rate of inappropriate PPI prescriptions. Literature review revealed evidence supporting the problem. This evidence was then reviewed, filtered for pertinence to the quality improvement project and synthesized to produce education that fits this, unique, home-based primary care practice. Preliminary interviews with organizational mentors, management and stakeholders lent information about barriers to knowledge use. During the application phase, the intervention evidence was applied specifically to the identified barriers and provider preference. In the creation phase, an intervention bundle was developed to increase deprescribing habits. Knowledge use was monitored throughout the 12-week intervention and outcomes evaluated via pre-posttest at the conclusion of the project. Each step of the project closely aligns with the seven steps of the KTA model. The KTA model ultimately allowed for fine tuning of the intervention to this home-based practice.
Methods

Design

This quality improvement project utilized a pre-post intervention design to increase clinician PPI deprescribing behaviors using a 12-week, evidence-based intervention. The intervention included education bundled with an EMR chart audit and deprescribing algorithm to assist clinicians in identifying opportunities to discontinue inappropriately prescribed PPIs. The aims of the project were to: 1) Determine the impact of the 12-week evidenced based PPI education program and EMR chart audit on clinician deprescribing behaviors; 2) Compare whether the educational program resulted in increased clinician knowledge regarding deprescribing habits, and 3) Evaluate the feasibility of continued evidenced based PPI educational programs and EMR chart audits.

Participants

The setting for this project was a small, private, primary care practice in the southeast United States that treats homebound patients in their primary residence. This project included two samples. The first sample included all nurse practitioners employed by the practice who treat patients in their primary residence. Exclusion criteria included nurse practitioners who do not see homebound patients, and nurse practitioners not utilizing the practice EMR for charting. In total, four potential participants were identified. The second sample included all patient charts for patients aged 50 and older who were prescribed a PPI in the 3 months prior to the intervention start date, with or without a supporting diagnosis. Exclusion criteria included patients less than 50 years old and patients with the following diagnoses: Barrett’s esophagus, chronic nonsteroidal anti-inflammatory use with bleeding risk, severe esophagitis, or a documented history of bleeding GI ulcer. Any patient charts admitted during the course of the 12-week intervention period were also
excluded. Of the 300 homebound patients in the practice, 103 patient charts were identified as potential charts to include in the project.

**Intervention and Procedure**

Following notification of exemption from the organizations’ Institutional Review Board (IRB) to conduct this quality improvement project, an implementation team was convened. The team consisted of the project lead, organizational mentor, project advisor, practice manager and supervising physician. Evidence was reviewed and customary daily practices were discussed with clinicians, the practice manager, and the supervising physician, leading to the development of the intervention. Evidence based strategies for improvement included: 1) an initial educational seminar seeking to improve clinical knowledge regarding appropriate PPI prescribing and use of an evidenced-based PPI deprescribing algorithm (See Appendix B) and; 2) daily chart audits with EMR notifications cuing clinicians to evaluate the appropriateness of discontinuing the PPI.

Beginning in early August 2022, recruitment using blast emails and in person communication began, resulting in recruitment of 4 clinician participants. On August 22, 2022, the initial educational seminar was held with each participant, the practice manager and the supervising physician. On this day, a preintervention Knowledge, Attitudes and Practices (KAP) survey as administered via Qualtrics to each participant prior to the educational seminar. Each participant was provided copies of the evidenced-based PPI deprescribing algorithm (See Appendix B). Following the seminar, the primary investigator conducted an EMR chart audit, using the identified inclusion and exclusion criteria to identify all potential patient charts to be included in the intervention and the information was placed in a data extraction tool. Starting August 28’ 2022, and continuing through November 18, 2022, daily chart audits of the patient schedule were conducted by the primary investigator, and clinicians were notified of patients on
OUTCOMES DATA ANALYSIS AND SUMMARY

their schedule who were prescribed a PPI and asked to determine the appropriateness of discontinuing the medication. Mid intervention, a re-education session was held, and individual coaching sessions were conducted as needed throughout the intervention. From November 18, 2022, through November 23, 2022, participants completed a post intervention KAP survey and the Evidence-Based Practice Attitudes Survey (EBPAS) via Qualtrics. On November 21, 2022, and November 22, 2022, the primary investigator performed a postintervention EMR query using the inclusion and exclusion criteria to identify patients prescribed a PPI at the end of the intervention period. All Qualtrics survey data was then extracted by the primary investigator and imported into a single excel spreadsheet.

**Instruments**

To collect patient chart data for Aim 1, a data extraction tool was developed using excel. The tool included a deidentified patient record number, gender, age, the preintervention PPI prescribed and associated diagnosis, as well the post intervention PPI prescribed and associated diagnosis.

To measure clinician knowledge regarding deprescribing PPIs, the KAP scale was adapted to fit the local context and utilized pre-post intervention. KAP is a valid and reliable scale originally developed to assess knowledge and attitudes regarding guidelines for PPI prescribing (Luo et al., 2019). The survey was evaluated by gastroenterology physicians (Luo et al., 2019). Length and readability were piloted prior to is use (Luo et al., 2019). The survey consists of 33 “yes/no” and Likert type answer with continuous levels of measurement (Luo et al., 2019). There are 20 Awareness questions answered in yes/no fashion (Luo et al., 2019). Five points are assigned to correct answers and 0 points to wrong answers (Luo et al., 2019). There are 6 questions related to attitude and they are scored as follows: 5- for ‘completely agree’, 4-‘almost agree’, 3-indifferent,
2 almost disagree, 1 completely disagree (Luo et al., 2019). A higher score in section 1 or 3 indicates more knowledge or more positive attitudes (Luo et al., 2019). The last 7 questions evaluate behavior related to PPI use (Luo et al., 2019). The first questions assessed if the participant has used PPIs and if so, they continue to the next section (Luo et al., 2019). The next 6 questions are scored as follows: 1- always, 2- often, 3- sometimes, 4- seldom, 5- never (Luo et al., 2019). Higher scores indicate better PPI usage behavior (Luo et al., 2019). Cronbach’s α was determined to be 0.78, indicating internal consistency (Luo et al., 2019).

To measure continued feasibility of the quality improvement project at the project site, the Evidence-Based Practice Attitude (EBPAS) survey was utilized. The EBPAS is a self-report used to assess providers attitudes towards adopting new evidenced based practices (EBP) (Rye et al., 2017). The EBPAS was originally developed to assess mental health providers’ attitudes toward adopting EBP practices and assesses four domains: appeal of EBP, likelihood of adopting EBP, openness to new practices, and likelihood of diverging from EBP toward personal preference (Rye et al., 2017). The EBPAS was adapted to the local context. It includes 36 Likert style questions loaded on to 12 different domains, including requirements, appeal, openness, divergence, limitations, fit, monitoring, balance, burden, job security, organizational support and feedback (Rye et al., 2017). Higher scores indicate participants’ attitudes are more positive towards adoption of EBP (Rye et al., 2017). Lower scores indicate more negative attitudes toward adoption of EBP (Rye et al., 2017). The EBPAS has been shown to be a reliable and valid survey. EBPAS has low misspecification (.045). Cronbach’s α for EBPAS is 0.86 with subscales ranging from 0.61 and 0.92 (Rye et al., 2017).

**Data Analysis**
To evaluate Aim 1, descriptive statistics and socioeconomic characteristics were first analyzed on patient chart data. Data was identified as patient level, bivariate, and categorical. A Dichotomous variable was utilized, either ‘ prescribed a PPI’ or “Not prescribed a PPI”. A McNemar’s test was conducted with one dependent group at different time points. A power analysis was performed with 2 tails, an odds ratio of 3.45 for a moderate effect, an α of 0.5, power of 0.8, and discordant pairs of 0.3. A clinically significant sample size was determined to be 84 participants, and ultimately 104 patient charts were included.

To evaluate aim 2, descriptive statistics and socioeconomic demographics were analyzed and described. Each subscale of the KAP survey was be analyzed separately. Given the continuous outcomes variables and same pretest/posttest participants, a Wilcoxon signed rank test with matched pairs was performed on each category. Two tails were used, with a normal parent distribution, medium effect size of 0.5, α of 0.8 and power of 0.8. A clinically significant sample size was determined to be 15 participants. Since this project was a pilot project with only 4 clinician participants, the data calculated was underpowered. A Cohen’s D effect score and medium effect size of 0.5 or greater will computed to determine if there is meaningful effect, even if not clinically significant.

To evaluated aim 3, descriptive statistics was utilized to conduct a frequency analysis and report the percentage of participants who agree or disagree with the feasibility of continued EBP based on responses to the EBPAS. The score for each subscale is created by computing a mean score for each set of items on a given subscale and a total score for the 36 item survey was also computed.
Data Protections and Storage

To protect identity, participants were asked to use the last four digits of their phone number as their identifier. No participant names, patient names or identifiers are stored outside of the original EMR. Patient chart data is considered deidentified after having removed participant and chart names, dates of stay, ages greater than 90, and IP addresses. A single Excel spreadsheet using only an identifier number for patient and participant data will be stored using the Johns Hopkins OneDrive and was made available solely to the project advisor for review and collaboration. Two factor identification is used to access the computer. Only the principal investigator will have access to the computer. SPSS will be used for statistical analysis of deidentified data only. During and after the dissemination phase of the project, site staff will receive results of the analysis using aggregate data only. Concluding all phases of the scholarly project, including presentations and publications, data will be stored for a maximum of 3 years using the Johns Hopkins OneDrive.

Results

Participant Demographics

This project was conducted between August 2022 and November 2022. 4 participants were enrolled in the clinician intervention group. Over the course of the study all participants continued enrollment and completed all pre and post surveys. Clinician participants were 25% aged 31-40, and 75% age 51-60, 25% male, 75% female and 100% with master’s degrees and 0% with doctoral degrees. 75% (3) of participants reported prescribing a PPI in the past year, and 25% (1) reporting they had not prescribed a PPI in the past year (Table 1).

A total of 103 patient charts were included in this project, with a mean age of 69.45 (SD 9.987), 38.8% male, 60.2% female and 1% undifferentiated, with 100% of diagnoses listed as
gastroesophageal reflux disease (GERD). At project start, 0% were not prescribed a PPI, 46.6% were prescribed omeprazole 25% aged 31-40, and 75% age 51-60, 25% male, 75% female and 100% with master’s degrees and 0% with doctoral degrees. (Table 1)

Table 1.  
Baseline Demographic Characteristics of Clinician Participants

<table>
<thead>
<tr>
<th>Demographic characteristics</th>
<th>(N = 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex, % (n)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>25.0 (1)</td>
</tr>
<tr>
<td>Female</td>
<td>75.0 (3)</td>
</tr>
<tr>
<td>Undifferentiated</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Age, % (n)</td>
<td></td>
</tr>
<tr>
<td>18-30</td>
<td>0 (0)</td>
</tr>
<tr>
<td>31-40</td>
<td>25.0 (1)</td>
</tr>
<tr>
<td>41-50</td>
<td>0 (0)</td>
</tr>
<tr>
<td>51-60</td>
<td>75.0 (3)</td>
</tr>
<tr>
<td>Education Level, % (n)</td>
<td></td>
</tr>
<tr>
<td>Master’s Degree</td>
<td>100 (4)</td>
</tr>
<tr>
<td>Doctoral Degree</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Table 2.  
Baseline Characteristics of Patient Charts Prescribed a PPI

<table>
<thead>
<tr>
<th>Demographic characteristics</th>
<th>(N = 103)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>69.45 (9.9)</td>
</tr>
<tr>
<td>Sex, % (n)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>38.8 (40)</td>
</tr>
<tr>
<td>Female</td>
<td>60.2 (62)</td>
</tr>
<tr>
<td>Undifferentiated</td>
<td>1.0 (1)</td>
</tr>
<tr>
<td>Prescribed PPI, % (n)</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Omeprazole</td>
<td>46.6 (48)</td>
</tr>
<tr>
<td>Esomeprazole</td>
<td>6.8 (7)</td>
</tr>
<tr>
<td>Lansoprazole</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Rabeprazole</td>
<td>1.0 (1)</td>
</tr>
<tr>
<td>Pantoprazole</td>
<td>45.6 (47)</td>
</tr>
<tr>
<td>Associated Diagnoses, % (n)</td>
<td></td>
</tr>
<tr>
<td>GERD</td>
<td>100 (103)</td>
</tr>
<tr>
<td>Nausea</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Indigestion</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Heartburn</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

SD=standard deviation

Outcomes Measures

Reduction in Proton Pump Inhibitor Prescriptions Post Intervention

There was a significant decrease in the median ± SD number of PPI’s prescribed pre and post intervention (Pre: $M = 1.00$, SD 0 vs Post: $M = 0.8155$, SD .38976, Diff: $M - .1845$, SD .38976). Preintervention, 100% (103) participants were prescribed a PPI and 0% (0) were not prescribed a PPI. Postintervention 81.6% (84) patients were prescribed a PPI and 18.4% (19) were not prescribed a PPI. The results of the McNemar’s test showed that the two proportions were significantly different, $p = .000$ (2 sided), thus the null hypothesis is rejected.
Change in Knowledge, Attitudes and Practice Scores

The median total score for the KAP survey increased from pre to post intervention (Pre: $Mdn: 95 \pm SD 8.06$ vs Post: $Mdn: 102 \pm SD 15.5$) but was not statistically significant based on the results of the two-tailed Wilcoxon signed rank test ($\alpha = .05$, $V = 2.00$, $z = -0.53$, $p = .593$), with a small effect size ($r = 0.18$). (Fig. 3) Participant knowledge scores increased from pre to post intervention (Pre: $Mdn: 45.0 \pm SD 8.66$ vs Post $Mdn: 50.0 \pm 15.5$).
SD 1.89), but were not statistically significant ($\alpha$ .05, $V = 3.00$, $z = 0.00$, $p = 1.000$), with a small effect size ($r = 0.0$) (Fig. 4). Behavior scores increased (Pre: $Mdn$: 22.0 ± SD 1.91 vs Post $Mdn$: 22.50 ± SD 2.16), but the result was not statistically significant ($\alpha$ .05, $V = 0.00$, $z = -1.41$, $p = .157$), with a medium effect size ($r = 0.49$) (Fig. 5). Lastly, attitude scores were the same pre/post intervention (Pre $Mdn$: 29.50 ± SD 2.38 vs Post $Mdn$ 29.50 ± SD 1.89) and the results were not statistically significant ($\alpha$ .05, $V = 1.00$, $z = -0.45$, $p = .655$) with a small effect size ($r = 0.16$). (Fig. 6)
Post Intervention Feasibility

Descriptive statistics were used to calculate the results of the total EBPAS survey score and each of its 12 domains (Table 3). The median total score on the EBPAS was 108.76 ± SD 24.54 out of 144 possible points, indicating an overall high level of agreeability to continued evidence-based practice interventions in the workplace. Participants scored highest in openness (M 10.25±SD 1.71), fit (M 11.25±SD 1.50), burden (M11.50 ± SD 1.0), divergence (M 11± SD 2.0), and limitations (M 10.75± SD 10.75) indicating a greater extent of willingness to use the intervention because it was manualized and based on research. Participants felt they would be more likely to continue to use it if it fit their clinical approach and was individualized and right for their patients. Scores were lowest for balance (M 5.50 ±SD 3.7) and job security (M 6.00± SD 6.0) indicating participants felt only to a slight or moderate extent that evidence-based practice was more important than overall competence and that only to a slight or moderate extent would using the intervention help them keep their current job or attain a new one. Median scores were mid-range for requirements (M 9.0±SD 3.46), monitoring (M8.75±SD 4.27), appeal (M9.75±SD 2.87), organizational support (M8.50±SD 4.04) and feedback (M 8.50±SD 2.65) indicating participants felt to a moderate extent that they would use the intervention if it was required by their employer, that it was important to have oversight, that they would use it if the organization supported it and that feedback on their job performance was important. Participants score were most variable on monitoring (M8.75±SD 4.27), job security (M 6.00± SD 6.0) and organizational support (M8.50±SD 4.04) indicating there was a larger difference between participants in how they felt about whether their work should be monitored, whether using evidenced based
practice was important in keeping their job and whether they would continue to use it based on how well the organization supported it.

Table 3

Summary Statistics Table for Interval and Ratio Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>n</th>
<th>SE</th>
<th>Min</th>
<th>Max</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPENNESS</td>
<td>10.25</td>
<td>1.71</td>
<td>4</td>
<td>0.85</td>
<td>8.00</td>
<td>12.00</td>
<td>-0.43</td>
<td>-1.15</td>
</tr>
<tr>
<td>FIT</td>
<td>11.25</td>
<td>1.50</td>
<td>4</td>
<td>0.75</td>
<td>9.00</td>
<td>12.00</td>
<td>-1.15</td>
<td>-0.67</td>
</tr>
<tr>
<td>BURDEN</td>
<td>11.50</td>
<td>1.00</td>
<td>4</td>
<td>0.50</td>
<td>10.00</td>
<td>12.00</td>
<td>-1.15</td>
<td>-0.67</td>
</tr>
<tr>
<td>REQUIREMENT</td>
<td>9.00</td>
<td>3.46</td>
<td>4</td>
<td>1.73</td>
<td>6.00</td>
<td>12.00</td>
<td>0.00</td>
<td>-2.00</td>
</tr>
<tr>
<td>DIVERGENCE</td>
<td>11.00</td>
<td>2.00</td>
<td>4</td>
<td>1.00</td>
<td>8.00</td>
<td>12.00</td>
<td>-1.15</td>
<td>-0.67</td>
</tr>
<tr>
<td>MONITORING</td>
<td>8.75</td>
<td>4.27</td>
<td>4</td>
<td>2.14</td>
<td>3.00</td>
<td>12.00</td>
<td>-0.60</td>
<td>-1.24</td>
</tr>
<tr>
<td>JOB SECURITY</td>
<td>6.00</td>
<td>6.00</td>
<td>4</td>
<td>3.46</td>
<td>0.00</td>
<td>12.00</td>
<td>0.00</td>
<td>-1.50</td>
</tr>
<tr>
<td>APPEAL</td>
<td>9.75</td>
<td>2.87</td>
<td>4</td>
<td>1.44</td>
<td>6.00</td>
<td>12.00</td>
<td>-0.49</td>
<td>-1.37</td>
</tr>
<tr>
<td>LIMITATIONS</td>
<td>10.75</td>
<td>2.50</td>
<td>4</td>
<td>1.25</td>
<td>7.00</td>
<td>12.00</td>
<td>-1.15</td>
<td>-0.67</td>
</tr>
<tr>
<td>BALANCE</td>
<td>5.50</td>
<td>3.70</td>
<td>4</td>
<td>1.85</td>
<td>1.00</td>
<td>9.00</td>
<td>-0.27</td>
<td>-1.56</td>
</tr>
<tr>
<td>ORGANIZATIONAL SUPPORT</td>
<td>8.50</td>
<td>4.04</td>
<td>4</td>
<td>2.02</td>
<td>3.00</td>
<td>12.00</td>
<td>-0.63</td>
<td>-1.16</td>
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<tr>
<td>FEEDBACK</td>
<td>8.50</td>
<td>2.65</td>
<td>4</td>
<td>1.32</td>
<td>6.00</td>
<td>12.00</td>
<td>0.50</td>
<td>-1.24</td>
</tr>
<tr>
<td>TOTAL SCORE</td>
<td>108.67</td>
<td>24.54</td>
<td>3</td>
<td>14.17</td>
<td>94.00</td>
<td>137.00</td>
<td>0.71</td>
<td>-1.50</td>
</tr>
</tbody>
</table>

Note. '-' indicates the statistic is undefined due to constant data or an insufficient sample size.
Figure 12  
**DOMAIN 3 OPENNESS**

Figure 13  
**DOMAIN 4 DIVERGENCE**

Figure 9  
**DOMAIN 5 LIMITATIONS**

Figure 14  
**DOMAIN 6 FIT**

Figure 11  
**DOMAIN 7 MONITORING**

Figure 16  
**DOMAIN 8 BALANCE**
OUTCOMES DATA ANALYSIS AND SUMMARY

Figure 18
DOMAIN 9 BURDEN

Figure 19
DOMAIN 10 JOBSECURITY

Figure 15
DOMAIN 11 ORGANIZATIONAL SUPPORT

Figure 20
DOMAIN 12 FEEDBACK

Figure 17
TOTAL SURVEY SCORE
Discussion

PPI’s are used extensively in clinical practice to treat a wide range of gastrointestinal disease. While they have long been considered benign drugs, clinically inappropriate prescribing is currently one of the largest contributors to increased risk of adverse events and increased healthcare spending (Abramowitz et al., 2016; Dharmarajan, 2021). Poor clinician identification of inappropriate prescriptions and the resulting lack of subsequent discontinuation remains the primary cause of continued overuse (Mafi et al., 2019). Clinician education, clinical decision support tools and EMR chart audits have been demonstrated as effective means of increased clinician identification and increased PPI deprescribing behaviors (Bowman, 2020; Gawron et al., 2014; Walsh, 2016; Wilsdon et al., 2017).

In this quality improvement project, clinician education with use of an evidenced-based practice deprescribing algorithm and a 12-week EMR chart audit with notifications significantly reduced the overall number of patients prescribed a PPI. Educating providers on appropriate indications for PPI use and providing them with a clinical decision algorithm to assist them in determining the appropriateness of deprescribing the medication enhanced clinician abilities to determine the overall appropriateness of continued use. The intervention also included daily EMR chart notifications for patients prescribed a PPI, cuing providers to consider if the medication was clinically appropriate and increasing their ability to identify unnecessary prescriptions. The project findings are congruent with previous intervention studies examining the effectiveness of education, clinical decision support tools and EMR chart audits with feedback (Bowman, 2020; Gawron et al., 2014; Walsh, 2016; Wilsdon et al., 2017). The significant reduction in overall PPI prescriptions by end of the intervention study suggests that
Clinician education and EMR chart audits are a feasible and efficacious means to reduce inappropriate PPI use.

Clinician education resulted in a small but non-significant increase in clinical knowledge regarding proton pump inhibitor usage and subjective behaviors, but no increase in positive attitude toward the importance of appropriate prescribing. While not statistically significant, the study is congruent with other findings that education results in improved knowledge and deprescribing behaviors (Bowman, 2020; Gawron et al., 2014; Walsh, 2016; Wilsdon et al., 2017). No studies to date have examined specific effects of clinician education on overall attitudes towards to PPI prescribing. However, this intervention was focused more on identifying inappropriate prescriptions and using sound clinical judgement to discontinue those medication than it was focused on changed attitudes and biases regarding PPI use. Furthermore, with a small sample size and short intervention time, clinicians may have lacked the opportunity to note positive outcomes in patients as a result of discontinuing the medication.

The intervention also demonstrated an overall positive attitude towards continued use of evidence based practice improvements in the clinical setting. Providers reported they were likely to continue use of evidence based practice interventions in the workplace if they posed only a small burden on their usual daily tasks, were manualized and supported by research. Participants also felt they were more likely to continue use if the tool fit with their clinical approach and benefited the patient. Interestingly participants overall felt overall competence was more important than evidence based practice and did not feel the intervention was important in helping them keep their job. This may reflect both the small sample size and unique organizational culture of this small home, based primary care practice.
This study was limited by a small participant sample size (N=4). With only 4 participants, implicit bias regarding attitudes about PPI prescribing and the use of evidence based practice may be overestimated or overly skewed. Additionally, the overall focus of the intervention was identifying opportunities for prescribing via chart audit as opposed to specific PPI focused education. This may explain the lack of statistically significant improvement in clinician knowledge and attitudes as compared to the significant reductions in PPI prescribing. Lastly, the unique setting in which this study was implemented is another limitation. The study was designed to fit within the organizational structure of a small, home based primary care practice that has minimal clinical support or automated processes available. Organizations wishing to replicate this study on a larger scale may interested in focusing their efforts on automated and built in EMR notification systems.

Continued efforts aimed at reducing inappropriate PPI prescription use will continue to lower overall healthcare spending and patient adverse events. Because of overarching beliefs related to the safety of PPI usage and wide spread bias about lack of adverse events, large scale education efforts promoting evidence based practices may have a larger effect on overall clinician awareness and attitudes towards PPIs. Additional directions also include multidisciplinary audits and automated notifications to providers to help increase identification of inappropriate prescriptions on a much larger scale. Because providers play such a role in patient overuse of prescriptions, a multifaceted approach will be essential to large scale reductions in use.

**Dissemination**

The results of this study will be shared initially with the collaborating organization and key participating stakeholders through a presentation of aggregate data and results. Following
this presentation, the findings will be developed into a manuscript and submitted for publication to a national nursing journal. Dissemination to the participating organization will be used to incorporate the intervention in every department of the organization. Following the build out of an automated EMR within the organizations EMR, clinicians treating patients in any will be able to participate in the intervention within six months.

**Conclusion**

PPI overuse is widespread problem, but can be overcome with large scale education, persistence, and a multi-faceted approach. Clinician education regarding appropriate indications and length of therapy combined with clinical decision support tools such as algorithms and EMR notifications will continue to improve overuse. Establishing a large scale, evidence-based programs that include patients in many different medical settings will lead to reduced adverse effects and healthcare spending.
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Appendices with Instruments, Protocols, Algorithms etc.

Appendix A

Knowledge to Application Model

1. High rate of inappropriate PPI prescriptions
2. Lack of clinician knowledge
3. Patient reluctance
Appendix B

Proton Pump Inhibitor Deprescribing Algorithm

[Diagram showing the algorithm for deprescribing proton pump inhibitors, including indications, reasons for deprescribing, and steps to follow.]