# Interventions to Curb the Overuse Of Acid-Suppressive Medications On an Inpatient General Medicine Service

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## ABSTRACT

**Purpose:** We conducted a study to measure the impact of three sequential levels of intervention on prescribing patterns of acid-suppressive medications (ASMs) on an inpatient internal medicine service at a university hospital.

**Methods:** This retrospective review compared prescribing patterns on four different tiers: a phase 1 study, conducted one year before the phase 2 intervention study; and three phase 2 interventions. Each group was assessed for the percentage of all patients receiving ASMs and the percentage of patients receiving these drugs with an inappropriate indication. The three phase 2 studies are described in this article.

**Results:** Intervention A (a beginning-of-year lecture to all interns) was not enough to decrease total in-hospital use of these medications, compared with the phase 1 historical controls (62% vs. 66%, respectively); however, it did decrease the rate of inappropriate use from 59% to 37% ($P < 0.001$).

When Intervention B (an early-in-the-month rotation "reminder lecture") was added, the volume of agents used was significantly reduced to 53% ($P = 0.025$) and the number of inappropriate prescriptions was reduced to 32% ($P < 0.001$), compared with rates in phase 1.

Finally, when Intervention C (a clinical pharmacist making rounds with the health care team on most post-call days) was added to Interventions A and B, the total volume of drug use in the hospital declined to 53% ($P = 0.025$) and the number of inappropriate prescriptions fell to 19%, compared with rates in phase 1 ($P < 0.001$).

**Conclusion:** Providing educational lectures for interns was helpful in curbing the inappropriate prescribing of ASMs, but the benefit was augmented when a clinical pharmacist was added to the team.

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## INTRODUCTION

Even with all of the technological advances gained in both pharmaceutical care and the practice of medicine in recent decades, there is growing concern about polypharmacy because of an ever-increasing number of medications taken by patients. Studies have shown that a large proportion of all written prescriptions are not necessary. Increasing the number of medications prescribed not only increases costs and the risk of noncompliance but also puts patients at increased risk for experiencing an adverse drug event.[1–4]

One class of medications that has been enjoying steady popularity is the proton pump inhibitors (PPIs). PPIs appear near the top of many lists of the most commonly prescribed medications in the U.S.[5] Numerous publications from both inpatient and outpatient settings also show that the prescribing of PPIs and other acid-lowering agents, namely the histamine-2 receptor antagonists ($H_2$RAs), is often inappropriate.[6–11]

Two independently implemented and published studies conducted at our institution reported similar findings.[7,9] It was estimated that more than half of all PPI prescribing within the studied hospital service was inappropriate and that inappropriate use within the hospital often led to the continued use of PPIs at patient discharge.

Given the proclivity for inappropriate prescribing of these agents and the increased concern that PPIs might be linked to such adverse outcomes as *Clostridium difficile* colitis,[12–14] pneumonia,[15–18] and hip fractures resulting from calcium malabsorption,[19] there is cause for concern regarding the widespread and indiscriminate use of these agents.[20] In this article, we describe a multitiered and multidisciplinary approach in an attempt to curb inappropriate prescribing of these agents at our institution.

## MATERIALS AND METHODS

### Study Design

Our study involved four inpatient general medicine teams at our institution, a large university hospital with more than 800 beds. All of the teams were homogeneous in terms of average census as well as the types of patients who were admitted and treated. The teams took turns being on call to the general medicine service once every four days. Each team consisted of four members: one attending physician, one senior medical officer, and two interns. Every month the physician teams completely rotated personnel in a staggered manner so that no more than two individuals were switched at any given time.

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**Table 1 Study Design of Interventions to Curb the Overuse of Acid-Suppressive Agents**

Phase 1: historical controls from the 2005 retrospective review (N = 257)
Phase 2:
- Intervention A: intern boot camp for all 2006 interns (N = 242)
- Intervention B: intern boot camp (N = 144)
  - plus additional Intern boot camp lecture at beginning-of-month lecture
- Intervention C: intern boot camp (N = 137)
  - plus additional intern boot camp lecture at beginning-of-month lecture
  - plus clinical pharmacist interventions

N = number of patients in each respective group.

Table 1 presents the study design. Patients who were admitted to two of the four general medical services between November and December 2005 (phase 1) served as the historical controls for our 2006 intervention study, which we conducted from October through December 2006 to limit variations in the seasonal influx of patients (phase 2).

The residents from 2005 had not received any formal education about the use of acid-suppressive medications (ASMs); however, all members of the incoming 2006 medical resident class received an "intern boot camp" lecture in July at the beginning of the academic year. This lecture was labeled as Intervention A and was attended by all four teams in phase 2. The lecture included information from the medical literature, along with the FDA indications for appropriate use of ASMs. These indications are listed in Table 2.

One of the authors (A.O.) gave a second lecture to the two remaining teams at the beginning of the month to refresh the memory of the interns (Intervention B). These two teams were chosen because they shared the same conference room. At the beginning of the month, they received the same lecture by A.O. that was given at the beginning of the year to all interns at the intern boot camp.

**Table 2 Acceptable Indications For Acid-Suppressive Medications**

- Symptomatic GERD within the last three months
- Active gastrointestinal bleeding within the last three months
- Documented peptic ulcer disease
- Documented erosive esophagitis
- Prolonged NSAID use
- Prolonged corticosteroid use
- Treatment of *Helicobacter pylori* gastritis (for 1 to 2 weeks)
- Non-ulcer dyspepsia
- Underlying coagulopathy
- Mechanical ventilation for greater than 48 hours

GERD = gastroesophageal reflux disease; NSAID = nonsteroidal anti-inflammatory drug.

Data from Nardino R, et al. *Am J Gastroenterol* 2000;95:3118–3122;[6] Pham CQD, et al. *Ann Pharmacother* 2006;40:1261–1266;[7] Naunton M, et al. *J Clin Pharm Ther* 2000;25:333–340;[8] and Heidelbaugh JJ, Inadomi JM. *Am J Gastroenterol* 2006;101:2200–2205.[9]

Finally, Intervention C was afforded to only one of the two Intervention B teams. This lecture included continual reminders by the clinical pharmacist, who accompanied the team on rounds on post-call days to help with all matters of drug therapy, including the attempt to decrease the inappropriate use of $H_2$RAs and PPIs. During the two-month study period, the clinical pharmacist did not accompany the three non–Intervention C teams.

Communication about the project among the four teams was neither encouraged nor discouraged. As previously mentioned, two medical services shared the same conference room, and two others were based in geographically separate locations from all other services. Thus, those two teams sharing the same conference room were the most likely ones to overhear each other's conversations and to provide residual influence. For this reason, they received the same lecture at the beginning of the month. The study was designed so that the geographic separation from the other two teams would minimize the chance of confounding the effects of the interventions. The University of Michigan's institutional review board approved the study.

## Materials and Methods

After the study period was completed, one reviewer (A.O.) examined the electronic records of each patient who had been admitted to the general medicine service during that period. The following information was collected:

- baseline outpatient ASMs and other relevant medications
- type of inpatient ASMs (PPIs or $H_2$RAs)
- the indication for inpatient ASM therapy

Table 2 lists the indications that were considered appropriate for prescribing these drugs. The criteria were similar to those used in previous studies.[6–9]

After the information obtained from medical records was analyzed, the following data were compiled and evaluated:

- the number and percentage of patients who were prescribed an ASM in each intervention group
- the percentage of acceptable and unacceptable reasons for prescribing these drugs in each intervention group
- an itemization of proper and improper indications in the control and intervention groups

### Statistical Analysis

*Chi*-square testing was used to compare the calculated percentage within each group with that of the other groups. To determine the sample size in each group, we assumed that 60% to 70% of the control group would be receiving ASMs. We based our guess on two previous studies.[7,9] We then estimated that there would be approximately 65 admissions to each general medicine service each month. To have at least 80% power in the study to detect at least a 20% reduction in inappropriate use of ASMs between phases 1 and 2, we determined that at least 520 patients would be needed for the entire duration of phase 2. Therefore, we needed to include the period of October through December 2006 to supply a sufficient quantity of patients to power the study.

## RESULTS

Tables 3 and 4 present comparisons of overall use and inappropriate use of ASMs in phases 1 and 2. Even though the study was originally powered to distinguish between phase 1 and the entire phase 2 patient populations, we also performed analyses between phase 1 and individual phase 2 subgroups (Interventions A, B, and C) as well as between the phase 2 subgroups themselves.

### Intervention A Alone

In the phase 1 control group (general medicine services), 66% of patients (170/257) received ASMs on admission. Of these phase 1 patients, 59% (101/170) had received prescriptions of ASMs for inappropriate reasons. In the phase 2 group of 2006, Intervention A (intern boot camp) lowered the percentage of patients who received ASMs from 66% to 62%, although this number was not statistically significant. However, Intervention A was successful in decreasing the rate of inappropriate use of ASMs from 59% to 37% ($P < 0.001$).

### Adding Intervention B to Intervention A

When Intervention B (the early-in-the-month reminder lecture) was added to Intervention A, the volume of ASM use was significantly reduced to 53% ($P = 0.025$) and the rate of inappropriate ASM use was reduced to 32% ($P < 0.001$), compared with the 2005 phase 1 controls. However, there was no statistical difference between this group and the Intervention A group alone.

### Adding Intervention C to Interventions A and B

When Intervention C (pharmacists making rounds with the team on post-call days) was added to Interventions A and B, the volume of ASMs was reduced to 53% over Intervention A alone ($P = 0.025$). Intervention C decreased the rate of inappropriate use even further to 19% ($P < 0.001$). In fact, compared with Intervention A, the reduction in the rate of inappropriate use with Intervention C, from 37% to 19%, was statistically significant ($P = 0.007$).

Table 5 lists the distribution of inappropriate indications for the use of ASMs in phase 2. In all three intervention groups combined, 95 patients had received prescriptions with unapproved indications; this comprised 31.5% of all patients (95/302) audited in this intervention study, a figure that was substantially lower than the 59% in the phase 1 historical controls. Of all patients for whom ASMs were deemed inappropriate, the reviewer (A.O.) could discern no reason for 48% of these orders; the prescribers justified another 34% of these orders in the medical record for use as stress ulcer prophylaxis. Finally, 10% of these patients received ASMs for prophylaxis resulting from corticosteroid use.

## DISCUSSION

As noted in other publications,[6–11] including two studies conducted at our institution,[7,9] there was an apparent overuse of ASMs on the general medicine service. Also in accordance with previous findings, many of the patients in medical wards were prescribed these agents for stress ulcer prophylaxis, an indication that pertains to only a few high-risk patients who generally occupy intensive-care units.[21,22]

In an unpublished drug utilization review performed in 2005, which was used as the phase 1 control group for this study and that employed the same criteria as our phase 2 study, 66% of patients received orders for PPIs or $H_2$RAs during their hospitalization. More important, based upon our criteria, the use of these drugs was inappropriate 59% of the time. On these services, interns were the primary prescribers responsible for writing these orders. Therefore, we hypothesized that some form of education in early internship might be helpful in decreasing the inappropriate use of these agents.

Intervention A, the intern boot camp lecture provided to all interns in the summer before clinical rotations in 2006,

**Table 3 Overall Use of Acid-Suppressive Drugs during the Hospital Stay (Phase 2 Interventions versus Phase 1 Historical Controls)**

| Group | No. | No. of Patients Using ASMs | Patients Using ASMs (%) | *P* Value |
|---|---|---|---|---|
| Historical controls Phase 1 (2005) | 257 | 170 | 66% | — |
| Intervention A Phase 2 (2006, IBC alone) | 242 | 152 | 62% | NS |
| Intervention B Phase 2 (2006, IBC + BML) | 144 | 77 | 53% | 0.025 |
| Intervention C Phase 2 (2006, IBC + BML + CPI) | 137 | 73 | 53% | 0.025 |

ASM = acid-suppressive medication (either a histamine $H_2$ antagonist or a proton pump inhibitor); IBC = intern boot camp; BML = beginning-of-month lecture; CPI = clinical pharmacist intervention; No. = total number of patients admitted on service; NS = not statistically significant.

**Table 4 Inappropriate Use of Acid-Suppressive Drugs (Phase 2 Interventions versus Phase 1 Historical Controls)**

| Group | No. of Patients Using ASMs | No. of Patients Using Inappropriate ASMs (%) | *P* Value |
|---|---|---|---|
| Historical controls Phase 1 (2005) | 170 | 101 (59%) | — |
| Intervention A Phase 2 (2006, IBC alone) | 152 | 56 (37%) | <0.001 |
| Intervention B Phase 2 (2006, IBC + BML) | 77 | 25 (32%) | <0.001 |
| Intervention C Phase 2 (2006, IBC + BML + CPI) | 73 | 1 (19%) | <0.001 |

ASM = acid-suppressive medication (either a histamine $H_2$ antagonist or a proton pump inhibitor); IBC = intern boot camp; BML = beginning-of-month lecture; CPI = clinical pharmacist intervention; No. = total number of patients admitted on service.

did elicit a significant decline in inappropriate use from 59% to 37%. In fact, inappropriate use declined at each level of intervention. Intervention B, which added a lecture at the beginning of the month, reduced inappropriate use to 32%, thus showing a trend toward further benefit over the boot camp lecture (Intervention A) alone.

Intervention C (in which the boot camp lecture was added to the beginning-of-month lecture and a clinical pharmacist accompanied the team on rounds, provided reminders during the course of the month, or both) resulted in a decline in inappropriate use to 19%. This figure was statistically significant when compared with Intervention A, which involved only the boot camp lecture.

Thus, the presence of a clinical pharmacist who made rounds with the team further extended the effectiveness rendered by the group lectures. Overall, the rate of inappropriate ASM use declined from 59% in phase 1 (2005) to 31.5% in our phase 2 study population of 2006.

**Table 5 Inappropriate Indications for Acid-Suppressive Medications in 2006 (N = 95)**

| Indication | No. of Patients (%) |
|---|---|
| No reason found | 46 (48%) |
| Stress ulcer prophylaxis | 32 (34%) |
| Corticosteroids | 10 (10%) |
| Peptic ulcer disease, but more than 3 months before admission | 3 (3%) |
| GERD, but more than 3 months since symptoms reported | 3 (3%) |
| Lower gastrointestinal tract bleeding | 1 (1%) |

GERD = gastroesophageal reflux disease.

## STUDY LIMITATIONS

We acknowledge some limitations to our study. First, after much deliberation, we decided to label corticosteroid use as an appropriate indication for ASMs, even though, unlike concomitant nonsteroidal anti-inflammatory drugs (NSAIDs), they do not have an evidence-based indication. Therefore, we might have underestimated the true percentage of inappropriate prescribing of ASMs.

Of course, within this study reside the inherent limitations of doing a retrospective chart review design. Obviously, lacking the ability to randomize the ASM therapy, it is possible that some subgroups were sicker than others but merely lacked adequate documentation.

We did not make demographic or comorbidity comparisons between the groups; however, we assumed that because these were separate teams within the same services who admitted patients under the same criteria and simply took turns being on call every four days, populations within each service would have been relatively homogeneous, especially over a two-month study period that would include 15 admission cycles. We also studied both phases during the same two months of the year to reduce seasonal patient variation.

It is possible that some patients receiving ASMs might have had clinical indications that were simply not documented on the chart.

Despite markedly reducing inappropriate ASM use from 59% to 19% from phase 1 to Intervention C in phase 2, the volume of overall use was reduced only from 66% to 53%. It is possible that in just that one year's time—with the before-and-after phase 1 study effect, physicians' increased familiarity with the literature, and the newly placed internal educational endeavors—there was better documentation for more patients as to why ASMs were being prescribed for them. This could have placed more patients who lacked documentation—and who were therefore "inappropriate"—into the "appropriate" category if the physician took more time to place a confirming diagnosis for the ASM within the medical record. This could have further explained the low inappropriate prescribing rate (19%) in the phase 2 Intervention C group. Perhaps adding the clinical pharmacist to the team inspired the physicians to ensure that some documentation justifying ASM use appeared in the record.

That being said, the underlying motivation behind most institutions' drug utilization reviews is two-fold: first, to reduce inappropriate use, and second, to improve documentation when the use of the agent in question is appropriate.

Reviewer bias might have come into play, but we attempted to minimize any bias by having the same person review all the charts. In addition, the clinical pharmacist was not privy to the data until several months after the data were collected and

analyzed.

Another limitation concerns the accurate assessment of each intervention's influence; that is, either collateral influence or a Hawthorne effect could have blunted the true differences between each intervention. For instance, residents who received the second lecture before the beginning of the month (Interventions B and C) understood that ASM use was being studied. In an effort to improve their teams' numbers for this study, they might have changed their prescribing practices for that month alone.

Finally, our study took place in an in-patient teaching ward service of a university hospital. Thus, the results might not be applicable to a non-teaching service or a community hospital.

The influence of the clinical pharmacist on all facets of the study may have been subliminal but could have been significant in diffusing out to all four teams by word of mouth. Even though the pharmacists did not accompany three of the four teams on rounds during the two study months, they did join all four teams, off and on, during both of these study years, and they remained vigilant in discouraging the superfluous use of these agents whenever they did go with the teams on post-call days. The presence of the clinical pharmacist might have helped to discourage inappropriate prescribing of ASMs and to improve documentation when ASM prescribing *was* appropriate.

Overall, having a clinical pharmacist join the teams on rounds appeared to significantly decrease both the total volume of ASMs used in the hospital and the rate of inappropriate prescribing of ASMs. Indeed, the literature is now replete with studies that document the value that clinical pharmacists bring to health care teams in both cost-effectiveness and patient safety.[23,24] Nonetheless, for institutions that lack the resources to have clinical pharmacists available to round with teams on a regular basis, an educational lecture early in residency might still be beneficial in decreasing the inappropriate use of ASMs. Further benefit could be gained with "booster" lectures at the beginning of each monthly rotation.

## CONCLUSION

As observed in this study and in several others in the literature, most patients who are admitted to university-based general medicine services received either an initial order or a continuing prescription of an acid-suppressive agent during their hospital stay. Based upon current FDA indications, the use of these drugs was inappropriate for at least half of the time during which they were prescribed in this setting.

The inappropriate prescribing of ASMs can be curbed by several forms of intern education. A lecture given at the beginning of the academic year may itself be moderately successful, and a reminder lecture at the beginning of the month of the internal medicine rotation adds slightly to this benefit. However, additional advantages in curbing inappropriate use can be gained when a clinical pharmacist accompanies the health care team on rounds on a regular basis.

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