RESEARCH ARTICLES

Pharmacy Student Impact on Inappropriate Prescribing of Acid Suppressive Therapy

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Objective. To examine the impact that having pharmacy students on internal medicine patient care teams had on inappropriate prescribing of acid suppressive therapy (AST).

Methods. In this observational cohort study, internal medicine patients who received care from teams with a pharmacy student were compared to patients who received care from teams without a pharmacy student. The primary endpoint was proportion of patients on inappropriate AST.

Results. The overall proportion of patients receiving inappropriate AST was 24.4%. There was no significant difference between patients seen by teams with a pharmacy student and those seen by teams without a pharmacy student. The proportion of patients discharged with new inappropriate AST prescriptions was lower after pharmacy student review, though not significantly (6.1% vs. 9.4%, $p = 0.07$). Pharmacy student reviews shortened the median duration of inappropriate AST by 1.5 days (6 vs. 8.5 days, $p = 0.025$).

Conclusions. Patient care teams on which pharmacy students performed medication reviews had a reduced duration of inappropriate use of AST in patients.

Keywords: pharmacy students, acid suppressive therapy, prescribing

INTRODUCTION

Stress ulcers are a form of hemorrhagic gastritis occurring in critically ill patients who are experiencing abnormally increased physiologic demands as the result of surgery, trauma, organ failure, sepsis, thermal injury, or prolonged mechanical ventilation.^{1,2} The inclusion of acid suppressive therapy (AST) with proton pump inhibitors (PPIs) or H₂-receptor antagonists (H₂RAs) has substantially decreased the incidence of stress ulcer bleeding.^{3,4} The use of AST to prevent stress ulcers in hospitalized patients not in the intensive care unit (non-ICU) has occurred without direct supportive outcome evidence.⁵ This practice resulted in 22% to 60% of non-ICU inpatients receiving inappropriate AST during hospitalization.^{2,5} Three months after discharge, 25% of the patients who

received inappropriate AST during hospitalization were still receiving inappropriate AST. This is a patient safety issue because of the patients' increased risk for developing AST-associated complications such as upper respiratory infections, fractures, drug and nutrient malabsorption, and drug interactions.⁶

Multidisciplinary patient care models use pharmacy students who are participating in patient rounds as part of internal medicine teams to review the appropriateness of AST. Published reviews of pharmacy students on clinical pharmacy practice experiences report on the quantity of interventions and perceived benefit according to other health care professionals.⁷⁻⁹ Studies to evaluate whether pharmacy students can influence physician prescribing behavior in specific practices including AST are needed. We performed a prospective, observational study to evaluate the impact of pharmacy students on inappropriate prescribing of AST for stress ulcer prophylaxis among internal medicine patients. We hypothesized that pharmacy student medication reviews would reduce inappropriate AST in patients admitted to internal medicine services.

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METHODS

A prospective, observational cohort study was designed that included all adult non-ICU patients admitted to internal medicine teaching services from June 1, 2008, through January 31, 2009, who were receiving AST. Patients who had been transferred from the ICU were eligible for inclusion in the study. The study setting was a 650-bed academic medical center affiliated with schools of medicine and pharmacy. The Institutional Review Board approved the research methods.

Data were collected from electronic medical records. AST was defined as the prescription of at least one dose of PPI or H2RA at any point during hospitalization. AST was considered appropriate for all patients if at least 1 of the following indications could be identified in the patient's record: home AST at admission, history of gastroesophageal reflux disease, acute or suspected upper gastrointestinal (GI) bleeding or GI bleeding during the previous 3 months, erosive esophagitis or gastritis, dyspepsia, peptic ulcer disease, post bariatric surgery, or the administration of 2 or more of the following medications: nonsteroidal anti-inflammatory drugs, aspirin, clopidogrel, warfarin, heparin or low molecular weight heparin for therapeutic anticoagulation, or corticosteroids.^{2,10} AST was considered inappropriate if these conditions were not met. These criteria for AST appropriateness also were applied to patients transferred into the internal medicine service from the ICU.

Medical residents in the internal medicine residency program worked in teaching teams consisting of 1 third-year and 2 first-year medical residents supervised by an attending physician. From October to January, teaching teams also had 1 fourth-year advanced pharmacy practice experience (APPE) student participating in patient rounds with them for 5 days per week. The internal medicine teams without pharmacy students (June through September) served as the control group for this study.

Patients were selected for medication review from the internal medicine team's daily list of new admissions. Every third patient who had been prescribed at least one dose of an acid suppressive medication was selected for review until 20 patients from each week during the study period were identified, allowing for equal sampling from each pharmacy student's clinical APPE.

Each pharmacy student began the APPE by undergoing standard training with a pharmacist. Training included a 30-minute teaching session based on a key review article describing appropriate AST.⁶ Sessions emphasized evidence-based AST in internal medicine patients and the impact of unnecessary AST, including increased risk of the patient developing *Clostridium dif-*

ficile colitis, pneumonia, osteoporosis, medication side effects, and drug-drug interactions, and increased costs. Strategies for student interventions for patients receiving inappropriate AST were discussed, including the pharmacy student questioning AST indication during rounds, presenting patient-specific implications of inappropriate AST, and following up with the patient's physician to determine whether the recommendation was accepted. Pharmacy students were evaluated on how successful their actions were in the discontinuation of inappropriate AST prescriptions.

The pharmacy students evaluated medication profiles daily for AST. When inappropriate AST was identified, students addressed AST therapeutic issues and determined the most effective method for communicating the information to the internal medicine team. Pharmacy students participated in patient rounds without a pharmacist preceptor present to encourage them to practice communicating directly with patients and physicians. Pharmacist preceptors met with students following rounds to review the recommendations the students had made. All pharmacy student recommendations to discontinue AST for a patient then were verified by a pharmacist preceptor who approved the recommendation or advised the student to communicate an alternative recommendation to the patient's physician.

An internal pilot study of AST appropriateness conducted in 50 patients prior to this study estimated that 40% of AST prescriptions were inappropriate. These internal data agreed with data from other studies which found that 22%-60% of AST was prescribed inappropriately.^{2,5} We estimated that pharmacy students would reduce the proportion of inappropriate AST prescriptions to 25%. Sampling required having 165 patients in the study group and 165 in the control group (330 patients), providing an expected effect size of 37.5%, with an alpha of 0.05 and 80% power. We calculated the proportion of patients receiving inappropriate AST prescriptions during hospitalization, proportion discharged on inappropriate AST, and median days of inappropriate AST. Proportions were compared using Pearson's chi-square or the Fisher exact test as appropriate. A Wilcoxon rank sum test was used to compare medians. Kruskal-Wallis ANOVA *t* tests with unequal variances or F-tests for multiple comparisons were used to report significant differences in linear variables.

RESULTS

Three hundred eighty-nine internal medicine patients who had received AST were evaluated. Pharmacy students followed and reviewed 197 of the patients and teams without pharmacy students followed and reviewed the other 192 patients. Proportions of primary diagnoses were similar between groups, with some exceptions. The most frequently ordered medication for AST was esomeprazole

Table 1. Demographics of Internal Medicine Patients Included in a Study to Determine the Impact That Pharmacy Students Had on Inappropriate Prescribing of Acid Suppressive Therapy

	Patients Cared for by Teams With a Pharmacy Student (n = 197)	Patients Cared for by Teams Without a Pharmacy Student (n = 192)
Diagnosis category, No. (%)		
Infectious disease	47 (23.9)	29 (15.1) ^a
Gastrointestinal	28 (14.2)	26 (13.5)
Cardiovascular	26 (13.2)	25 (13.0)
Pulmonary	23 (11.7)	19 (9.9)
Neurologic	11 (5.6)	25 (13.0) ^a
Hematological	7 (3.6)	10 (5.2)
Other	55 (27.9)	58 (30.2)
AST medication(s)		
Esomeprazole	169 (85.8)	159 (82.8)
Famotidine	34 (17.3)	48 (25.0) ^a
Days of hospitalization, median (range)	7 (2,146)	8 (1,79)

^a $P < 0.05$ for comparison between the 2 groups.

(Table 1). Indications for appropriate AST are depicted in Figure 1.

The overall proportion of patients receiving inappropriate AST was 24.4%. There was no significant difference between the rate of inappropriate AST in patients cared for by teams with a pharmacy student and those cared for by teams without a pharmacy student (23.4% vs. 25.5%, $p = 0.62$). The proportion of patients who were discharged with new prescriptions for inappropriate AST was lower for teaching teams with pharmacy students, though the difference was not significant (6.1% vs. 9.4%, $p = 0.07$). However, mean duration of inappropriate patient AST was 1.5 days less for teaching teams with pharmacy

students than for teams without students (6 vs. 8.5 days, $p = 0.025$). Of the 46 patients receiving inappropriate AST who were cared for by the teams with pharmacy students, 18 recommendations to discontinue therapy were accepted (39.1%).

DISCUSSION

In this prospective cohort study in a large academic medical center, pharmacy student reviews of AST decreased the duration of inappropriate therapy but did not reduce the overall proportion of patients started on inappropriate AST. One in 4 patients in the study received AST without having an indication for it. This is on the lower end of previously reported rates of inappropriate AST, which range from 22% to 60%.^{2,5}

Lieberman and Whelan reported an educational intervention that reduced inappropriate AST in hospitalized inpatients by 26% for at least 6 months.¹¹ Our intervention had lower rates of inappropriate AST (24% vs. 33%) and therefore a lower than expected effect size. The most likely explanation for similar rates of inappropriate AST is that the physicians placing the initial AST order were on patient care teams that made patient rounds at night and did not receive the team-based education provided by pharmacy students.

Approximately 24% to 39% of patients started on AST while hospitalized are discharged inappropriately with new AST prescriptions.^{5,10-12} We found much lower baseline levels of discharge with inappropriate AST prescriptions. Although having pharmacy students on the patient care teams may have reduced the number of patients discharged with inappropriate AST prescriptions, this finding would be incidental.

Figure 1. Appropriate AST indication by type of medical team (* $P < 0.05$). Abbreviations: GI = gastrointestinal; GERD = gastroesophageal reflux disease.

Table 2. Pharmacy Students' Impact on Inappropriate Prescribing of Acid Suppressive Therapy

Endpoint	Pharmacy Students (n = 197)	No Pharmacy Students (n = 192)	P
Patients on inappropriate AST, No. (%)	46 (23.4)	49 (25.5)	0.62
Days of inappropriate AST, Mean (SD)	6.0 (3.5)	8.5 (7.3)	0.025 ^a
Patients on inappropriate AST discharged with a new prescription, No. (%)	12 (6.1)	18 (9.4)	0.07

^a Using linear regression, adjusting for length of stay and clustering within physician.

Our study has several limitations. First, it was performed at a single academic medical center, which may limit generalization, although overuse of AST is a frequent issue in hospitalized patients. Also, patients were not randomly assigned to the study groups so patient features may not have been balanced between the study and control groups. Specifically, the control group was historical, ie, comprised of patients who received care before the intervention took place, and included months in which new interns began training. Although staff members at our institution were required to perform medication reconciliation using the electronic medical record, pharmacy students were generally not required to participate. Because we did not require pharmacy students to verify the indication for home AST use, patients admitted to the hospital already on inappropriate AST would not have been targeted for a pharmacy student intervention. While standardized education on AST appropriateness was provided, the students who presented the information varied widely in their assertiveness, communication skills, and effectiveness in making pharmacotherapeutic recommendations. These observations highlight the importance of effective communication, team-building, and trust in educational partnerships with health care professionals encountered on clinical practice experiences.

Based on our findings, several strategies to increase the effectiveness of pharmacy student educational interventions should be explored. During the teaching session, the pharmacy students verbalized understanding of the concepts discussed. The students also were given a review article to refer back to the information discussed. We feel this initial 30-minute teaching session was adequate, but in the future we will meet with the pharmacy students after rounds to discuss strategies they used that day to get the AST discontinued. By encouraging the students to share information with each other on strategies that worked or did not work, hopefully the intervention will become more successful throughout the practice experience.

CONCLUSION

Pharmacy students had a positive but limited impact on inappropriate AST prescribing in an adult internal medicine ward of a 650-bed academic medical center where 1 in 4

patients received inappropriate AST. Pharmacy students were effective in reducing the duration of inappropriate AST by 1.5 days but did not reduce the overall proportion of inappropriate AST prescriptions. Academic medical centers can develop and refine specific strategies using pharmacy students to improve the appropriateness of medical therapy and prescribing behaviors.

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