An Interprofessional Approach to Reducing the Overutilization of Stress Ulcer Prophylaxis in Adult Medical and Surgical Intensive Care Units

Chelsea L. Tasaka, PharmD1, Cindy Burg, PharmD, BCPS1, Sherilyn J. VanOsdol, PharmD, BCPS2, Lynne Bekeart, MPH, HSA2, Andrew Anglemyer, PhD, MPH1, Candy Tsourounis, PharmD, FCSHP2, and Stephanie Rennke, MD1

Abstract

Background: Overutilization of stress ulcer prophylaxis (SUP) in the intensive care unit (ICU) is common. Acid-suppressive therapies routinely used for SUP are best reserved for patients with greatest risk of clinically important bleeding as they have been associated with nosocomial pneumonia, Clostridium difficile infection and increased hospital cost. Objective: The primary objective was to reduce inappropriate utilization of SUP in 2 adult medical and surgical ICU settings at the University of California, San Francisco Medical Center. Secondary objectives included reduction of inappropriate continuation of SUP at ICU and hospital discharge. Methods: To attain the study objective, an interprofessional team developed a bundled quality improvement initiative, including an institution SUP guideline, pharmacist-led intervention, and an education and awareness campaign. To assess the impact of these interventions, we conducted a retrospective cohort study comparing data on prescribing practices at baseline before and after the intervention. Since computerized prescriber order entry (CPOE) was implemented during this time frame, preintervention data collection consisted of 2 periods, one before and one after CPOE implementation. Results: The incidence of the inappropriate use of SUP was not significantly different between the pre-CPOE and post-CPOE groups (20 and 19 per 100 patient-days, respectively; P = .88), but the incidence of inappropriate use of SUP was significantly lower in the postintervention group versus the post-CPOE group (9 and 19 per 100 patient-days, respectively; P = .03). At ICU discharge, 4% of patients in the post-intervention group were discharged inappropriately on SUP compared with 8% in the post-CPOE group (P = .54). At hospital discharge, none of the patients in the postintervention group were discharged inappropriately on SUP compared with 7% in the post-CPOE group (P = .22). Conclusions: Implementation of an interprofessional bundled quality improvement initiative is effective in decreasing inappropriate use of SUP in adult medical and surgical ICUs at a university-affiliated, tertiary care academic medical center.

Keywords
stress ulcer prophylaxis, gastrointestinal prophylaxis, critical care, histamine-2 receptor antagonist, proton pump inhibitor, quality improvement

Background

Stress-related mucosal disease and impaired mucosal repair mechanisms leave critically ill patients vulnerable to gastrointestinal bleeding (GIB); however, only a fraction of these patients will develop clinically important GIB (overt GIB complicated by one of the following within 24 hours after onset: spontaneous decrease >20 mm Hg in systolic blood pressure, increase >20 beats per minute in heart rate, decrease of >10 mm Hg in systolic blood pressure measured on sitting up, or a decrease in hemoglobin of greater than 2 g/dL and subsequent transfusion).1 Occurrence of clinically important bleeding in critically ill patients is highly variable and has been reported with an incidence between 0.1% and 31% though most sources cite an incidence of less than 6%.1-6 The reported incidence of clinically important bleeding has decreased over the past few decades, which is

1University of California, San Francisco, CA, USA
2Department of Clinical Pharmacy Medication Outcomes Center, School of Pharmacy, University of California, San Francisco, CA, USA

Corresponding Author:
Chelsea Tasaka, 2315 Stockton Boulevard, Sacramento, CA 95817, USA.
Email: cltasaka@gmail.com
attributed to advancements in standards of care such as improved management of hypotension and shock, and the shift toward early initiation of enteral feeding.\textsuperscript{6,7} Despite this relatively low incidence of clinically significant sequelae, methods for prevention are of interest as GIB is associated with a significantly higher mortality rate (64\% vs 9\%).\textsuperscript{8}

Histamine-2 receptor antagonists (H2RAs) and proton pump inhibitors (PPIs) have both been proven to be effective in decreasing the incidence of clinically important bleeding; however, this benefit has not been translated to a reduction in mortality or a decrease in intensive care unit (ICU) length of stay in critically ill patients when administered for stress ulcer prophylaxis (SUP).\textsuperscript{3} Acid-suppressive therapies carry some risk of adverse effects and are associated with an increased incidence of pneumonia and \textit{Clostridium difficile} infection.\textsuperscript{9-11} Because of these risks, use of these medications for SUP is best reserved for patients at high risk for developing clinically important bleeding or in whom these agents have been shown to yield beneficial effect such as those with coagulopathy, mechanical ventilation for duration greater than 48 hours, or recent history of GIB.\textsuperscript{9-13} Unnecessary prescribing of SUP for patients at low risk for developing GIB is common among hospitals nationwide. This issue has recently been highlighted as one of the American Board of Internal Medicine Foundation’s Choosing Wisely list, “Five Things Physicians and Patients Should Question,”\textsuperscript{14} including 5 evidence-based recommendations for targeting areas of possible overuse in the care of hospitalized patients.\textsuperscript{14} Despite the attention directed toward overuse of these therapies, a recently published survey suggests that many physicians have an incomplete understanding of the indications for SUP.\textsuperscript{15} Many previously published observational studies suggest that the impact of unnecessary use of SUP extends beyond the ICU, and report that up to 68.8\% of patients are inappropriately discharged from the hospital with a PPI.\textsuperscript{16-18}

The University of California, San Francisco (UCSF) Medical Center is a level II trauma, 690-bed university-affiliated, tertiary care, teaching hospital with 32 adult medical and surgical ICU beds at the Parnassus campus. The objective of this retrospective cohort study was to characterize SUP prescribing practices in medical and surgical ICUs at the UCSF Medical Center Parnassus campus, and assess the efficacy of a bundled quality improvement initiative to reduce the overutilization of SUP at an academic, tertiary care medical center.

**Methods**

This was a retrospective, observational cohort study consisting of 3 cohorts. Each cohort encompassed a different time period relative to key events or interventions we hypothesized could impact SUP prescribing practices. An interprofessional team composed of pharmacists, physicians, nurses, and dieticians met on a bimonthly basis to plan and develop a bundled approach to reduce the overutilization of SUP in adult medical and surgical ICU patients (Figure 1). This team created SUP process maps, contacted key stakeholders, and conducted surveys to identify critical intervention points and potential barriers to change. The final strategy consisted of 3 intervention components: an institution SUP guideline, an education and awareness campaign, and a pharmacist-led intervention.

The SUP guideline was formulated by our team after extensive review of the pertinent medical literature. SUP was only recommended for patients with independent or compelling risk factors for developing clinically important GIB or for patients who were excluded from key studies as they were deemed to be at high risk for GIB at baseline (eg,
history of GIB within the past year). In patient populations where there were conflicting data or a paucity of high-quality evidence to guide SUP use, we relied on the consensus of experienced critical care clinicians. Given the relatively lower association of H2RAs with *C difficile* infection and nosocomial pneumonia, as well as the lower cost, our team recommended H2RAs as the preferred SUP agent. In line with our institutional formulary, famotidine was designated as our preferred SUP agent. The SUP guideline was then vetted through various stakeholders and received approval by the hospital Pharmacy and Therapeutics Committee in December 2012 (Figure 2).

The second component of our initiative, an education and awareness campaign, launched officially on January 7, 2013. The campaign involved publication in hospital newsletters, e-mails to attending physicians, development of facilitator guides to use during teaching rounds and presentation to various clinician groups. Providers targeted for education included surgery teams, medicine residents, anesthesia residents, dieters, ICU nurses, and pharmacists. Pocket cards summarizing the SUP guideline were also disseminated to medical residents rotating through the ICU, pharmacy residents, and pharmacists. The majority of this campaign took place during January 2013; however, training sessions were repeated monthly to improve awareness of appropriate SUP use.

Critical care pharmacist-driven recommendations on SUP therapy comprised the third component of the intervention. ICU pharmacists recommended appropriate SUP in person during daily patient care rounds to the primary team, or via text page or phone call to prescribing physicians. Within the UCSF adult medical and surgical ICU, a critical care pharmacist participates in patient care rounds with the ICU team each morning and provides clinical service coverage. In addition to usual care, the ICU pharmacists began documenting their recommendations and resultant prescriber actions in a standardized format. The pharmacists documented in “iVent,” a feature within the

---

**Figure 2.** Adult stress ulcer prophylaxis (SUP) guideline approved by the University of California, San Francisco, Pharmacy and Therapeutics Committee in December 2012.
EPIC platform in the patients’ electronic medical record (APeX Electronic Health Record, Epic Systems Corporation, Verona, WI). Specifically, pharmacists were able to track their assessments, recommendations, method of communication to prescribers, and outcomes.

Data were collected before and after implementation of these interventions. Computerized prescriber order entry (CPOE) was initiated in June 2012. Prior to this change, the core hospital admission order set included SUP, but after CPOE implementation neither the core order set nor the newly created ICU admission order set include SUP. To be able to assess whether CPOE implementation had any effect on SUP prescribing, there were 2 data collection periods that took place prior to our intervention: one prior to and one after CPOE implementation. The 3 data collection periods took place during the following phases: pre-CPOE, post-CPOE, and postintervention (each phase covering a 2-week period in May 2012, September 2012, and February 2013, respectively).

All adult patients admitted to an adult medical and surgical ICU during the data collection periods were included in this study. Patients were excluded if they had active GIB, active peptic ulcer disease, total gastrectomy, or solid organ transplant. Patients were also excluded if they were receiving dual antiplatelet therapy, concurrent antiplatelet and anticoagulation therapy, or nonenteric coated pancrelipase via gastric feeding tube. These patients were excluded because they either had an additional indication for acid-suppressive therapy (H2RA or PPI) or they were not indicated for SUP regardless of risk factors (eg, total gastrectomy). Data were collected via retrospective review of electronic medical records and medication profiles. In addition to demographic and ICU admission–related data (including indications for acid-suppressive therapy and therapy prior to admission), the following were recorded on a daily basis for each patient in the ICU: risk factors for clinically important GIB, pharmacist recommendations for SUP, and changes to acid-suppressive therapy regimen. Data collected for patients in the post-CPOE and postintervention groups included the date of ICU and hospital discharge, acid-suppressive therapies ordered on ICU transfer or discharge orders, and indication for acid-suppressive therapies at each transition of care. Patients were excluded from the ICU and hospital discharge data set if they expired prior to discharge from that setting. Patients were excluded at the time at which they met exclusion criteria.

The primary endpoint was the incidence of inappropriate utilization of SUP in the ICU reported in inappropriate days of therapy per 100 patient-days. The secondary endpoints were the incidence of inappropriate nonuse of SUP for patients in whom therapy was indicated, and the proportion of patients receiving inappropriate continuation of SUP after ICU and hospital discharge. For each patient-day, the use or nonuse of SUP use was categorized as “appropriate,” “inappropriate,” or “unknown.” “Appropriate” therapy was defined as acid-suppressive therapies ordered with an indication for SUP present (per developed guideline), another indication for acid-suppressive therapy, or conversely acid-suppressive therapy that was absent for patients who did not carry an indication for this therapy. Examples of other indications for acid-suppressive therapy included gastroesophageal reflux disease or Barrett’s esophagus. In contrast, “inappropriate” therapy was defined as acid-suppressive therapy ordered for patients who had no indication for SUP or an acid-suppressive therapy, or inappropriate absence of acid-suppressive therapy for patients with an indication for SUP. Lastly, patients who had acid-suppressive therapy continued from home without a documented indication for this therapy in their past medical history were categorized as “unknown.” The Human Research Protection Program Committee denied review of this project as it was considered a quality improvement project.

**Statistical Analysis**

Data were analyzed in R 3.0.0 (R Core Team. R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2013. http://www.R-project.org/) and comparison between groups were performed using Fisher’s exact probability test to detect differences between comparison groups. Statistical significance was determined at $P < .05$. Inpatient data are described as incidence per 100 patient-days and there are more patient-days than patients; we were more concerned with treatment per patient-day rather than treatment per person. As such, we considered days as our unit of analysis in the inpatient data analysis. The unit of analysis for the discharge data was at the patient level.

**Results**

There were a total of 54 patients, 75 patients, and 56 patients included in the pre-CPOE, post-CPOE, and postintervention periods, respectively (Figure 3). Follow-up time included

![Figure 3. Included and excluded patients for each data collection period.](image-url)
194 patient-days in the pre-CPOE group, 200 patient-days in the post-CPOE group, and 165 patient-days in the postintervention group. In the pre-CPOE group, 72 of 266 patient-days were excluded (37 patient-days for active gastrointestinal bleed/ulcer, 25 patient-days for solid organ transplant, and 10 patient-days for dual antiplatelet therapy or concurrent anticoagulation and antiplatelet therapy). In the post-CPOE group, 61 of 261 patient-days were excluded (23 patient-days for active gastrointestinal bleed/ulcer, 23 patient-days for solid organ transplant, 5 patient-days for dual antiplatelet therapy or concurrent anticoagulation and antiplatelet therapy, and 10 patient-days for total gastrectomy). In the postintervention group, 104 of 269 patient-days were excluded (47 patient-days for active gastrointestinal bleed/ulcer, 33 patient-days for solid organ transplant, 5 patient-days for dual antiplatelet therapy or concurrent anticoagulation and antiplatelet therapy, and 10 patient-days for total gastrectomy). In the postintervention period, 104 of 269 patient-days were excluded (47 patient-days for active gastrointestinal bleed/ulcer, 33 patient-days for solid organ transplant, and 24 patient-days for dual antiplatelet therapy or concurrent anticoagulation and antiplatelet therapy). There was acid-suppressing therapy ordered for 85% (165/194), 68% (136/200), and 67% (110/165) of patients in the pre-CPOE, post-CPOE, and postintervention groups, respectively ($P = .001$ for pre-CPOE vs post-CPOE; $P = .82$ for post-CPOE vs postintervention; Table 1).

The incidence of inappropriate use of SUP was 20 patient-days per 100 (33/165) in the pre-CPOE group and 19 patient-days per 100 (26/136) in the post-CPOE group ($P = .88$); however, in the postintervention period, the incidence of inappropriate use of SUP was 9 patient-days per 100 (10/110), which is significantly lower than the post-CPOE group ($P = .03$; Figure 4). In contrast, the incidence of the nonuse of SUP when patients had an indication for this therapy was 3 patient-days per 100 (1/29) in the pre-CPOE group and 7 patient-days per 100 (4/64) in the post-CPOE group, which were not significantly different from 7 patient-days per 100 (4/55) in the postintervention group ($P = 1.00$ for both comparisons; Figure 5).

We also assessed the proportion of patients receiving inappropriate continuation of acid-suppressive therapies after ICU and hospital discharge in both the post-CPOE and postintervention groups. In the post-CPOE group ($n = 75$), 74 patients survived to discharge from the ICU and 73 patients survived to discharge from the hospital. In the postintervention group ($n = 56$), 50 patients survived to discharge from the ICU and 44 patients survived to discharge from the hospital. After ICU discharge, 8% (6/74) of patients in the post-CPOE group were inappropriately continued on SUP compared with 4% (2/50) in the postintervention group ($P = .54$; Figure 6). After hospital discharge, 7% (5/73) of patients in the post-CPOE group were continued inappropriately on their SUP compared with none of the patients in the postintervention group ($P = .22$; Figure 7).

**Discussion**

In the postintervention group, there was a statistically significant reduction in inappropriate use of SUP in the ICU.
comparing the pre-CPOE and post-CPOE groups (P = 0.03). A reduction in inappropriate SUP use at ICU and hospital discharge was shown, but this was not statistically significant (P = .54 and P = .22, respectively). The baseline data confirmed our suspicion that SUP overuse is present at our institution with unnecessary SUP ordered for approximately 20 patient-days per 100 in the ICU, and for 7% of patients inappropriately discharged from the hospital on these therapies. When comparing the pre-CPOE and post-CPOE groups, interestingly the incidence of inappropriate use of SUP remained unchanged (P = .88); however, the overall prescribing rates of acid-suppressive therapies were much greater in the pre-CPOE group with acid-suppressive therapies ordered for 85% of patient-days in this group versus 68% in the post-CPOE and 67% of patient-days in the postintervention groups (P = .001 for pre-CPOE vs post-CPOE; P = .82 for post-CPOE vs postintervention; Table 1). This change may be a result of the transition to CPOE and the removal of acid-suppressive therapies from the core admission order set. It is important to note that even with this decrease in overall use, the incidence of inappropriate use of SUP remained unchanged when comparing the pre-CPOE and post-CPOE groups (Figure 4). This suggests that the reduction in inappropriate SUP use in the postintervention period was because of the interventions implemented as opposed to CPOE implementation alone.

While the main focus of our study was to decrease the inappropriate use of SUP, we wanted to ensure SUP was provided for patients who had an indication for prophylaxis. ICU pharmacists evaluated all patients for SUP indications and recommended initiating prophylaxis if it was appropriate, but speculate that it may be difficult to see a reduction in this metric since this represents a relatively small number of patient-days. In the analysis of patient-days on which acid-suppressive therapy was not ordered (Figure 5), we found there were more patient-days in which SUP was indicated but not ordered for the post-CPOE group than the pre-CPOE group, but this was not statistically significant (P = 1.00). It is likely that the removal of SUP from core admission order sets and the overall reduction in acid-suppressive therapy use in the post-CPOE group were responsible for this trend. The incidence of failing to prescribe SUP for patients indicated for this therapy in the postintervention group (7 patient-days per 100) was not significantly different than the pre-CPOE group (3 patient-days per 100; P = 1.00). While this incidence is comparable to that in the pre-CPOE group, acid-suppressive therapy was ordered on more patient-days in the pre-CPOE group versus the postintervention group (85 vs 67 patient-days per 100). Thus, the incidence is lower in the postintervention group when considering the entire included sample of patients. The data suggest that the intervention described did not result in an increased incidence of absence of therapy for patients at risk for clinically important GIB and perhaps may have even improved this metric.

The ICU and hospital discharge data suggest that while the proportion of patients receiving inappropriate continuation of SUP at hospital discharge was lower than results from other studies, 7% of patients were discharged inappropriately on these medications prior to our intervention.16-18 Although 4% of patients in the postintervention group were discharged from the ICU inappropriately on SUP, it is encouraging that none of these patients were inappropriately discharged from the hospital on SUP. Medication reconciliation at this transition of care is critical as medications prescribed at hospital discharge can often be continued inappropriately long term. This not only contributes negatively to patients’ medication costs, but long-term therapy can also increase the risk for bone fracture, and may negatively affect the efficacy of other medications.19-24 Although the incidence of inappropriate continuation of
SUP at hospital discharge was lower in the postintervention group compared with the post-CPOE group (7% vs 0%, respectively), statistical significance was not achieved ($P = .22$). We hypothesize this may be due at least in part to the focus on targeting prescribing practices in the ICU (the interventions did not directly target non-ICU practices) in addition to the small sample size.

An issue of controversy pertaining to SUP is the choice of H2RAs versus PPIs. The SUP guideline created by our team contrasts the SUP agent of choice recommendations in the recently updated Surviving Sepsis Campaign Guidelines, which recommend PPIs over H2RAs as the agents of choice for SUP. Despite more potent acid suppression with PPIs and recent meta-analyses suggesting that PPIs may be superior to H2RAs for SUP, there has been no well-designed randomized trial to independently demonstrate this. This, in conjunction with the relatively lower association of H2RA use with $C$ difficile infection and nosocomial pneumonia, as well as the lower cost led our team to recommend H2RAs as the preferred SUP agent at our institution. Because of the overall reduction in acid-suppressive therapy use and potential avoidance of nosocomial pneumonia or $C$ difficile infection, we presume that our intervention resulted in an overall reduction in health care costs, but in lieu of an analysis, this unfortunately cannot be quantified or confirmed. Our team decided not to pursue a cost analysis since the cost of acid-suppressive therapies are relatively small and thus would be unlikely to yield meaningful results.

There were several limitations to this study, most notably this was an observational study and thus there could potentially be external factors contributing to the reduction in inappropriate SUP. The time course, particularly at an academic teaching hospital may have contributed to differences in prescribing practices with the influx of new house staff in July each year. This cyclic change might lead one to expect more inappropriate prescribing earlier in the residency year; however, the comparison of our pre-CPOE (May 2012) and post-CPOE (September 2013) data argues against this with inappropriate prescribing remaining unchanged.

Our study was also limited by the fact that we collected data via retrospective chart review, which may have led to variability in categorizing the appropriateness of therapy in circumstances where the indication, diagnosis, medical history, or medication history were not clearly documented. While our results suggest reduction in the inappropriate use of SUP, the small sample size limits our ability to determine the effect on clinical outcomes such as pneumonia, $C$ difficile infection or clinically important GIB. The investigators of this study decided against collecting data on these outcomes as the incidence of these events are too low to adequately detect in this sample size.

The approach described is unique in that it encompassed an intervention bundle consisting of guideline implementation, pharmacist involvement, and an education and awareness campaign. Similar approaches have been described, but none has sought to decrease the overutilization of SUP with the same bundled, interprofessional approach. The success of this initiative was based on a very strong collaboration between medicine, pharmacy, and nursing. All groups worked together to accommodate the goals of this project without interruptions to patient care. We consider our interventions to be sustainable on a long-term basis as our ICU pharmacists continue to evaluate and recommend changes to therapy as appropriate. Our guidelines will only require updating with publication of new pertinent literature, and our educational effort has been streamlined to a 30-minute monthly lecture for residents rotating through the ICU. Currently, we are working on subsequent data collection to assess the sustainability of this effect and plan to make changes to the CPOE process that will help minimize the overuse of acid-suppressive therapy. Our group envisions a process in which prescribers will be required to select and document patients’ indications and will be able to access the SUP guideline electronically when ordering acid-suppressive therapy. Collectively, our results suggest that implementation of a bundled, interprofessional quality improvement initiative can be effective in reducing the inappropriate use of SUP and reducing the inappropriate continuation of SUP at hospital discharge.

**Authors’ Note**

Parts of this study were previously presented at the University Health System Consortium Pharmacy Council Meeting, Las Vegas, Nevada, December 2012; the University of California, San Francisco Spring Research Symposium, San Francisco, California, May 2013; the Western States Conference, San Diego, California, May 2013; the Society of Hospital Medicine, Annual Meeting, Washington, DC, May 2013; the California Society of Health-System Pharmacists Golden Gate Chapter Hospital CE Program, San Francisco, California, June 2013; and the Society of Critical Care Medicine Congress, San Francisco, California, January 2014.

**Declaration of Conflicting Interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Funding**

The author(s) received no financial support for the research, authorship, and/or publication of this article.

**References**


