ABSTRACT

- **Objective:** To examine the knowledge and attitudes of residents towards stress ulcer prophylaxis (SUP) and response to an intervention to decrease inappropriate use of SUP.

- **Methods:** SUP rate was calculated in a pre-intervention cohort of 100 consecutive non-critically ill patients admitted to the internal medicine service. Residents were surveyed regarding their knowledge and attitudes towards SUP and then engaged in a group discussion to identify issues leading to inappropriate prescription of SUP. Based on survey results, current practice patterns and evidence regarding SUP use were discussed during an educational conference. One year later, SUP rates were recalculated in a cohort of 100 patients.

- **Results:** Residents prescribed SUP to 74.1% of patients despite demonstrating good knowledge of SUP guidelines on the survey. Following the intervention, SUP rates decreased significantly to 28.6% (P < 0.001). However, the rate of inappropriate continuation of acid suppressive therapy at discharge did not change over the study period (35% vs. 35.7%, P = 0.603).

- **Conclusions:** Residents are prone to overprescribe SUP even when they possess adequate knowledge of guidelines and require guidance from attending physicians to develop good practice patterns. This, along with educational intervention, had a durable effect on reducing SUP use at our institution 1 year after the intervention. Inappropriate SUP prescription at discharge remains a problem and needs to be addressed.

Stress ulcer prophylaxis (SUP) is commonly used to decrease gastrointestinal bleeding in critically ill patients. Guidelines have been developed to define patients who benefit from SUP [1]. However, SUP is commonly used in non-critically ill patients despite little evidence to support it [2]. Two randomized trials have been performed [3,4], of which only 1 showed significant reduction in bleeding [3]. However, these studies conducted in the same institution suffer from design limitations (including study populations who were sick enough to be designated critically ill in most hospitals) and lack generalizability [2]. A recent retrospective study found gastrointestinal bleeding to be rare in non-critically patients (0.4%) and found no protective effect from de novo acid suppressive therapy [5]. Despite such ambiguous data, SUP prescription rates of 27% to 50% have been reported in non-critically ill patients [6–8]. Inappropriate use of SUP is fraught with risks [9]. It exposes patients to potential adverse effects such as *C. difficile*-associated diarrhea, community-acquired pneumonia, malabsorption, osteoporosis, and hip fracture [9]. SUP may lead to adverse drug interactions (eg, clopidogrel) and increase the risk for rehospitalization and added health care costs [9,10]. In addition, 24% to 35% of these patients may end up receiving an inappropriate prescription for acid suppressive therapy at discharge [11–13]. This has major economic and patient safety implications.

Internal medicine residents inappropriately prescribe SUP to more than half of their patients [13,14]. Whether this occurs due to a lack of knowledge of guidelines has
not been studied. Educational interventions have been shown to decrease SUP use by residents [13,15]. At our university-affiliated community hospital, we sought to study the knowledge and attitudes of internal medicine residents towards SUP in non-critically ill patients and use this information to design an educational intervention to decrease inappropriate SUP use. This report employed the SQUIRE publication guidelines for reporting health care quality improvement research [16].

METHODS
This pre- and post-intervention study was conducted as a quality improvement project at a not-for-profit hospital affiliated with a university-based internal medicine residency program. The study consisted of 3 phases.

Phase 1 – Needs Assessment
The rate of SUP prescription by internal medicine residents was determined through chart review of 100 consecutive patients admitted to the general medicine teaching service in April 2009 at our academic center. The teaching service consists of 3 teams, each consisting of a hospitalist attending physician, 2 interns (PGY1), 1 senior resident (PGY3), and medical students. The average daily census at the hospital on the service was approximately 45 patients. All new non-critically ill admissions on the teaching service, including readmits were included, while consults and ICU transfers were excluded.

Acid suppressive therapy was defined as the use of proton pump inhibitors, H2-receptor antagonists, antacids, and cytoprotective agents. Patients who were receiving acid suppressive therapy prior to hospitalization and those receiving it for a gastrointestinal reason (e.g., bleeding, epigastric pain) during admission were excluded. Acid suppressive therapy given to patients without these indications was considered SUP. SUP was considered appropriate if the patient was at high risk (≥ 2 risk factors) based on the Estruch et al. findings: respiratory failure with a PaO2 less than 60 (not requiring intubation), heart failure requiring inotropic support, sepsis, stroke, hepatic encephalopathy or jaundice, renal failure, hypotension, previous gastrointestinal disease, and treatment with high-dose corticosteroids (equivalent to prednisone > 60 mg daily or methylprednisolone > 50 mg daily), nonsteroidal anti-inflammatory drugs, heparin, or warfarin [3]. The type of medication, route of administration, and the number of doses administered were collected by review of the electronic medical record. Rate of inappropriate continuation of acid suppressive therapy upon discharge was determined based on the discharge medication list. The economic impact of inappropriate SUP was calculated based on hospital acquisition costs of the drug.

A paper-based survey consisting of 16 questions concerning knowledge and attitudes towards SUP in non-critically ill patients was administered to residents. After the survey results were tabulated, a “town hall” style meeting was held to elicit resident concerns and insights into this problem.

Phase 2 – Need-Based Intervention
The recurrent theme that emerged from the survey results and resident responses was that SUP was being used as a matter of routine practice and there was a lack of guidance from attending physicians or senior residents regarding the appropriateness of SUP use. Based on the results of the survey, a 1-hour educational conference was held for residents that reviewed pre-intervention rates of SUP use and discussed the issues identified to improve appropriate use of SUP. A power-point presentation was done to review the indications of SUP in non-critically ill medical inpatients based on the Estruch criteria. The authors discussed the culture of inappropriate SUP usage, lack of rationale documentation in patients who were started on SUP, and encouraged the interns to ask senior residents and/or the attending in case of doubt. At a separate faculty meeting, the survey results were shared with attending physicians who were encouraged to help residents alter their SUP prescription practice. Senior residents and attendings were encouraged to question the intern about SUP and review reasons for appropriate decision on the use of SUP. Discussions regarding appropriate SUP were encouraged during morning report and rounds with the senior resident initiating a discussion that was facilitated by an attending.

Phase 3 – Post-Intervention
One year after the intervention, the charts of 100 consecutive non-critically ill medical inpatients admitted in April 2010 to the internal medicine teaching service were reassessed using the same standardized data collection form.

Descriptive and nonparametric (chi-square) statistics were computed using PASW-18 software (SPSS, Chicago, IL). We considered a P value of < 0.05 statistically
significant. The project was approved by the Springfield Committee for Research Involving Human Subjects (IRB).

**RESULTS**

**Pre-Intervention**

The Figure describes the pre-intervention cohort. SUP was prescribed to 74.1% (40/54) of all patients during their hospital stay. Based on the Estruch criteria, SUP could be considered appropriate only in 15% (6/40) of these patients. Esomeprazole, a proton pump inhibitor (PPI), at the dose of 40 mg/d constituted 100% of all acid suppressive therapy prescriptions, as it was the preferred PPI on the hospital formulary. Among 34 patients who received inappropriate SUP, 134 oral and 52 intravenous doses of esomeprazole were used. Patients received an average of 3.94 oral and 1.53 intravenous doses during hospitalization. Acid suppressive therapy was inappropriately continued at discharge in 14 (35%) patients.

**Results of Survey**

Of 52 eligible residents, 34 (65.4%) returned surveys. Residents were PGY1 (44.1%; \( n = 15 \)), PGY2 (23.5%; \( n = 8 \)), and PGY3 or greater (32.4%; \( n = 11 \)). Most (91.2%; \( n = 31 \)) had rotated at least once through the
that their preferred agents for SUP were PPIs (94.1%; \( n = 34 \)) followed by H2 receptor blockers (5.9%; \( n = 32 \)) and ICU during their training as a resident. The 3 residents who had not yet rotated were in their first year of training. The majority of residents reported learning about SUP from their senior residents (70.6%; \( n = 24 \)). Other sources included hospitalists (29.4%; \( n = 24 \)), intensivists (23.5%; \( n = 8 \)), and ICU fellows (17.6%; \( n = 6 \)). A majority of residents (97%; \( n = 33 \)) observed that most of their patients admitted to the general medical floor receive some form of SUP. Residents reported that their preferred agents for SUP were PPIs (94.1%; \( n = 32 \)) followed by H2 receptor blockers (5.9%; \( n = 2 \)).

No residents reported a preference for antacids or cytoprotective agents. Table 1 shows the results by collective and individual PGY levels, respectively. The high rate of SUP use occurred in spite of a majority of residents acknowledging the lack of benefit of SUP in non-critically ill patients and the risks involved. Less than half the residents recalled being ever questioned about SUP prescription in the past 6 months. The town hall meeting elicited similar responses and revealed a pattern where SUP was being prescribed to most patients by the admitting intern which was rarely questioned by the se-

<table>
<thead>
<tr>
<th>Knowledge and Attitudes</th>
<th>All PGY</th>
<th>PGY1</th>
<th>PGY2</th>
<th>PGY3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct Response</td>
<td>(n = 34)</td>
<td>(n = 15)</td>
<td>(n = 8)</td>
<td>(n = 11)</td>
</tr>
<tr>
<td>There is good evidence to start most acutely ill patients in a non ICU setting on SUP</td>
<td>76.5%</td>
<td>86.7%</td>
<td>75%</td>
<td>63.6%</td>
</tr>
<tr>
<td>Most patients admitted to the medical floor should receive some form of gastric SUP</td>
<td>82.4%</td>
<td>93.3%</td>
<td>100%</td>
<td>54.5%</td>
</tr>
<tr>
<td>Proton pump inhibitors (PPIs) protect acutely ill patients in a non ICU setting from significant GI bleeding</td>
<td>61.8%</td>
<td>40.0%</td>
<td>87.5%</td>
<td>72.7%</td>
</tr>
<tr>
<td>Patients who receive PPIs in the ICU for SUP should have it continued once they are clinically better and are transferred to the general medical floor</td>
<td>64.7%</td>
<td>60.0%</td>
<td>100%</td>
<td>45.5%</td>
</tr>
<tr>
<td>Non critically ill patients who don’t receive SUP have a significant risk of developing overt GI bleeding</td>
<td>91.2%</td>
<td>100%</td>
<td>100%</td>
<td>72.7%</td>
</tr>
<tr>
<td>There is no potential harm in prescribing SUP so overuse is not a problem</td>
<td>91.2%</td>
<td>93.3%</td>
<td>87.5%</td>
<td>90.9%</td>
</tr>
<tr>
<td>The risk of stress ulcer–induced GI bleeding in all patients admitted to the medical floor is &lt; 1%</td>
<td>76.5%</td>
<td>73.3%</td>
<td>75%</td>
<td>81.8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Behaviors</th>
<th>All PGY</th>
<th>PGY1</th>
<th>PGY2</th>
<th>PGY3</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Yes” Response</td>
<td>(n = 15)</td>
<td>(n = 7)</td>
<td>(n = 4)</td>
<td>(n = 3)</td>
</tr>
<tr>
<td>I recall discussing the indications for gastric ulcer prophylaxis at admission or during rounds with my ICU attending over the past 6 months</td>
<td>41.2%</td>
<td>46.7%</td>
<td>50%</td>
<td>27.3%</td>
</tr>
<tr>
<td>I recall discussing the indications for gastric ulcer prophylaxis at admission or during rounds with my hospitalist over the past 6 months</td>
<td>41.2%</td>
<td>40.0%</td>
<td>50%</td>
<td>36.3%</td>
</tr>
<tr>
<td>I recall my hospitalist questioning my use of SUP over the past 6 months</td>
<td>41.2%</td>
<td>46.7%</td>
<td>25%</td>
<td>45.5%</td>
</tr>
<tr>
<td>My hospitalist generally does not care if I prescribe SUPs routinely</td>
<td>35.3%</td>
<td>53.3%</td>
<td>25%</td>
<td>18.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Correct Response</th>
<th>(n = 10)</th>
<th>(n = 14)</th>
<th>(n = 11)</th>
<th>(n = 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n = 6)</td>
<td>(n = 8)</td>
<td>(n = 7)</td>
<td>(n = 2)</td>
<td>(n = 2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Correct Response</th>
<th>(n = 6)</th>
<th>(n = 8)</th>
<th>(n = 7)</th>
<th>(n = 8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n = 6)</td>
<td>(n = 8)</td>
<td>(n = 7)</td>
<td>(n = 8)</td>
<td></td>
</tr>
</tbody>
</table>
nior residents or the attending physician. Residents also voiced concern about repercussions from attendings if they did not prescribe SUP, though none could recall an instance when this happened.

**Post-Intervention**

The 1-year post-intervention cohort is represented in the Figure. Over the study period, SUP use registered a statistically significant decrease to 28.6% (14/49) from the pre-intervention rate of 74.1% ($P < 0.001$) (Table 2). Fifty percent were considered inappropriate according to the Estruch criteria vs. 85% in the pre-intervention cohort ($P = 0.025$). Esomeprazole was used in all patients. Among 7 patients who received inappropriate SUP, 30 oral and 4 intravenous doses of esomeprazole were used. Patients received an average of 4.29 oral and 0.57 intravenous doses during hospitalization. However, among those receiving SUP, the rate of inappropriate acid suppressive therapy continuation upon discharge did not significantly change (35.0% vs. 35.7%).

**Cost Analysis**

The hospital costs for oral and intravenous esomeprazole were $2.87 and $10.67, respectively. Therefore, the hospital suffered a loss of $939.42 for every 100 non-critically ill medical patients admitted to the teaching service due to inappropriate SUP. There were 2339 non-critically ill medical patients admitted annually. Therefore, inappropriate SUP led to a total expenditure of $21,973 every year. For the post-intervention period, the hospital’s cost for oral and intravenous esomeprazole did not change. The hospital saved $810.64 for every 100 non-critically ill medical patients due to reduction in the inappropriate SUP use (a total cost savings of $18,961 annually). This analysis does not account for drug administration costs, savings in nursing time, and the potential savings from reduced side effects.

**DISCUSSION**

In spite of lack of evidence for its benefit, SUP continues to be widely prescribed by physicians and residents alike. Our pre-intervention cohort of patients had a SUP rate of 74.1%, which is similar to previous studies of SUP use by both physicians and residents [17,18]. We surveyed residents to assess their knowledge and determine system-wide issues that are responsible for this practice pattern. To our knowledge, there has been only one previous study assessing residents’ knowledge and attitudes towards SUP. Hussain et al surveyed internal medicine residents along with hospitalists regarding their knowledge and attitudes towards SUP [19]. However, they did not report results for residents separately as a group. They found that a higher knowledge of guidelines led to lower self-reported SUP prescription rates (OR 0.39, 95% CI 0.20–0.74). Use of standardized admission protocols was also suggested as a reason for increased use of acid suppressive therapy. At our institution, a majority of residents responded correctly to questions testing their knowledge of the current state of evidence regarding SUP use in non-critically ill patients and its potential side effects. However, there was an apparent disconnect between residents’ knowledge and their prescription patterns. The rate of SUP use was driven by routine prescription in most patients at admission (though standardized admission order sets were not being used during the study period) and a lack of guidance from the supervising residents and faculty thereafter. There were unfounded fears of retribution for not prescribing SUP routinely. Residents also indicated a lack of time during rounds to routinely go over the medication chart. SUP was routinely being prescribed and there was no mechanism of checking to question its widespread use. Thus our need-based intervention was focused on involving faculty physicians and empowering senior residents to stop SUP if not indicated. Previous literature has also noted various other

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**Table 2. Rates of Stress Ulcer Prophylaxis (SUP) Use**

<table>
<thead>
<tr>
<th></th>
<th>Pre-Intervention, $n$ (n = 54)</th>
<th>Post-Intervention, $n$ (n = 49)</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received SUP</td>
<td>40 (74.1%)</td>
<td>14 (28.6%)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Did not receive SUP</td>
<td>14 (28.6%)</td>
<td>35 (71.4%)</td>
<td></td>
</tr>
<tr>
<td>Use of SUP was inappropriate</td>
<td>34 (85.0%)</td>
<td>7 (50.0%)</td>
<td>0.025</td>
</tr>
<tr>
<td>AST continued inappropriately at discharge</td>
<td>14 (35.0%)</td>
<td>5 (35.7%)</td>
<td>0.603</td>
</tr>
</tbody>
</table>

AST = acid suppressive therapy.
reasons for SUP overuse, which includes fear of stress ulcer development in low-risk patients, especially in the presence of certain clinical conditions (eg, heart disease, acute renal failure) or co-treatments (eg, the use of corticosteroids), despite the lack of evidence to support this [20,21]. A survey reported that this practice seems to be rather ingrained and reflects as a higher prescribing attitude by hospital physicians or unnecessary incorporation of the SUP as the standard practice in many units [22].

Our intervention resulted in a significant decrease in SUP use and cost reduction 1 year after it was instituted. Our inpatient cost savings were consistent with that reported in previous studies performed in a similar setting [9,23]. Since the pre- and post-intervention cohorts were studied in different academic years, it is apparent that a new set of interns who were not exposed to the intervention were being trained in appropriate SUP use by faculty and residents. Two previous studies reported on interventions to decrease SUP use by residents. Liberman et al used practice-based learning methods to reduce SUP use from 59% to 33% ($P = 0.007$) over a period of 6 months [13]. They were also able to reduce inappropriate SUP prescription at discharge from 25.5% to 7% ($P < 0.009$). Kehr et al described a pharmacist-delivered educational intervention to reduce SUP use among family medicine residents [15]. After an initial lecture, pharmacists provided weekly 5-minute educational sessions and reminder cards. The results of this study, however, are confounded by the fact that they utilized the 1999 ASHP guidelines (for critically ill patients) for judging appropriateness in a non-critically ill population. In our study, we designed practical interventions that took into account local practice patterns. Our use of a survey and meeting with the residents helped us adopt a “train the teacher” in addition to a “train the trainer” approach. Our results emphasize the important role attending physicians play in correcting residents’ prescription practices. Emphasis on education during ward rounds and involving senior residents in re-education efforts helped decrease rates of inappropriate SUP. We were able to avoid repeat didactic sessions or using constant reminders with this needs assessment-guided intervention.

SUP initially started during admission can be overlooked and continued inappropriately upon discharge [11–13]. In our study, it was troubling to note that once initiated, acid suppressive therapy was inappropriately continued at discharge in 35% of the cohort and did not change significantly after the intervention period.

This subjects patients to unnecessary and prolonged use of acid suppressive therapy as outpatients, with adverse economic and health impacts. Though our intervention was not specifically aimed at the discharge process, we expected to see a decrease in inappropriate SUP prescription. Deficiencies in the discharge medication reconciliation process and a small sample size may be responsible. Moreover, for patients who received inappropriate SUP on discharge, we found that 3 out of the 7 patients in the post-intervention group continued to meet ≥2 Estruch criteria at the time of discharge. We did not have post hospitalization follow-up data to determine the time period of acid suppressive therapy continuation after discharge.

This prospective observational study has a number of limitations. We used the criteria by Estruch et al to judge appropriateness of SUP prescription. While there is no convincing evidence for the use of SUP in any non-critically ill patients, acid suppressive therapy may be appropriate in some patients such as those on double antiplatelet therapy with a history of gastrointestinal bleeding. This may not decrease gastrointestinal bleeding in the hospital but is useful over the long term and is recommended by guidelines. The sample sizes were small, though similar to the previous study on SUP use by residents [13,15]. A third of residents did not complete the survey and their participation could have altered the results of the survey. The verbal responses by residents during the town hall meeting were not recorded and not analyzed in a manner consistent with qualitative research methods. This anecdotal evidence is the only proof that lack of attending guidance was a crucial factor in our institution. However, we believe that eliciting such information was essential to developing an effective quality improvement effort. We considered SUP appropriate based on the criteria by Estruch though it has been argued that there is simply no convincing evidence to justify SUP in non-critically ill patients [1]. Clinical outcomes were not studied. We did not study the effect of hospitalist involvement compared with resident education alone. We did not survey residents after the intervention period to assess changes in prescription patterns. Due to above reasons, this single institution study may not be applicable to other institutions or to other groups of residents or physicians.

In conclusion, inappropriate SUP by internal medicine residents can be reduced by simple interventions, guided by needs assessment and appropriate and effective in the local environment. In our institution, lack of attending
and senior resident participation was identified as a key factor. The impact of the intervention was durable and was carried over into the next academic year. In spite of successful decrease in rate of SUP, inappropriate SUP prescription at discharge remains a problem. The prescribing habits residents learn during training have a major impact on their later practice as independent physicians. Targeting prescription patterns of physicians during training is essential to reduce the inappropriate use of SUP.

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