Impact of Sepsis Order Set Updates on Carbapenem Utilization in a Community Regional Medical Center

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Our institution has updated its sepsis order sets to provide prescribers guidance when ordering antibiotics for septic patients with non-severe penicillin allergies. The objective of this study is to determine the impact of these sepsis order set updates on carbapenem utilization.

**BACKGROUND**

Patients with penicillin allergies who require broad-spectrum antimicrobial therapy for the treatment of sepsis often receive a carbapenem instead of a cephalosporin due to concerns of penicillin-cephalosporin cross-reactivity.

As rates of antibiotic resistance continue to increase, institutions should prioritize efforts to preserve the efficacy of carbapenems.

Reduction of carbapenem use in institutions has been shown to lower incidence rates of carbapenem-resistant organisms.

Cephalosporins have previously demonstrated low rates of cross-reactivity in penicillin allergic patients.

As of May 29th, 2018, updates to our institution’s sepsis order sets recommend the use of cephalosporins in place of piperacillin/tazobactam in patients with a non-severe penicillin allergy rather than a carbapenem.

An analysis of the results of these updates is warranted to identify areas of improvement that can further reduce carbapenem utilization.

**METHODS**

- Retrospective chart review of patients ≥18 years of age receiving at least one dose of antibiotic ordered via a sepsis order set
- Outcomes were compared between groups from pre and post order set update periods
  - Pre-update: June 1, 2017 – September 31, 2017
  - Post-update: June 1, 2018 – September 31, 2018
- Primary Outcome: Use of a carbapenem in the initial order from a sepsis order set
- Secondary Outcomes:
  - Adherence of antibiotic orders to order set recommendations in the penicillin-allergic population
  - Days of carbapenem therapy per 1000 patient days in the penicillin-allergic population
  - Incidence of allergy to a penicillin, cephalosporin, or carbapenem caused by a set-ordered antibiotic
- Additionally, a sub-analysis of the initial order for patients with penicillin allergy with an "unknown" reaction type was conducted

**RESULTS**

**Baseline Characteristics of Penicillin Allergic Population**

<table>
<thead>
<tr>
<th>Age (Years ± SD)</th>
<th>Pre-Update (n=427)</th>
<th>Post-Update (n=542)</th>
</tr>
</thead>
<tbody>
<tr>
<td>66.3 (±15.7)</td>
<td>63.36 (±16.7)</td>
<td></td>
</tr>
<tr>
<td>Mean Length of Stay (Days ± SD)</td>
<td>7.6 (±16.8)</td>
<td>6.8 (±16.8)</td>
</tr>
<tr>
<td>Admit Location (n, %)</td>
<td>ICU</td>
<td>Progressive Care Unit</td>
</tr>
<tr>
<td>16 (22.2%)</td>
<td>15 (20.8%)</td>
<td>41 (56.9%)</td>
</tr>
<tr>
<td>13 (19.4%)</td>
<td>13 (19.4%)</td>
<td>34 (47.9%)</td>
</tr>
<tr>
<td>Sepsis Source (n, %)</td>
<td>Intra-Abdominal</td>
<td>UTI</td>
</tr>
<tr>
<td>20 (33.3%)</td>
<td>20 (33.3%)</td>
<td>25 (35.3%)</td>
</tr>
<tr>
<td>14 (21.9%)</td>
<td>14 (21.9%)</td>
<td>18 (25.0%)</td>
</tr>
<tr>
<td>Reaction Type (n, %)</td>
<td>Severe</td>
<td>Non-Severe</td>
</tr>
<tr>
<td>45 (65.2%)</td>
<td>44 (64.4%)</td>
<td>33 (30.3%)</td>
</tr>
<tr>
<td>14 (15.9%)</td>
<td>12 (16.2%)</td>
<td>10 (9.2%)</td>
</tr>
</tbody>
</table>

**Use of a Carbapenem in the Initial Order from a Sepsis Order Set**

- **Pre-update (n=427)**
  - Adherence of antibiotic orders to order set recommendations in the penicillin-allergic population: 55% of Manual Pull Complete
  - Days of Carbapenem Therapy per 1000 Patient Days: 200

- **Post-update (n=542)**
  - Adherence of antibiotic orders to order set recommendations in the penicillin-allergic population: 55% of Manual Pull Complete
  - Days of Carbapenem Therapy per 1000 Patient Days: 150

**Adherence to Order Set Recommendations: Penicillin Allergic Population, Post-update Group**

- **Pre-update (n=14, 19.4%)**
  - Adherence: 100%

- **Post-update (n=54, 99.2%)**
  - Adherence: 100%

**DISCUSSION & CONCLUSIONS**

- Updates to the sepsis order sets were effective in reducing carbapenem orders in the post-update period.
- Cefepime prescribing rose from 0% in the pre-update penicillin allergic group to 33% in the post-update penicillin allergic group, in line with order set recommendations.
- No increase in allergy incidence was seen as a result of the order set updates.
- A substantial portion of orders failed to adhere to the recommendations for penicillin allergic patients provided in the order sets, suggesting a need for further provider education on order set usage.
- Several patient factors could confound provider adherence, including MDR organism history and previous hospital admissions.
- Institutional changes to carbapenem dosing regimens were implemented during the study period, limiting the ability to utilize a cost savings analysis or measures of antibiotic use that require a dosage quantity (such as defined daily doses).
- A carbapenem days of therapy measure is less impacted by these dosage changes, and was used to quantify carbapenem use in this study.
- Efforts to clarify allergy type in patients who have a penicillin allergy with an unknown reaction could further reduce carbapenem usage and lead to safer antibiotic prescribing.
- This research demonstrates that further modification of the sepsis order sets is warranted, and that other antibiotic order sets should be assessed for potential interventions to spare carbapenem use.
- Considering that nearly 10% of carbapenem orders hospital-wide originated from sepsis order sets during the study period, the impact of these updates and future interventions is substantial.

**REFERENCES**