The HCAP Gap: Differences between Self-Reported Practice Patterns and Published Guidelines for Health Care–Associated Pneumonia

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(See the editorial commentary by Kollef, on pages 1875–7.)

**Background.** Health care–associated pneumonia (HCAP) is prevalent among hospitalized patients. In contrast to community-acquired pneumonia (CAP), patients with HCAP are at increased risk for multidrug-resistant organisms, and appropriate initial antibiotic therapy is associated with reduced mortality.

**Methods.** An online survey was distributed to faculty and housestaff at 4 academic medical centers. The survey required respondents to choose initial antibiotic therapy for 9 hypothetical pneumonia cases (7 cases of HCAP and 2 cases of CAP). Answers were considered correct if the antibiotic regimen chosen was consistent with published guidelines. In addition, physicians rated their knowledge of current guidelines, as well as their level of agreement with guideline recommendations.

**Results.** Surveys were sent to 1313 physicians with a response rate of 65% (n = 855). Respondents included physicians in the following categories: hospital medicine/internal medicine, 60%; emergency medicine, 25%; and critical care, 13%. Respondents selected guideline-concordant antibiotic regimens 78% of the time for CAP, but only 9% of the time for HCAP. Because mean scores for HCAP questions were extremely low (mean, 0.63 correct answers out of 7), differences in performance between groups were too small to be meaningful. Despite their poor performance, 71% of the respondents stated that they are aware of published guidelines for HCAP, and 79% stated that they agree with and practice according to the guidelines.

**Conclusions.** In this survey, physicians reported they were aware of, agreed with, and practiced according to published pneumonia guidelines; however, the overwhelming majority did not choose guideline-concordant therapy when tested.

Pneumonia is a common and costly condition in US hospitals, responsible for >1.2 million admissions in 2006 at an estimated expense of $27.5 billion [1]. Guidelines for management of community-acquired pneumonia (CAP) are well established [2–5], and a growing evidence base suggests that early administration of guideline-concordant antibiotic therapy is associated with reduced mortality [6–8].

In 2005, the American Thoracic Society (ATS) and the Infectious Diseases Society of America (IDSA) first described health care–associated pneumonia (HCAP) [9], a new category of pneumonia intended to apply to patients who have recently interfaced with the health care system. According to the guidelines, adults at risk for HCAP include those living in skilled nursing facilities, attending chronic hemodialysis centers, or those who have been recently hospitalized (Table 1). Patients with HCAP are at risk for the same multidrug-resistant organisms found in hospitalized patients [9], and mortality rates are double those of CAP [10–12].

Similar to CAP, early experience with HCAP has dem-
onstrated that the choice of initial antibiotics is critical, and inappropriate initial antibiotic therapy is linked to increased mortality [11, 12]. The guidelines recommend an initial antibiotic regimen that includes coverage of methicillin-resistant Staphylococcus aureus (MRSA) as well as resistant Pseudomonas for patients at risk for multidrug-resistant organisms, as described in Table 1. Unfortunately, guideline adherence in HCAP is low [12], and observational studies report inappropriate antibiotics are prescribed >20% of the time [11, 12]. It is not clear whether clinicians deviate from guideline-based antibiotics due to a failure to recognize HCAP risk factors, a lack of awareness of the guidelines, disagreement with the guidelines, or reliance on institution-based ordersets that fail to account for HCAP risk factors.

Given the link between appropriate initial antibiotic selection and outcomes, it is important to understand the impact of the existing guidelines on physicians’ practice. The objective of this study was to assess physicians’ knowledge of and attitudes toward published practice guidelines for HCAP using a brief survey.

METHODS

Recruitment. Respondents who practiced in specialties most likely to order the initial antibiotic regimen for hospitalized pneumonia patients were targeted. Hospital medicine, critical care (pulmonary or anesthesiology), and emergency medicine faculty, as well as internal medicine and emergency medicine residents and critical care fellows were recruited at 4 university teaching hospitals during the winters of 2007 and 2008. Infectious diseases specialists were not included as they typically serve as consultants at the participating institutions, and do not routinely order the initial antibiotic regimen. A gift card of nominal value was offered to encourage participation.

The survey format was identical at all sites. Responses were collected anonymously. The study was approved separately by the institutional review board at each site.

Survey design. An online survey was constructed based on the risk factors for multidrug-resistant organisms specified in the ATS/IDSA guidelines (Table 1) [9]. Study participants were presented 9 clinical scenarios of patients hospitalized with pneumonia; 2 scenarios represented CAP, 6 represented HCAP, and 1 represented a patient at risk for multidrug-resistant organisms based on immunosuppressive therapy. For the HCAP cases, each of the 6 risk factors was tested individually in a separate question.

The case histories stated that all patients were hospitalized for pneumonia treatment, and that each had fever, sputum production, and a pulmonary infiltrate by chest radiograph. All patients were stated to be hemodynamically stable on oxygen, 3 L/min, by nasal cannula. Respondents were asked to choose the most appropriate initial antibiotic regimen for each clinical scenario from a list of representative antibiotic classes used for pneumonia treatment. Any combination of antibiotics was allowed. Survey instructions specified that no drug allergies or interactions were present. Survey questions and answer choices are included in the Appendix.

After completing the cases, respondents were asked to state their level of agreement with the following statements using a 5-point Likert scale:

1. I am familiar with published guidelines for HCAP.
2. I agree with published guidelines for HCAP.
3. I practice in accordance with published guidelines for HCAP.

Finally, respondents were offered an opportunity to check their answers by reviewing a 1 page summary of the risk factors and treatment recommendations for HCAP from the ATS/IDSA guidelines [9]. This page of the survey was optional and could be viewed only after participants had submitted their final answers.

Scoring. Only complete responses to the survey were included in the final analysis. Answers were scored as “correct” if the antibiotic choice conformed to guideline recommendations [5, 9]. Specifically, correct HCAP answers had to include coverage of MRSA as well as 2 agents active against Pseudomonas aeruginosa. This was also the case for the patient with immunosuppression, and to simplify comparison, this patient was grouped with the patients with HCAP in all analyses. CAP answers required either a respiratory fluoroquinolone, or a combination of a third-generation cephalosporin and an advanced macrolide. Other antibiotics occasionally used for CAP (eg, doxycycline and amoxicillin-clavulanate) were not available to respondents in the list of answer choices.

Data analysis. Participant characteristics were summarized using counts and percentages for categorical data and means and standard deviations for continuous data. \( \chi^2 \) Tests of ho-
mogeneity and t tests were used to compare participant characteristics. ANOVA was used to compare differences between groups. All statistical tests were two-tailed, and statistical significance was defined as a P value <0.05. Analyses were performed using SPSS for Windows (SPSS) and Microsoft Excel (Microsoft).

**RESULTS**

Surveys were sent to 1313 physicians with 912 responses (69%). Of the 912, 57 were excluded as incomplete, leaving 855 for the final analysis and a complete response rate of 65%. Respondents included physicians in the following categories: hospital medicine faculty and internal medicine residents, 60%; emergency medicine, 25%; and critical care, 13%. The remaining 2% identified themselves as “other” and were thus not included in the subgroup analyses. Of the total respondents, 39% were faculty, 56% were housestaff, and 5% were fellows.

Overall, respondents correctly selected guideline-concordant antibiotic regimens 78% of the time for CAP (range, 77%–79%), but only 9% of the time for HCAP (range, 6%–12%). The proportion of respondents who selected guideline-concordant antibiotic regimens for each individual risk factor is shown in Figure 1. The average number of CAP questions answered correctly was 1.56 out of 2 questions (range, 0–2) compared to 0.63 out of 7 HCAP questions (range, 0–7). Seventy percent of respondents answered both CAP questions correctly, but only 1% answered all HCAP questions correctly. In contrast, 78% of respondents answered all HCAP questions incorrectly, but only 14% missed both CAP questions.

There was no significant difference in performance on CAP questions between specialties. Respondents in the specialties of emergency medicine and critical care scored higher on HCAP questions compared to hospital medicine/internal medicine (P = .02). Fellows scored higher than residents or faculty on both CAP and HCAP questions. For CAP, on average fellows scored 1.84 out of 2 possible questions, compared to 1.52 for residents and 1.59 for faculty (P = .04). For HCAP, on average fellows scored 1.33 out of 7 possible questions, compared to 0.59 for residents and 0.61 for faculty (P = .02). Results are summarized in Table 2.

Because there is no specific hospital medicine residency, we considered hospital medicine faculty and internal medicine residents to be the same specialty for purposes of our analysis. Mean scores of medicine residents and hospitalists were similar for HCAP (0.45 and 0.33, respectively; P = .13). Differences between emergency medicine residents and faculty were of borderline significance (1.22 vs. 0.78; P = .056), but critical care fellows achieved a higher mean score than faculty (1.44 vs. 0.78; P = .04).

Respondents who reported seeing a higher number of pneumonia patients per month tended to have a higher mean number of correct answers for HCAP questions (P = .003), but the highest performing subgroup (11–15 patients/month) achieved a mean score of only 1.08. Findings for CAP questions were similar. The number of years since graduation from medical school was not predictive of improved performance for HCAP; for CAP, those reporting >20 years of experience had a slightly lower mean score (P = .002) (Table 2).

Despite an overall poor performance on choice of guideline-concordant antibiotics, 71% of the respondents answered “somewhat agree” or “strongly agree” to the question “I am familiar with published guidelines for HCAP.” Similarly, 79%

**Figure 1.** Percent of respondents selecting guideline-concordant antibiotics, by health care–associated pneumonia (HCAP) risk factor. CAP, community-acquired pneumonia; IV, intravenous therapy; MDRO, multidrug-resistant organism; SNF, skilled nursing facility.
Table 2. Mean Scores, by Subgroup

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. (%) of respondents</th>
<th>No. of correct answers out of 7 for HCAP</th>
<th>No. of correct answers out of 2 for CAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specialty</td>
<td></td>
<td></td>
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<tr>
<td>Hospital medicine</td>
<td>515 (60)</td>
<td>0.43 ± 1.21</td>
<td>1.58 ± 0.72</td>
</tr>
<tr>
<td>Emergency medicine</td>
<td>212 (25)</td>
<td>0.96 ± 1.85</td>
<td>1.59 ± 0.68</td>
</tr>
<tr>
<td>Pulmonary or anesthesia/critical care</td>
<td>111 (13)</td>
<td>0.99 ± 1.75</td>
<td>1.51 ± 0.74</td>
</tr>
<tr>
<td>Level of training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resident</td>
<td>478 (56.0)</td>
<td>0.59 ± 1.40</td>
<td>1.52 ± 0.74</td>
</tr>
<tr>
<td>Fellow</td>
<td>43 (5.0)</td>
<td>1.33 ± 1.80</td>
<td>1.84 ± 0.48</td>
</tr>
<tr>
<td>Faculty</td>
<td>334 (39.1)</td>
<td>0.61 ± 1.55</td>
<td>1.59 ± 0.70</td>
</tr>
<tr>
<td>Specialty and level of training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital medicine faculty</td>
<td>125 (14.6)</td>
<td>0.33 ± 1.11</td>
<td>1.68 ± 0.68</td>
</tr>
<tr>
<td>Internal medicine resident</td>
<td>381 (44.5)</td>
<td>0.45 ± 1.24</td>
<td>1.54 ± 0.74</td>
</tr>
<tr>
<td>Emergency medicine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty</td>
<td>129 (15.1)</td>
<td>0.78 ± 1.80</td>
<td>1.64 ± 0.64</td>
</tr>
<tr>
<td>Resident</td>
<td>78 (9.1)</td>
<td>1.22 ± 1.94</td>
<td>1.53 ± 0.73</td>
</tr>
<tr>
<td>Pulmonary/critical care</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty</td>
<td>74 (8.6)</td>
<td>0.78 ± 1.66</td>
<td>1.36 ± 0.79</td>
</tr>
<tr>
<td>Fellow</td>
<td>36 (4.2)</td>
<td>1.44 ± 1.87</td>
<td>1.86 ± 0.42</td>
</tr>
<tr>
<td>Years since medical school graduation</td>
<td></td>
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</tr>
<tr>
<td>0–3</td>
<td>464 (54.3)</td>
<td>0.56 ± 1.36</td>
<td>1.5 ± 0.76</td>
</tr>
<tr>
<td>4–6</td>
<td>142 (16.6)</td>
<td>0.82 ± 1.66</td>
<td>1.75 ± 0.58</td>
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<tr>
<td>7–10</td>
<td>93 (10.9)</td>
<td>0.69 ± 1.55</td>
<td>1.68 ± 0.63</td>
</tr>
<tr>
<td>11–15</td>
<td>66 (7.7)</td>
<td>0.62 ± 1.61</td>
<td>1.58 ± 0.68</td>
</tr>
<tr>
<td>16–20</td>
<td>35 (4.1)</td>
<td>0.46 ± 1.42</td>
<td>1.60 ± 0.65</td>
</tr>
<tr>
<td>&gt;21</td>
<td>55 (6.4)</td>
<td>0.78 ± 1.78</td>
<td>1.36 ± 0.82</td>
</tr>
<tr>
<td>Estimated no. of patients with pneumonia per month</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–3</td>
<td>201 (23.5)</td>
<td>0.43 ± 1.23</td>
<td>1.45 ± 0.77</td>
</tr>
<tr>
<td>4–6</td>
<td>320 (37.4)</td>
<td>0.53 ± 1.36</td>
<td>1.53 ± 0.76</td>
</tr>
<tr>
<td>7–10</td>
<td>199 (23.3)</td>
<td>0.81 ± 1.69</td>
<td>1.64 ± 0.62</td>
</tr>
<tr>
<td>11–15</td>
<td>83 (9.7)</td>
<td>1.08 ± 1.9</td>
<td>1.61 ± 0.68</td>
</tr>
<tr>
<td>&gt;16</td>
<td>52 (6.1)</td>
<td>0.65 ± 1.30</td>
<td>1.85 ± 0.46</td>
</tr>
</tbody>
</table>

**NOTE.** Data are mean ± standard deviation, unless otherwise indicated. CAP, community-acquired pneumonia; HCAP, health care–associated pneumonia.

of respondents familiar with the guidelines somewhat or strongly agreed with the questions “I agree with published guidelines for HCAP” and “I practice according to published guidelines for HCAP” (Figure 2). Attitudes about the guidelines did not seem to predictably impact performance, as mean scores were similar for those who fell at both extremes of opinion (data not shown).

In an attempt to better understand the reasons for the large number of incorrect answers for HCAP questions, we evaluated survey responses for common errors. We suspected that single-agent rather than double-agent pseudomonal coverage, and lack of MRSA coverage, would be frequent reasons for guideline-discordant prescribing. For HCAP questions, respondents chose single-agent antipseudomonal coverage up to 36% of the time. A lack of MRSA coverage was responsible for incorrect answers up to 72% of the time (Figure 3).

**DISCUSSION**

In this survey study of physicians practicing or training at large academic medical centers, the respondents chose an initial antibiotic regimen consistent with published guidelines for HCAP.
<10% of the time. This contrasted sharply with their performance on questions about CAP, for which they chose a guideline-concordant regimen 78% of the time. Despite their poor performance, the overwhelming majority of respondents felt they were aware of, agreed with, and practiced in accordance with published guidelines.

Although subspecialists (emergency medicine and critical care) performed statistically better than generalists (hospital medicine faculty and internal medicine residents), the mean scores for all respondents were so low that differences in performance were not meaningful. For example, the highest scoring group (critical care fellows) had a mean score of 1.44 out of 7 on the HCAP questions, corresponding to only 20% correct.

In an exploration of reasons for incorrect answers to the HCAP questions, respondents more commonly neglected to include MRSA coverage than double gram-negative coverage. This may be due to the fact that community-acquired MRSA pneumonia remains relatively uncommon, and typically presents with illness more severe than that portrayed in the clinical scenarios in this survey [13, 14].

An exception was the final clinical scenario, which described a healthy 32-year-old woman whose 8-year-old son has cystic fibrosis and is completing home therapy for Pseudomonas pneumonia. Overwhelmingly respondents chose 2 antipseudomonal agents without MRSA coverage. Presumably most participants reasoned that because no MRSA was isolated in the child, there would be no need to treat it in his mother. This seems to reflect...
an instance of sound clinical judgment superseding guideline recommendations.

It is still not clear that the ATS/IDSA recommendations for antibiotic therapy reflect best practice for all hospitalized patients with HCAP. There are currently no prospective studies evaluating different treatment approaches for patients with HCAP. Treatment algorithms described in the guidelines are based heavily on data from intubated patients, in whom sputum samples are readily available. This is frequently not the case for many patients with HCAP, who are often culture negative. Expert opinion is still quite mixed as to whether these guidelines should be universally applied [15]. Several authors have attempted to define which risks best predict infection with multidrug-resistant organisms and the need for broad spectrum therapy [16, 17], but their approaches have not yet been validated. The uncertainty in the literature does not seem to account for the poor performance by participants in our survey, as the majority voiced agreement with and acceptance of the current guidelines.

Although antibiotic selection for CAP was consistent with guidelines much more frequently than HCAP, the performance was still unacceptably low. Over 20% of respondents in our study chose guideline-discordant regimens for CAP. This is consistent with the published literature [6–8], where appropriate antibiotic selection ranges from 59% to 79%. Given the clear link between mortality and guideline-concordant antibiotic selection, our results suggest room for improvement for CAP as well as HCAP.

This study has several limitations. Most importantly, we cannot be certain that physicians’ responses on the hypothetical scenarios presented in this survey reflect their antibiotic choices in clinical practice. Respondents may not put forth the same level of diligence in answering survey questions as they would with actual patients. However, there are several indications that the survey participants gave serious consideration to their answers. As noted above, the pattern of responses in the question about the patient caring for a child with cystic fibrosis suggests that most physicians were thinking carefully about each case. Furthermore, >90% of respondents elected to spend extra time viewing an optional screen at the end of the survey that allowed them to review the guidelines and check their answers. Finally, current observational studies have reported high rates of guideline-discordant antibiotic use for HCAP [11, 12].

Selection bias is an important limitation in survey studies; it is not clear whether physicians who elected to participate have a knowledge level equivalent to the nonresponders. The response rate of 65% in our survey is relatively high, which increases the likelihood that the sample is representative of the general population.

The study was performed only at academic medical centers, and thus, the findings may not be generalizable to other settings. However, differences between teaching and community hospitals in performance on evidence-based processes of care relating to pneumonia have been shown to be small [18].

Severity of illness often influences the choice of antibiotic therapy. In our survey, all cases were presented with the same underlying presentation. This design limited our ability to test for differences in prescribing patterns due to severity of illness. Although clinically important, guideline recommendations for initial antibiotics do not distinguish between levels of illness severity.

Finally, local resistance patterns often color choice of initial antibiotic selection. Our study design did not allow us to assess the impact of these institutional differences on antibiotic selection.

The study was not able to elucidate clear reasons for the discrepancy between participants’ self-reported support of the guidelines and their poor performance on the clinical scenarios. Either the physicians did not recognize the cases presented as HCAP, did not give careful consideration to their antibiotic choices, or did not accurately report their views on the guidelines. Most likely, physicians genuinely believe that they are aware of the guidelines, agree with the guidelines, and practice according to the guidelines. However, without the support that is built into improving systems of care (such as order sets or other clinical reminders), they may not be able to execute them [19–21].

Our findings have potentially serious implications, as mortality rates for patients hospitalized with HCAP initially treated with inappropriate antibiotics increase by at least 2 and as much as 6 times, depending on the study [11, 12]. Furthermore, a recent single-center study showed that escalation of antibiotic therapy in patients initially given inappropriate treatment did not attenuate the mortality risk [22]. Clearly the need to improve our understanding of which patients benefit most from broad spectrum therapy needs to be advanced [17], and a better understanding of the barriers to translating guidelines into practice is critical.

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Potential conflicts of interest. All authors: no conflicts.

APPENDIX

SURVEY QUESTIONS AND ANSWER CHOICES

Please answer the following questions based on your current practice and/or understanding of current guidelines for pneumonia treatment. We prefer that you do not consult outside references or colleagues.
Select the most appropriate initial empiric antibiotic regimen from the choices given for the following patients HOSPITALIZED with pneumonia.

You may select combination therapy when appropriate.

Each patient presents with fever, sputum production, and a pulmonary infiltrate by chest radiograph. All patients are hemodynamically stable on oxygen 3 L/min by nasal cannula.

Assume no drug allergies or interactions exist.

1. 44-year-old male with polycystic kidney disease and chronic renal insufficiency admitted from hemodialysis
2. 75 year old male with coronary artery disease and essential hypertension
3. 88 year old female with type 2 diabetes mellitus and osteoarthritis
4. 25 year old male with paraplegia due to spinal trauma at age 17, currently receiving wound care for a sacral decubitus ulcer by a home health nurse
5. 77 year old male with esophageal cancer on home total parenteral nutrition through a central venous catheter (Port-A-Cath)
6. 88 year old female with type 2 diabetes mellitus and osteoarthritis
7. Healthy 32 year old female whose 8 year old son has cystic fibrosis and is at home completing treatment for Pseudomonas pneumonia

Answer choices:
3rd generation cephalosporin (e.g. ceftriaxone)
Advanced macrolide (e.g. azithromycin)
Respiratory fluoroquinolone (e.g. moxifloxacin)
B-lactam/B-lactamase inhibitor (e.g. piperacillin/tazobactam)
Carbapenem (e.g. meropenem)
Antipseudomonal fluoroquinolone (e.g. ciprofloxacin)
Aminoglycoside (e.g. tobramycin)
Vancomycin or linezolid

References


