Early Discharge of Infected Patients Through Appropriate Antibiotic Use

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Background: Patients with infections are usually discharged from the hospital with antibiotics when afebrile and clinically improved.

Objectives: To compare outcomes of early vs conventionally discharged patients and to examine the role of antibiotic use in the discharge process.

Methods: One hundred eleven patients hospitalized with cellulitis, community-acquired pneumonia, or pyelonephritis (urinary tract infection) discharged from the hospital early in their clinical course before defervescence by an infectious diseases hospitalist (L.J.E.) were compared in a case-controlled study with 112 patients discharged from the hospital according to conventional standards of care by internal medicine (IM) hospitalists. Patients were matched for age, sex, diagnosis, and comorbidities. Outcomes were determined for average lengths of stay, readmission to the hospital within 30 days with the same diagnosis, satisfaction with their discharge program, and time to return to their normal activities of daily living.

Results: Patients cared for by the infectious diseases hospitalist had a shorter average length of stay (mean difference, 1.7 days), no readmissions, higher satisfaction scores, and a shorter time to return to their activities of daily living, compared with those cared for by the IM hospitalists. Analysis of the antibiotics that patients were discharged with revealed that the infectious diseases hospitalist used outpatient parenteral antibiotic therapy more frequently than IM hospitalists in the treatment of cellulitis, and switched from intravenous to oral antibiotics sooner than IM hospitalists for patients with community-acquired pneumonia and urinary tract infection.

Conclusions: The infectious diseases hospitalist discharged patients from the hospital earlier than the IM hospitalists by more efficient use of antibiotics. The earlier discharge did not adversely affect outcomes.

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PATIENTS AND METHODS

It was the intent of this study to compare patients discharged from the hospital early in their clinical course before defervescence with those discharged from the hospital using the conventional strategy, wherein patients undergo defervescence and improve clinically before discharge. To accomplish this, we analyzed 111 consecutive patients discharged early by the ID hospitalist from May 1, 1998, through July 31, 1999, whose anticipated lengths of stay would not exceed 6 days, as estimated by the triage physician. This criterion was required in an attempt to exclude potential outliers from the study that might skew results. They were matched in a case-controlled fashion as closely as possible for sex, age, comorbidities, and diagnoses, with a similar pool of patients discharged conventionally by IM hospitalists during the same period. These patients were not randomized between the 2 groups but rather were admitted by the IM hospitalists when the ID hospitalist was not on duty.

Patients were admitted directly by the ID hospitalist from 8 AM to 3 PM Mondays through Fridays or were admitted by night coverage from 8 PM to 8 AM Sundays through Thursdays and reassigned to the ID hospitalist at 8 AM Mondays through Fridays. They were admitted directly by the IM hospitalists from 3 PM to 8 PM Mondays through Fridays and during the entire weekend from Fridays at 8 PM until Sundays at 8 PM. This method of assignment of patients did not lead to a selection bias, as this Kaiser Foundation hospital's departments function 7 days a week, and it seems unlikely that confounding differences could have been introduced solely based on the time of admission. However, we cannot exclude the possibility of subtle effects leading to a selection bias, as a result of nonrandomization.

Community-acquired pneumonia was defined as fever (temperature >38°C), tachypnea, production of purulent sputum, decrease in oxygen saturation on pulse oximetry, and radiological evidence of alveolar infiltrates. Urinary tract infection was defined as fever (temperature >38°C) with abdominal or costovertebral angle tenderness, pyuria, and bacteriuria. Cellulitis was defined as fever (temperature >38°C) with signs of inflammation of the skin. Clinical improvement for cellulitis was defined as no further advancement of cellulitis, normalization of the white blood cell count, and improvement in feelings of well-being. Clinical improvement for UTI was defined as lessening of the costovertebral angle or abdominal tenderness and improvement in feelings of well-being. Clinical improvement for CAP was defined as a decrease in tachypnea, lessening of crackles on auscultation of the lungs, an increase in oxygen saturation on pulse oximetry, radiological improvement, and improvement in feelings of well-being. Cure was defined as disappearance of all of the previously described signs of infection. Patients were discharged from the hospital by IM hospitalists following defervescence and clinical improvement, and by the ID hospitalist before defervescence and demonstration of improvement in all clinical indications of infection. Following discharge from the hospital, patients were followed up in the infusion clinic if they received OPAT. If they were discharged from the hospital with oral antibiotics, they were followed up by either their hospitalist or their primary care provider, at the discretion of the hospitalist.

Patients from the IM group were matched to those in the ID group, first of all, based on diagnosis. Once categorized by diagnosis, patients were next matched on comorbidities. Finally, patients were matched based on sex and age. The 2 groups were then compared for average length of stay, defined as the number of nights spent in the hospital following admission. If they were admitted during the previous night by night coverage and sent home the same day by the hospitalist, the length of stay was counted as 1 day. If they were sent home from the emergency department or from the infusion clinic without being admitted, their length of stay was counted as 0 days. These patients were usually observed for several hours in the hospital before being discharged to be sure that they were not worsening clinically. Approximately 1 month following discharge from the hospital, they were sent an anonymous questionnaire regarding their attitudes toward the discharge program and the time it took them to return to their normal activities of daily living following discharge. The components of the survey included 3 questions: “How long did it take you following discharge from the hospital to return to at least one of your normal activities of daily living (such as work, school, homemaking, hobbies, etc.)? How did you feel about the timing of your discharge? Did you feel that your home environment aided in your recovery (strong agreement, agreement, neutral, disagreement, or strong disagreement)?” The response rates (77% and 86% for ID and IM hospitalists’ patients, respectively) were similar between the 2 groups.

Antibiotics used in the hospital were compared, as were those used following discharge from the hospital. Patients were followed up for 30 days after discharge from the hospital for possible readmission with the same diagnosis. Since our organization is vertically integrated, it is unlikely that any readmissions were missed.

We used SAS statistical software, version 6.12 (SAS Institute Inc, Cary, NC), for all statistical calculations. Statistical analyses were based on 2-sample t test (length of stay and age) and χ² test for equality of distribution (sex and comorbidities).

by the ID hospitalist overall and for each type of infection (Table 2). There was only one readmission within 30 days, a patient with CAP, and that occurred in the group conventionally treated by the IM hospitalists. The patient subsequently did well, and was discharged from the hospital uneventfully. There were no readmissions within the group discharged from the hospital early by the ID hospitalist.

Patients with cellulitis were treated by the ID hospitalist with intravenous cefazolin sodium, ceftriaxone sodium, or clindamycin while hospitalized, and they were discharged from the hospital while still febrile and before improvement in the cellulitis with ceftriaxone, cefazolin, or oral clindamycin 2.4 days earlier than those treated by IM hospitalists. Those discharged from the hospital with intravenous ceftriaxone or cefazolin were later switched to treatment with oral cloxacillin or cephalaxin by the ID hospitalist to complete their course of therapy, but this was not included in the analysis. Patients with cellulitis cared for by the IM hospitalists re-
ceived cefazolin or various other antibiotics in the hospital, but were not discharged from the hospital until defervescence with improvement in the cellulitis; they were discharged with oral cephalexin or a similar antibiotic combination. Cefazolin was given as cefazolin sodium, ceftriaxone as ceftriaxone sodium, and piperacillin as piperacillin sodium. ID indicates infectious diseases; IM indicates internal medicine.

Table 3. Antibiotics Used for Cellulitis*

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>ID Hospitalist</th>
<th>IM Hospitalists</th>
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</thead>
<tbody>
<tr>
<td>Inpatients</td>
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<td></td>
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</tr>
<tr>
<td>Cefazolin</td>
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<td>19</td>
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<tr>
<td>Clindamycin</td>
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<td>Ceftriaxone</td>
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<td></td>
</tr>
<tr>
<td>Piperacillin-tazobactam</td>
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</tr>
<tr>
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</tr>
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</tr>
<tr>
<td>Outpatients</td>
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</tr>
<tr>
<td>Ceftriaxone</td>
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<tr>
<td>Cefazolin</td>
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<td>4</td>
<td></td>
</tr>
<tr>
<td>Clindamycin (oral)</td>
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<tr>
<td>Miscellaneous</td>
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*Data are given as the number of patients treated with each antibiotic or antibiotic combination. Cefazolin was given as cefazolin sodium, ceftriaxone as ceftriaxone sodium, and piperacillin as piperacillin sodium. ID indicates infectious diseases; IM, internal medicine.

Patients with CAP were treated with ceftriaxone plus either oral doxycycline or azithromycin by the ID hospitalist while in the hospital and were discharged from the hospital before clinical improvement with either oral doxycycline or azithromycin a mean of 1.2 days earlier than the group cared for by the IM hospitalists. The patients with CAP cared for by the IM hospitalists were treated with ceftriaxone and oral doxycycline, azithromycin, clarithromycin, or erythromycin while hospitalized and were discharged from the hospital following defervescence and clinical improvement; they were discharged with various oral antibiotics (Table 5).

Satisfaction surveys of both groups revealed favorable responses for the discharge program, although there was one dissatisfied patient in each group. Using the discriminator of “strong agreement” with the discharge program (vs “agreement”), there were differences between the 2 groups. Patients discharged from the hospital earlier were more likely to be in strong agreement, than those conventionally discharged, with the timing of their discharge (60% vs 28%) and that their home environment aided their recovery (56% vs 29%). The early discharge group returned to work an average of 1.7 days earlier than typical hospital discharge.
return to their normal activities of daily living earlier than their own care and were more active, which led to their home. While at home, they likely participated more due to the patients' increased feelings of well-being at home and increased patient satisfaction. This may have been at the expense of increasing readmissions to the hospital and, in addition, increased the average length of stay for all disease categories without OPAT. The shorter hospital stay was attributable to the bioavailability of orally administered antibiotics and greater familiarization with the typical course of infected patients treated with antibiotics.

Another limitation of this study is that the exact criteria for discharge of patients in our study were not standardized for quantity of malaise, pain, tachypnea, crackles on auscultation, hypoxemia, or leukocytosis. They were subjective and, therefore, inexact, differing among physicians. However, it was not the intent of this study to validate criteria for hospital discharge, but rather to challenge the conventional requirement of defervescence and clinical improvement before discharge and to support this approach with outcomes data, which is the main strength of this study. We chose to focus on antibiotic use as a potential tool for early discharge from the hospital rather than assaying real or spurious differences between the management styles of ID compared with IM hospitalists for fear of fostering an “us vs them” mentality. Such an approach would likely invite methodological criticism based on the simple fact that having only one ID hospitalist could likely skew results in that group.

Antibiotic use differed between the 2 groups of patients in this study. The ID hospitalist’s more frequent use of OPAT for cellulitis and earlier switch to oral antibiotics for UTI and CAP likely resulted in the difference in average length of stay between the 2 groups. While IM hospitalists had the same access to OPAT, they did not use it as frequently, as noted elsewhere. The earlier switch to oral therapy may also reflect a familiarity with the ID hospitalist with the bioavailability of orally administered antibiotics. Indeed, it has been shown elsewhere that only 40% of patients with CAP were switched to oral antibiotics when they were believed to be clinically stable, which led to unnecessary delays in discharge of 24 hours or longer.

The ID physician has 2 advantages in this regard: greater understanding of effective antibiotic use, particularly for OPAT and oral therapy, and greater familiarity with the typical course of infected patients treated with antibiotics. While only 75% of patients with pyelonephritis may undergo defervescence within 48 hours and the additional 25% may take 3 or 4 days of optimal antibiotic therapy before defervescence, physicians may be reluctant to discharge patients while still febrile because of habit, training, or fear of litigation in the event of an unsuccessful outcome. If an ID hospitalist could be involved in an early consultative, if not a primary, consultative approach with outcomes data, which is the main strength of this study. We chose to focus on antibiotic use as a potential tool for early discharge from the hospital rather than assaying real or spurious differences between the management styles of ID compared with IM hospitalists for fear of fostering an “us vs them” mentality. Such an approach would likely invite methodological criticism based on the simple fact that having only one ID hospitalist could likely skew results in that group.

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lines in general.\textsuperscript{20} It remains to be seen whether alternative strategies such as the one described in the present study might not complement guidelines, with improved outcomes and increased satisfaction to patients and physicians alike.

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\section*{REFERENCES}


