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Teryl K. Nuckols, et al

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Craig A. Umscheid and S. Ryan Greysen

Caregiver Perspectives on Communication During Hospitalization at an Academic Pediatric Institution: A Qualitative Study
Lauren G. Solan, et al

EDITORIAL Engaging Families as True Partners During Hospitalization
Alisa Khan, et al

Improving Teamwork and Patient Outcomes with Daily Structured Interdisciplinary Bedside Rounds: A Multimethod Evaluation
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Hospitalist Perspective of Interactions with Medicine Subspecialty Consult Services
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Days of Therapy Avoided: A Novel Method for Measuring the Impact of an Antimicrobial Stewardship Program to Stop Antibiotics
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January 1, 2019 - December 31, 2024*

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*Please note: Some duties of the new editor will begin during a transition period starting October 1, 2018.
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BACKGROUND: Nationally, readmissions have declined for acute myocardial infarction (AMI) and heart failure (HF) and risen slightly for pneumonia, but less is known about returns to the hospital for observation stays and emergency department (ED) visits.

OBJECTIVE: To describe trends in rates of 30-day, all-cause, unplanned returns to the hospital, including returns for observation stays and ED visits.

DESIGN: By using Healthcare Cost and Utilization Project data, we compared 210,007 index hospitalizations in 2009 and 2010 with 212,833 matched hospitalizations in 2013 and 2014.

SETTING: Two hundred and one hospitals in Georgia, Nebraska, South Carolina, and Tennessee.

PATIENTS: Adults with private insurance, Medicaid, or no insurance and seniors with Medicare who were hospitalized for AMI, HF, and pneumonia.

MEASUREMENTS: Thirty-day hospital return rates for inpatient, observation, and ED visits.

RESULTS: Return rates remained stable among adults with private insurance (15.1% vs 15.3%; P = .45) and declined modestly among seniors with Medicare (25.3% vs 25.0%; P = .04). Increases in observation and ED visits coincided with declines in readmissions (8.9% vs 8.2% for private insurance and 18.3% vs 16.9% for Medicare, both P < .001). Return rates rose among patients with Medicaid (31.0% vs 32.1%; P = .04) and the uninsured (18.8% vs 20.1%; P = .004). Readmissions remained stable (18.7% for Medicaid and 9.5% for uninsured patients, both P > .75) while observation and ED visits increased.

CONCLUSIONS: Total returns to the hospital are stable or rising, likely because of growth in observation and ED visits. Hospitalists’ efforts to improve the quality and value of hospital care should consider observation and ED care. Journal of Hospital Medicine 2018;13:296-303. Published online first November 22, 2017. © 2018 Society of Hospital Medicine

Given the frequency, potential preventability, and costs associated with hospital readmissions, reducing readmissions is a priority in efforts to improve the quality and value of healthcare. State and national bodies have created diverse initiatives to facilitate improvements in hospital discharge practices and reduce 30-day readmission rates across payers. For example, the Agency for Healthcare Research and Quality (AHRQ) and the Institute for Healthcare Improvement have published tools for improving discharge practices. Medicare instituted financial penalties for hospitals with higher-than-expected readmission rates for acute myocardial infarction (AMI), heart failure (HF), and pneumonia in 2012, while private payers and Medicaid programs have established their own policies. Furthermore, private payers and Medicaid programs shifted toward capitated and value-based reimbursement models in which readmissions lead to financial losses for hospitals. Accordingly, hospitals have implemented diverse interventions to reduce readmissions. From 2009 to 2013, 30-day readmissions declined among privately insured adults (from 12.4% to 11.7%), Medicare patients (from 22.0% to 20.0%), and uninsured individuals (11.5% to 11.0%) but climbed among patients with Medicaid (from 19.8% to 20.5%) after index admissions for AMI, HF, pneumonia, or chronic obstructive pulmonary disease.

To date, research, policies, and quality improvement interventions have largely focused on improvements to one aspect of the system of care that provided in the inpatient setting – among older adults with Medicare. Yet, inpatient readmissions may underestimate how often patients return to the hospital because patients can be placed under observation or stabilized and discharged from the emergency department (ED) instead of being readmitted. Observation and ED visits are less costly to payers than inpatient admissions. Thus, information about utilization of inpatient, ob-
Returns to Acute Care Within 30 Days After Hospitalization   |   Nuckols et al

Acceptance, and ED visits within 30 days of hospital discharge may be more informative than inpatient readmissions alone. However, little is known about trends in returns to the hospital for observation and ED visits and whether such trends vary by payer.

Our objective was to assess whether changes have occurred in rates of total 30-day, all-cause, unplanned returns to the hospital among adults with index admissions for AMI, HF, and pneumonia in which returns to the hospital included inpatient readmissions, observation visits, and ED visits. We also assessed whether changes in the rate of hospital inpatient readmissions coincided with changes in rates of returns for ED or observation visits. To examine the effects of readmission policies implemented by diverse payers and broad changes to the health system following the Affordable Care Act, we compared data from 201 hospitals in 4 states in 2009 and 2010 with data from the same hospitals for 2013 and 2014.

METHODS

Data Sources, Populations, and Study Variables

We used Healthcare Cost and Utilization Project (HCUP) State

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</thead>
<tbody>
<tr>
<td>Index admissions, N</td>
<td>35,056</td>
<td>31,171&lt;sup&gt;a&lt;/sup&gt;</td>
<td>144,113</td>
<td>149,380&lt;sup&gt;a&lt;/sup&gt;</td>
<td>14,575</td>
<td>15,566&lt;sup&gt;a&lt;/sup&gt;</td>
<td>16,263</td>
<td>16,716&lt;sup&gt;a&lt;/sup&gt;</td>
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<td>AMI</td>
<td>13,002</td>
<td>13,324&lt;sup&gt;a&lt;/sup&gt;</td>
<td>26,566</td>
<td>29,452&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2290</td>
<td>2714&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5353</td>
<td>5820&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>HF</td>
<td>8371</td>
<td>7381&lt;sup&gt;a&lt;/sup&gt;</td>
<td>63,659</td>
<td>65,011&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5692</td>
<td>6615&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5382</td>
<td>5726&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>13,683</td>
<td>10,466&lt;sup&gt;a&lt;/sup&gt;</td>
<td>53,888</td>
<td>54,917&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6593</td>
<td>6237&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5528</td>
<td>5170&lt;sup&gt;a&lt;/sup&gt;</td>
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Variables used in matching procedure

Patient age, years, % of index admissions

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<tr>
<td>18-24</td>
<td>1.8</td>
<td>1.9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>–</td>
<td>–</td>
<td>3.8</td>
<td>3.4</td>
<td>2.2</td>
<td>2.0</td>
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<tr>
<td>25-34</td>
<td>4.7</td>
<td>4.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>–</td>
<td>–</td>
<td>8.9</td>
<td>8.4</td>
<td>7.7</td>
<td>7.4</td>
</tr>
<tr>
<td>35-44</td>
<td>13.5</td>
<td>13.2</td>
<td>–</td>
<td>–</td>
<td>15.9</td>
<td>15.8</td>
<td>20.3</td>
<td>20.2</td>
</tr>
<tr>
<td>45-54</td>
<td>32.1</td>
<td>32.4</td>
<td>–</td>
<td>–</td>
<td>33.6</td>
<td>33.8</td>
<td>38.9</td>
<td>39.2</td>
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<tr>
<td>55-64</td>
<td>48.0</td>
<td>48.6</td>
<td>–</td>
<td>–</td>
<td>37.9</td>
<td>38.6</td>
<td>30.9</td>
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<td>65-74</td>
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<td>35.8</td>
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<td>–</td>
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<td>75+</td>
<td>–</td>
<td>–</td>
<td>64.2</td>
<td>64.1</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<tbody>
<tr>
<td>Male, % of index admissions</td>
<td>59.3</td>
<td>60.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>46.1</td>
<td>46.2</td>
</tr>
<tr>
<td>Comorbidity index, mean</td>
<td>11.6</td>
<td>11.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>20.4</td>
<td>20.4</td>
</tr>
<tr>
<td>Hospital’s ratio of observation visits to inpatient stays, 2009 and 2010, mean</td>
<td>0.22</td>
<td>0.22</td>
<td>0.24</td>
<td>0.24</td>
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</tbody>
</table>

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<thead>
<tr>
<th>Type of visit, % of return&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Inpatient</th>
<th>Not inpatient</th>
<th>Observation</th>
<th>ED</th>
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<tr>
<td>Inpatient</td>
<td>58.6</td>
<td>53.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>72.2</td>
<td>67.8&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>Not inpatient</td>
<td>41.4</td>
<td>46.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>27.8</td>
<td>32.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Observation</td>
<td>8.0</td>
<td>11.1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4.7</td>
<td>6.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>ED</td>
<td>33.4</td>
<td>35.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>23.1</td>
<td>25.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
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</table>


<sup>a</sup> Includes records that could be matched and were included in the final analysis; results are weighted for matching.
<sup>b</sup> Percentage out of total revisits; other percentages are out of total index admissions. The revisit categories are mutually exclusive.
<sup>c</sup> Percentage out of total index admissions.
TABLE 2. Principal (First-Listed) Diagnosis at Return to Hospital, by Type of Return Visit and Whether the Index Admission was for AMI, HF, or Pneumonia

| Condition at the Index Admission and Principal (First-Listed) Diagnosis at the Revisit | Percentage of Index Admissions Resulting in a Return Visit |
|---|---|---|---|---|---|---|---|
| | Inpatient | Observation | ED |
| AMI, total | 11.6 | 10.7<sup>a</sup> | 1.6 | 2.5<sup>a</sup> | 5.4 | 5.9<sup>a</sup> |
| Heart failure | 2.0 | 1.9 | 0.1 | 0.1<sup>b</sup> | 0.2 | 0.1<sup>b</sup> |
| Nonspecific chest pain | 0.6 | 0.4<sup>b</sup> | 0.7 | 1.0<sup>b</sup> | 0.8 | 0.9 |
| Other lower respiratory disease | 0.1 | 0.1 | <0.1 | 0.1<sup>a</sup> | 0.3 | 0.3 |
| Complications of surgery or medical care | 0.5 | 0.4<sup>b</sup> | <0.1 | <0.1 | 0.1 | 0.1 |
| Cardiac dysrhythmias | 0.4 | 0.4 | <0.1 | 0.1<sup>a</sup> | 0.1 | 0.1 |
| Coronary atherosclerosis, other heart disease | 0.4 | 0.3<sup>b</sup> | 0.1 | 0.2<sup>a</sup> | 0.1 | 0.1 |
| HF, total | 19.5 | 18.6<sup>a</sup> | 1.3 | 1.8<sup>a</sup> | 6.2 | 6.9<sup>a</sup> |
| Congestive heart failure | 7.1 | 6.5<sup>a</sup> | 0.2 | 0.4<sup>a</sup> | 0.7 | 0.7 |
| Hypertension with complications | 0.8 | 0.9<sup>a</sup> | <0.1 | <0.1 | <0.1 | 0.1 |
| Cardiac dysrhythmias | 0.7 | 0.6 | <0.1 | 0.1 | 0.1 | 0.2 |
| Fluid and electrolyte disorders | 0.4 | 0.4<sup>b</sup> | 0.1 | 0.1 | 0.1 | 0.2<sup>b</sup> |
| Nonspecific chest pain | 0.3 | 0.1<sup>a</sup> | 0.2 | 0.3<sup>a</sup> | 0.4 | 0.4 |
| Other lower respiratory disease | 0.1 | 0.1<sup>a</sup> | <0.1 | 0.1 | 0.4 | 0.5 |
| Pneumonia, total | 15.1 | 14.5<sup>a</sup> | 1.0 | 1.4<sup>a</sup> | 6.6 | 7.0<sup>a</sup> |
| Pneumonia | 2.9 | 2.6<sup>a</sup> | 0.1 | 0.1 | 0.4 | 0.4 |
| Congestive heart failure | 1.2 | 1.2 | <0.1 | 0.1<sup>b</sup> | 0.1 | 0.1 |
| Chronic obstructive pulmonary disease | 1.0 | 0.9<sup>a</sup> | 0.1 | 0.1 | 0.4 | 0.4 |
| Other lower respiratory disease | 0.2 | 0.1<sup>a</sup> | <0.1 | 0.1 | 0.5 | 0.5 |
| Nonspecific chest pain | 0.1 | 0.1<sup>a</sup> | 0.2 | 0.2<sup>a</sup> | 0.3 | 0.3 |

*NOTE: The diagnosis categories are mutually exclusive. Conditions are defined according to Clinical Classification Software categories. Conditions shown are those that ranked in the top three reasons for inpatient, observation, or ED visits in 2009 and 2010 or 2013 and 2014 with a sample size of at least 10 patients. Conditions are sorted according to the number of inpatient readmissions in 2009 and 2010. Source: AHRQ, Center for Delivery, Organization, and Markets, HCUP, State Inpatient Databases, State Emergency Department Databases, and State Ambulatory Surgery and Services Databases, 4 States, 2009 and 2010 versus 2013 and 2014, weighted matched records. Abbreviations: AHRQ, Agency for Healthcare Research and Quality; AMI, acute myocardial infarction; ED, emergency department; HCUP, Healthcare Cost and Utilization Project.

†P < .05.
identifiers. The AHRQ Institutional Review Board considers research using HCUP data to have exempt status.

### Statistical Analysis
To compare rates at which patients returned to the hospital during 2 cohort periods (2009 and 2010 vs 2013 and 2014), we used coarsened exact matching, a well-established matching technique for balancing covariates between 2 populations of patients that may be related to the outcome. For observational datasets, coarsened exact matching is preferable to traditional matching because it enables the investigator to assess balance between the 2 populations, select the desired degree of balance, and eliminate observations for which comparable matches cannot be found.

We assembled sets of index admissions in each study period that were similar with respect to payer, primary diagnosis, and other factors. Matching variables included the patient's age group, sex, and Elixhauser Comorbidity Index in deciles, as well as the hospital's ratio of observation visits relative to inpatient admissions in 2009 and 2010 combined (in quartiles; see supplementary Appendix). For Medicare beneficiaries, we also matched on dual enrollment in Medicaid.

We conducted the matching process separately for each target condition and payer population. First, we grouped index admissions in both periods into strata defined by all possible combinations of the matching variables and allowing one-to-many random matching within strata. We then dropped records in any strata for which there were no records in 1 of the time periods. Finally, we calculated weights based on the size of each stratum. We used these weights to account for the different numbers of index admissions in each stratum between the 2 study periods. For example, if a stratum contained 10 index admissions in 2009 and 2010 combined and 20 in 2013 and 2014 combined, an admission weighed double in the earlier period. After weighting, the index admissions in each period (2009 and 2010; 2013 and 2014) had similar characteristics (Table 1). After matching and weighting, we compared the percentage of index admissions for which patients returned to the hospital and the primary diagnoses at the return visit between the 2 study periods using 2-sided $\chi^2$ tests ($P < .05$). Analyses were conducted by using SAS software (version 9.4; SAS Institute Inc., Cary, NC).

### RESULTS
There were 423,503 eligible index admissions for AMI, HF, and pneumonia in the 2 periods combined; 422,840 (99.8%) were successfully matched and included in this analysis. After matching weights were applied, there were few statistically significant differences across the 2 time periods (see Table 1 and supplementary Appendix).

From 2009 and 2010 to 2013 and 2014, the percentage of patients hospitalized for AMI, HF, and pneumonia who had only observation or ED visits when they returned to the hospital increased from 41.4% to 46.7% among patients with private insurance ($P < .001$), from 27.8% to 32.1% among older patients with Medicare ($P < .001$), from 39.5% to 41.8% among patients with Medicaid ($P = .03$), and from 49.2% to 52.8% among patients without insurance.
FIG 2. Matched comparison of hospitalizations for (a) AMI (b), HF, and (c) pneumonia individually in 2009 and 2010 versus 2013 and 2014: rates at which patients returned to the hospital within 30 days of discharge, by expected payer. The revisit categories are mutually exclusive and sum to the total. Expected payer was defined at the index admission. The asterisk indicates 2013 and 2014 versus 2009 and 2010, P < .05. NOTE: Source: AHRQ, Center for Delivery, Organization, and Markets, HCUP, State Inpatient Databases, State Emergency Department Databases, and State Ambulatory Surgery and Services Databases, 4 States, 2009 and 2010 versus 2013 and 2014, weighted matched records. Abbreviations: AHRQ, Agency for Healthcare Research and Quality; AMI, acute myocardial infarction; ED, emergency department; HCUP, Healthcare Cost and Utilization Project; HF, heart failure.
The percentage of returns to the hospital for observation increased across all payers ($P < .001$); in 2013 and 2014 combined, observation visits ranged from 6.8% of hospital returns among patients with Medicare to 11.1% among patients with private insurance. The percentage of returns to the hospital for an ED visit increased among patients with private insurance ($P = .02$) and Medicare ($P < .001$); in 2013 and 2014, ED visits ranged from 25.3% of returns to the hospital among patients with Medicare to 42.9% among uninsured patients.

The increases in 30-day observation and ED visits coincided with reductions in inpatient readmissions among patients with private insurance and Medicare and contributed to growth in total returns to the hospital among patients with Medicaid or no insurance (Figure 1). Among privately insured individuals, a decline in inpatient readmissions (from 8.9% to 8.2%; $P = .004$) coincided with increases in observation visits (from 1.2% to 1.7%; $P < .001$) and ED visits (from 5.1% to 5.5%; $P = .02$), leading to a stable rate of approximately 15% at which patients with AMI, HF, or pneumonia returned to the hospital during both periods ($P = .45$). Among Medicare patients, inpatient readmissions declined from 18.3% to 16.9% ($P < .001$), while observation visits and ED visits increased (from 1.2% to 1.7% and 5.8% to 6.3%, respectively; $P < .001$), leading to a small net decrease in total returns to the hospital (25.3% vs 25.0%; $P = .04$). Among Medicaid recipients, inpatient readmissions were unchanged (18.7%; $P = .93$), but an increase in observation visits (from 2.0% to 2.7%; $P < .001$) and a nonsignificant increase in ED visits (from 10.3% to 10.7%; $P = .26$) led to a rise in total revisits (31.0% vs 32.1%; $P = .04$). Among uninsured adults, inpatient readmissions were stable (around 9.5%; $P = .76$), while there was a rise in observation visits (1.3% vs 2.0%; $P < .001$) and ED visits (8.0% vs 8.6%; $P = .04$), yielding an increase in total revisits (18.8% vs 20.1%; $P = .004$).

Figure 2 shows individual differences for each of the 3 target conditions between 2009 and 2010 versus 2013 and 2014 by payer. Overall, rates at which patients returned to the hospital within 30 days remained stable, with 3 exceptions. For patients with private insurance, total returns to the hospital rose for pneumonia (14.8% vs 15.9%; $P = .02$). For seniors with Medicare, total returns to the hospital declined for pneumonia (from 24.1% to 23.5%; $P = .03$). Among the uninsured, total returns to the hospital rose for AMI (15.5% vs 17.2%; $P = .02$).

Patients initially hospitalized for HF and pneumonia who returned to the hospital within 30 days often returned for the same conditions (Table 2). Reasons for returning to the hospital were similar in the 2 periods (2009 and 2010; 2013 and 2014) across the 3 target conditions. However, when patients returned to the hospital in 2013 and 2014 with the same diagnosis as the index admission, they were less likely to be readmitted and more likely to be placed under observation than in 2009 and 2010.

**DISCUSSION**

Matching index admissions for AMI, HF, or pneumonia in 201 hospitals in 2009 and 2010 with those in 2013 and 2014, we observed that increases in observation and ED visits coincided with reductions in inpatient readmissions among patients with private insurance and Medicare and contributed to growth in total returns to the hospital among patients with Medicaid or no insurance. Among patients with private insurance and Medicare, inpatient readmissions declined significantly for all 3 target conditions, but total returns to the hospital remained constant for AMI and HF, rose for privately insured patients with pneumonia, and declined modestly for Medicare patients with pneumonia. Inpatient readmissions were unchanged for adults aged 18 to 64 years with Medicaid or no insurance, but total returns to the hospital increased significantly, reaching 32% among those with Medicaid.

These findings add to recent literature, which has primarily emphasized inpatient readmissions among Medicare beneficiaries with several exceptions. A prior analysis indicates that readmissions have declined among diverse payer populations nationally.18 Gerhardt et al25 found that from 2011 to 2012, all-cause 30-day readmissions declined among fee-for-service (FFS) Medicare beneficiaries following any index admission, while ED revisits remained stable and observation revisits increased slightly. Evaluating the CMS Hospital Readmission Reductions Program (HRRP), Zuckerman et al17 reported that from 2007 to 2015, inpatient readmissions declined among FFS Medicare beneficiaries aged 65 years and older who were hospitalized with AMI, HF, or pneumonia, while returns to the hospital for observation rose approximately 2%; ED visits were not included. We found that Medicare (FFS and Medicare Advantage) patients with AMI and HF returned to the hospital with the same frequency in 2009 and 2010 as in 2013 and 2014, and those patients with pneumonia returned slightly less often. In aggregate, declines in inpatient readmissions in the 4 states we studied coincided with increases in observation and ED care. Moreover, these shifts occurred not only among Medicare beneficiaries but also among privately insured adults, Medicaid recipients, and the uninsured.

Three factors may have contributed to these apparent shifts from readmissions to observation and ED visits. First, some authors have suggested that hospitals may reduce readmissions by intentionally placing some of the patients who return to the hospital under observation instead of admitting them.17,24 If true, hospitals with greater declines in readmissions would have larger increases in observation revisits. Zuckerman et al17 found no correlation among Medicare beneficiaries between hospital-level trends in observation revisits and readmissions, but returns to observation rose more rapidly for AMI, HF, and pneumonia (compared with other conditions) during long term follow-up than during the HRRP implementation period. Other authors have documented that declines in readmissions have been greatest at hospitals with the highest baseline readmission rates,27,28 and hospitals with lower readmission rates have more observation return visits.29

Second, shifts from inpatient readmissions to return visits for observation may reflect unintentional rather than intentional changes in the services provided. Clinical practice patterns are evolving such that patients who present to the hospital for acute...
care increasingly are placed under observation or discharged from the ED instead of being admitted, regardless of whether they recently were hospitalized. Inpatient admissions, which are strongly correlated with readmission rates, are declining nationally and both observation and ED visits are rising. Although little is known about effects on health outcomes and patient out-of-pocket costs, shifts from inpatient admissions to observation and ED visits reduce costs to payers.

Third, instead of substitution, more patients may be returning for lower-acuity conditions that can be treated in the ED or under observation. Hospitals are implementing diverse and multifaceted interventions to reduce readmissions that can involve assessing patient needs and the risk for readmission, educating patients about self-care and risks after discharge, reconciling medication, scheduling follow-up visits, and monitoring patients through telephone calls and home nursing visits. Although the intent may be to reduce patients’ need to return to the hospital, interventions that educate patients about risks after discharge may lower the threshold at which they find symptoms worrisome enough to return. This could increase lower-acuity return visits. We found that reasons for returning were similar in 2009 and 2010 versus 2013 and 2014, but we did not examine acuity of illness at the time of return. Other areas of concern are the high rates at which Medicare patients are returning to the hospital and the increases in rates of returns among Medicare patients and the uninsured. Individuals in these disadvantaged populations may be having difficulty accessing ambulatory care or may be turning to the ED more often for lower-acuity problems that arise after discharge. In 3 of the 4 states we studied, 15% to 16% of adults live in poverty and 10% to 30% live in primary care health professional shortage areas. Given the implications for patient outcomes and costs, trends among these populations warrant further scrutiny.

This analysis has several limitations. Data were from 4 states, but trends in readmissions are similar nationally. From 2010 through 2015, the all-condition readmission rate declined by 8% among Medicare beneficiaries nationally and by 6.1% in South Carolina, 7.4% in Georgia, 8.3% in Nebraska, and 8.7% in Tennessee. We report trends across hospitals and did not examine hospital-level revisits. Therefore, further research is needed to determine whether these findings are related to co-occurring trends, intentional substitution, or other factors.

In conclusion, measuring inpatient readmissions without accounting for return visits to the ED and observation underestimates the rate at which patients return to the hospital following an inpatient hospitalization. Because of growth in observation and ED visits, trends in the total rates at which patients return to the hospital can differ from trends in inpatient readmissions. In the 4 states we studied, total return rates were particularly high and rising among patients with Medicaid and lower, but also rising, among the uninsured. Policy analysts and researchers should investigate the factors contributing to growth in readmissions in these vulnerable populations and determine whether similar trends are occurring nationwide. Hospitalists play critical roles in admitting and discharging inpatients, caring for patients under observation, and implementing quality improvement programs. Irrespective of payer, hospitalists’ efforts to improve the quality and value of care should include observation and ED visits as well as inpatient readmissions.

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References

Returns to Acute Care Within 30 Days After Hospitalization   |   Nuckols et al


Caregiver Perspectives on Communication During Hospitalization at an Academic Pediatric Institution: A Qualitative Study

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OBJECTIVE: Communication among those involved in a child’s care during hospitalization can mitigate or exacerbate family stress and confusion. As part of a broader qualitative study, we present an in-depth understanding of communication issues experienced by families during their child’s hospitalization and during the transition to home.

METHODS: Focus groups and individual interviews stratified by socioeconomic status included caregivers of children recently discharged from a children’s hospital after acute illnesses. An open-ended, semistructured question guide designed by investigators included communication-related questions addressing information shared with families from the medical team about discharge, diagnoses, instructions, and care plans. By using an inductive thematic analysis, 4 investigators coded transcripts and resolved differences through consensus.

RESULTS: A total of 61 caregivers across 11 focus groups and 4 individual interviews participated. Participants were 87% female and 46% non-white. Analyses resulted in 3 communication-related themes. The first theme detailed experiences affecting caregiver perceptions of communication between the inpatient medical team and families. The second revealed communication challenges related to the teaching hospital environment, including confusing messages associated with large multidisciplinary teams, aspects of family-centered rounds, and confusion about medical team member roles. The third reflected caregivers’ perceptions of communication between providers in and out of the hospital, including types of communication caregivers observed or believed occurred between medical providers.

CONCLUSIONS: Participating caregivers identified various communication concerns and challenges during their child’s hospitalization and transition home. Caregiver perspectives can inform strategies to improve experiences, ease challenges inherent to a teaching hospital, and determine which types of communication are most effective. Journal of Hospital Medicine 2018;13:304-310. Published online first January 18, 2018. © 2018 Society of Hospital Medicine

P rovision of high-quality, high-value medical care hinges upon effective communication. During a hospitalization, critical information is communicated between patients, caregivers, and providers multiple times each day. This can cause inconsistent and misinterpreted messages, leaving ample room for error.1 The Joint Commission notes that communication failures occurring between medical providers account for ~60% of all sentinel or serious adverse events that result in death or harm to a patient.2 Communication that occurs between patients and/or their caregivers and medical providers is also critically important. The content and consistency of this communication is highly valued by patients and providers and can affect patient outcomes during hospitalizations and during transitions to home.3,4 Still, the multifactorial, complex nature of communication in the pediatric inpatient setting is not well understood.5,6

During hospitalization, communication happens continuously during both daytime and nighttime hours. It also precedes the particularly fragile period of transition from hospital to home. Studies have shown that nighttime communication between caregivers and medical providers (ie, nurses and physicians), as well as caregivers’ perceptions of interactions that occur between nurses and physicians, may be closely linked to that caregiver’s satisfaction and perceived quality of care.6,7 Communication that occurs between inpatient and outpatient providers is also subject to barriers (eg, limited availability for direct communication)8-12; studies have shown that patient and/or caregiver satisfaction has also been tied to perceptions of this communication.13,14 Moreover, a caregiver’s ability to understand diagnoses and adhere to postdischarge care plans is intimately tied to communication during the hospitalization and at discharge. Although many improvement efforts have

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ORIGINAL RESEARCH

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aimed to enhance communication during these vulnerable time periods, there remains much work to be done.

The many facets and routes of communication, and the multiple stakeholders involved, make improvement efforts challenging. We believe that more effective communication strategies could result from a deeper understanding of how caregivers view communication successes and challenges during a hospitalization. We see this as key to developing meaningful interventions that are directed towards improving communication and, by extension, patient satisfaction and safety. Here, we sought to extend findings from a broader qualitative study by developing an in-depth understanding of communication issues experienced by families during their child's hospitalization and during the transition to home.

METHODS

Setting
The analyses presented here emerged from the Hospital to Home Outcomes Study (H2O). The first objective of H2O was to explore the caregiver perspective on hospital-to-home transitions. Here, we present the results related to caregiver perspectives of communication, while broader results of our qualitative investigation have been published elsewhere. This objective informed the latter 2 aims of the H2O study, which were to modify an existing nurse-led transitional home visit (THV) program and to study the effectiveness of the modified THV on reutilization and patient-specific outcomes via a randomized control trial. The specifics of the H2O protocol and design have been presented elsewhere.

H2O was approved by the Institutional Review Board at Cincinnati Children's Hospital Medical Center (CCHMC), a free-standing, academic children's hospital with ~600 inpatient beds. This teaching hospital has >800 total medical students, residents, and fellows. Approximately 8000 children are hospitalized annually at CCHMC for general pediatric conditions, with ~85% of such admissions staffed by hospitalists from the Division of Hospital Medicine. The division is composed of >40 providers who devote the majority of their clinical time to the hospital medicine service; 15 additional providers work on the hospital medicine service but have primary clinical responsibilities in another division.

Family-centered rounds (FCR) are the standard of care at CCHMC, involving family members at the bedside to discuss patient care plans and diagnoses with the medical team. On a typical day, a team conducting FCR is composed of 1 attending, 1 fellow, 2 to 3 pediatric residents, 2 to 3 medical students, a charge nurse or bedside nurse, and a pharmacist. Other ancillary staff, such as social workers, care coordinators, nurse practitioners, or dieticians, may also participate on rounds, particularly for children with greater medical complexity.

Population
Caregivers of children discharged with acute medical conditions were eligible for recruitment if they were English-speaking (we did not have access to interpreter services during focus groups/interviews), had a child admitted to 1 of 3 services (hospital medicine, neurology, or neurosurgery), and could attend a focus group within 30 days of the child’s discharge. The majority of participants had a child admitted to hospital medicine; however, caregivers with a generally healthy child admitted to either neurology or neurosurgery were eligible to participate in the study.

Study Design
As presented elsewhere, we used focus groups and individual in-depth interviews to generate consensus themes about patient and caregiver experiences during the transition from hospital to home. Because there is evidence suggesting that focus group participants are more willing to talk openly when among others of similar backgrounds, we stratified the sample by demographic group.

TABLE 1. Participant Demographics

<table>
<thead>
<tr>
<th>Focus Group and Interview Participants Demographics (N=61)</th>
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</thead>
<tbody>
<tr>
<td>Gender:</td>
</tr>
<tr>
<td>Male:</td>
</tr>
<tr>
<td>Female:</td>
</tr>
<tr>
<td>Age range (years):</td>
</tr>
<tr>
<td>18-24:</td>
</tr>
<tr>
<td>25-34:</td>
</tr>
<tr>
<td>35-44:</td>
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<tr>
<td>45-54:</td>
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<tr>
<td>Marital status:</td>
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<tr>
<td>Single:</td>
</tr>
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<td>Single, living with partner:</td>
</tr>
<tr>
<td>Married:</td>
</tr>
<tr>
<td>Separated, divorced, widowed:</td>
</tr>
<tr>
<td>Race:</td>
</tr>
<tr>
<td>Black or African American:</td>
</tr>
<tr>
<td>White:</td>
</tr>
<tr>
<td>Other:</td>
</tr>
<tr>
<td>Ethnicity:</td>
</tr>
<tr>
<td>Non-Hispanic:</td>
</tr>
<tr>
<td>Hispanic:</td>
</tr>
<tr>
<td>Socioeconomic status based on census tract:</td>
</tr>
<tr>
<td>High socioeconomic status (&lt;15% below poverty level):</td>
</tr>
<tr>
<td>Low socioeconomic status (≥15% below poverty level):</td>
</tr>
<tr>
<td>Highest level of education completed:</td>
</tr>
<tr>
<td>Less than high school:</td>
</tr>
<tr>
<td>High school/GED:</td>
</tr>
<tr>
<td>2- or 4-year college:</td>
</tr>
<tr>
<td>Graduate education:</td>
</tr>
<tr>
<td>Currently enrolled in school:</td>
</tr>
<tr>
<td>Yes:</td>
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<tr>
<td>No:</td>
</tr>
<tr>
<td>Currently employed*:</td>
</tr>
<tr>
<td>No:</td>
</tr>
<tr>
<td>Full-time:</td>
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<tr>
<td>Part-time:</td>
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</tbody>
</table>

*Data missing from 2 participants.
by the family’s estimated socioeconomic status.21,22 Socioeconomic status was estimated by identifying the poverty rate in the census tract in which each participant lived. Census tracts, relatively homogeneous areas of ~4000 individuals, have been previously shown to effectively detect socioeconomic gradients.23-26 Here, we separated participants into 2 socioeconomically distinct groupings (those in census tracts where ≥15% of the population lived below the federal poverty level).26 This cut point ensured an equivalent number of eligible participants within each stratum and diversity within our sample.

### Data Collection

Caregivers were recruited on the inpatient unit during their child’s hospitalization. Participants then returned to CCHMC fa-

### TABLE 2. Major Theme 1 and Associated Subthemes

**Major Theme 1: Experiences that Affect Caregiver Perceptions of Communication between the Inpatient Medical Team and Families**

<table>
<thead>
<tr>
<th>Positive Experiences</th>
<th>Negative Experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeling like part of the team</td>
<td>Feeling left out of the loop</td>
</tr>
<tr>
<td>“I thought it was above and beyond family-centric care, like I felt like they really took me as the expert on my child and they were like, ‘What do you think?’... You know, I really felt like they actually waited for me to say ‘Yeah, he is back to normal and I don’t have, you know, a lot of concerns.’”</td>
<td>“But when they shut it [the door], it’s like you’re in there and they’re out there. And in order for me to get information you have to cross that threshold.”</td>
</tr>
<tr>
<td>“They ask you if you think they’re ready to be discharged. So, you don’t get sent home in a situation that you’re not really ready for.”</td>
<td>“I told them... I need to know what you’re talking about. Some things I understand, so I won’t ask about it, but some things that I don’t understand, I would like you to, you know, to also include me... I’m the parent... it’s important for me to know where you are getting all this information and how can it help me.”</td>
</tr>
</tbody>
</table>

### TABLE 3. Major Theme 2 and Associated Subthemes

**Major Theme 2: Communication Challenges for Caregivers Related to a Teaching Hospital Environment**

<table>
<thead>
<tr>
<th>Confusing messages with a large multidisciplinary team</th>
<th>Insufficient face time with physicians</th>
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<tbody>
<tr>
<td>“Well, on one hand like, you know the guy who did the surgery said to do this, and on the other hand they’re [the medical team] saying not to, back and forth.”</td>
<td>“...I was more frustrated. So because they [physicians] will say they’ll come back, but then they don’t come back for 24 hours and stuff like that.”</td>
</tr>
<tr>
<td>“I mean I understand it’s a teaching hospital, they [residents] have to learn, but that kind of can get frustrating as a parent. We were getting told so many different things by different people.”</td>
<td>“There was one doctor; he was really nice, but he came in [and] I was sleeping. And I actually woke up to him standing in front of me... So you’re asleep, you’re exhausted, and he’s like, ‘Hi,’ and like started talking. As soon as I opened my eyes, I’m like ‘I need more time,’ but he told me so much. And like two hours later, I could not remember anything we talked about.”</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Perceptions of family-centered rounds</th>
<th>Use of medical jargon</th>
</tr>
</thead>
<tbody>
<tr>
<td>“...They’re talking amongst themselves with you in the room. You’re trying to pick out what they’re talking about... They did ask me if I want to join a round in the room, but now I think I would round outside the room because they are confusing...that’s what happens with all the talking. Everybody talking at one time.”</td>
<td>“I think they shouldn’t assume that everybody has a strong understanding of medical terms. I think they should just forget all their training and explain it...”</td>
</tr>
<tr>
<td>“And that [FCR] we found frustrating as well because he had headaches and the light and sound bother him and all of a sudden he would have 15 doctors that were standing in your room asking questions... I mean the lights are off for a reason... he’s asleep.”</td>
<td>“If you’re not familiar with the medical field, you don’t know the terms.”</td>
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<table>
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<tr>
<th>Role confusion: who’s in charge of the team?</th>
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<tbody>
<tr>
<td>“That was my confusion is there were so many different people. Like always so many people, who is the doctor, like I don’t know.”</td>
<td>“...I basically figured out who was the chief of the whole group and I just pulled him to the side and ask him the questions to see what was going on.”</td>
</tr>
<tr>
<td>“Because there’s nobody really in charge. It’s like one big team and so like one person is not responsible. So no one takes ownership.”</td>
<td>“...So you would know who was who and they would make sure... ‘Now doctor so and so and he’s a cardiologist today and... And doctor so and so is your neurologist’ and so... the nurses kind of helped us manage the care plan which was very helpful.”</td>
</tr>
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</table>

**NOTE:** Abbreviation: FCR, family-centered rounds.
TABLE 4. Major Theme 3 and Associated Subthemes

<table>
<thead>
<tr>
<th>Major Theme 3: Caregiver Perceptions of Communication Between Medical Providers</th>
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</thead>
<tbody>
<tr>
<td>Communication between inpatient medical providers</td>
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<tr>
<td>“I guess my nurse switched in between the time at 11 o’clock or something… so the next nurse thought I was still waiting on the medicine and [child] already had the medicine and like an hour goes by and I’m like standing at the window like waiting for anyone to walk by. And somebody was like, ‘Do you need help?’ And I’m like, ‘can you send my nurse in? I think the first lady left.’”</td>
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</table>

Communication between inpatient and outpatient providers | “I wasn’t really clear on was did my primary already know what was happening, do you know what I mean?… [child] comes in, he gets even worse, he’s on a drip, he’s on all the stuff…and I’m thinking like, does he know everything that happened? Or am I going to call and be like, Well he was in the hospital for five days and on the first day…and then he had six other medicines and then now what do I do? and you know or does he already have it? That’s what I was unclear on. It’s like, am I just calling any random person and say, hey, let me get some medical advice or does he have the charts, does he have the stuff?” |
| “And because she was so little, we took her to our primary care, our normal doctor…and she read over [the discharge paperwork] so they sent over the right paperwork and the dismissals to her, so it was necessary that she was informed and it helped out a lot…” |

In addition to the major themes, the document also presents several tables and figures. The methodology section details the recruitment process, data collection methods, and analysis procedures. The paper discusses the results, focusing on caregiver experiences related to communication, where themes such as feeling like part of the team and nurses as caregivers are highlighted. The results are drawn from interviews conducted with caregivers over a period of 30 days, focusing on discharge processes and healthcare system transitions. The study was conducted at a teaching hospital and involved a multidisciplinary team, including pediatricians, nurses, and social workers. The data were analyzed using an inductive, thematic approach, and the results are presented in a structured manner, including tables and figures.
interpreters and navigators. The following 3 subthemes were characterized as negative: (1) feeling left out of the loop, (2) insufficient face time with physicians, and (3) the use of medical jargon (Table 2). More specifically, participants described feeling more satisfied with their care and the inpatient experience when they felt included and when their input and expertise as a caregiver was valued. They also appreciated how nurses often took the time after FCR or interactions with the medical team to explain and clarify information that was discussed with the patient and their caregiver. For example, 1 participant stated, “Whenever I ask about anything, I just ask the nurse. And if she didn’t know, she would find out for me…”

In contrast, some of the negative experiences shared by participants related to feeling excluded from discussions about their child’s care. One participant said, “They tell you…as much as they want to tell you. They don’t fully inform you on things.” Additionally, concerns were voiced about insufficient time for face-to-face discussions with physicians. “I forget what I have to say and it’s something really, really important…But now, my doctor is going, you can’t get the doctor back.” Finally, participants discussed how the use of medical jargon often made it more difficult to understand things, especially for those not in the medical field.

Major Theme 2: Communication Challenges for Caregivers Related to a Teaching Hospital Environment
At a large teaching institution with various trainees and multiple subspecialties, communication challenges were particularly prominent. Three subthemes were related to this theme: (1) confusing messages with a large multidisciplinary team, (2) perceptions of FCR, and (3) role confusion, or who’s in charge of the team? (Table 3). Participants described confusing and inconsistent messages arising from the involvement of many medical providers. One stated, “When [the providers] all talk it seems like it don’t make sense because [what] one [is] saying is slightly different from the other one…then you’d be like, ‘Wait, what?’ So it kind of confuses you…” Similarly, the use of FCR was overwhelming for the majority of participants who cited difficulty tracking conversations, feeling “lost” in the crowd of team members, or feeling excluded from the conversation about their child. One participant stated, “But because so many people came in, it can get overwhelming. They come in big groups, like 10 at once.” In contrast, some participants had a more favorable view of FCR: “What really blew me away was I came out of the restroom and there is 10 doctors standing around and they very well observed my child. And not only my doctor is going, you can’t get the doctor back.”

Major Theme 3: Caregiver Perceptions of Communication Between Medical Providers
Caregivers have a unique vantage point as they witness many interactions between medical providers during their child’s hospitalization. Still, they do not generally witness all the interactions between inpatient providers or between inpatient and outpatient providers. This led to variable perceptions of this communication. Specifically, the 2 subthemes described here were (1) communication between inpatient medical providers and (2) communication between inpatient and outpatient providers (Table 4). Caregivers assessed how well (or how poorly) medical providers communicated with each other based upon the consistency of messages they received or interactions they personally experienced or observed. One participant described how the medical team did not appear to be in consensus about when to discharge her child, highlighting the perception that team members did not have a shared understanding of the child’s needs: “One of the doctors was…nervous about sending him home. It was just one doctor…the other doctors on her team and everything and the nurses, they were like ‘He’s fine.’” Others shared concerns related to inadequate handoff and messages not getting passed along shift-to-shift.

Perceptions were not isolated to the inpatient setting. Based on their experiences, caregivers similarly described their sense of how inpatient and outpatient providers were communicating with each other. In some cases, it was clear that good communication, as perceived by the participant, had occurred in situations in which the primary care physician knew “everything” about the hospitalization when they saw the patient in follow-up. One participant described, “We didn’t even realize at the time, [the medical team] had actually called our doctor and filled them in on our situation, and we got [to the follow up visit]…He already knew the entire situation.” There were others, however, who shared their uncertainty about whether the information exchange about their child’s hospitalization had actually occurred. They, therefore, voiced apprehension around who to call for advice after discharge; would their outpatient provider have their child’s hospitalization history and be able to properly advise them?

DISCUSSION
Communication during a hospitalization and at transition from hospital to home happens in both formal and informal ways; it is a vital component of appropriate, effective patient care. When done poorly, it has the potential to negatively affect a patient’s safety, care, and key outcomes. During a hospitalization, the multifaceted nature of communication and multidisciplinary approach to care provision can create communication challenges and make fixing challenges difficult. In order to more comprehensively move toward mitigation, it is important to gather perspectives of key stakeholders, such as caregivers. Caregivers are an integral part of their child’s care during the hospitalization and particularly at home during their child’s recovery. They are also a valued member of the team, particularly in this era of family-centered care.19,20 The perspectives of the caregivers presented here identified both successes and chal-
Challenges of their communication experiences with the medical team during their child’s hospitalization. These perspectives included experiences affecting perceptions of communication between the inpatient medical team and families; communication related to the teaching hospital environment, including confusing messages associated with large multidisciplinary teams, aspects of FCR, and confusion about medical team member roles; and caregivers’ perceptions of communication between providers in and out of the hospital, including types of communication caregivers observed or believed occurred between medical providers. We believe that these qualitative results are crucial to developing better, more targeted interventions to improve communication.

Maintaining a healthy and productive relationship with patients and their caregivers is critical to providing comprehensive and safe patient care. As supported in the literature, we found that when caregivers were included in conversations, they felt appreciated and valued; in addition, when answers were not directly shared by providers or there were lingering questions, nurses often served as “interpreters.” Indeed, nurses were seen as a critical touchpoint for many participants, individuals that could not only answer questions but also be a trusted source of information. Supporting such a relationship, and helping enhance the relationship between the family and other team members, may be particularly important considering the degree to which a hospitalization can stress a patient, caregiver, and family. Developing rapport with families and facilitating relationships with the inclusion of nursing during FCR can be particularly helpful. Though this can be challenging with the many competing priorities of medical providers and the fast-paced, acute nature of inpatient care, making an effort to include nursing staff on rounds can cut down on confusion and assist the family in understanding care plans. This, in turn, can minimize the stress associated with hospitalization and improve the patient and family experience.

While academic institutions’ resources and access to subspecialties are often thought to be advantageous, there are other challenges inherent to providing care in such complex environments. Some caregivers cited confusion related to large teams of providers with, to them, indistinguishable roles asking redundant questions. These experiences affected their perceptions of FCR, generally leading to a fixation on its overwhelming aspects. Certain caregivers highlighted that FCR caused them, and their child, to feel overwhelmed and more confused about the plan for the day. It is important to find ways to mitigate these feelings while simultaneously continuing to support the inclusion of caregivers during their child’s hospitalization and understanding of care plans. Some initiatives (in addition to including nursing on FCR as discussed above) focus on improving the ways in which providers communicate with families during rounds and throughout the day, seeking to decrease miscommunications and medical errors while also striving for better quality of care and patient/family satisfaction. Other initiatives seek to clarify identities and roles of the often large and confusing medical team. One such example of this is the development of a face sheet tool, which provides families with medical team members’ photos and role descriptions. Unaka et al. found that the use of the face sheet tool improved the ability of caregivers to correctly identify providers and their roles. Thinking beyond interventions at the bedside, it is also important to include caregivers on higher level committees within the institution, such as on family advisory boards and/or peer support groups, to inform systems-wide interventions that support the tenants of family-centered care. Efforts such as these are worth trialing in order to improve the patient and family experience and quality of communication.

Multiple studies have evaluated the challenges with ensuring consistent and useful handoffs across the inpatient-to-outpatient transition, but few have looked at it from the perspective of the caregiver. After leaving the hospital to care for their recovering child, caregivers often feel overwhelmed; they may want, or need, to rely on the support of others in the outpatient environment. This support can be enhanced when outpatient providers are intimately aware of what occurred during the hospitalization; trust erodes if this is not the case. Given the value caregivers place on this communication occurring and occurring well, interventions supporting this communication are critical. Furthermore, as providers, we should also inform families that communication with outpatient providers is happening. Examples of efforts that have worked to improve the quality and consistency of communication with outpatient providers include improving discharge summary documentation, ensuring timely faxing of documentation to outpatient providers, and reliably making phone calls to outpatient providers. These types of interventions seek to bridge the gap between inpatient and outpatient care and facilitate a smooth transfer of information in order to provide optimal quality of care and avoid undesired outcomes (eg, emergency department revisits, readmissions, medication errors, etc) and can be adopted by institutions to address the issue of communication between inpatient and outpatient providers.

We acknowledge limitations to our study. This was done at a single academic institution with only English-speaking participants. Thus, our results may not be reflective of caregivers of children cared for in different, more ethnically or linguistically diverse settings. The patient population at CCHMC, however, is diverse both demographically and clinically, which was reflected in the composition of our focus groups and interviews. Additionally, the inclusion of participants who received a nurse home visit after discharge may limit generalizability. However, only 4 participants had a nurse home visit; thus, the overwhelming majority of participants did not receive such an intervention. We also acknowledge that those willing to participate may have differed from nonparticipants, specifically sharing more positive experiences. We believe that our sampling strategy and use of an unbiased, nonhospital affiliated moderator minimized this possibility. Recall bias is possible, as participants were asked to reflect back on a discharge experience occurring in their past. We attempted to minimize this by holding sessions no more than 30 days from the day of discharge. Finally, we present data on caregivers’ perception of communication and not directly observed communication.
occurrences. Still, we expect that perception is powerful in and of itself, relevant to both outcomes and to interventions.

**CONCLUSION**

Communication during hospitalization influences how caregivers understand diagnoses and care plans. Communication perceived as effective fosters mutual understandings and positive relationships with the potential to result in better care and improved outcomes. Communication perceived as ineffective negatively affects experiences of patients and their caregivers and can adversely affect patient outcomes. Learning from caregivers’ experiences with communication during their child’s hospitalization can help identify modifiable factors and inform strategies to improve communication, support families through hospitalization, and facilitate a smooth reentry home.

**Acknowledgments**

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**References**

Improving Teamwork and Patient Outcomes with Daily Structured Interdisciplinary Bedside Rounds: A Multimethod Evaluation

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BACKGROUND: Previous research has shown that interdisciplinary ward rounds have the potential to improve team functioning and patient outcomes.

DESIGN: A convergent parallel multimethod approach to evaluate a hospital interdisciplinary ward round intervention and ward restructure.

SETTING: An acute medical unit in a large tertiary care hospital in regional Australia.

PARTICIPANTS: Thirty-two clinicians and inpatients aged 15 years and above, with acute episode of care, discharged during the year prior and the year of the intervention.

INTERVENTION: A daily structured interdisciplinary bedside round combined with a ward restructure.

MEASUREMENTS: Qualitative measures included contextual factors and measures of change and experiences of clinicians. Quantitative measures included length of stay (LOS), monthly “calls for clinical review,” and cost of care delivery.

RESULTS: Clinicians reported improved teamwork, communication, and understanding between and within the clinical professions, and between clinicians and patients, after the intervention implementation. There was no statistically significant difference between the intervention and control wards in the change in LOS over time (Wald $\chi^2 = 1.05$; degrees of freedom [df] = 1; $P = .31$), but a statistically significant interaction for cost of stay, with a drop in cost over time, was observed in the intervention group, and an increase was observed in the control wards (Wald $\chi^2 = 6.34$; df = 1; $P = .012$). The medical wards and control wards differed significantly in how the number of monthly “calls for clinical review” changed from prestructured interdisciplinary bedside round (SiBR) to during SiBR (F (1,44) = 12.18; $P = .001$).

CONCLUSIONS: Multimethod evaluations are necessary to provide insight into the contextual factors that contribute to a successful intervention and improved clinical outcomes. Journal of Hospital Medicine 2018;13:311-317. © 2018 Society of Hospital Medicine

Evidence has emerged over the last decade of the importance of the front line patient care team in improving quality and safety of patient care.1,2 Improving collaboration and workflow is thought to increase reliability of care delivery.3 One promising method to improve collaboration is the interdisciplinary ward round (IDR), whereby medical, nursing, and allied health staff attend ward rounds together. IDRs have been shown to reduce the average cost and length of hospital stay,4,5 although a recent systematic review found inconsistent improvements across studies.6 Using the term “interdisciplinary,” however, does not necessarily imply the inclusion of all disciplines necessary for patient care. The challenge of conducting interdisciplinary rounds is considerable in today’s busy clinical environment: health professionals who are spread across multiple locations within the hospital, and who have competing hospital responsibilities and priorities, must come together at the same time and for a set period each day. A survey with respondents from Australia, the United States, and Canada found that only 65% of rounds labelled “interdisciplinary” included a physician.7

While IDRs are not new, structured IDRs involve the purposeful inclusion of all disciplinary groups relevant to a patient’s care, alongside a checklist tool to aid comprehensive but concise daily assessment of progress and treatment planning. Novel, structured IDR interventions have been tested recently in various settings, resulting in improved teamwork, hospital
performance, and patient outcomes in the US, including the Structured Interdisciplinary Bedside Round (SIBR) model.8–12

The aim of this study was to assess the impact of the new structure and the associated practice changes on interprofessional working and a set of key patient and hospital outcome measures. As part of the intervention, the hospital established an Acute Medical Unit (AMU) based on the Accountable Care Unit model.13

METHODS
Description of the Intervention
The AMU brought together 2 existing medical wards, a general medical ward and a 48-hour turnaround Medical Assessment Unit (MAU), into 1 geographical location with 26 beds. Prior to the merger, the MAU and general medical ward had separate and distinct cultures and workflows. The MAU was staffed with experienced nurses; nurses worked within a patient allocation model, the workload was shared, and relationships were collegial. In contrast, the medical ward was more typical of the remainder of the hospital: nurses had a heavy workload, managed a large group of longer-term complex patients, and they used a team-based nursing model of care in which senior nurses supervised junior staff. It was decided that because of the seniority of the MAU staff, they should be in charge of the combined AMU, and the patient allocation model of care would be used to facilitate SIBR.

Consultants, junior doctors, nurses, and allied health professionals (including a pharmacist, physiotherapist, occupational therapist, and social worker) were geographically aligned to the new ward, allowing them to participate as a team in daily structured ward rounds. Rounds are scheduled at the same time each day to enable family participation. The ward round is coordinated by a registrar or intern, with input from patient, family, nursing staff, pharmacy, allied health, and other doctors (intern, registrar, and consultant) based on the unit. The patient load is distributed between 2 rounds: 1 scheduled for 10 AM and the other for 11 AM each weekday.

Data Collection Strategy
The study was set in an AMU in a large tertiary care hospital in regional Australia and used a convergent parallel multimethod approach14 to evaluate the implementation and effect of SIBR in the AMU. The study population consisted of 32 clinicians employed at the study hospital: (1) the leadership team involved in the development and implementation of the intervention and (2) members of clinical staff who were part of the AMU team.

Qualitative Data
Qualitative measures consisted of semistructured interviews. We utilized multiple strategies to recruit interviewees, including a snowball technique, criterion sampling,15 and emergent sampling, so that we could seek the views of both the leadership team responsible for the implementation and “frontline” clinical staff whose daily work was directly affected by it. Everyone who was initially recruited agreed to be interviewed, and additional frontline staff asked to be interviewed once they realized that we were asking about how staff experienced the changes in practice.

The research team developed a semistructured interview guide based on an understanding of the merger of the 2 units as well as an understanding of changes in practice of the rounds (provided in Appendix 1). The questions were pilot tested on a separate unit and revised. Questions were structured into 5 topic areas: planning and implementation of AMU/SIBR model, changes in work practices because of the new model, team functioning, job satisfaction, and perceived impact of the new model on patients and families. All interviews were audio-recorded and transcribed verbatim for analysis.

Quantitative Data
Quantitative data were collected on patient outcome measures: length of stay (LOS), discharge date and time, mode of separation (including death), primary diagnostic category, total hospital stay cost and “clinical response calls,” and patient demographic data (age, gender, and Patient Clinical Complexity Level [PCCL]). The PCCL is a standard measure used in Australian public inpatient facilities and is calculated for each episode of care.16 It measures the cumulative effect of a patient’s complications and/or comorbidities and takes an integer value between 0 (no clinical complexity effect) and 4 (catastrophic clinical complexity effect).

Data regarding LOS, diagnosis (Australian Refined Diagnosis Related Groups [AR-DRG], version 7), discharge date, and mode of separation (including death) were obtained from the New South Wales Ministry of Health’s Health Information Exchange for patients discharged during the year prior to the intervention through 1 year after the implementation of the intervention. The total hospital stay cost for these individuals was obtained from the local Health Service Organizational Performance Management unit. Inclusion criteria were inpatients aged over 15 years experiencing acute episodes of care; patients with a primary diagnostic category of mental diseases and disorders were excluded. LOS was calculated based on ward stay. AMU data were compared with the remaining hospital ward data (the control group). Data on “clinical response calls” per month per ward were also obtained for the 12 months prior to intervention and the 12 months of the intervention.

Analysis
Qualitative Analysis
Qualitative data analysis consisted of a hybrid form of textual analysis, combining inductive and deductive logics.17,18 Initially, 3 researchers (J.P., J.J., and R.C.W.) independently coded the interview data inductively to identify themes. Discrepancies were resolved through discussion until consensus was reached. Then, to further facilitate analysis, the researchers deductively imposed a matrix categorization, consisting of 4 a priori categories: context/conditions, practices/processes, professional interactions, and consequences.19,20 Additional a priori categories were used to sort the themes further in terms of experiences prior to, during, and following implementation of the intervention. To compare changes in those different time periods, we wanted to know what themes were related to implementation and whether those themes continued to be applicable to sustainability of the changes.
Quantitative analysis. Distribution of continuous data was examined by using the one-sample Kolmogorov-Smirnov test. We compared pre-SIBR (baseline) measures using the Student t test for normally distributed data, the Mann-Whitney U z test for nonparametric data (denoted as M-W U z), and χ2 tests for categorical data. Changes in monthly “clinical response calls” between the AMU and the control wards over time were explored by using analysis of variance (ANOVA). Changes in LOS and cost of stay from the year prior to the intervention to the first year of the intervention were analyzed by using generalized linear models, which are a form of linear regression. Factors, or independent variables, included in the models were time period (before or during intervention), ward (AMU or control), an interaction term (time by ward), patient age, gender, primary diagnosis (major diagnostic categories of the AR-DRG version 7.0), and acuity (PCCL). The estimated marginal means for cost of stay for the 12-month period prior to the intervention and for the first 12 months of the intervention were produced. All statistical analyses were performed by using IBM SPSS version 21 (IBM Corp., Armonk, New York) and with alpha set at P < .05.

RESULTS
Qualitative Evaluation of the Intervention

Participants.
Three researchers (RCW, JP, and JJ) conducted in-person, semistructured interviews with 32 clinicians (9 male, 23 female) during a 3-day period. The duration of the interviews ranged from 19 minutes to 68 minutes. Participants consisted of 8 doctors, 18 nurses, 5 allied health professionals, and an administrator. Ten of the participants were involved in the leadership group that drove the planning and implementation of SIBR and the AMU.

Themes
Below, we present the most prominent themes to emerge from our analysis of the interviews. Each theme is a type of postintervention change perceived by all participants. We assigned these themes to 1 of 4 deductively imposed, theoretically driven categories (context and conditions of work, processes and practices, professional relationships, and consequences). In the context and conditions of work category, the most prominent theme was changes to the physical and cultural work environment, while in the processes and practices category, the most prominent theme was efficiency of workflow. In the professional relationships category, the most common theme was improved interprofessional communication, and in the consequences of change category, emphasis on person-centered care was the most prominent theme. Table 1 delineates the category, theme, and illustrative quotes (additional quotes are available in Supplemental Table 1 in the online version of this article).

Context and Conditions of Work
The physical and cultural work environment changed substantially with the intervention. Participants often expressed their understanding of the changes by reflecting on how things were different (for better or worse) between the AMU and places they had previously worked, or other parts of the hospital where they still worked, at the time of interview. In a positive sense, these differences primarily related to a greater level of organization and structure in the AMU. In a negative sense, some nurses perceived a loss of ownership of work and a loss of a collegial sense of belonging, which they had felt on a previous ward. Some staff also expressed concern about implementing a model that originated from another hospital and potential underresourcing. The interviews revealed that a further, unanticipated challenge for the nursing staff was to resolve an industrial relations problem: how to integrate a new rounding model without sacrificing hard-won conditions of work, such as designated and protected time for breaks (Australia has a more structured, unionized nursing workforce than in countries like the US; effort was made to synchronize SIBR with nursing breaks, but local agreements needed to be made about not taking a break in the middle of a round should the timing be delayed). However, leaders reported that by emphasizing the benefits of SIBR to the patient, they were successful in achieving greater flexibility and buy-in among staff.

Practices and Processes
Participants perceived postintervention work processes to be more efficient. A primary example was a near-universal approval of the time saved from not “chasing” other professionals now that they were predictably available on the ward. More timely decision-making was thought to result from this predicted availability and associated improvements in communication.

The SIBR enforced a workflow on all staff, who felt there was less flexibility to work autonomously (doctors) or according to patients’ needs (nurses). More junior staff expressed anxiety about delayed completion of discharge-related administrative tasks because of the midday completion of the round. Allied health professionals who had commitments in other areas of the hospital often faced a dilemma about how to prioritize SIBR attendance and activities on other wards. This was managed differently depending on the specific allied health profession and the individuals within that profession.

Professional Interactions
In terms of interprofessional dynamics on the AMU, the implementation of SIBR resulted in a shift in power between the doctors and the nurses. In the old ward, doctors largely controlled the timing of medical rounding processes. In the new AMU, doctors had to relinquish some control over the timing of personal workflow to comply with the requirements of SIBR. Furthermore, there was evidence that this had some impact on traditional hierarchical models of communication and created a more level playing field, as nonmedical professionals felt more empowered to voice their thoughts during and outside of rounds.

The rounds provided much greater visibility of the “big picture” and each profession’s role within it; this allowed each clinician to adjust their work to fit in and take account of others. The process was not instantaneous, and trust developed over
a period of weeks. Better communication meant fewer misunderstandings, and workload dropped.

The participation of allied health professionals in the round enhanced clinician interprofessional skills and knowledge. The more inclusive clinician approach facilitated greater trust between clinical disciplines and a development of increased confidence among nursing, allied health, and administrative professionals.

In contrast to the positive impacts of the new model of care on communication and relationships within the AMU, interdepartmental relationships were seen to have suffered. The processes and practices of the new AMU are different to those in the other hospital departments, resulting in some isolation of the unit and difficulties interacting with other areas of the hospital. For example, the trade-offs that allied health professionals made to participate in SIBR often came at the expense of other units or departments.

**Consequences**

All interviewees lauded the benefits of the SIBR intervention for patients. Patients were perceived to be better informed and more respected, and they benefited from greater perceived timeliness of treatment and discharge, easier access to doctors, better continuity of treatment and outcomes, improved nurse knowledge of their circumstances, and fewer gaps in their care. Clinicians spoke directly to the patient during SIBR, rather than consulting with professional colleagues over the patient’s head. Some staff felt that doctors were now thinking of patients as “people” rather than “a set of symptoms.” Nurses discovered that informed patients are easier to manage.

Staff members were prepared to compromise on their own needs in the interests of the patient. The emphasis on the patient during rounds resulted in improved advocacy behaviors.

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**TABLE 1. Category, Theme, and Illustrative Quotes**

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>THEME</th>
<th>ILLUSTRATIVE QUOTES</th>
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<tbody>
<tr>
<td>Conditions and context of work</td>
<td>Greater level of organisation and structure post-implementation</td>
<td>“I previously worked in rehab and it was a very stressful area and a lot that was - nothing was organised or structured. So it’s a big relief for me to come onto a ward where those things are available.” (Admin, Interview #23)</td>
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<td>Perceived loss of ownership and sense of belonging post-intervention</td>
<td>“We were not happy … because we’re not prepared to join them … we didn’t have prior get together or meet these people that we are going to work with.” (Nurse, Interview #17)</td>
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<td>Implementing a model from elsewhere</td>
<td>“[Emory], for instance, has two consultants on for that same number of patients. Two consultants would be great. That would make it a lot easier …” (Leader, Interview #1)</td>
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<td>Potential under resourcing post-intervention</td>
<td>“One of the logistical difficulties [is that] we weren’t set up, so we had to do ad hoc projector and whatnot. [We didn’t have] that equipment - I think because of the short timeframe … The acquisition of equipment … involves dollars and cents.” (Leader, Interview #12)</td>
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<td>Maintaining conditions of work post-intervention</td>
<td>“The other thing was lining it up with the nursing breaks, so that’s one of the big differences compared with America; we’ve got a much more structured, unionised nursing workforce, so we had to fully respect their ability to have their breaks.” (Doctor, Interview #21)</td>
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<td>Staff were accepting when changes were seen to benefit the patient</td>
<td>“[after implementation] the ward had started to get to the point where people said ‘I’ll have my break to fit in with the ward round.’” (Doctor, Interview #21).</td>
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<td>Practices and processes</td>
<td>Improved efficiency post-intervention</td>
<td>“[you spend] less time chasing people and [get] very clear directions [about the plan for the patient]!” (Doctor, Interview #29)</td>
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<td>Less flexibility and autonomy post-intervention</td>
<td>“Nothing stopped the SIBR. It was like the train.” (Nurse, Interview #19)</td>
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<td>SIBR had priority over other administrative tasks</td>
<td>“You’ve got a couple of hours. You’ve got to do the whole lot, plus do your pills, your washes and all the other work kind of thing. Sometimes still the permanent staff still have trouble getting their work done around SIBR.” (Nurse, Interview #1)</td>
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<td>Allied health professionals had to meet other hospital commitments</td>
<td>“Now I’m far less flexible because I know that I have to be here between 10:00 and 12:00 whereas before I could say well I know there’s three hours work here, I’ll come and do it in the afternoon…” (Allied Health, Interview #13)</td>
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<td>Professional interactions</td>
<td>Improved interprofessional communication post-intervention</td>
<td>“everyone is there at the same time on the same page and you get a really good chance to be heard by people from other disciplines, what your concerns are and their specialty … I think the relationship between the disciplines [now] is really, really good.” (Nurse, Interview #14)</td>
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<td>Improved interprofessional trust postintervention</td>
<td>“…it’s been great having … the pharmacist there. He’ll pick up on things that as juniors we haven’t got the knowledge or the nous to pick up on … it makes life easier.” (Doctor, Interview #8)</td>
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<td>Clinicians adjusted their work to fit in post-intervention</td>
<td>“I think it’s got advantages not necessarily for the [senior doctors] at all, that most of the advantages are in fact for the patient, the nursing staff and the junior staff. As a senior doctor you’ve got to change your notes; you’ve got to change the way you used to do business.” (Leader, Interview #21)</td>
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<td>Power shifted to a more level playing field post-intervention</td>
<td>“I think sometimes in some hospital systems you can get this is the doctors; this is the nurses, the doctor will say what happens and the nurse doesn’t question, but this is more a case of we’re all working together for the patient. It’s not just doctors and nurses, it’s allied health, it’s everyone, it’s everyone together.” (Nurse, Interview #9)</td>
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<td>Poorer interdepartmental relationships</td>
<td>“So basically it’s meant that at 7:00 in the morning, the pharmacist comes here first, and that they are committed to those two wards until 1:00, and then at 1:00 that person goes to the dispensary. Now, that’s meant elsewhere in the hospital that that slightly reduced pharmaceutical support for some other parts of the hospital.” (Doctor, Interview #23)</td>
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Continued on page 315
of clinicians. The nurses became more empowered and able to show greater initiative. Families appeared to find it much easier to access the doctors and obtain information about the patient, resulting in less distress and a greater sense of control and trust in the process.

**Quantitative Evaluation of the Intervention**

**Hospital Outcomes**

In the 12 months prior to the intervention, patients in the AMU were significantly older, more likely to be male, had greater complexity/comorbidity, and had longer LOS than the control wards ($P < .001$; see Table 2). However, there were no significant differences in cost of care at baseline ($P = .43$).

Patient demographics did not change over time within either the AMU or control wards. However, there were significant increases in Patient Clinical Complexity Level (PCCL) ratings for both the AMU (44.7% to 40.3%; $P < .005$) and the control wards (65.2% to 61.6%; $P < .001$). There was not a statistically significant shift over time in median LoS on the ward prior to (2.16 days, IQR 3.07) and during SIBR in the AMU (2.15 days; IQR 3.28), while LoS increased in the control (pre-SIBR 1.67, 2.34; during SIBR 1.73, 2.40; M-W U $z = -2.46$, $P = .014$). Mortality rates were stable across time for both the AMU (pre-SIBR 2.6% [95% confidence interval [CI], 1.9-3.5]); during SIBR 2.8% [95% CI, 2.1-3.7]) and the control (pre-SIBR 1.3% [95% CI, 1.0-1.5]; during SIBR 1.2% [95% CI, 1.0-1.4]).

The total number of “clinical response calls” or “flags” per month dropped significantly from pre-SIBR to during SIBR for the AMU from a mean of 63.1 (standard deviation 15.1) to 31.5 (10.8), but remained relatively stable in the control (pre-SIBR 72.5 [17.6]; during SIBR 74.0 [28.3]), and this difference was statistically significant ($F (1,44) = 9.03$, $P = .004$). There was no change in monthly “red flags” or “rapid response calls” over time (AMU: 10.5 [3.6] to 9.1 [4.7]; control: 40.3 [11.7] to 41.8 [10.8]). The change in total “clinical response calls” over time was attributable to the “yellow flags” or the decline in “calls for clinical review” in the AMU (from 52.6 [13.5] to 22.4 [9.2]). The average monthly “yellow flags” remained stable in the control (pre-SIBR 32.2 [11.6]; during SIBR 32.3 [22.4]). The AMU and the control wards differed significantly in how the number of monthly “calls for clinical review” changed from pre-SIBR to during SIBR ($F (1,44) = 12.18$, $P = .001$).

The 2 main outcome measures, LOS and costs, were analyzed to determine whether changes over time differed between the AMU and the control wards after accounting for age, gender, and PCCL. There was no statistically significant difference between the AMU and control wards in terms of change in LOS over time (Wald $\chi^2 = 1.05$; degrees of freedom [df] = 1; $P = .31$).

### TABLE 1. Category, Theme, and Illustrative Quotes (continued)

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<tr>
<th>CATEGORY</th>
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<th>ILLUSTRATIVE QUOTES</th>
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<tr>
<td>Consequences</td>
<td>Patients perceived to be better informed and more respected</td>
<td>“The patients also tell you they’re not getting mixed messages. The junior coming and telling them one thing. Then the consultant coming in, in the evening, and telling them something totally different.” (Leader, Interview #1)</td>
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<td>Patients perceived to benefit from greater perceived timeliness of treatment and discharge</td>
<td>“From a patient flow and a bed management point of view, yes, we have seen a decreased length of stay of the patients in the acute medical ward.” (Leader, Interview #12)</td>
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<td>Patients perceived to have better continuity of treatment and outcomes</td>
<td>“It’s amazing how many [allied health] referrals I pick up just by being there and listening to what the doctors are saying … it’s really good because we’re not missing out on the people that would – that we probably would normally have fallen through the gaps” (Allied Health, Interview #16)</td>
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<td>Improved nurse knowledge of patients’ circumstances, fewer gaps in care</td>
<td>“You actually get to communicate with the doctor and the patient at the same time, so you’re involving the patient, which helps. Because sometimes the patient won’t tell the nurse something but will tell the doctor something or vice versa, whereas with the whole team there, everyone hears everything about the patient.” (Nurse, Interview #30)</td>
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<td></td>
<td>Patients were ‘humanised’</td>
<td>“From the point of view of the doctors the issue of how the doctors relate to the patients is very important now; they’re no longer a set of a symptoms in a bed, it’s Mr Smith and it’s all very personalised.” (Nurse, Interview #34)</td>
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<td>Informed patients are less work</td>
<td>“Because they know what’s going on, they don’t ring the bell as often … if you go to another medical ward you would never hear the bell stop, it would just go all day, all day, all day. Here it’s quiet for an hour sometimes.” (Nurse, Interview #14)</td>
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<tr>
<td></td>
<td>Staff members prepared to compromise on own needs for the patient</td>
<td>“So in terms of lunch breaks and morning tea breaks, they’ve definitely suffered, they’ve gone down to non-existent, which is something I’m still happy to do because at the end of the day you’re here for the patients and you can see the benefits that it does have.” (Allied Health, Interview #2)</td>
</tr>
<tr>
<td></td>
<td>Improved advocacy behaviours of clinicians</td>
<td>“I get to be much more of an advocate, because I get the opportunity to bring up concerns in front of a team who have the abilities to make changes …” (Nurse, Interview #14)</td>
</tr>
<tr>
<td></td>
<td>Nurses more empowered</td>
<td>“They’re not just giving Clexane because they’re reading up on the medication now. They’re actually saying to the patient ‘I’m giving you Clexane because this is going to help prevent you from developing any blood clots or anything until you’re more mobile and that. It’s also saying in that report they’re not very mobile. They’re not on a DVT prophylaxis, should they be?” (Leader, Interview #31)</td>
</tr>
<tr>
<td></td>
<td>Easier access to doctors for patients’ family members</td>
<td>“I think families loved it … They knew when the doctors and teams were going to be around, they knew they could find out in plain English what was going to happen, and they knew they had a plan, even if it’s ‘we don’t know’.” (Doctor, Interview #20)</td>
</tr>
</tbody>
</table>
There was a statistically significant interaction for cost of stay, indicating that ward types differed in how they changed over time (with a drop in cost over time observed in the AMU and an increase observed in the control) (Wald $\chi^2 = 6.34; df = 1; P = .012$).

**DISCUSSION**

We report on the implementation of an AMU model of care, including the reorganization of a nursing unit, implementation of IDR, and geographical localization. Our study design allowed a more comprehensive assessment of the implementation of system redesign to include provider perceptions and clinical outcomes.

The 2 very different cultures of the old wards that were combined into the AMU, as well as the fact that the teams had not previously worked together, made the merger of the 2 wards difficult. Historically, the 2 teams had worked in very different ways, and this created barriers to implementation. The SIBR also demanded new ways of working closely with other disciplines, which disrupted older clinical cultures and relationships. While organizational culture is often discussed, and even measured, the full impact of cultural factors when making workplace changes is frequently underestimated. The development of a new culture takes time, and it can lag organizational structural changes by months or even years. As our interviewees expressed, often emotionally, there was a sense of loss during the merger of the 2 units. While this is a potential consequence of any large organizational change, it could be addressed during the planning stages, prior to implementation, by acknowledging and perhaps honoring what is being left behind. It is safe to assume that future units implementing the rounding intervention will not fully realize commensurate levels of culture change until well after the structural and process changes are finalized, and only then if explicit effort is made to engender cultural change.

Overall, however, the interviewees perceived that the SIBR intervention led to improved teamwork and team functioning. These improvements were thought to benefit task performance and patient safety. Our study is consistent with other research in the literature that reported that greater staff empowerment and commitment is associated with interdisciplin ary patient care interventions in front line caregiving teams.

The perception of a more equal nurse-physician relationship resulted in improved job satisfaction, better interprofessional relationships, and perceived improvements in patient care. A flatter power gradient across professions and increased interdisciplinary teamwork has been shown to be associated with improved patient outcomes.

Changes to clinician workflow can significantly impact the introduction of new models of care. A mandated time each day for structured rounds meant less flexibility in workflow for clinicians and made greater demands on their time management and communication skills. Furthermore, the need for human resource negotiations with nurse representatives was an unexpected component of successfully introducing the changes to workflow. Once the benefits of saved time and better communication became evident, changes to workflow were generally accepted. These challenges can be managed if stakeholders are engaged and supportive of the changes.

Finally, our findings emphasize the importance of combining qualitative and quantitative data when evaluating an intervention. In this case, the qualitative outcomes that include “intangible” positive effects, such as cultural change and improved staff understanding of one another’s roles, might encourage us to continue with the SIBR intervention, which would allow more time to see if the trend of reduced LOS identified in the statistical analysis would translate to a significant effect over time.
We are unable to identify which aspects of the intervention led to the greatest impact on our outcomes. A recent study found that interdisciplinary rounds had no impact on patients’ perceptions of shared decision-making or care satisfaction. Although our findings indicated many potential benefits for patients, we were not able to interview patients or their carers to confirm these findings. In addition, we do not have any patient-centered outcomes, which would be important to consider in future work. Although our data on clinical response calls might be seen as a proxy for adverse events, we do not have data on adverse events or errors, and these are important to consider in future work. Finally, our findings are based on data from a single institution.

CONCLUSIONS

While there were some criticisms, participants expressed overwhelmingly positive reactions to the SIBR. The biggest reported benefit was perceived improved communication and understanding between and within the clinical professions, and between clinicians and patients. Improved communication was perceived to have fostered improved teamwork and team functioning, with most respondents feeling that they were a valued part of the new team. Improved teamwork was thought to contribute to improved task performance and led interviewees to perceive a higher level of patient safety. This research highlights the need for multimethod evaluations that address contextual factors as well as clinical outcomes.

Acknowledgments

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Disclosures: None of the authors had conflicts of interest in relation to the conduct or reporting of this study, with the exception that the lead author’s institution, the Australian Institute of Health Innovation, received a small grant from the New South Wales Clinical Excellence Commission to conduct the work. Ethics approval for the research was granted by the Greater Western Area Health Service Human Research Ethics Committee (HREC/13/GWAHS/22). All interviewees consented to participate in the study. For patient data, consent was not obtained, but presented data are anonymized. The full dataset is available from the corresponding author with restrictions. This research was funded by the NSW Clinical Excellence Commission, which also encouraged submission of the article for publication. The funding source did not have any role in conduct or reporting of the study. R.C.W., J.P., and J.J. conceptualized and conducted the qualitative component of the study, including method, data collection, data analysis, and writing of the manuscript. G.L., C.H., and H.D. conceptualized the quantitative component of the study, including method, data collection, data analysis, and writing of the manuscript. G.S. contributed to conceptualization of the study, and significantly contributed to the revision of the manuscript. All authors, external and internal, had full access to all of the data (including statistical reports and tables) in the study and can take responsibility for the integrity of the data and the accuracy of the data analysis. As the lead author, R.C.W. affirms that the manuscript is an honest, accurate, and transparent account of the study being reported, that no important aspects of the study have been omitted, and that any discrepancies from the study as planned have been explained.

References

Hospitalist Perspective of Interactions with Medicine Subspecialty Consult Services

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BACKGROUND: Medicine subspecialty consultation is becoming increasingly important in inpatient medicine.

OBJECTIVE: We conducted a survey study in which we examined hospitalist practices and attitudes regarding medicine subspecialty consultation.

DESIGN AND SETTING: The survey instrument was developed by the authors based on prior literature and administered online anonymously to hospitalists at 4 academic medical centers in the United States.

MEASUREMENTS: The survey evaluated 4 domains: (1) current consultation practices, (2) preferences regarding consultation, (3) barriers to and facilitating factors of effective consultation, and (4) a comparison between hospitalist–fellow and hospitalist–subspecialty attending interactions.

RESULTS: One hundred twenty-two of 261 hospitalists (46.7%) responded. The majority of hospitalists interacted with fellows during consultation. Of those, 90.9% reported that in-person communication occurred during less than half of consultations, and 64.4% perceived pushback at least “sometimes” in their consult interactions. Participants viewed consultation as an important learning experience, preferred direct communication with the consulting service, and were interested in more teaching during consultation. The survey identified a number of barriers to and facilitating factors of an effective hospitalist–consultant interaction, which impacted both hospitalist learning and patient care. Hospitalists reported more positive experiences when interacting with subspecialty attendings compared to fellows with regard to multiple aspects of the consultation.

CONCLUSION: The hospitalist–consultant interaction is viewed as important for both hospitalist learning and patient care. Multiple barriers and facilitating factors impact the interaction, many of which are amenable to intervention. Journal of Hospital Medicine 2018;13:318-323. Published online first November 22, 2017. ©2018 Society of Hospital Medicine.

Hospitalist physicians care for an increasing proportion of general medicine inpatients and request a significant share of all subspecialty consultations.1 Subspecialty consultation in inpatient care is increasing,2,3 and effective hospitalist–consulting service interactions may affect team communication, patient care, and hospitalist learning. Therefore, enhancing hospitalist–consulting service interactions may have a broad-reaching, positive impact. Researchers in previous studies have explored resident–fellow consult interactions in the inpatient and emergency department settings as well as attending-to-attending consultation in the outpatient setting.4,5 However, to our knowledge, hospitalist–consulting team interactions have not been previously described. In academic medical centers, hospitalists are attending physicians who interact with both fellows (supervised by attending consultants) and directly with subspecialty attendings. Therefore, the exploration of the hospitalist–consultant interaction requires an evaluation of hospitalist–fellow and hospitalist–subspecialty attending interactions. The hospitalist–fellow interaction in particular is unique because it represents an unusual dynamic, in which an attending physician is primarily communicating with a trainee when requesting assistance with patient care.6 In order to explore hospitalist–consultant interactions (herein, the term “consultant” includes both fellow and attending consultants), we conducted a survey study in which we examine hospitalist practices and attitudes regarding consultation, with a specific focus on hospitalist consultation with internal medicine subspecialty consult services. In addition, we compared fellow–hospitalist and attending–
hospitalist interactions and explored barriers to and facilitating factors of an effective hospitalist–consultant relationship.

METHODS
Survey Development
The survey instrument was developed by the authors based on findings of prior studies in which researchers examined consultation. The survey contained 31 questions (supplementary Appendix A) and evaluated 4 domains of the use of medical subspecialty consultation in direct patient care: (1) current consultation practices, (2) preferences regarding consultants, (3) barriers to and facilitating factors of effective consultation (both with respect to hospitalist learning and patient care), and (4) a comparison between hospitalist–fellow and hospitalist–subspecialty attending interactions. An evaluation of current consultation practices included a focus on communication methods (eg, in person, over the phone, through paging, or notes) because these have been found to be important during consultation. In order to explore hospitalist preferences regarding consult interactions and investigate perceptions of barriers to and facilitating factors of effective consultation, questions were developed based on previous literature, including our qualitative work examining resident–fellow interactions during consultation. We compared hospitalist consultation experiences among attending and fellow consultants because the interaction in which an attending hospitalist physician is primarily communicating with a trainee may differ from a consultation between a hospitalist attending and a subspecialty attending. Participants were asked to exclude their experiences when working on teaching services, during which students or housestaff often interact with consultants. The survey was cognitively tested with both hospitalist and non-hospitalist attending physicians not participating in the study and was revised by the authors using an iterative approach.

Study Participants
Hospitalist attending physicians at University of Texas Southwestern (UTSW) Medical Center, Emory University School of Medicine, Massachusetts General Hospital (MGH), and the Medical University of South Carolina (MUSC) were eligible to participate in the study. Consult team structures at each institution were composed of either a subspecialist-attending-only or a fellow-and-subspecialty-attending team. Fellows at all institutions are supervised by a subspecialty attending when performing consultations. Respondents who self-identified as nurse practitioners or physician assistants were excluded from the analysis. Hospitalists employed by the Veterans Affairs hospital system were also excluded. The study was approved by the institutional review boards of UTSW, Emory, MUSC, and MGH.

The survey was anonymous and administered to all hospitalists at participating institutions via a web-based survey tool (Qualtrics, Provo, UT). Participants were eligible to enter a raffle for a $500 gift card, and completion of the survey was not required for entry into the raffle.

TABLE 1. Participant Baseline Data

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>63 (51.6)</td>
</tr>
<tr>
<td>Female</td>
<td>59 (48.4)</td>
</tr>
<tr>
<td>Age (mean +/- SD)</td>
<td>37.7 +/- 7.9</td>
</tr>
<tr>
<td>Primary practice site</td>
<td></td>
</tr>
<tr>
<td>Academic medical center</td>
<td>105 (86.1)</td>
</tr>
<tr>
<td>Community non-teaching hospital</td>
<td>2 (1.6)</td>
</tr>
<tr>
<td>Community teaching hospital</td>
<td>14 (11.5)</td>
</tr>
<tr>
<td>Years worked as a hospitalist (mean +/- SD)</td>
<td>5.6 +/- 5.0</td>
</tr>
<tr>
<td>Years worked in current institution (mean +/- SD)</td>
<td>3.6 +/- 2.9</td>
</tr>
<tr>
<td>Percentage of daytime shifts (mean +/- SD)</td>
<td>74.1 +/- 35.1</td>
</tr>
<tr>
<td>Percentage of time on teaching services (mean +/- SD)</td>
<td>19.2 +/- 25.1</td>
</tr>
<tr>
<td>Percentage of time on direct patient care (mean +/- SD)</td>
<td>70.5 +/- 34.0</td>
</tr>
<tr>
<td>Use of consult services over time</td>
<td></td>
</tr>
<tr>
<td>Increased a lot</td>
<td>9 (7.4)</td>
</tr>
<tr>
<td>Increased a little</td>
<td>38 (31.1)</td>
</tr>
<tr>
<td>No change</td>
<td>38 (31.1)</td>
</tr>
<tr>
<td>Decreased a little</td>
<td>20 (16.0)</td>
</tr>
<tr>
<td>Decreased a lot</td>
<td>7 (5.7)</td>
</tr>
<tr>
<td>Total consults per shift</td>
<td></td>
</tr>
<tr>
<td>0-1</td>
<td>48 (39.3)</td>
</tr>
<tr>
<td>2-3</td>
<td>62 (50.8)</td>
</tr>
<tr>
<td>4-5</td>
<td>8 (6.6)</td>
</tr>
<tr>
<td>&gt;5</td>
<td>2 (1.6)</td>
</tr>
<tr>
<td>Medical subspecialty consults per shift (mean +/- SD)</td>
<td>2.9 +/- 2.4</td>
</tr>
<tr>
<td>Most common reason for requesting consultation</td>
<td></td>
</tr>
<tr>
<td>Assistance with diagnosis</td>
<td>26 (21.3)</td>
</tr>
<tr>
<td>Assistance with treatment</td>
<td>49 (40.2)</td>
</tr>
<tr>
<td>Request a procedure</td>
<td>22 (18.0)</td>
</tr>
<tr>
<td>Patient request</td>
<td>4 (3.3)</td>
</tr>
<tr>
<td>Discharge planning</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

Statistics
Results were summarized using the mean with standard deviation for continuous variables and the frequency with percentage for categorical variables after excluding missing values. All analyses were conducted using SAS version 9.4 (SAS Institute, Cary, NC). A 2-sided P value of ≤0.05 was considered statistically significant.

RESULTS
Of a possible 261 respondents, 122 (46.7%) participated in the survey. Missing values for survey responses ranged from 0% to 21.3%, with a mean of 15.2%. Demographic characteristics are shown in Table 1. Respondents had a mean age of 37.7 years and had worked as attending hospitalists for an average of 5.6 years. The majority of respondents (86.1%) practiced in aca-
demic medical centers, with the remaining working in satellite community hospitals. Respondents reported working daytime shifts 74.1% of the time on average and being on inpatient, direct-care services without house-staff 70.5% of the time.

Current Consultation Practices
Current consultation practices and descriptions of hospitalist–consultant communication are shown in Table 2. Forty percent of respondents requested 0-1 consults per day, while 51.7% requested 2-3 per day. The most common reasons for requesting a consultation were assistance with treatment (48.5%), assistance with diagnosis (25.7%), and request for a procedure (21.8%). When asked whether the frequency of consultation is changing, slightly more hospitalists felt that their personal use of consultation was increasing as compared to those who felt that it was decreasing (38.5% vs 30.3%, respectively).

An exploration of communication practices during consultation revealed that hospitalists most often interacted with fellows rather than attending physicians (81.4%). However, even when a fellow performs a consult and communicates with a hospitalist, a subspecialty attending is involved in the care of the patient, although he or she may not communicate directly with the hospitalist. Respondents indicated that they most often communicated a consult request to the consultant by phone (76.2%). Pushback from consultants (defined as perceived reluctance or resistance to perform the consult for any reason) was perceived as common, with 64.4% of hospitalists indicating that they experience pushback at least “sometimes” (3 on a 5-point Likert scale) and 22.1% reporting that pushback was “frequent” or occurred “most of the time”. Follow-up interactions (defined as communication of recommendations after the consultant evaluated the patient) infrequently occurred through in-person communication, with 90.9% reporting that this occurred in less than half of consultations. Communication by phone was most common, with 61.2% reporting that it occurred at least half the time, and 86% of respondents reported that communication by paging only occurred at least “sometimes”. Consultation was commonly seen as a valuable educational experience, with 56.9% of hospitalists indicating that they learned from at least half of consultations.

Hospitalist Preferences
Eighty-six percent of respondents agreed that consultants should be required to communicate their recommendations either in person or over the phone. Eighty-three percent of hospitalists agreed that they would like to receive more teaching from the consulting services, and 74.0% agreed that consultants should attempt to teach hospitalists during consult interactions regardless of whether the hospitalist initiates the teaching–learning interaction.

Barriers to and Facilitating Factors of Effective Consultation
Participants reported that multiple factors affected patient care and their own learning during inpatient consultation (Figure 1). Consultant pushback, high hospitalist clinical workload, a perception that consultants had limited time, and minimal in-person interactions were all seen as factors that negatively affected the consult interaction. These generally affected both learning and patient care. Conversely, working on an interesting clinical case, more hospitalist free time, positive interaction with the consultant, and having previously worked with the consultant positively affected both learning and patient care (Figure 1).

Fellow Versus Attending Interactions
Respondents indicated that interacting directly with the consultant attending was superior to hospitalist–fellow interactions in all aspects of care but particularly with respect to pushback, confidence in recommendations, professionalism, and hospitalist learning (Figure 2).

DISCUSSION
To our knowledge, this is the first study to describe hospitalist attending practices, attitudes, and perceptions of internal medicine subspecialty consultation. Our findings, which focus
on the interaction between hospitalists and internal medicine subspecialty attendings and fellows, outline the hospitalist perspective on consultant interactions and identify a number of factors that are amenable to intervention. We found that hospitalists perceive the consult interaction to be important for patient care and a valuable opportunity for their own learning. In-person communication was seen as an important component of effective consultation but was reported to occur in a minority of consultations. We demonstrate that hospitalist–subspecialty attending consult interactions are perceived more positively than hospitalist–fellow interactions. Finally, we describe barriers and facilitating factors that may inform future interventions targeting this important interaction.

Effective communication between consultants and the primary team is critical for both patient care and teaching interactions.4-7 Pushback on consultation was reported to be the most significant barrier to hospitalist learning and had a major impact on patient care. Because hospitalists are attending physicians, we hypothesized that they may perceive pushback from fellows less frequently than residents.4 However, in our study, hospitalists reported pushback to be relatively frequent in their daily practice. Moreover, hospitalists reported a strong preference for in-person interactions with consultants, but our study demonstrated that such interactions are relatively infrequent.

Researchers in studies of resident–fellow consult interactions have noted similar findings, suggesting that hospitalists and internal medicine residents face similar challenges during consultation.4-6 Hospitalists reported that positive interpersonal interactions and personal familiarity with the consultant positively affected the consult interaction. Most importantly, these effects were perceived to affect both hospitalist learning and patient care, suggesting the importance of interpersonal interactions in consultative medicine.

In an era of increasing clinical workload, the consult interaction represents an important workplace-based learning opportunity.4 Centered on a consult question, the hospitalist–consultant interaction embodies a teachable moment and can be an efficient opportunity to learn because both parties are familiar with the patient. Indeed, survey respondents reported that they frequently learned from consultation, and there was a strong preference for more teaching from consultants in this setting. However, the hospitalist–fellow consult interaction is unique because attending hospitalists are frequently communicating with fellow trainees, which could limit fellows’ confidence in their role as teachers and hospitalists’ perception of their role as learners. Our study identifies a number of barriers and facilitating factors (including communication, pushback, familiarity, and clinical workload) that affect the hospitalist–consultant teaching interaction and may be amenable to intervention.

FIG 1. Barriers to and facilitating factors of patient care and hospitalist learning.
Hospitalists expressed a consistent preference for interacting with attending subspecialists compared to clinical fellows during consultation. Preference for interaction with attendings was strongest in the areas of pushback, confidence in recommendations, professionalism, and learning from consultation. Some of the factors that relate to consult service structure and fellow experience, such as timeliness of consultation and confidence in recommendations, may not be amenable to intervention. For instance, fellows must first see and then staff the consult with their attending prior to leaving formal recommendations, which makes their communication less timely than that of attending physicians, when they are the primary consultant. However, aspects of the hospitalist–consultant interaction (such as professionalism, ease of communication, and pushback) should not be affected by the difference in experience between fellows and attending physicians. The reasons for such perceptions deserve further exploration; however, differences in incentive structures, workload, and communication skills between fellows and attending consultants may be potential explanations.

Our findings suggest that interventions aimed at enhancing hospitalist–consultant interactions focus on enhancing direct communication and teaching while limiting the perception of pushback. A number of interventions that are primarily focused on instituting a systematic approach to requesting consultation have shown an improvement in resident and medical student consult communication\textsuperscript{17,18} as well as resident–fellow teaching interactions.\textsuperscript{9} However, it is not clear whether these interventions would be effective given that hospitalists have more experience communicating with consultants than trainees. Given the unique nature of the hospitalist–consultant interaction, multiple barriers may need to be addressed in order to have a significant impact. Efforts to increase direct communication, such as a mechanism for hospitalists to make and request in-person or direct verbal communication about a particular consultation during the consult request, can help consultants prioritize direct communication with hospitalists for specific patients. Familiarizing fellows with hospitalist workflow and the locations of hospitalist workrooms also may promote in-person communication. Fellowship training can focus on enhancing fellow teaching and communication skills,\textsuperscript{19-22} particularly as they relate to hospitalists. Fellows in particular may benefit because the hospitalist–fellow teaching interaction may be bidirectional, with hospitalists having expertise in systems practice and quality efforts that can inform fellows’ practice. Furthermore, interacting with hospitalists is an opportunity for fellows to practice professional interactions, which will be critical to their careers. Increasing familiarity between fellows and hospitalists through joint events may also serve to enhance the interaction. Finally, enabling hospitalists to provide feedback to fellows stands to benefit both parties because multisource
feedback is an important tool in assessing trainee competence and improving performance. However, we should note that because our study focused on hospitalist perceptions, an exploration of subspecialty fellows’ and attendings’ perceptions of the hospitalist–consultant interaction would provide additional, important data for shaping interventions.

Strengths of our study include the inclusion of multiple study sites, which may increase generalizability; however, our study has several limitations. The incomplete response rate reduces both generalizability and statistical power and may have created selection or nonresponder bias. However, low response rates occur commonly when surveying medical professionals, and our results are consistent with many prior hospitalist survey studies. Further, we conducted our study at a single time point; therefore, we could not evaluate the effect of fellow experience on hospitalist perceptions. However, we conducted our study in the second half of the academic year, when fellows had already gained considerable experience in the consultation setting. We did not capture participants’ institutional affiliations; therefore, a subgroup analysis by institution could not be performed. Additionally, our study reflects hospitalist perception rather than objectively measured communication practices between hospitalists and consultants, and it does not include the perspective of subspecialists. The specific needs of nurse practitioners and physicians’ assistants, who were excluded from this study, should also be evaluated in future research. Lastly, this is a hypothesis-generating study and should be replicated in a national cohort.

CONCLUSION

The hospitalists represented in our sample population perceived the consult interaction to be important for patient care and a valuable opportunity for their own learning. Participants expressed that they would like to increase direct communication with consultants and enhance consultant–hospitalist teaching interactions. Multiple barriers to effective hospitalist–consultant interactions (including communication, pushback, and hospitalist–consultant familiarity) are amenable to intervention.

Disclosure: The authors have no financial disclosures or conflicts of interest.

References

Portal vein thrombosis (PVT) is thought to be rare in the general population and is most commonly found among patients with cirrhosis. The risk of developing PVT in patients with cirrhosis has been correlated with the severity of hepatic impairment. There is a lack of national-level data on the epidemiology of PVT and its related outcomes in the inpatient setting. The aim of our study was to describe the prevalence of PVT in hospitalized patients with cirrhosis in the United States. Using the National Inpatient Sample (NIS) database, we described the differences in hepatic decompensation, length of stay, in-hospital mortality, and total charges between patients with cirrhosis with PVT and those without.

METHODS
This study was performed using the 2012 NIS to assess the relationship between PVT and cirrhosis-related outcomes. The NIS has been used reliably to make national estimates of healthcare utilization and estimate disease burden, charges, and outcomes. All admissions with either a primary or secondary discharge diagnosis of an International Classification of Diseases, 9th Revision–Clinical Modification (ICD-9-CM) code for PVT (452) and cirrhosis (571.2, 571.5, and 571.6) were identified from the NIS and correlated with age, gender, inpatient length of stay, in-hospital mortality, total charges, and commonly associated diagnoses. Complications of cirrhosis, such as hepatic encephalopathy (572.2), abdominal ascites (789.5), and gastrointestinal bleeding (456 and 456.2), were also identified. Data were assessed using IBM Statistical Package for the Social Sciences Statistics version 19.0 (Chicago, IL). Statistical significance was defined as a P value < .05.

RESULTS
There were 7,296,968 total unweighted admissions in the 2012 NIS, which included 113,766 (1.6%) inpatient admissions for cirrhosis, with 61,867 for nonalcoholic cirrhosis, 49,698 for alcoholic cirrhosis, and 2202 for biliary cirrhosis. The prevalence of PVT among all inpatient admissions was 0.07% (n = 5046) and 1.8% (n = 2046) in patients with cirrhosis (P < .001). On univariate analysis, patients who had a diagnosis of both cirrhosis and PVT had higher proportions of hepatic encephalopathy (22.5% vs 17.7%; P < .00001) as well as gastrointestinal bleeding (11.6% vs 5.7%; P < .00001) as compared with patients with cirrhosis without PVT (Figure). Furthermore, patients with both cirrhosis and PVT incurred a greater average length of stay than did patients with cirrhosis and no PVT (7.7 vs 5.9 days, respectively; P < .05) and in-hospital mortality (9.5 vs 6%, respectively; P < .05). The median cost of an admission of a patient with cirrhosis and PVT was $39,934 as compared to $28,040 for an admission of a patient with cirrhosis without PVT (P < .05).

DISCUSSION
We found that hospitalized patients with concurrent diagnoses of cirrhosis and PVT had longer hospital length of stay, higher mean hospital charges, and a higher proportion of cirrhosis-related complications. Our study represents the largest examination of hospitalized patients with cirrhosis and PVT to date and contributes to the evolving understanding of PVT in end-
stage liver disease. The relationship between cirrhotic complications and PVT may be independent, but the 2 have similar underlying etiologic processes. Thus, given our findings, intervening to address the underlying factors leading to microvascular and/or PVT or mitigating the propagation of PVT in patients with cirrhosis may be beneficial to reducing morbidity and mortality in these patients. In addition, the prevalence of PVT in the overall hospitalized patient population in our study (0.07%) was similar to the 0.05% to 0.5% previously described in a US autopsy series, which should decrease the likelihood that PVT was missed in the cirrhotic population, which is more likely to have inpatient ultrasound imaging. Our study is limited by its retrospective nature, dependency on ICD-9-CM codes for extracting data, and lack of clinical, physical exam, and laboratory results to allow for the calculation of a model for the end-stage liver disease and Child-Pugh score. Also, the study was not designed to evaluate causation, and it is possible that patients with more severe cirrhosis were more likely to be diagnosed with PVT. Further prospective studies directed not only toward the mechanism and treatment of both micro- and macrovascular thrombosis but also at examining the prevention of PVT and attendant benefits are greatly needed.

Disclosures: The authors have nothing to disclose. The contents of this work do not represent the views of the Department of Veterans Affairs or the United States Government.

References
A proposed metric to quantify the impact of an antimicrobial stewardship program (ASP) is using changes in the antibiotic days of therapy (DOT) per 1000 patient-days, which is the total number of days any dose of an antibiotic is administered during a specified time period, standardized by the number of patient-days. Although DOT is useful for comparing antibiotic use among hospitals or time periods, this metric is a composite result of an ASP’s often multifaceted approach to improving antibiotic use. Thus, DOT provides a loose estimate of the direct impact of specific ASP activities and does not quantify the amount of antibiotics directly avoided or direct cost savings on the patient level. To ameliorate this, we reviewed our institution’s ASP prospective audit and feedback (PAF) and applied a novel metric, days of therapy avoided (DOTA), to calculate the number of antibiotic days avoided that directly result from our ASP’s actions targeting antibiotic stoppage. From DOTA, we also calculate attributable cost savings.

METHODS

As approved by the institutional review board, this was a retrospective chart review of electronic records performed at Rochester General Hospital (RGH) in Rochester, New York, a 528-bed, acute-care, community teaching hospital. The RGH ASP began in 2012 with 1 infectious diseases physician and 2 infectious diseases pharmacists, who conducted daily verbal and/or written PAF progress notes within the electronic medical record. In 2013, the ASP team developed a database to document PAF activities. The variables and definitions used are summarized in the Table. When no planned length of therapy (LOT) was documented, an LOT range (based on national guidelines or, when unavailable, local practices) for the documented infection was assumed. This database was used to collect records on patients who received written ASP recommendations for no infection (NI) or therapy complete (TC; Table) antibiotic stoppage between January 2013 and December 2016. Only written and accepted interventions (changes occurring within 48 hours of the ASP note) were included in the data set.

To quantify the direct impact of PAF, DOTA (Table) was calculated. Antibiotic costs avoided were calculated by multiplying the average wholesale price (AWP) per day (range: $0.44-$534; mean: $67.85) by DOTA. This calculation was done twice under 2 assumptions: that PAF led to the prevention of (1) 1 more day of antibiotic prescription and (2) the remainder of the documented or assumed LOT.

RESULTS

Over 4 years, the ASP made 1594 interventions to stop antibiotics. Accepted interventions totaled 1151 (72%): 513 (44.5%) for NI and 638 (55.4%) for TC, involving 431 and 575 unique patients, respectively. Nearly half (45.8%) of the NI interventions targeted asymptomatic bacteriuria, whereas respiratory tract infections were the most common (42.2%) indication for the TC intervention.

Under the most conservative assumption that each accepted PAF recommendation avoided 1 day of unnecessary antibiotics, we estimated a total of 1151 DOTA; 690 (59.9%) were intravenous antibiotics. The average DOT on which the PAF note was written was 3.07 ± 1.69 for NI and 6.38 ± 2.73 for TC. A planned LOT was documented for only 36.7% of the courses. On the basis of documented or assumed LOT, we estimate that the NI and TC interventions led to between 1077 and 2826 DOTA and between 397 and 1598 DOTA, respectively. Potential fluoroquinolone DOTA ranged from 300 to 1126; for third- and fourth-generation cephalosporins, there were 314 to 1017 DOTA.

Using the conservative estimate of 1151 DOTA, the costs avoided totaled $16,700, which includes $10,700 for intravenous antibiotics. When the AWP per day of each antibiotic was applied to the remaining LOTs avoided, the maximum potential cost savings was $67,100. Additional cost savings may have been realized if indirect expenses, such as pharmacy preparation and nursing administration time or costs of medical supplies, were evaluated.

CONCLUSION

We investigated DOTA as a measure of the direct patient-level and intervention-specific impact of an ASP’s PAF. DOTA may be useful for ASPs with limited access to an electronic record or electronically generated DOT reports because DOTA and
The limitations of measuring DOTA include time consumption, particularly if not collected prospectively. However, we make several conclusions. ASP PAF stopping antibiotics was well accepted and reduced antibiotic use. Second, calculating DOTA requires little technology and only knowledge of the planned LOT and drug costs. DOTA also identifies which infectious indications to focus PAF efforts on and gain the greatest impact. Overall, DOTA is a simple, useful, and promising measurement of the direct antibiotic and economic impacts of specific ASP PAF and warrants further investigation as an ASP metric.

Acknowledgments
The authors thank the patients and RGH staff, particularly the departments of infectious diseases, pharmacy, and internal medicine, for their support.

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References
When are Oral Antibiotics a Safe and Effective Choice for Bacterial Bloodstream Infections? An Evidence-Based Narrative Review

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Bacterial bloodstream infections (BSIs) are a major cause of morbidity and mortality in the United States. Traditionally, BSIs have been managed with intravenous antimicrobials. However, whether intravenous antimicrobials are necessary for the entirety of the treatment course in BSIs, especially for uncomplicated episodes, is a more controversial matter. Patients that are clinically stable, without signs of shock, or have been stabilized after an initial septic presentation, may be appropriate candidates for treatment of BSIs with oral antimicrobials. There are risks and costs associated with extended courses of intravenous agents, such as the necessity for long-term intravenous catheters, which entail risks for procedural complications, secondary infections, and thrombosis. Oral antimicrobial therapy for bacterial BSIs offers several potential benefits. When selected appropriately, oral antibiotics offer lower cost, fewer side effects, promote antimicrobial stewardship, and are easier for patients. The decision to use oral versus intravenous antibiotics must consider the characteristics of the pathogen, the patient, and the drug. In this narrative review, the authors highlight areas where oral therapy is a safe and effective choice to treat bloodstream infection, and offer guidance and cautions to clinicians managing patients experiencing BSI. Journal of Hospital Medicine 2018;13:328-335. Published online first February 27, 2018. © 2018 Society of Hospital Medicine

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as offer guidance to clinicians managing patients experiencing BSI. Given the lack of robust clinical trials on this subject, the evidence for performing a systematic review was insufficient. Thus, the articles and recommendations cited in this review were selected based on the authors’ experiences to represent the best available evidence.

**INFECTION SOURCE CONTROL**

Diagnosing the source of a patient’s BSI is vital to successful treatment for 2 reasons. First, without achieving source control, antimicrobial therapy of any sort is more likely to fail. For example, patients with *Staphylococcus aureus* abscess and persistently positive blood cultures despite intravenous antimicrobials require drainage. Similarly, patients with a CLABSI typically benefit from removal of the foreign body.11 Second, particular oral antibiotics have different penetration levels into various tissues (Table 1).12 For instance, if a patient has meningitis due to *Streptococcus pneumoniae* with concurrent BSI, doxycycline would be an inferior choice, despite having good bioavailability and achieving high blood concentrations, because it poorly penetrates the central nervous system. An oral regimen must adequately penetrate the source of infection.

**PATHOGEN AND ANTIMICROBIAL FACTORS**

Several important factors regarding the BSI pathogen should be considered when deciding on oral versus intravenous therapy, as follows: 1) organism speciation and susceptibilities should be available; 2) the pathogen should be susceptible to an oral antimicrobial with high bioavailability that achieves adequate blood and source-tissue concentrations; 3) the candidate antibiotic should have a high barrier to acquired resistance for the pathogen. For example, although *S. aureus* is often susceptible to rifampin, it has a low genetic barrier to resistance; thus, rifampin monotherapy is not recommended; and 4) the selected agent should generally be well-tolerated and have an acceptable safety profile. Table 2 summarizes the characteristics of several key antibiotics.

**TABLE 1. Penetration of Select Oral Antimicrobials to Tissue Sites**

<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>Bloodstream Bioavailability</th>
<th>Lung</th>
<th>Liver</th>
<th>Urinary Tract</th>
<th>Prostate</th>
<th>Bone</th>
<th>GI</th>
<th>Skin</th>
<th>Bile</th>
<th>CSF</th>
<th>Synovial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
<td>70%</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>93%</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>90%</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>+</td>
<td>+++</td>
</tr>
<tr>
<td>Trimethoprim-Sulfamethoxazole</td>
<td>90%</td>
<td>++</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>95%</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Minocycline</td>
<td>95%</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Linezolid</td>
<td>99%</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>90%</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>90%</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>50%</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Penicillin V</td>
<td>50%</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>85%</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Cephalexin</td>
<td>60%</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
</tbody>
</table>

+++ Tissue concentrations equal to or higher than serum concentrations
++ Tissue concentrations at least 50% of the serum concentrations
+ Tissue concentrations less than 50% of the serum concentrations

Bioavailability represents the percentage of the dose that reaches systemic circulation. Tissue penetration reflects the drug movement from the vascular to the interstitial and intracellular compartments of a particular body site. Drugs passively diffuse through fenestrated capillaries into the interstitial compartment of most tissues. However, some tissue sites (eg, the brain and prostate) contain nonfenestrated capillaries and/or active transport pumps that prevent entry or remove the drug. Tissue concentrations are methodologically dependent on the various techniques used in their quantification, and, in some body sites, are influenced by the presence or absence of inflammation (eg, brain tissue). Thus, the values presented here are best approximations.
Finally, the patient should be available for close follow-up. Table 3 summarizes the patient factors to consider.

**TABLE 2. Selected Oral Antibiotics**

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Typical Oral Dose*</th>
<th>Dietary Interaction</th>
<th>Notable Side Effects</th>
<th>Approx. Cost per Day(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciprofloxacin</td>
<td>500–750 mg BID</td>
<td>Decreased by concurrent calcium/magnesium/aluminum intake. Take 2 hours before or 6 hours after intake of antacids, dairy, or calcium-fortified food.</td>
<td>Black Box Warning: potentially irreversible serious adverse reactions include tendinitis, tendon rupture, peripheral neuropathy, and CNS effects. QTc interval prolongation, hypoglycemia.</td>
<td>$10.90</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>500–750 mg daily</td>
<td></td>
<td></td>
<td>$24.61</td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td>400 mg daily</td>
<td>No recommendations</td>
<td>Myelosuppression, serotonin syndrome (avoid other proserotonergic drugs), peripheral/optic neuropathy</td>
<td>$26.77</td>
</tr>
<tr>
<td>Linezolid</td>
<td>600 mg BID</td>
<td>Concurrent ingestion of foods rich in certain amino acids (eg, tyramine) such as red wine or aged cheese can precipitate hypertensive crisis.</td>
<td></td>
<td>$366.00</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>500 mg TID</td>
<td>No recommendations</td>
<td>Black Box Warning: possibly carcinogenic (based on animal data), Disulfiram reaction with alcohol use, Neurotoxicity</td>
<td>$4.02</td>
</tr>
<tr>
<td>Trimethoprim-sulfamethoxazole</td>
<td>160 mg/800 mg (DS tablet) 1–2 tablets BID</td>
<td>No recommendations</td>
<td>Hypersensitivity to sulfas-drugs, Blood dyscrasias, Severe dermatologic reactions, Hyperkalemia</td>
<td>$2.18</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>300–450 mg QID</td>
<td>Take with food</td>
<td>Black Box Warning: Risk for severe C. difficile infection, Gastrointestinal upset, Large pill with unpleasant taste</td>
<td>$9.52</td>
</tr>
<tr>
<td>Doxycycline</td>
<td>100 mg BID</td>
<td>Decreased by concurrent calcium and/or high-fat foods and high gastric pH. Avoid taking with antacids, dairy, or calcium-fortified food.</td>
<td>Photosensitivity, Esophagitis if not taken with water</td>
<td>$12.30</td>
</tr>
<tr>
<td>Minocycline</td>
<td></td>
<td>No recommendations</td>
<td>Photosensitivity, Esophagitis if not taken with water, Autoimmune syndromes, Hyperpigmentation, Vertigo</td>
<td>$6.79</td>
</tr>
<tr>
<td>Most β-lactams such as ampicillin or dicloxacillin</td>
<td>Not typically recommended for BSI</td>
<td>Penicillin should be taken on an empty stomach</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>1g TID</td>
<td>No recommendations</td>
<td>Hypersensitivity, Rash</td>
<td>$2.98</td>
</tr>
<tr>
<td>Cephalexin</td>
<td></td>
<td>No recommendations</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

White denotes best evidence for treating select BSIs. Light yellow denotes antimicrobials with a good bioavailability profile, but minimal data for use in BSI. Dark yellow denotes antimicrobials with a poor bioavailability profile; these are included to highlight the risks of using such agents for BSI.

*Assuming normal renal function. Unless bioavailability is 100%, the doses recommended here, in the context of treating BSI, are often higher than for other indications, given the need to achieve adequate blood concentrations. Doses adapted from reference 44.

\(^b\)Cost per day based on the 2017 average wholesale price (AWP). AWP refers to the average price pharmacies pay for drugs from their wholesale distributors. The price that patients pay will vary depending upon prescription markups and insurance coverage, although in most instances, AWP would be the bare minimum.

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**EVIDENCE REGARDING BLOODSTREAM INFECTIONS DUE TO GRAM-NEGATIVE RODS**

BSIs due to gram-negative rods (GNRs) are common and cause significant morbidity and mortality. GNRs represent a broad and diverse array of pathogens. We focus on the Enterobacteriaceae family and Pseudomonas aeruginosa, because they are frequently encountered in clinical practice. 1

**Gram-Negative Rods, Enterobacteriaceae Family**

The Enterobacteriaceae family includes Escherichia coli, Klebsiella, Salmonella, Proteus, Enterobacter, Serratia, and Citrobacter species. The range of illnesses caused by Enterobacteriaceae is as diverse as the family, encompassing most body sites.
Resistance to fluoroquinolones such as ciprofloxacin has been identified as a risk factor for GNR BSI oral treatment failure, highlighting the importance of confirming susceptibilities before committing to an oral treatment plan. Even ESBL Enterobacteriaceae can be considered for treatment with fluoroquinolones if susceptibilities allow.

The ideal duration of therapy for GNR BSI is an area of active research. A recent retrospective trial showed no difference in all-cause mortality or recurrent BSI in GNR BSI treated for 8 versus 15 days. A recent meta-analysis suggested that 7 days of therapy was noninferior to a longer duration therapy (10–14 days) for pyelonephritis, in which a subset was bacteremic. However, another trial reported that short course therapy for GNR BSI (<7 days) is associated with higher risk of treatment failure. Further data are needed.

**TABLE 3. Checklist for Using an Oral Antibiotic for Bloodstream Infection**

**Bacterial/Antimicrobial Factors**

- Speciation and susceptibilities are available
- Susceptibilities indicate an oral antibiotic is effective against the pathogen
- Oral agent is highly bioavailable
- Oral agent has a low acquired-resistance potential for the given pathogen
- Oral agent is well-tolerated and has an acceptable safety profile for the patient (Table 2)
- No serious drug–drug interactions between the selected agent and other medications

**Patient Factors**

- No allergies or intolerances to the selected agent
- No impaired gastrointestinal absorption
- Hemodynamically stable
- Minimal compliance concerns
- Patient has received appropriate education and demonstrated understanding regarding importance of compliance
- Dietary interactions considered (Table 2)
- Underlying source of bloodstream infection identified and controlled
- Upon discharge, patient has access to the oral agent
  - The pharmacy has the agent available
  - The patient is able to get medication from pharmacy before the next dose is due
  - Medication copay at the pharmacy is affordable
- Available for follow-up

Although most Enterobacteriaceae are intrinsically susceptible to antibiotics, there is potential for significant multi-drug resistance. Of particular recent concern has been the emergence of Enterobacteriaceae that produce extended-spectrum β-lactamases (ESBL) and even carbapenem-resistant strains.

However, Enterobacteriaceae species susceptible to oral antimicrobials are often suitable candidates for oral BSI therapy. Among 106 patients with GNR BSI treated with a highly bioavailable oral antibiotic (eg, levofloxacin), the treatment failure rate was only 2% (versus 14% when an antimicrobial with only moderate or low bioavailability was selected). Oral treatment of Enterobacteriaceae BSIs secondary to urinary tract infection has been studied. A prospective randomized, controlled trial evaluated oral versus intravenous ciprofloxacin amongst 141 patients with severe pyelonephritis or complicated urinary tract infections, in which the rate of bacteremia was 38%. Notably, patients with obstruction or renal abscess were excluded from the trial. No significant differences in microbiological failure or unsatisfactory clinical responses were found between the IV and oral treatment groups. Additionally, a Cochrane review reported that oral antibiotic therapy is no less effective than intravenous therapy for severe UTI, although data on BSI frequency were not provided.

**EVIDENCE REGARDING BLOODSTREAM INFECTIONS DUE TO GRAM-POSITIVE COCCI**

The majority of bloodstream infections in the United States, and the resultant morbidity and mortality, are from gram-positive cocci (GPCs) such as Staphylococcus, Streptococcus, and Enterococcus species.

Gram-Positive Coci, Streptococcus pneumoniae

Of the approximately 900,000 annual cases of S. pneumoniae infection in the United States, approximately 40,000 are complicated by BSI, with 70% of those cases being secondary to pneumococcal pneumonia. In studies on patients with pneumococcal pneumonia, bacteremic cases generally fare worse than those without bacteremia. However, several trials demonstrated comparable outcomes in the setting of bacteremic pneumococcal pneumonia when switched early (within 3 days) from intravenous to oral antibiotics to complete a 7-day course. Before pneumococcal penicillin resistance became widespread, oral penicillin was shown to be effective, and remains an option for susceptible strains. It is worth noting, however, that other trials have shown a mortality benefit from treating bacteremic pneumococcal pneumonia initially with dual-therapy including a β-lactam and macrolide such as azithromycin. This observation highlights the importance
of knowing the final susceptibility data prior to consolidating to monotherapy with an oral agent, and that macrolides may have beneficial anti-inflammatory effects, though further research is needed.34,35

Although the evidence for treating bacteremic pneumococcal pneumonia using a highly active and absorbable oral agent is fairly robust, S. pneumoniae BSI secondary to other sites of infection is less well studied and may require a more conservative approach.

Gram-Positive Cocci, β-hemolytic Streptococcus species

β-Hemolytic Streptococci include groups A to H, of which groups A (S. pyogenes) and B (S. agalactiae) are the most commonly implicated in BSIs.36 Group A Streptococcus (GAS) is classically associated with streptococcal pharyngitis and Group B Streptococcus (GBS) is associated with postpartum endometritis and neonatal meningitis, though both are virulent organisms with a potential to cause invasive infection throughout the body and in all age-groups. Up to 14% of GAS and 41% GBS BSIs have no clear source;37,38 given these are skin pathogens, such scenarios likely represent invasion via microabrasion. As β-hemolytic streptococcal BSI is often observed in the context of necrotizing skin and soft tissue infections, surgical source control is particularly important.39 GAS remains exquisitely susceptible to penicillin, and intravenous penicillin remains the mainstay for invasive disease; GBS has higher penicillin resistance rates than GAS.40 Clindamycin should be added when there is concern for severe disease or toxic shock.41 Unfortunately, oral penicillin is poorly bioavailable (approximately 50%), and there has been recent concern regarding inducible clindamycin resistance in GAS.42 Thus, oral penicillin V and/or clindamycin is a potentially risky strategy, with no clinical trials supporting this approach; however, they may be reasonable options in selected patients with source control and stable hemodynamics. Amoxicillin has high bioavailability (85%) and may be effective; however, there is lack of supporting data. Highly bioavailable agents such as levofloxacin and linezolid have GAS and GBS activity43 and might be considered as the preferred pharmacotherapy. Although bacteriostatic against GAS, linezolid is bactericidal against GBS.44 Linezolid has favorable pharmacokinetics, with approximately 100% bioavailability, and S. aureus resistance to linezolid is rare.52 Several randomized trials have compared oral linezolid with intravenous vancomycin for S. aureus BSI; for instance, Stevens et al. randomized 460 patients with S. aureus infection (of whom 18% had BSI) to linezolid versus vancomycin and observed similar clinical cure rates.53 A pooled analysis showed oral linezolid was noninferior to vancomycin specifically for S. aureus BSI.54 However, long-term use is often limited by hematologic toxicity, peripheral or optic neuropathy (which can be permanent), and induced serotonin syndrome. Additionally, linezolid is bacteriostatic, not bactericidal against S. aureus. Using oral linezolid as a first-line option for S. aureus BSI would not be recommended; however, it may be used as a second-line treatment option in selected cases. Tedizolid has similar pharmacokinetics and spectrum of activity with fewer side effects; however, clinical data on its use for S. aureus BSI are lacking.55 Fluoroquinolones such as levofloxacin and the newer agent delafloxacin have activity against S. aureus, including MRSA, but on-treatment emergence of fluoroquinolone resistance is a concern, and data on delafloxacin for BSI are lacking.56,57 Older literature suggested the combination of ciprofloxacin and rifampin was effective against right-sided S. aureus endocarditis,58 and other oral fluoroquinolone-rifampycin combinations have also been found to be effective59. However, this approach is currently not a standard therapy, nor is it widely used. Decisions on the duration of therapy for S. aureus BSI should be made in conjunction with an infectious diseases specialist; 14 days is currently regarded as a minimum.47,48

Published data regarding oral treatment of coagulase-negative Staphylococcus (CoNS) BSI are limited. Most CoNS bacteremia and up to 80% Staphylococcus epidermidis bacteremia represent blood culture contamination, though true infection from CoNS is not uncommon, particularly in patients with indwelling catheters.60 An exception is the CoNS species Staphylococcus lugdunensis, which is more virulent, and bacteremia with this organism usually warrants antibiotics. Oral antimicrobial therapy is currently not a standard treatment practice for CoNS BSI that is felt to represent true infection; however, linezolid has been successfully used in case series.51

Gram-Positive Cocci, Enterococcus

E. faecium and E. faecalis are commonly implicated in BSI. Similar to S. aureus, infective endocarditis must be ruled out when treating enterococcal BSI; a scoring system has been
proposed to assist in deciding if such patients require echocardiography. Intravenous ampicillin is a preferred, highly effective agent for enterococci treatment when the organism is susceptible. However, oral ampicillin has poor bioavailability (50%), and data for its use in BSI are lacking. For susceptible strains, amoxicillin has comparable efficacy for enterococci and enhanced bioavailability (85%); high dose oral amoxicillin could be considered, but there is minimal clinical trial data to support this approach. Fluoroquinolones exhibit only modest activity against enterococci and would be an inferior choice for BSI. Although often sensitive to oral tetracyclines, data on their use in enterococcal BSI are insufficient. Nitrofurantoin can be used for susceptible enterococcal urinary tract infection; however, it does not achieve high blood concentrations and should not be used for BSI.

There is significant data comparing oral linezolid with intravenous daptomycin for vancomycin-resistant enterococci (VRE) BSI. In a systematic review including 10 trials using 30-day all-cause mortality as the primary outcome, patients treated with daptomycin demonstrated higher odds of death (OR 1.61, 95% CI 1.08–2.40) compared with those treated with linezolid. However, more recent data suggested that higher daptomycin doses than those used in these earlier trials resulted in improved VRE BSI outcomes. A subsequent study reported that VRE BSI treatment with linezolid is associated with significantly higher treatment failure and mortality compared with daptomycin therapy. Further research is needed, but should the side-effect profile of linezolid be tolerable, it remains an effective option for oral treatment of enterococcal BSIs.

### EVIDENCE REGARDING ANAEROBIC BACTERIAL BLOOD STREAM INFECTION

Anaerobic bacteria include *Bacteroides*, *Prevotella*, *Porphyromonas*, *Fusobacterium*, *Peptostreptococcus*, *Veillonella*, and *Clostridium*. Anaerobes account for approximately 4% of bacterial BSIs, and are often seen in the context of polymicrobial infection. Given that anaerobes are difficult to recover, and that antimicrobial resistance testing is more labor intensive, antibiotic therapy choices are often made empirically. Unfortunately, antibiotic resistance amongst anaerobes is increasing. However, metronidazole remains highly active against a majority of anaerobes, with only a handful of treatment failures reported, and has a highly favorable pharmacokinetic profile for oral treatment. Oral metronidazole remains an effective choice for many anaerobic BSIs. Considering the polymicrobial nature of many anaerobic infections, source control is important, and concomitant GNR infection must be ruled out before using metronidazole monotherapy.

Clindamycin has significant anaerobic activity, but *Bacteroides* resistance has increased significantly in recent years, as high as 26%-44%. Amoxicillin-clavulanate has good anaerobic coverage, but bioavailability of clavulanate is limited (50%), making it inferior for BSI. Bioavailability is also limited for cephalosporins with anaerobic activity, such as ceftaxime. Moxifloxacin is a fluoroquinolone with some anaerobic coverage and a good oral pharmacokinetic profile, but *Bacteroides* resistance can be as high as 50%, making it a risky empiric choice.

### CONCLUSIONS

Bacterial BSIs are common and result in significant morbidity and mortality, with high associated healthcare costs. Although BSIs are traditionally treated with intravenous antimicrobials, many BSIs can be safely and effectively cured using oral antibiotics. When appropriately selected, oral antibiotics offer lower costs, fewer side effects, promote antimicrobial stewardship, and are easier for patients. Ultimately, the decision to use oral versus intravenous antibiotics must consider the characteristics of the pathogen, patient, and drug.

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### References


Shorter Versus Longer Courses of Antibiotics for Infection in Hospitalized Patients: A Systematic Review and Meta-Analysis

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BACKGROUND: Infection is a leading cause of hospitalization with high morbidity and mortality, but there are limited data to guide the duration of antibiotic therapy.

PURPOSE: Systematic review to compare outcomes of shorter versus longer antibiotic courses among hospitalized adults and adolescents.


STUDY SELECTION: Inclusion criteria were human randomized controlled trials (RCTs) in English comparing a prespecified short course of antibiotics to a longer course for treatment of infection in hospitalized adults and adolescents aged 12 years and older.

DATA EXTRACTION: Two authors independently extracted study characteristics, methods of statistical analysis, outcomes, and risk of bias.

DATA SYNTHESIS: Of 5187 unique citations identified, 19 RCTs comprising 2867 patients met our inclusion criteria, including the following: 9 noninferiority trials, 1 superiority design trial, and 9 pilot studies. Across 13 studies evaluating 1727 patients, no significant difference in clinical efficacy was observed (d = 1.6% [95% confidence interval (CI), −1.0%-4.2%]). No significant difference was detected in microbiologic cure (8 studies, d = 1.2% [95% CI, −4.1%-6.4%]), short-term mortality (8 studies, d = 0.3% [95% CI, −1.2%-1.8%]), longer-term mortality (3 studies, d = −0.4% [95% CI, −6.3%-5.5%]), or recurrence (10 studies, d = 2.1% [95% CI, −1.2%-5.3%]). Heterogeneity across studies was not significant for any of the primary outcomes.

CONCLUSIONS: Based on the available literature, shorter courses of antibiotics can be safely utilized in hospitalized patients with common infections, including pneumonia, urinary tract infection, and intra-abdominal infection, to achieve clinical and microbiologic resolution without adverse effects on mortality or recurrence. Journal of Hospital Medicine 2018;13:336-342. Published online first January 25, 2018. © 2018 Society of Hospital Medicine

Acute infections are a leading cause of hospitalization and are associated with high cost, morbidity, and mortality.1 There is a growing body of literature to support shorter antibiotic courses to treat several different infection types.2-4 This is because longer treatment courses promote the emergence of multidrug-resistant (MDR) organisms,7,9 microbiome perturbation,10 and Clostridium difficile infection (CDI).11 They are also associated with more drug side effects, longer hospitalizations, and increased costs.

Despite increasing support for shorter treatment courses, inpatient prescribing practice varies widely, and redundant antibiotic therapy is common.12-14 Furthermore, aside from ventilator-associated pneumonia (VAP),15,16 prior systematic reviews of antibiotic duration have typically included outpatient and pediatric patients,3,4,17,18 for whom the risk of treatment failure may be lower.

Given the potential for harm with inappropriate antibiotic treatment duration and the variation in current clinical practice, we sought to systematically review clinical trials comparing shorter versus longer antibiotic courses in adolescents and adults hospitalized for acute infection. We focused on common sites of infection in hospitalized patients, including pulmonary, bloodstream, soft tissue, intra-abdominal, and urinary.20,21 We hypothesized that shorter courses would be sufficient to cure infection and associated with lower costs and fewer complications. Because we hypothesized that shorter durations would be sufficient regardless of clinical course, we focused on studies in which the short course of antibiotics was specified at study onset, not determined by clinical improvement or biomarkers. We analyzed all infection types together because current sepsis treatment guidelines place little emphasis on infection site.22 In contrast to prior reviews, we focused exclusively on adult and adolescent inpatients because the risks of a too-short treatment duration may be lower in pediatric and outpatient populations.

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METHODS
We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses. The review was registered on the Prospero database.

Information Sources and Search Strategy
We performed serial literature searches for articles in English comparing shorter versus longer antibiotics courses in hospitalized patients. We searched MEDLINE via PubMed and Embase (January 1, 1990, to July 1, 2017). We used Boolean operators, Boolean logic, and controlled vocabulary (eg, Medical Subject Heading [MeSH] terms) for each key word. We identified published randomized controlled trials (RCTs) of conditions of interest (MeSH terms: “bacteremia,” “sepsis,” “pneumonia,” “pyelonephritis,” “intra-abdominal infection,” “cellulitis,” “soft tissue infection”) that compared differing lengths of antibiotic treatment (keywords: “time factors,” “duration,” “long course,” “short course”) and evaluated outcomes (key words: “mortality,” “recurrence,” “secondary infections”). We hand searched references of included citations. The full search strategy is presented in supplementary Appendix 1.

Study Eligibility and Selection Criteria
To meet criteria for inclusion, a study had to (1) be an RCT; (2) involve an adult or adolescent population age ≥12 years (or report outcomes separately for such patients); (3) involve an inpatient population (or report outcomes separately for inpatients); (4) stipulate a short course of antibiotics per protocol prior to randomization and not determined by clinical response, change in biomarkers, or physician discretion; (5) compare the short course to a longer course of antibiotics, which could be determined either per protocol or by some other measure; and (6) involve antibiotics given to treat infection, not as prophylaxis.

Two authors (SR and HCP) independently reviewed the title and/or abstracts of all articles identified by the search strategy. We calculated interrater agreement with a kappa coefficient. Both authors (SR and HCP) independently reviewed the full text of each article selected for possible inclusion by either author. Disagreement regarding eligibility was adjudicated by discussion.

Data Abstraction
Two authors (SR and HCP) independently abstracted study methodology, definitions, and outcomes for each study using a standardized abstraction tool (see supplementary Appendix 2).

Study Quality
We assessed article quality using the Cochrane Collaboration’s tool, which evaluates 6 domains of possible bias, including sequence generation, concealment, blinding, and incomplete or selective outcome reporting. The tool is a 6-point scale, with 6 being the best score. It is recommended for assessing bias because it evaluates randomization and allocation concealment, which are not included in other tools. We did not exclude studies based on quality but considered studies with scores of 5-6 to have a low overall risk of bias.

Study Outcomes and Statistical Analysis
Our primary outcomes were clinical cure, microbiologic cure, mortality, and infection recurrence. Secondary outcomes were secondary MDR infection, cost, and length of stay (LOS). We conducted all analyses with Stata MP version 14 (StataCorp, College Station, TX). For each outcome, we reported the difference (95% confidence interval [CI]) between treatment arms as the rate in the short course arm minus the rate in the long course arm, consistent with the typical presentation of noninferiority data. When not reported in a study, we calculated risk difference and 95% CI using reported patient-level data. Positive values for risk difference favor the short course arm for favorable outcomes (ie, clinical and microbiologic cure) and the long course arm for adverse outcomes (ie, mortality and recurrence). A meta-analysis was used to pool risk differences across all studies for primary outcomes and for clinical cure in the community-acquired pneumonia (CAP) subgroup. We also present results as odds ratios and risk ratios in the online supplement. All meta-analyses used random effects models, as described by DerSimonian and Laird, with variance estimates of heterogeneity taken from the Mantel-Haenszel fixed effects model. We investigated heterogeneity between studies using the I² statistic. We considered a P < .1 to indicate statistically significant heterogeneity and classified heterogeneity as low, moderate, or high on the basis of an I2 of 25%, 50%, or 75%, respectively. We used funnel plots to assess for publication bias.

RESULTS
Search Results
We identified 5187 unique citations, of which 110 underwent full-text review (Figure 1). Reviewer agreement for selection of title and/or abstracts for full evaluation was 99.1% (kappa = 0.71). Nineteen RCTs with a total of 2867 patients met inclusion criteria and were included in the analysis.

Characteristics of Included Studies
Publication years ranged from 1991 to 2015 (Table). Study populations were primarily from Europe (n = 9) or the United States (n = 5). Pneumonia was the most common infection studied, with 3 studies evaluating VAP and 9 studies evaluating CAP. There were also 3 studies of intra-abdominal infections, 2 studies of urinary tract infections (UTIs), 1 study of typhoid fever, and 1 study of hospital-acquired infection of unknown origin. No studies of bacteremia or soft tissue infections met inclusion criteria. Short courses of antibiotics ranged from 1 to 8 days, while long courses ranged from 3 to 15 days.

Common study outcomes included clinical cure or efficacy (composite of symptom cure and improvement; n = 13), infection recurrence (n = 10), mortality (n = 9), microbiologic cure (n = 8), and LOS (n = 7; supplementary Table 1).

Nine studies were pilot studies, 1 was a traditional superiority design study, and 9 were noninferiority studies with a prespecified limit of equivalence of either 10% (n = 7) or 15% (n = 2).
<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Country</th>
<th>Number of Patients</th>
<th>Patient Location</th>
<th>Infection Type</th>
<th>Short Course Antibiotic</th>
<th>Short Course Duration (days)</th>
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<th>Long Course Duration (days)</th>
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<tr>
<td>Bohte et al.</td>
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<td>5</td>
<td>Erythromycin or benzylpenicillin</td>
<td>10 or 5 days past last fever</td>
<td>Clinical cure by day 21</td>
<td>Superiority</td>
</tr>
<tr>
<td>Capellier et al.</td>
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<td>France</td>
<td>225</td>
<td>ICU</td>
<td>VAP</td>
<td>Beta-lactam, aminoglycoside</td>
<td>8</td>
<td>Beta-lactam, aminoglycoside</td>
<td>15</td>
<td>Clinical cure at day 21</td>
<td>Non-inferiority</td>
</tr>
<tr>
<td>Chastre et al.</td>
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<td>401</td>
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<td>Beta-lactam, aminoglycoside or fluoroquinolone</td>
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<td>5</td>
<td>Cefoperazone</td>
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<td>Physician discretion</td>
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<td>Fleroxacin</td>
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<td>Microbiologic cure 4 to 6 weeks post therapy</td>
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<tr>
<td>Dunbar et al.</td>
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<td>5</td>
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<tr>
<td>Kuzman et al.</td>
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<td>Leophonte et al.</td>
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<td>Meropenem, ticloperin</td>
<td>2</td>
<td>Meropenem, ticloperin</td>
<td>7</td>
<td>Composite mortality and need for further antibiotics</td>
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<tr>
<td>Sawyer et al.</td>
<td>1999</td>
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<td>98</td>
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<td>3</td>
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<tr>
<td>Zhao et al.</td>
<td>2014</td>
<td>China</td>
<td>220</td>
<td>Ward</td>
<td>CAP</td>
<td>Levofloxacin</td>
<td>5</td>
<td>Levofloxacin</td>
<td>7+</td>
<td>Overall efficacy at 7 to 14 days post therapy</td>
<td>Non-inferiority</td>
</tr>
</tbody>
</table>

* Number of patients included in primary outcome and/or subset of patients hospitalized.
* Primary outcome(s) not specified; outcome(s) discussed first and/or most extensively considered to be primary outcome(s).
* Standard choices oral fluoroquinolone and amoxicillin; aztreonam and vancomycin used in patients unable to tolerate oral antibiotics; antibiotic choice based on prior sensitivities if available.
* Acceptable if consistent with Surgical Infection Society and Infectious Diseases Society of America guidelines.

NOTE: Abbreviations: CAP, community-acquired pneumonia; CA-UTI, catheter-associated urinary tract infection; c-UTI, complicated urinary tract infection; ICU, intensive care unit; SBP, spontaneous bacterial peritonitis; SIRS, systemic inflammatory response syndrome; UK, United Kingdom; USA, United States of America; VAP, ventilator-associated pneumonia.
Clinical Cure and Efficacy

Thirteen studies of 1727 patients evaluated clinical cure and efficacy (Figure 2). The overall risk difference was $d = 1.6\%$ ($95\% \text{ CI}, -1.0\%-4.2\%)$, and the pooled odds ratio was 1.11 ($95\% \text{ CI}, 0.85-1.45$; supplementary Table 2). There was no heterogeneity between studies ($I^2 = 0\%$, $P = .55$).

Five of 6 studies with a noninferiority design met their prespecified margin, while 1 study of VAP failed to meet the 15% noninferiority margin ($d = -11.2\%$ [95% CI, −26.3%-3.8%]).

Nine studies of 1225 patients evaluated clinical cure and efficacy in CAP (supplementary Figure 1). The overall risk difference was $d = 2.4\%$ ($95\% \text{ CI}, -0.7%-5.5\%)$. There was no heterogeneity between studies ($I^2 = 0\%$, $P = .55$).

Microbiologic Cure

Eight studies of 366 patients evaluated microbiologic cure (supplementary Figure 2). The overall risk difference was $d = 1.2\%$ ($95\% \text{ CI}, -4.1%-6.4\%)$. There was no statistically significant heterogeneity between studies ($I^2 = 13.3\%$, $P = .33$).

Mortality

Eight studies of 1740 patients evaluated short-term mortality (in hospital to 45 days; Figure 2). while 3 studies of 654 patients evaluated longer-term mortality (60 to 180 days; supplementary Figure 3). The overall risk difference was $d = 0.3\%$ ($95\% \text{ CI}, -1.2%-1.8\%)$ for short-term mortality and $d = -0.4\%$ ($95\% \text{ CI}, -6.3%-5.5\%)$ for longer-term mortality. There was no heterogeneity between studies for either short-term ($I^2 = 0.0\%$, $P = .66$) or longer-term mortality ($I^2 = 0.0\%$, $P = .69$).

Infection Recurrence

Ten studies of 1554 patients evaluated infection recurrence (Figure 2). The overall risk difference was $d = 2.1\%$ ($95\% \text{ CI}, -1.2%-5.3\%)$. There was no statistically significant heterogeneity between studies ($I^2 = 21.0\%$, $P = .25$). Two of the 3 studies with noninferiority design (both evaluating intra-abdominal infections) met their prespecified margins.

In Chastre et al., the overall population ($d = 3.0\%$; 95% CI, −5.8%-11.7%) and the subgroup with VAP due to nonfermenting gram-negative bacilli (NF-GNB; $d = 15.2\%; 95\% \text{ CI}, -0.9%-31.4\%) failed to meet the 10% noninferiority margin.

Secondary Outcomes

Three studies of 286 patients (with VAP or intra-abdominal infection) evaluated the emergence of MDR organisms. The overall risk difference was $d = -9.0\%$ ($95\% \text{ CI}, -19.1%-1.1\%$, $P = .081$). There was no statistically significant
heterogeneity between studies ($I^2 = 7.6\%, \ P = .34$).

Seven studies examined LOS—3 in the intensive care unit (ICU) and 4 on the wards—none of which found significant differences between treatment arms. Across 3 studies of 672 patients, the weighted average for ICU LOS was 23.6 days in the short arm versus 29.7 days in the long arm. Across 4 studies of 235 patients, the weighted average for hospital LOS was 23.5 days in the short arm versus 29.7 days in the long arm. This difference was driven by a 1991 study of spontaneous bacterial peritonitis (SBP), in which the average LOS was 37 days and 50 days in the short- and long-course arms, respectively.

Three studies of 186 total patients (with SBP or hospital-acquired infection of unknown origin) examined the cost of antibiotics. The weighted average cost savings for shorter courses in 2016 US dollars was $265.19.

Three studies of 618 patients evaluated cases of CDI, during 10-, 30-, and 180-day total follow-up. The overall risk difference was $d = 0.7\%$ (95% CI, −1.3%−2.8%), with no statistically significant heterogeneity between studies ($I^2 = 0\%$, $P = .97$).

**Study Quality**

Included studies scored 2-5 on the Cochrane Collaboration Risk of Bias Tool (supplementary Figure 4). Four studies had an overall low risk of bias, while 15 had a moderate to high risk of bias (supplementary Table 3). Common sources of bias included inadequate details to confirm adequate randomization and/or concealment ($n = 13$) and lack of adequate blinding ($n = 18$). Two studies were stopped early, and 3 others were possibly stopped early because it was unclear how the number of participants was determined. Covariate imbalance (failure of randomization) was present in 2 studies. There was no evidence of selective outcome reporting or publication bias based on the funnel plots (supplementary Figure 5).

**DISCUSSION**

In this study, we performed a systematic review and meta-analysis of RCTs of shorter versus longer antibiotic courses for adults and adolescents hospitalized for infection. The rate of clinical cure was indistinguishable between patients randomized to shorter versus longer durations of antibiotic therapy, and the meta-analysis was well powered to confirm noninferiority. The lower 95% CI indicates that any potential benefit of longer antibiotics is not more than 1%, far below the typical margin of noninferiority. Subgroup analysis of patients hospitalized with CAP also showed noninferiority of a prespecified shorter treatment duration.

The rate of microbiologic cure was likewise indistinguishable, and the meta-analysis was again well powered to confirm noninferiority. Any potential benefit of longer antibiotics for microbial cure is quite small (not more than 4%).

Our study also demonstrates noninferiority of prespecified shorter antibiotic courses for mortality. Shorter- and longer-term mortality were both indistinguishable in patients randomized to shorter antibiotic courses. The meta-analyses for mortality were well powered, with any potential benefit of longer antibiotic durations being less than 2% for short-term and less than 6% for long-term mortality.

We also examined for complications related to antibiotic therapy. Infection recurrence was indistinguishable, with any potential benefit of longer antibiotics being less than 6%. Select infections (eg, VAP due to NF-GNB, catheter-associated UTI) may be more susceptible to relapse after shorter treatment courses, while most patients hospitalized with infection do not have an increased risk for relapse with shorter treatment courses. Consistent with other studies, the emergence of
MDR organisms was 9% less common in patients randomized to shorter antibiotic courses. This difference failed to meet statistical significance, likely due to poor power. The emergence of MDR pathogens was included in just 3 of 19 studies, under-scoring the need for additional studies on this outcome. Although our meta-analyses indicate noninferiority of shorter antibiotic courses in hospitalized patients, the included studies are not without shortcomings. Only 4 of the included studies had low risk of bias, while 15 had at least moderate risk. The nearly universal source of bias was a lack of blinding. Only 1 study was completely blinded, and only 3 others had partial blinding. Adequate randomization and concealment were also lacking in several studies. However, there was no evidence of selective outcome reporting or publication bias.

Our findings are consistent with prior studies indicating non-inferiority of shorter antibiotic courses in other settings and patient populations. Pediatric studies have demonstrated the success of shorter antibiotic courses in both outpatient and inpatient populations. Prior meta-analyses have shown non-inferiority of shorter antibiotic courses in adults with VAP in neonatal, pediatric, and adult patients with bacteremia; and in pediatric and adult patients with pneumonia and UTI. Our meta-analysis extends the evidence for the safety of shorter treatment courses to adults hospitalized with common infections, including pneumonia, UTI, and intra-abdominal infections. Because neonatal, pediatric, and nonhospitalized adult patients may have a lower risk for treatment failure and lower risk for mortality in the event of treatment failure, we focused exclusively on hospitalized adults and adolescents.

In contrast to prior meta-analyses, we included studies of multiple different sites of infection. This allowed us to assess a large number of hospitalized patients and achieve a narrow margin of noninferiority. It is possible that the benefit of optimal treatment duration varies by type of infection. (And indeed, absolute duration of treatment differed across studies.) We used a random-effects framework, which recognizes that the true benefit of shorter versus longer duration may vary across study populations. The heterogeneity between studies in our meta-analysis was quite low, suggesting that the results are not explained by a single infection type.

There are limited data on late effects of longer antibiotic courses. Antibiotic therapy is associated with an increased risk for CDI for 3 months afterwards. However, the duration of follow-up in the included studies rarely exceeded 1 month, which could underestimate incidence. The effect of antibiotics on gut microbiota may persist for months, predisposing patients to secondary infections. It is plausible that disruption in gut microbiota and risk for CDI may persist longer in patients treated with longer antibiotic courses. However, the existing studies do not include sufficient follow-up to confirm or refute this hypothesis.

Our review has several limitations. First, we included studies that compared an a priori-defined short course of antibiotics to a longer course and excluded studies that defined a short course of antibiotics based on clinical response. Because we did not specify an exact length for short or long courses, we cannot make explicit recommendations about the absolute duration of antibiotic therapy. Second, we included multiple infection types. It is possible that the duration of antibiotics required may differ by infection type. However, there were not sufficient data for subgroup analyses for each infection type. This highlights the need for additional data to guide the treatment of severe infections. Third, not all studies considered antibiotic duration in isolation. One study included a catheter change in the short arm only, which could have favored the short course. Three studies used different doses of antibiotics in addition to different durations. Fourth, the quality of included studies was variable, with lack of blinding and inadequate randomization present in most studies.

CONCLUSION

Based on the available literature, shorter courses of antibiotics can be safely utilized in hospitalized adults and adolescents to achieve clinical and microbiologic resolution of common infections, including pneumonia, UTI, and intra-abdominal infection, without adverse effect on infection recurrence. Moreover, short- and longer-term mortality are indistinguishable after treatment courses of differing duration. There are limited data on the longer-term risks associated with antibiotic duration, such as secondary infection or the emergence of MDR organisms.

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Disclosure: Drs. Royer and Prescott designed the study, performed data analysis, and drafted the manuscript. Drs. DeMerle and Dickson revised the manuscript critically for intellectual content. Dr. Royer holds stock in Pfizer. The authors have no other potential financial conflicts of interest to report. This work was supported by K08 GM115859 (HCP). This manuscript does not necessarily represent the position or policy of the US government or the Department of Veterans Affairs.

References

Things We Do for No Reason – The “48 Hour Rule-out” for Well-Appearing Febrile Infants

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The “Things We Do for No Reason” (TWDFNR) series reviews practices that have become common parts of hospital care but may provide little value to our patients. Practices reviewed in the TWDFNR series do not represent “black and white” conclusions or clinical practice standards but are meant as a starting place for research and active discussions among hospitalists and patients. We invite you to be part of that discussion.

Fever, defined as a rectal temperature of ≥38°C (100.4°F), is a common reason for hospital admission of infants aged ≤ 90 days. Febrile infants are often admitted to the hospital due to risk for serious bacterial infections, such as urinary tract infection, bacteremia, and meningitis. The traditional observation time is 48 hours following the collection of blood, urine, and cerebrospinal fluid cultures. In the majority of these infants, bacterial infection is not the source of fever. When a bacterial source is identified, less than 0.3% of the bacteria will be detected more than 24 hours after the cultures were obtained in low-risk infants.1 Recent studies show that the traditional 48 hour hospital observation period is unnecessary for infants aged ≤ 90 days who are at low risk for serious bacterial infection based on available scoring systems.

CASE PRESENTATION

A 3-week-old, full-term term male febrile infant was evaluated in the emergency department (ED). On the day of admission, he was noted to feel warm to the touch and was found to have a rectal temperature of 101.3°F (38.3°C) at home.

In the ED, the patient was well appearing and had normal physical exam findings. His workup in the ED included a normal chest radiograph, complete blood count (CBC) with differential count, cerebrospinal fluid (CSF) analysis (cell count, protein, and glucose), and urinalysis. Blood, CSF, and catheterized urine cultures were collected, and he was admitted to the hospital on parenteral antibiotics. His provider informed the parents that the infant would be observed in the hospital for 48 hours while monitoring the bacterial cultures. Is it necessary for the hospitalization of this child to last a full 48 hours?

INTRODUCTION

Evaluation and management of fever (T ≥ 38°C) is a common cause of emergency department visits and accounts for up to 20% of pediatric emergency visits.2

In infants under 90 days of age, fever frequently leads to hospitalization due to concern for bacterial infection as the cause of fever.3 Serious bacterial infection has traditionally been defined to include infections such as bacteremia, meningitis, pneumonia, urinary tract infection, skin/soft tissue infections, osteomyelitis, and septic arthritis.4 (Table 1) The incidence of serious bacterial infection in febrile infants during the first 90 days of life is between 5%-12%.5,6 To assess the risk of serious bacterial infections, clinicians commonly pursue radiographic and laboratory evaluations, including blood, urine, and cerebrospinal fluid (CSF) cultures.3 Historically, infants have been observed for at least 48 hours.

Why You Might Think Hospitalization for at Least 48 Hours is Necessary

The evaluation and management of fever in infants aged less than 90 days is challenging due to concern for occult serious bacterial infections. In particular, providers may be concerned that the physical exam lacks sensitivity.7 There is also a perceived risk of poor outcomes in young infants if a serious bacterial infection is missed. For these reasons, the evaluation and management of febrile infants has been characterized by practice variability in both outpatient10 and ED4 settings.

Commonly used febrile infant management protocols vary in approach and do not provide clear guidelines on the recommended duration of hospitalization and empiric antimicrobial treatment.11-14 Length of hospitalization was widely studied in infants between 1979 and 1999, and results showed that the majority of clinically important bacterial pathogens can be detected within 48 hours.15-17 Many textbooks and online references, based on this literature, continue to support 48 to 72 hours of observation and empiric antimicrobial treatment for febrile infants.18,19 A 2012 AAP Clinical Report advocated for limiting the antimicrobial treatment in low-risk infants suspected of early-onset sepsis to 48 hours.20
Why Shorten the Period of In-Hospital Observation to a Maximum of 36 Hours of Culture Incubation

Discharge of low-risk infants with negative enhanced urinalysis and negative bacterial cultures at 36 hours or earlier can reduce costs and potentially preventable harm (eg, intravenous catheter complications, nosocomial infections) without negatively impacting patient outcomes. Early discharge is also patient-centered, given the stress and indirect costs associated with hospitalization, including potential separation of a breastfeeding infant and mother, lost wages from time off work, or childcare for well siblings.

Initial studies that evaluated the time-to-positivity (TTP) of bacterial cultures in febrile infants predate the use of continuous monitoring systems for blood cultures. Traditional bacterial culturing techniques require direct observation of broth turbidity and subsequent subculturing onto chocolate and sheep blood agar, typically occurring only once daily. Current commercially available continuous monitoring bacterial culture systems decrease TTP by immediately alerting laboratory technicians to bacterial growth through the detection of $^{14}$CO$_2$ released by organisms utilizing radiolabeled glucose in growth media. In addition, many studies supporting the evaluation of febrile infants in the hospital for a 48-hour period include those in ICU settings, with medically complex histories, and aged < 28 days admitted in the NICU, where pathogens with longer incubation times are frequently seen.

Recent studies of healthy febrile infants subjected to continuous monitoring blood culture systems reported that the TTP for 97% of bacteria treated as true pathogens is ≤36 hours. No significant difference in TTP was found in infants ≤28 days old versus those aged 0–90 days. However, at 17 sites for more than 2 years demonstrated that the mean TTP in infants aged 0-90 days was 15.41 hours; only 4% of possible pathogens were identified after 36 hours. (Table 2) In a recent single-center retrospective study, infant blood cultures with TTP longer than 36 hours are 7.8 times more likely to be identified as contaminant bacteria compared with cultures that tested positive in <36 hours. Even if bacterial cultures were unexpectedly positive after 36 hours, which occurs in less than 1.1% of all infants and 0.3% of low-risk infants, these patients do not have adverse outcomes. Infants who were deemed low risk based on established criteria and who had bacterial cultures positive for pathogenic bacteria were treated at that time and recovered uneventfully.

CSF and urine cultures are often reviewed only once or twice daily in most institutions, and this practice artificially prolongs the TTP for pathogenic bacteria. Small sample-sized studies have demonstrated the low detection rate of pathogens in CSF and urine cultures beyond 36 hours. Evans et al. found that in infants aged 0-28 days, 0.03% of urine cultures and no CSF cultures tested positive after 36 hours. In a retrospective study of infants aged 28-90 days in the ED setting, Kaplan et al. found that 0.9% of urine cultures and no CSF cultures were positive at >24 hours. For well-appearing infants who have reassuring initial CSF studies, the risk of meningitis is extremely low. Management criteria for febrile infants provide guidance for determining those infants with abnormal CSF results who may benefit from longer periods of observation.

Urinary tract infections are common serious bacterial infections in this age group. Enhanced urinalysis, in which cell count and Gram stain analysis are performed on uncentrifuged urine, shows 96% sensitivity of predicting urinary tract infection and...
can provide additional reassurance for well-appearing infants who are discharged prior to 48 hours.27

When a Longer Observation Period May Be Warranted
An observation time of >36 hours for febrile infants can be considered if the patient does not meet the generally accepted low-risk clinical and/or laboratory criteria (Table 2) or if the patient clinically deteriorates during hospitalization. Management of CSF pleocytosis both on its own28 and in the setting of febrile urinary tract infection in infants remains controversial 29 and may be an indication for prolonged hospitalization. Incomplete laboratory evaluation (eg, lack of CSF due to unsuccessful lumbar puncture, lack of CBC due to clotted samples) and pretreatment with antibiotics 31 can also affect clinical decision making by introducing uncertainty in the patient’s pre-evaluation probability. Other factors that may require a longer period of hospitalization include lack of reliable follow-up, concerns about the ability of parent(s) or guardian(s) to appropriately detect clinical deterioration, lack of access to medical resources or a reliable telephone, an unstable home environment, or homelessness.

What You Should Do Instead: Limit Hospitalization to a Maximum of 36 Hours
For well-appearing febrile infants between 0–90 days of age hospitalized for observation and awaiting bacterial culture results, providers should consider discharge at 36 hours or less, rather than 48 hours, if blood, urine, and CSF cultures do not show bacterial growth. In a large health system, researchers implemented an evidence-based care process model for febrile infants to provide specific guidelines for laboratory testing, criteria for admission, and recommendation for discontinuation of empiric antibiotics and discharge after 36 hours in infants with negative bacterial cultures. These changes led to a 27% reduction in the length of hospital stay and 23% reduction in inpatient costs without any cases of missed bacteremia.21 The reduction in the in-hospital observation duration to 24 hours of culture incubation for well-appearing febrile infants has been advocated 32 and is a common practice for infants with appropriate follow up and parental assurance. This recommendation is supported by the following:

- Recent data showing the overwhelming majority of pathogens will be identified by blood culture <24 hours in infants aged 0-90 days with blood culture TTP in infants aged 0-30 days being either no different 26 or potentially shorter 32
- Studies showing that infants meeting low-risk clinical and laboratory profiles further reduce the likelihood of identifying serious bacterial infection after 24 hours to 0.3%.1

RECOMMENDATIONS

- Determine if febrile infants aged 0-90 days are at low risk for serious bacterial infection and obtain appropriate bacterial cultures.
- If hospitalized for observation, discharge low-risk febrile infants aged 0–90 days after 36 hours or less if bacterial cultures remain negative.
- If hospitalized for observation, consider reducing the length of inpatient observation for low-risk febrile infants aged 0–90 days with reliable follow-up to 24 hours or less when the culture results are negative.

CONCLUSION

Monitoring patients in the hospital for greater than 36 hours of bacterial culture incubation is unnecessary for patients similar to the 3 week-old full-term infant in the case presentation, who are at low risk for serious bacterial infection based on available scoring systems and have negative cultures. If patients are not deemed low risk, have an incomplete laboratory evaluation, or have had prior antibiotic treatment, longer observation in the hospital may be warranted. Close reassessment of the rare patients whose blood cultures return positive after 36 hours is necessary, but their outcomes are excellent, especially in well-appearing infants.7,33

What do you do?
Do you think this is a low-value practice? Is this truly a “Thing We Do for No Reason”? Let us know what you do in your practice and propose ideas for other “Things We Do for No Reason” topics. Please join in the conversation online at Twitter (#TWDFNR)/Facebook and don’t forget to “Like It” on Facebook or retweet it on Twitter. We invite you to propose ideas for other “Things We Do for No Reason” topics by emailing TWDFNR@hospitalmedicine.org.

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References
A 62-year-old man with severe chronic obstructive pulmonary disease (COPD; forced expiratory volume during the first second [FEV1] 40% predicted) and type 2 diabetes mellitus presented to a Veterans Affairs emergency department (ED) with a steadily worsening cough of 4-months’ duration. He also reported subjective fevers, sputum production, shortness of breath, and unintentional 20-pound weight loss. He denied chills, chest pain, nausea, or vomiting.

Cough is classified as acute, subacute, or chronic based on duration of less than 3 weeks, between 3-8 weeks, and greater than 8 weeks, respectively. Common causes of chronic cough include bronchitis, acid reflux, cough-variant asthma, and a side effect of angiotensin converting enzyme inhibitors. Unintentional weight loss suggests a serious disorder, including indolent infection, end-stage COPD, malignancy, and autoimmune causes. Among patients with chronic bronchitis, the microbiology of sputum is often mixed with commensal respiratory flora, including Streptococcus pneumoniae and Haemophilus species. When these organisms are not recovered in sputum, or when patients fail to respond to empiric treatment, the differential diagnosis should be broadened to include pulmonary tuberculosis, nontuberculous mycobacterial infection, lung abscess, pulmonary nocardiosis, or pertussis.

An exposure and social history can focus the differential. For example, coccidioidomycosis or histoplasmosis may present indolently, but have distinct geographic distributions. Bird fanciers may acquire hypersensitivity pneumonitis, psittacosis, or cryptococcosis. Risk factors including smoking history, corticosteroid use, uncontrolled diabetes, and ill contacts should be assessed.

He was discharged from the ED twice in the last 2 weeks after presenting with similar symptoms. On each occasion, he was treated for presumed COPD exacerbations with nebulized albuterol and ipratropium, methylprednisolone followed by oral prednisone, and azithromycin, which did not lead to improvement. Over the last 3 days, he developed lower extremity edema, orthopnea, and dyspnea at rest. He reported worsening fatigue, night sweats, and anorexia. He denied any sick contacts.

Two diagnostic issues have emerged. His edema, orthopnea, and dyspnea at rest suggest a new cause of hypervolemia, perhaps caused by sodium retention from corticosteroids, pulmonary edema from valvular or myocardial disease, or renal failure. More concerning is that he has been treated with azithromycin twice recently but still has night sweats, fatigue, and anorexia. The presence of weight loss despite extracellular volume accumulation suggests an indolent systemic illness. Infection with macrolide-resistant organisms, such as nocardia, mycobacteria, or endemic mycoses, remains high on the differential diagnosis.

His past medical history included hypertension, untreated chronic hepatitis C, tobacco dependence, alcohol use disorder, and extraction of 8 decayed teeth 2 months earlier. He served in a noncombat role during the Vietnam War. He consumed 12 beers weekly with a remote history of alcoholism which required rehabilitation, reported a 50 pack-year smoking history, and denied intravenous (IV) drug use. He lived with an appropriately vaccinated dog and denied recent insect or animal exposures. He had a cat that passed away from an unknown illness 3 years prior. He was in a monogamous relationship with his girlfriend of 35 years. His father had coronary disease. His medications included glyburide, hydrochlorothiazide, lisinopril, theophylline, and meloxicam.

Chronic cough, weight loss, diabetes, alcoholism, and history of dental disease raise concern for lung abscess. Oral microbiota such as Streptococcus viridans and Actinomycetes are usu-
ally harmless, but when aspirated repeatedly, such as during alcohol intoxication, may evolve into a lung abscess via bronchogenic spread. The combination of unintentional weight loss and smoking history raises concern for lung malignancy. Small cell lung cancer can present with paraneoplastic Cushing’s syndrome and could explain the patient’s volume overload. Finally, human immunodeficiency virus (HIV) serostatus should be determined in all adult patients.

His temperature was 37 °C, blood pressure 161/69 mm Hg, pulse 104 beats per minute, respiratory rate 20 breaths per minute, and oxygen saturation was 95% on room air. On examination, he was an unkempt, ill-appearing man. He had poor dentition, but no oral ulcers or petechiae. Pulmonary exam revealed diffuse ronchi and scattered wheezes. He developed dyspnea after speaking 2 sentences. Cardiovascular exam showed regular tachycardia, normal S1 and S2 heart sounds, and both an S3 and S4 gallop. A grade III/VI holosystolic murmur at the left lower sternal border with apical radiation, and an early, grade III/IV diastolic murmur at the right upper sternal border were present. Neck exam showed jugular venous distention (JVD) 8 cm above the right clavicle. Lower extremities showed symmetric 3+ pitting edema to the knees. His abdomen was soft, nondistended, and without hepatosplenomegaly. There was no lymphadenopathy. Skin exam showed small, healed excoriations on his anterior shins, forearms, and knuckles. There were no petechiae, Janeway lesions, or Osler’s nodes.

These exam findings change the differential substantially. New regurgitant murmurs strongly suggest infective endocarditis (IE). A diastolic murmur is never normal and suggests aortic regurgitation. The holosystolic murmur with apical radiation suggests mitral regurgitation. Cutaneous stigmata should always be sought, but are found in fewer than half of cases of subacute IE, and their absence does not rule out this diagnosis. Disheveled hygiene and excoriations suggest a skin source of infection, and poor dentition is concerning for an oral source. For the moment, the source does not matter. His clinical condition is serious: tachycardia, JVD, edema, and two-sentence dyspnea indicate congestive heart failure. Even before labs and imaging return, inpatient admission is warranted.

An electrocardiogram (EKG) showed sinus tachycardia and findings suggestive of left atrial enlargement and left ventricular hypertrophy. Chest x-ray demonstrated diffuse bronchial markings and prominent pulmonary vasculature (Figure 1). He was admitted and treated with IV furosemide for acute congestive heart failure. Oral prednisone and IV azithromycin were continued for COPD exacerbation. He noted an improvement in his orthopnea after 2 liters of urine output. His chest x-ray is not consistent with acute or chronic pulmonary infection. His symptoms, EKG, edema, and improvement with diuresis support the diagnosis of congestive heart failure. The leading diagnosis is left-sided IE, and antimicrobial therapy should not be delayed for the sake of awaiting positive blood cultures. He should immediately receive empiric antibiotics to cover gram-positive bacteria (Methicillin-resistant Staphylococ-
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Bacterial aortic valve endocarditis (BAVE) can be particularly challenging to diagnose as it is often associated with no significant symptoms, small vegetations, and prolonged positive blood cultures.

**Figure 2.** (A) Transesophageal echocardiogram (2-dimensional long axis view) in the end-diastolic phase illustrating small vegetations on the coronary cusps of the aortic valve (short arrows) and a mitral valve aneurysm (long arrow). (B) Color flow Doppler focused on the mitral valve demonstrates moderate mitral regurgitation (short green arrow) and regurgitant flow within the aneurysm from valve perforation (long green arrow). The combination of these findings suggests an infectious process, in which an aortic valve infection with regurgitation seeds an infection on the anterior leaflet of the mitral valve.

CUS aureus, Methicillin-sensitive S. aureus, coagulase-negative staphylococci, and enterococci) and Haemophilus species, Actinobacillus actinomycetemcomitans, Cardiobacterium hominis, Eikenella species, and Kingella kingae (the HACEK group). In accordance with Infectious Diseases Society of America (IDSA) practice guidelines, he should empirically receive IV vancomycin plus ceftriaxone and urgently undergo echocardiography.

Transthoracic echocardiogram (TTE) showed severe aortic insufficiency, aortic valve vegetations, and raised suspicion for a moderate-sized vegetation on the anterior leaflet of the mitral valve. There was moderate mitral insufficiency, moderate tricuspid insufficiency, and an elevated right ventricular systolic pressure of 50 mm Hg. The left ventricle showed concentric hypertrophy with an ejection fraction of 55%. A previous echocardiogram 2 years prior showed mild mitral insufficiency, but no aneurysm or aortic insufficiency. Blood cultures from admission yielded no growth.

Due to concern for IE, blood cultures were repeated, and IV vancomycin, IV ceftriaxone, and IV gentamicin were initiated. Azithromycin and prednisone were discontinued. His respiratory status continued to improve with IV furosemide, albuterol, ipratropium, and supportive care.

TTE inadequately visualizes the mitral valve, but is useful for tricuspid valve assessment because the right ventricle is closer to the chest wall. Transesophageal echocardiography (TEE) is indicated for a more detailed assessment of the left heart valves for vegetations and perivalvar abscesses. The new regurgitant murmurs satisfy a major criterion of the modified Duke criteria, and valvar vegetations suggests IE. He does not yet fulfill the other major modified Duke criterion for IE, nor does he satisfy enough minor criteria because there are no diagnostic vascular, microbiologic, or immunologic phenomena. However, no diagnostic rubric is perfect, and these results should not supersede clinical judgment. Despite the absence of positive cultures, the concern for bacterial IE remains high. The absence of embolic phenomena fits best with subacute rather than acute IE. Three negative blood cultures to date suggest a fastidious organism is responsible, although oral flora remain on the differential.

There is rarely a need to “hold” blood cultures for prolonged periods because modern instruments typically yield positive results within 7 days for most bacteria, including the HACEK group. Blood culture-negative endocarditis (BCNE) is considered when 3 sets of cultures are negative for at least 5 days. In this situation, one should consider other microorganisms based on the patient’s exposure history. Only certain species with complex growth requirements, such as Brucella and Bartonella, require prolonged holds. Revisiting his exposure history would be helpful in deciding whether serologic testing warranted. If he recalls exposure to parturient animals, then Coxiella is worth pursuing; if he has been bitten by lice, then B. quintana rises as a possibility; if the scratches on his limbs are from recent cat scratches, then B. henselae becomes more likely. Both C. burnetii and Bartonella endocarditis might be partially treated by his courses of azithromycin, confounding the picture.

If the infectious work-up is ultimately negative, one could then consider other etiologies of endocarditis, such as nonbacterial thrombotic endocarditis, which is seen in the context of malignancy and systemic lupus erythematosus (Libman-Sacks endocarditis). Other mimickers of IE include myxomatous valve degeneration, ruptured mitral chordae, and eosinophilic heart disease (Löffler’s endocarditis).

A transesophageal echocardiogram confirmed the presence of small echodensities on the aortic valve’s right and left coronary cusps, consistent with vegetations. The vegetation on the anterior leaflet of the mitral valve from the TTE also showed an aneurysm with a small perforation (Figure 2).

He denied exposure to parturient animals. All blood cultures remained negative at 7 days. He was placed on empiric
IV vancomycin, IV gentamicin, and IV ampicillin-sulbactam for suspected culture-negative endocarditis. Serology studies for *Bartonella quintana* immunoglobulin G (IgG) and immunoglobulin M (IgM), *Coxiella burnetii* IgG and IgM, *C. burnetti* DNA polymerase chain reaction (PCR), and urine *Legionella* antigen were negative. IgM titers for *Bartonella henselae* were <1:64, but IgG returned markedly elevated at ≥1:1024 (Positive > 1:256). Serum DNA PCR for *B. henselae* was positive.

The combination of aortic regurgitation and the mitral valve aneurysm supports IE, because the aortic regurgitant jet directly strikes the anterior mitral valve leaflet, seeding the valve with infection from the aortic cusps. A positive serum PCR is diagnostic, but if it had been negative or unavailable, the serology would remain very helpful. In this context, the elevated IgG titer implicates *B. henselae*, the agent responsible for cat scratch disease (CSD). Out of context, these titers would not be diagnostic, because anti-*Bartonella* IgG may be increased due to a prior subclinical episode of CSD. Anti-*Bartonella* IgM is an unreliable indicator of recent infection because it may wane within weeks, and this IgG titer is higher than what is observed with most remote infections.

Revisiting previous cat exposure is warranted. He lost his cat to an illness 3 years prior, however it would be appropriate to inquire about other animals, such as a stray kitten with fleas, which his skin scratches suggest. Up to 50% of all cats in flea endemic regions harbor *Bartonella* and are asymptomatic. Rarely, dogs can serve as reservoirs of this organism, with a presumed transmission route via flea, louse, or tick. Regardless of the route of infection, treatment should be focused on *B. henselae* IE.

Azithromycin can treat CSD, and its use for his presumed COPD exacerbation may have temporized his infection. However, azithromycin monotherapy is not recommended for *B. henselae* IE. Treatment is usually with 2 antibiotics, including an aminoglycoside (gentamicin) for the first 2 weeks, combined with either a tetracycline, a macrolide, or a beta-lactam for a minimum of 4-6 weeks. Oral rifampin can be considered if gentamicin is not tolerated. After completing IV treatment, an additional 6 months of oral doxycycline or azithromycin should be considered, especially for those who have not undergone valve surgery.

Significant probing revealed that he was scratched by a neighborhood cat 6 months earlier but had no symptoms. The scratches on his leg were from his dog. He received IV antibiotics for 6 weeks and was transitioned to oral doxycycline. He suffered a seizure from a presumed mycotic middle cerebral artery aneurysm, thus valve replacement was postponed for another 6 weeks. He underwent bioprosthetic aortic and mitral valve replacement. Valve pathology (Figure 3) showed myxoid degeneration, focal calcifications, mixed acute and chronic inflammation of both valves, and a small granuloma on the mitral valve. No organisms were seen on hematoxylin-eosin (H&E) staining, and Steiner stain was negative for *Legionella* and spirochetes. A Warthin-Starry stain was not performed. He felt well at 24 months.

The mitral valve aneurysm, abscesses, and heart failure warranted valve replacement. Surgery should be considered for all patients with *Bartonella* IE, primarily because delayed diagnosis often leads to irreversible valve damage. Ideally, surgically explanted tissue should be divided into 2 portions: half should...
be sent to pathology and stained with H&E, Warthin-Starry, and Steiner staining procedures, while the other half should be sent for culture, and then PCR if stains are negative.

His symptoms are compatible with subacute IE, which is typically more difficult to diagnose than acute IE due to its insidious onset. He meets criteria for blood culture negative IE based on 3 sets of negative blood cultures for greater than 5 days and major criteria for IE. The pathologic changes are consistent with *B. henselae* infection.

**DISCUSSION**

The incidence of IE in the United States is 40,000 cases per year with an in-hospital mortality of 15%-20% and a 1-year mortality of up to 40%.

Five to 20% of patients with IE never develop positive blood cultures due to receipt of antibiotics prior to culture, inadequate microbiologic testing, or infection caused by noncultivable bacteria (eg, *Tropheryma whippelii*), fastidious extracellular bacteria (eg, *HACEK* group and nutritionally variant streptococci), or by intracellular pathogens with complex nutrient requirements (eg, *Bartonella, Chlamydia, Brucella, or Coxiella*). Previous administration of antibiotics reduces the likelihood of isolating an organism by 35%-40%.

Patients meeting criteria for BCNE should prompt consideration of serologic testing. The most prevalent pathogens vary globally, and incidence data in the US is scarce. Worldwide, the majority of BCNE cases are caused by *Coxiella, Bartonella*, and *Brucella* species.

When clinical suspicion for IE remains high despite negative cultures, detailed history can uncover clues and guide additional testing. For example, contact with contaminated milk products or farm animals is associated with *Brucella, Coxiel-lla, and Erysipelothrix species* IE. *Bartonella* species are zoonotic gram-negative bacilli with a tropism for endothelial cells and are transmitted by arthropod vectors (ie, fleas, lice, ticks, and sandflies), cat scratches, or cat bites. *Bartonella* may account for 3%-4% of all cases of IE, most of which are due to *B. henselae* and *B. quintana*. Underlying heart valve disease, alcoholism, cirrhosis, and homelessness are associated with *B. henselae* endocarditis.

Diagnostic criteria are lacking for *B. henselae* IE, and the modified Duke criteria is of limited utility for diagnosing *Bartonella* IE because blood cultures are often negative and echocardiographic evidence of vegetation is not always apparent. Serology plays a critical role in the diagnosis of *Bartonella* infections. The addition of positive serology, Western blot or PCR for *B. henselae* and *B. quintana* as a major criterion in the modified Duke criteria for IE has been proposed but has not yet been formally accepted. For *B. henselae* IE, an IgG titer of ≥1:800 has been recommended as a cutoff for subacute IE because it combines a high specificity and positive predictive value along with reasonable sensitivity and negative predictive value in this situation. The humoral immune response rises over time, and thus acute IE due to *Bartonella* may not generate a substantial IgG titer.

Interestingly, because of the indolent nature of this pathogen, most cases of IE present once IgG titers have begun to rise. Serum PCR testing has shown a sensitivity and specificity of 58% and 100%, respectively. Isolation by blood culture requires specific growth media and prolonged incubation, with a sensitivity as low as 20% and 30% for blood and tissue, respectively. The microbiology laboratory should be notified of suspected *Bartonella* to intensify efforts to cultivate this organism. If infection with *Coxiella* or *Brucella* is suspected, the lab should also be informed, both to increase diagnostic yield and to trigger enhanced biosafety precautions when handling the specimens. Despite attempts to optimize the yield, up to 75% of *Bartonella* IE may remain culture negative, making it difficult to meet the current major modified Duke criterion of positive blood cultures. H&E staining of valve tissue infected with *Bartonella* commonly reveals increased inflammation, fibrosis, and calcified granulomas relative to endocarditis from other causes. The Warthin-Starry silver stain can identify small, darkly staining bacteria in more than 75% of *Bartonella* endocarditis; however, this stain is not specific for *Bartonella* species.

This case highlights the challenge of diagnosing subacute IE because this patient received antibiotics and steroids prior to presentation, clouding the clinical picture. Although he did not exhibit textbook signs of endocarditis, his symptoms (new onset heart failure and new regurgitant murmurs) prioritized the diagnosis. The combination of elevated serum titers, positive PCR, valve granulomas and abscesses on TEE, and pathology findings led the discussant to the correct diagnosis. Scratching beneath the surface revealed his penchant for cats, but this was only considered a key epidemiological feature later in his clinical course.

**TEACHING POINTS**

- Subacute IE typically presents with indolent constitutional symptoms over a course of weeks to months, whereas acute IE causes a rapid onset of fevers, rigors, and is more likely to exhibit embolic phenomena.

- Epidemiologic features specific to *Bartonella* species include alcoholism, cirrhosis, dog or cat exposure, homelessness, and body lice, and should be considered in suspected cases of BCNE.

- If suspicion for endocarditis remains high and animal exposure is elicited, then serologic and PCR testing for fastidious organisms should be strongly considered. The most common causes of BCNE include *Coxiella*, *Bartonella*, and *Brucella* species.

- The modified Duke criteria do not incorporate *Bartonella* within the diagnostic schema. Presentation is usually late and often requires valve replacement.

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The Harm We Do: The Environmental Impact of Medicine

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While often unseen and infrequently discussed, the environmental impact of hospital systems and healthcare providers is substantial. However, some US hospitals and healthcare systems have developed innovative approaches to reduce their environmental impact while reducing costs. In this perspective, we discuss how hospitalists may support ongoing environmental efforts through education and awareness, measurement and amelioration, public reporting, and individual actions. Given the extent of healthcare’s impact on the environment, the benefits of interventions, and the link between hospitalists and hospitals, We must minimize the harm we do. Journal of Hospital Medicine 2018;13:353-355. Published online first February 27, 2018. © 2018 Society of Hospital Medicine

Healthcare is a “dirty” business with widespread effects on the environment. In the US, healthcare is estimated to generate 9.8% of our greenhouse gases and 9% of our particulate matter emissions.1 Hazardous wastes must be incinerated, emitting carbon dioxide, nitrogen oxides, and volatile substances into the atmosphere.2 Similarly, hospitals are responsible for 7% of commercial water use in the US.3 Conventional water treatment systems are not designed to remove heavy metals, pharmaceuticals, and disinfectants in hospital wastewaters; these compounds have been detected in rivers and streams throughout the US.4,5 Furthermore, pharmaceutical compounds such as antibiotics, anti-epileptics, and narcotics have even been isolated in our drinking water.5

As hospitalists, we are the directors of inpatient care, yet we only witness brief moments in the lives of our patients and the products we use for their care. For example, we are unaware of particulate matter emissions needed to power an extra imaging study or the contribution of unused materials to a growing landfill. However, pollution, including that from our clinical practice, is detrimental to human health in many ways. Exposure to particulate matter and toxic wastes has been linked to increased rates of reproductive and developmental disorders, cancer, and respiratory disease.6 Particles <2.5 µm in diameter can diffuse through alveoli into the bloodstream, contributing to heart disease, stroke, and lung disease.7 Climate change has been linked to a wide range of adverse cardiovascular, respiratory, infectious, and mental health outcomes.8,9 These examples of the health impacts of pollution are illustrative but not exhaustive.

The environmental impact of US healthcare accounts for an estimated 470,000 disability-adjusted life years lost; this figure is on par with the burden of preventable medical errors.1 Clear- ly, change is necessary at all levels in the healthcare system to address our impact on human health. Fortunately, healthcare systems and hospital administrators have begun to address this issue. This perspective describes sustainability efforts in hospitals and healthcare systems and seeks to motivate hospitalists to build upon these efforts.

EFFECTS BY HOSPITALS AND HEALTHCARE SYSTEMS

With the ability to affect change from the top down, health systems are playing an important role in healthcare’s environmental sustainability. Ambitiously, Kaiser Permanente outlined eight environmental stewardship goals, which include becoming net carbon positive and recycling, reusing, or composting 100% of their non-hazardous waste by 2025.10 The Cleveland Clinic has pledged to become carbon neutral within the next 10 years.11 Other healthcare systems may follow suite. Many “green” interventions aimed at reducing waste and pollution also protect population health and reduce hospital operating costs.

From 2011 to 2015, a group of Boston Hospitals decreased energy use by 9.4% compared with a historical growth of 1.5% per year and saved over 15 million dollars.12 Similarly, Virginia Mason reduced landfill waste by reprocessing single-use medical devices, thereby decreasing purchasing costs by $3 million.13 As part of a regional campaign to protect the St. Croix River, Hudson Hospital and Clinic in Wisconsin saved over $20,000 with new recycling and waste reduction programs.13 Notably, these programs not only benefit hospitals but also patients and payers by reducing costs of care.

ROLE OF THE HOSPITALIST

These examples illustrate that a greener healthcare industry is achievable. Despite the potential benefits, sustainability efforts in US hospitals are the exception, not the rule, and the
diffusion of such innovations must be encouraged from within. In addition to the moral case for environmentally sustainable healthcare,\textsuperscript{14,15} such efforts can also improve our quality of care. The conversation around healthcare waste has focused on costs. Yet, examining our waste from a new perspective may reveal new ways to increase the value of patient care while protecting population health. Our communities and families are not immune to the health impacts of pollution, including that generated by our industry. However, predicted effects of climate change including altered patterns of vector-borne disease and frequent hurricanes and forest fires are upon us, affecting our communities, hospitals, and health delivery enterprise today. These challenges represent educational, academic, and economic opportunities that hospitalists should embrace.

**RECOMMENDATIONS FOR ACTION**

**Education and Awareness**

The first step to engagement is to promote awareness of the effects of healthcare waste. Physicians remain one of the most trusted sources of information about the health impacts of climate change.\textsuperscript{16} By educating ourselves, we can spread accurate knowledge to our patients and communities. Furthermore, we have the ability to advocate for our hospitals to follow institutions such as Kaiser Permanente and the Cleveland Clinic.

Given that hospitalists play a key role in educating students and residents, they are ideal vehicles for such dissemination. Education should begin in medical and nursing schools, where curricula detailing the importance and impact of healthcare pollution may be introduced. As hospitalists, we should champion such efforts.

**Measurement and Amelioration**

Second, resource use, waste production, and areas for improvement must be systematically quantified. At a national level, the Sustainable Development Unit of the National Health System (NHS) measures and reports water use, waste production, and energy consumption of the UK’s healthcare sector. Consequently, the NHS has surpassed their 2015 goal of reducing their carbon footprint by 10%.\textsuperscript{17} By establishing a baseline understanding of our carbon emissions, waste production, and water consumption, areas where physicians and hospitals can target improvement can similarly be identified.

Physicians appreciate the practical tradeoffs between clinical work and change efforts; thus, they are critical in establishing pragmatic policies. Physicians, often in collaboration with environmental engineers, have used evidence-based methods such as life-cycle analysis (LCA) to evaluate the environmental impacts of the pharmaceuticals and procedures that they use.\textsuperscript{18-20} An LCA is a cost-benefit analysis that examines multiple parameters of a product, namely, emissions, water use, costs, and waste production, from production to disposal. For example, an LCA of disposable custom packs for hysterectomies, vaginal deliveries, and laryngeal masks found costs savings and environmental benefits from choosing reusable over single-use items and removing unnecessary materials such as extra towels in this setting.\textsuperscript{18-20} By considering the full life cycle of a procedure, LCAs reveal important information about the value and safety of care. LCAs, along with other sustainable design strategies, are tools that can provide hospitalists with new insights for quality improvement.

**Public Reporting**

Numerous physicians are known for educating their communities about the impacts of pollution on health. Recently, a pediatrician brought the presence of lead in Flint’s water supply to the public’s attention, instigating government action and policy change.\textsuperscript{21} A group called Utah Physicians for a Healthy Environment publishes online summaries of peer-reviewed information on air pollution and health. The Huma Lung Foundation led by a pulmonologist in Chennai, India, is working with a local radio station to report daily air quality measurements along with health advisories for the city.

We must now extend this paradigm to encompass transparency about healthcare’s practices and their impact on health. Indeed, the public is comfortable with this idea: a survey of 1011 respondents in the UK found that 92% indicated that the healthcare system should be environmentally sustainable.\textsuperscript{22} One idea may be a public-facing scorecard for hospitals, akin to publicly reported quality metrics. We can look to the example of the SDU and corporations such as Apple, which publicly report their carbon emissions, waste production, water use, and other metrics of their environmental impact. By galvanizing efforts to quantify and report our impact, hospitalists have the opportunity to be a role model for the industry and increase trust within their communities.

**Individual Actions**

What can a hospitalist do today? First, simple measures, like turning off idle electronics, recycling appropriately, or avoiding the use of unnecessary supplies or tests, are behavioral steps in the right direction. Second, just as education, goal setting, and feedback have met success in improving hand hygiene,\textsuperscript{23} we must begin the hard work of developing programs to monitor our environmental impact. Individual hospitalist carbon scores may help intensify efforts and spur improvement. Finally, we should learn and celebrate each other's success. Renewed focus on this topic with increased reporting of interventions and outcomes is needed.

**CONCLUSIONS**

As hospitalists, we must look within ourselves to protect our planet and advocate for solutions that assure a sustainable future. By recognizing that a healthy environment is crucial to human health, we can set an example for other industries and create a safer world for our patients. Eliminating the harm we do is the first step in this process.

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Here is little doubt that preventing 30-day readmissions to the hospital results in lower costs for payers. However, reducing costs alone does not make this metric a measure of “high value” care.1 Rather, it is the improvement in the effectiveness of the discharge process that occurs alongside lower costs that makes readmission reduction efforts “high value” — or a “win-win” for patients and payers.

However, the article by Nuckols and colleagues in this month’s issue of the Journal of Hospital Medicine (JHM) suggests that it might not be that simple and adds nuance to the ongoing discussion about the 30-day readmission metric.2 The study used data collected by the federal government to examine changes not only in 30-day readmission rates between 2009-2010 and 2013-2014 but also changes in emergency department (ED) and observation unit visits. What they found is important. In general, despite reductions in 30-day readmissions for patients served by Medicare and private insurance, there were increases in observation unit and ED visits across all payer types (including Medicare and private insurance). These increases in observation unit and ED visits resulted in statistically higher overall “revisit” rates for the uninsured and those insured by Medicaid and offset any improvements in the “revisit” rates resulting from reductions in 30-day readmissions for those with private insurance. Those insured by Medicare—representing about 300,000 of the 420,000 visits analyzed—still had a statistically lower “revisit” rate, but it was only marginally lower (25.0% in 2013-2014 versus 25.3% in 2009-2010).2

The generalizability of the Nuckols’ study was limited in that it examined only index admissions for acute myocardial infarction (AMI), heart failure (HF), and pneumonia and used data from only Georgia, Nebraska, South Carolina, and Tennessee—the four states where observation and ED visit data were available in the federal database.2 The study also did not examine hospital-level revisit data; hence, it was not able to determine if hospitals with greater reductions in readmission rates had greater increases in observation or ED visits, as one might predict. Despite these limitations, the rigor of the study was noteworthy. The authors used matching techniques to ensure that the populations examined in the two time periods were comparable. Unlike previous research,3,4 they also used a comprehensive definition of a hospital “revisit” (including both observation and ED visits) and measured “revisit” rates across several payer types, rather than focusing exclusively on those covered by fee for service Medicare, as in past studies.4,5

What the study by Nuckols and colleagues suggests is that even though patients may be readmitted less, they may be coming back to the ED or getting admitted to the observation unit more, resulting in overall “revisit” rates that are marginally lower for Medicare patients, but often the same or even higher for other payer groups, particularly disadvantaged payer groups who are uninsured or insured by Medicaid.2 Although the authors do not assert causality for these trends, it is worth noting that the much-discussed Hospital Readmission Reduction Program (or “readmission penalty”) applies only to Medicare patients aged more than 65 years. It is likely that this program influenced the differences identified between payer groups in this article.

Beyond the policy implications of these findings, the experience of patients cared for in these different settings is of paramount importance. Unfortunately, there are limited data comparing patient perceptions, preferences, or outcomes resulting from readmission to an inpatient service versus an observation unit or ED visit within 30 days of discharge. However, there is reason to believe that costs could be higher for some patients treated in the ED or an observation unit as compared to those in the inpatient setting,6 and that care continuity and quality may be different across these settings. In a recent white paper on observation care published by the Society of Hospital Medicine (SHM) Public Policy Committee,7 the SHM reported the results of a 2017 survey of its members about observation care. The results were concerning. An overwhelming majority of respondents (87%) believed that the rules for observation care are unclear for patients, and 68% of respondents believed that policy changes mandating informing patients of their observation status have created conflict between the provider and the patient.7 As shared by one respondent, “the observation issue can severely damage the therapeutic bond with patient/family, who may conclude that the hospitalist has more interest in saving someone money at the expense of patient care.”7 Thus, there is significant concern about the nature of observation stays and the experience for patients and providers. We should take care to better understand these experiences given

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that readmission reduction efforts may funnel more patients into observation care.

As a next step, we recommend further examination of how “revisit” rates have changed over time for patients with any discharge diagnosis, and not just those with pneumonia, AMI, or HF. Such examinations should be stratified by payer to identify differential impacts on those with lower socioeconomic status. Analyses should also examine changes in “revisit” types at the hospital level to better understand if hospitals with reductions in readmission rates are simply shifting revisits to the observation unit or ED. It is possible that inpatient readmissions for any given hospital are decreasing without concomitant increases in observation visits, as there are forces independent of the readmission penalty, such as the Recovery Audit Contractor program, that are driving hospitals to more frequently code patients as observation visits rather than inpatient admissions. Thus, readmissions could decrease and observation unit visits could increase independent of one another. We also recommend further research to examine differences in care quality, clinical outcomes, and costs for those readmitted to the hospital within 30 days of discharge versus those cared for in observation units or the ED. The challenge of such studies will be to identify and examine comparable populations of patients across these three settings. Examining patient perceptions and preferences across these settings is also critical. Finally, when assessing interventions to reduce inpatient readmissions, we need to consider “revisits” as a whole, not simply readmissions. Otherwise, we may simply be promoting the use of interventions that shift inpatient readmissions to observation unit or ED revisits, and there is little that is patient-centered or high value about that.

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References
Engaging Families as True Partners During Hospitalization

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COMMUNICATION FAILURES ARE A LEADING CAUSE OF SENTINEL EVENTS, THE MOST SERIOUS ADVERSE EVENTS THAT OCCUR IN HOSPITALS.1 Interventions to improve patient safety have focused on communication between healthcare providers.2-4 Interventions focusing on communication between providers and families or other patient caregivers are under-studied.5,6 Given their availability, proximity, historical knowledge, and motivation for a good outcome,7 families can play a vital role as “vigilant partners”8 in promoting hospital communication and safety.

In this month’s Journal of Hospital Medicine, Solan et al conducted focus groups and interviews of 61 caregivers of hospitalized pediatric patients at 30 days after discharge to assess their perceptions of communication during hospitalization and discharge home.9 They identified several caregiver themes pertaining to communication between the inpatient medical team and families, communication challenges due to the teaching hospital environment, and communication between providers. Caregiver concerns included feeling out of the loop, excessive provider use of medical jargon, confusing messages on rounds, and inadequate communication between inpatient and outpatient providers.

The manuscript serves both to uncover family concerns that may be underappreciated by clinicians and suggest some potential solutions. For instance, caregivers can be apprehensive about whom to call for postdischarge advice because they are sometimes uncertain whether their outpatient providers have sufficient information about the hospitalization to properly advise them. The authors propose using photo “face sheets” to improve caregiver identification of healthcare provider roles, including families in hospital committees, improving transition communication between inpatient and outpatient healthcare providers through timely faxed discharge summaries and telephone calls, and informing families about such communications with their outpatient providers.

In order to partner with one another, families and healthcare providers need to speak a common language. A key way to ensure that families and providers speak a common language is for providers to espouse good health literacy principles. Health literacy is the “capacity to obtain, process, and understand basic health information and services to make appropriate health decisions.”13 Health literacy is dynamic, varying based on medical problem, provider, and healthcare system.14 Overall, only 12% of United States adults possess the health literacy skills required to navigate our complex healthcare system.15,16 Stress, illness, and other factors can compromise the ability of even highly literate families—not least of all those who are physicians—to understand health information. Yet health literacy is routinely overestimated by providers.17,18

To optimize communication with families, providers should use “universal health literacy precautions”16 with all patients, not just those believed to need extra assistance, in both verbal (eg, family-centered rounds (FCRs) and written communications (eg, discharge instructions).16 Providers should speak in plain, nonmedical language, be specific and concrete, and have families engage in “teach-back” (ie, state in their own words their understanding of the plan). They should focus on what families “need to know” rather than what is “good to know.” They should use simpler sentence structure and “chunk and check”20 (ie, provide small, “bite-sized” pieces of information and check for understanding by using teach-back).21 In writing, they should use simpler sentence structure, bullet points, active statements, and be cognizant of reading level, medical jargon, and word choice (eg, “has a fever” instead of “febrile”). It is worth recognizing that even highly educated, highly literate families—not least of all those who are physicians and nurses themselves—can benefit from universal health literacy precautions because the ability to process and grasp information is dynamic and can be markedly lower than usual when faced with the illness of a loved one.

HEALTH LITERACY

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EDITORIAL
At a systematic level, medical schools, nursing schools, residency training programs, and continuing education should include health literacy training in their curricula. While learning to speak the language of medicine is an important part of medical education, the next step is learning to “unspeak” it, a challenging but important charge to promote partnership.

**SHARED DECISION MAKING**

SDM is the process by which providers and patients make decisions together by balancing clinical evidence with patient preferences and values. However, despite providers believing they are engaging in SDM, families report they are often not as involved in SDM as they would like. Indeed, most hospital communications with families, including FCRs and discharge instructions, typically emphasize information sharing, not SDM. SDM tends to be more commonly applied in outpatient settings. To encourage SDM in the hospital setting, patients and families should not only understand communication during FCRs and at discharge but should be encouraged to be active participants in developing care plans, no matter how minor the decisions involved. SDM can be applied to a variety of discussions, both during hospitalization (eg, initiation of antibiotics, transition from intravenous to oral medications, pursuing imaging) and at discharge (eg, assessing discharge readiness, deciding duration of therapy, formulating follow-up recommendations). Providers will benefit from incorporating information from personal and medical histories that only families possess, resulting in more informed and potentially safer care plans that may be more likely to fit into the family’s life at home. SDM can also ensure patient and family “buy-in” and increase the likelihood of compliance with the shared plan.

**FAMILY CENTERED DISCHARGES**

Discharge processes often involve multiple redundancies and parallel processes that fail to actively involve families or promote transparency. Discharge summaries are typically written in medical jargon and intended for the outpatient provider (who may not receive them in a timely fashion), not the family. Separate discharge instructions are often provided to families without sufficient attention to health literacy, contingency planning, or individualization (eg, a generic asthma fact sheet). Outpatient providers are not always contacted directly about the hospitalization, nor are families always informed when providers are contacted, as Solan et al. describe. Providers can apply lessons from FCRs to discharge processes, pursuing a similar family-centered, interprofessional approach promoting partnership and transparency. Just as providers engage families during discussions on FCRs, they can engage families in discharge conversations with outpatient providers and nursing colleagues. Indeed, Berry et al. propose a discharge framework that emphasizes involvement of and dialogue between patients, families, and providers as they systematically develop and assess plans for discharge and postdischarge care. To accomplish this, inpatient providers can copy families on discharge summaries and other correspondence with outpatient providers (eg, through secure emails or open-source notes such as OpenNotes). Moreover, particularly for complex discharges, inpatient providers can call outpatient providers in the family’s presence or invite outpatient providers to join—via telephone or videoconference—day-of-discharge FCRs or discharge huddles. Such efforts require logistical and pragmatic considerations, as well as culture change, but are not insurmountable and may help address many family concerns around peri-discharge communication and care. Such efforts may also promote accountability on the part of families and providers alike, thereby ensuring that families are truly engaged as vigilant partners in care.

As one of us (SC) reflected once when considering her experience navigating healthcare as a parent of 2 children with cystic fibrosis, “We have to make it easier for families to be a true part of their children’s care. When patients and families are true members of the medical team, care is more informed, more targeted, and more safe for everyone.”

Disclosures. Dr. Landrigan has consulted with and holds equity in the I-PASS Patient Safety Institute, a company that seeks to train institutions in best handoff practices and aid in their implementation. Dr. Landrigan is supported in part by the Children’s Hospital Association for his work as an Executive Council member of the Pediatric Research in Inpatient Settings (PRIS) network. Dr. Landrigan has also served as a paid consultant to Virgin Pulse to help develop a Sleep and Health Program. In addition, Dr. Landrigan has received monetary awards, honoraria, and travel reimbursement from multiple academic and professional organizations for teaching and consulting on sleep deprivation, physician performance, handoffs, and safety and has served as an expert witness in cases regarding patient safety and sleep deprivation.

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The proper duration of antibiotic therapy for various infections is a matter of long-standing consternation. For decades, the standard antibiotic course for most acute bacterial infections has been 7 to 14 days, based largely on the fact that the week has 7 days in it. The reason the week has 7 days in it dates back, in an edict issued by Constantine the Great in 321 AD. To underscore the absurdity of basing 21st century antibiotic course durations on an ancient Roman Emperor’s decree, I refer to such durations as “Constantine Units.” One Constantine Unit is a 7-day course of antibiotics, and 2 Constantine Units is a 14-day course.

It has been nearly 10 years since Dr. Lou Rice first publicly called out the need to move to shorter courses of antibiotic therapy based on high-quality data. Nearly 5 years ago, colleagues picked up Dr. Rice’s mantle and again called for the medical community to move to short-course antibiotic therapies. There have been dozens of antibiotic trials comparing shorter versus longer durations of therapy for a variety of acute bacterial infections (Table). Essentially, all such trials studying acute bacterial infections in adults have found that shorter-course therapy is just as effective as longer therapy.

On such a plethora of data, a year ago, I suggested that physicians replace the dogma of Constantine-Unit-based durations of therapy with a new mantra, “shorter is better.” A year later, that mantra is no longer new. It is maturing, but it is not yet sufficiently widespread among providers. As a result, providers continue to prescribe unnecessarily long durations of antibiotic therapy, which wastes antibiotics, results in increased selective pressure driving antibiotic resistance, and continues to erode the miraculous efficacy of these drugs.

Royer et al. have now added to the overwhelming evidence in favor of short-course antibiotic therapy with a new meta-analysis comparing shorter courses with longer courses of therapy for acute bacterial infections, specifically for hospitalized patients. They studied clinical trials comparing shorter versus longer courses of therapy for hospital inpatients with pneumonia, complicated urinary tract infections, intraabdominal infections, or nosocomial infections of unknown origin. Across 13 clinical trials that included efficacy data, cumulatively, the investigators found no difference in clinical cure, microbiological cure, mortality, or infection relapses between short courses and longer courses of therapy. As mentioned, this result is concordant with an extensive body of literature on this topic (Table).

The fact that short durations of antibiotics can cure infections has been known for a long time. In the early penicillin era, courses of therapy were typically 1 to 4 days with good success rates. Interestingly, in a recent clinical trial in which daptomycin was found to be ineffective for community-acquired pneumonia (because of inactivation by pulmonary surfactant), a single dose of ceftriaxone markedly improved the cure rate for pneumonia in the daptomycin arm. The salutary effect of a single dose of ceftriaxone on the clinical cure for pneumonia reinforces how badly we have been overtreating infections for many years.

Many of the signs and symptoms of bacterial infections result from the inflammatory response to the bacteria rather than the direct presence of viable bacteria. Thus, the persistence of symptoms for a few days does not necessarily mean that viable bacteria are still present (ie, symptoms can persist even when all the bacteria are dead). It is likely that a reasonable proportion of patients with acute bacterial infections are cured with 1 day of therapy, and that additional days are decremental to increasing that cure rate. Even 5 days of antibiotics are likely more than is needed to cure the large majority of patients with acute bacterial infections.

Unfortunately, we do not yet have the technology to truly customize durations of therapy in individual patients, although the resolution of high-procalcitonin levels can assist with this question by enabling earlier termination of therapy. Rather, we tend to select fixed durations of therapy knowing that we are overtreating some (if not most) patients because we cannot distinguish individual treatment needs, and we want to be sure that the duration we select will maximally cure everyone we treat. Our desire to maximize cures across a population has led us to expand durations of therapy over many decades based on increments of Constantine Units. Fortunately, more recent randomized controlled trials now tell us with great confidence that shorter courses of antibiotic therapy are as effective as longer courses, with the added benefit of reducing the exposure of patients to antibiotics. Reduced exposure intrinsically reduces the risk of adverse events and of selective pressure that drives resistance in our microbiomes.

Thus, shorter is indeed better. The thought is no longer new; it is maturing. It is based on real, repeated, high-quality randomized controlled trials across multiple types of infections. Medical staffs of hospitals should pass expected practices
around short-course antibiotic therapy to encourage their providers to practice modern antiinfective medicine. National guidelines for specific types of infections and regulatory standards for clinical trial conduct should also be updated. In short, it is time for the medical community to support changing our old habits and help to transform how we use and protect the rapidly eroding societal trust that is effective antimicrobial therapy.

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References
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