holds a minority equity position in the privately held company Medicalis, which develops web-based decision support for radiology test ordering. He serves on the board for SEA Medical Systems, which makes intravenous pump technology. He serves as an advisor to Calgary Scientific, which makes technologies that enable mobility within EHRs. He is on the clinical advisory board for Zynx Inc, which develops evidence-based algorithms, and Patient Safety Systems, which provides a set of approaches to help hospitals improve safety. He is a consultant for EarlySense, which makes patient safety monitoring systems.

**Funding/Support:** Dr Baer was supported by a Mentored Research Scientist Career Development Award from the Agency for Healthcare Research and Quality (K01HS019789). Some funding for this work also was provided by the Eleanor and Miles Shore 50th Anniversary Fellowship for Scholars in Medicine from Harvard Medical School.

**Role of the Sponsors:** The funding organization had no role in the design and conduct of the study; in the collection, analysis, and interpretation of the data; or in the preparation, review, or approval of the manuscript.


<table>
<thead>
<tr>
<th>Element</th>
<th>Implementation Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge summary template in the electronic medical record</td>
<td>July (month 1 of program)</td>
</tr>
<tr>
<td>We incentivized 2 template fields: (1) whether the patient expressed wishes for care during the hospitalization and (2) whether the patient identified a surrogate decision maker; additional fields allowed residents to enter detailed information</td>
<td>July (month 1 of program)</td>
</tr>
<tr>
<td>Financial incentive program</td>
<td>July (month 1 of program)</td>
</tr>
<tr>
<td>For residents to receive the $400 financial incentive, documentation of the 2 incentivized fields was required within 48 h of discharge for 75% of patients in at least 3 of 4 quarters of the year</td>
<td>July (month 1 of program)</td>
</tr>
</tbody>
</table>

**Audit and feedback**

- General information about the program, including targets and requirements, in monthly reminder e-mails and at education sessions

- Feedback at the team level in biweekly e-mails

- Standardized graphical and tabular data comparing overall, team, and individual residents’ documentation rates in biweekly e-mails

- November (month 5 of program)

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**Incentivizing Residents to Document Inpatient Advance Care Planning**

Discussing preferences for care near the end of life increases the likelihood that patients will receive care consistent with their preferences.\(^1\)\(^-\)\(^4\) Recent work\(^5\) demonstrates that medical professionals infrequently ask about and document preferences for patients upon hospitalization. Because most end-of-life discussions occur in hospitals,\(^6\) we implemented a quality improvement program incentivizing resident physicians to consistently document key information about patient advance care planning discussions in a timely manner in an accessible location.

**Methods**\(^*\) We conducted the project between July 1, 2011, and May 31, 2012, on the medical service at the University of California, San Francisco (UCSF), where the Medical Center and departments of medicine and graduate medical education collaborated to form the Housestaff Incentive Program. In this program, trainees choose quality improvement goals and faculty mentor trainee champions through design and implementation of projects. If goals are met, all trainees receive a financial incentive. Internal Medicine residents selected the goal of improving documentation of advance care planning discussions on the basis of pilot work and experience that inconsistent documentation was a barrier to honoring patients’ wishes on transitions of care. Input from key stakeholders, including emergency department, outpatient, hospital, and palliative care providers, informed the intervention, especially location and content of documentation. The project included 3 key elements; the details of each of these are included in the Table. To assess documentation rates, program residents reviewed charts of a random sample of recently discharged patients on a biweekly basis. The UCSF institutional review board approved the project.

**Results**\(^*\) The Figure shows implementation of key aspects of the intervention and the percentage of discharge summaries that included the required documentation by project month. Documentation rates are based on medical record review of 1474 patients, comprising 55.5% of those discharged from the medical service during the project period. Rates rose from 22.2% at the beginning of the program to more than 90% by October and remained near this level through May. In comparison, documentation rates for patients discharged from an attending-only service, which used the electronic template but did not receive the financial incentive or feedback, were 0% to 50% with a yearly mean of 11.7%.

**Discussion**\(^*\) We implemented a multifaceted intervention to improve resident documentation of advance care planning discussions in a consistent format and location. We believe that...
the discharge summary template and the financial incentive program provided the foundation for the observed increase in documentation rates. However, rates did not begin to increase until we implemented and refined performance feedback, indicating that this aspect was essential. Further work should be designed to demonstrate which specific interventions are most important.

Several limitations of this project warrant consideration. A key limitation was that we did not measure patient outcomes, and doing so will be critical in future work. In addition, we did not track documentation rates after the end of the program. Future programs should focus on sustainability, for example, by electronic medical record automation of audit and feedback. Finally, it is possible that factors other than the intervention contributed to the increase in rates that we observed during the course of the program.

In conclusion, our trainee-led quality improvement project, including a structured electronic medical record template, a financial incentive, and performance feedback, increased timely documentation of inpatient advance care planning discussions. Our results highlight the effectiveness of engaging residents in quality improvement activities. In addition, they present the possibility that such an incentive program could improve patient outcomes by ensuring that their wishes are available across care transitions.

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Published Online: July 15, 2013.

Author Contributions: Dr Lakin had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: All authors.

Acquisition of data: Lakin, Le.

Analysis and interpretation of data: Lakin, Le, Mourad, Hollander.

Drafting of the manuscript: Lakin, Le, Mourad, Hollander.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Le.

Administrative, technical, and material support: Lakin, Hollander.

Study supervision: Mourad, Hollander, Anderson.

Conflict of Interest Disclosures: None reported.

Funding/Support: The University of California, San Francisco (UCSF), Medical Center and Department of Graduate Medical Education funded this project. The UCSF Clinical and Translational Science Institute Career Development Program, supported by National Institutes of Health grant KL2 RR024130, funded Dr Anderson.

Previous Presentation: Dr Lakin presented this work at the Annual Assembly of the American Academy of Hospice and Palliative Medicine; March 15, 2013; New Orleans, Louisiana.

Additional Contributions: Sumant Ranji, MD, Krishan Soni, MD, and Rebecca Sudore, MD, all from UCSF, provided leadership and guidance in managing this program. In addition, Ari Hoffman, MD, Jeffrey Dixson, MD, Ajay Dharia, MD, YinChong Mak, MD, Christopher Moriates, MD, Kara Bischoff, MD, and Aparna Goel, MD, also all from UCSF, built and refined this project and generated the required momentum to complete this incentive program.
Hospital Clinicians’ Responsiveness to Assay Cost Feedback: A Prospective Blinded Controlled Intervention Study

In developed countries, the costs of providing medical care are consistently increasing and projected to continue to do so. Some components of health care may be regarded as discretionary, and this is reflected in the large variation in hospital costs that was not associated with clinical outcomes and the conclusions of a systematic review that non-evidence-based variables influence physicians’ test ordering. In the United Kingdom, health care is provided by the National Health Service (NHS), with hospital physicians requesting diagnostic tests based on their perception of good clinical practice. The service is free at source, and physicians are not routinely informed of the individual cost of their activities. We tested the hypothesis that hospital clinicians are sensitive to feedback of assay cost in a blinded prospective controlled study.

Methods | The study was based in Nottingham University Hospitals NHS Trust. The study population consisted of all inpatients and outpatients who attended either Nottingham City Hospital (NCH) (intervention site) or Queen’s Medical Centre (QMC) (control site). The intervention consisted of a message stating “Cost per test £1.00; total NUH [Nottingham University Hospitals] spent on C-reactive protein [CRP] assays in 2010 was £200 914” that was added to the CRP reports. The intervention was introduced at the NCH site but not at QMC. The total number of blood CRP assays requested were obtained for the 52 weeks before and after the intervention. We also collected data over the same period on the number of complete blood cell count requests to generate an independent measure of clinical activity in the 2 centers. The primary comparison used time series analysis of the difference in weekly frequency of the total number of blood CRP assays requested in the 52 weeks before compared with the 52 weeks after the intervention was introduced at NCH vs QMC. More details are available in the eMethods in the Supplement.

Results | At NCH there was a significant decrease in the number of assays after the intervention was implemented, with a mean decrease in demand of 382 CRP assays per week (95% CI, 319 to 444) (P < .001), representing a proportionate decrease from baseline of 32% (95% CI, 27% to 37%). No such change was observed in the weekly number of CRP assays at QMC (Table).

Comparison of the difference in the weekly number of CRP assays requested at NCH vs QMC demonstrated a significant increase in the difference between the 2 sites of 338 CRP assays per week (95% CI, 279 to 396) (P < .001) after the intervention was implemented (Figure), representing a 99% (95% CI, 82% to 116%) change compared with the baseline weekly difference. These differences were a consequence of a decrease in demand in inpatients at NCH (increase in weekly difference between sites of 386 assays [95% CI, 339 to 433]).

Discussion | To our knowledge, this is the first study that has investigated the implementation of feedback of the cost of an assay to the requesting clinicians on subsequent demand at the institutional level. Our data clearly demonstrate that after the introduction of the intervention, the demand for CRP blood assays decreased.

### Table. Total Number of CBC and CRP Assays Requested at NCH (Intervention Site) and QMC (Control Site) Sites Before and After Intervention Implemented to CRP Reports

<table>
<thead>
<tr>
<th>Site</th>
<th>Total CBC Assays, No.</th>
<th>Total CRP Assays, No.</th>
<th>Absolute Change in No. of Weekly CRP Assays*</th>
<th>P Value</th>
<th>% Change in No. of Weekly CRP Assays From Baseline*</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inpatients</td>
<td>154 976</td>
<td>143 213</td>
<td>53 222</td>
<td>35 730</td>
<td>~336 (~395 to ~278)</td>
</tr>
<tr>
<td>Outpatients</td>
<td>60 074</td>
<td>60 523</td>
<td>8556</td>
<td>6197</td>
<td>~45 (~54 to ~36)</td>
</tr>
<tr>
<td>Total</td>
<td>215 050</td>
<td>203 736</td>
<td>61 778</td>
<td>41 927</td>
<td>~382 (~444 to ~319)</td>
</tr>
<tr>
<td>QMC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inpatients</td>
<td>140 697</td>
<td>151 425</td>
<td>58 667</td>
<td>61 259</td>
<td>+50 (~27 to +127)</td>
</tr>
<tr>
<td>Outpatients</td>
<td>69 357</td>
<td>74 713</td>
<td>20 826</td>
<td>15 941</td>
<td>~94 (~125 to ~63)</td>
</tr>
<tr>
<td>Total</td>
<td>210 054</td>
<td>226 138</td>
<td>79 493</td>
<td>77 200</td>
<td>~44 (~148 to +60)</td>
</tr>
</tbody>
</table>

Abbreviations: CBC, complete blood cell count; CRP, C-reactive protein; NCH, Nottingham City Hospital; QMC, Queen’s Medical Centre.

*Time series analysis comparing before and after intervention.