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.
The strengths of our study design include that it was a prospective blinded controlled study with the specific hypothesis of testing whether feedback of the cost of CRP assays will modify subsequent demand. The data are captured by information technology systems and hence are correct and unbiased. Stratifying for requests for blood CRP assays identified that the impact of price feedback is effective on demand for inpatients but not for outpatients. This is important, as the more junior physicians who are in training posts request most of the inpatient blood tests in the United Kingdom, and our data suggest that this group may be more susceptible to feedback of cost.

The main weakness in our data is that the configuration of clinical services across sites within Nottingham University Hospitals NHS Trust are consistently being modified. Because our results remain significant in comparisons before and after the intervention, both internally within the NCH and also in comparison with the QMC (control site), and because the size of change in demand for CRP assay is large (with a 32% reduction, which is closely temporarily associated with the intervention [Figure]), the associations are likely to be a causal consequence of providing the cost of the CRP assay back to the requesting clinician.

This study has significant potential implications for health care delivery. As we remain challenged with the task of providing health care in the face of rising costs and demand,3 the possibility of introducing feedback of the cost of discretionary diagnostic tests to the requesting clinician is an area that deserves further evaluation, ideally under controlled circumstances, considering any inadvertent adverse effects that may occur as well as the potential economic benefits.

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Additional Information: This work was initiated in collaboration with Tony Hitch, PhD, who sadly died in April 2012.


Invited Commentary
Can Physicians Change Their Laboratory Test Ordering Behavior? A New Look at an Old Issue

Although there has been lingering concern about rising expenditures for medical care for at least 4 decades, the issue has become more prominent recently, driven by distress about the federal deficit, the opportunity costs of excessive medical expenditures, and the reality that the levels of spending in the United States do not generate comparable health benefits. One way to contain medical expenditures is to change how physicians order costly medical resources such as hospitalizations, laboratory tests, imaging, and pharmaceuticals. Strategies to do this include changing financial incentives, education, peer review, and feedback.1 The reality that costs can be selectively reduced without harming outcomes is buttressed by data showing wide variations in care among physicians practicing in the same setting2 and across regions.3 Fogarty and colleagues4 tested whether education about the price of a laboratory test that is of limited diagnostic and therapeutic value (C-reactive protein [CRP] assay) could change the frequency of test ordering at a United Kingdom (UK) hospital when compared with a control medical center. The answer: test ordering was significantly reduced (by 32% compared...