### Meaningful Use and Quality of Care

The American Recovery and Reinvestment Act of 2009 included $30 billion for implementation of the Electronic Health Record (EHR) Meaningful Use (MU) incentive program with a goal of increasing EHR adoption and improving quality of care. Stage 1 of the EHR MU incentive program specified required core objectives, menu objectives, and clinical quality measures. We assessed if being a “meaningful user” (defined as meeting 15 core objectives, eg, computerized order entry, safe electronic prescribing, clinical decision support, and providing health information to patients, as well as meeting 5 of 10 optional menu objectives) was associated with improved quality on 7 measures for 5 chronic diseases. (See the eAppendix and eReferences in the Supplement.)

### Methods

We evaluated physicians who used a homegrown advanced EHR (ie, with integrated clinical decision support) and provided care for adult outpatients at Brigham and Women’s Hospital and affiliated ambulatory practices. In our institution, physicians do not choose whether to participate in the MU program, but rather the objectives are calculated centrally by the organization and reported to physicians and to the federal government. As specified by the MU criteria, we used a 90-day reporting period, September through November 2012. We assessed MU status by physician age, sex, and specialty (using the same categories as the National Ambulatory Medical Care Survey—Primary Care, Medical, and Surgical Specialties) (Table 1). We compared mean physician performance on 7 quality measures for 5 chronic diseases—hypertension, diabetes mellitus, coronary artery disease, asthma, and depression—between meaningful users and non–meaningful users. We used a t test to compare the distribution of proportions between meaningful users and non–meaningful users. We excluded physicians with zero patients in the denominator for each of the 7 quality measures. We did not control for confounders because all physicians must meet the same MU criteria regardless of practice, physician, or patient characteristics. Analyses were performed using SAS statistical software (SAS Inc). Brigham and Women’s Hospital institutional review board approved the study.

### Results

Of 858 physicians, 540 (63%) were meaningful users. Meaningful use was associated with marginally better quality for 2 measures, worse quality for 2 measures, and not associated with better or worse quality for 3 measures (Table 2).

### Discussion

Despite hope that achieving meaningful use improves quality, we found that meaningful users did not consistently provide higher quality care. A limitation of our analysis is that we cannot establish whether EHR use preceded clinical care. Also, we have presented MU among all eligible physicians because organizations hope to see higher quality for meaningful users regardless of physician specialty or other demographic characteristics. A strength of our study is that both groups of users were using the same advanced EHR.

Electronic health record use likely helps more for some conditions than others. We found better control of cholesterol in

### Table 1. Association of Physician Characteristics and Specialty With Meaningful Use (MU) Status

<table>
<thead>
<tr>
<th>Physician Characteristic or Specialty</th>
<th>Total (n = 858)</th>
<th>MU (n = 540)</th>
<th>Non-MU (n = 318)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, mean (SD), y</td>
<td>49 (11)</td>
<td>48 (10)</td>
<td>51 (11)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Male sex, No. (%)</td>
<td>487 (57)</td>
<td>291 (54)</td>
<td>196 (62)</td>
<td>.03</td>
</tr>
<tr>
<td>Specialty, No. (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary Care</td>
<td>218 (25)</td>
<td>170 (31)</td>
<td>48 (15)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Medical</td>
<td>492 (57)</td>
<td>307 (57)</td>
<td>185 (58)</td>
<td></td>
</tr>
<tr>
<td>Surgical</td>
<td>148 (17)</td>
<td>63 (12)</td>
<td>85 (27)</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Association of Stage 1 Meaningful Use (MU) Status With Clinical Quality Measures

<table>
<thead>
<tr>
<th>Clinical Quality Measure</th>
<th>MU Physicians, No.</th>
<th>Patients With High-Quality Care For MU Physicians, Mean (SD), %a</th>
<th>Non-MU Physicians, No.</th>
<th>Patients With High-Quality Care For Non-MU Physicians, Mean (SD), %a</th>
<th>P Valueb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension: BP &lt;140/90 mm Hg</td>
<td>471</td>
<td>44 (23)</td>
<td>155</td>
<td>38 (24)</td>
<td>.005</td>
</tr>
<tr>
<td>DM: HbA1c level &lt;8.0%</td>
<td>320</td>
<td>57 (25)</td>
<td>103</td>
<td>55 (29)</td>
<td>.60</td>
</tr>
<tr>
<td>DM: urine protein screen or ACE/ARB</td>
<td>358</td>
<td>76 (24)</td>
<td>135</td>
<td>78 (24)</td>
<td>.39</td>
</tr>
<tr>
<td>DM: LDL-C &lt;100 mg/dL</td>
<td>373</td>
<td>81 (22)</td>
<td>139</td>
<td>76 (26)</td>
<td>.02</td>
</tr>
<tr>
<td>CAD: β-blocker therapy</td>
<td>128</td>
<td>96 (12)</td>
<td>19</td>
<td>99 (4)</td>
<td>.24</td>
</tr>
<tr>
<td>Asthma: chronic therapy</td>
<td>339</td>
<td>59 (24)</td>
<td>77</td>
<td>66 (28)</td>
<td>.03</td>
</tr>
<tr>
<td>Depression: treatment for ≥12 wk</td>
<td>93</td>
<td>42 (25)</td>
<td>6</td>
<td>68 (26)</td>
<td>.02</td>
</tr>
</tbody>
</table>

Abbreviations: ACE/ARB, angiotensin-converting enzyme inhibitors/angiotensin receptor blockers; BP, blood pressure; CAD, coronary artery disease; DM, diabetes mellitus; HbA1c, hemoglobin A1c; LDL-C, low-density lipoprotein cholesterol.

*Conversion factors: To convert HbA1c to a proportion of total hemoglobin, multiply by 0.01; to convert LDL-C to millimoles per liter, multiply by 0.0259.

a Mean of the proportion of patients meeting each quality measure for each physician.

b P value for difference between groups, calculated using a t test.
patients with diabetes mellitus and better control of blood pressure in patients with hypertension, but worse treatment of asthma and depression. Other studies of EHR use found no consistent association with quality for given chronic conditions.\(^2\)\(^-\)\(^5\) Likewise, specific EHR functions (ie, reminders, test results, order entry, visit notes, problem lists, and medication lists) have been associated with higher quality for some conditions and not others.\(^4\)\(^-\)\(^5\)

Federal policy for stage 1 of MU set a low bar; for example, for 1 measure, physicians using an EHR function 50% of the time were grouped with physicians using the same EHR function 100% of the time. The fact that we found no consistent benefit in quality for stage 1 supports the implementation of more stringent criteria in MU stages 2 and 3.\(^4\)\(^-\)\(^5\) Throughout implementation, MU should be monitored to ensure the large investment in effort, time, and money translates into improved quality for patients.

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**Invited Commentary**

**Measuring the Impact of “Meaningful Use” on Quality of Care**

Through the Health Information Technology Economic and Clinical Health Act (HITECH) of 2009, the federal government is investing nearly $30 billion in incentives for hospitals and health care providers to adopt and meaningfully use electronic health records (EHRs). The federal government’s goal is to be transformative—to enable new and improved ways of managing patients that cannot easily be accomplished via paper—rather than merely doing electronically what was previously done on paper.

The federal government has defined “meaningful use” (MU) in detail. Eligible hospitals and health care providers who meet these definitions can receive the financial incentive payments, which began in 2011. For example, in the first stage of the MU program, health care providers can earn financial incentives for meeting 15 “core” objectives, 5 of 10 “menu” objectives, and a total of 6 clinical quality measures. Examples of MU objectives include implementing computerized physician order entry, maintaining an up-to-date problem list, and generating and transmitting prescriptions electronically.

In this issue of *JAMA Internal Medicine*, Samal et al\(^1\) report on a cross-sectional study of 858 physicians at the Brigham and Women’s Hospital and affiliated ambulatory practices. They collected data on the physicians, all of whom were using EHRs, for a 3-month period in 2012, and then compared the quality of care provided by the 540 physicians who met MU criteria with the quality of care provided by the 318 who did not. The authors found essentially no association between MU and quality for 7 clinical quality measures that are included in the MU program. Meaningful users provided slightly higher quality of care for 2 measures, worse quality for 2 measures, and similar quality for 3 measures, compared with non–meaningful users.

This study raises important questions about how to measure the effects of MU and whether MU improves quality. The effects of MU on quality are not yet well understood. Previous studies have suggested that EHRs are associated with higher quality of care, but it is not known whether achieving MU per se will result in greater quality gains than adoption of EHRs without achieving MU.\(^7\)\(^-\)\(^3\) Samal et al\(^1\) have begun to address this issue, but additional studies are needed.

One major issue to consider when interpreting studies that explore the relationship between MU and quality is the study setting. The Brigham and Women’s Hospital is a national leader in the use of EHRs to improve quality and safety, and their physicians have extensive experience using an advanced EHR product. It is notable that this study was conducted at a time when the Brigham had a home-grown EHR that had been iteratively refined for decades, but that since then the Brigham has been transitioning to a commercially available EHR.\(^4\) Other studies are needed in settings that are typical of the rest of the country, including community-based settings with commercially available EHRs, in order to maximize generalizability.

Another issue is the duration of EHR use. This study took place at the end of 2012, which was the second year of the MU...
program. It is not clear how long these physicians had been using EHRs prior to the study period. Many meaningful users will be implementing EHRs for the first time because of this policy. Studies on applications for e-prescribing have shown that, even 2 years after implementation, physicians are still on a learning curve, improving their care. Thus, studies conducted too soon after implementation may not find an effect, even if one exists.

A third issue is the reliability of electronic reporting of quality measures. Previous studies have shown that automated electronic algorithms for extracting quality data from EHRs are not always accurate. Automated reporting can underestimate or overestimate rates of recommended care because it tends to capture only those elements that are structured fields (eg, drop-down menus, check boxes, or other similar fields) and not those elements that are documented as free text. These challenges can be addressed, with both more nuanced specifications for automated reporting and more structured documentation of the care provided.

A fourth issue is the importance of understanding how physicians actually use EHRs to achieve MU and how that usage affects medical decision-making. The study by Samal et al and other similar studies could be strengthened by measuring not only achievement of MU as the predictor variable but actual usage of EHRs as well. Without measurement of actual usage, any apparent association between achievement of MU and quality could be confounded by unmeasured variables.

Finally, MU is being rolled out in stages, and each stage is designed to become more complex and more difficult to achieve than the previous one. Stage 1 MU, which the study by Samal et al examined, began in 2011 and involves attesting to the use of EHRs to capture clinical data electronically. For example, health care providers attest to measures such as recording vital signs in the EHR for at least 50% of patients. Stage 2 begins in 2014 and raises the thresholds for many measures (eg, record vital signs for at least 80% of patients). Stage 2 also promotes electronic health information exchange and carries the option of reporting performance on quality measures electronically, among other goals. Stage 3 is expected to begin in 2017 and to reward providers for not only reporting the level of quality provided but for improving on that level as well. Thus, the full effects of MU on quality may not be measurable until stages 2 or 3.

In conclusion, the MU program is unprecedented, both in terms of the magnitude of the financial incentives and in the degree to which it is shaping day-to-day clinical care. It is not clear whether MU will improve quality, but it is also not clear that quality would be improved without adoption and use of EHRs. Electronic health records are powerful tools with which to manage populations of patients, and there are few ways to manage populations of patients with paper records. Quality is also only 1 relevant outcome; measuring the value of health care, which incorporates both quality and cost, is extremely important. The need to adopt and use EHRs is also leading to many secondary effects in health care delivery, including the merging of small practices that do not have enough resources to adopt EHRs on their own. Ongoing evaluation is critical to understanding the effects of the transformative MU program, not only on patients but also on the health care system.

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Use of Mechanical Ventilation by Patients With and Without Dementia, 2001 Through 2011

Increasing demand for US critical care resources, including beds, intensivists, and invasive mechanical ventilation (IMV), has placed substantial strain on the critical care system. Since 2000, elderly patients treated in the intensive care unit have received higher intensity care (and have experienced lower mortality rates) than historical cohorts. Yet certain populations of elderly patients exposed to intensive care experience substantial long-term adverse effects, including functional decline and excess mortality. Patients with dementia receiving IMV, for example, are at high risk for delirium, which confers a 3.2-fold increased risk of 6-month mortality. The increasing use of aggressive therapies suggests that demand for IMV in elderly populations will increase in the future, both among patients that are likely to benefit and among those with terminal illness. We examined temporal trends in IMV use by older patients with and without dementia and projected future use.