APPENDIX S. EVALUATING BENEFITS AND COSTS OF NEW INCENTIVES FOR EHR ADOPTION BY INELIGIBLE PROVIDERS

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In this section presents results of original research on the effect of the HITECH Act on adoption of EHR by hospitals. The research highlights the potential for incentives to promote EHR adoption and discusses factors for evaluating the cost and benefits.

I. Overview

This section of the report presents a framework for estimating the benefits and costs of programs to accelerate adoption of EHR by ineligible providers. First a number of key theoretical issues in cost-benefit analysis are examined, followed by a review of the research evidence on the effectiveness of the EHR and a presentation of criteria for evaluating the costs and benefits of incentive programs. These criteria to assess several specific programs, and finally issues associated with promoting interoperability are considered.

A. The Importance of Looking at Incremental Effects

Cost-benefit analysis (CBA) compares the *incremental* benefits accruing from a policy program against the *incremental* costs. A program creates incremental benefits or costs if it causes *changes in behaviors*. This is important to bear in mind because the adoption of EHR by ineligible providers is expected to continue to grow with or without government intervention. (See Table S1 for estimates of adoption by various categories of ineligible providers.[1]) Any program designed to increase adoption will engender benefits only if it accelerates adoption above and beyond the projected growth path. For example, suppose that 60 percent of providers currently adopt EHR and that figure is expected to increase to 80 percent in the absence of any policy intervention. If a policy intervention increases adoption by to 90 percent, then the incremental benefits of the policy accrue from the 10 percentage point increment in adoption above the forecasted level.

[1] Adoption estimates should be interpreted with caution due to "significant variability in breadth and depth of survey content, data item construction, terminology, and definitions (when definitions are provided at all), as well as issues of sample size and representativeness." http://aspe.hhs.gov/daltcp/reports/2009/HITlitrev.htm#assess.

While the benefits of a program accrue from *incremental* adoption above the forecast trend, the cost of the program may accrue from *all* future adopters. Continuing our example, suppose that the intervention involves a subsidy to all future adopters, whether or not they planned to adopt without the subsidy. This subsidy would be paid out to the 30 percent that adopt EHR -- this includes the 10 percent that respond to the subsidy and the 20 percent that would have adopted EHR regardless. Because it may be difficult to target a subsidy towards incremental adopters, the cost of such programs can be very high relative to the benefits.

B. The Importance of Perspective

The calculation of benefits and costs of any intervention depends on one's perspective. Suppose that it costs a medical provider $40,000 to adopt EHR. A new government policy will subsidize 75 percent of the cost of adoption. What cost should be used in a CBA framework? If one takes the perspective of the provider, the cost of adoption is $10,000. From the government's perspective, the cost is $30,000. From the perspective of the EHR vendor, adoption is a benefit. Similar concerns arise for the calculation of benefits.

It is common when assessing government interventions to view the costs as those accruing to the government. In the previous example, this would include $30,000 in subsidy payments plus any costs associated with administering the incentive program. It is also common to view the benefits as accruing to the ultimate beneficiaries of the intervention. In the case of EHR, those benefits would include reductions in medical spending (some of which may ultimately be recouped by the government through lower medical fees) and improvements in the quality of care. This is the manner in which costs and benefits in this analysis.

C. Evidence on Benefits and Costs

There have been numerous studies of the benefits and costs of EHR adoption. Every EHR study begins from the same place: EHR is expensive. One prominent estimate, from the Congressional Budget Office (CBO 2008), estimates that the cost of adopting EHR for office-based physicians is between $25,000 and $45,000 per physician, with annual maintenance costs of $3000-$9000. For a typical urban hospital, these figures range from $3-$9 million for adoption and $700,000-$1.35 million for maintenance. In context these costs are quite significant: If the adoption costs are amortized over 10 years, EHR can account for about 1 percent of total provider costs. It would be no surprise, therefore, if research suggested that EHR may not pay for itself, let alone generate hundreds of millions of dollars in savings.

In their review of 257 studies of EHR effectiveness, Chaudry et al. (2006) note that few studies focus on cost savings, providing, at best, indirect evidence of productivity gains.[2] Most of the studies they review focus on quality of care, with mixed results.[3]

[2] Chaudry et al. state that they study Health Information Technology and they do not indicate if they distinguish between health IT and EHR.

Ten studies examine the effects of EHR on utilization of various services. Eight studies show significant reductions of 8.5-24 percent, mainly in laboratory and radiology testing. While 15 studies contained some data on costs, none offered reliable estimates of cost savings. Indeed, only three reported the costs of implementing EHR and two of these studies were more than 10 years old.

One of the most widely cited cost studies, Hillestad et al. (2005) uses results from prior studies of EHR and medical utilization and extrapolates the potential cost savings net of adoption costs. They identify several dozen potential areas of cost savings, including reduced drug, radiology, and laboratory usage, reduced nursing time, reductions in clerical staff, fewer medical errors, and shorter inpatient lengths of stay. They estimate that if 90 percent of United States hospitals were to adopt EHR, total savings in the first year would equal $41.8 billion, rising to $77.4 billion after 15 years. They also predict that EHR adoption could eliminate several million adverse drug events annually, and save tens of thousands of lives through improved chronic disease management. Sidorov (2006) challenges these findings, arguing that the projected savings are based on unrealistic assumptions. Sidorov also questions whether EHR will generate forecasted reductions in medical errors.

Buntin et al. (2011) reviewed 73 studies of the impact of EHR on medical utilization. EHR is associated with a significant reduction in utilization in 51 (70 percent) of these studies. They do not break these down into specific areas of savings, however. Buntin et al. do not identify any studies of EHR and costs. To our knowledge, such studies remain few and far between.

Indeed, only three focused cost studies have been identified.[4] Borzokowski (2009) examines whether early versions of financial and clinical information technology systems generated significant savings between 1987 and 1994. He finds that hospitals adopting the most thoroughly automated versions of EHR realize up to 5 percent savings within 5 years of adoption. He also finds that hospitals that adopt less automated versions of EHR experience an increase in costs. His conclusions mirror the popular discussion: there appears to be the potential for savings but there is little understanding of the drivers of the heterogeneity across hospitals. Furukawa, Raghu, and Shao (2010) study the effect of EHR adoption on overall costs among hospitals in California for the period 1998-2007. They find that EHR adoption is associated with 6-10 percent higher costs per discharge in medical-surgical acute units, in large part because nursing hours per patient day increased by 15-26 percent. This is plausible because nurse use of EHR can be very time consuming. Finally, Agha (2012) analyzes 2.5 million inpatient admissions across 3,900 hospitals between the years 1998-2005. She finds no evidence of cost savings, even 5 years after adoption. Additionally, adoption appears to have little impact on the quality of care, measured by patient mortality, medical complication rates, adverse drug events, and readmission rates.

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[3] For recent studies of the impact of EHR on patient outcomes, see McCullough, Parente, and Town (2012) and Miller and Tucker (2012).

[4] For related work on the implications of HIT for hospital productivity, see Lee, McCullough, and Town (2012).

Overall, these studies present an ambiguous picture of EHR effectiveness. Two recent studies take more nuanced views of EHR and help to explain the seemingly inconsistent findings. Dranove et al. (2012) view EHR as a business process innovation whose success requires human capital that is skilled at working with information technology. They present evidence that hospitals that are located in more information technology-intensive communities enjoy larger cost savings after adoption of EHR. In addition, hospitals that have more experience with early (from the 1990s), primitive forms of EHR enjoy large cost savings after adoption of advanced EHR. Finally, McCullough et al. (2012) find that EHR adoption reduces mortality for patients with complex diagnoses but has no effect on mortality of patients with average severity.

In its 2008 study, the CBO anticipates a cost reduction of 0.36 percent as a result of implementation of the HITECH ACT, although it is difficult to find supporting empirical evidence.[5] Despite the ambiguous and noisy evidence at hand, it is still worth exploring the potential savings from EHR adoption. In doing so, savings rates ranging from 0.25 percent to 1.5 percent are assumed, not because any particular figure is likely to be valid, but rather to illustrate how one might perform these calculations were we to have more precise information about EHR effects.

D. Interoperability

The full potential of EHR may not be unleashed until providers use the technology to share clinical information. Thus far, however, the EHR market is fragmented and exchanging information across different vendor platforms can be difficult. Even providers adopting the same vendor platform may find it difficult to exchange data with other providers. One exception is the EPIC platform, which was developed and marketed to facilitate information exchange among other providers that use the Epic system.

In principle, any estimate of the benefits of EHR adoption should be sensitive to the extent of information exchange. While the HITECH Act encourages information exchange, this does not appear to be a requirement for the incentives for Stage 1 of the Medicare and Medicaid EHR Incentive Programs. Moreover, it is difficult to predict the magnitude of the benefits of information exchange and these benefits may vary substantially across provider types. Thus, this analysis does not attempt to model or quantify any benefits from information exchange.

II. Preliminary Evidence on Effects of Incentives on Adoption

In this section we present results of original research on the effect of the HITECH Act on adoption of EHR by hospitals. The research highlights the powerful potential for incentives to promote EHR adoption.

[5] CBO cost estimate for HITECH on January 21, 2009. Federal Costs for Extending EHR Incentive Payments to Behavioral Health Providers. October 15, 2010. Avalere Health LLC.

A. HIMSS Data

Evidence on the effectiveness of adoption incentives can be obtained by examining how eligible providers have responded to the incentives in the HITECH Act. To perform this analysis we rely on data provided by the Healthcare Information and Management Systems Society (HIMSS) Analytics database. The HIMSS Annual Study collects information systems data related to software and hardware inventory and reports the current status of EHR implementation in more than 5,300 health care providers nationwide. Organizations that seek access to HIMSS Analytics data must provide their information on software and hardware use. Because most organizations tend to participate for a long period of time, the HIMSS Analytics data closely approximates panel data and can be used for fixed effects regression.

Most of the surveyed respondents are eligible for incentives under the HITECH Act (mainly hospitals). However, HIMSS also surveys many ineligible providers, nearly all of which are affiliated with hospital systems. These can be categorized into three groups of providers: Subacute, Ambulatory Care, and Home Health.

HIMSS reports adoption of 99 different technologies in 18 categories. Examples include Emergency Department Information Systems, Financial Modeling for Financial Decision Support, and a Laboratory Information System. For hospital and subacute providers, we restrict attention to five applications in the category Electronic Medical Records that are commonly used in other studies of EHR adoption:

- A *Clinical Data Repository (CDR)* is a real time database that combines disparate information about patients into a single file. This information may include test results, drug utilization, pathology reports, patient demographics, and discharge summaries.

- *Clinical Decision Support Systems (CDSS)* use clinical information to help providers diagnose patients and develop treatment plans.

- *Order Entry* provides electronic forms to streamline hospital operations (replacing faxes and paper forms).

- *Computerized Provider Order Entry (CPOE)* is a more sophisticated type of electronic order entry and involves physician entry of orders into the computer network to medical staff and to departments such as pharmacy or radiology. CPOE systems typically include patient information and clinical guidelines, and can flag potential adverse drug reactions.

- *Physician Documentation* (PD) helps physicians use clinical information to generate diagnostic codes that are meaningful for other practitioners and valid for reimbursement.

These closely represent the kind of EHR applications that many proponents believe will lead to dramatic cost savings and quality enhancements.

For hospitals and subacute care providers, the five EHR applications are aggregated into two broad categories labeled the “basic” and “advanced” EHR. Applications within each of these categories involve similar costs of adoption and require similar types of co-invention to be used successfully. It is determined that a provider has basic EHR if it has adopted a clinical data repository (CDR), clinical decision support systems (CDSS), or order entry/communication. A provider has advanced EHR if it has adopted either computerized practitioner order entry (CPOE) or physician documentation, applications that are more difficult to implement and more difficult to operate successfully due to the need for physician training and involvement. Analyses of health IT adoption, such as the HIMSS Forecasting Model, consider advanced EHR applications to represent the final stage of EHR adoption (HIMSS Analytics 2011).

Tables S2-S7 show adoption rates for each category of provider for every year that data is available for that category, through 2011. The tables also report adoption trends for the Epic EHR platform. Adoption by all provider types has been trending steadily upward since 2001. It seems that the pace of adoption quickens around 2008 and 2009, around the time of passage of the HITECH Act. This is especially noteworthy because with each passing year there are fewer holdouts; it appears that a greater percentage of holdouts chose to adopt EHR after HITECH. In addition, there is a strong increase in adoption of Epic EHR following HITECH.

B. Statistical Analysis of Adoption Trends

In this section the results of a statistical analysis of the effects of the HITECH Act on EHR adoption by hospitals is reported and “Hazard Regression” models are estimated. Hazard regressions study the rate at which some event occurs over time. In this case the “event” is the adoption of EHR. The key variable under study is the adoption “rate;” which can be thought of as the fraction of hospitals in a given year that (a) had not yet adopted EHR and (b) adopt EHR in that year. For example, if there are 1,000 total hospitals and as of 2005, 600 have adopted EHR, it stands to reason that 400 hospitals have not adopted EHR. If the hazard rate is 10 percent, then we would expect 40 of the 400 hospitals to adopt EHR in 2005, leaving 360 without EHR at the start of 2006. If the hazard rate remains 10 percent, an additional 36 hospitals can be expected to adopt EHR in 2006. Hazard regression can be used to determine whether the HITECH Act increased the hazard rate.

Table S8 presents results of a hazard regression for hospital adoption of both elements (CPOE and PD) of advanced EHR. These elements are important for hospitals to satisfy the meaningful use criteria in HITECH, but hospitals with advanced EHR do not necessarily exchange information with other providers, a requirement for meaningful use. Thus, results are suggestive of the impact of HITECH on the fulfillment of the meaningful use requirement, but not definitive. The key predictors in the model

include an indicator for the passage of HITECH and interactions between the passage of HITECH and various hospital characteristics.

The regression results imply that for the average hospital, the adoption rate increased after the passage of the HITECH Act by a considerable amount. Prior to the Act, only 29.8 percent of hospitals had adopted both elements of advanced EHR and the new adoption rate by these hospitals was approximately 6 percent. After the Act, the new adoption rate increased to approximately 20 percent. Thanks to this increase, 54.8 percent of hospitals used both advanced EHR applications by 2011. If this adoption rate continues, then 84.3 percent of hospitals will adopt both applications by 2016. Had the adoption rate remained at 6 percent, then only 70.9 percent will have adopted EHR by 2016. In other words, the increase in the adoption rate that occurs at the time that HITECH is enacted is predicted to lead to a 13.4 percentage point increase in the number of hospitals that adopt both elements of advanced EHR by 2016.[6]

The coefficients on hospital characteristics indicate that smaller and for-profit hospitals were less likely to adopt advanced EHR prior to the Act but saw a larger increase in their adoption rate after the Act. Smaller hospitals may view the costs of adoption as excessive relative to the benefits, and therefore would be more responsive to subsidies. Likewise, for-profits may have been reluctant to invest in EHR without subsidies. Academic hospitals were more likely to invest prior to the Act and also saw a larger than average increase in adoption after the Act. Finally, hospitals that were part of larger systems were more likely to adopt advanced EHR prior to the Act but showed a smaller increase in their adoption rate after the Act.

In unreported regressions, ineligible providers affiliated with hospital systems were also found to increase adoption of advanced EHR following the passage of HITECH. This is important; system membership seems to be a big predictor of EHR adoption.

This analysis shows that hospitals and affiliated providers increased adoption of advanced EHR after the passage of the HITECH Act. We cannot be certain of causality, however, as there may have been other factors affecting adoption that arose at the same time. However, the fact that a similar increase in adoption of basic EHR was not identified confirms that a spurious trend is not being observed.

III. Modeling EHR Adoption

The goal of government incentive programs is to reduce the costs and/or increase the benefits of EHR adoption. In this section these costs and benefits are described in more detail so that a better understanding of how incentive programs may affect adoption can be obtained.

[6] Over time, this gap will decrease as more hospitals would adopt EHR with or without the incentives in HITECH.

A. A Simple Example

A health care provider considering EHR would weigh the private costs against the private benefits. It would consider financial factors, such as the cost of installing and maintaining the EHR as well as any potential impact on efficiency. It may also consider the impact on quality, both because higher quality could translate into more demand and higher revenues, and because it might directly cares about quality independent of financial considerations. EHR may create positive spillovers to other providers; a provider that is part of an integrated organization may internalize these spillovers, making it more likely to adopt EHR.

A simple example captures these ideas. *Note: the numbers included in this example do not bear any relationship to actual nursing home revenues or profits, or EHR costs for nursing homes. The numbers in this example are included only to illustrate some of the cost/benefit considerations that may inform a decision to invest in an EHR system, with or without incentives*.

> Consider an independent nursing home that has total revenues of $100m and expected profits of $40m. (All dollar amounts are expressed in terms of net present value.) Of this, 50 percent of its profits is derived from Medicare and Medicaid. This is based on estimated Medicaid/Medicare revenues of $60m and estimated costs of $40m. The nursing home is considering adopting EHR. The home estimates that the cost of adopting and maintaining EHR is $5m. It expects to enjoy cost savings equal to 2 percent of total revenues ($2m) and quality of care improvement that it "monetizes" at 1 percent of total revenues ($1m). Thus, the benefits or adoption are $3m while the cost is $5m. Because the costs outweigh the benefits, the home does not adopt EHR at this time.[7]
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> Suppose that a new program will augment Medicare and Medicaid reimbursements by 5 percent for nursing homes that adopt EHR. The nursing home in this example calculates that this bonus payment will amount to $3m, based on its Medicare/Medicaid revenues of $60m. The benefits of adoption increase to $6m while the costs remain at $5m. Therefore, the home adopts.

This simple example illustrates the some of the many factors that we must consider if we are to predict the number of providers that will adopt EHR regardless of incentives, and, more importantly, the extent to which incentives will accelerate EHR adoption. To predict adoption rates in the absence of incentives, we must consider the factors that will affect the costs and benefits of adoption.

[7] Note that a rational decision maker might not follow this simple go/no-go adoption decision if the benefits appear to outweigh the costs but there is uncertainty about benefits or costs that will be resolved over time. The decision maker may prefer to wait for the uncertainty to be resolved before adopting.

B. Factors Affecting Costs and Benefits of Adoption

Factors affecting adoption costs

- *Size:* Adoption costs tend to increase with the size of the provider, due to the need for greater system capacity and complexity as well as the need to train additional staff. However, fixed adoption costs increase less than proportionately with size, for two reasons. First, there is a substantial fixed component to EHR costs. Second, larger providers will likely have lower financing costs.

- *Access to capital independent of size:* Providers that have superior access to capital can more easily finance the substantial costs of adoption. Thus, for-profit providers, nonprofits that enjoy favorable financial performance, and providers that are part of large systems may enjoy greater access to capital.

- *Presence of complementary labor inputs:* EHR is a business process innovation and successful implementation requires access to labor that is skilled at working with information technology.

Factors affecting adoption benefits

- *Size:* Adoption benefits are likely to increase proportionately with size.

- *System membership:* To the extent that information exchange creates spillover benefits, providers in systems will internalize these benefits.

- *Patient severity*: EHR may be more likely to improve outcomes for patients with complex conditions.

- *Market competitiveness*: To the extent that EHR improves quality and this leads to higher demand, then a competitive EHR provider may value EHR more than a provider that faces little or no competition.

- *Provider objectives:* Providers that value quality of care independent of profits may value EHR more highly than a purely profit driven provider.

Many of these considerations are borne out by the empirical analysis of the HITECH Act described earlier. Smaller hospitals, for-profit hospitals, and teaching hospitals are more likely to adopt EHRs when incentives are available. Hospitals that are part of smaller integrated delivery systems are more likely to adopt when incentives are available.

Factors affecting incremental adoption

Size, ownership, and system membership may predict EHR adoption, but do not necessarily predict *incremental adoption* from the incentive program. The model suggests that incremental adoption depends on the following:

- *The size of the incentives:* This will be very dependent on the specific incentives under consideration. In our example, the size of the incentive is proportional to the total Medicare and Medicaid revenues.

- *The size of the provider:* Larger providers are likely to perceive larger gaps between benefits and costs, whether positively or negatively, simply because the stakes are higher. Thus, it will take bigger incentives to motivate a given number of large providers relative to a given number of small providers.

- *The number of fence sitters*: The number of providers for whom the costs of adoption exceed the benefits in the absence of incentives but for whom the benefits exceed the costs with incentives. In other words, we need to know the number of "fence sitters."

- *Decision-making:* The extent to which the provider's decision to adopt EHR is based on financial rather than medical considerations.

Most of these considerations are supported by the empirical analysis of HITECH. No empirical evidence outlines the relationship between the size of the incentives and the adoption rate, as there have been no experiments in which the size of the incentives have varied. Smaller hospitals responded more strongly to HITECH, which could indicate that smaller hospitals were more likely to be fence sitters. Finally, for-profits responded more strongly to HITECH, likely because they placed more weight on financial considerations.

The biggest unknown when forecasting incremental adoption is identifying the fence sitters. Ideally, one would obtain such information from a carefully constructed survey. Absent survey data, simple statistical theory can be used to conjecture about incremental adoption rates. Noting that there is likely to be a distribution of providers with a range of benefit/cost ratios for EHR adoption. Like most distributions, this is likely to be bell-shaped with disproportionate number of providers "in the middle" of the distribution. This helps account for the classic "S-curve" of new technology adoption, whereby there are a few early adopters, adoption accelerates, and then slows.

If there is a bell curve of benefit/cost ratios, then there are more fence sitters when about half of all providers have chosen to adopt EHR than when either 10 percent or 90 percent have chosen to adopt. Put another way, when very few providers have adopted, then most are probably far away from choosing to adopt and an incentive program may not change many minds. When most have adopted, there are few providers left whose minds need changing. Thus, the biggest impact of any incentive

program will come when some but not all providers have adopted. Referring to Table S1, which lists adoption rates of basic EHR by provider category shows a wide range of reported adoption rates. If these adoption rates are valid, then for those classes of ineligible providers, including rehabilitation hospitals and long-term care hospitals, where less than 10 percent have adopted EHR, then large incentives may be necessary to encourage substantial additional adoption in these categories. On the other hand, about half of providers in categories such as nursing homes and home health care have adopted basic EHR. Small incentives might be sufficient to generate substantial additional adoption. However, these conclusions are dependent on the availability of reliable and valid data regarding EHR adoption rates for these providers.

IV. Comparing Different Approaches to Encouraging Incremental Adoption

A. Caveats

Although it is difficult to forecast with any degree of confidence the impact of incentives on incremental EHR adoption, the CBO and other organizations have made such forecasts in conjunction with the HITECH Act and a proposed extension to mental health providers. Unfortunately, it is difficult to determine whether they have forecasted overall growth in EHR adoption or incremental growth attributable to the incentives in the legislation. Nor has there been any retrospective review to ascertain the accuracy of these forecasts.

Rather than attempt to provide specific forecasts of the impact of extending the EHR Incentive Program on adoption, we believe it is more reasonable to use the ideas developed above to compare the relative effectiveness of different incentive programs.

B. Comparing Incentives

When evaluating a specific program to encourage EHR adoption, there are many considerations.

- How large are the incentives?
- Are the incentives larger for some providers than for others? Which providers get the largest benefits from adoption? Which enjoy the largest cost reductions?
- How large are the benefits relative to the incentives?
- Does the program target “fence sitters?”
- Will the program pay for adoption by providers that have already adopted and/or would have adopted in the absence of incentives?

We bear these in mind as we consider three different programs: Payment incentives, Financing, and Information technology consulting.

Payment Incentives

The HITECH Act creates incentive payments under Medicare and Medicaid for hospitals that meet a range of criteria for EHR adoption. Incentive payments have several advantages. The government can stipulate precisely what providers must do to be eligible. Providers can easily understand these requirements and easily compute the financial benefits from compliance. Incentive payments also have disadvantages. They tend to be broad based, so that the government must reimburse providers that would have adopted EHR and complied with the stipulations even if no incentive payments were forthcoming. And the strict requirements for payment can strait-jacket providers into EHR solutions that are not optimal for their particular circumstances. Our research evidence suggests that HITECH's incentives had a powerful effect on EHR adoption.

Financing Programs

Low interest loan programs allow providers lacking access to capital to obtain low interest loans to finance EHR adoption. These tend to be low stakes programs for the government -- in the long run the cost of these programs is equal to the discount on the interest rate afforded to the providers. But these programs can have a high return because they target the types of providers that seem to be most responsive to financial incentives -- small and unaffiliated with larger systems. We are aware of a few loan programs that make available low interest loans to support EHR acquisition and use, such as the financial program offered by North Dakota, but we are unaware of any studies documenting whether these programs have been effective.

Information Technology Consulting

Dranove et al. (2012) showed that the EHR is more effective when adopting providers are located in a community rich with information technology expertise. Government might consider programs that provide information technology training to providers that lack this necessary complement to EHR adoption. These programs could target information technology-poor communities, both by reducing the costs and increasing the benefits of EHR implementation and use. But these programs cannot be short term -- they must provide enduring local information technology knowledge.

V. Programs to Improve Interoperability

This comparison of incentive programs has largely ignored a key criterion for incentive payments under HITECH and a key success factor for EHR: Interoperability. To date, information exchange across different EHR platforms is difficult. With just a few exceptions, such as with the Epic system, exchange among providers using the same platforms is also difficult. Such exchange creates positive externalities for patients that may not be captured by providers; thus, providers may not give proper weight to interoperability when choosing an EHR vendor. This is one of the reasons that interoperability is a key criterion for meaningful use under HITECH.

The meaningful use criteria in HITECH do seem to be influencing platform choices, as evidenced by the sharp increase in adoption of EPIC. Note, however, that while EPIC offers has high interoperability among EPIC users, it is not especially interoperable with other platforms. It remains to be seen whether providers interpret the interoperability requirement as a *de facto* endorsement of Epic, thereby driving providers towards a single platform.

Financial incentives can be a powerful tool for promoting interoperability, as evidenced by the growth of Epic subsequent to HITECH. Incentives to promote interoperability can be thought of as being quite distinct from incentives for EHR adoption, as the latter affect the costly *decision to adopt* any EHR platform whereas the former merely affect the *choice of platform*. Given the ongoing rise in EHR adoption, it might be cost effective to focus on promoting interoperability. This focus would satisfy the goal of achieving the maximum benefit at minimal cost to the government. Indeed, a key focus of the Stage 2 Meaningful Use EHR Incentive Program includes a focus on interoperable health information exchange.

Before the government invests too heavily in further promoting interoperability, it should take stock of ongoing changes in the provider landscape, specifically the growth of formally integrated provider systems as well as the growth of "virtual" provider systems such as Accountable Care Organizations. These systems can internalize the benefits of health information exchange. Ongoing system growth is likely to further promote EHR adoption and interoperability among eligible and ineligible providers.

References

Agha, L. 2012. The Effects of Health Information Technology on the Costs and Quality of Medical Care. Working Paper, Boston University.

Bassett, J. "Wired for Success." Advance for Physical Therapy & Rehab Medicine. http://physical-therapy.advanceweb.com/Archives/Article-Archives/Wired-for-Success.aspx.

Borzokowski, R. 2009. Measuring the Cost Impact of Hospital Information Systems: 1987-1994. *Journal of Health Economics* 28: 938-49.

Buntin, M., M. Burke, M. Hoagline, & D. Blumenthal. 2011. The Benefits of Health Information Technology: A Review of the Recent Literature Shows Predominately Positive Results. *Health Affairs* 30(3): 464-471.

Chaudhry, B., J. Wang, S. Wu, M. Maglione, W. Mojica, E. Roth, S. Morton, & P. Shekelle. 2006. Systematic Review: Impact of Health Information Technology on Quality, Efficiency, and Costs of Medical Care. *Annals of Internal Medicine* 144(10): 742-752.

Congressional Budget Office. 2008. “Evidence on the Costs and Benefits of Health Information Technology.”

Dranove, D., C. Forman, A. Goldfarb, & S. Greenstein. 2012. “The Trillion Dollar Conundrum: Complementarities and Health Information Technology.” NBER Working Paper.

Fuji, K., K. Galt, M. Siracuse, & J.S. Christofferson. 2011. “Electronic Health Record Adoption and Use by Nebraska Pharmacists.” *Perspectives in Health Information Management* (Summer): 1-11.

Furukawa, M., T. Raghu, & B. Shao. 2010. Electronic Medical Records, Nurse Staffing, and Nurse-Sensitive Patient Outcomes: Evidence from California Hospitals, 1998-2007. *Health Services Research* 45(4): 941-962.

Hillestad, R., J. Bigelow, A. Bower, F. Girosi, R. Meili, R. Scoville, & R. Taylor. 2005. Can Electronic Medical Record Systems Transform Healthcare? An Assessment of Potential Health Benefits, Savings, and Costs. *Health Affairs* 24(5): 1103-17.

Lee, J., J.S. McCullough, & R.J. Town. 2012. The Impact of Health Information Technology on Hospital Productivity. NBER Working Paper #18025.

Maine Rural Research Center. RHCs At The Crossroads. 2012.

McCormick, D., D. Bor, S. Woolhandler, & D. Himmelstein. 2012. Giving Office-Based Physicians Electronic Access to Patients’ Prior Imaging and Lab Results Did Not Deter Ordering Of Tests. *Health Affairs* 31(3): 488-496.

McCullough, J., S. Parente, & R. Town. 2012. “Health Information Technology on Patient Outcomes: The Role of Organizational and Informational Complementarities.” Unpublished Working Paper. University of Minnesota.

Miller, A. & C. Tucker. 2012. Can Healthcare Information Technology Save Babies? *Journal of Political Economy* 119(2): 289-324.

Pizzi, R. Ambulatory Surgery Centers Short on IT Healthcare IT News http://www.healthcareitnews.com/news/ambulatory-surgery-centers-short-it?page=0,0.

RCHN Community Health Foundation Research Collaboration. 2011. Policy Research Brief #27: Results from the 2010-11 Readiness for Meaningful Use of HIT and Patient Centered Medical Home Recognition Survey.

Resnick, H.E., & M. Alwan. 2010. Use of Health Information Technology in Home Health and Hospice Agencies: United States, 2007. *Journal of the American Medical Informatics Association (JAMIA)* 17: 389-395.

Resnick, H.E., B.B. Manard, R.I. Stone, & M. Alwan. 2009. Use of Electronic Information Systems in Nursing Homes: United States, 2004. *Journal of the American Medical Informatics Association (JAMIA)* 16: 179-186.

Sidorov, J. 2006. It Ain't Necessarily So: The Electronic Health Record and the Unlikely Prospect of Reducing Health Care Costs. *Health Affairs* 25(4): 1079-85.

Winsten, D., & H. Weiner. 2010. Improve Outreach Performance by Leveraging the Internet. CLMA Thinklab '10 Session 504.

Wolf, L., J. Harvell, & A. Jha. 2012. Hospitals Ineligible For Federal Meaningful-Use Incentives Have Dismally Low Rates of Electronic Health Records. *Health Affair*, 31(3).

TABLE S1. EHR Adoption Rates by Ineligible Providers[a]	
Ineligible Provider	**Adoption Rates for Basic EHR System for Some Clinical Processes**
Long-Term & Post-Acute Care	
Home Health	43%[b]
Hospice	43%[c]
Nursing Facility	43%[d]
Rehabilitation Hospital	4%[e]
Long Term Acute Care Hospital	6%[f]
Intermediate Care Facilities/Mentally Retarded	Unknown
Community Residential Home	Unknown
Behavioral Health	
Psychiatric Units and Hospitals	2%[g]
Substance Abuse Treatment Facilities	Unknown
Community Mental Health Center	65%[h] (2% could meet meaningful use)
Psych/BH Out-pt Clinic	Unknown
Partial Day-Treatment Center/Hospital	Unknown
Psychologist	Unknown
Clinical Social Worker	Unknown
Licensed Counselor	Unknown
Psychiatric Advanced Practice Nurse	Unknown
Safety Net Providers	
Federally Qualified Health Center	68.5%[i]
Rural Health Clinic	42%[j] (limited study n=65 of 3950 providers)
Health Care Related	
Ambulatory Surgery Center	18%[k]
Renal Dialysis Facilities (ESRD Benefit)	Unknown
Ambulance (EMS)	Unknown
Pharmacy	12%[l] *NE
Laboratory	24.2%[m] can post to an EHR via interface
Blood Center	Unknown
Therapists (PT, OT, SLP)	PT=28%[n]
Dieticians and Nutritionists	Unknown

a. This summary provides the limited available information regarding adoption rates by ineligible providers for basic level EHRs (some functionality to support clinical needs. It is difficult to compare values among providers due to a lack of uniform definitions. Adoption estimates should be interpreted with caution due to "significant variability in breadth and depth of survey content, data item construction, terminology, and definitions (when definitions are provided at all), as well as issues of sample size and representativeness. http://aspe.hhs.gov/daltcp/reports/2009/HITlitrev.htm#assess.
b. Resnick, H.E., Alwan, M. "Use of Health Information Technology in Home Health and Hospice Agencies: United States, 2007." *Journal of the American Medical Informatics Association (JAMIA)*, 2010, 17: 389-395.
c. Ibid Resnick.
d. Resnick, H.E., Manard, B.B., Stone, R.I., Alwan, M. "Use of Electronic Information Systems in Nursing Homes: United States, 2004." *Journal of the American Medical Informatics Association (JAMIA)*, 2009, 16: 179-186.
e. Wolf, L., Harvell, J. and Jha, A. "Hospitals Ineligible for Federal Meaningful-Use Incentives Have Dismally Low Rates of Electronic Health Records." *Health Affair*, 2012, 31(3).
f. Ibid Wolf.
g. Ibid Wolf.
h. "HIT Adoption and Readiness for Meaningful Use in Community Behavioral Health." National Council for Community Behavioral Healthcare. June 2012. http://www.thenationalcouncil.org/galleries/business-practice%20files/HIT%20Survey%20Full%20Report.pdf. This study on health IT adoption for community behavioral health organizations reports that 21% of organizations have EHRs at all of their sites; 65% of the behavioral health organizations surveyed reported having adopted some form of an EHR at some of their sites. Only 2% of responding community behavioral health organizations reported adopting technology that could meet the base requirements of the Meaningful Use Program.
i. RCHN Community Health Foundation Research Collaboration. Policy Research Brief #27: Results from the 2010-11 Readiness for Meaningful Use of HIT and Patient Centered Medical Home Recognition Survey. November 2011.

TABLE S1 (*continued*)
j. Maine Rural Research Center. RHCs At The Crossroads. 2012. http://muskie.usm.maine.edu/Publications/rural/RHCs-at-the-crossroads_Gale-NRHA-2012.pdf.
k. Pizzi, R. Ambulatory Surgery Centers Short on IT Healthcare IT News http://www.healthcareitnews.com/news/ambulatory-surgery-centers-short-it?page=0,0.
l. Fuji, K., Galt, K., Siracuse, M., Christofferson, J.S. "Electronic Health Record Adoption and Use by Nebraska Pharmacists." *Perspectives in Health Information Management* (Summer 2011): 1-11.
m. Winsten, D. and Weiner, H. "Improve Outreach Performance by Leveraging the Internet." CLMA Thinklab '10 Session 504 (May 2010).
n. Bassett, J. "Wired for Success." Advance for Physical Therapy & Rehab Medicine. http://physical-therapy.advanceweb.com/Archives/Article-Archives/Wired-for-Success.aspx.

TABLE S2. Hospital Adoption of Basic EHR (CDS, CDR, OER)

Year	N of Facilities	% Using at Least 1 Application	% Using All 3 Applications	% Using EPIC for Any Application
2001	4,013	91.4	37.5	0.2
2002	3,985	93.3	43.1	0.7
2003	4,005	93.7	45.4	1.6
2004	3,989	94.3	46.4	2.0
2005	4,010	94.3	54.0	3.8
2006	5,082	77.5	45.7	4.9
2007	5,073	88.6	57.4	5.6
2008	5,168	91.2	63.0	5.6
2009	5,237	93.0	77.3	6.2
2010	5,315	94.6	80.9	9.5
2011	5,339	95.5	83.8	10.9

TABLE S3. Hospital Adoption of Advanced EHR (CPOE, PD)

Year	N of Facilities	% Using at Least 1 Application	% Using All 3 Applications	% Using EPIC for Any Application
2005	4,010	47.5	12.9	6.78
2006	5,082	41.6	17.6	7.99
2007	5,073	49.3	26.4	8.71
2008	5,168	52.9	29.8	8.67
2009	5,237	55.3	33.7	9.71
2010	5,315	68.2	50.1	12.7
2011	5,339	73.6	54.8	13.68

TABLE S4. Subacute Facility Adoption of Basic EHR (CDS, CDR, OER)				
Year	N of Facilities	% Using at Least 1 Application	% Using All 3 Applications	% Using EPIC for Any Application
2001	3,508	73.7	33.35	0.2
2002	3,546	80.1	38.01	0.4
2003	3,380	80.0	32.1	0.7
2004	3,007	90.4	40.94	1.0
2005	2,875	92.9	46.47	2.1
2006	3,017	89.4	45.81	2.7
2007	2,940	94.3	52.21	3.2
2008	2,733	94.6	58.95	3.8
2009	2,665	94.5	68.22	4.4
2010	2,521	95.0	70.92	7.4
2011	2,422	95.5	75.14	8.9

TABLE S5. Subacute Facility Adoption of Advanced EHR (CPOE, PD)				
Year	N of Facilities	% Using at Least 1 Application	% Using All 3 Applications	% Using EPIC for Any Application
2005	2,875	41.2	10.3	3.7
2006	3,017	41.9	15.9	4.8
2007	2,940	46.2	22.5	5.2
2008	2,733	50.1	27.3	5.9
2009	2,665	51.6	29.5	7.6
2010	2,521	60.0	42.5	11.2
2011	2,422	66.4	47.4	12.4

TABLE S6. Ambulatory Care Provider Adoption of EHR			
Year	N of Facilities	Adoption Rate (%)	Adoption Rate of EPIC ($)
2005	17,837	24.8	5.2
2006	19,714	35.6	7.6
2007	20,458	43.7	8.8
2008	21,796	47.7	10.6
2009	22,870	52.6	12.4
2010	25,290	59.3	15.6
2011	26,090	61.5	16.5

TABLE S7. Home Health Care Provider Adoption of EHR			
Year	**N of Facilities**	**Adoption Rate (%)**	**Adoption Rate of EPIC ($)**
2002	2,087	76.1	0.1
2003	1,953	78.4	0.2
2004	1,842	80.2	0.0
2005	1,853	83.2	0.2
2006	2,054	81.4	0.6
2007	2,128	82.8	0.8
2008	2,293	83.7	1.3
2009	2261	85.8	1.6
2010	2302	88.3	1.7
2011	2324	89.1	1.9

TABLE S8. Hazard Regression Results -- Adoption of Advanced EHR[1]	
Variable	**Hazard Ratio**
Log(Beds)	1.277***
For-Profit Dummy	0.131***
IHDS Size[b]	1.015***
Academic Hospital Dummy	1.196*
Post-HITECH	3.242***
Log(Beds)*Post_HITECH	0.920**
For-Profit*Post_HITECH	3.097***
Academic*Post_HITECH	1.376*
IHDS Size *Post_HITECH	0.992***
No. of Observations	8161

a. A coefficient of 1 indicates that the variable does not affect the hazard ratio
b. IHDS size is the number of hospitals in the same Integrated Health Delivery System (IHDS) as the hospital.

* Significantly different from 1 at p<0.10
** Significantly different from 1 at p<0.05
*** Significantly different from 1 at p<0.01

EHR PAYMENT INCENTIVES FOR PROVIDERS INELIGIBLE FOR PAYMENT INCENTIVES AND OTHER FUNDING STUDY

Files Available for This Report

Main Report
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI.shtml
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI.pdf

APPENDIX A. Medicare and Medicaid EHR Incentive Programs
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http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendA.pdf

APPENDIX B. Definitions and Certification of EHR Technology
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http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendB.pdf

APPENDIX C. Public Health Service Act Section 3000(3) as Added by HITECH Section 13101 -- Provider Analysis
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendC
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendC.pdf

APPENDIX D. Ineligible Provider Characteristics
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APPENDIX E. Long-Term and Post-Acute Care Provider Profiles
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendE
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendE.pdf

APPENDIX F. Behavioral Health Provider Profiles
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http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendF.pdf

APPENDIX G. Safety Net Provider Profiles
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APPENDIX H. Other Health Care Provider Profiles
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APPENDIX I. Table Summary of Patient Protection and Affordable Care Act Provisions with Relationship to Ineligible Providers and Health IT Use
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendI
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendI.pdf

APPENDIX J. Behavioral Health Provider Analysis
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendJ
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendJ.pdf

APPENDIX K. Grant, Demonstrations and Cooperative Agreement Programs
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendK
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendK.pdf

APPENDIX L. Loan Programs
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendL
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendL.pdf

APPENDIX M. Technical Assistance Programs
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendM
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendM.pdf

APPENDIX N. Administrative Infrastructure Building Programs
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendN
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendN.pdf

APPENDIX O. Anti-Kickback Statute EHR Safe Harbor Regulations
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendO
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendO.pdf

APPENDIX P. Private Sector Programs to Advance Certified EHR Technology
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendP
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendP.pdf

APPENDIX Q. Regulations for Medical Records
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendQ
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendQ.pdf

APPENDIX R. Technical Advisory Group Summary
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendR
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APPENDIX S. Evaluating Benefits and Costs of New Incentives for EHR Adoption by Ineligible Providers
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendS
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendS.pdf

APPENDIX T. CIO Consortium EMR Cost Study Data
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendT
http://aspe.hhs.gov/daltcp/reports/2013/EHRPI-appendT.pdf

APPENDIX U. Abbreviations and Acronyms
http://aspe.hhs.gov/daltcp/reports/2013/EHRPIap.shtml#appendU
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APPENDIX V. References
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