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Title

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Journal

Proceedings of the UCLA Department of Medicine, 18(1)

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Publication Date

2014-05-31

CLINICAL COMMENTARY

Estimation of the return of investment on implication of electronic medical records systems in the United States

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Introduction

Healthcare expenditures per capita in the United States have been rising at a higher rate than inflation and GDP growth, to a level that is about double the median of the Organization for Economic Cooperation and Development (OECD) average and totals \$2.3 trillion¹. In order to control expenditures, several legislations were passed to reduce the cost of care, such as the Affordable Care Act (ACA) and the Health Information Technology for Economic and Clinical Health (HITECH) act, incentivizing the use of health information technology (health IT). The wide adoption of broadly interconnected electronic medical record (EMR) systems might have enormous economic benefits at the national level² but broad adoption has been hampered by the disparity between the separation of the parties carrying the burden of the transformation (mainly the care providers) and the parties reaping the benefits of such a change (payers and patients)³. It is therefore necessary to examine costs and benefits on both the national level as well as at the provider level in order to provide convincing arguments for providers to adopt an EMR.

Economics on the National Level

A study performed by the RAND Corporation² estimates that the adoption of broadly interoperable EMR systems might save the US healthcare system between \$142-371 billion annually.

Costs of adoption in their model include the acquisition of commercial EMR systems, a temporary productivity loss of the provider and additional annual hardware and maintenance costs of 20% of the initial implementation cost. As savings, they include in their analysis potential safety benefits such as reduction in medication errors and adverse drug event rates, estimates for reduction of medical error rates by use of computerized physician order entry (CPOE), and other benefits such as disease prevention and chronic disease management.

Since other industries such as the telecommunication industry have already adopted computerized systems, RAND uses these data to extrapolate increases in efficiency through the use of IT systems with the lower end at a 1.5% increase (mimicking the retail sector) and the upper end at a

4% increase (mimicking half of the increase seen in the telecommunications sector) (Exhibit 1). An increase in efficiency applied to the current growth rate of healthcare spending might reduce spending by \$346 billion on the lower end, and \$813 billion on the upper end.

The majority of the savings through higher efficiencies would be mainly due to a reduction in redundant and repeated tests, a reduction of adverse drug events and prevention of hospitalization. Further savings from switching to a broadly interoperable EMR system would be in short-term preventive care as well as near-term and long-term chronic disease management, the major drivers of US healthcare spending.

Including an estimated \$98 billion cost to increase adoption of EMR systems by hospitals from 20% to 90% with an average yearly cost of \$6.5 billion, as well as \$17.2 billion and \$1.1 billion for physicians, respectively, RAND estimates the potential net savings from EMR systems to be \$371 billion for hospitals and \$142 billion for physicians.

The financial benefits of these improvements are realized mainly by the payers such as Medicare, Medicaid and private payers. Thus, providers face limited incentive to adopt EMR systems since they may lose revenue as compared to a fee-for-service reimbursement structure. Additionally, the current EMR systems may worsen overall physician work satisfaction if not functioning efficiently, therefore increasing the threshold that needs to be surpassed for widespread adoption. However, the broad adoption of these systems is the requirement to make the nation-wide savings possible. A separate study by Jan Walker and colleagues estimates that 100% adoption of interoperable EMR systems might lead to a nationwide net savings of \$337 billion in the first ten years – mainly due to the mentioned increases in efficiencies⁴. This number does not, however, reflect the lost revenues for less services performed by providers resulting from better patient health and less redundancy in the services and treatments provided. It is therefore imperative that providers are incentivized to invest into the new technology.

The HITECH act aims to provide financial benefits to adopt EMR systems⁵. Under this act, the US

government provides a stimulus of \$27 billion in incentive payments based on Medicaid and Medicare reimbursements. If physicians demonstrate “Meaningful Use” of EMRs, they may be eligible to receive \$44,000 to \$63,750. Hospitals may be eligible to receive up to \$2 million. Additionally, providers and hospitals will be penalized for non-adherence to Meaningful Use by reductions in Medicare reimbursements ranging from 1% to 5% (Medicaid providers are exempt from the penalties). The bill furthermore aims to ensure adherence to interoperability standards, which will be critical for the realization of the nationwide potential benefits of EMR implementation.

Key barriers to broad adoption persist and include acquisition and implementation costs, slow and uncertain financial payoffs for providers and disruptive effects on practices². Additionally, since the trend has been to integrate smaller practices into larger healthcare systems, those smaller businesses are faced with increased uncertainty, making them less receptive to incentives to change to a new system⁶.

It should also be noted that these savings rely on the assumption that the use of EMR systems will lead to higher adherence to treatment regimens and drug use by patients and that this will lead to better outcomes and quality of care in the long run, which may not be realized in the near future, as a report by Welch and colleagues suggests⁷. They report increased costs due to a higher capture of billable services through the use of EMR systems, which may outweigh any financial benefit in the short-term.

On a broader scale, the widespread use of EMRs will also allow for data mining of deidentified patient records in order to conduct research on patient outcomes, disease association and adverse drug events⁸.

Overall, there is great potential in net savings on the national level but a key to realizing these is to (financially) incentivize providers to adopt EMR systems.

Economics at the provider level

Since financial considerations such as high cost and uncertain payoffs are main barriers for adoption of EMR systems by providers, a few studies have tried to analyze the costs and benefits of such a transition^{3,7,9,10}.

A recent review summarizes the findings of 33 quantitative studies on the cost-effectiveness of EMR adoption at the provider level and concludes that 69.7% of those report positive findings, with an 86.7% positive value in the primary care sector¹⁰.

For example, Amarasingham and colleagues report that implementing EMRs led to decreased death rates and complications and an average saving of \$132 per patient¹¹. Overall, the sectors positively affected by using EMR systems are primary care, medication management and disease management systems. CPOE, immunization and documentation had uncertain financial payoffs¹⁰.

A study conducted by Fleming and colleagues on 26 primary care practices in Texas reports the cost of adoption of EMR systems³. The cost analysis includes capital expenditures for hardware (fixed: switches, cables, wireless internet connections; variable: personal computers, printers and scanners), software licensing, hosting and technical support. Additionally, time spent by internal staff (health system as well as practice network implementation teams) as well as outside consultants on work-flow mapping and redesign, training and simulation to prepare and conduct the transition. This also includes additional hours spent by physicians and clinical staff (practice end user) in the process of transitioning to EMR systems. The results of their analysis are summarized in Exhibit 2 and show an average cost of \$46,659 per provider in the first year.

A study that not only estimated cost but also financial net benefit of transitioning to EMR systems in primary care practices was conducted by Wang and colleagues⁹. They construct a hypothetical patient mix for a primary care provider to estimate financial benefits from the switch to an EMR system. Their analysis assumes a patient mix of 75% of patients under the age of 65 with 17% of those belonging to captivated plans as opposed to pay-per-service plans. As costs, they include software and hardware, training, implementation and ongoing maintenance and support (Exhibit 2), as well as induced costs in loss of productivity, similar to Fleming and colleagues. The cost they estimate for this is lower than in the Fleming study and may affect their modeling for net benefits to show a more positive outcome. Benefits of EMR implications for primary care practices include averted costs and increased revenues such as reduced chart pull and transcription costs (payer independent), less adverse drug events, better drug utilization, less laboratory and radiology utilization, higher charge capture and reduced billing errors. Factoring these benefits into their model while assuming the aforementioned patient-mix, Wang and colleagues estimate an average financial benefit of \$86,400 per practitioner (normalized to 2002 USD) over a 5-year period. With a total cost of about \$43,000 this would equal about a two-fold return on investment.

Importantly, a sensitivity analysis of the net benefit over a period of 5 years reveals that the highest variability of the net outcome will be due to the

proportion of capitated patients (Exhibit 4), demonstrating that only a high enough proportion of capitated patients in contrast to fee-for-service insured patients will guarantee a positive financial net-outcome for primary care providers. A potential incentive for primary care providers to adopt EMR systems is therefore the increase in capitated reimbursement programs as intended by the Affordable Care Act.

Exhibit 2 summarizes the cost-benefit analyses of the Wang and Fleming reports to help healthcare providers estimate a return on investment of an implementation of EMR in their practices. It further incorporates information provided by the Healthcare Information and Management Systems Society (HIMSS)¹², a non-profit organization dedicated to improving healthcare quality, safety, cost-effectiveness, and access, through the best use of information technology and management systems.

The return of investment of the use of EMRs is hard to determine, since many of the current costs or savings are not easy to quantify prior to the actual implementation. Costs that can be determined are the hardware and software cost that will be incurred by the healthcare providers. The planning of adjusted workflows and exact software features may require consulting services and additional (temporary) staff, which will add to the cost. Further losses will be incurred through decreased productivity and training activities of the staff during the initial period. Wang reports a reduction in productivity of an average of 20% in the first year, which drops to 10% in the second year and 5% in the third year after implementation, with a return to baseline or better thereafter. It should also be considered that by non-adoption of an EMR system, providers may face a reduction in Medicare reimbursements between 1% and 5% according to the HITECH act.

The majority of the benefits accrue from increased efficiencies. It is hard to exactly quantify those, but the percent reduction in costs that primary care providers have experienced as summarized in Exhibit 2 may serve as a starting point for estimations for those considering the extent of the financial benefit they may see at their institution upon adoption of EMR systems. Increased efficiencies can be expected in overall operations such as reduced or abolished chart pull times, the decreased need for transcription services and a reduction in overtime payments due to increased workflow efficiencies. Furthermore, EMR systems have had an impact on the choice of drug to be prescribed, with lower-cost drugs being more frequently prescribed with EMRs. A large part of the savings will come from reduced redundancies in lab tests and radiology exams performed resulting from the better availability of these results through

the EMR records. Additional benefits have been realized through better charge-capture during patient visits, lower billing errors and an improved efficiency in the collection of the charges from patients. Furthermore, reduced adverse drug events, reduced lengths of hospital stays and emergency department visits have been reported, giving healthcare providers better leverage to negotiate lower malpractice insurance premiums. The incentives provided by the HITECH act should be factored into the benefit analysis, with up to \$63,750 for small practices and \$2 million for hospitals. Switching from paper records to EMR systems may also free up storage space which could be used for more profitable activities such as additional exam rooms to increase the overall patient number per year that can be seen. Providers who have already switched also reported a better control over their inventory¹², which might also translate into additional savings.

EMR records hold a treasury of data that can be analyzed for research purposes. Healthcare systems are starting to explore options of using these data in a depersonalized way and might benefit financially either through patents and research generated through their own efforts or by granting third parties access to this data.

It should also be noted that there are non-financial benefits that will result from EMR adoption, such as increased satisfaction of providers, staff and patients through reduced wait times for patients and increased face-to-face time.¹³ Reduced overtime and more efficient workflows will also result in a higher satisfaction of non-physician staff members.

As outlined above, on a big scale, the use of EMRs is geared towards an increased quality of care. At the patient and provider level, this will mean improved care through real-time access to patient records, better patient education and therefore better patient compliance and disease prevention. Especially in healthcare settings, which contain pharmacy services, the increased use of e-prescriptions will significantly reduce pharmacist time required per patient.

It should also be noted that much progress has been made in developing medical devices and services that will be able to integrate with EMRs. Therefore, by adopting EMRs, healthcare providers are creating a platform for adoption of further innovation and will enable them to deliver the highest-quality care using the most modern technology.

Determining the return on investment (ROI) of EMRs remains a tricky undertaking as there still are many unknowns. Looking to providers who have already switched and reported the results of EMR implementation might be a good proxy for those in

the process of adoption. It is encouraging to see that the reported ROIs on successful EMR implementation have been overall positive on the provider level, despite the major benefit being anticipated for patients and payers. However, one must cautiously view these results as the ever

changing landscape of healthcare will have a significant effect on these assumptions. The authors of this article hope that the considerations outlined here may help healthcare providers address this issue.

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Submitted on May 31, 2014

¹ Reprinted from *Am. J. Med.* 114, Wang, S. J. et al., A cost-benefit analysis of electronic medical records in primary care., 397-403 (2003) with permission from Elsevier.

Exhibit 1: Possible improved productivity effects of health information technology on future national health spending. Modified after Hillestad *et al*²

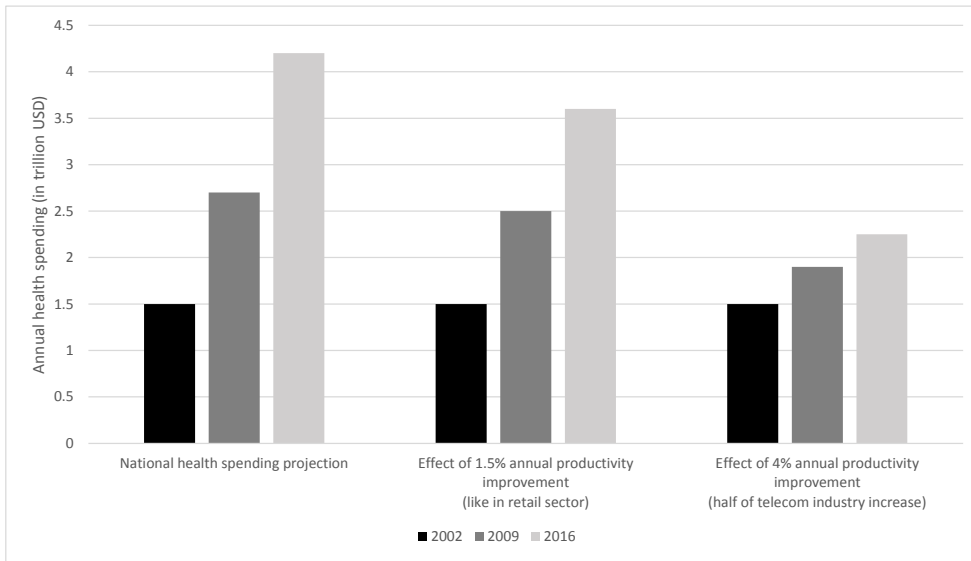


Exhibit 2: Cost-benefit analysis of EMR implementation. Sources are Wang *et al*⁹, Fleming *et al*³ and HIMSS¹² where indicated.

	Wang <i>et al.</i>		Fleming <i>et al.</i>	HIMSS.org
	annual expenditure/provider before implementation	actual cost / provider	actual cost / provider	
costs (per provider)				
hardware (fixed, one time cost)		\$ 6,600	\$ 5,000	
software (fixed, one time cost)		\$ 3,400	\$ 7,058	
software (variable)				
annual license fee		\$ 1,600	\$ 17,100	
hosting and maintenance		\$ 1,500		
consulting costs			\$ 5,605	
implementation (variable)				
additional staff			\$ 1,483	
training of current staff			\$ 10,331	
productivity loss		20% year 1 10% year 2 5% year 3		
total first year cost			\$ 46,659	
potential losses on reimbursement upon non-adoption (HITECH)		1% - 5% of Medicare reimbursements		
benefits				
increased efficiencies		savings possible with EMR		savings possible with EMR
operational				
chart pulls: \$5/chart	\$ 3,000	100%		
transcription	\$ 9,600	28%		
workflow/overtime compensation				\$5000/week
drug savings (prescription of lower cost drugs)	\$ 109,000	15%		
prevention of redundancies				
laboratory test	\$ 27,600	9%		
radiology	\$ 59,100	14%		
billing				
charge capture improvement		2%		
billing error decrease		78%		
improved charge collection				61%
medical				
prevention of adverse drug effects	\$ 6,500	34%		48%
reduced malpractice claims				
reduction in emergency department admissions				
reduced length of patient stay				9%
HITECH incentives				
potential financial benefits				
improved use of space				
improved inventory control				
income from granting third parties access to depersonalized medical records				
income from patents and research conducted using depersonalized medical records				
non-financial benefits				
provider, patient and staff satisfaction				
reduced patient wait times				
increased time for patient face-to-face interaction				
quality of care				
better quality of care through real-time access of health records and lab reports				
increased use of e-prescribing				
better prevention and improved compliance				
improved patient education				
potential future benefits				
further benefits through adoption of emerging technologies such as medical devices that can be integrated with EMR system				

Exhibit 3: Tornado diagram showing the one-way sensitivity analysis of net 5-year benefits per provider.

Each bar depicts the overall effect on net benefits as that input is varied across the indicated range of values, while other input variables are held constant. The vertical line indicates the base case. Reprinted with permission from Wang *et al*ⁱ

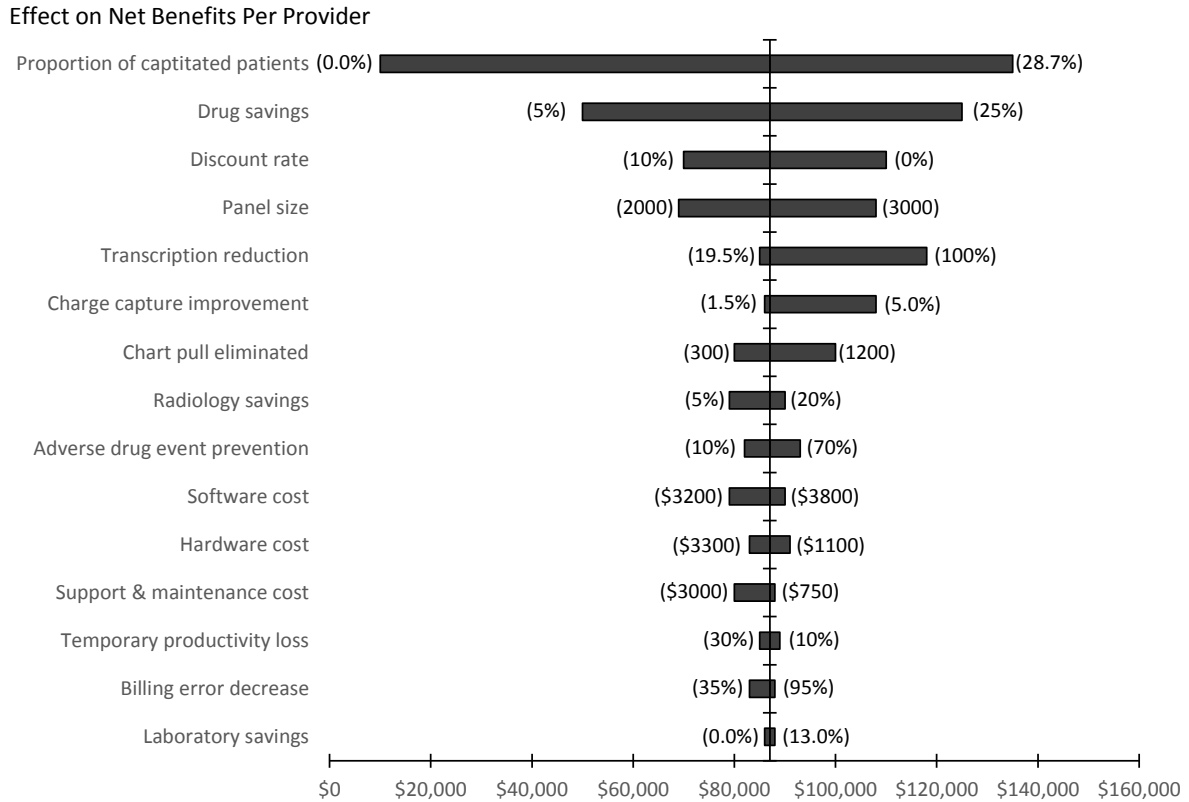


Exhibit 4: Possible improved productivity effects of health information technology on future national health spending. Modified after Hillestad *et al*²

