Center for
Technology Innovation
at BROOKINGS

JANUARY 2015

A Sustainable Business Model for Health Information Exchange Platforms: The Solution to Interoperability in Healthcare IT[1]

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INTRODUCTION

Timely access to patients' medical records helps physicians to make better decisions. They can provide their patients with higher quality of care and avoid many redundant and often harmful medical procedures. Fewer redundancies and medical errors will naturally lead to the much needed savings in the health care system. A nationwide network in which all of the medical providers can access the medical records of their patients is estimated to save up to $81 billion in annual costs (Hillestad et al., 2005).

The most recent efforts to promote health care IT started in 2004 by the executive order of President George W. Bush to establish the Office of National Coordinator for Health IT (ONC). Five years later, this position was legislatively mandated as a part of Health Information Technology for Economic and Clinical Health (HITECH) Act. President Obama's administration knew very well that reforming the health care system starts with building the nation's infrastructure of health care IT. To achieve this goal, the federal government has already spent over $27 billion as financial incentives to promote the adoption and use of modern IT systems among health care professionals (Galbraith, 2013). Although the generous federal incentives have led the majority of health care providers to adopt basic Electronic Health Record (EHR) systems, they rarely exchange their medical information with each other (Furukawa et al., 2014). The lack of technical interoperability remains to be the most important challenge in the health care system (JASON, 2014). That is, the expensive and often not so user friendly EHR systems that are used to collect and archive patients' medical data are not able to communicate with each other. The potential benefits of these systems, and the $27 billion spent on them, will only be realized if they can exchange patients' medical data

1 Many of the ideas in the paper are polished and refined over the numerous discussions that I had with Suzette Stoutenburg, Mary Jo Deering and Grace Moon. I appreciate their kind help. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of these individuals or the organizations they are affiliated with.

with each other. To overcome the interoperability problem and facilitate the exchange of medical data among the EHR systems, ONC has taken the lead to promote the compliance of EHR software with unified technical standards such as HL-7 (Dolin et al., 2006). More importantly, the third stage of the Medicare and Medicaid EHR meaningful use incentive programs will also be designed with a focus on information exchange.2

While I admire the efforts to address interoperability as a technical problem, I argue that it is more of an economic and political rather than a technical issue. As long as the long-term economic benefits of all of the medical providers are not adequately addressed, neither the development of new IT standards, nor allocating more financial incentives would drive them to effectively engage in the electronic exchange of medical information.

In the first section of this paper I provide a simplified yet general description of the interoperability problem. In the second section, I describe the economic interactions between multiple entities in the health care market and maintain that even in a fully interoperable environment, it would be against the economic interests of some health care providers to exchange medical information of their patients with each other. In the third section, I focus on third stage of the Medicare and Medicaid EHR meaningful-use incentive program and discuss that unless the qualification criteria for these incentives are not carefully designed and accompanied with high standards for EHR software certifications, the billions of dollars of federal incentives will not have a tangible and long lasting effect on increasing the level of medical information exchange. Finally, in the fourth section I lay out a business environment in which the economic incentives of different entities in the health care market would lead them to actively engage in exchanging heath information. In the proposed business model the value generated from real-time data services and asynchronous data analytics and customized reports will create a self-sustainable network that is not dependent on state or federal financial support.

INTEROPERABILITY: TECHNICAL INHIBITOR OF EXCHANGING HEALTH INFORMATION

The patients' medical history, including their medications, hospitalization records, laboratory test results, and radiology images are now collected and stored in Electronic Medical Records (EMR) systems. EMRs act as electronic databases which replace the traditional hard-copy archives and have been shown to be effective in reducing costs and increasing efficiency in the health care system (Schmitt & Wofford, 2002; Wang et al., 2003). However, EMRs are only silos of medical information and often cannot exchange information with other systems. Many of the EMR systems cannot automatically receive the electronic tests results from laboratories and almost none of them can automatically merge the patient records with the information from other EMR systems.

Exchange of information between different EMR systems is facilitated through Health Information Exchange (HIE) platforms. HIE members can connect to a central or federated database in which the medical records of the patients are collected from multiple providers and consolidated together. If the EMR systems of HIE members have the technical capability to automatically receive data from HIEs, the hospitalization records, and the results

2 See the public notice here:
http://www.reginfo.gov/public/do/eAgendaViewRule?pubId=201410&RIN=0938-AS26

of laboratory tests and radiology examinations will seamlessly imported into the EMR system under the patient name.3

Think of EMRs as personal computers and HIE as the Internet. While a personal computer is a powerful machine, its benefits would significantly increase if it connects to the Internet. The interoperable EMRs are like personal computers that have a modem and can connect to the Internet of HIE. Many of the EMRs do not have this functionality. Automatic exchange of information between different EMR systems is almost nonexistent.

In addition to EMRs, there is a wide variety of other systems which collect medical and health related data. Information systems designed for administration and billing services in health care sector are rarely capable to communicate with EMR systems. Different applications on smartphones such as S Health4, and various wearable devices such as Fitbit5, collect huge amounts of data about users' activity, diet, exercise, and overall health conditions. These new technologies are only used by individuals as a self-monitoring system and cannot be merged with the other types of medical data already collected and stored in the EMR systems.

The lack of data exchange functionality between different types of health care IT systems is referred to as interoperability problem. The most notable efforts of government to tackle interoperability as a technical problem are enforcing EHR vendors to comply with unified standards and driving medical providers to engage in exchange of information through the third stage of Medicare and Medicaid EHR Incentive Programs.

NETWORK EFFECTS: ECONOMIC DRIVERS AND INHIBITORS OF EXCHANGING HEALTH INFORMATION

Imagine a perfect world where there is no such thing as interoperability problem and data is easily exchanged among different health care information systems. Consider a scenario where a patient is admitted to a hospital and a plethora of laboratory tests and radiology examinations are performed for him. After getting discharged from the hospital, if the primary care physician of the patient exactly knows what kind of medical services has been provided to the patient at the hospital and what the details of the test results are, he would be able to provide the patient with much better care. Rather than ordering new medical tests, he will probably refer to the results of the recent tests and saves patient's time and insurer's money by avoiding the unnecessary tests. Being well informed about the patient's medical history, the physician will be able to reduce the chance of readmission to the hospital, which again saves hospital's money, and patient's time.

There is empirical evidence that various types of financial and economic incentives also play a major role in how medical providers practice medicine.

3 In this paper I use "HIE" as a noun rather than a verb. It refers to an *entity* that facilitates the information exchange rather than the action of exchanging health information. There are multiple methods to exchange health information, including traditional off-line methods such as faxing or mailing the health records, secure email exchange systems such as DIRECT, query based services provided by Regional Health Information Organizations, etc. "HIE" in this report is referring to a platform that creates and manages a database by collecting health data from multiple sources and allows its members to access and query this data base.

4 http://content.samsung.com/us/contents/aboutn/sHealthIntro.do

5 http://www.fitbit.com/

Multiple entities should collaborate with each other to make this scenario to happen in real life. The hospital, and laboratory, and radiology centers that perform the medical procedures and tests should be willing to provide the results electronically and the patient should agree to allow them to share his medical records with others on the HIE platform. Most importantly, the primary care physician should be willing to use the system and review the medical records of the patient to provide better care.

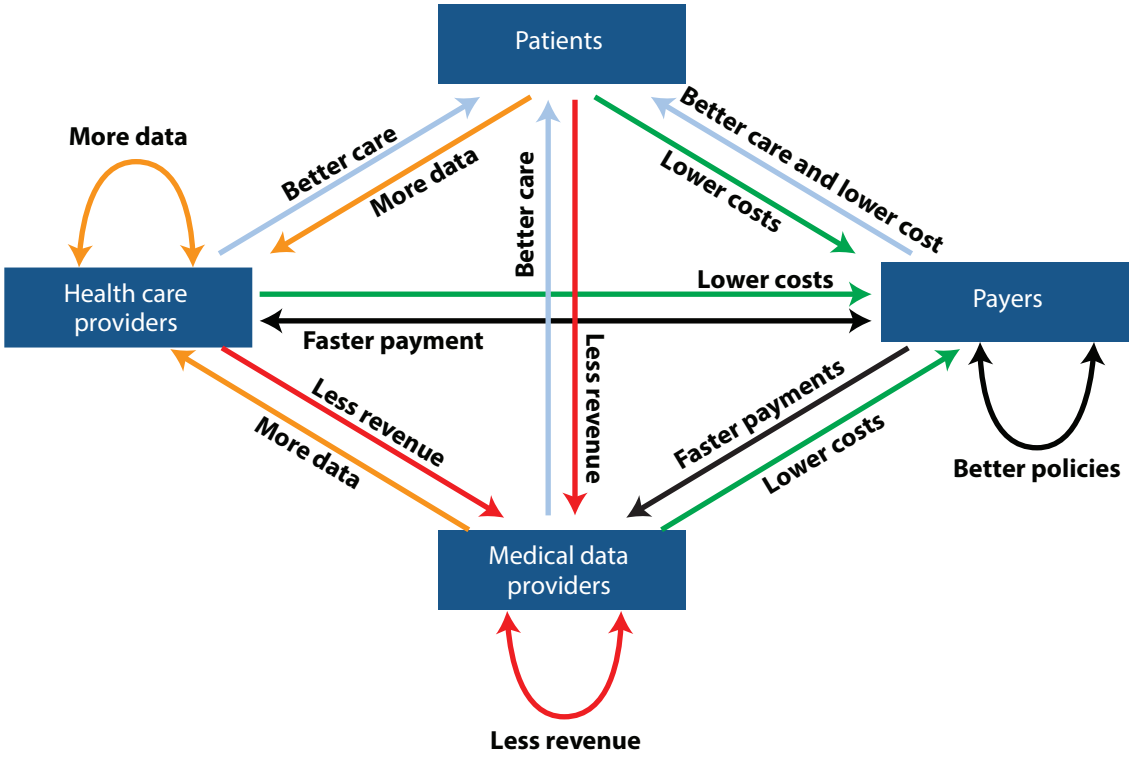
Although I firmly believe that most of the health care professionals are deeply concerned about their patients and strive to provide them with the best possible medical care, there is empirical evidence that various types of financial and economic incentives also play a major role in how medical providers practice medicine (Clemens & Gottlieb, 2014; Engelberg, Parsons, & Tefft, 2014).

If a medical testing facility invests in IT systems and provides the results in an interoperable format, the likelihood of reordering tests would decrease. In the current fee-for-service payment format, reduced likelihood of repeating tests equals reduced likelihood of generating revenue. With widespread of interoperable EHR systems, the likelihood of repeating tests would decrease even more and the laboratory and radiology centers would have significantly lower revenue. Federal incentives to promote interoperability will certainly cover the initial investments and potential losses, but are very unlikely to cover the future reductions in potential revenue.

In addition to the testing facilities, the primary care providers and specialists do not have enough economic interests to use the EHR systems. Even if they could access all of the medical records of their patients on their office computer, providing better care at a lower cost is not necessarily their best financial decision. Physicians have to invest extra effort in accessing the HIE platforms to review their patients' medical records. These investments in many cases eventually benefit other entities in the health care system rather than the physicians who made these investments. Consider a primary care physician who access an HIE platform to review the details of a patient's medical history and as a result, prevents the patient from being readmitted to the hospital. Many insurers do not pay hospitals for treating readmitted patients and thus reduced readmissions result in significant financial savings for the hospitals. The physician is not rewarded for his efforts to access HIE despite the financial benefits that his efforts create for the hospital. Although the federal incentives will drive physicians to maintain a minimum level of EHR usage and health information exchange, their effects will disappear as soon as the federal incentives are discontinued.

Involvement in information exchange can be determined by positive and negative forces in a network of different entities in the health care market. Consider HIE systems as platforms that have multiple sides and connect different types of users together and enable them to share medical information. The value created by an HIE platform to members on any side is not only a function their own characteristics, but also depends on the members on other sides of the platform. Increase in the membership at each side can create positive or negative direct network effects among the members in the same side and indirect network effects among the members at the other sides. Even if we assume that all of the entities in the market have access to interoperable information systems and are initially willing to effectively use the HIE services, in the long run their level of information exchange will be changed as a result of the network effects. The following figure presents a very simplified illustration of the positive and negative network effects among different types of users of an HIE platform. The following paragraphs excerpted from the recent research article by my colleagues and I (Yaraghi et al., 2014) discuss the direct and indirect network effects originating from each of the sides.

Network Effects in Health Information Exchange Market



PATIENTS

The availability of the records to other users of an HIE platform is controlled by the consent of the patients, and such consents are usually given with different levels of availability constraints. As the level and volume of patient consents increase, more data becomes available on the platform. Hence, the sharing will be greater and the value of the HIE to its other participating user types will increase, leading to potentially better service that patients receive from health care providers. Furthermore, an increase in the level and volume of patient consents would increase the quality of health care services and reduce the probability of redundant tests. Both will eventually result in lower costs of health care services that payers including private insurance companies or state and governmental payers such as Medicare and Medicaid will benefit. The lower costs of the health care services will indirectly benefit patients by reducing the premium for their insurance coverage. On the other hand, although health care payers and providers will enjoy positive effects of indirect externalities from increased number of patients with consent, the data providers such as laboratories and radiology centers will lose a part of their potential revenue by the decrease in the number of potential patients as the customers of their services. This happens due to the reduction in the number of redundant tests and increase in better care which also reduces the need for extra laboratory and radiology tests and other surplus clinical work. Finally, same-side direct network effects on the side of the patients are in general not significant.

HEALTH CARE PROVIDERS

When more practices and physicians join an HIE platform and access medical data, the probability of receiving better care increases for patients. With a high number of physicians with access to previous medical records, patients may undergo fewer tests, receive more rapid health care service which in many emergency cases, may

be vital for them. The better health care service and increased performance of health care providers will significantly lower the health care cost which benefits the payers. However, an increase in the number of physicians with access to previous medical records could also negatively affect the potential market share of laboratory and radiology centers in the same way that increased levels of patient consent do. The most interesting externality with this side is the direct network externality among physicians. When they become a member of HIE, the tests that they order will become accessible on the system and other physicians will be able to use them. In other words, the increased number of physician members will result in a richer medical dataset. This happens either as a result of more consent forms signed at the locations of the member health care providers or the future capabilities of the EHR systems to upload medical information to HIE platforms (Yaraghi, Du, Sharman, Gopal, & Ramesh, 2013; Yaraghi, Du, Sharman, Gopal, Ramesh, et al., 2014). In conclusion, we can expect positive indirect network effects from the side of health care providers to the sides of the patients and payers, a potential negative effect on the side of medical data providers, and positive same-side effects due to the reasons cited above.

MEDICAL DATA PROVIDERS

As membership of medical data providers in an HIE increases, the chance of creating digital health records on the HIE platform also increases. This would positively affect both patients and health care providers. Patients would have a larger portion of their medical history online and thus will receive the benefits of an HIE in increased health care quality and reduced costs at higher levels. In a similar way, with more data providers on the HIE system, health care providers can access larger pools of medical data of their patients and thus would be able to provide better care at lower costs. As discussed earlier, this would again benefit insurance companies and other payers by reducing the chances of paying for redundant tests. More importantly, the availability of more thorough and comprehensive medical histories reduces the chances of occurrences of unusual medical complications caused by wrong diagnoses and prescriptions. This would eventually reduce the health care costs for payers. When more data providers join an HIE and contribute to its digital database of medical records, less patients would need surplus tests and lab work. This happens due to the availability of previous medical records that reduces the chances of re-ordering redundant tests. Further, more comprehensive medical histories help physicians to make better decisions and provide better care which in turn would reduce the possibility of extra tests which would otherwise be administered based on wrong diagnoses and practices. Thus, the membership of more medical data providers in a HIE could create negative direct network externality among other data providers. In summary, we can expect positive indirect network effects from the side of medical data providers to the sides of the patients, payers and health care providers, and a potential negative same-side effect due to the reasons cited above.

PAYERS

A significant value offered by an HIE to the participants on the payers side is the capability it affords them to better control the quality of health care services and manage the billing and claims processes better and smoother. The increase in membership on the payers side increases the likelihood of better quality control over the health care services provided by medical providers that would result in better care for patients. It also enhances the precision and speed of coverage payments to medical providers as well as major data providers. An HIE provides a unique and rich pool of data which payers can utilize to better analyze the cost-effectiveness of their coverage policies and investigate the effects of many different options in health care coverage. As the number of members in the payers side increases, their collective business intelligence leads to more sophisticated data analysis towards better coverage policies and health care services recommendations. In conclusion, we can expect positive indirect

network effects from the side of payers to the sides of the patients, health care providers and medical data providers and positive same-side effects due to the reasons cited above.

THE 3RD STAGE OF THE EHR INCENTIVES PROGRAM: A DOUBLE-EDGED SWORD

The federal incentives may have an immediate impact on surging the EHR adoption levels and increasing the level of information exchange, but by definition, they are temporary and will terminate in near future. Unless there is a system in which a part of the financial savings that occur as a result of health information exchange is shared between the entities that engage in exchanging information, there is no reason to believe that the providers will continue to actively exchange health information with each other. On the other hand, with the existence of a shared saving program in which all of the health care providers are held responsible and respectively rewarded for their efforts in exchanging medical information and collaborating in reducing the overall costs of services, I believe that interoperability will be achieved with minimal involvement of the government. The financial benefits of exchanging information will lead medical providers to independently seek IT systems that are capable of communicating with others and, with creating enough demand, the software vendors will ultimately have to find a technical solution for interoperability and produce IT systems which are capable of exchanging information with other systems.

To effectively incent a large number of medical providers, the qualification criteria for the third stage of Medicare and Medicaid EHR incentives will probably be set very low. The low standards of these incentives may potentially have reverse outcomes. These grants are intended to encourage medical providers to reach a minimum level of information exchange and seek software vendors who can produce such IT solutions. With low qualification standards, the EHR vendors who have currently dominated the market can increase their interoperability capabilities up to a certain level that enables their users to qualify for federal grants. The dominant EHR vendors will have an even greater incentive to only enable the capability of exchanging information between their own products and prevent the other types of EHR software to communicate with theirs. Dominant EHR vendors will use their larger network of users to expand their market even more and eliminate any competition from vendors with smaller networks of users. The federal grants will inadvertently help EHR vendors rather than medical providers and lead to a situation in which a handful of vendors dominate and control the market and allow exchange of information only within the network of the users of their own products and create bigger silos of medical data. With the ultimate termination of the federal incentives, the medical providers will have no interest to maintain their minimal level of information exchange even with the other users within the same network. These unintended consequences can be avoided if ONC only certifies EHRs that are completely interoperable with a wide variety of other EHR systems. Adoption of fully interoperable EHR solutions that are capable to exchange information with other types of EHR systems should also be included as a minimum criterion of qualification for the federal incentive programs.

A SUSTAINABLE BUSINESS MODEL FOR HEALTH INFORMATION EXCHANGE

Creating an integrated, nationwide electronic network for exchanging information is not a novel idea. There are multiple instances of similar networks that have been designed and implemented at a much larger scale decades ago, and have been financially self-sufficient ever since. The health care industry can learn many lessons from the successful design, implantation and management of the electronic network of information exchange among hundreds of thousands of financial institutions. In the following I provide a summary of the similarities and differences

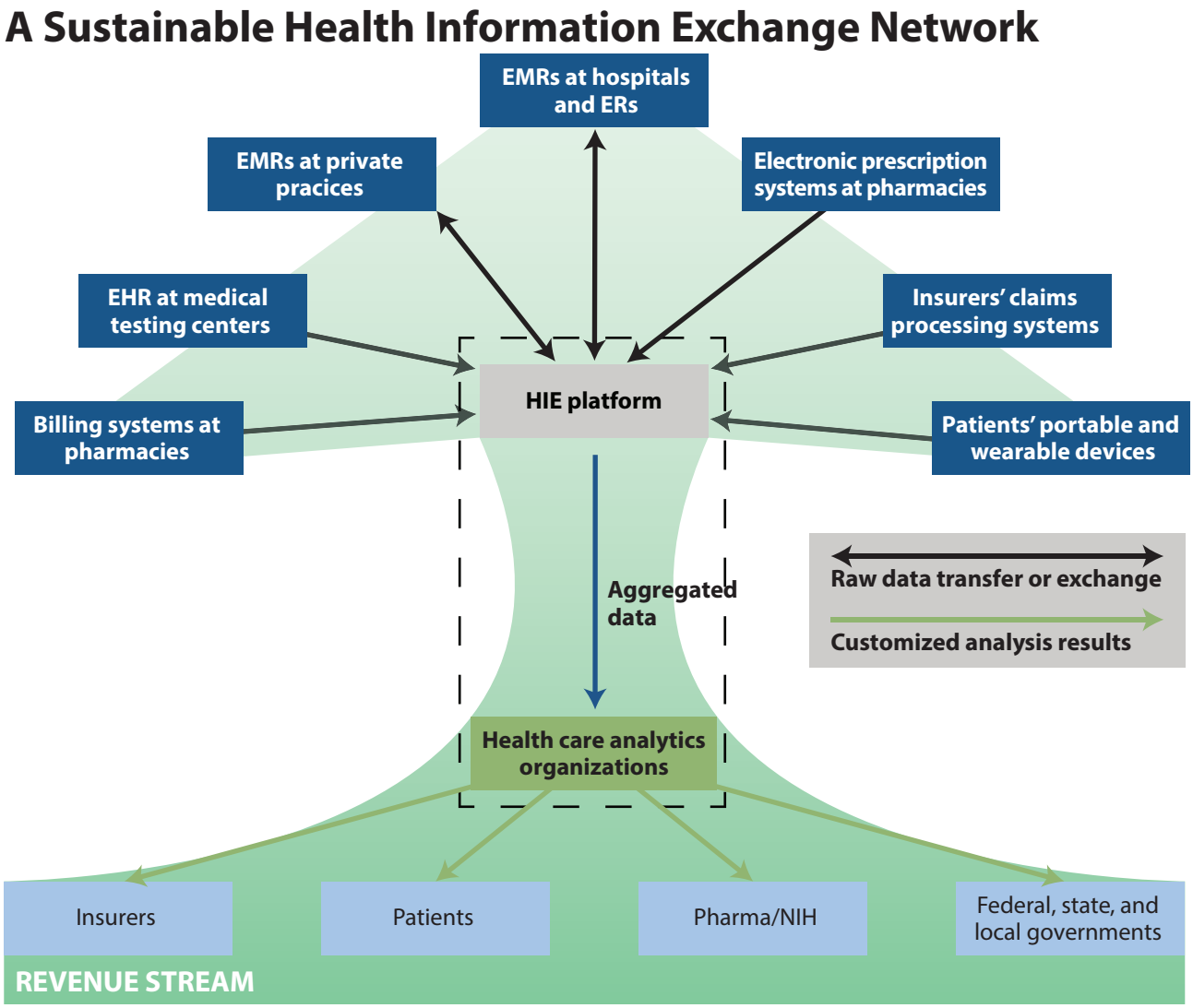
between the financial and health care information exchange networks and briefly discuss the potential strategies that can create a dependable source of revenue by extracting the potential value of health care information from the heaps of available health care data.

All of the three major credit bureaus in the United States are for-profit organizations that, like other private businesses, do not receive any support from the government. These entities collect financial data from various private and public organizations with which consumers have financial relationships. Creditors, banks, public courts, collection agencies, and other data furnishers provide the credit bureaus with real-time and detailed financial data of nearly half a billion credit holders worldwide. The detailed financial data is provided by institutions in different countries which each of them use their own customized information systems. The electronic information network that enables various financial institutions around the world to efficiently exchange financial information has been developed many years ago using information technologies which in today's standards would be considered very basic and rudimentary. The federal government has not been involved in creating such systems and has not spent billions of dollars as incentives to encourage banks and other financial institutions to exchange their information with each other. Obviously, the coordination and management of such a vast network that connects financial institutions in many different countries with unique cultures, languages and regulations is much more difficult than coordinating a small number of health care providers within a relatively small geographical area here in the United States. If the financial sector could resolve the problem of interoperability decades ago, using an outdated information technology and no governmental support, the health care sector should have been able to address this problem today, with a much more advanced information technology and billions of dollars of government incentives. Information technology, many years ago, has passed the point in which interoperability could be a technical problem. As I discussed above, the current method of the payment system in the health care industry seems to be the major barrier to efficient exchange of health information. The lenders need to have a risk management system and use as much information as possible in order to reduce the risks of their decisions. The existence of interoperable information system in which they can effectively exchange their financial data with each other is vital for their survival. The health care providers are currently not bearing the risks of their decisions; instead, they transfer these risks to insurers and patients. As a result, they do not need to extensively use the patient records as a strategy to mitigate the risks of their decisions. For health care providers interoperable EHR systems and exchanging health care information fits into the category of "expenses on luxury items" rather than "essential business investments".

The secret to the success of credit bureaus is generating value from the raw financial data. A simple data point about the payment history of a consumer reported by a credit card company may not be valuable on its own. However, when these data points are combined and merged together, analyzed, summarized, and presented as a brief and understandable credit score, significant value will be created. Credit scores help lenders to accurately estimate the risks of their financial decisions. The value of the services of credit bureaus are high enough for financial institutions that they are willing to invest in interoperable information systems which can send their raw data to credit bureaus and in return receive credit scores from them. Each of the three credit bureaus generate well over a billion dollars of annual revenue from selling the results of their analyses of the raw financial data to various types of customers who need these services for financial decision making and marketing purposes. A portion of these revenues would suffice to maintain and expand the whole financial information exchange network.

The health care sector can follow the successful strategies of financial sector. The advent of independent, for-profit businesses that can create value by analyzing raw health care data and turning it into actionable summaries may

be the key to a fully interoperable health information exchange system. In the following figure I outline a business environment in which health information exchange platforms can generate substantial revenue from two sources: (1) real-time data services to different healthcare providers and (2) asynchronous data analytics and customized reports. The value of these services can drive different entities in the health care market to willingly exchange their medical information. The revenue generated from these services can partially be transferred to different medical data providers in order to provide them with economic incentives to engage in higher levels of information exchange. In such business environment, complete interoperability would be achieved even without financial incentives from the federal government. I describe the details of these two types of services below.



Data providers include hospitals, medical practices, testing centers, patients, pharmacies, and insurers. Different clinical, administrative and financial data such as test results, medical diagnoses, prescriptions, insurance claims and activity levels are reported to a central data repository that I refer to as health information exchange (HIE) platform. Note that this platform is not necessarily the same entity as the traditional Regional Health Information Organizations (RHIOs); its functionalities may be expanded well beyond the functionalities of current RHIOs. The various data components reported by the data furnishers are collected, cleaned and merged at the patient level by

the HIE platform. This data can then be passed back to the hospitals and medical practices to be used during the care process of the patients. This aggregated data can include test results, hospital transcriptions and medication histories of the patients. The cleaned and aggregated data can also be transferred to the health care analytics organizations. These entities (which can also be a part of the HIE platforms) will generate revenue by performing customized analyses that are of value to a wide variety of potential customers. These services can include risk assessment reports for health insurance companies, automatic alerts to patients about the negative interactions of the drugs that are being prescribed, deidentified summaries of patient records for medical researchers and geographical health trends or prediction of outbreaks of infectious disease for public health authorities.

Although all of the four mentioned services are already being provided by different entities, none are based on analyzing complete sets of patient data. These services currently are either very expensive or limited to small and incomplete data sources. For example, the Charlson Index has been used for a long time by both insurance companies and medical researchers as a measure of mortality risk of patients (Charlson et al.,1987)1987. This index and its variations predict the chance of patient's mortality based on the severity of 22 different comorbid medical conditions that a patient may suffer from. As one can imagine, the complete medical history of the patients that include data from various resources would result in much more precise indexes. The Center for Disease Control and Prevention has been successfully monitoring and predicting the Influenza epidemics in the United States for years. This process is based on analyzing samples of five different types of data collected from various sources across the country. Although the predictions are often very close, they are very expensive, very slow and very limited. A more financially efficient process to predict a series of infectious disease can be based on the data that are provided by the data furnishers mentioned above, aggregated by HIE platforms and analyzed by health care analytics organizations. The medical research that includes projects funded by National Institute of Health (NIH) or privately funded research by pharmaceutical companies can hugely benefit from such services to be done in much shorter time at a much lower cost. Finally, one should note that pharmaceutical companies are already spending millions of dollars to collect and analyze the prescription behavior of physicians for their marketing purposes. Although this is a controversial practice, it is permitted under the freedom of commercial speech law (Curfman, Morrissey, & Drazen, 2011; Boumill, Dunn, Ryan, & Clearwater, 2012). There is no reason to believe that the pharmaceutical companies and medical device manufacturers will not be interested to leverage the details of the data that HIE platforms can provide them to increase the efficiency of their marketing practices even more.

In this model, many of the potential customers include federal agencies that already face serious budgetary constraint. Although it may seem that these agencies cannot afford to include the services of health care analytics organizations as an additional item to their budget, one should note that by doing so, they will be able to significantly reduce the cost of their ongoing parallel processes. This will result in significant net savings for these agencies. For example, CDC can outsource the task of influenza monitoring system and pay a fraction of what it already spends on this process to receive comparable service from the health care analytics organizations. A major part of the research budgets funded by NIH are already spent on data collection processes. The same budget can be allocated to acquire much better data from the HIE platforms. Transferring the budgets from in-house processes to out-sourced services will not only reduce the direct costs and partially finance the HIE platforms, but also will have potential cost savings in the future. Reducing the time of the research projects funded by NIH or faster identification of the outbreaks of infectious disease by CDC can potentially save many priceless lives.

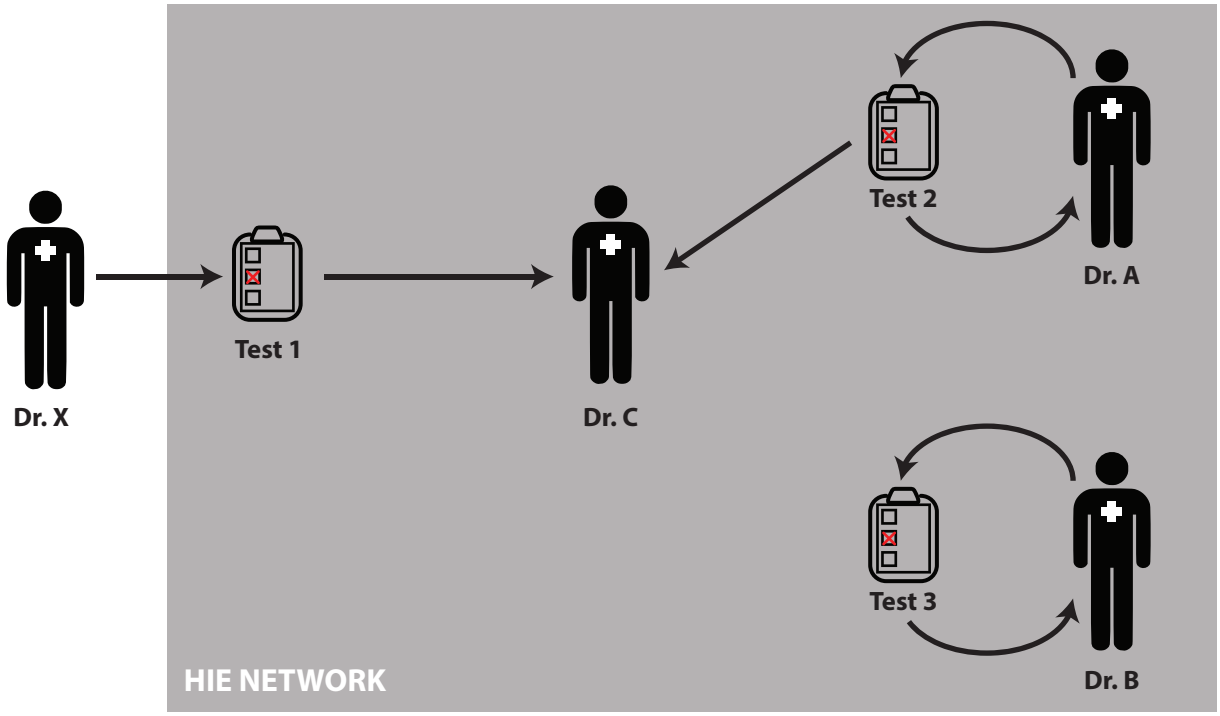
To acquire cleaned, aggregated data sets from HIE platforms, the health care analytics organizations would pay HIE platforms. This would be a source of revenue for the HIE platforms to cover their maintenance and operations costs. The HIE platforms can in turn pay their data furnishers to acquire the raw data from them.

In such environment, the medical providers have economic incentives to provide the HIE platform with the patient data (upon the consent of the patients), but unless they are a part of an accountable care organization (ACO), they do not have economic incentives to use the data provided by other data sources. ACOs share the risks of the care process with the payers. In a capitated payment system, these organizations will have strong incentives to reduce their costs in order to increase their profit margins. The strategies for increasing efficiency in different ACOs should be designed independently with regards to the unique characteristics of different providers who have created an ACO. They should have the discretion to choose the best approach for enhancing the efficiency of their operations that may or may not include investing on health information exchanging between the providers within their own organization. These organizations will most likely arrive at the conclusion that receiving additional medical records from an HIE platform will help them to reduce their costs and increase their margin of benefit. If this happens, an HIE platform can charge ACOs a subscription fee for its services. To encourage providers outside of an ACO to use the other sources of data available on HIE platforms, a part of the potential savings should be shared with them. In the following, I provide more details on how a shared savings program can be designed.

The value of different types of medical records in reducing the overall cost of the health care services depends on a wide variety of factors including but not limited to the specialty of the provider, the personal and medical characteristics of the patients and the cost of reproducing the same medical record. The payers in collaboration with the HIE platform first need to have precise estimates on the financial impact of accessing the medical history of different types of patients by different types of providers. Reviewing medication history may help a neurologist to avoid prescribing unnecessary drugs, which will result in substantial savings in medication costs for the payer. On the other hand, reviewing radiology images may not provide the neurologist with useful information and will not have any impact on reducing the costs. Conducting rigorous empirical analyses will help the payers to have a reasonable estimation on the effect of accessing the medical history of the patients by different providers. They can then provide a part of these savings to the providers as an economic incentive to encourage them to use the medical data available on HIE platforms and reduce the cost of their services even more. Accessing the HIE platform and reviewing appropriate medical records should be deemed as a part of the routine medical services that providers are paid for. The payers and insurance companies can also assign a part of these savings to support the HIE platforms. In the following provide an example on how to measure the effects of patient records on HIE platforms on reducing the number of redundant medical tests. Similar procedures can be used to estimate the savings associated with accessing other types of information on HIE platforms.

When a specific medical test is ordered, regardless of the HIE membership of the ordering doctor, an electronic copy of the test results is sent to the HIE database by the testing facility that has performed the test. Note that according to my previous discussions on the design of the business environment, the testing facility will receive a financial payment for providing the results to the HIE platform in an interoperable electronic format. If the ordering doctor is a HIE member, then he or she can access the results via HIE, otherwise, the ordering doctor will receive the results off-line via fax or mail. In both cases, the results are always delivered to the ordering doctor. The actual value proposition of HIE is in eliminating the need to re-order similar tests. That is, HIE creates value when doctors access the medical records that were previously ordered by another doctor rather than themselves. These concepts are represented in the following example:

Value Creation on Health Information Exchange Network



Physician X is not a member of HIE, he orders test T1. The test is produced by a laboratory, a copy of the results is sent to physician X via fax, and an electronic copy is uploaded to the HIE system. If doctors A and C who are HIE members access the same test via HIE platform, we can assume that two repetitions are avoided and thus HIE has created two units of value (2 Cost of re-ordering test T1). Doctor A is member of HIE. He orders test T2 and receives the results via HIE. There is no value creation here since doctor A would have received the results of test T2 even if he was not a member of HIE. Doctor C accesses test T2 via HIE, so one redundant test is avoided and a unit of value is created (1 Cost of re-ordering test T2). Doctor B is a member of HIE, he orders test T3 and received the results via HIE. The test is never accessed by any other doctor. No redundancies are avoided by HIE here, and thus no value is created. Overall, in this simplified scenario, HIE has helped to avoid three instances of redundant ordering of medical tests.

The current technical capabilities of the HIE platforms enable them to easily track the access trends of all of their members. In collaboration with the HIE platforms, the payers can first estimate the savings associated with the HIE access by specific types of provider and then design appropriate incentive programs which transfer a part of these savings to the providers and another part to the HIE platforms. The long term impacts of these policies on reducing the over-all costs of care and increasing the quality of care can also be measured thanks to the abundance of available data from the HIE platforms. As mentioned above, patients have to first consent to sharing of their medical records. As many studies confirm, due to its potential benefits, an overwhelming majority of patients are willing to provide consent and enable different providers to access their medical records on the HIE platforms. In addition to these benefits, patients can be encouraged further to provide consent by including them into the shared savings program.

The following table summarizes the potential services that an HIE platform (along with a data analytics organization) can provide to various customers. The last column suggests the sources from which the customers can finance the costs of receiving such services from the HIE platform.

Table 1: The HIE Platform's Potential Services and Financing Sources

Potential Customers	HIE Service	Financing sources
ACO	Access to health records	Reduced costs and increased margin of benefits
Payers	Prompting physicians to use the recent test results instead of ordering new ones / customized alerts and summaries of health data	Shared savings program between the HIE platforms, health care providers and payers
Patients	Access to organized personal health records	Customized reports and alerts provided through third party vendors such as mobile apps
NIH	Customized patient data summaries	A part of the budget of the research projects that are currently allocated to data collection
Pharmaceutical companies	Customized patient data summaries	Faster research projects and more efficient marketing strategies
Public health authorities	Data analytics / Customized summaries of health data	A part of the budget that are currently allocated to the slow and expensive data collection and analysis tasks

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