

Estimated financial savings associated with health information exchange and ambulatory care referral

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Abstract

Data and financial models based on an operational health information exchange suggest that health care delivery costs can be reduced by making clinical data available at the time of care in urban emergency departments. Reductions are the result of decreases in laboratory and radiographic tests, fewer admissions for observation, and lower overall emergency department costs. The likelihood of reducing these costs depends on the extent to which clinicians alter their workflow and take into account information available through the exchange from other institutions prior to initiating a treatment plan.

Far greater savings can be realized in theory by identifying individuals presenting to emergency departments whose acute and long-term care needs are more suitably addressed at lower costs in ambulatory settings or medical homes. These alternative ambulatory settings can more effectively address the chronic care needs of those who receive most of their care in emergency departments.

To support a shift from emergency room care to clinic care, health care information available through the health information exchange must be made available in both emergency department and ambulatory care settings. If practice workflow and patient behavior can be changed, a more effective and efficient care delivery system will be made possible through the secure exchange of clinical information across regional settings.

These projections support the case for the financial viability of regional health information exchanges and motivate participation of hospitals and ambulatory care organizations—particularly in urban settings.

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1. Background

In June of 2004, the Governor of Tennessee initiated an effort to improve the quality and cost-effectiveness of health care delivery for approximately one million people receiving care in Memphis, Tennessee and the surrounding three-county region. Memphis, like many other communities, had made unsuccessful attempts to exchange information through a community health information network [1]. The Governor's effort in 2004 differed in that it was part of a broader response to a heightened awareness of a serious crisis in regional health care financing and delivery [2].

With funding and support from the Agency for Healthcare Research and Quality, the State of Tennessee, Vanderbilt University and a broad array of leaders from the Memphis Community, the Governor's initiative created a health information exchange that was operational in a test setting within one year and in emergency department settings within two years [3,4].

The health information exchange is governed by the MidSouth eHealth Alliance, a non-profit corporation that includes representatives from health care delivery organizations, state government, local government, and public health [5]. The Alliance and its health information exchange initial participants include state and regional government, all four major hospital systems, two of the largest ambulatory clinics, a faith-based safety net clinic, and a large Medicaid managed care organization. All care

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delivery organizations publish data into a logically separate database (or vault) in the health information exchange. These data are under control of the publishing organization until they are used by others in the delivery of care (No secondary use of data or population queries are permitted at the present time). Data from all organizations are linked in the health information exchange through a record linking and locator service and presented to emergency department clinicians through a secure web browser requiring two-factor authentication. A comprehensive set of data-sharing agreements bind the organizations and allow individuals to “opt out” at the institutional level [6]. Within one year of operation, the health information exchange had approximately 1 million records on over 800,000 individuals and was receiving on a daily basis approximately 33,000 records, 3700 encounter data items, 1000 ICD-9 admission chief complaints, 4000 “reason for visit” messages, 12,000 discharge codes, 200 procedures codes, 80,000 laboratory values, 1200 chest X-ray reports and a wide range of other items.

To maintain the voluntary participation of all major health care delivery systems during the critical formative months in 2004, a pro forma economic impact model was developed to demonstrate the financial impact of the health information exchange on emergency room operation costs among participating hospitals. The initial model did not estimate the financial impact of reduced medication errors, efficiencies for reporting public health or quality metrics, or the economic impact of alternative care delivery options made possible through the health information exchange. In 2006, the model was expanded to reflect the potential value of using the health information exchange to coordinate care among emergency departments and ambulatory care facilities to support better means of addressing non-urgent acute and chronic health conditions.

2. Emergency departments

Emergency department care is in crisis [7–9]. A disproportionate percentage of individuals seek care in emergency departments for disorders best treated in ambulatory clinics. Because individuals often seek care in multiple emergency departments for the same complaints, health care leaders in the Memphis area hypothesized that a regional data exchange would allow clinicians to provide better care to individuals without repeating costly, inconvenient, and possibly harmful tests.

The initial evaluation examined the extent to which regional data exchanges could demonstrate or propose savings or quality improvements in emergency department settings. The approach consisted of a review of the literature, emphasis on factors deemed most easily demonstrated, and attenuation of financial impacts based on the experience and views of participants. Particular attention was paid to data supporting lower ED expenditures, reduced dupli-

cate laboratory and radiology tests, reduced hospitalizations for observations, and lower communication costs.

The models did not include adverse drug event or other patient safety factors that could have financial impact. Estimation of such avoidance costs is problematic. The financial impact of medication history services—vital to safety and effective care—also were not included since such services can be provided through commercial systems and in principle do not require a health information exchange. Similarly, the model did not include benefits accrued by producing more accurate metrics for assessing quality of care across delivery settings, reporting data to public health, or enhancing the ability to provide differential incentives based on quality (e.g., pay-for-performance). Each of these services may impact the long-term operations of a health information exchange, but early emphasis was placed on measurable, short-term benefits accrued by early participants.

3. Baseline data

Five-year financial estimates were based on a static emergency department visit rate of 460,000 per year. The model assumed a static total of 924,000 laboratory tests per year in the emergency departments and 1.3 million radiology tests performed from the emergency departments or from admissions where outside information was not available. The estimated use of the health information exchange to support the care of eligible emergency department patients was estimated to be zero in the first year, 5% in the second year, 5% in the third year, 75% in the fourth year, and 90% in the fifth year. This impact factor was modified further for some interventions.

4. Emergency department expenditures

Health information exchanges may reduce overall emergency department costs but data supporting this claim are not conclusive. A randomized trial conducted by Overhage and colleagues in 2000 suggested that under certain assumptions the reduction in ED charges in one of two hospitals studied was \$26 per visit. No reduction in emergency department charges was found in the second institution and this finding was hypothesized to be due to lower use of the clinical information exchange in this hospital. In contrast to previous work conducted in their own facility, the investigators in this study did not find a statistically significant reduction in laboratory tests [10,11]. These discrepancies may be due to workflow difference outside of the single institution in which earlier studies were performed.

The Memphis financial model made a conservative estimate and assumed that only 50% of the visits in which the system was used would impact overall costs. Assuming a \$10 savings per impacted patient, the total decrease in emergency department expenditures under these conservative estimates was still over \$4 million.

5. Duplicate laboratory tests

Early estimates of duplicate laboratory tests from Indiana and Santa Barbara ranged from 13–20% [11,12]. Using an estimated duplication rate of 13%, an average test costs of \$27.75 and the adoption rate previously described, the Memphis model predicts total duplicate laboratory test savings of over \$5 million in the five-year period. As laboratory tests have been converted to LOINC standards and made more easily available, anecdotal evidence suggesting changes in test-ordering behavior is growing, but since patients in emergency departments usually receive more than one laboratory test and the marginal cost of obtaining an additional test is low, it is not clear if the projected savings will be realized in routine settings. If tests require hours or days for results to appear or if tests cannot be repeated with ease it is reasonable to assume that reliance will be placed on data made available through the health information exchange. Other significant effects on quality and costs are also being reported on an anecdotal basis. For example, one patient presented to an emergency department needing a laceration repair was discovered to have active tuberculosis recently diagnosed in another care setting but lost to treatment.

6. Duplicate radiology tests

Developers of the Memphis model found no persuasive data in the literature on the impact of health information exchanges on the avoidance of radiology tests and made initial conservative estimates of duplicate radiology tests based on clinical interviews and a survey of medical claims. The model assumes that 13% of the 1.3 million radiology tests may be duplicate and that the health information exchange could impact a progressive percentage of these by a reduction of 5% in the second year to a constant reduction of 50% in years four and five. The cost per radiology tests was based on a portfolio of regional charges and was conservatively estimated at \$60 per radiology test.

Subsequent anecdotal experience suggests that tests are repeated with great frequency and that physician ordering behavior can be changed based only on the availability of report results from recent radiology tests. Conducting very simple queries on the database after seven months of operation, 44 patients were identified who had visited more than one institution within a two week period and had more than one radiograph, head CT, head MR, or abdominal CT examination in this interval. In most instances, these individuals had chronic symptoms and signs that in the absence of data from their other care settings raised a possibility of a serious disorder (e.g., abdominal pain with mild anemia evidence of gastrointestinal blood loss). Approximately one-fourth of the procedures in this small sub-set of patients repeated a similar high-cost radiology procedure performed at another institution in the region within the past 14 days. If the cost of these repeat tests is assumed to be \$500, the financial implications for these

108 tests alone suggests duplicate radiology costs of over \$1000 per patient in just this small population.

7. Reduced hospitalizations

Using secondary data, investigators at First Consulting Group estimated that one out of seven admissions from emergency departments is due to missing information [13]. This number corresponds with studies estimating the implication of missing data in ambulatory settings [14]. These numbers may overestimate the impact of missing data. The initial Memphis economic model estimated 30% of the 235,430 hospitalizations followed emergency department visits; 14% if these were estimated to be due to missing information; by the fifth year of operations 37.5% of these would be avoided by use of the health information exchange. An estimated cost of a 23-h observation admission (\$1000) rather than an average length of stay cost was used. Under these assumptions, 3784 23-h admissions would be prevented when the system was fully used for an annual savings of \$3.7 million. Because these benefits are realized progressively as the system is introduced, the overall savings for the first five years was estimated to be \$7.5 million. The model did not estimate the impact of the prevented ED on capacity and throughput [15].

8. Lower communication costs

Health care organizations receive hundreds if not thousands of documents that must be placed into the hands of individuals outside of their walls. Any substitution of postage costs with electronic transmission or even fax communication is associated with reduced expenditures and more timely availability of information. Most organizations have realized substantial gains first through fax transmission and later by means of secure transmission through provider Web portals. Automatic routing of information in digital form is the most labor-saving because of far lower labor costs.

9. Total estimated benefits

The benefits to the participating entities are substantive if several conditions hold. First, one must demonstrate that the availability of information leads to behavioral change. Although we have some evidence from the literature and from anecdote, a systematic assessment of the degree of benefit from our exchange is not yet complete. Second, our calculations assume that avoiding a repeat test leads to a lower marginal operational cost and has no impact on revenue. Where savings are concerned, the actual degree of operational costs savings is low if a facility has a high fixed cost and is not running at capacity (i.e. the cost savings incurred in by avoiding a scan on a CT that is otherwise not used are due only to the marginal expense of transport labor, materials, and supplies). Some CFOs believe “redundant” test ordering is not as great a concern

as is liability risk if a test is not performed. Where revenues are concerned, commercial insurers at times pay for “redundant” tests because they cannot make an estimate of clinical need. This anomaly has contributed to a reluctance on the part of some providers to support health information exchanges because a decrease in “redundant” tests—no matter how rational—actually may lead to a loss in short-term revenues [16]. We believe that as health information exchanges become more prevalent, those who repeat tests recently performed in another setting may be held to higher degrees of accountability. It is reasonable to believe that some form of “prior authorization” will someday be imposed on certain instances involving repeat high-cost tests.

Our population has a high mix of self-pay and Medicaid patients. The delivery system is dedicated to lowering overall costs if such costs do not lead to quality so that greater resources are available to improve the quality of care in their community. For this reason, there is widespread support for a system that in principle improves the quality and safety of medical care while at the same time reducing expenditures by over \$20 million in a five year period (see Table 1).

10. Estimated costs

Frequently the potential economic benefit of health information exchanges overshadows the equally vital discussions surrounding the creation and support of such systems. Return on investment depends as much on the cost of the investment as it does on the return. For this reason, we took a very conservative approach to architecture and operational costs. In the initial years of the project, we use logically separate and isolated technology resources already in use at Vanderbilt University Medical Center to operate the health information exchange in Memphis. Rather than ask institutions to adopt standards quickly for the sake of interoperability, our approach allows institutions to use data in the format they have, allows our health information exchange to mimic interoperability, and then let institutions evolve towards standards at a more reasonable pace. Each organization “publishes”

whatever data it has over secure lines to a logically separate “vault.” All data are maintained in their original format but some (e.g., laboratory tests) are converted to standardized formats when data are used. Rather than employ a comprehensive master person index, our architecture uses linking tables that have been demonstrated to confer equal results in use. Hence, our five-year budget for costs may not reflect a realistic cost for an exchange “de novo” but we do believe our estimates are consistent with the operational costs of other clinical exchanges.

From our estimates and early experience, we believe that under a discount rate of 10%, our low-cost health information exchange may produce a positive five-year net present value of \$3 million with a return-on-investment ratio of 0.41 and a payback period of 2.1 years (see Table 2).

11. Integrating the emergency department with ambulatory care

One should be skeptical when examining claims of financial benefit requiring behavior changes by providers and patients. As long as the emergency department is the primary source for non-acute care for a significant portion of a population, increased information availability can do little more than work around the edges of an imperfect system of health care delivery. Addressing both costs and quality in an urban setting will require tighter linkages between emergency departments and ambulatory care facilities through a health information exchange.

It is from a systems perspective that emergency department utilization patterns are best understood. In an October 2006 report based on survey data, the California Healthcare Foundation reported that 46% of emergency department patient respondents stated that their problem could have been handled on an out-patient basis [7]. The report cites California trends as well. Fifteen percent of California residents have visited an emergency department in the past year and 2% have visited more than 3 times in the past year. This latter group constitutes 35% of all emergency department visits for the year [7]. Major factors affecting emergency department use cited in this report include lack of access to medical care outside of the ED

Table 1

The total estimated benefits from the contributing entities through a restricted set of savings realized in the emergency room exceeds \$20 million in the first five years of operations

| Potential reduction (\$,000) | Yr1 | Yr2 | Yr3 | Yr4 | Yr5 | Summary |
|--|------|-------|--------|--------|--------|----------|
| | 2005 | 2006 | 2007 | 2008 | 2009 | Total |
| <i>Intervention</i> | | | | | | |
| Lower emergency department expenditures | \$0 | \$115 | \$575 | \$1724 | \$2068 | \$4481 |
| Decrease # of duplicate laboratory tests | \$0 | \$96 | \$956 | \$956 | \$1435 | \$3443 |
| Decrease # of duplicate radiology tests | \$0 | \$299 | \$1493 | \$2986 | \$2986 | \$7764 |
| ED communication Distribution | \$0 | \$0 | \$86 | \$86 | \$103 | \$276 |
| Reduced inpatient Hospitalizations | \$0 | \$56 | \$699 | \$1397 | \$2096 | \$4247 |
| <i>Total potential reduction</i> | \$0 | \$565 | \$3809 | \$7149 | \$8688 | \$20,210 |

Table 2

Cost estimates for the data exchange implementation. Most of the investment is in people and not in technology

| Anticipated exchange expenditures (\$,000) | Yr1 | Yr2 | Yr3 | Yr4 | Yr5 | Summary |
|--|--------|--------|--------|--------|--------|----------|
| | 2005 | 2006 | 2007 | 2008 | 2009 | Total |
| Participating organizations (11) | \$329 | \$438 | \$449 | \$416 | \$416 | \$2048 |
| Project team | \$1207 | \$536 | \$1294 | \$1005 | \$1030 | \$5072 |
| Infrastructure | \$565 | \$610 | \$2160 | \$1182 | \$1127 | \$5644 |
| Evaluation | \$21 | \$33 | \$66 | \$313 | \$313 | \$765 |
| Meetings and coordination | \$90 | \$88 | \$209 | \$114 | \$27 | \$527 |
| Travel | \$23 | \$16 | \$27 | \$27 | \$27 | \$121 |
| <i>Total expenditures for exchange</i> | \$2235 | \$1720 | \$4225 | \$3057 | \$2940 | \$14,177 |

Operational costs greatly depend on the approach taken and the extent to which each participating entity must standardize data.

emergency department, lack of alternatives (e.g., urgent care clinics), and positive attitudes towards the emergency department as a site of care.

Similar patterns of overuse and preference have been observed in the Memphis area. In an eight month period in 2005, 12,000 patients visited participating emergency departments more than one time and 2307 patients visited the participating emergency departments more than five times. 365 patients visited the emergency departments five times or more and of these 57 visited the emergency departments more than 25 times. Individuals who visited the emergency department two or more times constitute 22% of all emergency department visits. Positive perceptions of emergency departments are also prevalent. One unpublished survey among Memphis hospitals suggests that almost 50% of the uninsured view the emergency department as their medical home [17].

The need for alternatives to emergency department care is also acute and the referral process is complicated. Each patient who is a candidate for additional care is assigned an emergency department social worker who is responsible for follow-up. If the patient does not have a medical home, a referral is made to the medical home closest to the patient. Communication to the medical home is done manually and all transmission of medical information is done through phone or facsimile. Unpublished observations in Memphis suggest that in one major urban hospital alone over 500 referrals are made to medical homes every month. Only a small fraction of these individuals seek care at the institutions to which they are referred.

We believe many of these referrals take place during usual business hours and could be made more efficient by providing additional information technology support for coordination of care. Our analyses suggest that for the period July 2006 through December 2006, 52% of all ED visits occur during the hours of 8 a.m. to 5 p.m. Coordination technologies could also be used after-hours to bring referral cases to the attention of care coordinators during business hours. Unpublished studies using standard criteria suggest that approximately 40% of ED patients would be classified as non-urgent and would be candidates for referral [18].

12. Enabling better resource utilization

Technologies and policies supporting health information exchanges can be extended to create a system that alerts clinic staff of referrals from emergency departments, triggers notifications if patients are not seen in ambulatory settings, and allows authorized individuals to pursue follow-up and individual care plans. We believe the financial impact of such a system—if successful—would be striking. Referral from the emergency department would replace an average charge of \$275 with an ambulatory clinic charge of \$54. For the population of high-frequency emergency department patients, the savings would be in excess of \$1000 annually. These savings could be re-directed toward more effective ambulatory-based care management. Assuming successful re-direction of only 3000 patients, the reduction in emergency expenditures would in principle equal the operational costs of the entire health information exchange.

13. Conclusions

Our very preliminary findings suggest that an urban region can realize a significant and measurable annual savings if regional health information data are used at the point of care in emergency departments. If an exchange were fully operational in the Memphis region, savings from use in emergency departments can be in excess of \$8 million per year.

Similarly, referral of non-acute patients to ambulatory care settings and shifting care from emergency departments to ambulatory settings can avoid costly emergency department visits and provide more regular care in non-acute ambulatory settings. As more patients seek appropriate care through ambulatory settings, the expense reduction opportunities in emergency departments decrease.

Actual savings are very dependent on both the behavior of health care providers and the behavior of individuals seeking care. From the provider perspective, any change in behavior will be influenced strongly by liability concerns, availability of information, discomfort with test results from other institutions, and workflow concerns. Reimbursement for “redundant” tests leads to a counter-intuitive

trend to repeat tests rather than rely on information recently obtained. From the perspective of the individual, alternatives to emergency care must meet the perceived acute needs and the importance of long-term treatment of chronic diseases must be instilled so that individuals change their focus from acute reaction to disease to active prevention of disease.

Perhaps the most critical missing part of the current analysis is the overall impact on the quality of care. In principle, a medical home and an ambulatory setting will allow clinical time with patients to be spent addressing long-term health care needs, prevention, medication adherence, and disease management. The true societal impact is realized by a major transition from a largely reactive emergency department setting to a primarily proactive ambulatory care setting. In the final analysis the goal of any regional effort should be a measurably healthier community through financially responsible management of resources. Our preliminary experience in Memphis suggests that a regional health information exchange can be a fiscally responsible means of enabling better care within a community. Without such technologies and interoperable, patient-focused information systems, it is difficult to envision how such improvements can take place.

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