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A SYSTEM DYNAMICS SIMULATION MODELING: HEALTH INFORMATION EXCHANGE ADOPTION IN THE U.S. HEALTHCARE SYSTEM

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ABSTRACT

On February 17, 2009 The Health Information Technology for Economic and Clinical Health (HITECH) Act, enacted as part of the American Recovery and Reinvestment Act of 2009 was signed into law, to promote the adoption and meaningful use of health information technology (HIT) (Public Law 111-5 2009). Health Information Exchange (HIE) is one of the focus areas within this act, and there are a number of concerns with its implementation and sustainability; slow adoption rate, cost, benefits to healthcare providers (HCPs), and sustainable business model without government subsidies. This research uses a systems dynamics (SD) simulation modeling approach to map complex relationships among healthcare systems to help policy and decision makers on a strategic level to estimate financial performance over time, and to investigate key factors affecting the HIE adoption rate feedback loops.

1 INTRODUCTION

Health information exchanges (HIEs) are internet based portals intended to facilitate the exchange and sharing of medical information among medical providers. Studies, surveys have noted the benefits of HIEs in terms of increasing the efficiency, quality and safety of healthcare systems as well as overall financial gains (value-added). Despite these apparent benefits, it is uncertain whether HIEs are sustainable without government subsidies. Key factors that will influence the success of such exchanges on a national or state-wide level include adoption rates, subscription rates overtime, subscription policies associated with different types of HCPs and the overall costs and associated financial benefits.

2 MODELING AND SIMULATION APPROACH

With the current complexity in the US's healthcare system a call for system thinkers are needed to develop models that will allow for comprehension of the system's entire structure. System dynamics modeling (SD) is a methodology and set of conceptual tools that would help policy and decision makers to understand the complex relation between the system elements (Sterman, 2000). The main point of this research to provide a holistic and strategic view of the HIE system on a state level; NY state will be case study in this research to apply the SD approach on the set of data publicly available. First, a qualitative Causal Loop Model (CLM) is developed to discuss the HIE system elements and the complex interactions that influence the adoption rate of the HIE system. There are two types of loops in the CLM, reinforcing loops (positive) which are the vehicle for growth in the system denoted by (R) and balancing loops (negative) which act as brakes or dampers in the system denoted by (B). Figure 1 depicts a simplified CLM to present a conceptual model of the HIE adoption elements; a complete CLM is being developed. Balancing

loops (B1,B2,B3) will have a negative effect on the attractiveness to adopt HIE as follow: (B1) loop represents the patient privacy concerns, a patient consent is required prior to any health information being exchanged, privacy and confidentiality policies need to address the electronic health information exchange , (B2) loop addresses pay-for-service attitudes, HIEs create benefits to providers (reduce number of readmissions, hospitalization and duplicate lab/radiology tests) however reductions in patient volumes impact HCP profitability, (B3) loop covers HIE maintenance, operational and interoperability R&D costs. Reinforcing loops (R1-R4) will have a positive effect on the attractiveness to adopt HIE as follows: (R1) loop addresses how greater adoption of HIE by HCPs translates into greater information storage and reuse, (R2) loop health information organizations and federal/state programs to socialize and market the HIE, (R3) loop federal and state funds available to establish and sustain HIOs and Electronic Health Records (EHR), (R4) loop cost savings for insurance/payers and Medicaid/Medicare (M/M) HIEs benefits, and the reduction of patient volumes (reduce number of readmissions, hospitalization and duplicate lab/radiology tests), although healthcare system transformation to a pay-for-performance model makes it more likely that profitable HCPs will increase HIE implementations.

Secondly, the author will use the CLM to develop a stock and flow to simulate the HIE adoption rate for different HCPs with different subscription fees; sensitivity analysis will be employed to assess different business models.

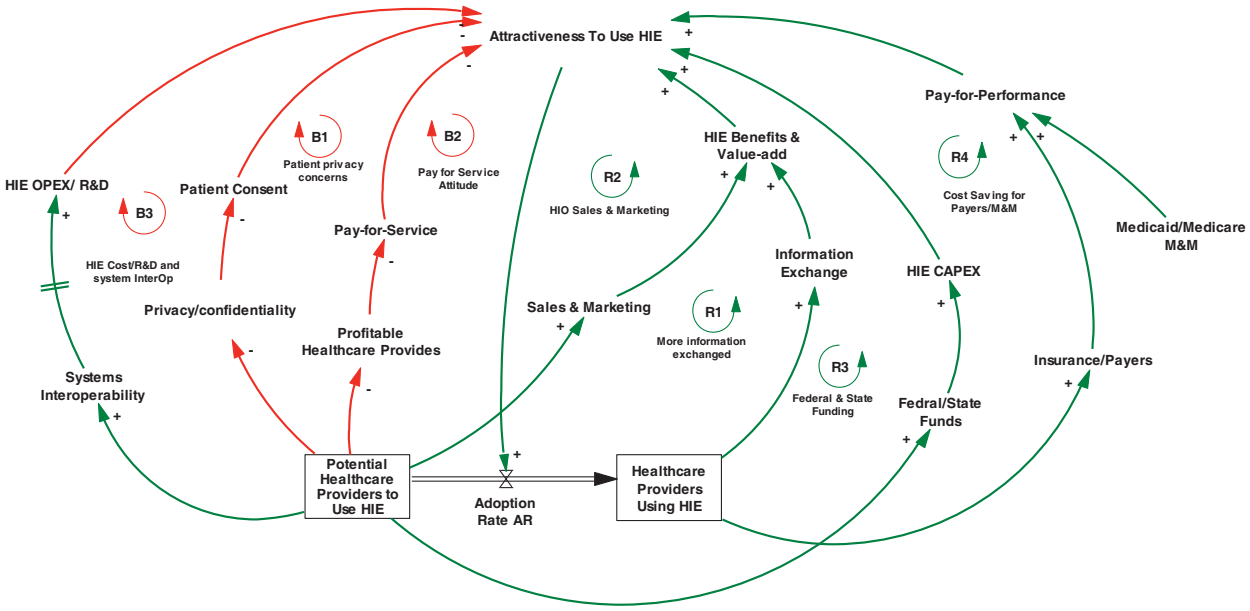

Figure 1: Simplified Causal Loop Diagram for Health Information Exchange

REFERENCES

Public Law 111-5, 111th Congress. From the U.S. Government Printing Office. Feb 2009. http://www.gpo.gov/fdsys/pkg/PLAW-111publ5/html/PLAW-111publ5.htm.

Brailsford, Sally C. "System dynamics: What's in it for healthcare simulation modelers." In Simulation Conference, 2008. WSC 2008. Winter, pp. 1478-1483. IEEE, 2008.

Sterman, John D. Business dynamics: systems thinking and modeling for a complex world. Vol. 19. Boston: Irwin/McGraw-Hill, 2000.

Otto, Peter, and Dorit Nevo. "Electronic health records: A simulation model to measure the adoption rate from policy interventions." Journal of Enterprise Information Management 26, no. 1/2 (2013): 165-182.