

## **APPENDIX C: Case Study- Systemic consequences of provider Health Information Exchange (HIE) implementation policies**

### **Objective**

In our manuscript, we argue that HIE usage depends on each of its participating agents. In this document, we illustrate how our framework can measure the consequences of HIE implementation policies adopted by an individual agent, on all other agents participating in the system. This document is built under the expectation that the HIE implementation satisfies ethical and contractual requirements.

### **Background**

Vest and colleagues (2010)[1] studied the impact of HIE implementation on clinician behavior. They observed that HIE usage was positively associated with patients covered by Charity care. For our study population, we observed that HIE information were more important for providers with a higher proportion of HMO patients. Our results also demonstrated that, for our study population, the reduction of medical work performed on patients covered by commercial FFS payers has a negative financial impact on the provider. One possible consequence of these observations is that providers may implement an policy of not using the HIE system for commercial FFS patients. Such policies would have consequences for all agents in the HIE system.

In this study, we demonstrate how decision makers can use our framework to study both the systemic and agent-wise consequences of an individual agent's HIE implementation/usage policy. We emphasize that the specific HIE pricing recommendations apply to the study population. However, our framework allows for analysis of this exemplified in the modeling approach, which is generalizable to other settings

### **Two provider HIE usage/implementation policies**

We consider two HIE implementation implemented by providers:

**Policy A:** No restriction of HIE usage (assumed in our main manuscript);

**Policy B:** Providers disable HIE usage for commercial FFS patients.

Under Policy A, providers enable HIE usage on all patients irrespective of payer types. Under Policy B (motivated by observations of Vest et. al.[1]), providers chose to disable the HIE usage for commercial FFS patients. In following sections, we measure the effect of Policy B on (a) Agent-wise savings due to HIE participation, (b) Annual HIE subscription fee and (c) Net Effect of the HIE i.e the difference between the benefits and the costs. Tables 1,2 and 3 present results corresponding to (a), (b) and (c) respectively.

#### **(a) Effect on HIE Savings**

Table 1 compares Policies A and B with respect to the agent-wise annual savings due to HIE participation. We observed that Policy B has no effect of HIE savings accrued by Govt. FFS and HMO payers. Savings due to HIE, as evaluated by Policy B, was exactly 0\$ for Commercial FFS payers. Policy B created more savings than Policy A for all providers. Providers 1, 2, and 3 procured a 36%, 37% and 35% increase in the savings created due to HIE by choosing Policy A instead of Policy B. We attributed this increase in savings to the nature of the provider-FFS payer association: Providers

Table 1: Effect of provider level policy on savings due to HIE participation. (Concerns the study population)

Agents	Annual Savings due to HIE participation			
	No restriction of HIE use (Policy A)		Provider disables HIE for Commercial FFS patients (Policy B)	
Providers	Absolute (\$)	Relative (%) <sup>+</sup>	Absolute (\$)	Relative (%) <sup>+</sup>
Hospital 1	24,663	1.0%	33,580	1.36%
Hospital 2	24,571	1.1%	32,834	1.47%
Hospital 3	15,834	1.0%	21,166	1.35%
Payers	Absolute (\$)	Relative (%) <sup>+</sup>	Absolute (\$)	Relative (%) <sup>+</sup>
HMO	203,531	1.4%	203,531	1.4%
Government	63,120	0.3%	63,120	0.3%
Commercial FFS	75,451	2.3%	0	0%

<sup>+</sup> Measured as a percentage of funds spent in the three hospitals, to care for Asthma/COPD/Diabetes

Table 2: Effect of provider level policy on annual HIE subscriptions. (Concerns the study population)

Providers	Annual Subscription Scheme (\$)	
	No restriction of HIE use (Policy A)	Provider disables HIE for Commercial FFS patients (Policy B)
Hospital 1	12,891	21,248
Government	14,021	21,665
Hospital 3	7,974	13,249
Payers	Annual Subscription Scheme (\$)	
	No restriction of HIE use (Policy A)	Provider disables HIE for Commercial FFS patients (Policy B)
HMO	66,054	66,054
Government	24,140	49,032
Commercial FFS	24,920	0

make considerable profits on medical work performed on patients covered by commercial FFS payers. Hence, a reduction in medical work performed on commercial FFS patients negatively impacts the providers.

We observed that the net societal saving was reduced from \$407,170 p.a for Policy A to \$354,230 p.a for Policy B. This case study illustrates that a provider-level policy, implemented in its own interest, may have significant financial consequences on the system and all its participating agents.

Table 3: **Net effect** of provider level policy on savings due to the HIE. (Concerns the study population)

Providers	Annual Savings (Table 1) – Subscription Fee (Table 2) (\$)	
	No restriction of HIE use (Policy A)	Provider disables HIE for Commercial FFS patients (Policy B)
Hospital 1	11,772	12,332
Hospital 2	10,550	11,169
Hospital 3	7,860	7,917
Payers	Annual Savings (Table 1) – Subscription Fee (Table 2) (\$)	
	No restriction of HIE use (Policy A)	Provider disables HIE for Commercial FFS patients (Policy B)
HMO	137,477	137,477
Government	38,200	14,088
Commercial FFS	51,311	0

### Net Effect of the HIE

In this section, we compare the effect of the “Fixed annual rate” subscription charges (defined in the main manuscript) for each agent evaluated under Policies A and B. Table 2 summarizes the subscription schemes and shows the actual charges that optimize the performance gain to the system under the two policies. We observed a 61% increase in the average annual subscription rates charged by the HIE to the providers for Policy B relative to Policy A. Thus, Policy B created a proportional increase in both the savings (due to the HIE) and charges (by the HIE). For a complete picture of the net effect of the HIE on each of its participating agents, it is more useful to understand the *net effect of HIE* (Table 3) which is the difference between (a) the annual HIE subscription fee (Table 2) and (b) estimated HIE benefits (Table 1). Table 3 suggests that Policy B resulted in a negligible effect on the net profit procured by each provider.

In contrast with the providers, we observed that Policy B created a 200% increase in the annual subscriptions charged by the HIE to Government which resulted in a reduced *net effect* of HIE information. In conclusion, we observed that the behavior of some agents, acting in their own interest have financially significant consequences for the system and all other participating agents.

## **Conclusion**

We illustrated how decision makers can use our framework to account for perverse behavior of each institutional agent effecting other agents in the system. This is financially significant when some agents set policies that conflict with optimal system-wide performance. We observed that Policy B had a negligible overall effect on Providers and HMOs, created a negative impact on the Government and increased overall costs for the system.

## **References**

- 1 Vest, JR, Zhao, H., Jasperson, J., Gamm, LD & Ohsfeldt, RL. (2010) Factors motivating and affecting health information exchange usage. J J Am Med Infor AssocAMIA (2010) doi:10.1136.004812