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# Institutional perspectives on implementing health information systems in developing countries: the case of electronic medical records (EMR) for children health in Vietnam

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## ABSTRACT

*Research motivation:* the research is motivated by the urgent need of electronic medical record (EMR) in developing countries to address major health problems.

*Theoretical backgrounds:* concepts of institutional theories formal rules and informal constraints

*Research setting:* the case of development and implementation of EMR for children in Ho Chi Minh city, Vietnam

*Research method:* qualitative research tradition and comparative case study

*Analysis and findings:* clinics where the system implemented are classified into two groups based on their level of successful implementation, the overlapping between formal rules and informal constraints are analyzed to identify **social conditions** that contribute to the differences in outcomes.

*Contributions:* the paper contributes a practical guideline in building EMRs in resource constraint settings; it also helps to give better understanding on how the relation between formal rules and informal constraints affects the success or failure of EMRs implementation.

### Keywords:

EMR, health information system, developing countries, OSS, formal rules and informal constraints

## 1 INTRODUCTION

The developing world currently faces a series of health crisis that threaten the lives of millions of people (Biondich et al 2005, Mamlin and Biondich 2005). Indeed, fatal diseases like HIV, tuberculosis, malaria or serious chronic diseases like malnutrition, heart problem, and diabetic are widespread in these countries. Efforts from international communities through WHO, UNAIDS, USAIDS have been put to relief the impact of these epidemics. Those large scaled projects require good information systems in order to effectively manage and monitor the result of the interventions (Fraser et al 2005).

Health information system (HIS) is a term referring to many different types of system used in the health care sector to support planning, management, and decision-making process. For a broad classification, there are two types of systems: name-based system and aggregation-based system. However, in developing countries, HIS has been mainly driven by the need to report aggregate statistics for government and funding agencies while this approach (aggregation based) tends to be difficult and time-consuming and may provide little or no feedback to staffs that collect data (Fraser et al 2005). In contrast with this, the name based approach that includes electronic medical record, electronic health record, and hospital management system recently acquire attentions from health managers, vendors, and system implementers, believing that it can thoroughly solve the problems of current approach (Forster et al 2007, Garcia et al 2009, Blaya et al 2009). Advantages of individual patient data over aggregated data can be summarized as follows 1) ability to check patient clinical history, drill down for more detailed information, and evaluate outcomes of treatment, hence improve quality of care and prevent clinical error 2) patient data can be used to quickly generate aggregate reports, which should be more complete and accurate as users will more likely recognize errors regarding to their own patients (Fraser et al 2005). However, empirical data from

development and implementation of such systems have so far reported more failure than success (Littlejohns et al 2003, Heeks et al 1999).

This paper explores the process of building and implementing an EMR system in a provincial city (Hochiminh city) of Vietnam using institutional perspectives. Within two years, the system was slowly scaled up into 45 clinics at different levels: 1 at city level, 14 at district level, and 30 at ward level. This scale up takes place in a context with limited resources is an interesting phenomenon. Through the analysis of empirical data, I identify factors contributing to the continuous use of the system and relate them to the model of overlapping between formal and informal institution developed by Sautet (2005). Also, I make some recommendations on how to increase this overlapping in order to scale up this system to a larger geographical location.

The rest of this paper is organized as follows. In the next section, I introduce the concepts of formal rules and informal constraints and how they are used in existing literature. Section 3 discusses research approach and data collection method employed by this research. Section 4 presents the comparative cases and analysis. Conclusion and discussion is provided in section 5.

## 2 THEORETICAL BACKGROUNDS

In this section, I discuss several concepts of institutional theory that are relevant to the issue of implementing health information systems in developing countries.

“If institutions are the rules of the game, organizations are the players” is a famous statement by North (1990) to distinct the two interconnected but completely separated concepts: organization and institution. Institutions include formal rules and informal constraints which frame and guide human behaviors within an organization. It help to reduce uncertainty and confusion but also create resistance over changes. Institutions are not stable entities. They evolve and change over time. Gradually, new institutions are formed to replace old institutions. The process by which new institutions are formed is called institutionalization. Sautet (2005) suggested a simple model which describes the relationship between formal and informal institution arguing that if there is little overlap between the formal and informal institution, the change is difficult and costly to take place.

This model has been used in a number of researches to understand the resistance of organizational change. Madon et al (2004) studied the case of property tax collection in Bangalore (India) which informal constraints based on interpersonal relationship between tax collectors and property owner mainly shaped the process of tax assessment. There was a little overlapping between the formal calculations of tax made the introduction of reforms extremely complex and consuming.

In the area of health information system for developing countries, those concepts are also used by Piotti et al (2006) as a lens to look at the case of HIS reforms in Mozambique. In this case study, there is little, or even not existing, overlapping between formal rules and informal constraints. One example is while delivering clinical services is a primary task of health workers; making reports and doing other paper work are considered less important, leading to poor quality of collected data (Piotti et al 2006). In addition, the number of indicators requested in STI/HIV/AIDS program increased while weak enforcement mechanism is in place, making it is hard to implement the system successfully (Piotti et al 2006).

To increase the chance of success, the paper suggests adopting the concepts of contradictions to look for the potential for changes. For example, to increase overlap between formal rules (advocating quality data) and informal constraints (care is more important than administration) a formal structure of information officer at every level of health care delivery should be established and provided with career incentives (Piotti et al 2006).

Different researchers understand formal and informal institutions differently. The following table summarizes examples of formal and informal institutions from the above cases:

	Formal institutions	Informal institutions
Property tax collection in Bangalore, India	Formal calculation for assessment of tax	Interpersonal relationships between the property owners and tax collectors
HIS reform in Mozambique	<ul style="list-style-type: none"> <li>- Several strategic plans to enforce the use of HISs for collecting data and building indicators</li> <li>- STI/HIV/AIDS plan, which established 15 components requiring 98 indicators</li> </ul>	<ul style="list-style-type: none"> <li>- Giving health care services are more important than making reports</li> <li>- Inadequate trained staffs and lack of supervision</li> </ul>

**Table 1: Formal and informal institutions used in literature**

### 3 RESEARCH AND DATA COLLECTION METHOD

#### 3.1 Research approach

Qualitative research in the interpretive tradition (Walsham 1995) was employed to understand how development and implementation process of EMR was taken place in a particular context – health care domain in Ho Chi Minh City. In line with qualitative, a quantitative method was also mobilized to analyze the progress of implementation in different clinics over time.

Furthermore, a comparative case study the two groups of clinics was made to highlight how the difference in organizational structure, work practice, and purpose of use has shaped the outcome of implementation and the status of use. Yin (1984) suggests the use of single-case studies where the cases are revelatory, critical or unique, while a comparative case study design is a powerful way of studying the same phenomenon in different settings, and analyzing how different contextual conditions shape the phenomenon.

#### 3.2 Data collection methods:

Several data collection methods were employed to gather data from the field including participant observations during the development of the system, formal and informal interviews (20) with system developers, health workers, clinic managers at different level (city, district, and ward), data archives such as email, project documents (design, user manuals, reports).

The participant observation of development enabled me to understand how the design and coding processes take place at the micro level, developer feeling and motivation. It also helped us understand technical design choice was made to scope with reality requirements. Interviewing users who directly use the system provided information related to user’s reaction to the system and their motivation in using the system. For example, interviews helped to answer the question: why some districts are actively in entering data while others are not.

Data archives analysis supplemented the overall picture of development and use the system and importantly child health record database provided us valuable resource in order to analyze the history and status of data use over a long period of time (2 years) and a large geographical distribution (45 clinics).

#### 3.3 Mode of data analysis:

After collecting, field data was put into analysis process. First step of this process was classified related facts into different groups. Later, a quantitative approach was employed to create the distinction of outcomes in different clinics where number of records entered and date of entry appear to be important for the study. Several SQL (Structure Query Language) queries were created to extract the essential data for analysis. Results of the queries were then imported into Microsoft Excel for further manipulation and presenting data in graphs.

## 4 THE CASE

### 4.1 Building the new electronic child health record:

Child health data is very important to health managers and policy makers in order to give a precise and timely preventive plan related to child mortality and nutrition. Also, health of children is always a big concern in every family when number of children per family is dramatically decreasing. Therefore, it will lead to a great social affection in every decision related to children. HoChiMinh city, a city with a population about 10 millions, had a paper-based system to manage records of all children in the city. There had been An Access-based software for capturing basic child data such as the health status right after being born, immunization history, development progress. However, this system had number of bugs stopping it from being use, and other major issue was it did not support data exchange between clinics, which is crucial for health managers to have adequate data for strategic planning.

A development team founded in July 2007 including me and two developers received funding from Health Information System Program (HISP), a University of Oslo based project aiming at strengthening HISs in developing countries started to build a new system that is scalable and exchangeable to address the major problems of the existing system. The system was developed based on the OpenEPR, a flexible software allowing end-users build applications without requiring knowledge of programming. After 2 months, the newly built system was presented to the manager of the child health program (the Manager). He was happy and allowed us to pilot it in the Child Health Clinic of Centre for Reproductive Health Ho Chi Minh city (from now called Center Clinic for short).

To prepare for this first implementation site, we deployed the system to a prosaic personal computer (PC) as we could not afford to have a fancy server. To act as a server, this PC would be kept running 24/7.

### 4.2 First effort of implementation:

We started the implementation in the Center Clinic by giving an on job-training session to a nurse who was in charge of the front desk. Her computer was a relatively old one (Pentium III) and had no Ethernet card - a network card which allows computer to connect to local area network (LAN). We had to install a network card in order to connect to the server we setup earlier.

The training progressed slowly as the nurse was not very skillful in computer. We had to sit next to her and showed her how to use the system step by step, and let her try by herself. If many patients arrived at the same time, we had to help her to do the data entry so she could take care of other administrative tasks such as measuring weights of the babies. That mode of intensive training lasted for several days but the nurses still had difficulties in using the system.

After one week, we left her to work a lone and she could call us any time when she had problems. This would be easy to give support as our office is close to her desk. Still, we received many complaints about the systems, and started to worry that there must be something wrong in the design. Incidentally, the nurse was internally transferred to another department and replaced by another nurse. The new nurse made us very surprised as she could use the system without any training. She told us that the former nurse had taught her how to use the software and she could manage to use it on her own. As we observed, the new nurse has a very good computer skill. Since then, we received fewer and fewer complaints about the system except some time the server was turned off in the morning. We found down that a security guard of the clinic switched off the server during the night as his concerns of fire. However, later on, the nurse managed to turn on the server whenever she could not access the system.

After this initial success, the Manager requested us to implement the system in other clinics. Firstly, we organized a training session to all child health clinics in District 4. The training was taken place smoothly in a morning with the presence of about 20 clinical staffs from different clinics. The training room that was actually an Internet café had Internet access so that the trainees could learn and experiment with the actual running system – the one that we installed in the server. Each clinic was provided a username and password. We decided to let the trainees to practice on the real system, as we believed that they could easily replicate what they learned in their own offices. After this, another second training was organized for 24 clinics in Binh Thanh district.

Those were only three formal training sessions we delivered. Due to the lack of finance, there was no more training organized since then.

**4.3 The “informal” scale up in other districts:**

However, in December 2007, the Manager requested us to organize a training for districts in using DHIS2 software, an aggregation based and statistical system. The health program would cover all expense of the training and we only provided trainers. He suggested that we could allocate some minutes of the training to introduce about the child health record system for districts which did not have chance to attend any training before. The training happened within one morning, at the end; we spent some 15 minutes to introduce trainees about the new electronic child health record online, and encourage them to start to use the system after the training. This was the last training in using child health record we organized.

Although the training was short as it mainly introduced the system as an online service, it attracted the interests from the districts. The list of districts engaged in using child health record system can be summarized as follows:

No	Child health clinic at	Description
	District 6	started entering data right away after the training, in February 2008 and continued using the system till now. However, there is a little vacancy in data entry in May and June 2008
	District 12	also enrolled into the system in February 2008. Like in District 6, there were some months (September, October, and November 2008) which data was not entered in.
	District 8	started to use the system on April 2008, 4 months after the training. However, data enter was not done frequently. The district stopped using the system at the end of 2008
	Tan Phu district	engaged in using the system a little bit later, in June 2008. However, in early 2009, number of records entered was decreased and did not exactly reflex number of children born in the district within the period
	Phu Nhuan district	firstly registered child health records into the system in August 2008. There was also months without data entry which are November and October 2008
	Go Vap district	only started to use the system in March 2009 and the data entry is still on-going

**Table 1: Informal scale up in a number of districts**

In this section, we have discussed the detailed process of development and implementation of the electronic child health record in two different phases: the official phase with the center clinic and two districts and the unofficial phase with other volunteer districts. Analysis is given in the next section.

**5 DATA ANALYSIS**

In this section, the model of overlapping between formal rules and informal constraints is applied to find out how the relationship between formal and informal institution greatly affect the outcome of the introduction of technical system which in this case is the electronic child health record.

In my case study, so far there is no official letter or document related to the use of the web based child health record system at any levels. The implementation of the system at different levels is mainly driven by the intention of the chiefs of each clinic. Though no official document exists, issuing such documents is not something beyond the capacity of the chiefs of clinics. This “intention” of having the system is possibly considered as a formal institution. Informal constraints that contribute to the outcome of the implementation are varying, ranging from organizational structure to computer skills or Internet infrastructure. The overlapping between the two is now analyzed.

**5.1 The differences in outcome between two groups of clinics:**

**Group 1: Center Clinic, District 4 Clinic, and Binh Thanh District Clinic**

**Group 2: The rest of clinics**

Based on the case study previously discussed, we could easily realize that the first group of implementation sites including the center clinic and district 4, and Binh Thanh district gained more success than the second group (the rest of the clinics). The term “success” is assessed by the following criteria:

- Percentage of children in the area is registered: the higher percent of children registered the more complete data could be.
- Frequency of use: daily use of the system is a good indicator, implying that the system has a big influence in the routine work.
- Reports and other outputs automatically generated by the system are used for management purpose.

Indeed, at the center clinic, all doctors and nurses could use the system to register and input clinical data of children who come for check up. Reports generated by the system are often used for daily meeting. In other districts, the system is used only for registering administration and immunization information, and nutrition status of children. This could be done once a week or twice a week. The comparison of data entry between the first and second group of sites is demonstrated in the following charts:

Group 1:

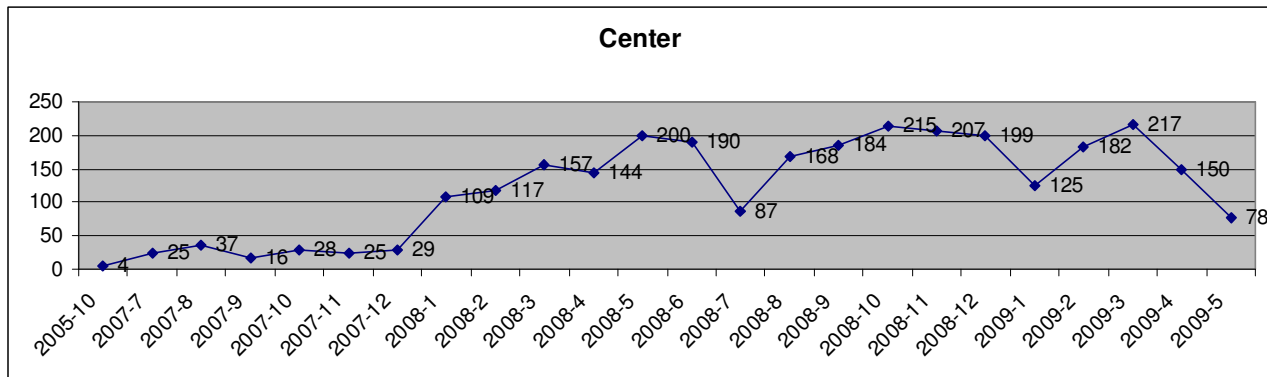


Figure 1: At the center clinic, data entered continuously, no month without data.

Group 2:

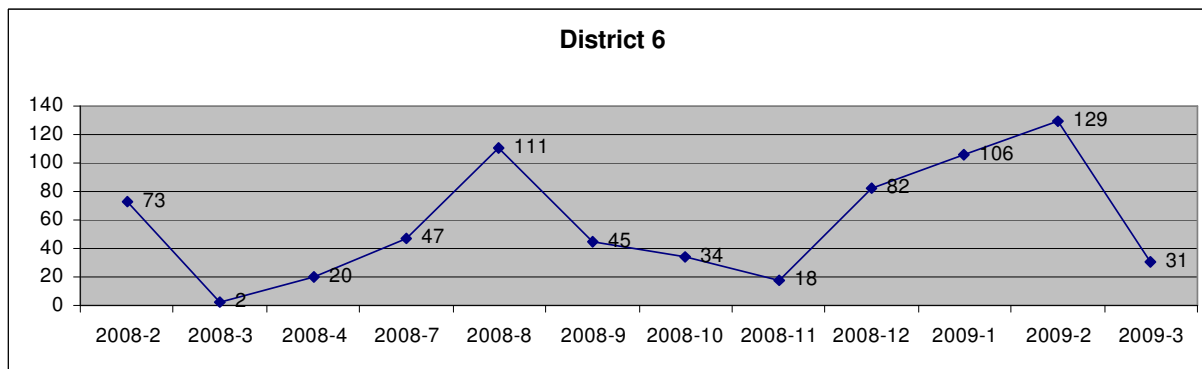


Figure 2: At district 6 clinic, month of missing data: May, June 2008

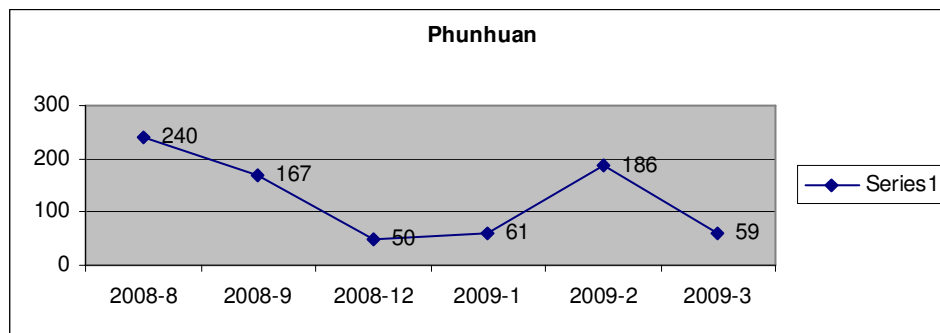


Figure 3: At Phu Nhuan district clinic, months of missing data: October, November 2009

In term of data use, the district users seldom extract records from the system for other purpose but only use the data to follow the children they are responsible for. Examples of use are shown as follow:

I. TÌNH HÌNH QUẢN LÝ TRẺ:									
1. Số lượt trẻ đến khám:									
1 - 12 tháng	13 - 24 tháng	25 - 60 tháng	61 - 72 tháng	> 72 tháng	Tổng cộng				
355	349	269	20	14	1007				
2. Tổng số trẻ được cân đo:									
1 - 12 tháng	13 - 24 tháng	25 - 60 tháng	61 - 72 tháng	> 72 tháng	Tổng cộng				
355	349	269	20	14	1007				
3. Dự tật bẩm sinh:									
II. QUẢN LÝ TRẺ SUY DINH DƯỠNG									
2. Phân tích số trẻ SDD đến khám theo tháng tuổi và theo độ SDD									
	1 - 6 tháng		7 - 12 tháng		13 - 24 tháng		25 - 60 tháng		Tổng số
	ĐP	NK	ĐP	NK	ĐP	NK	ĐP	NK	
Độ I	0		0		0		0		0
Độ II	0		0		0		0		0
Độ III	0		0		0		0		0
Tổng cộng	0		0		0		0		0
Béo phì	0		0		0		0		0

Figure 4: Report on number of children have checkup and weight measurement monthly at the center clinic.

### 5.2 The overlapping between informal and formal institutions in the first groups:

The first group comprises clinics where the system was implemented in the first phase. The main characteristics of the clinics in this group are:

**Formal institution:**

- The commitment of top manager in implementing the system:

This was the case in the center clinic and district 4 and Binh Thanh district. These managers were volunteering to pilot the system in their districts and enthusiastic in organizing training sessions and encouraging their staffs continue to use the system.

**Informal institution:**



- Stable in organizational structure:

In the center clinic, although there were some staffs leaving and others coming, there is a stable structure of organizational chart of many users from doctors to nurse who are capable and interested in using the software. Therefore, the leave of some staffs did not affect to the whole implementation.

- Computer skills of nurses and doctors:

Indeed, most of doctors and nurses at the center clinic are young and clever in computer. They also have computer and Internet at home and use them for other purpose rather than the system.

- Using the system to register patients is one of routine activities:

At the center clinic, the system became an obligatory passing point as registration books were no longer used. As the system is important for the whole process of giving health care service, the technical team has an agreement with the clinic that all maintenance tasks must be done in weekend or not in working hours.

- The proximity from the supporting team and the location of central database server:

The availability of the server is crucial for a stable use. In fact, we received lots of complaints related to inaccessibility of the server. There were many reasons for this problem. In the summer time, electricity cut happened frequently. The PC server without power backup (UPS) easily shut downed and sometimes could restart. This problem was only solved in November 2008 when we could afford a UPS. In early 2009, we encountered another serious issue related to Internet connection. The network cables were damaged by severe climate and became unstable, making the server lost Internet connection many times. Problem from Internet Service Provider also contributed to instability of the server, and the consequence is frustrating users.

At the center, the connection to the server did not depend on Internet connection but only LAN so that the use of system was not affected by the instability of Internet. As the technical team and the clinic share the same building, it is convenient for timely and face-to-face support.

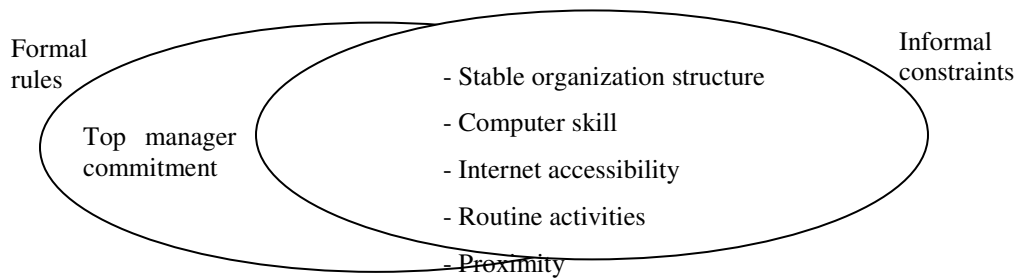


Figure 5: the overlap between informal and formal institution in the first group

**5.3 The little overlapping between formal and informal in the second group:**

The implementation of the second group including ward and district clinics earns a less success compared to the first group according to the following indicators:

- Unstable in data entry: some missing months (months without data).
- Limited in data use: modest use of data to support decision making processes

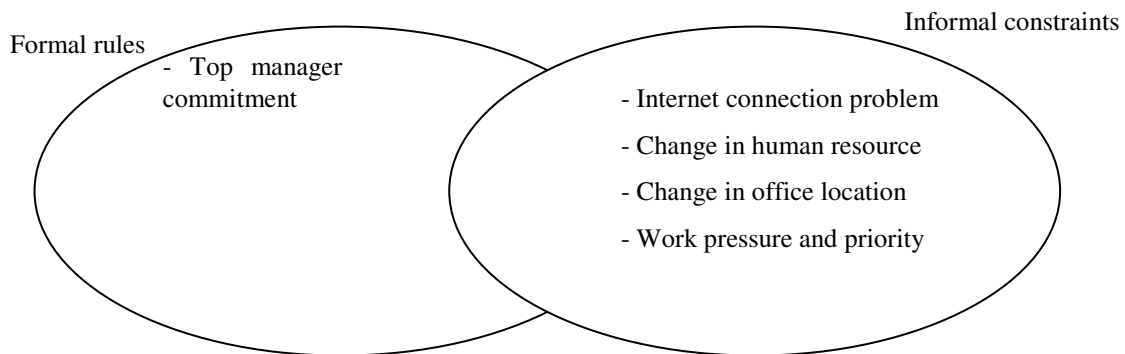
The following table summarizes problems accounting for not entering data frequently as reported by users:

ID	Problem	Explanation	
1	Internet connection	Internet connection directly affects the use of the system. As the system was deployed online and database was centralized, every implementation site needs to have	

		<p>Internet connection to use the system. In order to achieve this, both Internet connection at the place where the server is located and Internet from the client computer must be available.</p> <ul style="list-style-type: none"> <li>- Internet at the server's location: Data entry from the database shows that whenever the Internet of the server has problem, data was missing. For example, there are missing data in early 2009 due to "chronic" server problem.</li> <li>- Internet in the districts is also a factor affecting the use of the system. For example, Go Vap district started to use the system in March 2009. At this point of time, the new location of the clinic had no Internet connection.</li> </ul>	
2	Change in human resource	<ul style="list-style-type: none"> <li>- This is very dangerous for any system implementation. The trained and experienced staffs were replaced. The training must be given again, taking time for the new ones to get used to the system. For example, the case of district 12, district 8, and Tan Binh.</li> </ul>	
3	Change in office location	<ul style="list-style-type: none"> <li>- The change in office location some times leads to the change in human resource. The contradiction is that the new office sometime has a better infrastructure (Internet, computer) but some time this is not the case.</li> </ul>	
4	Work pressure and priority	<ul style="list-style-type: none"> <li>- This is the case when the system has not yet become a routine activity in these districts. Health staffs easily allocate time for a more urgent task rather than using the system. For example, September each year is the milestone for yearly performance assessment. This leads to the consequence that October and November have little data entered.</li> </ul>	

**Table 2: Informal constraints in the first group**

In the second group of clinics, there is also commitment from top managers who are responsible for the child health program in districts. This commitment is manifested in actions like allocating and encouraging their staffs in data entry. However there is too little overlap with the informal institution has made it extremely difficult to enforce the full replacement of the system for paper based work. The relationship between formal and informal institution is demonstrated in the following figure:



**Figure 6: The overlapping between formal and informal institution in the second group of clinics**

## 6 DISCUSSION AND CONCLUSION

To some extends, this project gained some positive outcomes. The initial plan for this project was to build a pilot system for electronic child health records in Ho Chi Minh City that can help to make intervention and preventive plan for child health in the two main areas: immunization and nutrition. The system is the first of its kind implemented in Vietnam with geographically distributed users and central database. The data sharing capacity enabled by the web-based design has been appreciated by a user as follows:

*“The system helps me to track treatment history of a child, and even the child was registered from the district, here, I still can see his data”*

*(Interview note, 2009)*

The team could only give proper support to the implementation of the system in the center clinic. However, at the moment, there are nearly 45 clinics at different levels using the system. This result makes it feasible for having an extended “Internet-based” electronic medical record system for other chronic diseases such as tuberculosis, malaria, mental illness, and pregnant mother in the future. The success of this implementation could help to convince the health department invests to build such kinds of systems.

In addition to the current status of implementation, this system needs to be scaled up to the whole city in order to have a comprehensive data of children in the city. To successfully scale up this system, based on the analysis in the previous section, I propose some actions need to be taken:

- An official document needs to be issued by the health department to make sure that entering medical records of children is a routine activity.
- Investment needs to be made into the server to solve the problem of connectivity thoroughly. The server must be running and accessible via Internet 24/7.
- While ADSL Internet connection is really cheap and easy to get, giving Internet to all districts must be formally done.
- The change in human resource is somehow inevitable; the impact of this change could be reduced by forming a group of users in every clinic.

This research contributes a practical guideline on how to build and implement electronic patient record in developing countries. Theoretically, this research extends the understanding of formal institutions by which formal institutions can include un-written artifacts such as “intention” or “will” of the top managers of the organizations, hence contribute to a broader perspective of applying institution theory to figure out the dynamics of the social conditions that shape the technology.

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