

APT ICT Development Programme for Supporting ICT Pilot Projects in Rural Areas 2010 (J3 Project)

“The Thai –Japan collaborative pilot system for rural e-Health development in Indochina region in honor of 84th anniversary of King Bhumibol Adulyadej Maharaja”

Final Report

Table of Contents

1. Executive Summary
2. Project Information
 - 2-1 Introduction
 - 2-2 Objectives
 - 2-3 Project Team
3. Summary of the Financial Statement
4. Project Activities
 - 4-1 Development of chronic disease registry and referral system application
 - 4-2 Remote prenatal system
 - 4-3 Remote medical consultation system
 - 4-4 Network security for medical information system
5. Project Outputs
 - 5-1 Data base arrangement
 - 5-2 Remote prenatal system
 - 5-3 Remote medical consultation system
 - 5-4 Network security system
6. Impacts of the Project
7. Project Sustainability
8. Lessons Learned
 - 8-1 Project execution
 - 8-2 Network coverage issue and ideas
 - 8-3 Modification of prenatal system (MCTG)
9. Future Plan
10. Conclusion

1. **Executive Summary**

Based on the clear recognition and firm understanding that pilot system aiming at developing regional e-Health network is worth implementing for the well-being of the people after our APT J 2 project in 2010 under the title of “Study on rural e-Health development via Thailand telecommunications network”, we applied for APT funding to carry out system implementation in which we planned “Development of chronic disease registry and referral system application”, “Remote prenatal system”, “Remote medical consultation system” and “Network security for medical data system”.

These systems except for security system were successfully implemented and put them into practice for the actual medical services in Phitsanulok Province. This province is regarded to represent the average level in various social elements so that testing results here could be applied mostly to the rest of the country.

This report describes the process of pilot system implementation and the fruitful results of operations which prove the success of this project. Only regret is that the operation period was limited to one month and so due to the aftermath of flooding disaster in Autumn 2011.

2. **Project Information**

2-1 **Introduction**

Well-being of the people is one of the basic human rights and need to be assured on equal basis regardless of environment. It is however not true in reality as recognized in medical services for the inhabitant in rural areas that they are in a situation with no medical doctors attended in their daily life and suffer from unease when get sick or pregnant.

Now that ICT has developed in various ways, application to the field of medical services needs to be focused in order to seek for actual availability and effectiveness. This project aims to approach to its challenging subject.

2-2 **Objectives**

The project aims to promote medical ICT which will contribute to the improvement of well-being of the people by proving effectiveness of the system. It is intended to verify the potency of ICT applied medical services for chronic disease and remote medical consultation including prenatal medicine those of which are considered key issues in health affairs in developing countries.

2-3 Project Team

The team members of this project are shown in Table 1 below.

Table-1

Name	Role	Designation	Contact
Dr. Boonchai KIJSANAYOTHIN	Chief Expert	Medical Officer Ministry of Public Health	boonchai.k@moph.mail.go.th
Prof. Dr. Supasit Pannarunothai	Senior Advisor	Dean of Faculty of Medicine Naresuan University	supasitp@nu.ac.th
Mr. <i>Somboon</i> Mekpaiboonwattana	Senior Advisor	Executive Director of ICT Promotion & Development Usage Bureau, Ministry of Information and Communication Technology (MICT) , Thailand	
Mr. Thiti PHUPETCH	Project member	ICT officer Ministry of Public Health	thiti.p@moph.mail.go.th
Mr. Ratapon HUTAYON	Senior Advisor	Director of Strategic Planning Sector / TOT	rataponh@tot.co.th
Mr. Kusolmongkol SUVARNAKUDHT	Project manager	Engineer 9 Network Planning Sector	kusolmos@tot.co.th
Professor Dr. Kazuhiro HARA	Senior Advisor	Professor Seto Inland Sea Regional Research Center, Kagawa University	hara@med.kagawa-u.ac.jp
Dr. Chie Sakuragi	Project member	NTT DATA Corporation	sakuragic@nttdata.co.jp
Mr. Hchihei Kurematsu	Project member	Vice President BHN Association(NGO)	kurematsu@nict.go.jp
Mr. Hideo Baba	Project member Coordinator	Counselor BHN Association(NGO)	baba@bhn.or.jp

2-4 **The purpose of this pilot project**

The purpose of this pilot project is to ensure the function of e-Health network which consists of data base (DB) for chronic disease and clinical data bases of other hospitals in the same region in conjunction with referral system common to all medical fronts.

It also seeks for practicality of remote medical consultation for inhabitants in the rural areas suffering from no or less medical treatment.

The successful result of the project will be deployed to the rest of the provinces in the country to provide them with better and healthier life, and further expansion to other countries in Indochina region as a humanitarian aids.

3. **Summary of the Financial Statement**

A total budget of 149,924 USD was approved by APT for this project. The details will be reported in Financial Final Report.

4. **Summary of the Project Activities**

The project established 4 action items to contribute to the realization of our primary objective, which are;

- Medical database
- Remote prenatal system
- Remote medical consulting system
- Network security for medical data system

Although there was 3 months delay of implementation due to the flooding disaster in Bangkok and its vicinity, three out of four items were successfully carried out having great cooperation of the relevant medical facilities and TOT officers and could come to an end with outcomes.

The 4th item, security system was ready to implement but considering a possibility of interruption to the actual services by installing the planned system, it was not put into practice, and careful study by the security specialists of both countries was made to sort out the best system to Thai environment.

4-1 **Pregnant woman data analysis Information System (PIS)**

1. Along with CTG monitoring data which are available for the clinicians in this project are provided through the K-Mix service in Japan, clinical data of pregnant

women are available for the obstetrician at the consulted hospital through the Pregnant woman data analysis information System (PIS) at the provincial health office.

2. The PIS provides clinical information for the teleconsultingservices. Information of pregnant women from all health centers and community hospitals in Phitsanulok province are resided in the PIS's database. The database is a dedicated database which drawn pregnant women's medical information from the Phitsanulok Data Center System (PDCS). See Figure 1

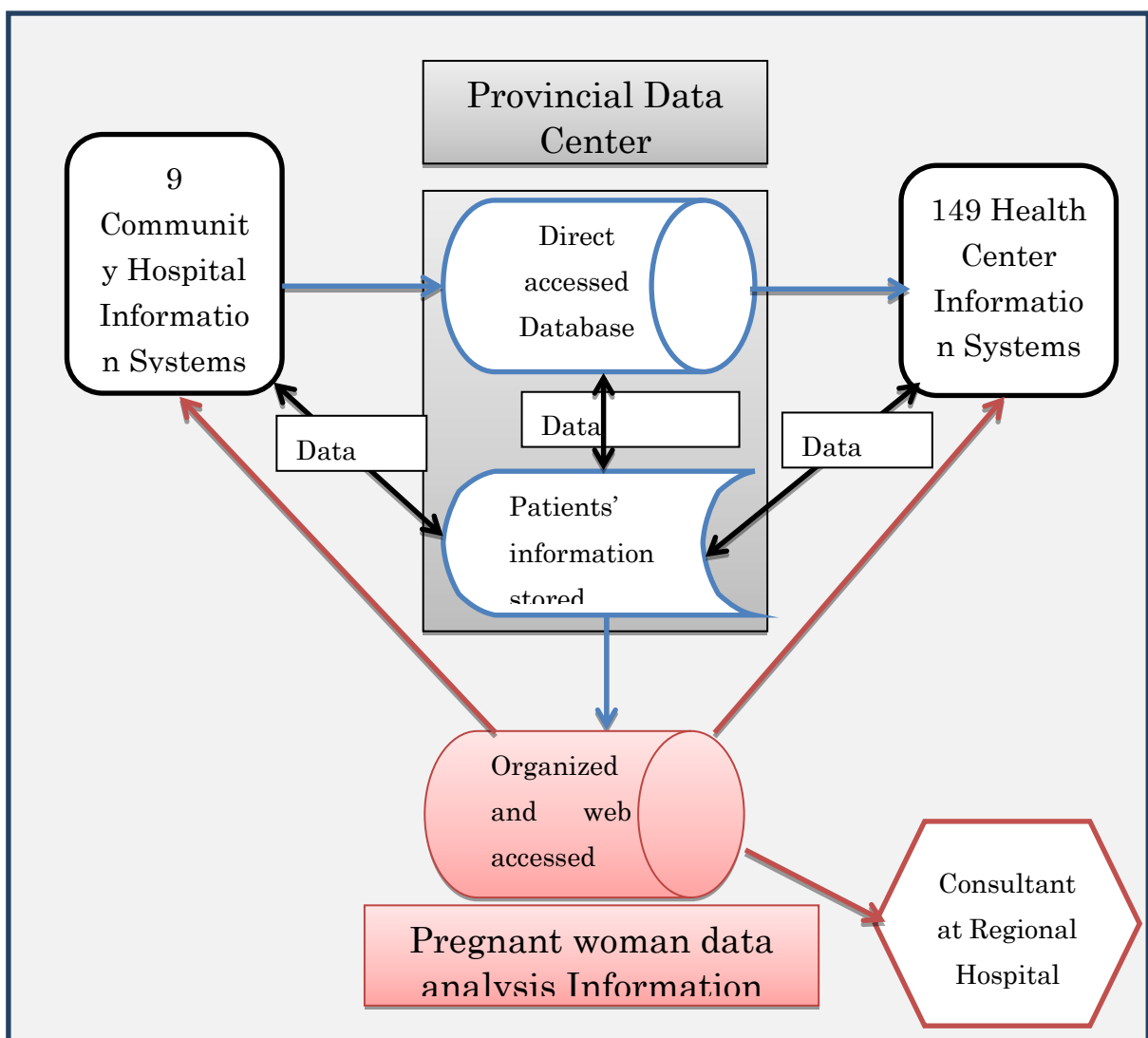


Figure 1 Diagram shows connection between the Provincial Data Center System (PDCS) and the Pregnant woman data analysis Information System (PIS)

3. Phitsanulok Data Center System (PDCS) is a centralized database resided and maintained by the provincial health office. All nine communities hospitals' and 149 health centers' information systems are linked with the PCDS. Patient visit information from health centers and community hospitals are synced and organized in the centralized database. The PDCS provides a portal for authorized clinicians to access patients' information from all health centers and community hospitals and health statistics in the province.

การเข้าใช้ระบบระบบ Data analysis web for pregnant women สามารถเข้าได้ที่ <http://203.157.118.105:8999/> หรือ เว็บไซต์สำนักงานสาธารณสุขจังหวัด พิษณุโลก www.pkhealth.go.th เลือกเมนูด้านซ้ายมือ



4. The Pregnant woman data analysis Information system (PIS) is web base services. Mother's medical records are shared between consulting clinicians and obstetricians at the regional hospital during consultation sessions and also available after the sessions. Patient's antenatal care information, including mothers' clinical information history of previous visits, immunization, laboratory results, and

medications are seen and used by the consultation partners. Figure 2-4 show sample of web user interfaces of the PIS.



Figure 2 The login page of the Pregnant woman data analysis Information System (PIS)

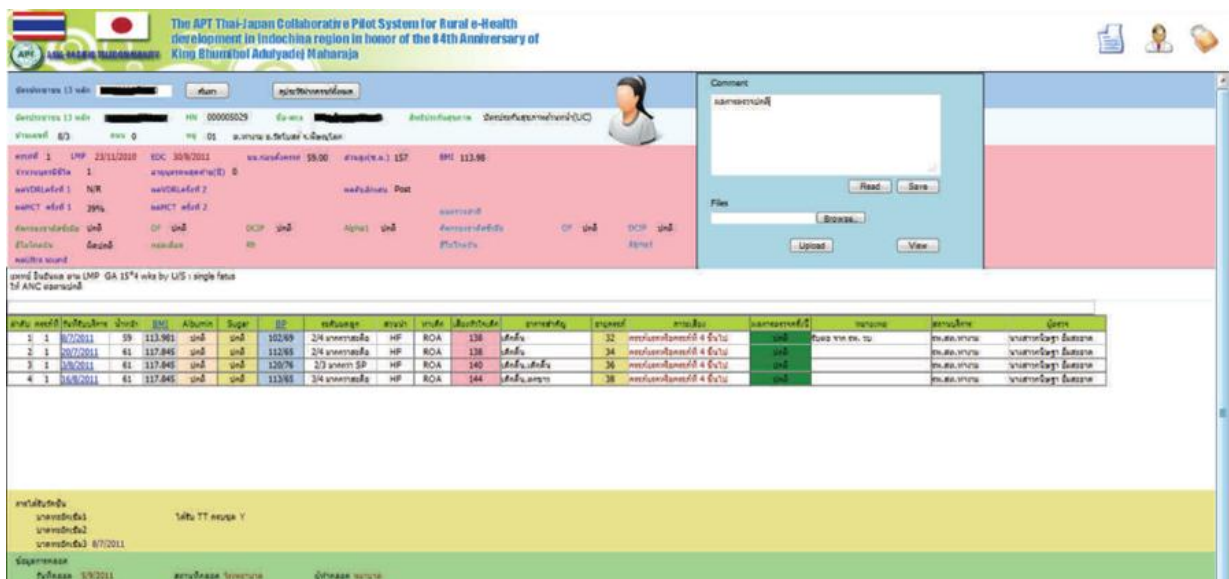


Figure 3 Mother's clinical information of previous visits page of the Pregnant woman data analysis Information System (PIS)

4-2 Remote prenatal system

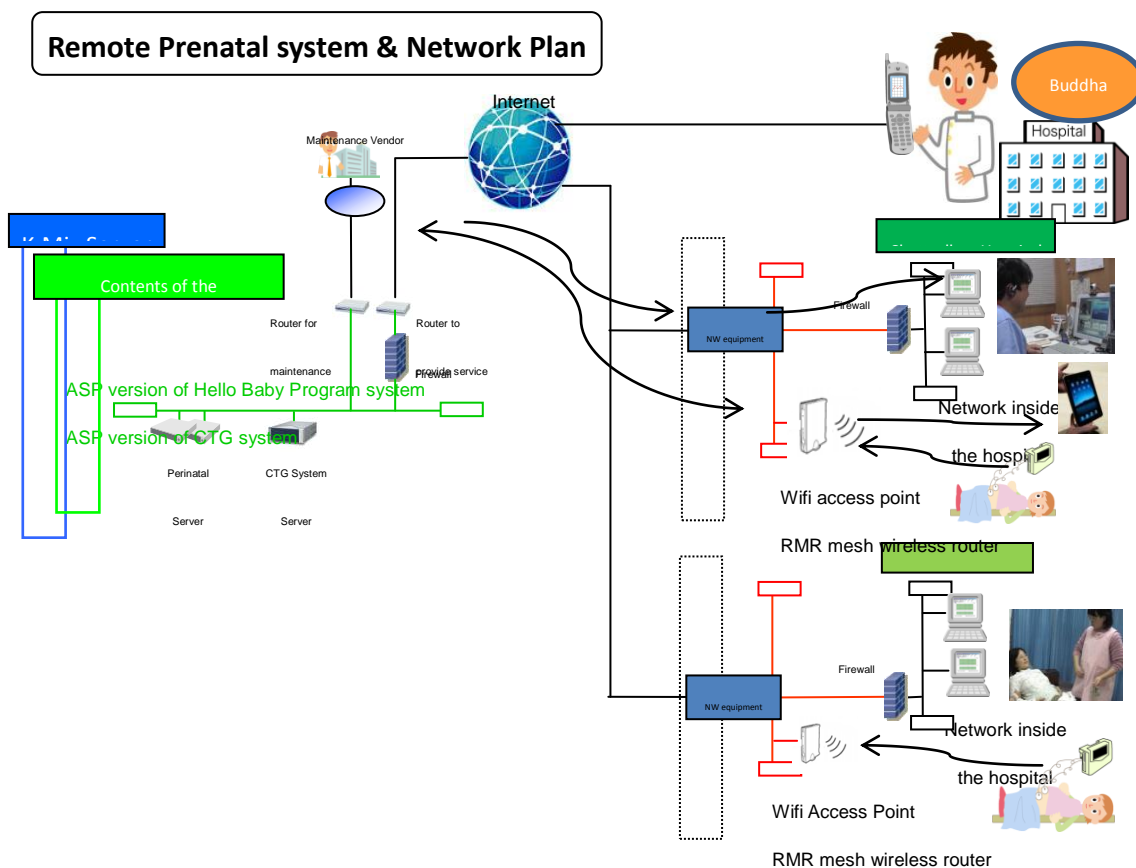
Women living in rural area or villages with no doctors attended are at unease all the time when they get pregnant, for they are seldom able to have medical check whether

they as well as fetus are in normal physiological/physical status.

The remote prenatal system using Mobile CTG (Cardiotacogram) is capable to allow obstetrician to remotely diagnosis the status of pregnancy checking fetus heart rate and uterine contraction.

We installed 2 sets of MCTGs at the local hospital and clinic in Phitsanulok province both are 60 and 120 km. away from general hospital in the city, and set up remote monitoring arrangement through Internet by which specialist obstetrician can check the pregnant woman.

The service using this system was set ready for obstetrician at general hospital in Buddha Chinaraj Hospital in Phitsanulok to diagnose pregnant women in the areas of Chattrakan hospital and Bang Klang clinic.



4-3 Remote medical consultation

Similarly to pregnant women in rural area, inhabitants with no doctor attended feel uneasy when they have something wrong with their health or get injured. Communication system both by visual and verbal is very effective tool in such an

situation that patient is able to consult with doctor remotely and given an advice of what he or she has to do for medical treatment.

We installed web conference system at the medical facilities which are Chattrakan Hospital, Bang Klang Clinic and Buddha Chinaraj Hospital and set such an arrangement that each of them is able to communicate with each other over Internet. This service allows patient in rural to consult with medical doctors at general hospital in the city about the health problem and to be advised of proper prescription or medical instruction as necessary.

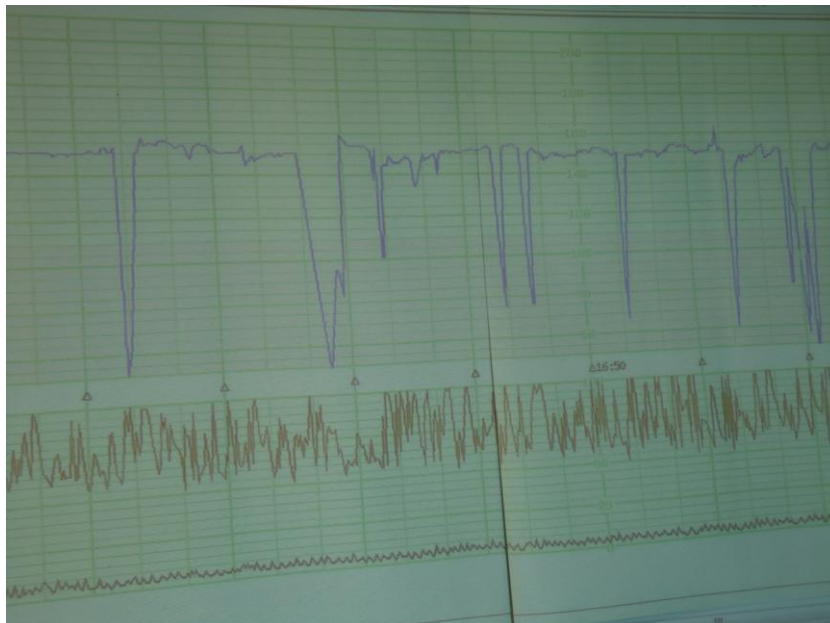
Above mentioned anxiety of pregnant woman can also be eased by this service that mid-wife or pregnant woman consulting with obstetrician by visual communications.



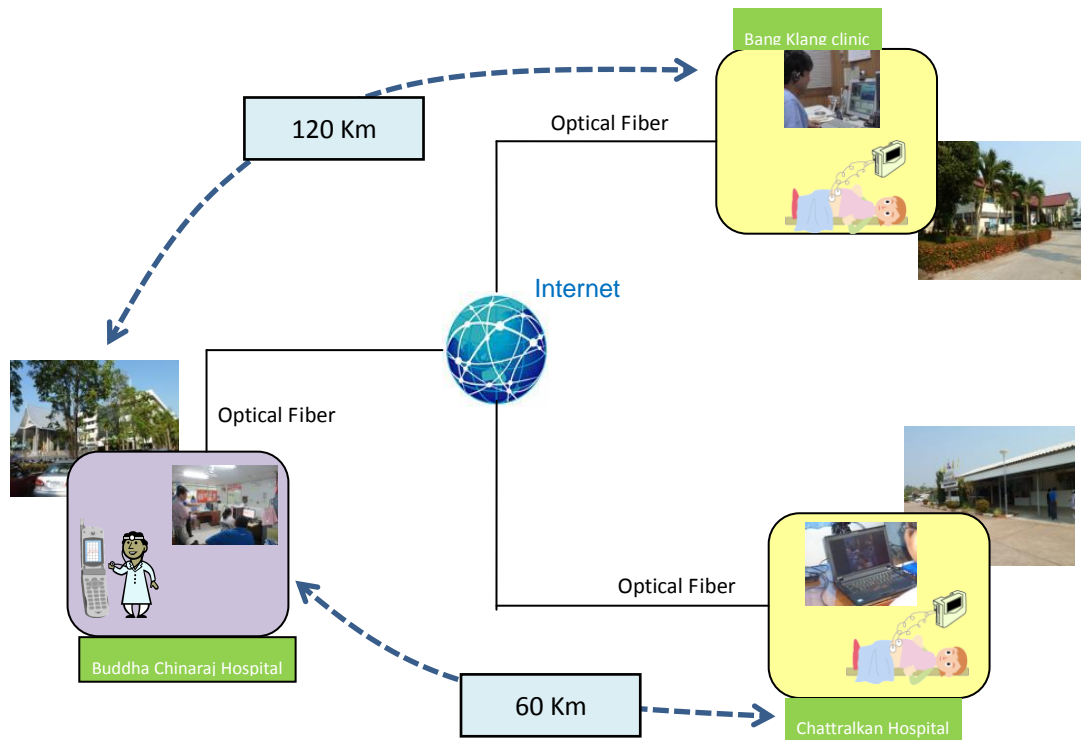
Using Mobile CTG at Chattrakan Hospital



Waveforms of fetus heart rate and uterine contraction



Remote prenatal system & Web-conference system



4-4 Network security for medical information system

Security arrangement for medical data informatics system is mandatory to prevent any anticipated network crime such as hacking and masquerading, and it is an international movement (inclination) to set up an official guide line instructed by government.

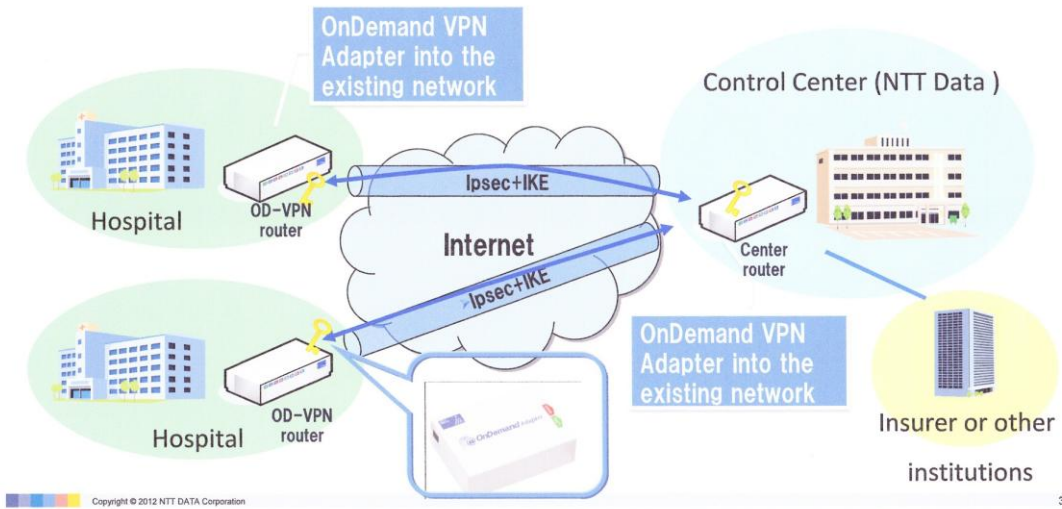
As an original plan for the project, an established security system by NTT Data Corporation named "ODVPN" was to install into the network for the pilot system. It is however not implemented because a partial installation was considered to affect the normal operation of current data system.

Instead, we had joint study on security system in view of our need to select an idealistic security system and the said OVPN and IP-VPN were on the table to make comparative study having specialists from Naresuan University and TOT.

Security for medical data service

OnDemand VPN (Virtual Private Network) NTT DATA

The service enables hospitals to establish VPN
It provides highly secured network easily and at a lower cost.



Discussion on NW security



Group Photo after NW security discussion



NTT Data, MoPH, Naresuan University, MoPH of Phitsanulok, TOT experts

5. Project Outputs

5-1 Remote prenatal system

Two (2) sets of MCTG were installed at Chattrakan Hospital and Bang Klang Clinic in the suburbs of Phitsanulok and internet arrangement was set up in order to deliver medical data of fetus heart rate and uterine contraction to obstetrician at Buddha Chinaraaj Hospital in Phitsanulok City.

The systems have been made use of for one month and half for pregnant women in rural areas and result of consultation by obstetrician.

Screen view of medical information



Left side is MCTG waveforms

Right side is perinatal data of Phitsanulok MoPH website

5-2 Remote medical consultation system

Web conference systems were installed at Chattrakan Hospital and Bang Klang Clinic and Buddha Chinaraaj Hospital.

The systems were used for remote medical consultation among the above three medical facilities, and also for education and training of new doctors at Chattrakan Hospital and Bang Klang Clinic from Buddha Chinaraaj Hospital.

Operation results of MCTG: Total Number of pregnant women checked, Normal pregnancy, Pregnancy not normal, among 3 sites

The screenshot shows a web browser window with a table titled 'Export to Excel'. The table lists the number of MCTG uses per month for the year 2012. The data is as follows:

No	เดือน	จำนวน
1	มกราคม	0
2	กุมภาพันธ์	0
3	มีนาคม	0
4	เมษายน	0
5	พฤษภาคม	28
6	มิถุนายน	11
7	กรกฎาคม	7
8	สิงหาคม	1
9	กันยายน	0
10	ตุลาคม	0
11	พฤศจิกายน	0
12	ธันวาคม	0

The translation of the above screen with regard to the number of MCTG usage vs. obstetrician's diagnoses result during pilot test period are as follows:

No.	Month	Quantity (of pregnant women checked)
1	January	0
2	Febuary	0
3	March	0
4	April	0
5	May	28
6	June	11
7	July	7
8	August	1
9	September	0
10	October	0
11	November	0
12	December	0

The equipments have been used **with total number of pregnant women checked 47 cases, which only 1 case in Chartrakarn site and 9 cases in Ban Klang site of the Pregnancy not normal (needs more details examination)** were found.

The criteria, that hospital decides to determine non-normal pregnancy case is as follows:

1. The **baby moves less than 10 times/day** and has **FHS (Fetal Heart Sounds) less than 120 times/minutes, or more than 160 times/minutes**
2. Complications of pregnancy as follows:
 - High **blood pressure during pregnancy starts at 160/90 mm/Hg** or Pre eclampsia
 - **Diabetes during pregnancy (GDMA1/ GDMA2)**
 - **UTI: Urinary Tract Infection**
3. Use of MCTG system **for Consult a medical examination before birth**

5-3 Network security system

Careful study were made by the specialists on the subject of comparison between ODVPN and IP-VPN to seek for the best network security system for Thai environment.

The study concluded that security guidelines which healthcare IT services comply with and the service certification scheme are needed to establish secure e-Health system in Thailand.

5.3.1 Security Guidelines in Japan

We are using IT systems for healthcare data management including exchanging data over networks.

Protecting personal healthcare data is one of the common issues in the world for implementing e-Health services. It is no doubt that the healthcare related information is confidential and it should be kept between the patient and the doctor.

Introducing security systems is important. However it is always the balance of cost for security system implementation and security performance. If you pay a lot, you could introduce more effective solutions. However budget limitation is always an issue to be concerned with.

All the very least, we need to implement a minimum security system set by the act or official guidelines.

There are a law and guidelines to protect personal information and personal

healthcare data as well as its authorizing scheme in Japan.

The Japanese law, guidelines and authorizing scheme for personal healthcare data protection are described below.

1) **A Law and guidelines for information security in Japan**

- i) Act on the Protection of Personal Information¹
- ii) Guidelines issued by the Ministry of Health, Labour and Welfare
 - a) Guidelines for Proper Handling of Personal Information by Medical Care/Nursing Care Service Providers²
 - b) Guidelines for security management of medical information system³
- iii) A guideline issued by the Minister of Economy, Trade and Industry
 - a) Guidelines for an information processing provider controlling medical information in trust⁴
- iv) A guideline issued by The Ministry of Internal Affairs and Communications
 - a) Guideline for security management on handling of medical information by an ASP-SaaS provider⁵

The medical information systems in Japan are required to comply with these guidelines. There is a certification scheme for Guidelines for security management of medical information system.

2) **Authorization**

The compliance guideline is officially confirmed by an authorized organization, Health Information Security Performance Rating Organization (HISPRO). This scheme is a third party conformity assessment scheme for service and system provided by a vender on guideline for security management of medical information system.

HISPRO assesses IT vender's services objectively and certifies them.

This operation is mostly working well, however there are some issues to be solved. Getting certified by HISPRO is not compulsory. Smaller companies still don't get authorized.

5.3.2 The Characteristics of VPN services

There are several types of VPN services.

1) **Internet VPN**

The Internet VPN is a virtual network that it constructed via the Internet. It

¹ <http://law.e-gov.go.jp/htmldata/H15/H15HO057.html> (Japanese)

² <http://www.mhlw.go.jp/topics/bukyoku/seisaku/kojin/dl/170805-11a.pdf>(Japanese)

³ <http://www.mhlw.go.jp/shingi/2010/02/dl/s0202-4a.pdf>(Japanese)

⁴ http://www.meti.go.jp/policy/it_policy/privacy/080724iryoku-kokuzi.pdf(Japanese)

⁵ http://www.soumu.go.jp/main_content/000030806.pdf(Japanese)

enables to operate the same way as you are connected to each other in the LAN network in remote location while maintaining confidentiality. It provide the service with very lo cost compared to leased line, because it uses the Internet backbone. However, there is a risk of data flowing through the Internet by eavesdropping, for example, it encrypt data using IPsec so that it is able to communicate sensitive data in the Internet VPN.

2) IP-VPN

The IP-VPN is a virtual network that is constructed via the IP wide area communications network owned by the carrier. Like the Internet VPN, it enables to operate the same way as you are connected to each other in the LAN network in remote location while maintaining confidentiality. However, it is expensive compared to the Internet VPN. IP-VPN provides high security and good quality communication service.

3) Entry VPN

The Entry VPN is a virtual network and is one of the wide area network (WAN) services which connect between company sites. It uses a line such as broadband FTTH (fiber to the home) and ADSL (asymmetric digital subscriber line) to access from the base line. The Entry VPN is a new type of the IP-VPN. The IP-VPN provides digital leased line and Ethernet leased line as a menu of access lines.

They will be a quality guaranteed service to ensure the quality of the network by a service contract such as communication speed and failure recovery time. The Entry VPN provide the best-effort service because it use access lines with no guaranteed of the quality of the network.

Table 1 shows the characteristics of the each service.

Table 1 The characteristics of VPN services

	Internet VPN	IP-VPN	Entry VPN
Base technology	IPsec ,SSL-VPN	MPLS	IPsec
Topology	Star	Full mesh	Pseudo- mesh
Available nodes	Depends on adapters	100-	10-100
Level of blocking	Rather low	High	Rather high
QoS (Quality of Service)	Not guaranteed	Guaranteed	Not Guaranteed

SLA(Service Level Agreement)	Not available	Available	Not available
Limit of accessible lines	limitless	limitless	Limited

5.3.3 ODVPN service

On Demand VPN service (ODVPN service) is one of Internet VPN services provided by NTTDATA Corporation in Japan.

Figure 1 shows the image of ODVPN service.

This service provides a secure network service with some facilities such as hospitals and clinics when they send data including personal data related to their health.

The service is used widely in Japan as the online-invoicing service is expanding.

This service is easy to implement however it depends on the current network system.

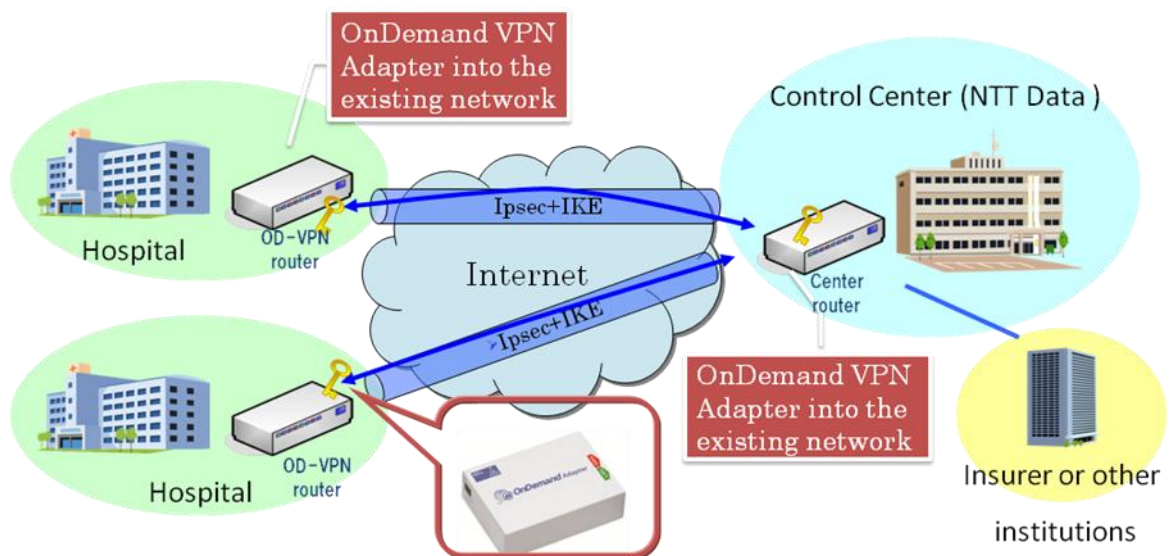


Figure 1. The image of ODVPN service

The features of ODVPN service are described below.

- i) It adopts the IPsec and the IKE system. The IPsec is a security architecture framework for the Internet. The combination of IPsec and IKE is used widely and it protects data transmission over Internet.
- ii) The service complies with the security guideline published by the Ministry of Health , Welfare and Labour.
- iii) You are able to implement the service if you have the Internet access.
- iv) You can establish and switch 16 VPNs at most for one router and switch them when you need it.
- v) Network consulting service is provided when you have a network system in your facility to make sure it would not affect the current network system and current operating System.
- vi) We provide a 24hours all year round call center to support customer's requirement

The service is being implemented into some data exchange services in Japan, such as the on-line invoicing service and the regional healthcare information network.

6. Impacts of the Project

Through the implementation of the pilot system, three out of four (4) items are proven effective for the preventive healthcare and medical services of the inhabitant, particularly those in the rural areas with no medical doctors attended as a whole.

This is a good sign that some types of systems for e-Health are able to be contributive to the people in the similar environment and hence be applicable to other countries in Asia and Pacific region.

It was symbolized by the fact of celebration that a ceremony to cut-off service was spectacularly taken place in Buddhachinaraj Hospital having honorable guests such as Vice-governor, Vice president of Naresuan University, Executive Vice president of TOT, Provincial Chief Medical Officer and other distinguished medical doctors and relevant concerned people in the region.

This is an indication of expectancy of the people for the pioneering medical ICT services.

7. Project Sustainability

With achievement of the project that proved effectiveness of tested systems, it would be sustained having funding from the governments of Japan or international

organization in order to review the outputs of system implementation for wider expansion, not only in Thailand but also the interested countries in vicinity.

8. Lessons Learned

There are a couple of points we learned as goodness and things to reflect for future improvement as follows.

Lessons learnt

Key items for Project success

Local support

Key persons

Coordination

Leadership

8-1 Project execution

a. Coordination and cooperation

In carrying out such an international project, a close communication is very important to maximize the potential power that each team members and to avoid any possible risk.

We made it a rule continuously to keep in touch with all project members through project manager (Mr. Kusolmongkol SUVARNAKUDHT TOT Engineer9, IEEE member in Communications Society and Computer Society) and could go through all items planned in spite of unexpected disaster of flooding in the country of project site.

Launching ceremony for pilot system (Honorable guests)



In the name of Governor of Phitsanulok province, President of Naresuan University, President of MoPH of Phitsanulok, Dean of Medicine Faculty Naresuan University

Launching ceremony / medical side



President of Neresuan University, President of MoPH of Phitsanulok, President and Chief of obstetrician of Buddhachinaraj hospital

Launching ceremony / telecom side



TOT Network Team with Dean of Medicine Faculty Naresuan University (most right)

Ceremony Photograph (Launching Pilot system)



Honorable guests from both Japan side and Thai side

b. Leadership

Our project activity has been helped by a strong leadership of “Chief Expert” Dr. Boonchai KIJSANAYOTHIN and “Senior Advisor” Prof. Dr. Supasit Pannarunothai and Mr. Somboon Mekpaiboonwattana of the project team to drive the project actively in time for milestones, in which an example is that the unexpected flooding disaster was not a fatal to project progress.

It is also notable that a system cut-off ceremony inviting big shots in the province was taken place thanks to efforts of those leaders.

Training on computer operation for
remote medical consultation by “Chief Expert”



“Chief Expert” Dr. Boonchai KIJSANAYOTHIN (white shirt)

“Project Manager” Kusolmongkol SUVARNAKUDHT (most right)

c. Support of local

We received great works of support from organizations at the site the project carried out.

Local office of TOT played a significant important role to make high speed internet access realized, and special team was formed having volunteers around Naresuan University to take care of operation support for the systems installed.

Instruction and local training of Mobile CTG



Medical diagnosis by local obstetricians with MCTG



At Buddhachinaraj hospital with Japan MCTG experts and Local TOT team

Medical diagnosis by obstetricians



8-2 Network coverage issue and ideas

a. Internet arrangement

In this project, facility arrangement for internet is indispensable and TOT did a great deal of such works for this arrangement as to lay fiber optical cable to the project sites and to set up local access network.

Without this contribution, the project would have never succeeded.

b. Ideas to realize internet access

It is an issue how to realize accessibility to Internet from the rural areas where normally land lines are hardly prepared by TOT.

Through the pilot system operation a couple of ideas were discussed to be studied for future. They are;

b.1. access through mobile network

TOT 3G does not yet provides to these rural project sites, but may be possible in the future.

b.2. access through satellite (IP-Star)

Only applied to the case that both land line and mobile accesses are not available, because of high operation cost.

Both require modification of interface arrangement at terminal system (in case of MCTG) but it is technically possible so that will be reflected to vendor.

8-3 Modification of prenatal system (MCTG)

It was realized that a few basic parameters for data format in Thai medical informatics system are different from Japan, therefore such as Personal ID digit and office code digit embedded in MCTG need to be expanded to fit to Thai system.

The language shown on MCTG screen is also important for international use, and needs to be all in English or English/Japan/Thai.

The pilot operation for prenatal system has been supported by the data server in Takamatsu, Japan. For future use in large scale in Thailand or other countries, an independent data server should be established in each country.

The CTG function has been used for long time in this pilot area, but in emergency mode solely, in case that there would be danger to the mother and child.

It is owing to ICT performance of MCTG, remote feature can be possible. Real healthcaring to rural mother taken care by midwife in regional center can be distantly performed from obstetrician of main hospital staff through Medical Remote Consultation.

One more improvement of public caring in this pilot area which can be addressed is that the proactive mode of MCTG has been happened to the mom besides existing emergency mode of CTG.

Local obstetricians supervisor team supports this pilot system and confirm the benefit and improvement to the sites. They urged to implement more this kind of system and expecting for MCTG waveforms on Smart phone mode for obstetricians.

Moreover, WiFi range around healthcare center makes flexible to the perinatal care around center.

The user friendly interactivity would be possibly improved i.e. local language or English in MCTG, one-touch shortcut on computer screen in each process among Medical Consultation work station, Perinatal Database Website, KMIX center, Smartphone of supervisor doctors, etc. .

Metropolitan area hospital would probably use MCTG system to the rich people by sale or rent per unit with personal nurse in better high performance of ICT network.

Implemented by Foundation for the poor mothers is another public healthcare possibility even in high densed wireless area for bettering decreasing gap.

9. Future Plan

Recognizing that the pilot systems were successfully done and proven to contribute to betterment of people's well-being, they should be deployed, with minor modification and improvement of the points clarified in pilot system operation, to other areas of the country and the neighboring countries which suffer from the similar healthcare problems e.g. Laos, Myanmar, etc. .

10. Conclusion

The pilot system for e-Health in Phitsanulok/Thailand has successfully completed despite of 3 months interruption due to natural disaster, and obtained significant technical and operational fruits that should be reflected to the future systems for wider dissemination. All project members wish that this outcome will play a meaningful and pioneering role of e-Health deployment in Asia and pacific region for the improvement of people's welfare.
