

**THE DEVELOPMENT OF AN APPOINTMENT SYSTEM
FOR NON-INVASIVE CARDIAC INVESTIGATION**

The seal of Mahidol University is a circular emblem. It features a central blue field with a golden chedi (a traditional Thai Buddhist stupa) and a flame-like motif below it. The seal is surrounded by a golden border containing Thai script. The text 'WIPHAWIN WATTANAPRAKARNCHAI' is superimposed over the central blue field.

WIPHAWIN WATTANAPRAKARNCHAI

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Thematic Paper
Entitled

**THE DEVELOPMENT OF AN APPOINTMENT SYSTEM
FOR NON-INVASIVE CARDIAC INVESTIGATION**



Wiphawin Watthanaprakarnchai
Mrs Wiphawin Watthanaprakarnchai
Candidate

Prangtip Ucharattana
Assoc. Prof. Prangtip Ucharattana,
M.A. (Nursing Administration)
Major-Advisor

Saovaluck Jirathummakoon
Dr. Saovaluck Jirathummakoon,
Ph.D. (Nursing Administration)
Co-Advisor

M. R. Jisnusun Svasti
Prof. M. R. Jisnusun Svasti,
Ph.D.
Dean
Faculty of Graduate Studies

Pornsri Sriussadaporn
Assoc. Prof. Pornsri Sriussadaporn,
M.Ed. (Educational Research)
Chair
Master of Management Programme in
Nursing Management
Faculty of Nursing

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Wiphawin Watthanaprakarnchai
Mrs Wiphawin Watthanaprakarnchai
Candidate

Prangtip Ucharattana
Assoc. Prof. Prangtip Ucharattana,
M.A. (Nursing Administration)
Chair

Duangmanee Laohaprasitiporn
Prof. Duangmanee Laohaprasitiporn,
M.D., Diploma Thai Board
of Pediatric Cardiology
Member

Saovaluck Jirathummakoon
Dr. Saovaluck Jirathummakoon,
Ph.D. (Nursing Administration)
Member

Pornsri Sriussadaporn
Assoc. Prof. Pornsri Sriussadaporn,
M.Ed. (Educational Research)
Member

Liangchai Limlomwongse
Prof. Liangchai Limlomwongse,
Ph.D.
Dean
College of Management
Mahidol University

M. R. Jisnuson Svasti
Prof. M. R. Jisnuson Svasti,
Ph.D.
Dean
Faculty of Graduate Studies
Mahidol University

Kobkul Phanchaoenworakul
Assoc. Prof. Kobkul Phanchaoenworakul,
Ph.D. (Nursing)
Dean
Faculty of Nursing
Mahidol University

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Wiphawin Watthanaprakarnchai

THE DEVELOPMENT OF AN APPOINTMENT SYSTEM FOR NON-INVASIVE CARDIAC INVESTIGATION

WIPHAWIN WATTHANAPRAKARNCHAI 4637852 MGNM/M

M.M. (NURSING MANAGEMENT)

THEMATIC PAPER ADVISORS: PRANGTIP UCHARATTANA, M.A. (NURSING ADMINISTRATION), SAOVALUCK JIRATHUMMAKON, Ph.D. (NURSING ADMINISTRATION)

ABSTRACT

The non-invasive cardiac investigation service in the Cardiovascular Special Investigation Unit experienced a major problem which greatly affected quality of service, i.e., an inefficient appointment system resulting in long client waiting time. Client waiting time was a significant key performance indicator of service quality. Developing an efficient appointment system starting from the client making an appointment and attending on the appointed date to have an investigation until discharge from the investigation unit as the major framework for this thematic paper.

The development of an appointment system started from an analysis of the problem from empirical evidence, academic data and research studies searched from electronic databases, and manual searches in libraries in Thailand and abroad. This material then was synthesized and summarized. A new appointment system improving the operation management was developed. The validity of content was verified by three experts. The new appointment system was expected to decrease echocardiography investigation time by 65%, decrease exercise stress test and tilt table test time by 69%, and increase client satisfaction.

The recommendation is that the benefits of the new system be communicated as a priority to all staff prior to pilot implementation to maximize its beneficial effect. Client and health care personnel satisfaction data, including hospital expense data, need to be collected before and after pilot implementation to evaluate the effectiveness and efficiency of the new appointment system.

KEY WORDS: APPOINTMENT / WAITING TIME / QUEUEING / SCHEDULING
NON-INVASIVE CARDIAC INVESTIGATION

124 P.

การพัฒนาาระบบนัดหมายเพื่อการตรวจวินิจฉัยโรคหัวใจด้วยวิธีนอนอินเวซีฟ (THE DEVELOPMENT OF AN APPOINTMENT SYSTEM FOR NON-INVASIVE CARDIAC INVESTIGATION)

วิภาวิน วัฒนะประการชัย 4637852 MGNM/M

กจ.ม. (การจัดการการพยาบาล)

คณะกรรมการควบคุมสารนิพนธ์: ปรารักษ์ทิพย์ อู่ระรัตน, M.A. (Nursing Administration),
เสาวลักษณ์ จิรธรรมคุณ, Ph.D. (Nursing Administration)

บทคัดย่อ

การบริการตรวจวินิจฉัยโรคหัวใจด้วยวิธีนอนอินเวซีฟ ของหน่วยตรวจพิเศษหัวใจและหลอดเลือด พบปัญหาสำคัญที่ส่งผลกระทบต่อคุณภาพการบริการ คือ ระบบนัดหมายขาดประสิทธิภาพทำให้ผู้ใช้บริการต้องรอตรอนาน ซึ่งระยะเวลาการรอคอยเป็นตัวชี้วัดคุณภาพการบริการตัวหนึ่งที่มีความสำคัญ การพัฒนาระบบนัดหมายให้มีประสิทธิภาพโดยเริ่มตั้งแต่การมานัดตรวจ การมารับบริการการตรวจ จนกระทั่งจำหน่ายจากหน่วยตรวจ เป็นแนวทางสำคัญในการศึกษาครั้งนี้

การพัฒนาระบบนัดหมายเริ่มจากการวิเคราะห์แยกสาเหตุของปัญหา สร้างแนวทางพัฒนาเพื่อแก้ไขปัญหา จากข้อมูลเชิงประจักษ์ของหน่วยงาน จากข้อมูลทางวิชาการ วิจัย ในฐานข้อมูลอิเล็กทรอนิกส์ และห้องสมุดต่างๆทั้งในประเทศไทยและต่างประเทศ นำมาพัฒนาเป็นระบบนัดหมายใหม่ และการปรับปรุงการบริหารจัดการภายในหน่วยงาน ผ่านการตรวจสอบความเที่ยงตรงและนำมาปรับปรุงแก้ไขตามข้อเสนอแนะโดยผู้ทรงคุณวุฒิ 3 ท่าน ระบบนัดหมายที่พัฒนาขึ้นใหม่นี้คาดว่าจะสามารถลดเวลาที่ใช้ในการตรวจหัวใจด้วยคลื่นเสียงสะท้อนความถี่สูงลงได้ ร้อยละ 65 ลดระยะเวลาเวลาที่ใช้ในการทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย และการตรวจหาสาเหตุการเป็นลมหมดสติโดยใช้เตียงปรับระดับลงได้ร้อยละ 69 และระดับความพึงพอใจของผู้ใช้บริการเพิ่มขึ้น

ข้อเสนอแนะในการศึกษาครั้งนี้คือ ก่อนนำระบบไปทดลองใช้ จะต้องทำการชี้แจงและสร้างความเข้าใจให้กับบุคลากรที่เกี่ยวข้องยอมรับและเห็นด้วยเพื่อความร่วมมือที่ดี และควรทำการเก็บข้อมูลความพึงพอใจของผู้ใช้บริการ ผู้ให้บริการ รวมทั้งค่าใช้จ่ายของโรงพยาบาล ก่อนและหลังทำการทดลองระบบเพื่อประเมินประสิทธิผลและประสิทธิภาพของระบบนัดหมาย

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CHAPTER I

INTRODUCTION

Background and significance of the study

The rapid and greatly change due to globalization affects directly to Thailand economy, policy, and social and technological advancement. The change propels the country into high technology society which also arouses high business competition locally and internationally. The healthcare business is also affected from these global changes. People can assess more into health care information and other beneficial resources. As a result, health care service expectation is also getting higher. When economic crisis occurs, people are more aware in the service or product quality in the worthiness and satisfaction of product or money they buy. As a result, governmental and private sector organizations in this competition era have to produce product or provide service with high quality concern (Boonjai Srisatitnarakool, 2001). Hospitals also change their roles to improve their healthcare service quality in order to maintain their business competency so that they can fulfill the client's needs and motivate client to return to buy their service in the future (Kritsada Sawaengdee, 1996).

Cardiovascular Special Investigation is a working unit in Her Majesty's Cardiac Center, Siriraj Hospital. The unit provides non-invasive cardiac investigation for diagnosis, treatment, follow up, assessment for all kind of cardiovascular disease from pre-natal to elderly except emergent patient since the unit does not run service on extra office time and carrying out cardiovascular research and study. The unit is equipped with modern medical instruments and machines and employed highly competent healthcare personnel in order to provide fast and accurate investigation in appropriate with the pathology, ensure standard and no complication, provide information support and self-care practice for continuing care to patients with fully satisfaction. Cardiovascular Special Investigation Unit is similar in function with

the outpatient department where each patient with cardiovascular risk has to come into investigation service for cardiovascular diagnosis for treatment, follow up the treatment and prognosis.

According to economic recession, more patients visit governmental hospitals in order to save their expense. Siriraj Hospital has a major advantage than any other hospital in its long time fame and reputation and its cutting edge medical technology. So, there has been a large number of clients visiting Siriraj Hospital (Pravet Wasi, 1997). According to Cardiovascular Special Investigation patient statistics, the total number of patients visit the hospital in the year 2002, 2003, and 2004 was 11,948, 14,337, and 16,696 (Her Majesty's Cardiac Center administration office, Faculty of Medicine, Siriraj Hospital. 2005). Obviously, the number of patients visiting the unit for investigation have increased every year. As similar to other outpatient units, long waiting time and less numbers of service personnel are major problems of unit service management causing patient dissatisfaction. (Chommanard Nownkookhetkhong, 2004).

The service problem in Cardiovascular Special Investigation Unit occurred in consequence from making appointment with all patients in the same time on 08.00 a.m. Moreover, using first come first served queuing management with the reason that the unit did not want to have an unoccupied time of physician since each investigation procedure and each complexity level of cardiovascular illness takes different investigation time. Non-attendance can cause the non-invasive investigator to waste their time unoccupied. Besides, the hospital regulation concerning source of payment which requires every client who hold universal coverage card and social security card to check their payment coverage which takes 1 hours. As a result, making same time appointment causes clients to have long waiting time to get the investigation. The investigation start on 9.00 a.m. which according to the investigator's experience, most of patients arrived earlier to book the queue. The waiting time to be called in investigation room was 2 hours 30 minutes for echocardiography and 1 hour 30 minutes for exercise stress test and tilt table test. Some patients waited for more than 5 hours before being seen by physicians whilst the investigating time is 25 minutes for exercise stress test and 45-60 minutes for echocardiographic investigation. There are still waiting time for appointment card presenting and post-investigation activities.

Therefore, the time patient spent on each investigating visit at the unit is very long. The unit had received a lot of complaint concerning long waiting time from patients continuously. Due to long waiting time, patients were stressful and dissatisfied. One of major causes of long waiting time is inefficient appointment system (Athlar and Soemon). The other cause is that the service process comprises many stages. Some stages such as processing universal coverage card and social welfare card or searching X-ray film have to be done by patients and relatives. As a result, the patients found the service inconvenient, delay, and low quality. (Figure 1).

The other reason that physicians started the investigation late because of their high workload. Sometimes, the cancellation was unexpected causing delayed services. Some patients expressed their dissatisfaction to the service personnel and system. According to the internal survey results by the Division of Quality Development, Siriraj Hospital, 3rd of 2004 during 2-3 February, 2005, the improvement opportunity of Cardiovascular Special Investigation Unit was the appointment/reservation system. It was recommended that service time assurance should have been identified by identifying the service time in appointment card. Then, the unit should have provided the service in the assured time. As a result, the congestion of patients in waiting area would be decreased.

The patient waiting time was one of the important service quality indicators indicating service efficiency of such organization (Wipada Kunaviktikul, 1999). Also, waiting time also affect the client satisfaction upon the service (Arjen et al., 2005). According to Marilyn (2003) reviewing the studies of waiting time & client satisfaction, there was a negative relationship between waiting time and client satisfaction. Several studies revealed the similar results that long waiting time in waiting room and treatment room drastically decreased the client satisfaction (Chung et al., 1999; Dansky & Miles, 1997; Probst, Greenhouse & Selassie, 1997). Moreover, Rondeau (1998) summarized that long waiting time in a clinic not only decreased the client satisfaction but also caused clients felt stress, anxiety and distress with the waste of time for many hours so they could not go back to work. Consequently, the clients had bad impression with service personnel.

According to the SWOT analysis in 2004 of the Cardiovascular Special Investigation Unit, the main weakness was delayed, non-punctual, and unable to

Appointment

Client → getting appointment card

Process flow chart on appointed date

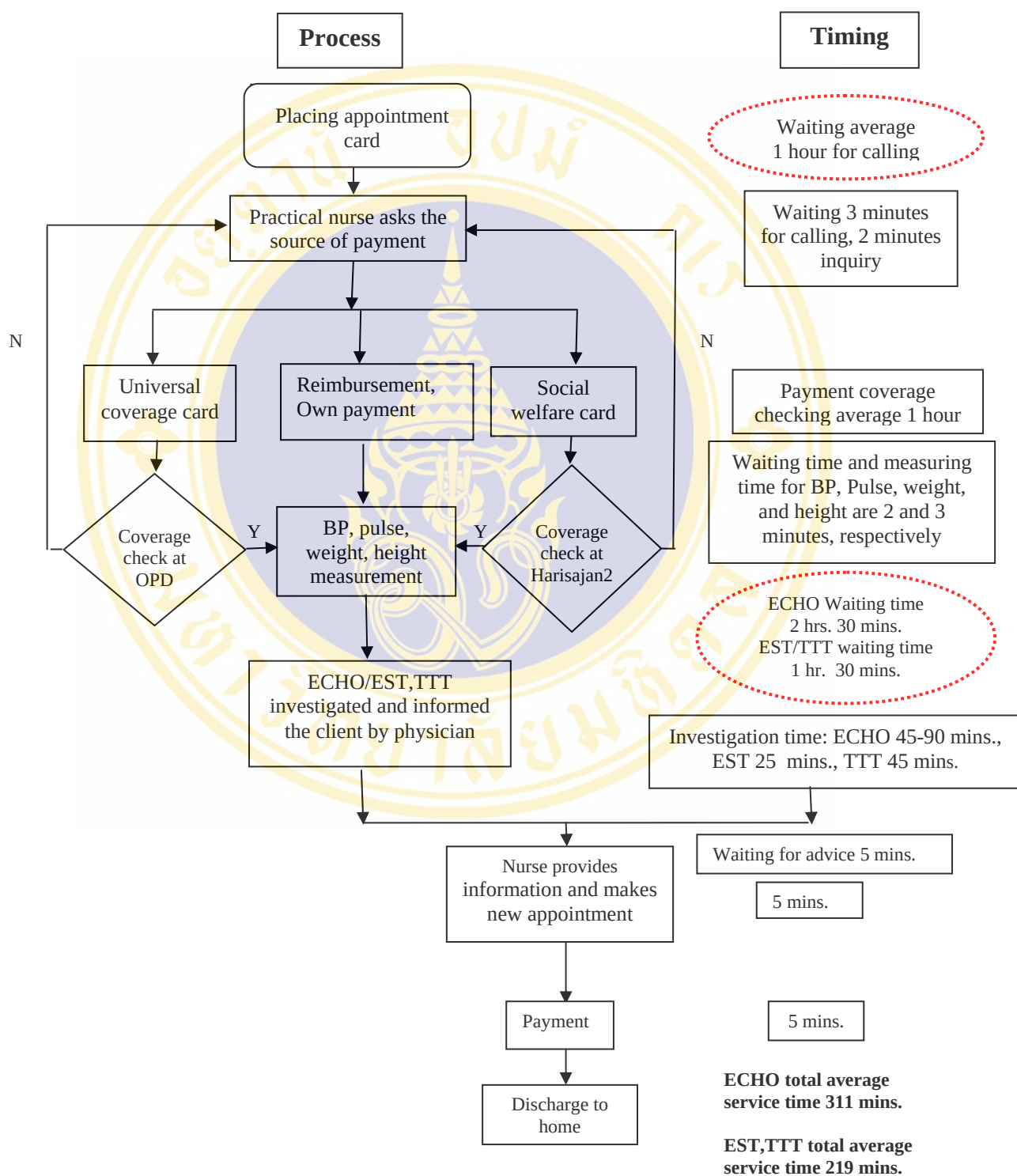


Figure 1: Process flow chart of non-invasive cardiac investigation service

assure the service time. Most of the patients cannot get the services they needed. For example, they could not make appointment with a specific physician, or cannot make appointment in specific time they needed since the appointment scheduling was arranged according the availability of physicians. As a result, the patients are crowded with a lot of congestion in service queue in some day. In the means time, limited number of nurses in the unit kept nurses busy most of the time and sometimes distracted them from having appropriate interaction with clients. As a result, the service provided by nurses sometimes did not cover all service expectation of clients.

The appointment making with patients for investigation in each procedure was therefore vitally important since the working plan of the whole unit could be made by the appointment schedule. Too few appointment in each day can affect in the way that if non-attendance without priory advice occurred, unoccupied time of the unit could occur since no chance to call for the other clients in replacement. The Cardiovascular Special Investigation Unit faced the problem of non-attendance nearly everyday since the review and follow up of appointment in advance could not be done regularly. This problem also needed to be rectified.

In addition, when patients first visit for the unit to making appointment. Nurses should consider the urgency of investigation. In some cases, the long waiting list appointment was not appropriate for patients condition. Emergency cases should be replaced, rescheduling is necessary. The practical nurses working on scheduling should consult the registered nurses. This event has occurred at least 2-3 times per week. The lacking of competency of practical nurses to make the appropriate appointment to match between the nature and extent of disease and the expertise of physicians were also the problem although occasionally. This also caused delay to patients who arrived as appointed but did not have investigation and had to make a new appointment which caused them a lot of trouble as some had to travel from upcountry wasting their time and money. These difficulties caused dissatisfaction to patients.

The appointment task is the first service station which clients and family have contact with health care personnel of investigation unit. So, the appointment service is an important ingredient to create service satisfaction or dissatisfaction to clients and family. Therefore, the healthcare personnel should be competent in

coordination, communication, human relationship, and have excellent service behavior. In addition they have to possess good knowledge in every procedure of non-invasive cardiac investigation to provide information support to clients. This information support is different in details for each cases as well as giving pre-investigating practice instruction to patients since these information can enable the corporation and correct patients practice in investigation date. According to investigator's experience, most patients did not know what investigation procedure they would have and did not know the practice instruction prior having investigation especially for transesophageal echocardiography and tilt table test which require patient to take NPO at least 4-6 hours prior investigation. Many patients did not follow the instruction. Some patients have had their breakfast and continued taking their medication. As a result, they could not have investigation on that day and caused a lot of difficulties as mentioned earlier.

According to the abovementioned problems, 7 main issues of this study were discussed as follows

Main issues

1. The present appointment system in the unit was to make appointment at 8.00 a.m. for every patients and then first come first served queuing management was applied. Most of clients arrived the units as early as possible to get the head of queue and then had to wait for the investigation unit to open for approximately 1 hour, after that they had to wait for calling into investigation room for 2 hours 30 minutes for echocardiography and 1 hour 30 minutes for exercise stress test and tilt table test.
2. Irregular operating time of physicians.
3. Different investigation steps and times of each procedures.
4. Non-attendance problem, the unit did not know the exact number of clients in each day and sometimes caused unoccupied time of personnel. Moreover, the clients on the following days queue could not present for replacing the queue just in time.
5. Lack of efficiency in appointment service as practical nurses could not make decision in all appointment problem and had to consult with registered nurses in investigation room for decision making.

6. Ineffective communication: clients preparation problem since the information support for each investigation procedure was inadequate and unclear.

7. Uncompleted preparation of patients documentation: investigation referral order, ECG and x-ray film which caused time delay in searching.

The Cardiac service was an important healthcare service of Siriraj Hospital according to 2003 statistics, the cardiac service earn 18% of income for the hospital (Her Majesty's Cardiac Center office and Cost Controlling Unit, Faculty of medicine, Siriraj Hospital, 2003) which could be said to be the important source of income and the frontline of hospital service. If the service provided by unit was efficient, the clients would have satisfaction and communicate the positive aspect of the hospital to their society. From the traditional service management of the unit the clients centered service had not been intensively focused. The inadequate focus on clients centered service management could not be applied any more in the modern society which emphasize on clients centered service. In present the waiting time to see physicians are the decision criteria for the choice of healthcare service provider (Athula & Soemon, 2005). Thus the development of an appointment is an urgent issue to solve the above serious problem in order to eliminate the weakness and create the strength of service unit. As a result the operating unit can increase its competitiveness and able to convince the potential clients to buy the service which increase the hospital's income.

According to the above circumstance and rationalization, including the realization in the importance of service quality improvement of Cardiovascular Special Investigation Unit which was under the direct responsibility of all staff nurses, the investigator was interested in studying this problem by performing problem analysis, situation assessment, then proposing the methods for improving the appointment system for non-invasive cardiac investigation of Cardiovascular Special Investigation Unit which investigator currently worked with. The target of study is to provide service to maximize clients benefit as much as possible by decrease waiting time and provide high service quality in fulfillment of clients expectation. The expected outcome of the study is that clients have full satisfaction with service and continuously seek for service from the unit. Beside, the study also corresponds to the policy of Siriraj Hospital which specify patients waiting time assurance as part of

strategic plan in 2006. Ability to assure patients waiting time is one of many important factors in international hospital quality improvement (Joint Commission International, JCI).

Purpose of the study

The purpose of the study is to develop appointment system for non-invasive cardiac investigation of Cardiovascular Special Investigation Unit, Siriraj Hospital to enhance investigating operation efficiency, reduce the total service time and increase client satisfaction.

Scope of the study

1. Confined in non-invasive cardiac investigations of adult clients in Cardiovascular Special Investigation Unit, Siriraj Hospital. The investigations were transthoracic echocardiography, transesophageal echocardiography, exercise stress test, and tilt table test.
2. Confined to appointed patients for investigation during 8.00-12.00 a.m., which were the congested time of service.
3. This study excluded the Magnetic Resonance Imaging (MRI) which was situated in separated premise and managed the separated appointment system.

Definition of terms

1. Cardiovascular special investigation referred to a healthcare service unit providing non-invasive cardiac investigation comprising of transthoracic echocardiography, transesophageal echocardiography, exercise stress test, and tilt table test.

2. Appointment system referred to the process of making appointment with patients for having non-invasive cardiac investigation by healthcare personnel of Cardiovascular Special Investigation Unit. The system characterized reservation system starting from clients attended the unit to make appointment, having investigation as appointed until discharged from investigation unit.

3. Same time appointment referred to all patients were appointed to arrive at Cardiovascular Special Investigation Unit at 8.00 a.m. and arranged queuing system on first come first served basis.

4. Staff referred to a physician who was expertising in cardiovascular disease from Faculty of Medicine Siriraj Hospital.

5. Fellow referred to a resident physician who got medicine certification and continues cardiology study to be a physician specialist. There were 2 groups of fellows, fellow₁ was the first year fellow and fellow₂ was the second year fellow.

6. Sonographer referred to the registered nurse who passed the sonographer training course. Sonographer was responsible for transthoracic echocardiography investigation. Sonographer provided investigation in on-the-job training basis so the staffs had to review and supervised the correctness of investigation. Sonographer could not perform complete investigation independently.

Expected benefits/outcomes

1. Establish efficient and appropriate appointment system for the setting to be used as practice guideline of the unit.
2. Clients have full satisfaction from convenient, fast and accurate service and information support.
3. Better service quality because of more efficient appointment system which can decrease clients waiting time which is a key performance indicator of service quality improvement.
4. To obtain a studied data for researcher and executive personnel in order to apply the appointment system development concept to the other problem to develop practice guidelines.

Conceptual framework of the study

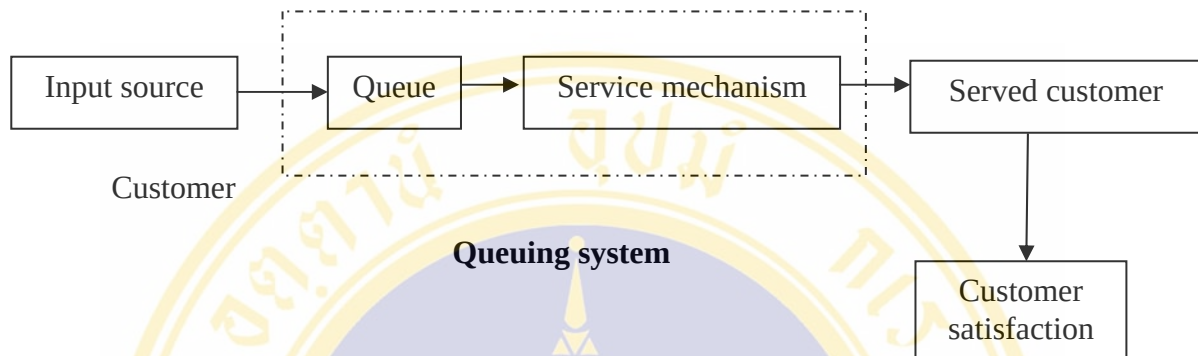


Figure 2: Conceptual framework

The system theory is adopted as conceptual framework of this study by visualizing the system as a continuous process comprising of interconnected and interacted components. The system theory can be applied in actual situation by projecting the real world problem into the system of input, process, and output or outcome (Arlene, 1978) which can be applied in this study as follows;

Input source is the clients attending the Cardiovascular Special Investigation Unit for non-invasive cardiac investigation starting from the date of making appointment. On the appointment date, clients arrive at the unit and enter the queuing system in order to waiting for investigation. The queuing system can be characterized as first come first served or priority. From the queue, clients enter into service mechanism which are either production or service providing, the components of service comprising service time, number of service station and service personnel which are physicians, nurses, practical nurses, equipments, and instruments. After having the services, the clients depart from the queuing system and the output or outcome is the benefits from services and patient satisfaction.

CHAPTER II

LITERATURE REVIEW

Literatures review in development of an appointment system for non-invasive cardiac investigation of Cardiovascular Special Investigation Unit, Siriraj Hospital, were carried out covering the following issues.

1. Service business concept
2. Queueing management
3. Appointment structure and factor influencing appointment
4. Non-invasive cardiac investigation
5. Operating procedure of Cardiovascular Special Investigation Unit
6. Nursing service management of Cardiovascular Special Investigation Unit

1. Service business concept

Service is the process of action which yields the performance of service perceived by the clients. Sometimes the output of service is tangible but not belongs to clients (Somwong Pongsathaporn, 2003). For hospital business, client is patient or service seeker in hospital, and service providers are physicians, nurses, practical nurses and all health care personnel.

1.1 Main characteristics of service: service has its main characteristics which are different from products as follows;

1.1.1 Intangibility

Service is invisible and cannot be sensed before purchasing. So, the service provider is responsible to set up the quality and benefit criteria of service output in order to create trust in buying in terms of venue, personnel, instruments, communication, symbols and price. Service provider has to provide these attributes in best possible condition to assure the buyer to make decision to buy the service faster.

1.1.2 Inseparability

Service is the production and consumption on the same time, for example, a physician can provide consultation service for one patient at a time. Since each physician possesses their own characteristics and expertise so he can not be replaced by the other physicians, the service time limitation therefore results. As a result, the service strategy improvement is required to solve the service time limitation problem by set a fast standard service time in order to provide faster service. Using staffs can accelerate the service time thus can provide service to more patients in a given time.

1.1.3 Variability

Each service is different. Even the service which is provided from the same service provider with the same service types, the outcome of services are different depending on venue, situation, condition of service provider, timing, including condition of clients. The service has variability in itself which also yield varied quality of service. For example, in transesophageal echocardiography investigation, the quality of service depends on pathology, physicians readiness, the readiness of tools and equipments, and corporation of clients. If every factor gets along well, the investigation would be successful and the clients would be satisfied with the service and tend to come back for the next medical service. The service quality control can be performed in two ways: control the quality of service providers and create client satisfaction to service by listening to suggestion, opinion and survey the service outcome information from clients to improve the services.

1.1.4 Perishability

Service process comprises of production and subsequent delivery which cannot produce in advance or delivery later. So if service demand is certainly regular, the service would be smooth. However, if the service demand is uneven, the service problem would arise on service provider side such as the service provider can not provide service just in time causes long waiting line and reduces service quality. So the demand of clients should be adjusted in balance with service supply as follows;

- 1) Motivate clients to get service in the low demand period such as motivates private sector clients to have the service in private sector holiday which is the governmental sector working day.

2) Reservation system. In order the health care unit to know the exact number of clients in each period to plan for adequate service such as arranging the adequate numbers of health care personnel, and preparing tool and equipment ready for service. This is in accordance with Chiraporn Chanpradab (1998), who studied the development of an appointment in old orthopedic outpatient service, Pramongkutklo hospital in 100 veteran outpatients. The study result revealed that the outpatients had to identify themselves to medical registration department very early in the morning in order to get the early numbers in queue and all were of opinion that the waiting time in queue were too long. All patients absolutely agreed to have exact time appointment reservation since it would reduce the patient's file searching time, reducing congestion of patients in each service station and the exact time appointment could enable more service time provided for each clients. From the observation, the average consulting time of physicians were indifferent, so the average time can be used for scheduling of orthopedic outpatient reservation. Similarly, Pei Likun (1993) studied strategic issues for reducing patient waiting time and improving satisfaction with services at the outpatient department of the First Affiliated Hospital, Kunming Medical College, People's Republic of China. The result showed that long waiting time and satisfaction level of outpatient were dominant problem. The appropriate and feasible strategies to reduce waiting time and increase service satisfaction to clients were: reservation system, first time outpatient estimation system, appropriate work scheduling of health care personnel and coordination with other hospital.

1.2 Assessment of service quality

When consider the above 4 characteristics of service, the quality of service assessment can be performed on **input** i.e., service providers competence and commitment in continuous quality development; **process**, i.e., various components of interaction between service providers and clients including activity in a group or between the groups of clients, and services; **outcome**, i.e., effectiveness, efficiency, and safety. Anuwat Suphachutikun and Jirut Sriratanaban (2000) stated that in quality of service assessment, whether the outcome of service may be good or bad, but if the clients are satisfied with service process, they still perceive that the service quality is acceptable. For example, when physician provided satisfactory treatment to patient but

finally the patient is deceased, patient relative may accept the outcome of service as the act of god, not because of ineffective treatment. Especially if patient relative perceived during hospitalization that all health care service providers were doing their best to treat the patient, paid fully attention and took care of patient well including informed patient's relative regularly about patient's status and treatment.

Health care service has the other one exceptional character from general service that the health care service is a supply-determined service since the clients may not really realize their own health problem or may not understand their health care needs or possess inadequate knowledge to identify the types of services to respond their needs. However, the beneficiary of service is client wish, when incorporate with marketing concept that placing the needs of client as the first priority, can be summarized that client is the most suitable person to assess the quality of health care service.

As the quality of service is assessed by clients, so a service can be said a good quality service if the service can respond to client's needs appropriately. It can be summarized that quality of service depends on comparison of clients between the expected services and the client's perceived service. Since this kind of service was intangible, perishable, variable, and clients is unable to assess the quality of service prior making decision to buy the service, clients therefore has only service quality level expectation.

The component of service needs can be described as follows (Grönroos, 2000)

1. Core service: is the main stream business which clients really needs before deciding to buy the services. For the Non-Invasive Cardiovascular Unit, the core service is heart disease investigation using non-invasive technique and equipments. If the core service fails to respond to these needs, clients can be dissatisfied and assess this service as poor quality of service.

2. Expected service: is the peripheral service which closely related with core service that clients expect in advance that have to be given by service providers, for instance, the expectation of clients that they would get a fast service, get knowledge and information from service, and get empathetic from service providers. However, the needs of expected services change on situation, personnel, time, and

place, for instance, a single client when decides to buy a service from government hospital mostly has one level of service expectation which is certainly different with the level of service expectation on private hospital. Getting a service as expected can cause satisfaction to client, and subsequently assess the quality of service as good.

3. Augmented service: is the service which clients wish to get but not expect to get from service providers, for instance, pure drinking water service, newspaper service during waiting for main service, clean rest room, service timing guarantee. These unexpected services can enable client's delight which is far beyond mere satisfaction and assess this service as excellent. However clients would not be dissatisfied although they do not get this type of service.

There are many factors influencing dissatisfaction of service of clients. Somchart Maninoi (1992) carried out a study on first time outpatient's satisfaction to health care service of new outpatient department Siriraj Hospital and found that the highest found factor influencing dissatisfaction was the service system, for instance, the clients did not understand the service system or the part of system in detail such as waiting time, which caused the frustration and dissatisfaction to patients. According to a study of Saroj Satayakorn (1995) who studied service time and satisfaction to service time in outpatient department, Kampaengphet Hospital, the result revealed that waiting time were related to the satisfaction of patient, i.e., the clients who took short waiting time in service queue had more satisfaction in service more than clients with longer waiting time. In addition, it was found that the service satisfaction predicting factors were waiting time and relationship between clients and health care personnel (Pei Likun, 1993). Orapin Chaipayorm (1999) studied satisfaction of clients in outpatient service, Siriraj Hospital, and found that 72.2 % were not satisfied with quality of service, and demonstrated low and lowest satisfaction in opportunity to discuss with physicians (10.3% and 2.1%, respectively) since the physicians had to consult many patients in limited time so he cannot make the discussing session, as the patients did not have any chance to ask the questions, thus the patient's problem assessment and patient's needs assessment can not be completely done. The study also revealed 67.6% of patients were dissatisfied with the information support, and patients demonstrated low level and the lowest level in satisfaction the suggestion of nurses concerning the appropriate selfcare practice for the disease (19.6% and 3.6%,

respectively), and 59.7% were dissatisfied with service coordination by the finding that patients' had low and lowest level in coordination between medical record department, investigation unit, and pharmacy room (7.0, 2.4, respectively). This study suggested the health care personnel should provide service to patients with smile, polite, friendly which can enhance clients satisfaction of outpatient department.

2. Queueing management

Waiting line or queue is a normal situation in everyday life such as waiting line for movie ticket, waiting line or queue in petrol station, service queue in post office, hospital and department store.

The waiting time of clients in queue have significant effect to client satisfaction. In addition, queueing management is a demonstration of working efficiency of such business unit. Inefficient queue may have too many people in queue, the clients in queue overwhelm the service potential of business unit, delay in service time, which may be caused by inefficient service providers or delay of supporting work, or queueing arrangement is not appropriate with the real situation (Somwong Pongsathaporn, 2003).

2.1 Component of queueing/waiting line system

General queueing system should comprise of the following components: arrival of clients, establishing queue, getting services, and departure. The system was activated by having a customer in queue when the service was already done, he would leave the queueing system as shown in figure 3.

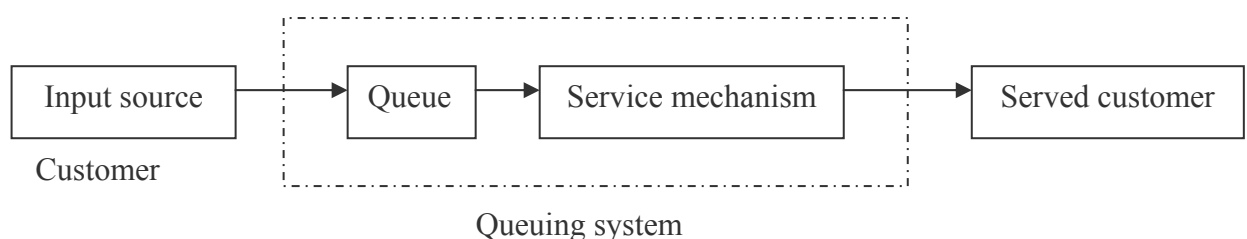


Figure 3: Basic structure of queueing system (Kitaev, 1995)

From figure 3 the input source here was the client of non-invasive cardiac investigation service in Cardiovascular Special Investigation, then the client has to

wait in queue or waiting line whilst physician trying their best to provide investigation service for the client ahead of him. After finishing of investigation service, the client left the queuing system.

2.2 Consideration factor in queuing management

Lovelock and Wright (2002 cited in Chatraporn Samerjai, 2004) explained the consideration factor of efficient queuing management as follows;

2.2.1 Total clients in queue: the needs and expectation of clients should be considered by classifying clients into groups and considered the needs and expectation of service.

2.2.2 Waiting time and numbers of clients in queue, estimate total time in queue of clients compare with the service capacity, rate of clients input per capacity of service system which may not equal in each period which can be utilized for the consideration whether and when an additional queue is needed. Jantra Na Nakorn (2005) studied the simulation technique of queueing problem for outpatient clinic in Kantang Hospital, Trang Province. The study revealed that, in current system, waiting time in queue is 65.87 – 83.20 minutes which patients had longest waiting period was around 39.90 – 50.61 minutes before receiving treatment, the result of simulation revealed that if adding 1 physician and 1 pharmacist, the average waiting time in queue would be minimum at 48.56 minute, which is the most efficient solution of this queuing problem.

2.2.3 Service discipline and service priority

1) First come first served, FCFS: the arrival time determined the position in queue.

2) Last come first serve, LCFS: for instance the last person entering the lift would exit first, the last goods kept in warehouse will be retrieved first.

3) Priority: Arrange the patient according to urgency or importance for example patients with severe injury or emergency patients are admitted in emergency room immediately without waiting for hospital registration as usual.

4) Random clients had equal possibility to get the service regardless of arrival or priority.

2.2.4 Service process: delay service process can cause long waiting line. The delay of process may occur from delay in service activity or delay in supporting activity. It is therefore important to identify the problem causing delay and improve the service process appropriately. According to the study of waiting time and related factors among patients in emergency department of Anchalee Bouthong (2003) in totally 3,780 samples attended in at Buddhachinaraj Hospital, Pitsanulok province, the median of waiting time was 2.67 minutes, the median of waiting time in night shift, morning shift, and evening shift were 5.05, 1.88, and 2.24 minutes respectively. Positive correlated factors to waiting time with statistical significance level at .01 were numbers of clients in queue which implied that the higher numbers of clients in queue, the longer waiting time resulted. Negative correlated factors to waiting time with statistical significance level at .01 were severity of patients, the extern's work experience, number of hospital permanent staffs, number of registered nurses, and numbers of caregivers. This finding demonstrated that if the illness is highly critical and emergent, the waiting time of patients are shorter since the nature of health care service queuing prioritization are by severity level.

2.2.5 How clients take the service: consider the method clients attending to service, total service time, and expected service quality of clients as follows;

- 1) Taking service from person or equipment or the combination of two, consider the behavior of clients upon their service preference and the quantity of clients in service entities to calculate the optimal numbers of service station both in the numbers of service personnel station and the numbers of automatic service machines.

- 2) Speed of service interaction: the consideration of the speed in terms of service interaction time per one client, number of clients having service per day, and the frequency of clients entity in each time interval of the day. Lin et al.(1999,cited in Pakinee Kasemsub, 2004) analyzed factors influencing the long waiting time to obtain medicine from pharmaceutical room by making observation and stop watch time study in each service stage. The study results revealed that the average waiting line for medicine divided into medicine dispensing stage 12.5 minutes and waiting time 106.3 minutes. The activity time starting from

receiving prescription, data recording, medicine preparing, rechecking and distributing were 1.3, 1.5, 7.9, 0.4, 1.4 minutes, respectively. The maximum waiting time was medicine dispensing 149.2 minutes and data recording 35.8 minutes. The service process improvement could be done by using the automatic dispensing machines, additional data recording computer or higher speed computer for faster data recording.

3) Service approaching to clients or clients approaching to service: due to technology advancement in every day life, some service can be enhanced by communication technology in order to provide online service at clients resident without any necessity to attend to service site, such as internet online or telephone banking. Closely observation on client's behavior can obtain useful information for planning of service station calculation and extending the modern strategy of communication and service in future.

4) Quality of service and waiting: this is the consideration of behavior and satisfaction of clients against their willing to wait for service which motivate the clients to remain in queue. A study of delay to seek for treatment of severe ill patients mostly pointed out the similar cause: too long waiting time. A study of Bindman and Grunbach (1991) found that too long waiting time resulted in patient's leaving the queue and go home without seeing the physicians. The same patients came back later with more severe illness. The service system with long waiting time not only cause delay in treatment but also cause patient dissatisfaction and activate more anxiety. As a result, delay in treatment can cause adverse effect to clients health physically and psychologically and also cause economical loss directly and indirectly to patients and government.

2.3 Shorter time perception

Due to limitation in place, budget and employee, we cannot improve the service faster in the time being but we can make the time perceived by clients shorter than the actual time by the various method as follows;

2.3.1 Provide activity for clients during waiting in queue such as watching television, reading or playing game. According to a study of Marilyn, (2003) on clients in queue at optical clinic, medical center, Midwest, United State of America by giving educational intervention from video tape about glaucoma and nursing

interaction in 160 experimental samples compared with 160 controlled samples who did not have educational intervention. The results revealed that the experimental group demonstrated more service satisfaction than the controlled group.

2.3.2 Inform the patients about their progress in service queue can enhance their patience.

2.3.3 Create nice, comfort, and clean atmosphere in waiting room to arouse better situation.

2.3.4 Identify the exact waiting time to patient is better than no information at all about waiting time which can cause anxiety and lengthen the perceived time of client to be longer than the actual time.

2.3.5 Providing information about the service process in details and explains them about the reasons of delay can reduce client frustration and dissatisfaction. According to Corbett, White, and Wittlake (2000, cited in Marilyn, 2003), reasoning of treatment delay in Emergency Department to patients can alleviate anxiety of client in queue. In addition, this study suggested that providing education intervention by means of video tape during waiting can greatly increase client satisfaction.

2.3.6 Unfairness such as jumping the queue, or incorrect queuing can cause dissatisfaction to clients.

2.3.7 Convince clients to perceive the high value of service can increase the patient acceptance to waiting in queue, for instance, many famous movies such as Star War which clients stayed in queue by sleeping over the night.

2.3.8 The waiting time for person waiting alone is perceived longer than the person with companion on the same actual time. Having conversation can spend time faster, so the waiting area should be arranged so that the client can have conversation with his companion or other clients.

2.3.9 Waiting in unaccustomed environment can be perceived as longer waiting time than accustomed environment. Friendliness and information support of service provider can facilitate clients to get accustomed with the service easier in more relax way.

2.3.10 Providing waiting time information periodically in order to give a

chance to clients to make decision whether to wait in queue or not. If the waiting time is only five minutes or less, the waiting time information support is not necessary. If the waiting time is 10-15 minutes the waiting time information should be provide.

According to the above discussion, it can be summarized that the queuing system comprises of 3 components which are, 1) clients which are numbers and possibility of number of clients in queue, 2) service providers which are the service system, service times, number of service stations, 3) queuing which can be characterized as first come first serve (FCFS), and priority. As a result, if we know the time consuming data in each procedure of physicians, the data can be utilized to make appointment with clients. There were researchers who apply queuing system into health care service successfully and can reduce waiting time in nearly 100%, the activity that should be performed altogether is the activity to alleviate negative feeling of clients in queue by creating comfort and entertaining atmosphere during waiting in queue.

3. Appointment structure and factor influencing appointment

3.1 Appointment structure

Athula and Soemon (2005) reviewed the literature concerning appointment structure and scheduling as follows;

According to Bailey (1952) and Welch (1964) who studied the development of an appointment by scheduling the patients evenly over the period based on average service time. This rule focused on reducing waiting time of clients and remained one of the best over the past fifty years.

Ho and Lau (1992) evaluated nine scheduling rules that reduced client waiting time and servers idle time, and they concluded that no single rule dominated in all environmental conditions. Ho and Lau (1999) extended their prior theoretical work by evaluating 50 scheduling rules via simulation and concluded that a variable-interval appointment scheduling system designed to reduce client waiting time perform well in most environmental conditions.

Worthington and Brahimi (1993) applied queueing theory to address this issue and proposed to place three clients at the start of the session and one every five minutes The good result of client waiting time reduction was reported.

Klassen and Rohleder (1996, 2004) proposed a rule in scheduling based on the client service time variance; for example, whether a client was “low variance” or “high variance.” This empirical research showed that setting low variance clients at the beginning of the session and high variance clients at the end of the session would minimize both client waiting time and server idle time in most instances since the client with complex diseases or with complications can take a long time in investigation and consulting which cause delay of total queue. Later they identified that this rule was still effective when the scheduler was unable to identify the low variance and high variance clients proportionately

Chung (2002) adopted modified-wave scheduling is to double-book clients for the first slot of each hour and then making appointment with 2 clients in next 15 minutes interval, leaving the end of the hour open so there's time to catch up if the physician begins to run behind schedule. Avoid making appointment with clients with complex problems at the beginning of first hour. In addition, the strategy to enhance smoothing patient flow was; review the schedule several days prior to the appointment day, confirm the clients emphasizing on appointing time. The review of appointment had many advantages to know exactly how many patients in the treatment queue and in each procedure, including the working style of each physicians in order to prepare and prevent the error which may occur.

Ward and McKee (1999) applied computer simulation with outpatient obstetrical clinics to allocate clinical resource in appropriate with service demand whilst maintaining good quality of service, low cost, and client satisfaction. This simulation model demonstrated the appointment scheduling in each day, appointing time, in charge physicians, length of time spent on investigation (minute), procedure. This demonstration can result in easier resource allocation such as staffing (physicians, nurses, practical nurses), examination room allocations, tools, equipments, including rotating system for clients and health care service providers which can be applied to general outpatient clinic.

Athula and Soemon (2005) applied a simulation model for outpatient department using simulation package Arena (Kelton, Sadowski, & Sadowski, 2003) by configured the model analogous to size and characteristics of department. This program can be used to sort the scheduling, identify the appointing time for the other

client groups, and input the other variable such as competency of physicians. The simulation model was tried out by applying with the appointment scheduling (ASs) in outpatient departments of all large hospital in Tajimi, Japan. The objective was to develop appointment scheduling system in organization having different groups of patient and large numbers in consultation waiting room. This appointment scheduling was identified, which drastically reduced patient waiting time while keeping doctor idle time as low as possible without adding extra resources. The sensitivity of performance was examined under three realistic environmental factors: no show, variance of consultation time, and variation of walk-ins.

According to the literature review of the study concerning the appointment scheduling, there had been many effort to reduce patient waiting time while keeping doctor idle time as low as possible in the situation of different clients whilst providing the clinical resource allocation in appropriate with service demand and still persisting on high quality of service, low cost, and highest possible satisfaction of patients.

3.2 Factors influencing appointment

Dunnill and Pounder (2004) reviewed the literature relating to medical outpatient services aimed to survey the outpatient's attitude, problem and needs in service in order to improve outpatient service to achieve highest possible efficiency. The survey was carried out in Medline and Embase database confined the evidence in hospital, clinic and ambulatory care in United Kingdom during 1966-2002, the survey reported many interesting finding as follows.

3.2.1 Surveys of patient attitudes and satisfaction

- Waiting time

Huang (1994, cited in Dunnill & Pounder, 2004) studied attitude of patients toward waiting time in outpatient clinic. He reported that patients are generally happy to wait for up to 37 minutes when arriving on time, and no more than 63 minutes when arriving late. Patients who arrived more than 15 minutes early expected to be seen earlier. Huang's paper suggests measures to improve satisfaction.

Marilyn (2003) collected literatures involving waiting time

and satisfaction which were: Chung, et al. (1999) studied about predictors of patient satisfaction in an outpatient plastic surgery clinic, Dansky and Miles (1997) who studied patient satisfaction and waiting time in ambulatory health care services, Probst, Greenhouse and Selassie (1997) who studied patient and physician satisfaction with an outpatient visit. All found that the time includes that spent in the waiting room and in the treatment room. Waiting times in clinics may adversely affect patient satisfaction.

Rondeau (1998) suggested that when clinic waits are too long, patient satisfaction may decrease, patients may experience stress and emotional turmoil, time is lost for other productive activities, and the morale of clinic staff may be adversely affected.

Prior studies in urgent care (Dansky & Miles, 1997), emergency departments (ED) (Mowen, Licata, & McPhail, 1993), physicians' offices (Sisk et al., 1996), and ambulatory clinics serving veterans (Oermann et al., 2001; Oermann et al., 2002) have found that longer waiting times were related to lower patient satisfaction. Patient satisfaction is not only an important service quality indicator, but also affect the attendance for treatment as appointed of clients and also reflecting the relationship and communication between physicians and clients (Fitzpatrick, 1991, cited in Thomas, Glynn, and Chait, 1997).

In addition, cost/damage from waiting or waiting cost is what the clients have to spent during waiting in queue. This cost depends on many attributes of clients such as occupation, patience in waiting, opportunity cost etc., for example, a house wife who is waiting for banking service queue incurs low waiting cost, but a business man who is waiting on the same queue incurs very high waiting cost since he may loss the opportunity to have a lot of income from his business transaction. So keeping the clients waiting for a long time can cause the clients to leave the service and find new service providers which are a drastic loss of income (Kallaya Wanichbancha, 1994).

3.2.2 Consultation

- Clinical staff : according to many researches in the past,

physicians or clinic staffs are an important source of satisfaction by friendly attitude, consultation competency, information providing, reassurance, especially if clinic staff is known to the patients, i.e. from a previous outpatient appointment. Thomas et al., (1997) studied patients' satisfaction with an oncology outpatient clinic who attended for a long time. The sample of study were chemotherapy patients totally 252 samples who visited the oncology clinic regularly. The result of study revealed that 80% of samples preferred to see the same physicians to ensure the continuity of treatment and 27% of them were of opinion that long waiting time was the worst attribute to clinic image.

- Length of time spent on the consultation is also important.

According to studies, if clinical staffs spent their time 10-20 minutes for consultation and advice, the client raised up their self esteem and satisfaction. In addition, satisfaction also depended on the content of consultation. Beside, clients were more satisfied to consult with specialist rather than general physician.

In addition, patients also expect staff to be formally dressed and to have chaperones during examinations, with women expecting female chaperones.

3.2.3 Information support

Information provided to patients before, during and after investigation is also very important to them and still be the service area which has to be improved. Many studies indicated that clients were still dissatisfied with information service of clinic staff. In addition, client expected to have both verbal and information sheet.

3.3 Running an outpatient services

According to Patient's Charter 1991 specified standard of outpatient service that specific appointment time has to be provided and the waiting time does not exceed 30 minutes. In the following session cause of delay and waiting time reduction strategies were reviewed.

Important consideration of appointment

There are certain key considerations for the appointment structure of a clinic.

1. Maximize physicians time utilization efficiency, there should be no unoccupied time of physicians in clinic.

2. Most of clinics make appointment with clients on the opening time of clinics and most clients arrive the clinic on time or earlier, however, most of physicians arrive later and cause delay in service at the first start. This situation needs to be corrected.

3. Overbooking the clinic to compensate for predicted non-attendance results in chaos on those occasions when all patients attend. Efficient appointment needs efficient scheduling system.

A study in a Urology clinic in 1998 surveyed physician's length of time for examining each patient compared to the time spent on other tasks. The results showed that nearly 50% of the consultant's time was spent on activities other than patient contact. Time was wasted on searching for missing data and on non-medical clerical tasks. The same clinic was re-evaluated in 2002 and, despite some changes in the clinic organization, they still found that 41% of the consultant's time was spent away from the patients. The most easily addressed inefficiency was time spent looking for missing information, mainly radiology reports. These findings were in accordance with Pakinee Kasemsub (2004) who studied the dispensary waiting time and dispensary element time in outpatient pharmacy at Roi-Et Hospital. The study showed the standard time for operating prescribed drug was 2.66 minutes/prescription. and the waiting time of outpatient per prescription was higher than the standard time of operators per prescription by 8.68 minutes. In addition, operators had idle time about 28.45%. The idle time was spent for delay in work, personal, and absence from work. Therefore, the waiting time of outpatient could be reduced by eliminating or decreasing delay in work, personal time and absence.

Mckee and Waghorn (2000, cited in Dunnill & Pounder, 2004) studied the cause of inefficient outpatient clinic management and found that the key factor which enable the outpatient clinic running smoothly was role and personality of individual clinic staff and found that the problems were ineffective communication, and no personnel training plan.

Chommanard Nownkookhetkhong (2004) applied computer simulation to improve service structure aimed mainly to reduce waiting time of outpatient in Non

Sa-At Hospital, Udon Thani province. The study results showed that after the improvement by having 2 physicians started working at the same time on 8.30 a.m. (previously the first on 8.30 a.m. and the second on 9.30 a.m.) which greatly reduced average total time of patients in the both of Non-Diabetes Mellitus and Diabetes Mellitus clinic day.

O'Keefe (1985 cited in Dunnill & Pounder, 2004) has suggested six ways to improve the efficiency of appointment scheduling as follows:

1. Make doctors start sessions on time.
2. Do not create a pool of patients at the start of the clinic.
3. Ensure that doctors are not disturbed during sessions.
4. Improve appointment/patients scheduling.
5. Inform physicians and other staffs about the improved operating efficiency of the new system.
6. Provide the facilities for more meaningful/entertaining waiting time.

3.4 Factors affecting non-attendance

There were many factors relating to quality of outpatient service are reflected in the non-attendance rate. According to Department of Health Dataset QMOP (2003, cited in Dunnill & Pounder, 2004), The non-attendance rate for all outpatient visits in England was 10.5% for first attendances, and 12.5% for subsequent attendances, representing a total of 1.45 million non-attendances in one quarter of a year.

Dunnill & Pounder (2004) reviewed many studies of factor affecting non-attendance. Most studies have focused on patient characteristics, the finding were most of non-attendance were male, age less than 50, urban home address, referral from accident and emergency, and being single (Frankel, Farrow, and West, 1989; Dickey, & Morrow, 1991). According to Frankel, Farrow, and West (1989), short notice of appointment, especially less than three days, was associated very strongly with non-attendance in one study, but a wait of over two months before the appointment was also predictive of non-attendance (Dickey & Morrow, 1991 and Bottomley & Cotterill, 1994). This finding was in accordance with Mcglade, Bradley, Murphy, and Lundy (1988 cited in Lyon and Reeves, 2004) who reported too long

waiting list had significant relationship with non-attendance. This study support the next studied which indicated that the clients still attend if the waiting time before appointment was averagely 36 days but if the waiting time before appointment was averagely longer than 86 days, non-attendance was significant. In addition, Stone, et al., (1999) and Murdock, et al., (2002) reported the causes of non-attendance from questionnaire were forgetting, illness, work commitments, transport, and administrative problems on the part of the hospital.

Non-attendees were more likely to complain of lack of information about the reason for the appointment (Frankel, Farrow, and West, 1989, cited in Dunnill & Pounder, 2004). Addressing this problem by informing patients by post what to expect, who they will see, what to bring, and where to park, reduced the non-attendance rate from 15% to around 7% (Hardy, O'Brian and Furlong, 2001 cited in Dunnill & Pounder, 2004). A reminder phone called to the patients one week before the appointment reduced the rate to 1%. Reminder telephone called before the clinic have also been shown to be helpful with elderly populations (Dockery, Rajkumar, Chapman, Bulpitt, and Nicholl, 2001 cited in Dunnill & Pounder, 2004). Appointment card could not reduce the rate of non-attendance, however, hospitals that had introduced partial booking systems, whereby patients were asked to telephone the hospital to agree an appointment time, had consistently reported low non-attendance rates. (Read, Byrne, and Walsh, 1997 cited in Dunnill & Pounder, 2004).

Chung (2002) stated that the strategy to convince client to attend as appointed was review the schedule in advance, confirm with patients emphasizing on the appointment time.

Lyon and Reeves (2004), studied patients in X-ray departments of a District General type of NHS Trust, using telephone interview questionnaires based on the Health Belief Model. The patients who attended as appointed were in controlled group totally 50 persons, non attendance patients totally 50 persons were experimental group. The interview form contains symptoms and health perception, experience from hospital, including factor affecting attendance or non-attendance as appointed. The study results revealed the main reason which cause non-attendance was forget the appointment date, the unit therefore let the clients choose the appointment date with

was agreeable on both side and suggested that the health care unit should have patient follow up and tracking system which is strictly operated.

NHS Confederation (adapted from Modernizing outpatients developing effective services, 2001) proposed recommendation for good practice outpatient clinic management as follows;

1. Set up management center to control and coordinate all process.
2. Run the system at less than 100% capacity and match demand and supply. This is more efficient because it avoids the costs and wasted time associated with a system that is out of control and 'lumpy'. Running at 80% capacity is suggested.
3. Do today's work today. This means removing the backlog to prevent its effect to appointment schedule.
4. Simplify queues and appointment types by classified the client into 3 types
 - 4.1 Standard care clients with predictable need
 - 4.2 Returnees with standard care
 - 4.3 Clients with more complex need
5. Reduce the number of times patients are passed between professionals. This will mean increased delegation and autonomy, empowering team members to take responsibility for organizing investigations and treatments according to protocols.
6. Preventing inadequate human resource, the bottle neck of work flow may be cause by shortage personnel especially physicians.
7. Increase the efficiency of visit, by making time interval appointment and improve network in primary care appropriately.

In summary, the problem of long waiting time was caused by delay on physicians starting session, too many duplicate appointments at the opening time of clinic, too many appointments to compensate non-attendance. The solution of problem can be achieved by process improvement, coordination from every staffs and every unit, the physicians have to start session on time, do not create a pool of patients at the start of the clinic, ensure that doctors are not disturbed during sessions, improve appointment scheduling, review appointment schedule in advance, confirm the appointment with clients emphasizing the appointment date and time, the department

is therefore able to know the exact number of patients on the next day. Setting the operating system in order every clinic staffs to coordinate to achieve high operating efficiency outcomes, provide the facilities for more meaningful/entertaining waiting time. Long waiting time can affect the quality of service since it can cause patient dissatisfaction, information support before, during, and after the investigation can increase client satisfaction, preventing shortage of physicians which may cause bottleneck of process and may cause workable interruption.

4. Non-invasive cardiac investigation

Cardiac investigation is the starting steps of primary assessing on risk of cardiac disease when the patients visit the physicians for diagnosis. Physicians make diagnosis whether or not patients have cardiac disease from sign and symptoms such as chest pain, palpitation, fainting, dyspnea, fatigue and edema, the finding from physical investigation such as cyanosis, abnormal blood pressure, abnormal pulse rate, abnormal blood vessel, and from special investigating instruments such as electrocardiography (ECG), chest X-ray. In this technology advancement era, the medical technology advancement enables more accurate and faster investigation especially cardiac disease investigation. Her majesty's Cardiac Center classifies the cardiac investigation using special instrument into 2 types, i.e., invasive, and non-invasive as follows:

Non-invasive cardiac investigation (work instruction of Cardiovascular Special Investigation, Her Majesty's Cardiac Center, 2001) provides the following services:

1. Transthoracic echocardiography
2. Transesophageal echocardiography
3. Exercise stress test
4. Tilt table test
5. Holter monitoring
6. Magnetic resonance imaging

For Invasive cardiac investigation (work instruction of Invasive Unit, Her Majesty's Cardiac center, 2001), the services provide electrophysiological study and

radio frequency ablation and cardiac catheterization which are carried out if the above mentioned procedures are inadequate.

In this study is confined to the non-invasive cardiac investigation of the Cardiovascular Special Investigation Unit, situated on 6th floor, Her Majesty's Cardiac Center Building, Siriraj hospital, providing service for patients with morning appointment, i.e., transthoracic echocardiography, transesophageal echocardiography, exercise stress test, tilt table test, except magnetic resonance imaging investigation which was provided by separated unit at 1st floor of 84th years building with separated appointment system.

1. Transthoracic echocardiography (TTE)

Clinical practice guideline for transthoracic echocardiography, Cheitlin, et al (2003) collected from American College of Cardiology/ American Heart Association (ACC/AHA) Guideline Update for the Clinical Application of Echocardiography, contained the following main issues;

1.1 Definition

Transthoracic echocardiography (TTE) is a diagnostic test that uses instrument comprising of transducer containing piezoelectric crystal inside. When placing transducer on patient's chest and transmit electricity through the transducer, the piezoelectric crystal is activated and emit high frequency sound beam more than 20,000 Hz. The high frequency sound wave penetrates to various parts of heart which may be reflected back or penetrate through the heart. The transducer performed both sending and receiving function and transmit the receiving signal to imaging compiler and finally obtaining a digital image of patient's. This is external and non intrusive cardiac investigation using computing image technology which is safe and painless.

1.2 Indication

- 1.2.1 Evaluate a heart murmur
- 1.2.2 Diagnose and determine the extent of valve conditions
- 1.2.3 Determine the presence of abnormalities in the structure of the heart

- 1.2.4 Measure the size and the thickness of the heart and its chambers.
- 1.2.5 Assess motion of the chamber walls and the extent of damage to the heart muscle after a heart attack
- 1.2.6 Assess how different parts of the heart are functioning in patients with chronic heart disease
- 1.2.7 Determine if fluid is collecting around the heart
- 1.2.8 Identify the presence of tumors in the heart
- 1.2.9 Assess for and monitor congenital defects
- 1.2.10 Evaluate a patient's response to treatment or a corrective procedure
- 1.2.11 Evaluate blood flow through the heart
- 1.2.12 Evaluate heart condition prior to donate to other patient for heart transplantation

1.3 Contraindication

- 1.3.1 Patients with congestive heart failure
- 1.3.2 Patients with infected wound on the transducer placing position

1.4 Scheduling

According to Intersocietal Commission for the Accreditation of the Echocardiography Laboratories (2002), the standard criteria in scheduling of adult transthoracic echocardiography testing was specified as follows; standard time (from starting procedure until finish) for uncomplicated study is 45-60 minutes and additional 15-30 minutes for complicated studies. The work scheduling can be performed as follows;

1. A routine study should be performed on the same working day as ordered except when the request comes at or near the end of the day.
2. An urgent study should be performed in the next available time period.
3. A stat study should be performed as soon as possible,

preempting routine studies.

4. Availability for emergencies: Qualified personnel and equipment should be available for urgent or stat studies outside normal working hours in inpatient facilities or where appropriate.

1.5 Nursing activities (Wiphawin Watthanaprakarnchai, 2543)

1.5.1 Making appointment

The nursing activities start when patients attend to clinic to receive appointment card. Nurses are responsible for making appointment by assessing the urgency of investigation for that patients. In some cases, too far appointment date can be harmful to patients, for instance, the patients with dyspnea from pericardial effusion, aortic pathology such as aneurysm, dissection. The physicians order should be carefully examined in order to arrange the appropriate appointment scheduling. Nurses should collect these data to provide information support to patients for self practice. The information provided to patients before investigation are;

- 1) Explain patients and relatives about investigation reason, steps, and self practice before procedure. Explain the patients about the non-invasive investigation technique using computer imaging technology which is very safe and painless.
- 2) Recommend patients to eat normally.
- 3) Advise patients about the medical expense, the source of payment, the attending and submission of appointment card in the appointed date, and telephone call to confirm the appointment.

1.5.2 Nursing activities before procedure

- 1) Staff nurses prepare ultrasound instruments including transducer of various sizes ready for use.
- 2) Check the functionality of video tape recorder which will be used for recording the images and preventing duplicate recording. Since the imaging obtained from investigation is important evidence in treatment. In some cases the recorder video imagings have to be replayed in echo conference with staffs to

make the final diagnosis and treatment such as valvular replacement, or medical treatment.

3) Check the readiness of database echo to report the result of echocardiogram

4) Prior procedure, nurses assess patients and arrange patients in queue. Then considers the patient's characteristics and arrange the probe S₃ which is used for very fat patients or thick chest wall. If the patients are fatigue and cannot have investigation for a long time, the investigation should be performed by Fellow₂ who is more expertise than Fellow₁, but in complex disease that difficult and complicated to examine, the procedure should be performed by staffs.

5) Explain patients and relatives about the reasons of investigation which are to diagnose and evaluate myocardium and valve functionality, and to diagnose other abnormality such as heart structure, tumors in the heart, and pericardial effusion for providing further appropriate treatment.

6) Explain the timing and procedure of investigation in order to inform and ask for corporation from patients. In patients with complex heart disease, more investigating data and time are required especially congenital heart disease, or limitation in investigation such as emphysema or thickening thoracic wall can consume 60-90 minutes of time but in an uncomplicated, total time consumed is 45-60 minutes.

7) Have the patients change their dresses to hospital garment for Comfortable condition.

1.5.3 Nursing activities during procedure

1) Positioning for patients by having patients lying on left side, lifting up left arm beside the head, stretching out left leg, bending right knee, putting right arm along the body and attaching ECG electrodes in 3 positions to compare the ECG with echocardiographic image on monitor.

2) Keeping patients position correctly during investigation in order to keep the heart nearest to transducer

- Lying on left lateral in parasternal and apical view, if patients have right sided heart, keep patients laying on right lateral.

- Lying supine in subcostal view.
- Lying supine with shoulder support and raising chin up in suprasternal notch view.

3) If the images from investigation are not clear which often found in smoking patients or very fat patients, the correction are to ask the patients to exhale completely then hold the breath or change to transesophageal echocardiography

4) In patients with heart failure, nurses should closely monitor symptoms such as cardiac rhythm, respiratory rate, blood pressure and oxygen saturation. If any abnormality is found, it should be reported to physicians immediately and necessary treatment should be performed fast and accurately.

1.5.4 Nursing activities after procedure

- 1) Wipe out conductivity gel from patients for cleanliness and comfort of patients include cleaning the transducers.
- 2) Remove ECG electrodes and clean the contact parts.
- 3) Take care of patients and relatives to know the results from physicians, provide emotional support to patients and relatives to alleviate their stress and anxiety if the abnormality is found and then advise them the self care practice. Filing the report in medical record to hand over to in charge physicians for further treatment.
- 4) In case of critical patients who have investigation and physician's opinion needs to admit for monitoring, nurses should organize the admission by coordinate with observation room or inpatient ward to make the referral, including take care of patients during transportation effectively with vital sign monitor, oxygen and other necessary equipments during transportation.

2. Transesophageal Echocardiography (TEE).

Clinical practice guideline for transesophageal echocardiography, Quiñones, et al. (2003) collected from the report of American College of Cardiology/American Heart Association/American College of Physicians–American Society of Internal Medicine which developed from The American Society of

Echocardiography, the Society of Cardiovascular Anesthesiologists, and the Society of Pediatric Echocardiography contained the following main issues;

2.1 Definition

Transesophageal echocardiography: is the procedure used for cardiovascular investigation, the transducer is swallowed into esophagus and can investigate cardiovascular anatomy especially the rear side of the heart clearer and in more detail than transthoracic echocardiography which the heart may be hidden by thick thoracic wall or lung. Transesophageal echocardiography can investigate abnormally of cardiac chamber, valves and great vessel completely.

2.2 Indication

Transesophageal echocardiography can give a clear image for diagnosis of heart and great vessel such as endocarditis, aortic disease such as aortic dissection and aortic pathologies, evaluate intracardiac thrombi and other masses, evaluation of valvular disorder including prosthetic valve dysfunction, diagnosis of congenital heart disease in both children and adults, diagnosis of traumatic patients who need cardiac investigation, investigating patients during heart surgery to check the completion of surgery such as the leaking after rectification of atrium wall leaking or after replacement of prosthetic valve and in the case which transthoracic echocardiography gives unfavorable result.

2.3 Contraindication

- Patient is not willing to cooperate.
- Patients with esophageal obstruction i.e., cancer, web, stricture, ring.
- Upper Gastrointestinal bleeding
- Perforated viscus
- Esophageal diverticulum
- Large osteophyte from cervical vertebrae.
- esophageal varices
- Severe infection of cervical vertebrae.
- Distortion of oropharynx

- Experience of oropharynx surgery
- Experience of radiotherapy on the neck

2.4 Scheduling

According to Intersocietal Commission for the Accreditation of the Echocardiography Laboratories (2002), the standard criteria in scheduling of adult transesophageal echocardiography (TEE) testing scheduling was specified as follows; standard time (from starting procedure until finish) for uncomplicated and complicated studies are equal to that of the transthoracic echocardiography mentioned in 1.4.

This investigation method is semi-invasive test which rather complicate and can cause severe complication. Physicians and nurses should be well trained for this special investigation instruments. The investigating preparation is also important, for instance, patient preparation, equipment preparation, as well as other tool preparation such as pulse oximeter, blood pressure monitoring equipment, oxygen supply equipment, airway, suction including monitoring abnormality which may occur during and after procedure.

2.5 Nursing activities (Wiphawin Watthanaprakarnchai, 2001).

2.5.1 Making appointment

Nursing activities start when patients attend the unit to receive appointment card. Nurses who make appointment should assess the investigating urgency of patients. In some cases, too long appointment date can be harmful to risk patients such as patients with valvular stenosis or pregnancy who need urgent investigation for further management. The patient's treatment order should be carefully reviewed. Since the information can be different for each investigation, nurses should collect all necessary informations to provide to patients which covering the following issues;

- 1) Explain the patients about the reason and benefit of transesophageal echocardiography investigation.
- 2) Explain the procedure and preparation before procedure,

which comprises of NPO after midnight before the appointment date in order to prevent vomiting or choking since the insertion of transducer into esophagus can stimulate gag reflex, including stop having some medicine which had been recommended by physicians and explaining reason to stop that medicine.

3) Advise patients to inform nurses if the self practice have not been complied such as forgot to take NPO or forgot to stop medicines since these can cause error in investigation or hazard for patient's health.

4) Patient's relatives or friends should accompany with patients since they are possible that patients may feel uncomfortable or be ill after procedure.

5) Advise patients about the medical expense, the source of payment, the attending and submission of appointment card in the appointed date, and telephone call to confirm the appointment.

2.5.2 Nursing activities before procedure

1) Staff nurses prepare ultrasound equipments, including transesophageal ultrasound transducers both biplane and multiplane ready to use.

2) Prepare tools & equipments such as medical gloves, spatula, light, kidney bowl, eye closing gauze, xylocain (viscous, spray and jelly), blood pressure monitoring equipment, pulse oximetry, oxygenation supply, airway, suctioning equipment, medicine and emergency care apparatus.

3) Prepare patients before inserting transducer as follows;

- Inform patients about objective, method and practice during procedure to avoid resistance during inserting transducer. Since this procedure can create fear, pain, and discomfort, consent form signed by patients need to be acquired before procedure.

- Every patients were informed to take NPO after midnight before the test date, and the patients with percutaneous mitral valvuloplasty (PBMV) would be informed to stop thrombolytic drug at least 7 days before procedure, nurses have to ask patients to confirm their compliance to the instruction.

- Take medical history concerning drug allergy, and dysphagia.

- Have the patients change their dresses to hospital garment for comfortable.
- Have patients clean their oral and remove their artificial teeth and eyeglass since artificial teeth can slip into larynx during procedure.
- Using anesthetic spray into larynx to reduce gag reflex, testing the absence of gag reflex before starting examination.

2.5.3 Nursing activities during procedure

- 1) Laying patients down left side to prevent choking during procedure, place right arm along the body, have patients stay still, slightly bending head downward in order to insert the transducer easier.
- 2) Attaching 3 ECG electrodes in 3 positions to compare with echocardiographic images on monitor.
- 3) Wrapping sphygmomanometer cuff on patient's arm, arranging microphone position in the proximity of brachial pulse.
- 4) Clip the pulse oximetry on any finger.
- 5) Close patient's eyes with triangular cloth
- 6) Pacify and encourage patients to cooperate in investigation, tell patients to swallow when insert the transducer into larynx.
- 7) During investigation, nurses stand beside the patient's head and closely take care of patients as follows;
 - Observe respiratory rate, skin and tongue color, if patients have a lot of saliva or mucous, suck it out.
 - Monitoring pulse rate, ECG and blood pressure which measured by automatic measuring instruments, recording every 3-5 minutes, if any abnormality was found, should report physicians immediately.
 - Observe change of oxygen saturation from finger tip type automatic pulse oximeter.
 - If the patients cough, the choking/aspiration can likely to occur, so keep the airway clear by using suctioning equipments.
 - Tell the physicians about the depth of transducer by reading the number in centimeter appears on the cable.

- 8) During procedure, severe complications may occur such as

heart failure, arrhythmia, or sudden death, especially patients with rupture of dissecting aortic aneurysm. Some patients were toxic from anesthetic allergy ranged from mild toxicity till shock. Nurses should report physicians immediately and provide fast accurate treatment.

2.5.4 Nursing activities after procedure

1) Observe the tip of transducer when removing from patient's larynx. If there is some blood stain on transducer, check the bleeding in oropharyngeal cavity. Ask the patients about the pain or other symptoms in laryngeal cavity after the effect of anesthesia.

2) Advise patients to rinse oral and dental by special mouth wash or pure water.

3) Have patients continue NPO for 30-45 minutes after examination. Patients can get burn injury or choking if having food or drink with remaining effect of anesthesia.

4) Provide information support to patients and relatives concerning investigation result especially if abnormality is found, including providing self care practice instruction and filing the report in medical record to give to in charge physicians for further treatment.

5) In case if critical patients have to be hospitalized or observed in observation room, nurses would be responsible for coordinate with the nurses of destination ward for referral. Nurses should also manage effectively between transportation by preparing monitoring equipments, oxygen, and other necessary for transportation.

3. Exercise stress test

Clinical practice guideline for exercise stress test, Gibbons et al (2002) collected from clinical practice guideline for exercise stress test of The American College of Cardiology/American Heart Association (Committee on Exercise Testing). The main issue is as follows;

3.1 Definition

The test is carried out to diagnose and plan for treatment in patients with known or suspected chronic coronary artery disease (CAD) This test is very beneficial and cheap. Using treadmill which patient running on whilst ECG and blood pressure is monitored. However, this method still have many limitations the accuracy of the test depends on age, sex, risk factors of coronary artery disease and characteristics of chest pain.

3.2 Indication

3.2.1 Diagnosis of coronary artery disease (more than 70% obstruction) in chest pain especially in moderate risk group considered from age, sex, risk factors, and characteristics of chest pain

3.2.2 To identify whether chest pain is from ischemic in origin or other causes.

3.2.3 Estimating disease risk in people who don't have symptoms but have risk factors

3.2.4 To assess severity of disease, risk assessment, and prognosis In patient with known or suspected chronic coronary artery disease (CAD).

3.2.5 Risk assessment of patients early after myocardial infarction.

3.2.6 To evaluate physical fitness and exercise capacity.

3.2.7 To specify the quantity of exercise for rehabilitation to specify the upper limit of exercise, to prevent hazard from too much exercise until getting myocardial ischemia or arrhythmia.

3.2.8 To follow up the treatment of patient with coronary artery revascularization and patient after coronary artery bypass graft to check whether the obstructive coronary artery remain.

3.2.9 Assess the symptoms which are related to the exercise in patient with arrhythmia.

In considering the use of exercise testing in individual patients, the following factors are important:

1. The quality, expertise, and experience of the professional and technical staff performing and interpreting the study.

2. The sensitivity, specificity, and accuracy of the technique.
3. The cost and accuracy of the technique compared with more expensive imaging procedures.
4. The effect of positive or negative results on clinical decision making.

Although exercise testing is generally a safe procedure, both myocardial infarction and death have been reported and can be expected to occur at a rate of up to 1 per 2500 tests (Stuart & Ellestad, 1980). Good clinical judgment should therefore be used in deciding which patients should undergo exercise testing including contraindications for testing. Exercise testing should be supervised by an appropriately trained physicians. In addition, the patient assessment has to be performed by properly trained nurses. During the test, monitoring and recording ECG and blood pressure are carried out continuously. Especially patient with chest pain and demonstrates ST segment abnormality and change or show a the sign of myocardial ischemia in each stage of the test.

3.3 Contraindication

The test must not be done for the following person:

1. Patients with acute myocardial infarction within 2 days
2. Patients with unstable angina and has not previously stabilized by medical therapy
3. Uncontrolled cardiac arrhythmias causing symptoms or hemodynamic compromise
4. Symptomatic severe aortic stenosis
5. Uncontrolled symptomatic heart failure
6. Acute pulmonary embolus or pulmonary infarction
7. Acute myocarditis or pericarditis.
8. Acute aortic dissection.
9. Acute illness which affect to the test such as infection, renal failure, or thyrointoxication
- 10 Patients did not sign consent form

In addition the patient's condition that should not be tested except the physician considers the benefit from testing is more than relative contraindication which is:

1. Left main coronary stenosis
2. Moderate stenotic valvular heart disease
3. Electrolyte abnormalities
4. Severe arterial hypertension, systolic blood pressure is more than or equal 200 mmHg and/or diastolic blood pressure is more than or equal 110 mmHg
5. Tachyarrhythmias or bradyarrhythmias
6. Hypertrophic cardiomyopathy and other forms of outflow tract obstruction
7. Mental or physical impairment leading to inability to exercise adequately
8. High degree atrioventricular block

3.4 Equipment

The equipments used for exercise stress test are

- 3.4.1 Treadmill can be programmed both speed and slope of treadmill.
- 3.4.2 Bicycle ergometer: the equipment is cheaper and takes less space than treadmill type. It is also appropriate for elderly who has problem with gaiting and balance.

3.5 Protocols

Commonly used treadmill protocols are summarized in a variety of published documents. Although much of the published data are based on the Bruce protocol which adjusting speed and slope of treadmill every 3 minutes, the 1st stage start at 1.7 miles per hour with treadmill slope 10 degrees for 3 minutes then entering 2nd stage which speed is 2.5 miles per hour with treadmill slope 12 degree for 3 minutes then changed to 3rd stage at the speed 3.4 miles per hour with treadmill slope 14 degrees for 3 minutes. If patient can still run, the speed and treadmill slope will increase according to the protocols. There are clear advantages to customizing the protocol to the individual patient to allow 6 to 12 minutes of exercise (Myer &

Froelicher, 1990). Exercise capacity should be reported in estimated metabolic equivalents (METs) of exercise.

3.6 Nursing activities (Kesaree Punlee, 2000)

3.6.1 Making Appointment

The nursing activities start when patients contact the nurses to make appointment card. Nurses should evaluate the urgency of the case. Since increase of far appointment date, patients can be at risk of life threatening condition. Nurses should check the physician's treatment order carefully since making appointment which have different details in different patients, for example, for patients who have the test for surgical assessment, should stop having medicine at least 3 days before the test. Nurses should gather all information to provide information support to patients. The information support should cover the following contents:

- 1) explain about the reasons and benefits of the exercise stress test for cardiac performance investigation.
- 2) Explain the exercise stress test steps and practices before having the test which are patients have soft diet in test date or take NPO 2 hours before the test to prevent abdominal distension during the test, including stop having some medicines before having the test, emphasizing the necessity of stop having medicines to prevent the interference of medicine action to test result.
- 3) Advise patients to inform nurses if he forgot to practice as instructed such as forgot to stop having medicines, since the incorrect practice can lead to harmful problem or can cause error in test result.
- 4) Advise patients to have the guardians on the test date in order to have somebody to assist if patients get ill after the test.
- 5) Advise patients about expense and the source of payment, including submission of appointment card before investigation and telephone confirmation of the appointment.

3.6.2 Nursing activities before procedure

- 1) Staff nurses prepare exercise testing equipments, including oxygenation supplies, drugs, accessories, and defibrillator for emergency cases.

2) All patients are advised to take NPO 2 hours or having soft diet before the test. Nurses are responsible for asking every patients before the test to ensure that patients follow the instruction to prevent abdominal distension during the test.

3) Evaluate every contraindication carefully before start testing.

4) Have patients change into comfortable cloth for exercise including the appropriate shoes.

5) Before testing, nurses should ask patients to stop beta-blocker group of medicine prescribed by physicians or myocardial ischemia treatment group of drug in order to prevent misinterpretation of the test due to drug action except the test done for the purpose of evaluating treatment or prognosis.

6) Explain the reason and necessity of the test, method, and step of practice before and during the test in order to calm down patients and to corporate including danger which can occur.

7) Sign the consent form before the test.

3.6.3 Nursing activities during procedure

1) Wrap the sphygmomanometer cuff on patient's arm, arranging microphone position in the proximity of brachial pulse, monitoring blood pressure during the test is vital since a slight error of measurement or discontinuous monitoring can cause misinterpretation of the test and life threatening condition on patient.

2) Attach ECG electrodes for total 10 positions on patient's chest.

3) Assist physicians in recording blood pressure and ECG before testing on the laying supine position to identify the abnormalities such as myocardial ischemia, arrhythmia, then record in sitting, and standing.

4) Demonstrates walking on the treadmill and have patients walk on it.

5) Have patients walk following protocol, if using BRUCE protocol, the total testing time would be 6-12 minutes.

6) During testing, blood pressure and pulse rate are measured and recorded periodically. Physicians would evaluate the change of ECG on the monitor.

During exercise, closed observation to patients such as facial expression, characteristic of voice when patient's answering the questions, gaiting, grip on the hand rail (touching lightly). Record the time of having chest pain or other symptoms. Ready to stop testing when having ST segment depression, severe arrhythmia, unsafe symptoms or too exhaust to continue exercise. If any test is stopped before the specified testing time, the exercise test is incomplete or inadequate exercise test

Indication for terminating exercise testing. Terminating exercise testing when the following incidence occurs;

- The positive exercise test on standard result interpretation which is myocardial ishchemia.
- Heart rate is reached 85% of maximum heart rate relating to age (maximum heart rate = $220 - \text{age}$). In some case of acute myocardial infarction, physician may perform test which having patient kept 70% of maximum heart rate.

3.6.4 Nursing activities after procedure

1. After stopping exercise, advise patients to sit and relax (more comfortable than laying) at least 6 minutes and more or until the change occurred during exercise had recovered back to normal condition such as ECG, pulse rate, respiratory rate, and blood pressure.

2. In case of positive result, provide nursing care by giving sublingual sprayed vasodilator according to treatment plan.

3 Taking all cable out of patients, having patients change their clothes, and see the patients again to hear the result. Then file the results in medical record in order to hand over the details to in charge physicians.

4 In case that the test result is positive, and patient has to be treated with cardiac catheterization and revascularization, nurses should advise patient about practice including the further step of treatment regimen for treatment continuity.

In summary, the time used for the test is patient's preparation time which is averagely 10 minutes, exercise time which is approximately 6-12 minutes (averagely 9 minutes) including recovery phase averagely 6 minutes, the total testing time is averagely 25 minutes.

4. Tilt table test (TTT)

Clinical practice guideline for tilt table test, Bendit et al., 1996 was developed by collecting report from expert consensus document from Board of Trustees of the American College of Cardiology which contains the following issue:

4.1 Definition

Syncope is a symptom, defined as a transient, self-limited loss of consciousness, usually leading to falling. The onset of syncope is relatively rapid, and the subsequent recovery is spontaneous, complete, and usually prompt. The underlying mechanism is a transient global cerebral hypo perfusion. The other word used is "back out" or "drop out".

Investigating the cause of syncope is an important step to provide appropriate and effective treatment. The diagnostic test of syncope starts from questions about history, physical examination, electrocardiogram (ECG), risk prioritization, and laboratory investigation. The investigation method, which is very beneficial for patients with unknown cause of syncope and no cardiac structure abnormality found, is **Tilt Table Test**. This test is a method to evaluate the trend of syncope from neurocardiogenic system which is the most the most common cause of syncope.

Tilt table test to investigate the cause of syncope is designed to study the human body's heart rate and blood pressure adaptations to changes in position, change from lying to standing or drug stimulation. The tilt table test is a widely accepted method for diagnostic the cause of syncope and only available method to investigate syncope from neurocardiogenic system related cause.

4.2 Contraindication

4.2.1 Syncope with clinically severe left ventricular outflow obstruction.

4.2.2 Syncope in the presence of critical mitral stenosis.

4.2.3 Syncope in the setting of known critical proximal coronary artery stenosis.

4.2.4 Syncope in conjunction with known critical cerebrovascular stenosis.

4.3 Tilt table testing technique

To utilize head-up tilt table testing effectively, depends on many factors such as the laboratory environment, physicians, nurses and protocols. There may not be a single “correct” protocol that is appropriate for all laboratories. So, the suitable protocol can be different in different places and circumstances.

4.4 Tilt table test protocol used in the Cardiovascular Special Investigation Unit, Her Majesty’s Cardiac Center, Siriraj Hospital.

1. Protocol for adult less than 60 years old.

- 1.1 Supine pre-tilt phase of 5 min.
- 1.2 Tilt angle is 60 degree of 20 minutes.
- 1.3 Sublingual nitroglycerin 400 microgram for drug provocation if passive phase has been negative. Drug challenge phase duration of 20 minutes.
- 1.4 If some abnormalities occur such as hypotension, bradycardia, stop the test immediately and adjust the table on horizontal plane.

2. Protocol for adult over than 60 years old.

- 2.1 Supine pre-tilt phase of 5 min.
- 2.2 Tilt angle is 60 degree of 45 minutes.
- 2.3 If patients show the sign of abnormalities such as hypotension, bradycardia, stop the test immediately and adjust the table on horizontal plane.

In summary, the time used for adult less than 60 years old is 45 minutes and the time used for adult aged more than 60 years is 50 minutes.

4.5 Nursing activities (Surang Akaniroj, 2002)

4.5.1 Making Appointment

The nursing activities start when patients contact the nurses to make appointment card. Nurses should evaluate the urgency of the case. Since increase of far appointment date, patients can be at risk of life threatening condition for example, the patients who often have syncope. Nurses should check the physician's treatment carefully since the test has different details in different patients, for example, some patients have to stop drug at least 3 days before the test. Nurses should gather all information to provide information support to patients. The information support should cover the following contents.

- 1) Explain the indication of the test to the patients, that the test was to investigate and diagnose the cause of syncope whether from neurocardiogenic related cause or not, in order to find the appropriate cause.

- 2) Explain the tilt table test procedure to evaluate the cause of syncope to patients in order to alleviate their anxiety. Having patients lying supine on tilt table, attach ECG electrodes on the patient's chest, wrap the cuff of automatic sphygmomanometer on patient's arm. Adjust the head side of table to tilt on 60 degrees angle. Sublingual drug is administered in this step if needed. Advise patients that he may feel faster and stronger heartbeat and may experience presyncope which is recovered when adjust the table back to horizontal position.

- 3) Advise patients should not have any food or fluid after midnight and explain the reason to take NPO which is to prevent vomiting or choking/aspiration.

- 4) For the patient who was advised to stop taking medications as prescribed, nurses should explain the reason that to prevent the interference of drug action to the test result.

- 5) Emphasize the patients to notify nurses on the testing date if the pre-test practice instruction is forgotten such as forgot to take NPO, or forgot to stop taking drugs, since the incorrect pre-test patient practice can lead to life threatening or can cause error in test result.

- 6) Advise patients to have the guardians on the test date in order to have somebody to assist if patients get ill after the test.

7) Advise about the expense and the source of payment including identifying the appointment card on the appointment date, and telephone call to confirm the appointment.

4.5.2 Nursing activities before procedure

1) Every patients were advised to take NPO after midnight before the test date, some patients may be advised to stop taking medications as prescribed at least 2-3 days before the test date. Nurses are responsible to ask every patients about their practice as advised to ensure the prevention of choking, including to prevent the interference of drug action to the test result.

2) Explain patients about the test procedure to alleviate anxiety and enhance their corporation.

3) Have patients sign the consent form.

4) Take care of patients to change into hospital garments for comfortable and easy to work.

5) Prepare oxygenation set, suction ready to use.

6) Prepare emergency cart ready to use.

4.5.3 Nursing activities during procedure

1) Prepare the room quietly, at a comfortable temperature and as no threatening as possible.

2) Positioning by having patients lying down on the back in comfort position. Keep both feet on foot-board support.

3) Connected to a blood pressure cuff on patient's arm. and arrange microphone on brachial pulse position. Monitoring blood pressure intermittently throughout the study is greatly important. If there is any testing error whilst the blood pressure cannot be measured, the accuracy of test result can be disturbed and patient can be in danger from undetected hypotension.

4) Attach ECG electrodes on patient's chest totally 10 positions.

5) Wrap the safety patch to fix patients with the tilt table to prevent falling from the table. The patch should not be so tight and maintain straight knees and ankles.

6) After patients rest in lying supine position for 5 minutes the test start by adjust the table to tilt the patients in 60 degrees standing position for 20 minutes.

7) If patients do not get syncope or presyncope nurses administrate nitroglycerin 400 microgram sublingual nebulization and have patients hold the drug in the mouth. Patients remaining in 60 degree tilted standing position for 20 minutes.

8) Closely monitor patient symptoms all along the test, observe patient facial expression and gesture, including listening to patient information. Nurses should encourage patients since some patients may be afraid when the heart rate increase after stimulated by drug.

9) Closely monitoring ECG and recording blood pressure. If patients show some abnormalities such as hypotension or bradycardia, the test must be stopped immediately and adjust the table in horizontal plane to avoid any adverse consequence to patients if continue testing.

4.5.4 Nursing activities after procedure

1) Remove the safety patch, sphygmomanometer cuff, and ECG electrode from the patients.

2) Patients may have fatigue, dizziness, nausea and vomiting, which still require nursing care until recovery.

3) Filing the test result in medication record and hand over it to in charge physicians to give further treatment.

5. Operating procedure of Cardiovascular Special Investigation Unit

The Cardiovascular Special Investigation Unit situated in 6th floor of Her Majesty's Cardiac Center building. The unit area is divided into investigation rooms as follows;

- Echocardiographic investigation room totally 8 rooms (5-6 rooms on actual operation)

- Exercise stress test room (including tilt table test) 3 rooms.
- 24 hours holter monitoring totally 1 room.
- Control echocardiogram room for education activities and conference.

The Cardiovascular Special Investigation Unit also cover cardiac magnetic resonance imaging which is the newest technology. The machine is situated at 1st floor, 84th Year Building. The setting of this study includes only the Cardiovascular Special Investigation Unit on the 6th floor of Her Majesty's Cardiac Center Building, Siriraj Hospital and excludes the cardiac magnetic resonance imaging which has separated service running and appointment.

5.1 Investigating service management

The Cardiovascular Special Investigation Unit provides non-invasive investigation of heart disease. The regular service hours is 8.00-16.00 Monday-Friday, all clients are appointed patients. The number of clients and service personnel differ on day and type of investigation which can be detailed as follows;

5.1.1 Adult transthoracic echocardiography (TTE)

TTE investigation service is available on Monday to Friday. The operators are staff, fellow₁ (F₁), fellow₂ (F₂), and sonographer. The number of operators and clients in each day is shown in Table 1.

The responsibility of service personnel for TTE can be divided into 2 areas as follows;

- Education: is the TTE investigation performed by Fellow₁ and sonographer for the purpose of TTE training service. When the investigation finished, the investigation result has to be confirmed by physician staff or fellow₂ before reporting. The average time for study is 90 minutes.

- Service: the service personnel are Fellow₂ (F₂) and staff. The standard time (from starting procedure until finish) for uncomplicated study is 45-60 minutes and additional 15-30 minutes for complicated studies. (Intersocietal Commission for the Accreditation of the Echocardiography Laboratories, 2002). In actual operation,

skillful staff takes 45 minutes and Fellow₂ takes 60 minutes (Echo time data of the Cardiovascular Special Investigation Unit)

1. Monday

8.00-12.00 hours: 1 staff (4 patients appointment), 1 fellow₁ (2 patients appointment), 1 fellow₂ (4 patients appointment), and 2 sonographers (6 patients appointment). Totally 16 patients are appointed.

To summarize service provider personnel contains

- 1 staff
- 1 fellow₂
- 1 fellow₁
- 2 sonographers

2. Tuesday

8.00-12.00 hours: 1 Staff (4 patients appointment), 1 Fellow₁ (2 patients appointment), 2 Fellow₂ (8 patients appointment), and 2 Sonographers (6 patients appointment). Totally 18 patients are appointed.

To summarize service provider personnel contains

- 1 Staff
- 2 Fellow₂
- 2 Sonographers

3. Wednesday

8.00-12.00 hours: 1 Staff (4 patients appointment) 1 Fellow₁ (2 patients appointment), 2 Fellow₂ (8 patients appointment), and 2 Sonographers (6 patients appointment). Totally 18 patients are appointed.

To summarize service provider personnel contains

- 1 Staff
- 2 Fellow₂
- 2 Sonographers

4. Thursday

8.00-12.00 hours: 1 Staff (4 patients appointment) 1 Fellow₁ (2 patients appointment), 1 Fellow₂ (4 patients appointment), and 2 Sonographers (6 patients appointment). Totally 16 patients are appointed.

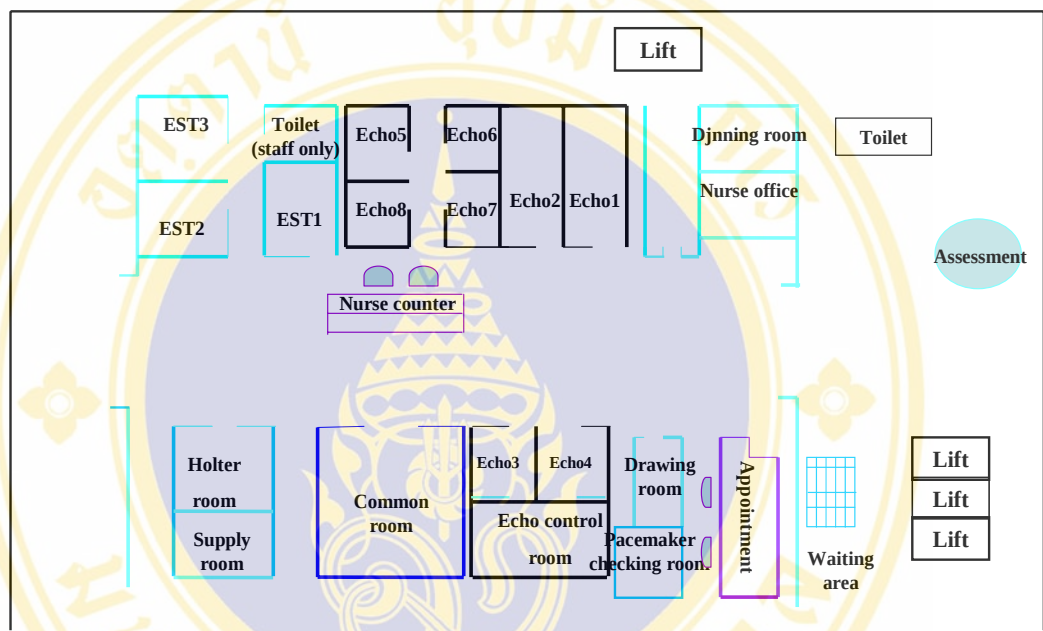


Figure 4: Cardiovascular Special Investigation Unit floor plan and operating layout

Table 1 Scheduling appointment of adult transthoracic echocardiography

	Monday	Tuesday	Wednesday	Thursday	Friday
Morning	Staff (4 patients)	Staff (4 patients)	Staff (4 patients)	Staff (4 patients)	-
	F ₁ (2 patients)	F ₂ (4 patients)	F ₂ (4 patients)	F ₁ (2 patients)	-
	F ₂ (4 patients)	F ₂ (4 patients)	F ₂ (4 patients)	F ₂ (4 patients)	-
	Sonographer (3 patients)	Sonographer (3 patients)	Sonographer (3 patients)	Sonographer (3 patients)	Sonographer (3 patients)
	sonographer (3 patients)	sonographer (3 patients)	sonographer (3 patients)	sonographer (3 patients)	sonographer (3 patients)
Total appointment	16 patients	18 patients	18 patients	16 patients	6 patients

To summarize service provider personnel contains

- 1 Staff
- 1 Fellow₂
- 1 Fellow₁
- 2 Sonographers

5. Friday

08.00-12.00 hours: 2 Sonographers (6 patients appointment), totally 6 patients are appointed. Since Staffs are on educational duty in Cardiology department. So, after investigation, Sonographer would take the investigated video tape to play for review with staff before reporting the result.

5.1.2 Transeophageal echocardiography (TEE).

The TEE cardiac investigation utilizes the same resources as TTE as well as appointment and service running. The appointment for TEE is average 2-3 cases which the TTE appointment numbers are reduced correspondingly to

maintain the total service ability numbers of the unit. TEE is performed by staff or Fellow₂ who is supervised by staff. The standard time of TEE is equal to TTE.

5.1.3 Exercise stress test (EST)

Exercise stress test service time is Monday 08.00-16.00 hours making appointment with 10 patients and Wednesday 08.00-12.00 hours making appointment with 6 patients. The average testing time is 15 minutes per person (excluding 10 minutes for preparing the patients). The operator is 1 Fellow₁ who rotated into this test. As shown in Table 2.

Table 2 Scheduling appointment of exercise stress test (EST) and tilt table test (TTT)

Day	Investigation Appointment		Total appointment
	EST	TTT	
Monday (8.00–16.00 hrs)	9 EST	1 TTT	10
Tuesday	-	-	-
Wednesday (8.00-12.00 hrs)	5 EST	1 TTT	6
Thursday	-	-	-
Friday	-	-	-

5.1.4 Tilt table test (TTT)

Tilt table test share the same resources and appointment system with EST. The appointment for test is 1 person per day which the EST appointment number is reduced accordingly to maintain service ability of the unit, as shown in Table 2. The standard time for aged less than 60 years old is 45 minutes and the standard time for aged more than 60 years old is 50 minutes.

5.2 Manpower

The total manpower in unit comprised 1 head nurse, 6 registered

nurses, 2 sonographers, 6 practical nurses and 3 workers. Within this resources 1 registered nurse and 1 practical nurses were taken to provide service for MRI investigation at 1st floor, 84th Years Building. In totally, there were 5 registered nurses and 5 practical nurses in Cardiovascular Special Investigation Unit.

Two sonographers were registered nurse who were trained in sonography course for nurse. Their duty was to provide training service of echocardiography supervision and approval of staffs as same as Fellow₁ who cannot give their service independently.

The arrangement of manpower except the head nurse is as follows;

5.2.1 Echocardiography rooms: totally 5-6 rooms, there were 3 registered nurses and 2 practical nurses.

5.2.2 EST room (including TTT): totally 3 rooms, there were 2 registered nurse and 1 practical nurses on duty.

5.2.3 Appointment station, there were 2 practical nurses, and 1 clerk (there were 1 medical statistician, and 1 medical statistics staff from Outpatient Department carrying out the medical statistics, ICD₁₀ coding and recording). The appointment station situates at the front of the unit. The task of appointment station is as follows;

- 1) Issues appointment card in each procedure. Identify the date of investigation and advise the step of practice for the test and also check the clients source of payment. The staff makes the appointment confirmation on telephone call. The schedule is prepared on the computer appointment system of Her Majesty's Cardiac Center which is not connected with hospital central database. As a result, an additional clerk was required to retype client's data again since the data can not be retrieved from the central database.

- 2) If clients do not make a telephone call to confirm the appointment before the test date 2-3 days, a practical nurse will make a confirm call to clients.

- 3) Make a postpone call in case that the physicians cannot investigate the clients as appointed.

- 4) Receive the appointment card from clients on the data of the procedure and arrange the queue in each procedure.

5) Make general assessment in vital sign, weight and height measurement, and record in patient's medical record.

6) Make an entrance registration in computer for clients in every procedure in order to build the database for typing additional test result especially for transthoracic echocardiography.

7) Coordinate with related health care unit, telephone reception both internal and external, including making appointment for some clients who want to have investigation from special clinic.

8) Input the data according to schedule in SQL system of hospital in order to search the medical record for 3 days in advance.

9) To return medical record and film X-ray.

6. Nursing service management of Cardiovascular Special Investigation Unit

The starting point of service of the Cardiovascular Special Investigation Unit is when clients receive appointment date for cardiac investigation. Cardiologist referred these patients for special investigation from the internal healthcare unit in the hospital or from the external hospital. Practical nurses issue the appointment card and advise the step of practice for the test including checking the source of medical payment. The appointment time is in the same time which is 08.00 a.m. of that day and arrange the queue by first come first serve (FCFS) structure by advising the patients on the date of picking up the appointment card. In the appointment of each procedure, if patients have some questions about the disease, the urgency of appointment, the medicine stopping before appointment date, the practical nurses would seek for advice from registered nurses.

Investigating service procedure

The service procedure given to clients at the date of investigation is as follows;

Stage 1 Clients place the appointment card and wait for calling based on the arriving time. This stage takes more than or equal to 1 hour. The appointment time for all patients is 8.00 a.m. and physician starts investigation at 9.00 a.m.

Stage 2 Check the source of payment for the patients with social

welfare card or universal coverage card which can be detailed as follows;

- Universal coverage card: in this stage patients or patient's family have to carry out the reimbursement by themselves, starting from finding the medical records from the Cardiovascular Special Investigation Unit and checking the validity of universal coverage card at 101 room outpatient department. Then patients and relatives take the invoice for investigating fee back to the Cardiovascular Special Investigation staff. This stage takes average 1 hour.

- Social welfare: patients or patient's family have to carry out the reimbursement by themselves, starting from finding the medical records and checking the validity of universal coverage card at Haritsachan Building 2nd floor. Then patients and relatives take the invoice for investigating fee back to the Cardiovascular Special Investigation staffs. This stage takes averagely 1 hour.

- Incase that the medical reimbursement is invalid, patients have to return to the Cardiovascular Special Investigation staffs to get the advice for the next appointment.

Stage 3 Clients have primary assessment, i.e., vital sign, blood pressure, weight and height measurement before investigation. This stage takes averagely 5 minutes.

Stage 4 To arrange clients a seat to wait for investigation according to the queue in waiting area. This stage takes averagely 2 hours and 30 minutes.

Stage 5 Having investigation according to waiting line in queue, the service time on this queue depends on the procedure type.

Step 6 During procedure, nurses may take care of patient's relative who makes own payment or reimbursement to pay for medical expense at the 3rd floor of the Her majesty's Cardiac Center Building. Except for patient who does not accompany with relative, he would pay by himself after finishing investigation.

Step 7 After finishing investigation, physicians explain the primary results to the patients and relatives.

Step 8 Nurses advise the patients to visit the in charge physicians on appointment for continuing treatment.

In summary, nursing and investigation service process of the

Cardiovascular Special Investigation Unit starts from patients getting appointment card at the unit. When the appointment date is reached, patients books the queue by placing the appointment card on arrival, and the service is provided by first come first serve system for each procedure. The service follows by the step of procedure from the arrival of patients until discharge. The procedure of interest in this study is an appointment, the waiting time in queue which has a long time averagely 2 hours 30 minutes for echocardiography and 1 hour 30 minutes for exercise stress test and tilt table test.



CHAPTER III

PROBLEM ANALYSIS

After studying the system and identify the problems of the non-invasive cardiac investigation service from the working experience, document, and clients complaint between January, 2004 and December, 2005, the important problems were identified: inefficient appointment system and long waiting time. The problem analysis of inefficient appointment system and long waiting time were illustrated using fishbone diagram. The causes of the problem were identified systemically. Then, the quality improvement process of each problem was presented. Finally, the appointment system for non-invasive cardiac investigation was developed.

The problem analysis and the appointment system development were supported using the following evidences:

Many reliable evidences were obtained to support the system development from many sources of literature review both in Thailand and abroad which can be detailed as follows;

- Review literature in Thailand from library database of Mahidol University, Khon-Kaen University, Kasetsart University, Chulalongkorn University, the searching keywords are waiting time, appointment, and queue. Nine related studies were obtained.

- Review literature from international electronic databases such as Medline, Embase, Entrez PubMed, and Science direct, using the following keyword; appointment, queueing, waiting time, scheduling, scheduling appointment, table, outpatient, patient satisfaction, quality improvement. Totally eleven related studies were obtained, seven of which were research studies and three of which were the clinical practice guidelines and one of which was the expert consensus document.

The details of problem analysis, quality improvement process and system development are as follows;

1. Inefficient appointment system

From the fishbone diagram, the causes of an inefficient appointment system were found as five categories: appointment system, employee, workload, information, and environment.

1.1 Appointment system

1.1.1 Same time appointment. The current appointment has been done on the same time. Every clients on every investigation procedure were appointed on 08.00 a.m.

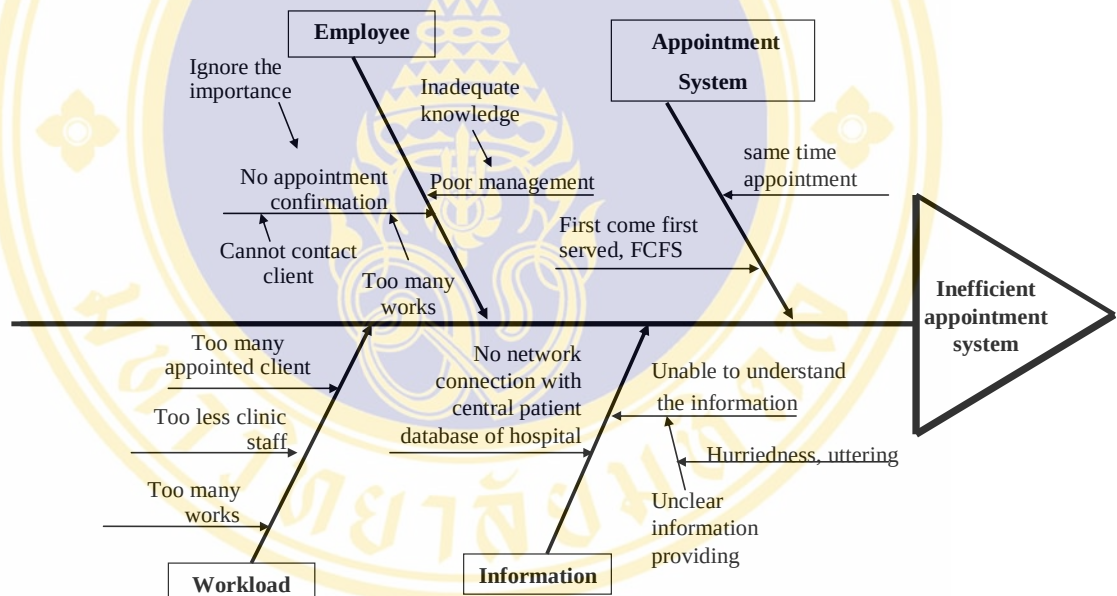


Figure 5: Fishbone diagram from problem analysis of an inefficient appointment system

1.1.2 First come first served, FCFS: when clients arrived the Cardiovascular Special Investigation Unit, the placed the appointment cards to book the queue as early as 06.30 a.m. in order to get the early place in queue before office

opening time at 08.00 a.m. and most of them arrived before 9.00 a.m.. The operator personnel comprised of fellows₁, fellows₂, staffs, and sonographers. Sonographers started investigation at 8.30 a.m. in the same time as fellows₁ and fellows₂. Staffs started the investigation at approximately 9.00 a.m. and 10.00 a.m. in the month of attending session which they would inform the nurses in advance. Since staffs had high workload, sometime they had to cancel the investigation due to the other urgent and important evident. As a result clients may had to wait for a long time. However, physicians always complete investigation for all clients in queue on daily basis. If including the post-investigation activities, the total service time for some patients from arrival to discharge is as long as 4-5 hours.

Improvement process

The new appointment system was planned to make scheduling appointments at different times. The appointment was set according to the following guidelines.

1. Standard time of each investigating procedure according to clinical practice guidelines, i.e.; 1) Transthoracic echocardiography takes 45-60 minutes (from starting procedure until finish) for uncomplicated cases and additional 15-30 minutes for complicated cases (Intersocietal Commission for the Accreditation of the Echocardiography Laboratories, 2002). In the actual operation, staffs took approximately 45 minutes, and fellow₂ took approximately 60 minutes (Echo time data, Cardiovascular Special Investigation Unit) 2) Transesophageal echocardiography takes the equal time as transthoracic echocardiography 3) Exercise stress test takes 15 minutes investigation time, and 4) Tilt table test takes 45 minutes for adult aged less than 60 years old and 50 minutes for adult aged more than 60 years old.

The transthoracic echocardiography done by fellow₁ and sonographer during their on-the-job training took averagely 90 minutes (Echo time data of Cardiovascular Special investigation Unit).

2. Number and skills of the operators, number of ultrasound instruments were used to estimate number of clients appointed per day.

3. Echocardiography can be classified by means of the level of case difficulty and skill of operators. Classified scheduling appointment into service and as on-the-job training. For the clients with difficult and complicated cardiovascular

condition and the transesophageal echocardiography, the investigation was plan to carry out by staffs.

4. Prioritize the appointment by the clients payment, for instance, the clients who make own payment or reimbursement were planned to be appointed on the earlier queue of every procedures. The clients with universal coverage or social welfare spent approximate 1 hour to check their card coverage.

From the development of an appointment system, investigator adopted the concept from Baily (1952) and Welch (1964) who developed an appointment system by scheduling the patients evenly over the period based on average service time. This recommendation focused on reducing waiting time for clients and remained one of the best over the past fifty years. According to Ho and Lau (1999), who evaluated 50 scheduling rules via simulation and concluded that a variable-interval appointment scheduling system designed to reduce clients waiting time performing well in most environmental conditions. Chiraporn Chanpradab (1998) studied the development of an appointment in old orthopedic outpatient service, Pramongkutklao Hospital and suggested that average time of service for one patient, this would be beneficial for appointment schedule. The results of study demonstrated the development of an appointment system which was able to minimize the waiting time of outpatient whilst able to minimize the idle time of the physicians in different queuing situation. The result of study on different time appointment with interval equal to service time can be applied to modify the appointment scheduling as shown in Appendix A

1.2 Employee

1.2.1 Appointment management is to provide service personnel in appropriate with work load and number of employees.

When clients visit the unit to make appointment, nurses should evaluate the urgency of investigation. In case of full reservation with the presence of urgent case, nurses may consider to swap the queue with any upcoming non-urgent case or make an extra-time appointment in coordinating with staffs. In the past the appointment making was the duty of practical nurses under supervision of registered nurses but there had been the problem of decision making and appointment system

management 2-3 times per week which the practical nurses had to seek for registered nurses to advise in investigation room which were inefficient. In addition, practical nurses sometimes could not have been able to screen the difficulty of the case so they did not make the appointment with the right operators due to lacking of knowledge and managerial skill, as a result, the clients might have attended but had no investigation due to wrong appointment. Although this case had rarely occurred but it produced adverse consequences especially if clients had to travel from rural province which re-appointment cost them a lot of money. This situation also caused client dissatisfaction.

Improvement process

1. Educate the practical nurses who are responsible for appointment scheduling and provide them work instruction manual concerning appointment management and information support to clients under supervision of registered nurses. The improving of skill for the in charge duty but having appropriate supervisor can improve their practice.
2. Assign registered nurses to give counseling for practical nurses and clients at appointment service station including coordinate with physicians to solve the investigation appointment problem.
3. Establish a practice guideline incase of pre-appointment investigation and canceling of existing appointment following with vacant time identification for new appointment, including the case of urgent appointment management whilst keeping the existing appointment unaffected.

According to the above quality improvement process, investigator applies Ward and McKee (1999)'s concept who applied computer simulation with outpatient obstetrical clinics to allocate clinical resource in appropriate with service demand whilst maintaining good quality of service, low cost, and client satisfaction. This simulation model demonstrated the appointment scheduling in each day, appointing time, in charge physicians, length of time spent on investigation (minute), procedure. This demonstration can result in easier resource allocation such as staffing (physicians, nurses, practical nurses), examination room allocations, tools, equipments, including rotating system for clients and health care service providers. Besides, Pei Li Kun (1993) studied strategic issues for reducing patients waiting time

and improving satisfaction with services at the out-patient department of the First Affiliated Hospital, Kunming Medical College, People's Republic of China. The study revealed that reservation system and appropriate work scheduling of health care personnel were important and feasible strategy to reduce waiting time and increase client satisfaction.

1.2.2 Appointment confirmation prior the appointed date

The clients rarely made telephone appointment confirmation on 2 or 3 days prior appointment. So, the appointment confirmation should be done by clinic appointment personnel by making telephone confirmation call to clients. This is an effective method which the clinic staffs can know the exact number. Too less appointment had disadvantage increase of non-attendance which cause the clinic staffs to be unoccupied and loss of opportunity of the clients in queue to replace the appointment. The Cardiovascular Special Investigation Unit faced the non-attendance problem for 10-15% each day. According to investigator's experience, the cause of non – attendance was mostly from forgetfulness incorporating with lack of appointment confirmation. The causes of inadequate appointment confirmation were due to too many workload, unaware of the importance of appointment confirmation, including unable to contact by the given telephone number.

Improvement process

As the non-attendance adversely affects to the subsequent process as discussed, the appointment confirmation system should be set up and practiced in order to solve non-attendance problem as follows;

1. Advise the appointment scheduler to realize the adverse effect of non-attendance and necessity to follow up the appointment confirmation.
2. Make a clear assignment to appointment scheduler in order to review and follow up the appointment confirmation 2-3 days prior to appointed date on regular basis. If the appointment scheduler could not make the telephone confirmation, she should advise the head nurse to assign the follow up job to the other person. The benefit of advance appointment confirmation is to get the information of numbers and cases of clients in order to arrange the clinic resources, getting more stable work load, able to substitute the canceled appointment with the subsequent clients in queue, able to advise the physicians about the cancellation, and able to

prepare the equipments and instruments efficiently. Accordingly, Chung (2002) found that the strategy to smoothen investigation flow was to review the appointment schedule in advance and make appointment confirmation with clients. The benefit of review is to get the number of clients in detail and in advance such as the total number of clients and number of clients in each procedures in the next day. According to Murdock, Rodgers, Lindsay, and Tham (2002), the main cause of non-attendance approximately 30% was from forgetting the appointed date or forgetting to cancel the appointment, which was in accordance with Rebecca and Pauline (2004) who reported the main reason of non-attendance was from forgetting the appointed date. In addition, Frankel, Farrow and West (1989) found that a main cause of non-attendance was from lack of information in necessity and rationalization of investigation as appointed. The corrective guidelines were studied by Dockery, Rajkumar, Chapman, Bulpitt, and Nicholl (2001) which reported that making follow up telephone call to confirm the appointment could decrease the rate of non-attendance to 1% and was found highly beneficial for elderly patient. Rebecca and Pauline (2004) suggested that the clinic should have strict system of appointment confirmation. Moreover, Hardy, O'Brien, and Furlong (2001) proposed the corrective measure of non-attendance, i.e., providing information support containing the benefit of investigation as appointed, the contact person when arriving at the unit, the stuffs carrying with, the parking area, and other information to provide convenience and confidence to clients, as a result, decreasing of non attendance from 15% to 7% is reported. These causes of problems and corrective action can be applied with the problems of this study.

1.3 Workload

1.3.1 Inadequate clinic staffs

There are 2 practical nurses on duty at appointment scheduling & contact station which is inadequate during 11.00-13.00 hours since one of them would leave for lunch alternately.

1.3.2 Too many clients contacted at the appointment scheduling & contacted station to make appointment card occasionally. On Tuesday which was the business day of pediatric cardiovascular clinic, a lot of parents visited the Cardiovascular Special Investigation Unit to make appointment for their children

especially on 11.00-13.00 hours when only 1 practical nurse was on duty at appointment station and coincidentally with the clients who finished from cardio clinic, 1st floor Chaofa Mahachakri Building, visited the appointment station for making the further management. As a result, the practical nurse had to rush in service so the interaction with clients was ineffective.

1.3.3 Too many tasks, the practical nurses at the appointment service station had to receive telephone call from 2 telephones set to coordinate with other department and then turned back to clients who were waiting for the services. So the clients perceived that the practical nurses paid too less attention to them and in hurry to make the job done.

Improvement process

Adjust the number of appointment service personnel in appropriate with the peak hours of clients in service by rotating the personnel from less work load station. In the day that rotating is not possible, clear communication to clients about the reason of delay is necessary since the access of problem can alleviate the client dissatisfaction (Lovelock and Wright, 2002)

1.4 Information

1.4.1 Information support

Information support concerning investigation requires good academic knowledge of each procedure since it can influence client preparation before procedure and corporation with clinic staffs during procedure. According to investigator's past experience, many clients did not know the procedure they supposed to have, and the pre-procedure preparation especially transesophageal echocardiography and tilt table test, for instance, patients were required to take NPO for 4-6 hours prior to procedure or stopped taking some drugs. So patients might have not practiced NPO or did not stop taking some drugs, thus they could not have investigation, wasting their time and traveling expense including loss of opportunity to have further diagnosis. The analysis of problem revealed the potential causes, i.e., the appointment service personnel gave incomplete information, spoke too fast and in hurry since many clients were waiting for service. The clients might not get all

information because they were not asked. After receiving appointment card and returning to home, the clients might not review the information on appointment card especially the elderly clients which the client relatives took the appointment card for them and communicated the patients with incomplete information, or in case of the relatives took the appointment card for the clients who did not live together so the missing of information could easily occur.

Improvement process

Develop information support method. If the clients who take the appointment card are literate, have them read the investigation procedure document and ask them whether they understand the information thoroughly and then let them ask for clarification. Moreover, advises them to review the document and appointment card again at home. For illiterate clients, appointment service person explains the investigation procedure for them and then asks them whether or not they understand all information then repeat the information with literate relatives to review the document and appointment card in order to review them before the appointed date. The service person emphasizes the literate relatives to review the document and appointment card before the appointed date in order to inform the clients properly. Registered nurses should give counseling to practical nurses who are appointment service personnel about the drug which have to be stopped before investigation as well as difficult and complicate illness. In addition, teaching media about each non-invasive cardiovascular investigation procedure should be produced in VCD format and played for the clients to reinforce their understanding. The practical nurses who are responsible for appointment service should have additional training and learning course to increase their ability in giving counseling and providing information support to increase confidence of clients and relatives. This recommendation is in accordance with Marilyn (2003) who reviewed many past literatures about information provider or counsel giver role of service person and summarized that information providing and counseling are an important activity to create clients satisfaction. Friendly attitude, information providing and counseling skill can create client confidence and satisfaction.

1.4.2 System networking

The appointment scheduling system of the Cardiovascular Special

Investigation Unit was run on stand alone computer without connecting to central patients database of hospital so the unit could not upload the clients data such as name address, date month year of birth or contact person. The appointment service person had to re-input the clients data in the unit's stand alone patients database in order to gain access into appointment scheduling system, the mistake easily occurred in this stage due to hurriedness.

Improvement process

The Quality improvement process is to propose to higher managerial level. In addition, make an assignment to clerical staff who is more skillful in typing to key in the clients data into computer.

2. Long waiting time

The same time appointment was one main cause of long waiting time. In addition to the other causes within the 5 major factors, i.e., system, customer, information, equipment, and operator.

2.1 System

2.1.1 Appointment system: the main cause was from same time appointment method which was discussed earlier.

2.1.2 Client source of payment, the clients who held a universal coverage card had to check for the card coverage by themselves including to contact financial office located at outpatient building to collect medical expense invoice. On 08.00 a.m., the clients got medical record at cardiovascular special investigation unit and utilize approximately 1 hour in this step. For example, a client placed the appointment card since 06.30 a.m. to get the early queue, suppose that the client got the first place in queue to has transthoracic echocardiography, he could take medical record at the opening of unit then went to check for the source of payment coverage at outpatient building and collecting the invoice then returned to the unit. In the means time, the client who paid for medical expense on his own on the later place in queue

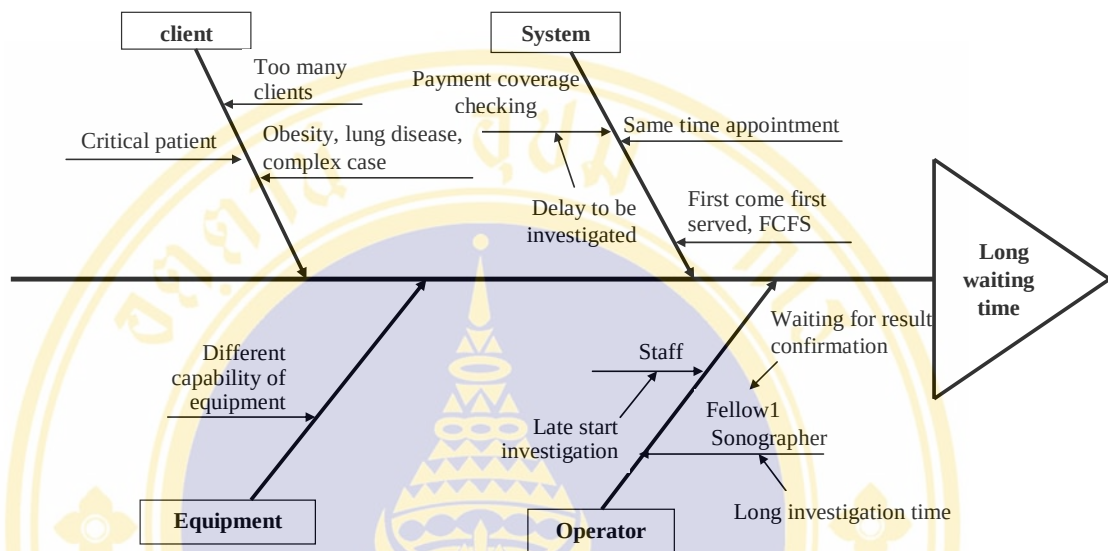


Figure 6: Fishbone diagram from long waiting time problem analysis

could be seen for investigation. When the client with universal coverage card returned to the unit, he had to wait for the client who made his own payment in investigation room. If the client in investigation room had a difficult and complicated cardiovascular illness, the client with universal coverage card had to wait longer. The same instance occurred with social security card, with the difference that the clients could get the medical record at the social security office the submit to check for the social security coverage then collecting the invoice then returned to the unit for investigation.

Improvement process

Nurses should advise the clients about the coverage checking of universal coverage card to provide facility to clients and reduce the checking time as follows;

1. Advise the clients about supporting document for coverage checking

of universal coverage card which comprises copy of gold card, identification card, hospital card, house registration document, refer document, totally 3 copies. The documents are given at room NO.101 within government office time, and at room NO.100 out of office time.

2. In case that the universal coverage card is valid on the appointed date, appointment service person suggests the clients to do card coverage checking in advance. The payment coverage checking service person makes a note in medical record as “checking the payment coverage in advance for..... investigation on.....date”. On the appointment date, clients only take the medical record to register at the card coverage checking unit which can reduce the payment coverage checking time. However, if the clients carry out the payment checking coverage within 2-3 days in advance of the investigation date, the payment coverage checking unit would not perform the checking to prevent the missing of medical record.

In case that the refer document covers one day or the source of payment does not cover the appointed date, appointment service persons should advise the clients to complete Por Sor 18 form (return-refer document) together with appointment card and then contact the identified hospital in universal coverage to issue the new refer document as per the next appointed date. The refer document is given to the payment coverage checking service persons in the morning of appointed date.

For the clients with social security card, appointment service persons suggest them to search for medical record at 2nd floor Harisajan building by preparing identification card, and social security card to submit.

According to the different steps of clients for each source of payment, the clients who hold universal coverage card and social security card should not be in the first place in investigation queue since they have to check for the payment coverage for 1 hour. The investigation queuing should be separated into 2 groups, the first group is transthoracic echocardiography and transesophageal echocardiography. The second group is exercise stress test and tilt table test. Both groups will have different color of queue card to prevent confusion between both groups. The first group received red queue card and the second group received green queue card (Figure 7).

2.2 Client

2.2.1 Number of clients who were appointed to have transthoracic echocardiography in adult were not appropriate with the number of investigating physicians since the staffs required for investigation had the other urgent job to do, so the fellow₂ had to perform investigation in replace which was the policy of faculty of medicine. As a result, the clients in queue had to wait longer.

Improvement process

One of the successful strategies to minimize waiting time is to shorten the waiting time perception by providing the knowledge and information intervention to make the waiting time interesting and valuable. The information support can be done by playing health care education VCD or video tape such as cardiovascular disease or hypertension including various non-invasive cardiac investigation procedures. This finding is in accordance with Marilyn (2003) who found that educational intervention from video tape about Glaucoma including close interaction between nurses and clients in an optical clinic can increase clients satisfaction compare with the clients who have no educational intervention.

2.2.2 The difficult and complicated cardiovascular illness or obesity of clients could prolong investigation time of transthoracic echocardiography. For instance, congenital heart disease or investigation for heart surgical decision making case which had to be investigated by staffs or investigated by fellows₂ but had to be confirmed by staffs which take longer investigation time than uncomplicated study. The clients with obesity or pulmonary disease also took longer investigation time since the images taken were not clear.

Improvement process

Communicate with clients that the investigation takes a long time due to complicated study in order to reduce clients anxiety. This recommendation is in accordance with Corbett, White, & Wittlake (2000) who reported that the information giving concerning the reason of delaying from video tape of emergency department can reduce anxiety of the waiting clients.

2.2.3 In case of transthoracic echocardiography if the clients arrived the unit with critical illness, or fatigue elderly patients, could reduce in waiting



Figure 7: Colored queuing card separated by non-invasive cardiac investigation procedure

tolerance. These clients perceived longer waiting time than reality and thus increase their dissatisfaction. In addition, the clients who were waiting for transesophageal echocardiography (TEE) or tilt table test (TTT) who had taken NPO from yesterday would be more frustrated due to hunger thus reduced waiting threshold and increased dissatisfaction.

Improvement process

Schedule fellows₂ or staffs to investigate the above mentionable cases for quick and accurate services. The fellows₁ who performs on-the-job training investigation is not appropriate for this case since the investigation takes longer time. These patients should be in the early place in queue as the service queue is arranged according to priority and urgency of the case (Lovelock and Wright, 2002).

The client who takes NPO for tilt table test has to be reserved in the early place in queue. For the client who makes payment on his own, the first place in queue can be arranged, for universal coverage the fifth place in queue on 09.00 a.m. is reserved since the card coverage checking takes 1 hour.

In case if the client takes NPO before having transesophagealechocardiography, the investigation has to be done by expert staffs to complete it fast and accurately. The early place in queue should be reserved for him since the client is hungry from NPO. If the client makes his own payment the first place in queue is reserved for him, if the client holds universal coverage card, the second queue on 09.15 a.m. is reserved since the card coverage checking takes 1 hour.

2.3 Operator

2.3.1 Transthoracic echocardiography (TTE) is a main non-invasive procedure of the Cardiovascular Special Investigation Unit (Table 3). According to 2005 statistics, there were 2,085 cases of transthoracic echocardiography, the TTE operators comprise of service task for educational purpose of fellow₁ and sonographer who carry out on-the-job training and service task of fellow₂ and staff.

The service task for educational purpose normally takes average 90 minutes investigation time per case. So the clients spent longer time in investigation room when investigated by fellow₁ and sonographer rather than when investigated by

Table 3 Non-invasive cardiac investigation statistics of Cardiovascular Special Investigation Unit

In regular clinic	Jan 05	Feb 05	Mar 05	Apr 05	May 05	Jun 05	July 05	Aug 05	Sep 05	Oct 05	Nov 05	Dec 05	Total
A.Echo	182	171	176	130	149	163	135	210	181	173	221	194	2,085
TEE	21	19	28	10	14	20	11	35	29	33	26	23	269
EST	57	52	54	36	48	62	36	59	57	47	49	32	589
TT	4	3	7	1	5	2	5	8	6	5	2	4	52

fellow₂ and staff which take averagely 60 minutes and 45 minutes respectively.

Improvement process

Before making appointment, the screening of the cases should be done in order to classify the severity and complexity of the illness. Mild severity and complexity cardiovascular illness can be investigated by fellow₁ or sonographer with on-the-job training investigation. In case of high severity and complexity case such as congenital heart disease with complex anomaly, or investigation for heart surgery decision making, the faculty staff shall be responsible for investigation. Apart of these, fellow₂ can be appointed as investigator since they can seek for counseling from the staff who is on duty on the same day.

2.3.2 Staff, in addition to echocardiography investigation, had a lot of workload such as management, service and academic work and sometimes had to meet in morning, during the month of attending in inpatient ward and had to perform round ward before going to the Cardiovascular Investigation Unit. As a result, during these periods staff started investigation quite late. During on duty in investigation room, the drug retailers, other business, or clinic staff relations which interrupted investigation time. The delayed investigation therefore occurred.

Improvement process

Improve the appointment scheduling during the month that staff is

the inpatient ward attending. The first queue is appointed at 09.30 a.m. Establish a formal regulation that the other activities need to be appointed or allowed to make with physicians only after the investigation time in order to prevent the interruption to physicians from the drug retailers, staff relatives, or other involving persons except the very critical and urgency cases. This recommendation is in accordance with the recommendation for improving an appointment system of O'Keefe (1985) which proposed to set up as a policy that no interruption was allowed to physician during procedure. In addition, there was a study of Duncan, Beale, Parry, and Miller (1998) who made a time saving study of physician in a Urology clinic and found that 50% of available consulting time was utilized for the activities other than consulting the clients such as data searching, and other paper work. In 2002 similar result of research was obtained by Patel, Luxman, Bailey, Brunning et al, who found that 41% of available time was occupied by the activities other than the time to see the patients such as searching radiography evidence. The Cardiovascular Investigation Unit therefore adopt this concept to improve the effective time utilization of all physicians by arrange a complete set of investigation supporting document so that the physicians would not waste further time to seek for the document such as searching form, investigation refer order, ECG tracing, X-ray film, which can accelerate investigating time. Different color strips in medical record identifies the searching form, investigation refer order, and ECG, the X-ray film is attached with the file (see figure 8).

2.4 Equipment

For transthoracic echocardiography, the ultrasound instruments technology also affected the waiting time of clients. As there were totally 6 ultrasound instruments. The first two instruments bought since 1998 did not have the tissue dropper investigation function and were not compatible with S₃ probe which could be used with thick chest wall or obese clients. As a result the very obese patients or with heart failure history who required tissue Doppler investigation to check diastolic function of heart have to wait for investigation with higher technology instruments which may be occupied by the other clients so the longer investigation time results.



Figure 8: Identification medical record by different color strips

Improvement process

Establish echocardiographic management to maximize equipments utilization efficiency by appropriate equipments rotation utilization. The screening of cardiovascular disease to classify the difficulty and complexity of investigation is required in order to assign the appropriate ultrasound instruments according to the case. For example, the clients with thick chest wall or obesity should be assigned to the ultrasound instruments which compatible with S₃ probe and communicate with clients to understand the reason of waiting for the specific ultrasound instruments which may take longer waiting time. Lovelock and Wright (2002) stated that providing information about various service steps and explain the reason of waiting can alleviate client anxiety and dissatisfaction.

In summary, from problem analysis, alternative analysis and system development discussed earlier, investigator summarized and developed the appointment system practice guidelines and submitted the developed appointment system practice guidelines to three experts. Three experts examined the accuracy of this developed appointment system before actual implementation. The developed system was discussed in Chapter 4.

Assessing implementation potential

In development of an appointment system, investigator supported the recommendation with reliable literature and evidence such as literature review of thesis and foreign research evidence, standard operation/practice document, expert practice report which had considered as conform to the characteristics of setting which was outpatient investigation unit, and having the target to develop the service quality to reduce the waiting time in clinic. Investigator then submitted the developed appointment system to three experts to verify the validity of content in order to improve the appointment system to be as good as possible prior to put into actual implementation. The three experts were managerial level personnel in relevant with Cardiovascular Special Investigation Unit and have authority in working procedure improvement and change. The first expert was faculty staff who was the head of Cardiovascular Special Investigation Unit, the second expert was faculty staff who was expertise in echocardiography in adult, including the direct responsible person in

non invasive investigation in adult, the third expert was head nurse of Cardiovascular Special Investigation Unit. For implementation, the investigator expected confidently that there would be no difficulty or interference with routine operation of clinic since the development was based on the improvement of existing working procedure to achieve higher efficiency. In addition, the appointment system improvement received willful support from unit management team.

Recommendation for implementation

Implementation in actual situation is one of the most important part of development. Since not only the investigator find out what the problem is, but also the investigator has to convince all clinic staffs of the unit to realize the necessity to improve the appointment system in order to get voluntary corporation from every section and every personnel which comprises of the following steps;

1. Present the improvement plan to management team to get the approval to implement the appointment system in actual operation and to inform related physicians.
2. Head nurse arrange a meeting with all concerned staffs which are staff nurses, clerical staffs, medical statisticians and workers, to advise the details and procedure of appointment system for unique understanding and corporation in actual practice.
3. Identify role and responsibility of each clinic staffs such as appointment confirmation by telephone making, searching of X-ray film.
4. Implementation
5. Evaluation

Evaluation guidelines

Follow up by evaluation every 3 months by

1. Total non-invasive cardiac investigation time (Table 4).
 - 1.1 Total echocardiographic investigation time reduces for 65% of the time before developed appointment system implementation.

1.2 Total exercise stress test and tilt table test investigation time reduces for 69% of the investigation time before developed appointment system implementation.

Table 4 Comparison of the investigation time before and after

Investigation time	Before development (Minutes)	After development (Minutes)	% reduction
1. Echocardiography	311	108	65
2. Exercise stress test and tilt table test	219	67	69

The calculation details are shown in Appendix B

Data collection can be made by recording waiting time in each steps of service, i.e.,

- Appointment time
- Time entering investigation room.
- Time leaving investigation room.
- Total time from appointment time to finishing investigation time.

2. Carry out the client satisfaction survey on the clients having non-invasive cardiac investigation at the setting using satisfaction questionnaires developed by investigator which modified from satisfaction questionnaires proposed by Thomas et al. (1997) who studied patients' satisfaction with an oncology outpatient clinic (Is it worth to wait? A survey of patient's satisfaction with an oncology outpatient clinic), the questionnaires were verified by thematic advisor and one expert then corrected and improved till get the final form of questionnaire prior to be used in actual situation (appendix C).

Table 5 Service time recording for non-invasive cardiac investigation

Date Month year	Investigation room No.	Operator	Queuing No.	Procedure	Appointment time	Time entering	Time finishing	Total time	remarks

This table shall be recorded by the clinic staffs of the Cardiovascular Special Investigation Unit on duty at appointment counter and investigation room.

- Date/month/year refer to the recording date.
- Investigation room number refers to the number shown in front of investigation room.
- Procedure refers to the non-invasive cardiac investigation assigned.
- Appointment time refers to the appointment time made with the clients to have non-invasive cardiac investigation.
- Time entering refers to time that staff nurses called the clients to enter into investigation room.
- Time finishing refers to time when physicians finish investigation and advise the result to clients.
- Total time refers to time start from appointment time until the finishing investigation.
- Remark refers in exceptional case such as emergency patients who jump in the queue.

CHAPTER IV

CONCLUSION AND RECOMMENDATION

Conclusion

This thematic paper was aimed to develop an appointment system for non-invasive cardiac investigation in the Cardiovascular Special Investigation Unit, Siriraj Hospital, in order to propose the appropriate and practical practice guidelines. The problem analysis, alternative analysis, and system development was done and discussed in chapter 3. The investigator summarized the problems and developed the new appointment system and practice guidelines. Then, the guidelines were submitted to three experts to verify the validity of content. The investigator, then, improved and corrected the guidelines follow the expert's opinions and recommendations. The developed appointment system comprised;

1. Appointment scheduling

The new developed appointment schedule was based on time wave scheduling (Appendix A). The development of appointment schedule can be detailed as follows:

1.1 Transthoracic echocardiography

1.1.1 Time wave scheduling, the clients are appointed at the amplitude of the equal interval time equally to the average investigation time which can be classified by the TTE investigators as 1) faculty staff: the time interval between appointment is 45 minutes, 2) fellow₂: time interval between appointment is 60 minutes, 3) fellow₁ and sonographer: time interval between appointment is 90 minutes. The actual appointment will be done at 30 minutes before entering investigation room to prepare clients ready for investigation.

1.1.2 The classification of the appointment according to each operators, by number of clients, difficulty levels of the cases, and the sources of payment which the payment coverage checking takes 1 hour before investigation.

- Faculty staff can investigate 4 clients a day from Monday to Thursday provides that complicated studies such as congenital heart disease with complex anomalies, the investigation for heart surgery identification, must be handled by the faculty staff only. The first client has to be appointed at 08.30 a.m. (the investigation time is 09.00 a.m.) and has to be a private sector client or able to reimburse. The next client in queue can be the client holding a universal coverage card or social security. The appointment time should be at 09.15, 10.00, 10.45 a.m. respectively.

In the month that the faculty staff works as the attending in inpatient ward, the first appointment will be arranged to 09.30 a.m. (the investigation time is 10.00 a.m.).

- Fellow₂: can investigate 4 clients a day from Monday to Thursday. On Tuesday and Wednesday there are 2 fellow₂ on duty at the setting. The case other than specifically assigned to faculty staff can be assigned to fellow₂. The first appointment for fellow₂ is 08.00 a.m. (the investigation starts on 08.30 a.m.) with the client who make own payment or reimbursement later. The next clients in queue are the patient with universal coverage card or social security card at 09.00, 10.00 and 11.00 a.m. respectively.

- Fellow₁: is capable for 2 clients investigation a day. The working days are Monday and Thursday. The cases which can be handled by fellow₁ are the uncomplicated study such as coronary artery disease, myocardial disease and non-diagnostic. The first appointment is on 08.30 a.m. (the investigation starts on 09.00 a.m.) with the clients who make own payment or reimbursement, the second appointment is on 10.00 a.m. with client who hold universal coverage card or social security card.

- Sonographer: is able to handle 3 clients a day, the working time are Monday to Friday. Sonographer is able to handle more difficult case than fellow₁ due to at least 3 years experience. The pathology that sonographer can handle are valvular heart disease, myocardial disease, coronary artery disease, pericardial disease, and non-diagnostic. The first appointment is at 08.00 a.m. (the investigation starts on 08.30 a.m.) with the client who make own payment or reimbursement, the

second and third appointment are 09.30 and 11.00 with client who hold universal coverage card and social security card.

1.2 Transesophageal echocardiography (TEE)

1.2.1 Time wave scheduling: the clients are appointed at the amplitude of the equal interval time which is equal to average investigation time of faculty staff which is 45 minutes.

The TEE is done by faculty staff, who able to handle 2-3 clients a day by substitute into the number of TTE investigation. The first appointment is 08.30 a.m. (the investigation start 09.00 a.m.) with the client who makes own payment or reimbursement, the second and third appointment are 09.15 and 10.00 a.m. respectively with the clients who hold universal coverage card or social security card.

1.3 Exercise stress test (EST) and tilt table test (TTT)

1.3.1 Time wave scheduling the equal time interval between each pair of adjacent appointments is arranged with the time interval is equal to the investigation time which is 15 minutes.

1.3.2 Arrange the appointment by service day with the constraint in both numbers and source of payment.

- Monday the investigation time 8.00 - 16.00 hours, the appointment is made for EST 9 clients and TTT 1 client totally 10 clients. In case if there is no TTT investigation on that day, the EST appointment can be made 10 clients that day. The first appointment is at 08.00 a.m. (investigation starts at 08.30 a.m.) with the client who make their own payment or reimbursement. The second, third, and fourth appointed clients still be the clients who make the own payment or reimbursement since the investigation time is only 15 minutes so the subsequent appointment time are 08.15, 08.30, 08.45 a.m. respectively. The clients who hold universal coverage card or social security card will be appointed subsequently thereafter.

TTT appointment is made 1 time per day. If the client make his own payment, the appointment is made on 08.00 a.m. since the NPO has to be taken the night before, and the EST is then appointed on 08.45 a.m. (the TTT investigation time is 45 minutes). In case if the client holds universal coverage or

social security card, the appointment for TTT investigation is on the fifth place at 09.00 a.m.

- Wednesday the service time is 08.00-12.00 hours, the appointment is made for 5 EST investigations and 1 TTT investigation totally 6 appointments. If there is no TTT investigation, the EST investigation is appointed in replacement. The regulation of appointment is the same as on Monday.

Additional advice

1. Advise all clients that they are responsible for checking and handling payment coverage before the appointment time. If the clients cannot finish the checking on time, they have to wait for the next queue.

2. Advise all clients about the payment coverage checking in case of universal coverage card in order to provide the clients to be more convenient and reduce the payment coverage checking time. The payment coverage checking advice are as follows;

- 2.1 Advise the clients to arrange complete set of supporting document which is 3 copies of universal coverage gold card, identification card, hospital card, house registration, and refer document. The coverage checking during office time is done at room NO.101 and during extra office time at room NO.100.

- 2.2 In cases that the payment coverage are valid until the appointment date, advise the clients who visit the unit to make the appointment card to check the payment coverage in advance on that day. The payment coverage checking service person makes a note in medical record as “checking the payment coverage in advance for investigation on.....date”. So on the appointment date, clients will take the medical record to register at the card coverage checking unit which can reduce the payment coverage checking time. In case if the referred document valid only one day does not cover on the date of appointment, the clients should fill in Por Sor 18 form (return-refer document) together with appointment card to present to the universal coverage specified hospital. The physicians will write the referred document that cover the appointed date for investigation.

Advise the clients with the social security cards to carry out the payment coverage checking at 2nd floor Harisajan building starting from searching medical

record and send with supporting documents (i.e., identification card and social security card) to the social security office.

2. The appointment system and operating unit management guideline

In order to achieve smooth and efficient operation of the Cardiovascular Special Investigation Unit, the management guidelines are proposed as follows:

2.1 Assign registered nurses to give counseling for practical nurses, clients and coordinate with physicians to solve the problems.

2.2 Educate the practical nurses who are responsible for appointment scheduling and provide them work instruction manual concerning appointment management and information support to clients under supervision of registered nurses. The improving of skill for the in charge duty but having appropriate supervisor can improve their practice.

2.3 Establish a practice guideline in case of pre-appointment investigation and canceling of existing appointment following with vacant time identification for new appointment, including the cases of urgent appointment management whilst keeping the existing appointment unaffected.

2.4 Make telephone call appointment confirmation on 2-3 days in advance of the appointment regularly in order to emphasize the appointment date, time and to prevent non-attendance which can let the clinic staffs know the exact clients number and able to plan for service and provide appropriate resources to achieve efficient service. In cases if the telephone confirmation cannot be done in reasonable time, practical nurses at appointment service station has to report to head nurse in order to assign the telephone confirmation job to the other staffs.

2.5 Arrange different color queuing cards to prevent confusion among different investigation procedures, the first group of investigation procedure comprises of transthoracic and transesophageal echocardiography, uses red queuing card, the second group comprises of exercise stress test and tilt table test, uses green queuing card.

2.6 Develop information providing to prevent clients from unprepared on the investigation date, by giving them the instruction brochure and review their understanding. Registered nurses give counseling and information to practical nurses

and clients in some complicated information such as having patients stop taking some drugs before investigation or in clients preparation for difficult and complex pathology cases. If clients are interested in having additional information, clinic staffs can play VCD or video tape instructing media arranged by the unit.

2.7 Arrange adequate service persons to the high workload period of the day in order to reduce the waiting time and bottle neck in operation, such as during lunch time which the appointment service persons have to rotate to have lunch so the rotation of personnel from the other work station to fulfill the manpower of appointment service station is necessary. In the day of unit manpower shortage, the remaining staffs have to advise the clients about the reason of delay.

2.8 Provides video tape or VCD education concerning cardiac health care or non-invasive cardiac investigation procedure during waiting for investigation in order to shorten waiting time perception or make the waiting time more valuable. Besides, the clinic staffs should communicate with clients about the estimate waiting time or the reason of delay.

2.9 Establish a formal regulation that the other activities need to be appointed or allowed to make with physicians only after the investigation time in order to prevent the interruption to physicians from drug retailers, staff relatives, or other involving persons except the very critical and urgency cases.

2.10 Prepare a complete set of investigation supporting document so that the physicians would not waste further time to seek for the document such as searching form, investigation refer order, ECG result, x-ray film, which can accelerate investigating time. For echocardiography investigation, the x-ray film is needed and the unit is responsible for acquiring the film together with the medical record.

2.11 Screening the clients and arrange the clients with echocardiography investigation in matching with the technology of ultrasound instruments and type of disease in order to achieve maximum efficiency utilization management.

In summary, the problems of non-invasive cardiac investigation in the Cardiovascular Special Investigation Unit characterized a domino effect. The apparent problems were inefficient appointment system and long waiting time together with operating unit management problem that needed to be solved and improved by developing appointment system. The operating unit management improvement was

expected to be more flexible. After actual implementation, the 3 month interval evaluation is planned. The new appointment system is expected to reduce the total time of echocardiography investigation for 65% and reduce the total time of exercise stress test and tilt table test investigation for 69% as well as increase client satisfaction on service. The new developed appointment system and the operating unit management improvement were summarized into flow diagrams as shown in figure 9 and 10., including its guidelines as shown in appendix D.

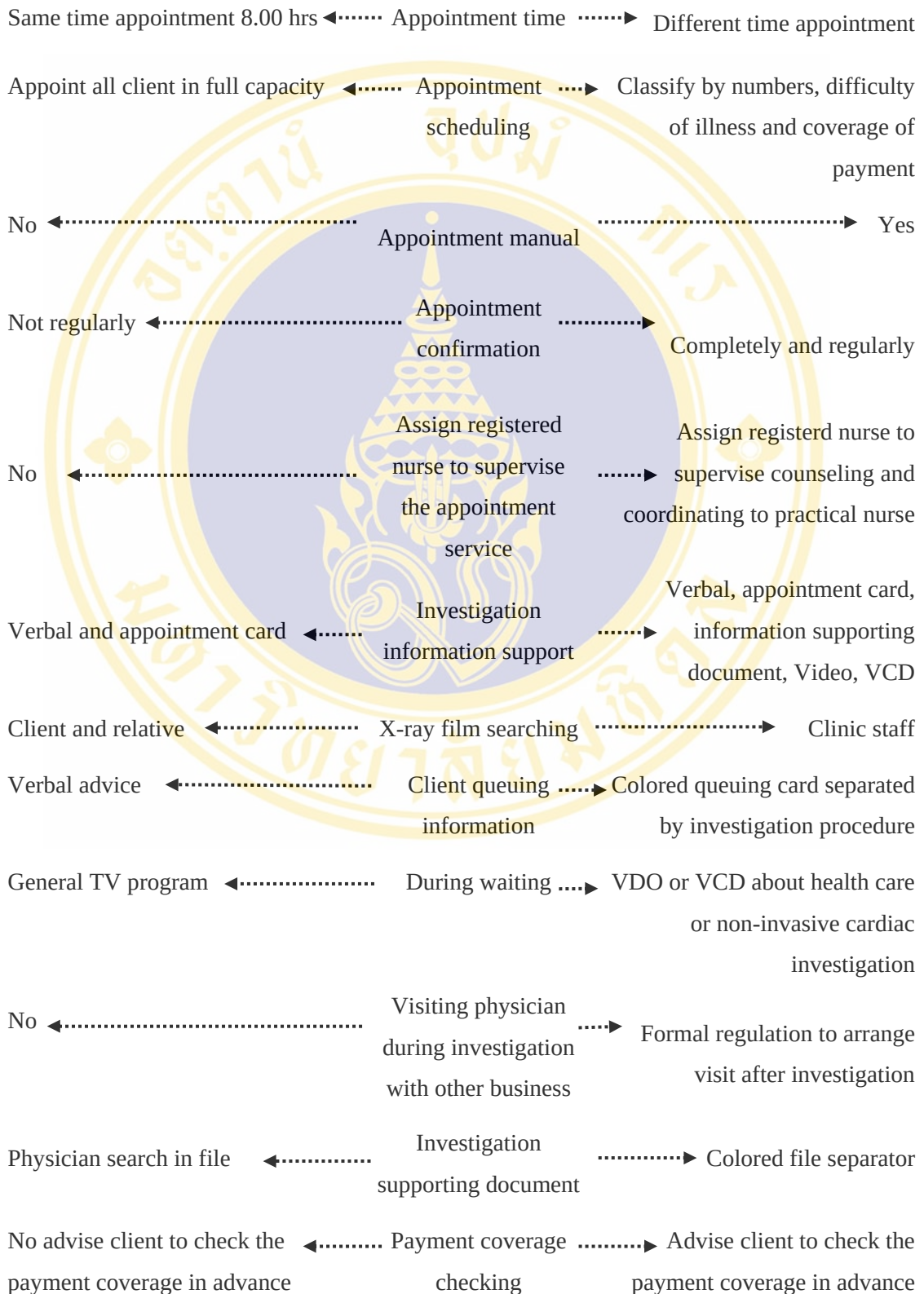
Recommendation

1. Prior the implementation of the new appointment system and management system improvement, clear and effective communication about the system is required to gain acceptance and corporation from the health care personnel.
2. The clients and health care personnel satisfaction data, including hospital expense data, should be collected before and after a pilot implementation of the system to evaluate the effectiveness and efficiency of the new appointment system.

Development of an appointment system and operating unit management

Before development

After development



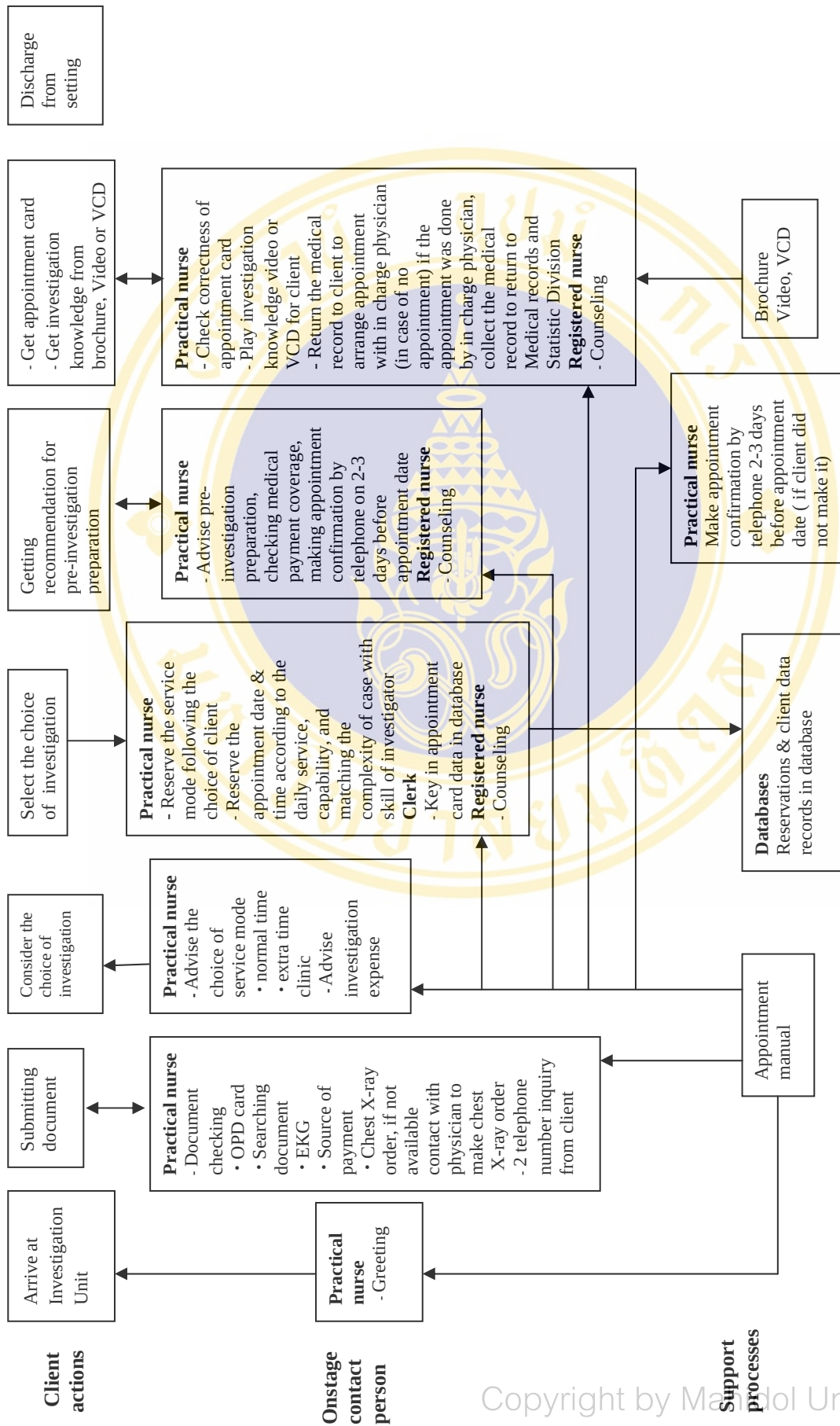


Figure 9: Development of a new appointment system on appointment card receiving date

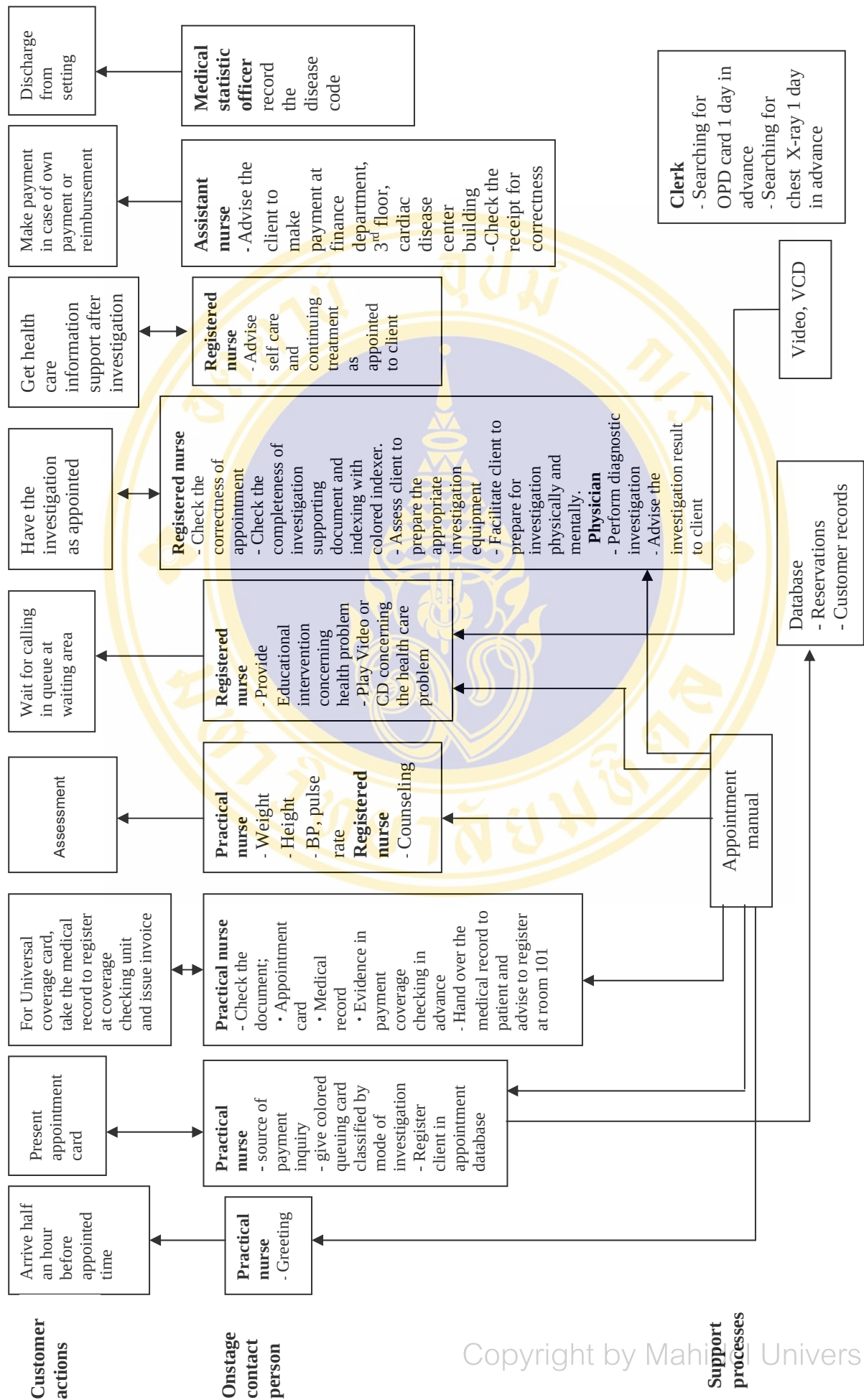


Figure 10: Development of a new appointment system on the date of investigation

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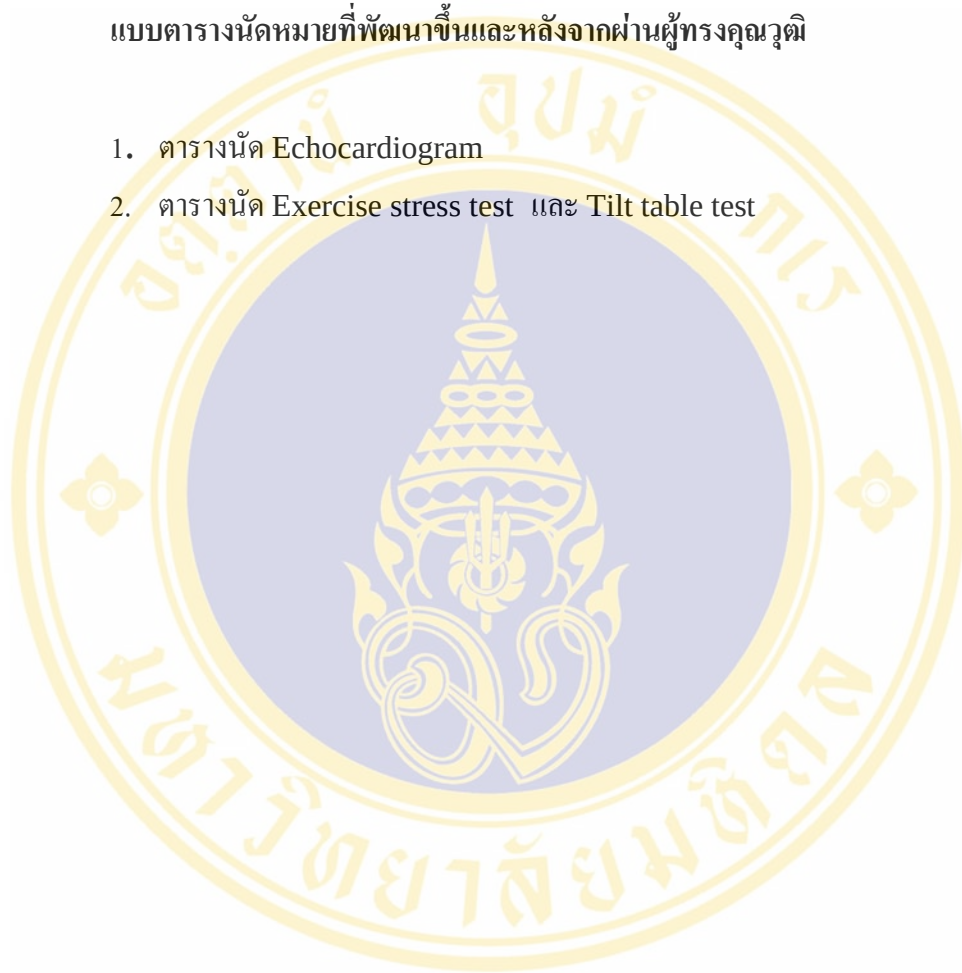
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APPENDIX A

แบบตารางนัดหมายที่พัฒนาขึ้นและหลังจากผ่านผู้ทรงคุณวุฒิ

1. ตารางนัด Echocardiogram
2. ตารางนัด Exercise stress test และ Tilt table test





ตารางนัด Echocardiogram ประจำวันจันทร์

ผู้ตรวจ	ลำดับที่	เวลาที่นัด	เวลาเริ่มตรวจ	เวลาตรวจเสร็จ	ลิทธิ	ชื่อผู้ป่วย HIN	อายุ	ประเภทการตรวจ	โรค	เบอร์โทรศัพท์	ตรวจสอบสิทธิล่วงหน้า	การยืนยันการตรวจ	หมายเหตุ
Staff	1	8.30น	9.00น	9.45น	เบิกได้หรือจ่ายเอง								
	2	9.15น	9.45น	10.30น									
	3	10.00น	10.30น	11.15น									
	4	10.45น	11.15น	12.00น									
F ₂	1	8.00น	8.30น	9.30น	เบิกได้หรือจ่ายเอง								
	2	9.00น	9.30น	10.30น									
	3	10.00น	10.30น	11.30น									
	4	11.00น	11.30น	12.30น									

- ผู้ที่โทรศัพท์ยืนยันการตรวจให้เสร็จก่อน และวัน/เดือน/ปี ที่โทรศัพท์ยืนยันการตรวจในช่องยืนยันการตรวจทุกครั้ง
- การตรวจสอบสิทธิล่วงหน้าเฉพาะผู้ที่ใช้สิทธิ 30 บาท และสิทธิประกันสังคม

ตารางนัด Echocardiogram ประจำวันจันทร์

ผู้ตรวจ	ลำดับที่	เวลาที่นัด	เวลาเริ่มตรวจ	เวลาตรวจเสร็จ	สิทธิ	ชื่อผู้ป่วย HN	อายุ	ประเภทการตรวจ	โรค	เบอร์โทรศัพท์	ตรวจสอบสิทธิล่วงหน้า	การยืนยันการตรวจ	หมายเหตุ
F ₁	1	8.00น	8.30น	10.00น	เบิกได้หรือจ่ายเอง								
	2	9.30น	10.00น	11.30น									

- ผู้ที่โทรศัพท์ยืนยันการตรวจให้เช่นชื่อ และวัน/เดือน/ปี ที่โทรศัพท์ยืนยันการตรวจในช่องยืนยันการตรวจทุกครั้ง
- การตรวจสอบสิทธิล่วงหน้าเฉพาะผู้ที่ใช้สิทธิ 30 บาท และสิทธิประกันสังคม

ตารางนัด Echocardiogram ประจำวันจันทร์

ผู้ตรวจ	ลำดับที่	เวลาที่นัด	เวลาเริ่มตรวจ	เวลาตรวจเสร็จ	ลิทธิ	ชื่อผู้ป่วย HN	อายุ	ประเภทการตรวจ	โรค	เบอร์โทรศัพท์	ตรวจสอบสิทธิล่วงหน้า	การยืนยันการตรวจ	หมายเหตุ
Sono1	1	8.00น	8.30น	10.00น	เบิกได้หรือจ่ายเอง								
	2	9.30น	10.00น	11.30น									
	3	11.00น	11.30น	13.00น									
Sono2	1	8.00น	8.30น	10.00น	เบิกได้หรือจ่ายเอง								
	2	9.30น	10.00น	11.30น									
	3	11.00น	11.30น	13.00น									

- ผู้ที่โทรศัพท์ยืนยันการตรวจให้เช่นชื่อ และวัน/เดือน/ปี ที่โทรศัพท์ยืนยันการตรวจในช่องยืนยันการตรวจทุกครั้ง
- การตรวจสอบสิทธิล่วงหน้าเฉพาะผู้ที่ใช้สิทธิ 30 บาท และสิทธิประกันสังคม



ตารางนี้ Exercise stress test และ Tilt table test ประจำวันจันทร์

ตารางนัด Exercise stress test และ Tilt table test ประจำวันจันทร์

ผู้ตรวจ	ลำดับที่	เวลาที่นัด	เวลาเริ่มตรวจ	เวลาตรวจเสร็จ	สิทธิ	ชื่อผู้ป่วย HN	อายุ	ประเภทการตรวจ	โรค	เบอร์โทรศัพท์	ตรวจสอบสิทธิล่วงหน้า	การยืนยันการตรวจ	หมายเหตุ
F1	1	8.00น	8.30น	9.15น	เบิกได้หรือจ่ายเอง			TT					
	2	8.45น	9.15น	9.30น				EST					
	3	9.00น	9.30น	9.45น				EST					
	4	9.15น	9.45น	10.00น				EST					
	5	9.30น	10.00น	10.15น				EST					
	6	9.45น	10.15น	10.30น				EST					
	7	10.00น	10.30น	10.45น				EST					
	8	10.15น	10.45น	11.00น				EST					
	9	10.30น	11.00น	11.15น				EST					
	10	10.45น	11.15น	11.30น				EST					
พักรับประทานอาหารกลางวัน													

- หมายเหตุ
- ตารางนัดตรวจนี้ใช้ในกรณีผู้ใช้บริการที่ใช้สิทธิเบิกได้ หรือจ่ายเองมานัดมาช TTT ในวันจันทร์เวลา 8.00 น และเป็นลำดับที่ 1
 - การตรวจสอบสิทธิล่วงหน้าเฉพาะผู้ที่ใช้สิทธิ 30 บาท และสิทธิประกันสังคม
 - ผู้ที่โทรศัพท์ยืนยันการตรวจให้เช่นชื่อ และวัน/เดือน/ปี ที่โทรศัพท์ยืนยันการตรวจในช่องยืนยันการตรวจทุกครั้ง

ตารางนัด Exercise stress test tilt และ table test ประจำวันจันทร์

ผู้ตรวจ	ลำดับที่	เวลาที่นัด	เวลาเริ่มตรวจ	เวลาตรวจเสร็จ	ลิฟท์	ชื่อผู้ป่วย HN	อายุ	ประเภทการตรวจ	โรค	เบอร์โทรศัพท์	ตรวจสอบสิทธิล่วงหน้า	การยืนยันการตรวจ	หมายเหตุ
F1	1	8.00น	8.30น	8.45น	เปิดได้หรือจ่ายเอง			EST					
	2	8.15น	8.45น	9.00น				EST					
	3	8.30น	9.00น	9.15น				EST					
	4	8.45น	9.15น	9.30น				EST					
	5	9.00น	9.30น	10.15น	บัตรทองหรือปกส.			TT					
	6	9.45น	10.15น	10.30น				EST					
	7	10.00น	10.30น	10.45น				EST					
	8	10.15น	10.45น	11.00น				EST					
	9	10.30น	11.00น	11.15น				EST					
	10	10.45น	11.15น	11.30น				EST					
พักรับประทานอาหารกลางวัน													

หมายเหตุ

- ตารางนัดตรวจนี้ใช้สำหรับผู้ให้บริการที่ใช้สิทธิบัตรทอง หรือประกันสังคมมานัดหมาย TTT ให้นัดหมายเวลา 9.00 น และเป็นลำดับที่ 5
- การตรวจสอบสิทธิล่วงหน้าเฉพาะผู้ที่สิทธิ 30 บาท และสิทธิประกันสังคม
- ผู้ที่โทรศัพท์ยืนยันการตรวจให้เซ็นชื่อ และวัน/เดือน/ปี ที่โทรศัพท์ยืนยันการตรวจในช่องยืนยันการตรวจทุกครั้ง



ตารางนี้แสดง Exercise stress test และ Tilt table test ประจำหน่วย

ตารางนัด Exercise stress test และ Tilt table test ประจำวันพุธ

ผู้ตรวจ	ลำดับที่	เวลาที่นัด	เวลาเริ่มตรวจ	เวลาตรวจเสร็จ	ลิทธิ	ชื่อผู้ป่วย HN	อายุ	ประเภทการตรวจ	โรค	เบอร์โทรศัพท์	ตรวจสอบ สิทธิ ล่วงหน้า	การยืนยัน การตรวจ	หมายเหตุ
F1	1	8.00น	8.30น	9.15น	เบิกได้ หรือ จ่ายเอง			TT					
	2	8.45น	9.15น	9.30น				EST					
	3	9.00น	9.30น	9.45น				EST					
	4	9.15น	9.45น	10.00น				EST					
	5	9.30น	10.00น	10.15น				EST					
	6	9.45น	10.15น	10.30น				EST					
พักรับประทานอาหารกลางวัน													

- หมายเหตุ
- ตารางนัดตรวจนี้ใช้ในกรณีผู้ใช้บริการที่ใช้สิทธิเบิกได้ หรือจ่ายเองมานัดหมาย TTT ให้นัดหมายเวลา 9.00 น และเป็นลำดับที่ 1
 - การตรวจทดสอบสิทธิล่วงหน้าเฉพาะผู้ที่ใช้สิทธิ 30 บาท และสิทธิประกันสังคม
 - ผู้ที่โทรศัพท์ยืนยันการตรวจให้เสร็จก่อน และวัน/เดือน/ปี ที่โทรศัพท์ยืนยันการตรวจในช่องยืนยันการตรวจทุกครั้ง

ตารางนัด Exercise stress test และ Tilt table test ประจำวันพุธ

ผู้ตรวจ	ลำดับที่	เวลาที่นัด	เวลาเริ่มตรวจ	เวลาตรวจเสร็จ	เวลาตรวจเสร็จ	ลิทธิ	ชื่อผู้ป่วย HN	อายุ	ประเภทการตรวจ	โรค	เบอร์โทรศัพท์	ตรวจสอบสิทธิล่วงหน้า	การยืนยันการตรวจ	หมายเหตุ
F1	1	8.00น	8.30น	8.45น	8.45น	เบิกได้หรือจำเอง			EST					
	2	8.15น	8.45น	9.00น	9.00น				EST					
	3	8.30น	9.00น	9.15น	9.15น				EST					
	4	8.45น	9.15น	9.30น	9.30น				EST					
	5	9.00น	9.30น	10.15น	10.15น	บัตรทองหรือปศ.			TT					
	6	9.45น	10.15น	10.30น	10.30น				EST					
พักรับประทานอาหารกลางวัน														

หมายเหตุ

- ตารางนัดตรวจนี้ใช้ในกรณีผู้ใช้บริการที่ใช้สิทธิบัตรทอง หรือประกันสังคมมานัดหมาย TTT ให้นัดหมายเวลา 9.00 น และเป็นลำดับที่ 5
- การตรวจสอบสิทธิล่วงหน้าเฉพาะผู้ที่สิทธิ 30 บาท และสิทธิประกันสังคม
- ผู้ที่โทรศัพท์ยืนยันการตรวจให้เชื่อนชื่อ และวัน/เดือน/ปี ที่โทรศัพท์ยืนยันการตรวจในช่องยืนยันการตรวจทุกครั้ง

APPENDIX B

แนวทางในการประเมินผล (Evaluation guidelines)

การประเมินผล ประเมินจากเวลารวมทั้งหมดที่ใช้ (total waiting time) ในการตรวจวินิจฉัยที่หน่วยตรวจพิเศษหัวใจและหลอดเลือด ซึ่งหมายถึง เวลาที่ผู้ให้บริการในแต่ละจุดบริการใช้ให้บริการ (service time) รวมกับเวลารอของผู้ใช้บริการที่รอเพื่อใช้บริการในแต่ละจุดบริการ (waiting time in queue) เช่น รอชั่งน้ำหนัก เวลาในการรอตรวจ เป็นต้น

โดยสรุป คือ เวลารวมทั้งหมดที่ใช้ในการตรวจ = เวลาที่ผู้ให้บริการในแต่ละจุดบริการใช้ให้บริการ + เวลารอคอยในแถวคอย

ก่อนการพัฒนา

จากภาพที่ 1 ที่แสดงระบบการไหลเวียนผู้มาใช้บริการการตรวจวินิจฉัยโรคหัวใจด้วยวิธี non-invasive พบว่าการบริการแบ่งออกเป็น 2 แถวคอย (queue) และเวลารวมที่ใช้ในแต่ละแถวคอยก็แตกต่างกัน คือ

แถวคอย (queue) ที่ 1 เป็นการตรวจหัวใจด้วยคลื่นเสียงสะท้อนความถี่สูง (echocardiogram) ใช้เวลาในการรอใช้บริการรวม 311 นาที ซึ่งมีวิธีคิด ดังนี้

1. เวลารอคอยในแถวคอย

1.1 ผู้ใช้บริการที่เบิกได้หรือจ่ายเอง เวลารอคอยในแถวคอยประกอบด้วย

1.1.1 นั่งรอเรียกชื่อเฉลี่ย 60 นาที (1 ชั่วโมง)

1.1.2 เมื่อหน่วยงานเปิดทำการ รอเรียกตามคิว 3 นาที

1.1.3 รอวัดความดันโลหิต ชีพจร ชั่งน่น. วัดส่วนสูง 2 นาที

1.1.4 นั่งรอตรวจเฉลี่ย 150 นาที (2 ชั่วโมง 30 นาที)

1.1.5 รอรับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 2 นาที

ดังนั้น ผู้ใช้บริการที่เบิกได้หรือจ่ายเองใช้เวลารอ $60 + 3 + 2 + 150 + 2 = 217$ นาที

1.2 ผู้ใช้บริการที่ใช้สิทธิประกันสังคม เวลารอคอยในแถวคอยประกอบด้วย

1.2.1 นั่งรอตรวจเฉลี่ย 150 นาที (2 ชั่วโมง 30 นาที)

1.2.2 รอรับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 2 นาที

ดังนั้น ผู้ใช้บริการที่ใช้สิทธิประกันสังคมใช้เวลารอ 150 + 2 = 152 นาที

1.3 ผู้ใช้บริการที่ใช้สิทธิบัตรทอง เวลารอคอยในแถวคอยประกอบด้วย

1.3.1 นั่งรอเรียกชื่อเฉลี่ย 60 นาที (1 ชั่วโมง)

1.3.2 เมื่อหน่วยงานเปิดทำการ รอเรียกตามคิวเพื่อไปตรวจสอบสิทธิ 3 นาที

1.3.3 นั่งรอตรวจเฉลี่ย 150 นาที (2 ชั่วโมง 30 นาที)

1.2.3 รอรับคำแนะนำจากพยาบาลหลังตรวจเสร็จ 2 นาที

ดังนั้น ผู้ใช้บริการที่ใช้สิทธิบัตรทองใช้เวลารอ 60 + 3 + 150 + 2 = 215 นาที

รวมเวลาที่รอเฉลี่ย = $(217 + 152 + 215) / 3 = 194$ นาที

2. เวลาที่มีกิจกรรม ประกอบด้วย

2.1 ผู้ใช้บริการที่เบิกได้หรือจ่ายเองผู้ให้บริการใช้เวลาในการทำกิจกรรม

ประกอบด้วย

2.1.1 เจ้าหน้าที่ซักถามข้อมูลต่างๆ 2 นาที

2.1.2 วัดความดันโลหิต ชีพจร ชั่งน้ำหนัก วัดส่วนสูง 3 นาที

2.1.3 รับการตรวจหัวใจด้วยคลื่นเสียงสะท้อนความถี่สูง (echocardiogram)

ซึ่งใช้เวลา 45-90 นาที เฉลี่ย = $(45+90) / 2 = 67$ นาที โดยพยาบาลให้การพยาบาลก่อนการตรวจขณะตรวจและภายหลังการตรวจ

2.1.4 รับคำแนะนำจากพยาบาลหลังตรวจเสร็จ 5 นาที

2.1.5 ชำระค่าตรวจ 5 นาที

ดังนั้น ผู้ใช้บริการที่เบิกได้หรือจ่ายเองใช้เวลา 2 + 3 + 67 + 5 + 5 = 82 นาที

2.2 ผู้ใช้บริการที่ใช้สิทธิประกันสังคมใช้เวลาในการทำกิจกรรมประกอบด้วย

2.2.1 เวลาในการตรวจสอบสิทธิ 60 นาที (1 ชั่วโมง)

2.2.2 วัดความดันโลหิต ชีพจร ชั่งน้ำหนัก วัดส่วนสูง 3 นาที

2.2.3 รับการตรวจหัวใจด้วยคลื่นเสียงสะท้อนความถี่สูง (echocardiogram) ซึ่ง

ใช้เวลาเฉลี่ย 67 นาที

2.2.4 รับคำแนะนำจากพยาบาลหลังตรวจเสร็จ 5 นาที

ดังนั้น ผู้ใช้บริการที่ใช้สิทธิประกันสังคมใช้เวลาทำกิจกรรม 60 + 3 + 67 + 5 = 135 นาที

2.3 ผู้ใช้บริการที่ใช้สิทธิบัตรทองใช้เวลาในการทำกิจกรรมประกอบด้วย

2.3.1 เวลาในการตรวจสอบสิทธิ 60 นาที (1 ชั่วโมง)

2.3.2 วัดความดันโลหิต ชีพจร ชั่งน้ำหนัก วัดส่วนสูง 3 นาที

2.3.3 รับการตรวจหัวใจด้วยคลื่นเสียงสะท้อนความถี่สูง(echocardiogram) ใช้เวลาเฉลี่ย 67 นาที

2.3.4 รับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 5 นาที

ดังนั้น ผู้ใช้บริการที่ใช้สิทธิบัตรทองใช้เวลาทำกิจกรรม $60 + 3 + 67 + 5 = 135$ นาที

รวมเวลาที่มีกิจกรรมเฉลี่ย = $(82 + 135 + 135) / 3 = 117$ นาที

สรุป เวลารวมทั้งหมดที่ใช้ในการตรวจหัวใจด้วยคลื่นเสียงสะท้อนความถี่สูงก่อนการพัฒนา เท่ากับ $194 + 117 = 311$ นาที

แถวคอย (queue) ที่ 2 เป็นการทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย (exercise stress test, EST) และการตรวจหาสาเหตุการเป็นลมหมดสติโดยใช้เตียงปรับระดับ (tilt table test, TTT) ใช้เวลาในการรอใช้บริการรวม 219 นาที ซึ่งมีวิธีคิด ดังนี้

1. เวลารอคอยในแถวคอย

1.1 ผู้ใช้บริการที่เบิกได้หรือจ่ายเอง เวลารอคอยในแถวคอยประกอบด้วย

1.1.1 นั่งรอเรียกชื่อเฉลี่ย 60 นาที (1 ชั่วโมง)

1.1.2 เมื่อหน่วยงานเปิดทำการ รอเรียกตามคิว 3 นาที

1.1.3 รอวัดความดันโลหิต ชีพจร ชั่งน่น. วัดส่วนสูง 2 นาที

1.1.4 นั่งรอตรวจเฉลี่ย 90 นาที (1 ชั่วโมง 30 นาที)

1.1.5 รอรับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 2 นาที

ดังนั้น ผู้ใช้บริการที่เบิกได้หรือจ่ายเองใช้เวลารอ $60 + 3 + 2 + 90 + 2 = 157$ นาที

1.2 ผู้ใช้บริการที่ใช้สิทธิประกันสังคม เวลารอคอยในแถวคอยประกอบด้วย

1.2.1 นั่งรอตรวจเฉลี่ย 90 นาที (1 ชั่วโมง 30 นาที)

1.2.3 รอรับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 2 นาที

ดังนั้น ผู้ใช้บริการที่ใช้สิทธิประกันสังคมใช้เวลารอ $90 + 2 = 92$ นาที

1.3 ผู้ใช้บริการที่ใช้สิทธิบัตรทอง เวลารอคอยในแถวคอยประกอบด้วย

1.3.1 นั่งรอเรียกชื่อเฉลี่ย 60 นาที (1 ชั่วโมง)

1.3.2 เมื่อหน่วยงานเปิดทำการ รอเรียกตามคิวเพื่อไปตรวจสอบสิทธิ 3 นาที

1.3.3 นั่งรอตรวจเฉลี่ย 90 นาที (1 ชั่วโมง 30 นาที)

1.2.3 รอรับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 2 นาที

ดังนั้น ผู้ใช้บริการที่ใช้สิทธิบัตรทองใช้เวลารอ $60 + 3 + 90 + 2 = 155$ นาที

รวมเวลาที่รอเฉลี่ย = $(157 + 92 + 155) / 3 = 134$ นาที

2. เวลาที่มีกิจกรรม ประกอบด้วย

2.1 ผู้ใช้บริการที่เบิกได้หรือจ่ายเองผู้ให้บริการใช้เวลาในการทำกิจกรรม ประกอบด้วย

2.1.1 เจ้าหน้าที่ซักถามข้อมูลต่างๆ 2 นาที

2.1.2 วัดความดันโลหิต ชีพจร ชั่งน้ำหนัก วัดส่วนสูง 3 นาที

2.1.3 รับการทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย ซึ่งใช้เวลา 25 นาที ในกรณีตรวจหาสาเหตุการเป็นลมหมดสติโดยใช้เตียงปรับระดับ ใช้เวลา 45 นาที ใช้เวลาเฉลี่ย $(25 + 45) / 2 = 35$ นาที

2.1.4 รับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 5 นาที

2.1.5 ชำระค่าตรวจ 5 นาที

ดังนั้น การทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย และการตรวจหาสาเหตุการเป็นลมหมดสติโดยใช้เตียงปรับระดับ ใช้เวลา $2 + 3 + 35 + 5 + 5 = 50$ นาที

2.2 ผู้ใช้บริการที่ใช้สิทธิประกันสังคมใช้เวลาในการทำกิจกรรมประกอบด้วย

2.2.1 เวลาในการตรวจสอบสิทธิ 60 นาที (1 ชั่วโมง)

2.2.2 วัดความดันโลหิต ชีพจร ชั่งน้ำหนัก วัดส่วนสูง 3 นาที

2.2.3 รับการทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย และการตรวจหาสาเหตุการเป็นลมหมดสติโดยใช้เตียงปรับระดับ ใช้เวลาเฉลี่ย 35 นาที พยาบาลให้การพยาบาล ก่อนการตรวจขณะตรวจและภายหลังการตรวจ

2.2.4 รับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 5 นาที

ดังนั้น ผู้ใช้บริการที่ใช้สิทธิประกันสังคมใช้เวลาทำกิจกรรม $60 + 3 + 35 + 5 = 103$ นาที

2.3 ผู้ใช้บริการที่ใช้สิทธิบัตรทองใช้เวลาในการทำกิจกรรมประกอบด้วย

2.3.1 เวลาในการตรวจสอบสิทธิ 60 นาที (1 ชั่วโมง)

2.3.2 วัดความดันโลหิต ชีพจร ชั่งน้ำหนัก วัดส่วนสูง 3 นาที

2.3.3 รับการทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย และการตรวจหาสาเหตุการเป็นลมหมดสติโดยใช้เตียงปรับระดับ ใช้เวลาเฉลี่ย 35 นาที

2.3.4 รับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 5 นาที

ดังนั้น ผู้ใช้บริการที่ใช้สิทธิบัตรทองใช้เวลาทำกิจกรรม $60 + 3 + 35 + 5 = 103$ นาที

รวมเวลาที่มีกิจกรรมเฉลี่ย $= (50 + 103 + 103) / 3 = 85$ นาที

สรุป เวลารวมทั้งหมดที่ใช้ในการทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย และการตรวจหาสาเหตุการเป็นลมหมดสติโดยใช้เตียงปรับระดับ ก่อนการพัฒนา เท่ากับ $134 + 85 = 219$ นาที

ภายหลังการพัฒนา

แถวคอย (queue) ที่1 เป็นการตรวจหัวใจด้วยคลื่นเสียงสะท้อนความถี่สูง (echocardiogram) ใช้เวลาในการรอใช้บริการรวม 108 นาที ซึ่งมีวิธีคิด ดังนี้ จากตารางนัดใหม่ ซึ่งมีการนัดผู้ให้บริการเป็นคลื่นเวลา โดยนัดก่อนเวลาตรวจจริง 30 นาที และนัดเหลื่อมกันตามเวลาที่ใช้ตรวจ

1. เวลารอคอยในแถวคอย แยกตามผู้ให้บริการ คือ

1.1 อาจารย์แพทย์

1.1.1 นัดตรวจเวลา 8.30 น. เริ่มตรวจเวลา 9.00 น. เวลารอตรวจ เท่ากับ 30 นาที

1.1.2 รอรับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 2 นาที

ดังนั้น ผู้ให้บริการที่อาจารย์แพทย์เป็นผู้ตรวจ ใช้เวลารอ $30 + 2 = 32$ นาที

1.2 Fellow₂

1.2.1 นัดตรวจเวลา 8.00 น. เริ่มตรวจเวลา 8.30 น. เวลารอตรวจ เท่ากับ 30 นาที

1.2.2 รอรับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 2 นาที

ดังนั้น ผู้ให้บริการที่ fellow₂ เป็นผู้ตรวจ ใช้เวลารอ $30 + 2 = 32$ นาที

1.3 Fellow₁

1.3.1 นัดตรวจเวลา 8.00 น. เริ่มตรวจเวลา 8.30 น. เวลารอตรวจ เท่ากับ 30 นาที

1.3.2 รอรับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 2 นาที

ดังนั้น ผู้ให้บริการที่ fellow₂ เป็นผู้ตรวจ ใช้เวลารอ $30 + 2 = 32$ นาที

1.4 Sonographer

1.4.1 นัดตรวจเวลา 8.00 น. เริ่มตรวจเวลา 8.30 น. เวลารอตรวจ เท่ากับ 30 นาที

1.4.2 รอรับคำแนะนำจาก sonographer ภายหลังตรวจเสร็จ 2 นาที

ดังนั้น ผู้ให้บริการที่ sonographer เป็นผู้ตรวจ ใช้เวลารอ 32 นาที

รวมเวลาที่รอเฉลี่ย $= (32 + 32 + 32 + 32) / 4 = 32$ นาที

2. เวลาที่มีกิจกรรม แยกตามผู้ให้บริการ คือ

2.1 อาจารย์แพทย์

2.1.1 เริ่มตรวจเวลา 9.00 น. ตรวจเสร็จเวลา 9.45 น. ใช้เวลาเท่ากับ 45 นาที

2.1.2 รับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 5 นาที

ดังนั้น ผู้ให้บริการที่ อาจารย์แพทย์เป็นผู้ตรวจ ใช้เวลาที่มีกิจกรรม $45 + 5 = 50$ นาที

2.2 Fellow₂

2.2.1 เริ่มตรวจเวลา 8.30 น. ตรวจเสร็จเวลา 9.30 น. ใช้เวลาเท่ากับ 60 นาที

2.2.2 รับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 5 นาที

ดังนั้น ผู้ให้บริการที่ fellow₂ เป็นผู้ตรวจ ใช้เวลาที่มีกิจกรรม $60 + 5 = 65$ นาที

2.3 Fellow₁

2.3.1 เริ่มตรวจเวลา 8.30 น. ตรวจเสร็จเวลา 10.00 น. ใช้เวลาเท่ากับ 90 นาที

2.3.2 รับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 5 นาที

ดังนั้น ผู้ให้บริการที่ fellow₁ เป็นผู้ตรวจ ใช้เวลาที่มีกิจกรรม $90 + 5 = 95$ นาที

2.4 Sonographer

2.4.1 เริ่มตรวจเวลา 8.30 น. ตรวจเสร็จเวลา 10.00 น. ใช้เวลาเท่ากับ 90 นาที

2.4.2 รับคำแนะนำจาก sonographer ภายหลังตรวจเสร็จ 5 นาที

ดังนั้น ผู้ให้บริการที่ sonographer เป็นผู้ตรวจ ใช้เวลาที่มีกิจกรรม $90 + 5 = 95$ นาที

รวมเวลาที่มีกิจกรรมเฉลี่ย = $(50 + 65 + 95 + 95) / 4 = 76$ นาที

สรุป เวลาทั้งหมดที่ใช้ในการตรวจหัวใจด้วยคลื่นเสียงสะท้อนความถี่สูงหลังการ พัฒนาเท่ากับ $32 + 76 = 108$ นาที (ก่อนการพัฒนา 311 นาที)

แถวคอย (queue) ที่2 เป็นการทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย (exercise stress test, EST) และการตรวจหาสาเหตุอาการเป็นลมหมดสติโดยใช้เตียงปรับระดับ (tilt table test, TTT) ใช้เวลาในการรอให้บริการรวม 67 นาที ซึ่งมีวิธีคิด ดังนี้

จากตารางนัดใหม่ ซึ่งมีการนัดผู้ให้บริการเป็นคลื่นเวลา โดยนัดก่อนเวลาตรวจจริง 30 นาที และนัดเหลื่อมกันตามเวลาที่ใช้ตรวจ ผู้ตรวจคือ fellow₁

1. เวลารอคอยในแถวคอย

1.1 นัดตรวจเวลา 8.30 น. เริ่มตรวจเวลา 9.00 น. เวลารอตรวจ จึงเท่ากับ 30 นาที

1.2 รอรับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 2 นาที

ดังนั้น ผู้ใช้บริการที่มาทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย และ
ตรวจหาสาเหตุอาการเป็นลมหมดสติโดยใช้เตียงปรับระดับ ใช้เวลารอ $30 + 2 = 32$ นาที

2. เวลาที่มีกิจกรรมแยกตาม procedure คือ

2.1 การทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย ใช้เวลาในการทดสอบ 15
นาที สำหรับเวลาที่ใช้เตรียม 10 นาที โดยเตรียมผู้ให้บริการไว้รอก่อนแล้วอีกห้องหนึ่ง ขณะรอ
คอยแพทย์ตรวจ เวลาจึงรวมอยู่ในเวลารอคอยแพทย์ตรวจ เพราะตรวจ 2 ห้อง สลับกัน

2.1.2 รับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 5 นาที

ดังนั้น เวลาที่ใช้ในการทำกิจกรรม $15 + 5 = 20$ นาที

2.2 การตรวจหาสาเหตุอาการเป็นลมหมดสติโดยใช้เตียงปรับระดับ ใช้เวลาในการ
ตรวจ 45 นาที สำหรับเวลาที่ใช้เตรียม 15 นาที โดยเตรียมผู้ให้บริการไว้รอก่อนแล้วอีกห้องหนึ่ง
ขณะรอคอยแพทย์ตรวจ เวลาจึงรวมอยู่ในเวลารอคอยแพทย์ตรวจ เพราะตรวจ 2 ห้อง สลับกัน

2.2.2 รับคำแนะนำจากพยาบาลภายหลังตรวจเสร็จ 5 นาที

ดังนั้น เวลาที่ใช้ในการทำกิจกรรม $45 + 5 = 50$ นาที

รวมเวลาที่มีกิจกรรมเฉลี่ย $= (20 + 50) / 2 = 35$ นาที

สรุป เวลารวมทั้งหมดที่ใช้ในการทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย
และการตรวจหาสาเหตุอาการเป็นลมหมดสติโดยใช้เตียงปรับระดับ ภายหลังการพัฒนา เท่ากับ
 $32 + 32 + 35 = 67$ นาที (ก่อนการพัฒนา 219 นาที)

เวลาในการให้บริการทั้ง 2 แถวคอย (queue) สรุปเป็นตาราง ได้ ดังนี้

เวลาที่ใช้	เดิม	ใหม่	ลดลงร้อยละ
1. การตรวจหัวใจด้วยคลื่นเสียงสะท้อนความถี่สูง	311 นาที	108 นาที	65
2. การทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย และการตรวจหาสาเหตุอาการเป็นลมหมดสติโดย ใช้เตียงปรับระดับ	219 นาที	67 นาที	69

APPENDIX C

แบบสอบถามความพึงพอใจของผู้ใช้บริการเกี่ยวกับระบบนัดหมายและการบริการ ที่หน่วยตรวจพิเศษหัวใจและหลอดเลือด ศูนย์โรคหัวใจฯ ชั้น 6 โรงพยาบาลศิริราช

เนื่องจากหน่วยงานจะดำเนินการพัฒนาปรับปรุงระบบนัดหมายและคุณภาพการบริการ เพื่อตอบสนองความต้องการของท่านให้ดียิ่งขึ้น จึงใคร่ขอความร่วมมือจากท่านในการตอบแบบสอบถาม และให้ข้อเสนอแนะเกี่ยวกับบริการที่ท่านได้รับ กรุณาตอบตามความเป็นจริง และขอขอบคุณในความร่วมมือมา ณ โอกาสนี้

คำชี้แจง โปรดทำเครื่องหมาย ✓ ลงในช่องว่าง () หน้าข้อความ หรือเติมข้อความลงในช่องว่างที่ตรงกับความเป็นจริงเกี่ยวกับตัวท่าน

1. ท่านเคยใช้บริการการตรวจของหน่วยตรวจพิเศษหัวใจและหลอดเลือด ศูนย์โรคหัวใจฯ ชั้น 6 มาก่อนหรือไม่
 () เคย ครั้งที่.....
 () ไม่เคย
2. ท่านใช้สิทธิการเบิกค่าใช้จ่ายในการตรวจครั้งนี้หรือไม่
 () ใช้ (ระบุประเภทสิทธิ)
 () ไม่ใช้
3. ท่านได้รับการนัดเพื่อตรวจ
 () การตรวจหัวใจด้วยคลื่นเสียงสะท้อนความถี่สูงผ่านผนังทรวงอก
 () การตรวจหัวใจด้วยคลื่นเสียงสะท้อนความถี่สูงผ่านหลอดอาหาร
 () การทดสอบสมรรถภาพหัวใจด้วยการออกกำลังกาย
 () การตรวจหาสาเหตุการเป็นลมหมดสติโดยใช้เตียงปรับระดับ
4. กรณีใช้สิทธิค่าใช้จ่ายในการตรวจ ท่านได้รับความสะดวกในการแนะนำเรื่องสิทธิค่าใช้จ่ายหรือไม่
 () สะดวก รวดเร็ว
 () ไม่สะดวก เพราะ.....

5. ท่านได้รับการโทรศัพท์ยืนยันการนัดหมาย ครั้งนี้หรือไม่
- () ได้
- () ไม่ได้
6. ท่านคิดว่าการโทรศัพท์ยืนยันการนัดหมายเป็นการอำนวยความสะดวกในการตรวจ หรือไม่
- () สะดวก
- () ไม่สะดวก เพราะ.....
7. คำแนะนำที่ได้รับในวันที่ท่านมานัดหมายครั้งนี้เป็นอย่างไร
- () ชัดเจน เข้าใจง่าย
- () ไม่เข้าใจ ควรปรับปรุง
8. เจ้าหน้าที่ให้บริการนัดหมายแก่ท่านเป็นอย่างไร (ตอบได้มากกว่า 1 ข้อ)
- () สุภาพ ยิ้มแย้มแจ่มใส มีอัธยาศัยดี
- () สนใจ เอาใจใส่ เต็มใจให้ความช่วยเหลือ
- (☒) หน้าที่ๆ ดูด่าย ไม่เอาใจใส่
- () อื่นๆ
9. ความพึงพอใจโดยรวมในการให้บริการนัดหมาย (กรณากากบาทบนเส้นตรง)
- | | |
|------------|---------|
| 0 | 10 |
| ไม่พอใจเลย | พอใจมาก |
10. ท่านรู้สึกว่าเวลาที่ใช้ในการรอตรวจครั้งนี้ เป็นอย่างไร
- () รวดเร็ว ตรงตามเวลา
- () นาน เพราะ.....
- ข้อเสนอแนะ.....
11. สถานที่นั่งรอหน้าหน่วยตรวจ เป็นอย่างไร
- () สะดวก
- () ไม่สะดวก เพราะ.....
- ข้อเสนอแนะ.....
10. ความรู้ที่ท่านได้รับขณะรอตรวจ
- () ดี
- () พอใช้
- () น้อย ไม่เพียงพอ

ข้อเสนอแนะ.....

13. บริการที่ท่านได้รับภายในห้องตรวจเป็นอย่างไร (ตอบได้มากกว่า 1 ข้อ)

- () ได้รับข้อมูลเกี่ยวกับการตรวจอย่างชัดเจน
- () ได้รับการเอาใจใส่ ช่วยเหลืออย่างดี
- () ไม่ได้รับการเอาใจใส่เท่าที่ควร เพราะ.....

ข้อเสนอแนะ.....

14. บริการที่ท่านได้รับภายหลังการตรวจเป็นอย่างไร ? (ตอบได้มากกว่า 1 ข้อ)

- () ได้รับความรู้ คำแนะนำ เกี่ยวกับการปฏิบัติตัว และการมาตรวจตามนัดครั้งต่อไป
- () ท่านได้รับการบริการอย่างเสมอภาค และให้เกียรติ
- () ควรปรับปรุง

ข้อเสนอแนะ.....

15. ท่านรู้สึกอย่างไรต่อบริการโดยรวมที่ได้รับครั้งนี้ (กรุณากากบาทบนเส้นตรง)

0	10
ไม่พอใจเลย	พอใจมาก

16. ข้อเสนอแนะอื่นๆในการปรับปรุงบริการให้ดีขึ้น

.....

.....

.....

.....

หน่วยตรวจพิเศษหัวใจและหลอดเลือด

APPENDIX D

แนวทางการพัฒนาเครื่องมือ (Development of an appointment system guidelines)

การดำเนินการพัฒนาระบบนัดหมายเพื่อการตรวจวินิจฉัยโรคหัวใจด้วยวิธี non-invasive ของหน่วยตรวจพิเศษหัวใจและหลอดเลือด โรงพยาบาลศิริราช ใช้ระยะเวลาดำเนินการ 7 เดือน โดยมีขั้นตอนการดำเนินงาน ดังนี้

1. ค้นหาปัญหาการบริการ/โอกาสพัฒนาของหน่วยงาน โดยใช้ประสบการณ์การปฏิบัติงานของผู้ศึกษา รวมทั้งศึกษาเอกสาร และข้อร้องเรียนต่างๆ ตั้งแต่เดือนมกราคม 2547 ถึงเดือนธันวาคม 2548 พบว่า ปัญหาสำคัญ ที่ส่งผลกระทบต่อคุณภาพการบริการ คือ ระบบนัดหมายขาดประสิทธิภาพ และการรอตรอนาน (long waiting time) ของผู้ใช้บริการ เหตุผลที่เลือกปัญหานี้ เนื่องจาก ระยะเวลารอคอยเป็นตัวชี้วัดคุณภาพบริการที่สำคัญตัวหนึ่งของการพัฒนาคุณภาพบริการ ที่ส่งผลให้ผู้ใช้บริการไม่พึงพอใจในบริการที่ได้รับ และระยะเวลารอตรอวยังเป็นปัจจัยที่ผู้ใช้บริการใช้ในการตัดสินใจเลือกสถานบริการสุขภาพ นอกจากนี้ ยังเป็นเรื่องที่เกี่ยวกับระบบงานหรือวิธีการทำงานซึ่งจะต้องนำมาพัฒนาคุณภาพ และ ยังตอบสนองต่อนโยบายของคณะแพทยศาสตร์ศิริราชพยาบาล ที่กำหนดให้การประกันเวลารอตรออยู่ในแผนยุทธศาสตร์ประจำปี พ.ศ.2549

2. สสำรวจสภาพปัจจุบัน โดยทำการสังเกตการณ์เพื่อทำความเข้าใจกับระบบนัดหมายและกระบวนการทำงานของหน่วยงาน นำมาเขียนแผนภาพ/แผนภูมิของกระบวนการทำงาน ในการศึกษาได้เขียนแผนภาพของระบบการไหลเวียนผู้มาใช้บริการการตรวจวินิจฉัยโรคหัวใจด้วยวิธี non-invasive (ภาพที่ 1) ทำให้เข้าใจกับกระบวนการทำงานอย่างลึกซึ้ง รวมทั้งจำนวนบุคคลากร หน้าที่ในแต่ละขั้นตอนของกระบวนการทำงาน ระยะเวลาในแต่ละกระบวนการ และยังใช้วิเคราะห์หาเครื่องชี้วัดในการศึกษาด้วย

3. ทบทวนวรรณกรรมที่เกี่ยวข้อง จากข้อมูลเชิงประจักษ์ของหน่วยงาน จากข้อมูลทางวิชา การ วิจัย ในฐานข้อมูลอิเล็กทรอนิกส์ และห้องสมุดต่างๆทั้งในประเทศไทยและต่างประเทศ ระหว่างปี ค.ศ.1992-2004 ดังนี้ คือ

3.1 ทบทวนวรรณกรรมที่เกี่ยวข้องในประเทศไทย จากห้องสมุดของมหาวิทยาลัยต่างๆ ได้แก่ มหาวิทยาลัยมหิดล มหาวิทยาลัยขอนแก่น มหาวิทยาลัยเกษตรศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย คำ/ข้อความสำคัญในการสืบค้น คือ ระยะเวลารอคอย การนัดหมาย คิว ได้วรรณกรรมที่เกี่ยวข้องจำนวน 9 เรื่อง เป็นงานวิจัย 6 เรื่อง และข้อมูลทางวิชาการ 3 เรื่อง

3.2 ทบทวนวรรณกรรมที่เกี่ยวข้องในต่างประเทศ โดยสืบค้นจากฐานข้อมูลอิเล็กทรอนิกส์ Medline, Embase, Entrez PubMed และ Science direct โดยกำหนดคำ/ข้อความสำคัญในการสืบค้น คือ appointment, queueing, waiting time, scheduling, scheduling appointment, table, outpatient, patient satisfaction, quality improvement ได้วรรณกรรมที่เกี่ยวข้องจำนวน 11 เรื่อง ซึ่งเป็นงานวิจัยจำนวน 7 เรื่อง มาตรฐานการปฏิบัติงานจำนวน 3 เรื่อง และรายงานการปฏิบัติงานของผู้เชี่ยวชาญ จำนวน 1 เรื่อง นำมาวิเคราะห์เพื่ออธิบายประเด็นปัญหาที่ระบุไว้

4. วิเคราะห์ปัญหา (problem analysis) โดยนำแต่ละประเด็น คือ ระบบนัดหมายขาดประสิทธิภาพ และการรอตรวจนาน มาวิเคราะห์แยกสาเหตุของปัญหา โดยใช้แผนภูมิก้างปลา (fishbone diagram) ซึ่งเป็นเครื่องมือในการวิเคราะห์ปัญหา และมองเห็นภาพรวมของสาเหตุของปัญหาอย่างเป็นระบบ เพื่อพิจารณาแนวทางในการแก้ไขอย่างเหมาะสม

5. สร้างแนวทางพัฒนา/แก้ไขปัญหา โดยนำข้อมูลเชิงประจักษ์มาสนับสนุน พัฒนาเป็นระบบนัดหมายใหม่ และการปรับปรุงการบริหารจัดการภายในหน่วยงาน (บทที่ 4 หน้า 84-89)

6. นำระบบนัดหมายใหม่ และการปรับปรุงการบริหารจัดการภายในหน่วยงาน ให้ผู้ทรงคุณวุฒิ จำนวน 3 ท่าน ตรวจสอบความเที่ยงตรง และนำมาปรับปรุงแก้ไขตามข้อเสนอแนะ

7. ประเมินความเป็นไปได้ในการนำแนวทางที่พัฒนาขึ้นไปใช้ (บทที่ 3 หน้า 79-80)

8. เสนอแนะแนวทางในการนำไปใช้ (บทที่ 3 หน้า 80)

9. เสนอแนะแนวทางในการประเมินผล โดยประเมินจากเวลารวมทั้งหมดที่ใช้ในการตรวจ (ภาคผนวก ข) และระดับความพึงพอใจของผู้ใช้บริการ (ภาคผนวก ค)

แผนงานและระยะเวลาดำเนินงาน

รายละเอียด	ธ.ค.48				ม.ค.49				ก.พ.49				มี.ค.49				เม.ย.49				พ.ค.49				มิ.ย.49			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1. ค้นหาปัญหาการบริการ	←	→																										
2. ตรวจสอบสภาพปัจจุบัน			←	→																								
3. ทบทวนวรรณกรรมที่เกี่ยวข้อง					←	→																						
4. วิเคราะห์ปัญหา										←	→																	
5. สร้างแนวทางพัฒนา/แก้ไขปัญหา														←	→													
6. นำแนวทางพัฒนา/แก้ไขปัญหาที่สร้างขึ้นให้ผู้ทรงคุณวุฒิตรวจสอบ																	←	→										
7. ประเมินความเป็นไปได้ในการนำแนวทางที่พัฒนาขึ้นไปใช้																			←	→								
8. เสนอแนะแนวทางในการนำไปใช้																				←	→							
9. เสนอแนะแนวทางในการประเมินผล																					←	→						

APPENDIX E

รายนามผู้ทรงคุณวุฒิ

1. ศาสตราจารย์แพทย์หญิงดวงมณี เลหาประสิทธิ์พร

- รองหัวหน้าภาควิชากุมารเวชศาสตร์ ฝ่ายบริการและพัฒนาคุณภาพ
คณะแพทยศาสตร์ศิริราชพยาบาล
- ประธานศูนย์ฝึกอบรมปฏิบัติการช่วยชีวิต คณะแพทยศาสตร์ศิริราชพยาบาล
- ประธานศูนย์รับเลี้ยงและพัฒนาเด็กศิริราช
- ประธานคณะทำงาน discharge planning / case management
คณะแพทยศาสตร์ศิริราชพยาบาล
- ประธานคณะทำงานกระบวนการรับผู้ป่วยนอก คณะแพทยศาสตร์ศิริราชพยาบาล
- รองประธานกรรมการบริหารองค์กรแพทย์ศิริราช
- กรรมการและผู้ช่วยเลขานุการคณะกรรมการกำกับดูแลงานเวชศาสตร์ฉุกเฉิน
คณะแพทยศาสตร์ศิริราชพยาบาล
- กรรมการการพัฒนางานบริการผู้ป่วยนอก คณะแพทยศาสตร์ศิริราชพยาบาล
- กรรมการคณะกรรมการบริหารคลินิกพิเศษนอกเวลาราชการ
คณะแพทยศาสตร์ศิริราชพยาบาล
- กรรมการคณะกรรมการจริยธรรมการวิจัยในคน คณะแพทยศาสตร์ศิริราช
พยาบาล
- หัวหน้าหน่วยตรวจพิเศษหัวใจและหลอดเลือด

2. ผู้ช่วยศาสตราจารย์นายแพทย์เดโช จักรพานิชกุล

- อาจารย์สาขาหทัยวิทยา ภาควิชาอายุรศาสตร์ คณะแพทยศาสตร์ศิริราชพยาบาล
- อาจารย์ผู้รับผิดชอบการตรวจวินิจฉัยโรคหัวใจด้วยวิธี non-invasive ในผู้ใหญ่
ของหน่วยตรวจพิเศษหัวใจและหลอดเลือด

3. นางสุเชาวนี อธิวิทย์

หัวหน้าพยาบาลประจำหน่วยตรวจพิเศษหัวใจและหลอดเลือด

BIOGRAPHY

NAME	Mrs.Wiphawin Watthanaprakarnchai
DATE OF BIRTH	23 March 1958
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	Mahidol University, 1982 : Bachelor of Nursing Mahidol University, 2006 : Master of Management (Nursing Management)
POSITION&OFFICE	2 Siriraj Hospital, Bangkok, Thailand Position: Nurse Tel. 02-4197000 ext 6040-1 E-mail: wwiphawin@yahoo.com
HOME ADDRESS	161/791 Charansanitwong Rd, Soi Charansanitwong 27, Bangkhunsri, Bangkoknoi, Bangkok 10700 Tel. 02-8666119, 06-0506200