DESIGN OF ELECTRONIC MEDICAL RECORD SYSTEM CONSIDERING THE JOINT COMMISSION INTERNATIONAL STANDARDS FOR HOSPITALS: A CASE STUDY OF A COMMUNITY HOSPITAL IN THAILAND

TAWINAN SIMAJARUK

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF ENGINEERING
(INDUSTRIAL ENGINEERING)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2012

Thesis
entitled

DESIGN OF ELECTRONIC MEDICAL RECORD SYSTEM CONSIDERING THE JOINT COMMISSION INTERNATIONAL STANDARDS FOR HOSPITALS: A CASE STUDY OF A COMMUNITY HOSPITAL IN THAILAND

……
Miss Tawinan Simajaruk
Candidate

……
Lect. Jirapan Liangrokapart,
Ph.D. (Industrial Engineering)
Major advisor

……
Assoc. Prof. Duangpun Kritchanchai,
Ph.D. (Industrial Engineering)
Co-advisor

……
Asst. Prof. Waressara Weerawat,
Ph.D. (Industrial Engineering)
Co-advisor

……
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

……
Asst.Prof. Thanakorn Naenna,
Ph.D. (Engineering Science)
Program Director
Master of Engineering Program
In Industrial Engineering
Faculty of Engineering,
Mahidol University

Thesis
entitled

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was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Master of Engineering
(Industrial Engineering)
on
22 August, 2012

.....
Miss Tawinan Simajaruk
Candidate

.....
Lect. Oraluck Pattanaprateep,
Ph.D. (Pharmacy Administrative)
Chair

.....
Sub.LtTongkarn Keawchalermtong
Ph.D.(Ocean Engineering)
Member

.....
Assoc.Prof.Duangpun Kritchanchai,
Ph.D. (Industrial Engineering)
Member

.....
Lect.Jirapan Lianggrokapart,
Ph.D.(Industrial Engineering)
Member

.....
Asst. Prof. Waressara Weerawat,
Ph.D. (Industrial Engineering))
Member

.....
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

.....
Lect. Worawit Isarangkul,
M.S. (Technical Management)
Dean
Faculty of Engineering
Mahidol University

ACKNOWLEDGEMENTS

I would like to express my sincere gratefulness and deep appreciation to my advisor, Dr. Jirapan Liangrokapart, for her guidance, supervision and encouragement throughout the course of this research project. The success of this thesis can be succeeded with the attentive support from my advisor. I would like to express my appreciation and deeply thank my big brother Mr. Sophon Muangchoo for the valuable advices and several suggestions knowledge to practice this research.

I would like to express my appreciation and deeply thank to my idol Assoc. Prof. Duangpun Kritchanchai, Asst. Prof. Waressara Weerawat, Dr. Oraluck Pattanaprateep and Sub. Lt. Tongkarn Kaewchalermtong, the external examiner of the thesis defense for their kindness in valuable suggestion and time sacrifice through this research.

I would like to thank the medical staffs from Phutthamonthol hospital, who provide all of medical record data which enable me to achieve this work. My friends from Rama9 hospital and Bumrungrad hospital who provide the information of Joint Commission International (JCI) accreditation standards for Hospitals.

I would like to express my most gratefulness to my mother and father, my family for their encouragement and moral support which have inspired me to achieve this goal.

Finally, thank to my friends, and staffs in Industrial Engineering department Mahidol University, for their help, kindness, support and cooperation during this research.

Tawinan Simajaruk

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TAWINAN SIMAJARUK 5236747 EGIE/M

M.Eng. (INDUSTRIAL ENGINEERING)

THESIS ADVISORY COMMITTEE: JIRAPAN LIANGROKAPART,PH.D., DUANGPUN KRITCHANCHAI,PH.D., WARESSARA WEERAWAT,PHD.

ABSTRACT

Nowadays, most public hospitals in Thailand still use paper-based medical system records which take a long time to retrieve, use a lot of storage space, and may cause a lot of medical errors. The objective of this research was to design an Electronic Medical Record (EMR) system for a community hospital in Thailand, considering the Joint Commission International (JCI) accreditation standards for hospitals and focusing on the out-patient department. The study began by identifying the current business process of the hospital and specifying the information required for each department. The value-added, necessary non-value-added, and non-value-added activities were identified, followed by an application of the Lean concept in order to reduce non-value-added activities. Next, a completed functional design of the EMR system was developed by standardizing the information, and simplifying the information flow among the hospital departments with the aim of following all necessary requirements for JCI accreditation standards. Lastly, lessons learnt from the applications were analyzed and will be used as a pilot study for intensifying other hospital services in the future.

KEY WORDS: ELECTRONIC MEDICAL RECORD/JOINT COMMISSION INTERNATIONAL ACCREDIATION STANDARDS/ LEAN CONCEPT/COMMUNITY HOSPITAL.

140 pages

การออกแบบ ระบบเวชระเบียนอิเล็กทรอนิกส์ตามมาตรฐาน Joint Commission International (JCI) accreditation สำหรับโรงพยาบาล กรณีศึกษา โรงพยาบาลชุมชนในประเทศไทย

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ทวินันท์ สิมะจารึก 5236747 EGIE/M

วศ.ม. (วิศวกรรมอุตสาหการ)

คณะกรรมการที่ปรึกษาวิทยานิพนธ์: จิรพรรณ เลี่ยงโรคาพาธ, PH.D., ดวงพรรณ กริชชาญชัย PH.D.,วเรศรา วีรวัฒน์, PH.D.

บทคัดย่อ

โรงพยาบาลของรัฐบาลส่วนใหญ่มีการเก็บข้อมูลของผู้รับบริการด้วยระบบแฟ้มเอกสาร ซึ่งขั้นตอนการเรียกดูแฟ้มเอกสารจะต้องใช้เวลานาน สิ้นเปลืองพื้นที่ในการจัดเก็บ และมีโอกาสเกิดความผิดพลาดได้มาก งานวิจัยนี้มีวัตถุประสงค์เพื่อทำการออกแบบระบบเวชระเบียนอิเลคทรอนิกส์สำหรับผู้ป่วยนอก โรงพยาบาลชุมชนแห่งหนึ่งในประเทศไทยโดยอ้างอิงตามมาตรฐาน Joint Commission International (JCI) สำหรับโรงพยาบาล งานวิจัยนี้ทำการศึกษาการเชื่อมโยงข้อมูลจากหน่วยงานที่เกี่ยวข้องภายในโรงพยาบาล โดยเริ่มจากวิเคราะห์กิจกรรมที่ก่อให้เกิดคุณค่า กิจกรรมที่จำเป็นแต่ไม่ก่อให้เกิดคุณค่า และกิจกรรมที่ไม่ก่อให้เกิดคุณค่าและทำการกำจัดกิจกรรมที่ไม่ก่อให้เกิดคุณค่าตามแนวความคิดลีนออกไปจากกระบวนการทำงาน หลังจากนั้นระบบเวชระเบียนอิเล็กทรอนิกส์ได้ถูกออกแบบขึ้นโดยทำข้อมูลให้มีมาตรฐานเดียวกันและทำให้เกิดการเชื่อมโยงของข้อมูลระหว่างแผนกต่างๆของโรงพยาบาลโดยอ้างอิงตามมาตรฐาน JCI สุดท้ายบทเรียนที่ได้จากการศึกษาจะถูกนำมาวิเคราะห์และใช้เป็นต้นแบบสำหรับการปรับปรุงบริการของโรงพยาบาลด้านอื่นๆต่อไป

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CHAPTER I
INTRODUCTION

1.1 Background and problem statement

The Institute for Healthcare Improvement (2005) believes that lean principles can be successfully applied to the healthcare industry. Krit (2010) stated that the basis of lean thinking begins with driving out wastes so that any effort putting into work will add value to the business process. Identifying the value-added, necessary non-value-added and non-value-added activities is the first step towards achieving lean. Although healthcare industry differs from manufacturing industry in many ways, there are still some surprising similarities. For example, the processes of manufacturing cars and providing healthcare services are complex. Some process activities are redundant and create non-value-added activities; hence, they should be cut. The implementation of advanced system and technology helps to reduce total costs, ease business processes, and eradicate wastes in both manufacturing and healthcare industries.

In healthcare industry, the Electronic Medical Record (EMR) system leads to major healthcare cost savings, medical error reduction, and overall health improvement. Many hospitals in the world adopt health care information technology (IT) to improve their services in term of quality, efficiency and patient safety. The IT helps healthcare professionals to electronically access to the healthcare information including demographic information, registration information, clinical care information, financial information, and quality improvement information. The EMR contains what has happened to a patient since he or she was born. Healthcare professionals include doctors, nurses, medical technologists, radiologists, pharmacists, public relations officers, medical officers, cashiers and other hospital staff are the users of EMR and they are responsible to input and update information in the EMR. Though 88.49 percent of hospitals in the USA use IT to support their day-to-day operations, the IT has not been used in all units in the hospitals due to the limited number of IT

specialists to solve real time problems and the lack of IT knowledge of some medical staff (Krit, 2010).

In Thailand, almost all hospitals have adopted IT to support some of their healthcare service activities. Even in a small 30-bed community hospitals located in the far provinces have applied some software to help managing their inventory. However, the fullest use of IT in recording medical information on community hospitals is limited and yet is the area to be explored in this paper.

Lean process is a management philosophy focusing on reduction of seven common wastes to improve the overall value for customers. The elimination of wastes helps to increase productivity, reduce costs and improve profits. The lean process has been firstly used in manufacturing industry and recently is applied in other industries including service. The seven wastes are

- Transportation
- Inventory
- Motion
- Waiting time
- Over-production
- Processing itself
- Defective product

Basically, Lean concept focuses on preserving value with less work (Jame et al,1990). The "value" mentioned above is defined as any action or process that a customer would be willing to pay for. In health care industry, many patients who are end customers have complained about poor services and long waiting time which are the result of complicated services along with service errors. Customers need good, cheap, fast, and suitable service. 'Good' means the quality treatment and quality service. 'Cheap' is worth for the medical treatment costs. 'Fast' is the rapid process. 'Suitable' means the standard of diagnosis and treatment in real time. When an organization responds to customer need, especially using less process for shorter waiting time, or have a one stop service, the customer satisfaction will be increased (Sumet,2010).

The business process of a hospital consists of value-added activities (i.e. doctor diagnosis), non-value-added activities (i.e. waiting time for find medical

record), and necessary non-value-added activities (i.e. Waiting for Lab or X-ray results). Loh (2010) has identified eight wastes for hospital including Defects, Over Production, Waiting time, Not using staff talent, Transportation, Inventory, Motion, and Excessive processing which is called "DOWNTIME" as shown in Table 1.1

Table 1.1 Waste in hospital operations (Loh, 2010)

Abbreviation	Definition	Example
D	Defects	Repeat blood test 2nd round due to miss labeling
O	Over production	Doing X-ray every day (no evidence for this) Dilating eyes several times before contact surgery
W	Waiting	Physical wait for X-ray and Lab result
N	Not using staff talent	No initiative by unmotivated staff
T	Transportation	Medical record moved between far location for different services in one visit
I	Inventory	Patients/ test specimens stacking up waiting
M	Motion	Physical walks back and font to type into the computer. The nurse looking for case note. Clerk looking for the right forms
E	Excessive processing	Asking patient information repeatedly (same information)

Lean process starts from the service process mapping called value stream mapping until the end of process. Then use methodology for getting rid of wastes by eliminating, rearranging, restructuring, simplifying, and combining processes and developing a good computer- based system to replace paper-based system. Lean process involves all of department service and is flexible.

Besides Lean, healthcare organization needs standard for controlling quality and services. Accreditation and/or certification is a process in which an external entity organization usually non-governmental organization, assesses the

health care organization to determine if it meets a set of quality standard requirements. This voluntary process provides a visible commitment by an organization to continually ensure a safe environment for its patients and staff**.** Therefore, this research applied the hospital accreditation program by the Joint commission International (JCI) which is designed for evaluating all the functions of acute care hospitals, medical and psychiatric, including any related out-patient clinics and clinical laboratories. The program is equally applicable to public and private hospitals. The JCI accreditation is internationally recognized as the premier credential for hospitals. In Thailand, there are 13 hospitals accredited by JCI in 2011 including Bangkok Hospital Medical Center , Bangkok Hospital Pattaya, Bangkok Hospital Phuket, BNH Hospital, Bumrungrad International, Chiangmai Ram Hospital, Praram9 Hospital, Ramkhamhaeng Hospital, Samitivej Srinakarin Hospital, Samitivej Sriracha Hospital, Samitivej Sukhumvit Hospital, Synphaet Hospital and Vejtani Hospital.

From the above introduction, this research combined the lean process tools, EMR and JCI standards and applied in healthcare service in order to improve its service to customers which in this case,the patients. As the competition has increased, the hospitals have to continually improve their performance and make their operation efficient. Therefore, the ultimate goals of the hospitals are patient safety, patient satisfaction and overall hospital efficiency.

Therefore, the objective of this research is to design a new EMR system for a hospital combining the use of Electronic Medical Record (EMR) with Lean process tool with an aim for patient safety, patient satisfaction overall hospital efficiency under the JCI standards for hospitals. It is expected that the new EMR system will help to improve the workplace layout, visual management, and standard work of medical procedures which are the major tools of Lean process while JCI will help to standardize the work of medical procedures which is also a part of Lean process. The ultimate goals of these integrated tools are for increasing patient safety, patient satisfaction, and overall efficiency of the hospital.

1.2 Objective of the study

The objective of the study is to design functional requirement for supporting EMR implementation after applying lean process tools and following JCI standard in order to help the hospitals to reach its goals of patient safety,patient satisfaction, and overall hospital efficiency.

1.3 Scope and limitation of the study

This scope of this study is at the Out-Patient Department of a community hospital which is used as a case study.

1.4 Expected Results

The expected outcomes of this study are completed functional requirements for EMR implementation in a community hospital in Thailand integrating the Lean process and JCI standard.

1.5 Organization of the study

The study comprises of an introduction, the literature review, the development of research methodology and presentation of results. The content of each chapter are as follows: Chapter 1 presents the background and problem statement, the objectives, the scope, the expected results and the organization of the study. Chapter 2 reviews the research methodology that has been done in the past related to four main parts: Lean process in the healthcare industry, Medical error in healthcare, EMR and application, and JCI standard. Chapter 3 describes the detail of research methodology. Chapter 4 contains an analysis of implementing lean and the link between the EMR and the JCI standard, the benefit of EMR for JCI standard.The new functional requirement. Chapter 5 shows conclusion and recommendation.

CHAPTER II
LITERATURE REVIEW

In this chapter, reviewing in details of the relevant literature has been done identify Medical Errors in Healthcare, Lean in healthcare Industry, Electronic Medical Record (EMR) and application, International Hospital Accreditation.

2.1 Medical Errors in Healthcare

There are many reasons for errors occurring in today's health care system. Medication errors diminish patient confidence in the healthcare system and increase healthcare costs. The problems and sources of medication errors are multidisciplinary and multi-factorial. Which can be classified into 7 groups including Staffing, Information technology (IT), Equipment, Policy and procedures, Teamwork factors, management/Organization and work environment. (See Table 2.1.)

2.1.1 Type of medical error

Two terms commonly used in error analysis are active errors and latent errors. In healthcare, active errors are obvious errors that occur at the interface between the healthcare worker and the patient. Active errors also include miscues that occur during the interaction of a healthcare worker with some other aspect of the health care system, such as a collection device, transportation system, instrument, or computer (Astion,2009). Examples of lab services include failing to identify the patient before a blood draw and missing the blood vessel when performing phlebotomy. A common management mistake is to identify and attack active errors rather than finding and eliminating latent errors. It is relatively easy to identify active errors and propose quick fixes for them, but it is painful, risky, and sometimes expensive to identify latent errors and resolve them. For example, even an inexperienced manager can easily identify the active error of incorrectly entering

patient information into a computer, and then counsel the offending tech to "slow down" because "there is a patient affected by that error." However, it is much harder to initiate a project that seeks to reduce or eliminate manual data entry by automating the medical and interfacing all the automated instruments to the Electronic medical record.

Table 2.1 List of some common categories of errors in hospital

Category	Examples
Staffing	- Staff rush to complete the high volume of work before the shift ends.
IT	- Lack of instrument interface with EMR leads to many active data entry errors - Poor formatting of lab results in electronic medical record leads to the frequent misinterpretation of lab results by doctors.
Equipment	- Error-prone analyzers held together by duct tape and covered in post-it notes. - Main chemistry analyzer is overloaded and has no backup leading to long delays when the instrument is down.
Policy and Procedures	- Policy allowing relabeling of mislabeled or unlabeled blood specimens by ordering doctor increases the chance of mislabeled specimen. - Multiple lab requisitions with different styles and designs leads to error-prone environment in test ordering and specimen log in.
Teamwork Factors	- Poor communication at shift change about problem specimens that remain unresolved.
Management /Organization	- Management that tends to focus on financial concerns and employee satisfaction while giving lip service to patient safety. - Management that emphasizes incident reporting and de-emphasizes analysis of incident reports and interventions based on that analysis.

Table 2.1 List of some common categories of errors in hospital (cont.)

Category	Examples
Work Environment	- Culture of multitasking leads to error-prone environment as technologists try to answer phones and analyze specimens at the same time. - Long term remodeling project leads to excessive noise that distracts technologists. - Convoluted physical layout of workplace creates an environment where specimens are more likely to be misplaced. - Disconnection of staff from the patient experience tends to decrease motivation to improve quality.

As IT is one of the categories causing errors for a hospital,Every hospital expect to be an error-free hospital. One way to prevent or defect or re check errors is to decide a good electronic medical record.

2.2 Lean process in healthcare industry

2.2.1 Introduction of Lean concept

Lean concept helps to create value by eliminating waste and increasing flexibility for organization. Lean concept aims to separate non-value activities, to eliminate, and to improve process by identifying value creating and non-value actions in the business processes of the hospital. Many healthcare facilities are adopting the Lean process improvement philosophy and evaluating their organizations for opportunities to implement resource saving solutions. With Lean processes, hospital and healthcare administrators are finding substantial savings of time, resources and money. To maximize the value within the process, the management in healthcare must evaluate and identify processes by accurately specifying the value desired to fulfill the need of the customer, in this case the patient (Castle and Harvey, 2008).

This process of identifying every step helps to pin-point the processes where the waste is made and non-value-added stream can be eliminated by making the value flow from beginning to end of the process. Focus is on business process flow in hospital using the conceptual framework and categorizing all of the tools and practices of Lean. Lean concept includes five basic areas:

1. Value - define value from the standpoint of the customer
2. Value Stream - view your product delivery system as a continuous flow of processes that add value to the product
3. Flow - the product should constantly be moving through the value stream toward the customer at the pace of demand
4. Pull - products should be pulled through the value stream at the demand of the customer rather than being pushed on the customer
5. Perfection - the never-ending pursuit of eliminating waste in the system such that products can flow seamlessly through the value stream at the rate of demand.

2.2.2 The Lean process

A Lean production tool is defined as any tool or technique that contributes to the production system in one of the following categories and subcategories.

1. Tools that improve the rate of flow :
    - Tools of standardization that eliminates variation
    - Tools of maintenance
2. Tools that facilitate flexibility, in capacity or order fulfillment.
3. Tools that reduce throughput time:
    - Tools of quality.
4. Tools of Continuous Improvement and/or implementation

The toolkit shown in Table 2.2 was developed using the former working definition and the criterion that the tool must be identified in at least three sources (Greene, 2002).

Table 2.2 The Lean tools

Tool	Definition
5 S	A methodology for organizing, cleaning, developing, and sustaining a productive work environment. Improved safety, ownership of workspace, improved productivity and improved maintenance are some of the benefits of 5S program.
Error Proofing	Error Proofing is a structured approach to ensure quality and error free manufacturing environment. Error proofing assures that defects will never be passed to next operation.
Current Reality Trees	Is a problem-analysis tool, aids to examine cause and effect logic behind our current situation.
Conflict Resolution Diagram	Is used to resolve hidden conflicts that usually perpetuate chronic problem
Future Reality Diagram	Is a sufficiency based logic structure designed to reveal how changes to the status quo would affect reality - specifically to produce desired effects.
Inventory Turnover Rate	The number of times an inventory cycles or turns over during the year. A frequently used method to compute inventory turnover is to divide average inventory level into annual cost of sales.
JIT	A philosophy of manufacturing based on planned elimination of all waste and continuous improvement of productivity. It encompasses the successful execution of all manufacturing activities required to produce a final product.
Kaizen	The Japanese term for improvement; continuing improvement involving everyone - managers and workers. In manufacturing kaizen relates to finding and eliminating waste in machinery, labor or production methods.
Kanban	Kanban is a simple parts-movement system that depends on cards and boxes/containers to take parts from one workstation to another on a production line. The essence of the Kanban concept is that a supplier or the warehouse should only deliver components to the production line as and when they are needed, so that there is no storage in the production area.

Table 2.2 The Lean tools (cont.)

Tool	Definition
LPI	Lean Performance Indicator is a consistent method to measure Lean implementation effectiveness.
One-piece Flow	One-piece flow or continuous flow processing is a concept means that items are processed and moved directly from one processing step to the next, one piece at a time. One-piece flow helps to maximum utilization of resources, shorten lead times, identify problems and communication between operations.
Lean Metric	Lean metrics allow companies to measure evaluate and respond to their performance in a balanced way, without sacrificing the quality to meet quantity objectives, or increasing inventory levels to achieve machine efficiencies. The type of the Lean metric depends on the organization and can be of following categories; Financial performance, behavioral performance and core process performance.
Prerequisite Tree	Is a logical structure designed to identify all obstacles and the responses needed to overcome them in realizing an objective. It identifies minimum necessary conditions without which the objective cannot be met.
Process Route Table	Shows what machines and equipment are needed for processing a component or assembly. These Tables aid in creating ordinary lines and grouping work pieces into work cells.
Quick Changeover.	Quick changeover is a technique to analyze and reduce resources needed for equipment setup, including exchange of tools and dies. Single Minute Exchange of Dies (SMED) is an approach to reduce output and quality losses due to changeovers

Table 2.2 The Lean tools (cont.)

Tool	Definition
Standard Rate or Work	The length of time that should be required to set up a given machine or operation and run one part, assembly, batch, or end product through that operation. This time is used in determining machine requirements and labor requirements.
Takt Time	The time required between completion of successive units of end product. Tact time is used to place lines in the production environments.
Theory of Constraints	A management philosophy that can be viewed as three separate but interrelated areas - logistics, performance measurement, and logical thinking. TOC focuses the organizations scarce resources on improving the performance of the true constraint, and therefore the bottom line of the organization.
Toyota Production System	The Toyota production system is a technology of comprehensive production management. The basic idea of this system is to maintain a continuous flow of products in factories in order to flexibly adapt to demand changes. The realization of such production flow is called Just-in-time production, which means producing only necessary units in a necessary quantity at a necessary time. As a result, the excess inventories and the excess work force will be naturally diminished, thereby achieving the purposes of increased productivity and cost reduction.
Transition Tree	Is a cause and effect logic tree designed to provide step-by-step progress from initiation to completion of a course of action or change. It is an implementation tool.

Table 2.2 The Lean tools (cont.)

Tool	Definition
Value added to Non-value added Lead time ratio	Provides insight on how many value added activities are performed compared to non value added activities, using time as a unit of measure.
Value Stream Mapping	Value stream mapping is a graphical tool that helps you to see and understand the flow of the material and information as a product makes its way through the value stream. It ties together Lean concepts and techniques.
Value Stream Costing	Value Stream Costing methodology simplifies the accounting process to give everyone real information in a basic understandable format. By isolating all fixed costs along with direct labor we can easily apply manufacturing resources as a value per square footage utilized by a particular cell or value stream. This methodology of factoring gives a true picture of cellular consumption to value-added throughput for each value stream company wide. Now you can easily focus improvement kaizen events where actual problems exist for faster calculated .benefits and sustainability.
Visual Management	Is a set of techniques that makes operation standards visible so that workers can follow them more easily. These techniques expose waste so that it can be prevented and eliminated.
Workflow Diagram	Shows the movement of material, identifying areas of waste. Aids teams to plan future improvements, such as one piece flow and work cells

Table 2.2 The Lean tools (cont.)

Tool	Definition
Total Productive Maintenance	Total Productive Maintenance (TPM) is a maintenance program concept, which brings maintenance into focus in order to minimize downtimes and maximize equipment usage. The goal of TPM is to avoid emergency repairs and keep unscheduled maintenance to a minimum.
Overall Equipment	Effectiveness Measures the availability, performance efficiency, and quality rate of equipment - it is especially important to calculate OEE for the constrained operations.

Every tool in this study's toolkit met the working definition. The application of Lean tools in hospital is linked to and executed in support of the organization's strategic plan. However, a high level overview of Lean methods in hospitals (Zidel , 2007) includes :

- Reducing waste
- Standard work
- Error proofing

Waste is the time a nurse might spend not providing "value added" care to patients. Examples include "searching for supplies", "searching for medications", "getting the wrong drugs from pharmacy", or "solving problems". Lean improvement team identifies and reduces waste in their processes, which allows nurses to spend more time caring for patients. The immediate impacts of waste reduction can be proper staffing levels, cost reduction, and nurse engagement. Table 2.3 show the 7 types of waste can be found. Waste in healthcare describes all activities that add cost but not value, and must be relentlessly targeted for elimination (Gemba, 2007).

Table 2.3 Waste in healthcare

Wastes - "Muda"	Definition	Healthcare
Overproduction	Producing more than the customer needs right now	- Pills given early to suit staff schedules - Testing ahead of time to suit lab schedule - Treatments done to balance hospital staff or equipment workload
Motion	Movement of people that does not add value	- Searching for patients - Searching for meds - Searching for charts - Gathering tools - Gathering supplies - Handling paperwork
Waiting	Idle time created when material, information, people, or equipment is not ready	- Bed assignment delay - Delay in admission to Emergency Dept. - Delays in testing, treatment, or discharge. - Delay in patient lab test results.
Processing	Effort that adds no value from the customer's viewpoint	-Multiple bed moves Retesting . -Excessive paperwork . -Unnecessary procedures Multiple testing .

Table 2.3 Waste in healthcare (cont.)

Wastes - "Muda"	Definition	Healthcare
Inventory	More materials, parts, or products on hand than the customer needs right now	-Bed assignments -Pharmacy stock -Lab supplies -Samples -Specimens waiting analysis -Paperwork in process -Patients in beds
Defects	Work that is less than the level the customer (the next process) has requested	-Medication error -Wrong patient -Wrong procedure -Missing information -Redraws -Poor clinical outcomes

Standard work represents a hospital taking advantage of what science has proven to be the "best practice". To be sure, following best practices (tools, processes, training, and targets) will be a culture change for any hospital.

Error proofing goes beyond fixing problems.It looks at why errors could happen. Most hospitals will have a Root-Cause Analysis methodology which analyzes past errors. This is very important, so mistakes are not repeated. Lean methods utilize FMEA (failure mode effects analysis) to identify where errors could happen. FMEA is used to expose near misses and unsafe practices that are predictive of Safety issues.

2.2.3 Lean hospital improvement and benefit of Lean

Lean concept has been use in many processes and departments in hospital such as Laboratory department when linked with other clinical information systems such as Computerized Doctor Order Entry and Electronic Medical Record, will support further healthcare quality improvement (Jeffrey et al,2007; Bakar et al,2009; Balle and Regnier,2007) Lean as a learning system in a hospital ward Lean is about

"making people before making parts" or, in the wards' context, developing nurses before delivering care. Adoption of Lean principles by an Emergency Department (ED) improves the value of emergency care delivered (Dickson, 2009; Hakimzadaa, 2007). Using Lean principles has been helping hospital pharmacy managers and teams across a number of organizations to rationalize their work settings and processes and maximize the contribution they make to the delivery of safe and effective healthcare (Yousri, 2010). For every person in the hospital to be so familiar with lean systems and tools that they are able to apply the underlying lean principles in new and creative ways by House of Lean that are ideal for unique challenges show in Figure 2.1

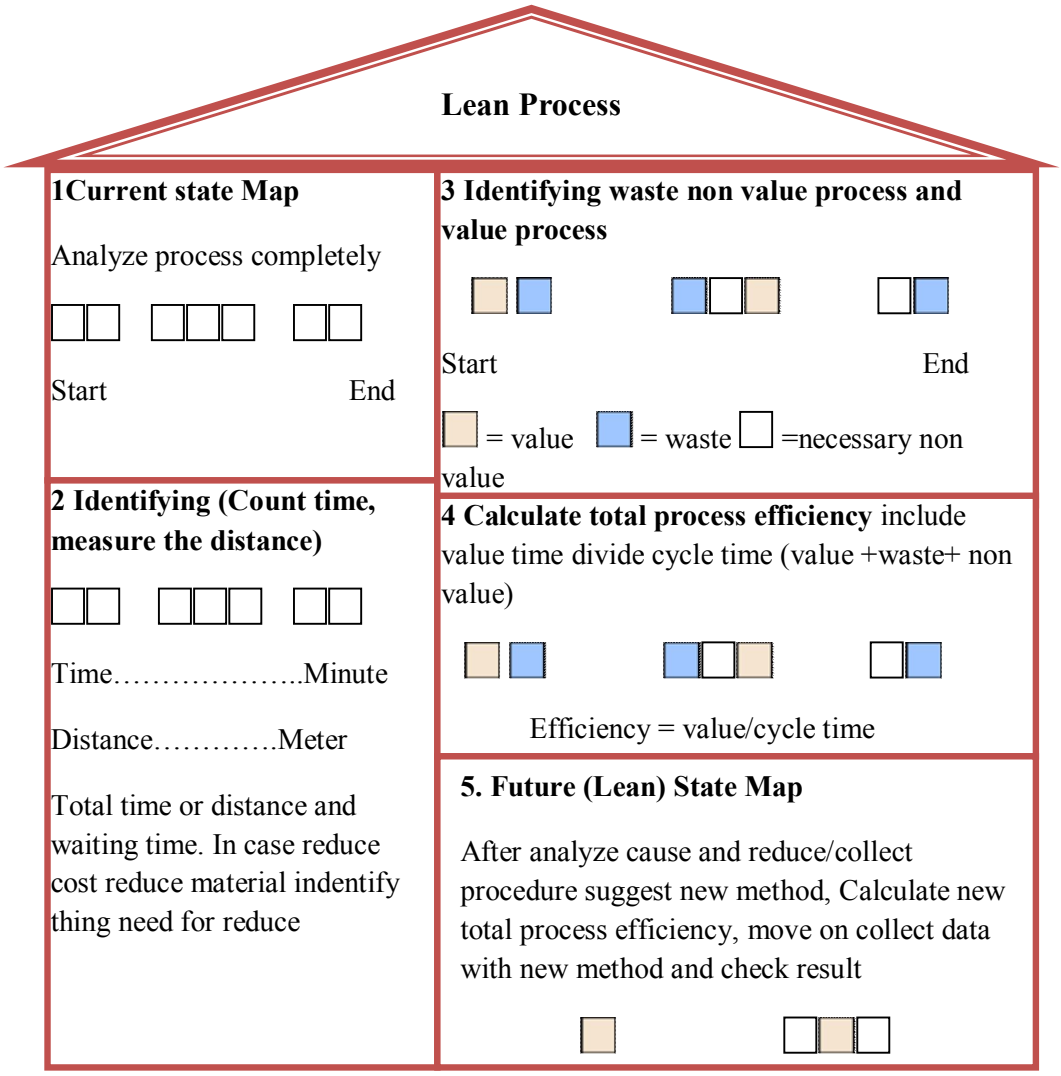

Figure 2.1 Lean Process

Source: Preawut, 2010

Increase patient safety need for improving quality and working process have resulted in many hospitals implementing process improvement efforts. These efforts are complicated of the hospital's organization structure. Two Lean tools commonly used to organize the workplace and minimize waste include 5S and value stream mapping. 5S stands for sift, sort, sweep, standardize, and sustain. This tool aids in separating the necessary from the unnecessary, keeping work areas Lean and organized, keeping a system in place to maintain the area, and making new procedures a habit.

The value-stream map identifies value-added and non-value added steps of a process that delivers a service. This tool allows for visual identification of opportunities for improvement (Womack and Jones, 1996). Every process or sub-process exists to provide a service for the patient and healthcare professionals(Snyder et al ,2005). This service is produced within a particular process according to defined requirements, rules, and constraints. For the purpose of mapping, the clinics' processes were divided into lab, x-ray, doctor service, front office, nursing, transcription/ dictation, and supplies ordering. These clinics needed to map their present or "current state" processes while working with the software company to design a system that would eventually become the "future state" of their processes. The main idea was to identify waste in the value stream, with the objective of eliminating that waste. Our goal is to connect all mapped processes so that when the change management process is in place, the clinics will be able to identify what effects any changes would have on other processes within the whole organization. The result is a health organization that once was a traditional, inflexible operation now is a flexible, fluid machine that thrives on change.

The value mapping will allow these health care providers to have a process map with which they will be able to optimize processes for the entire organization and not to simply optimize sub processes. This will be a key weapon that can be used to maintain the clinics as separate entities from the surrounding regional larger healthcare systems. Future-state value-stream maps depict a future condition that incorporates yet-to-be-made improvements. Team members, usually with the help of an experienced facilitator, identify the improvements by questioning current paradigms and thinking creatively about how to improve the process. Sometimes an

“ideal state” value-stream map will be drawn to guide additional future continuous improvement activities.

The team then presents the value-stream maps to senior management for review and approval. In order to make well founded and informed clinical or managerial decisions good quality data needs to be readily available. For the treatment of individual patient, this might include access to diagnostic results, healthcare records, drug charts and appropriate consultations with specialists when necessary. The duplication of documentation was eliminated and the medical consultants relocated from the medical assessment unit to the emergency department and other departments with the full access to the patient information.

This reduces delays in assessing patients and prevents inappropriate admissions (Kollberg and Dahlgaard, 2007). From the benefit of Lean process, plan and choose well can collect significant benefits from the use of EMR's. Achieving these benefits will require significant changes, such as in the way of logging patient data. Of course the data will now be electronically stored instead of on paper. The type of data being captured will also change. For instance, suppose that a doctor making rounds at a hospital leaves a note for nurses that involve the drawing of a figure on paper, such as the position of a bedsore. For most EMR systems, this will not be possible now. However, there will be room for comments to be added to the record. Hence, the doctor will need to be more descriptive now. Becoming adept at the new ways of entering data into the records will improve outcomes for patients and the caregivers.

2.3 Electronic Medical Record (EMR) and application

2.3.1 Definition

Medical Record defined as the collection of information concerning a patient and his or her health care that is created and maintained in the regular course of business in accordance with policies, made by a person who has knowledge of the

acts, events, opinions or diagnoses relating to the patient, and made at or around the time indicated in the documentation(UC,2000).

The medical record may include records maintained in an electronic medical / record system, e.g., an electronic system framework that integrates data from multiple sources, captures data at the point of care, and supports caregiver decision making. The medical record excludes health records that are not official business, such as personal health records managed by the patient.

Each Medical Record shall contain sufficient, accurate information to identify the patient, support the diagnosis, justify the treatment, document the course and results, and promote continuity of care among health care providers. The information may be from any source and in any format, including, but not limited to print medium, audio/visual recording, and/or electronic display.

The Medical Record may also be known as the "Legal Medical Record" or "LMR" in that it serves as the documentation of the healthcare services provided to a patient by a hospital, clinic or doctor.The Legal Medical Record is a subset of the Designated Record and is the record that will be released for legal proceedings or in response to a request to release patient medical records. The LMR can be certified as such in a court of law.

The National Health Security Office (NHSO) and Medical Council of Thailand specified contents in the medical record that shown include Patient profile, Patient's history,Physical examination, Treatment , Follow up plan, Operative note and Information account. The detail are shown below.

Patient's profile

- Hospital information
    - Hospital name and date/month/year for first arrive
- Patient information
    - Name and surname
    - Date of birth
    - Address on admission
    - Address
    - Number for identifying patient

- Identification number
- Admission number
- Visit number
- Hospital number

- Allergy information
- Blood group
- Contact person in care of emergency
- Date of record in medical record
- Insurance
- Name, address and telephone number of person or agency responsible for patient. Name of patient's admitting/attending doctor.
- Problem list

Patient's history

- Chief complaint
- Present illness
- Previous Medical history including immunization record, screening tests, nutritional evaluation, psychiatric, surgical and past medical history, social and family history, and for pediatric patients a neonatal history.
- Past illness
- Other history; personal history, social history, growth development/ vaccination
- Family medical history
- Social history
- Operative history (applicable)

Physical examination

- Record date, time and visit time for patient. Record time and pre screen patient .
- Record vital sign
- Record weight and height in child case

- Record by check, palpation, percussion & auscultation and related to chief complaint with in normal limit (WNL)
- Provisional diagnosis
- Show drawing or graphic photo for examination

Treatment/ Investigation

- Record order lab/X-ray Blood Transfusion Report and others. (Orders including those for medication, treatment, prescriptions, diet orders, lab, radiology and other ancillary services.),
- Record treatment detail, prescription order, and operative record
- Advise care record
- Follow up plan record
- Progress notes including current or working diagnosis
- Identify doctor name and sign by doctor, Initial diagnostic impression.
- Record by clear handwriting

Follow up plan

- Chronic case
- General case show follow up plan only appointment Detail for medical record
  - Indentify illness or appointment for follow up
  - History and follow up care plan
  - Vital sign Nurses' Notes which shall include, but not be limited to, the following:
  - Nursing assessment including nutritional, psychosocial and functional assessments.
  - Concise and accurate record of nursing care administered.
  - Record of pertinent observations including psychosocial and physical manifestations and relevant nursing interpretation of such observations.
  - Name, dosage and time of administration of medications and treatment. Route of administration and site of injection shall be recorded if other than by oral administration.

- Record of type of restraint and time of application and removal.
- Record of privacy and time of application and removal.
- Record order lab/X-ray and others.
- Treatment record.
- Advise care plan record or adverse drug reactions.
- Follow up plan record.
- Identify doctor name who diagnosis and sign by doctor.

Operative note

A document produced by a surgeon or other doctor (s) who have participated in a surgical intervention, which contains a detailed account of the findings, the procedure used, the specimens removed, the preoperative and postoperative diagnoses, and names of the primary performing surgeon and any assistants

Informed consent

Informed consent is a legal procedure to ensure that a patient or client knows all of the risks and costs involved in a treatment. The elements of informed consents include informing the client of the nature of the treatment, possible alternative treatments, and the potential risks and benefits of the treatment.

This research focus on Outpatient department not include the operative note and Informed consent.

2.3.2 Application of Electronic medical record (EMR)

Electronic medical record (EMR) is a computerized system of accessing in real time the history of a patient's care within a single practice. (Garets and Mike,2009) Many researches refer to concept about EMR in the different. The term of EMR defines a computerized medical records that can be accessed with concerned of patient privacy, confidential and security from multiple integrated system at any point of care within the health care enterprise Jerome (1999) defined EMR as a computer-based information system that integrates patients-specific information from diverse

sources and tracks that information overtime to facilitate clinical management and information retrieval, analysis and reporting. Morgan (2002) defined EMR as a confined medical record offering little integration with other system and is much restricted in its scope. Ponpirul (2004) seperated EMR into three words include "Electronic","Medical" and "Record"shown in Table 2.4.

Table 2.4 Word meaning as Electronic medical record

Electronic	Medical	Record
Computerized	Patient	Information
Computer-based	Health	
Online	Health care	

Tang et al (1997) found a paper record lack of decision information while EMR makes the data standard and medical staff know the patient information in real time. The content of an EMR is analogous to the paper record, but the electronic format creates usable data in medical outcome studies, improves the efficiency of care, and makes for more efficient communication among providers and easier management of health plans. A number of researchers have studied the implementation of EMR in hospitals in several countries including America, Sweden, Japan, Canada, Hong Kong and China. The EMR has been used in several process including patient registration or patient history (Ross, 2009), Drug management and prescription (O'Neil and Klepack, 2007), diagnosis and treatment, x-rays, doctor's note, diagnose images, scanned images of paper document and manage medical payment insurance (Rundell et al, 2007). Furthermore, the benefits of electronic medical record are prevented and control disease by analyzing premedical history and patient history, improve patient satisfaction, reduce medical error, reduce costs, and build up patient flow efficiency and raise hospital service efficiency as shown in Table 2.5.

Table 2.5 Useful of electronic medical record application

Study	Department	User	Data record
Hollbook et al, 2003	Inpatient Outpatient	Doctor	Prescriptions Chart summary/cumulative patient profile (Patient information) Diagnoses reports Laboratory orders
Norris III et al,2004	Outpatient	Nurse Doctor	Vital sign Diagnoses reports
Meijden et al.,2000	Inpatient	Nurse Doctor	Nursing record Doctors report Progress notes Laboratory results Diagnostic tests
Meyer et al,1998	Outpatient	Doctor	Use patient data Medical diagnosis
Tu et al, 2010	Diabetics	Doctor	Order laboratory tests
Silfen, 2006	Emergency	Doctor	Clinical information Diagnostic tests
Love et al,2007	Inpatient Outpatient	Doctor	Gaps in glycemic Blood pressure and lipid control Inadequate risk-factor monitoring and treatment plan.

Table 2.5 Useful of electronic medical record application (cont.)

Study	Department	User	EMR
Dobbing, 2001	Emergency	Doctor Pharmacy	Clinical information Prescribing
Bleich and Slack,2010	Ambulatory care	Doctor Surgical pathologist Radiologist	The results of diagnostic Laboratory results X-ray interpretations and pathology reports
Wright et al,2000	Inpatient Outpatient	Nurse	Vital signs
Perera et al, 2011	Inpatient	Doctor	Consent
Weiner et al, 2003	Inpatient Outpatient	Doctor	Medicare data, diagnosis, vital signs, results of laboratory and diagnostic tests,
Ayers et al, 2009	Outpatient	Doctor Pharmacy	Patient information Treatment plans
Temel, et al,2009	Outpatient	Doctor	Patient information
Chen et al,2009	Outpatient	Doctor	Medical information
Takeda et al. (1998)	Inpatient Outpatient	Doctor Pharmacy Health care staff	Patient information Pharmacy management LAB result Radiology result Meal admission Surgical operation Reservation

Table 2.5 Useful of electronic medical record application (cont.)

Study	Department	User	EMR
Cimino et al (2002)	Pathology	Nurse Doctor Health care staff	Patient information LAB result (Pathology, Microbiology) Radiology result Doctor examination, report and comment
Ariffin el at,2008	Malaysian Government Hospitals	Nurse Doctor Health care staff	Nurse note Patient's medical history
Mikkelsen and Aasly,2002	Neurology	Doctor	Use Patient information Doctors report
Krawczyk and Jain , 2005	Inpatient Outpatient	Doctor	Image result Medical history
Weber et al,2005	Inpatient Emergency Outpatient	Doctor nurse	Medications, radiologic, laboratory times and dates of appointments
Jacob and Smelcer, 2007	Infancy	Doctor Pharmacy Health care staff	Patient information Pharmacy Reimbursement
Ovretveit, et al ,2007	Pathology	Doctor Pharmacy	Patient information Prescription
Jian et al. ,2007	Surgical Emergency	Nurse Doctor	Nursing LAB result Radiology result Patient information

Table 2.5 Useful of electronic medical record application (cont.)

Study	Department	User	Data record
Shidhar et al,2009	Inpatient Outpatient	Doctor Pharmacy	Pharmacy data Prescription Accounts and billing
Bergman, 2003	Outpatient	Doctor	Laboratory results X-rays Important information.
Ludwick and John, 2009	Inpatient Outpatient	Doctor	Patient treatment, Diagnosis Lab test Patient information history Prescription and allergies
Otieno et al, 2008	Inpatient	Doctor Nurse Medical staff	Drug information
Cerrito, 2007	Emergency	Doctor Nurse	Treatment Plan Tests ordered.
Korst et al,2003	Obstetics	Nurse	Paper chart and Computer chart (documentation of patient care) Meal breaks Indirect care (Preparing medication)
Matsuo et al, 2009	Ophthalmology Outpatient	Nurse Doctor Health care staff	Appointments, Drug prescription, Fees and diagnoses input, Laboratory tests, Surgical theater and ward room reservations.

From Table 2.5 presents a structured and integrated approach to managing patient data with the end result of improving care by reducing the number of incomplete charts, reducing the number of incomplete charts, reducing the waiting time for paper-based test results and enhancing clinical decision making with real-time or on-line access to patient information. This way, a doctor can have a complete view of a patient's medical history, which may allow him or her to check for duplicate prescriptions, overdosing, over treatments and such, thus reducing medical errors. At the same time, a nurse can access the same patient record, without waiting for the chart to be physically transferred. Among other benefits that IT can bring to healthcare are also reduction of paper handling and inefficient use of resources by lowering test charges, lab and radiology tests and hospital admissions (U. S. Department of Health and Human Services, 2004). In determining the user requirements for the secure communication of patient record information, a number of scenarios, related to real life situations are considered. These include a health professional requests information from an electronic health care record maintained by another health professional referral (to a specialist) with inclusion of medical record excerpts, letter of discharge, permanent transfer of responsibility for the care to another health care enterprise, care team, pharmaceutical prescription, and Health professional who is on call at home. For each of the scenarios, the security requirements have been determined, which has resulted in generic and scenario specific security requirements. Problem areas encountered have been highlighted(Meyera,1998).

From the literature review, perious study had applied EMR in specific department in hospitals such as in Laboratory Department, X-ray Department and Pharmacy dispensing Department. Different literature had focus on different attributes of EMRs, but all research have similar goal of "Patient safety" and "Error Reduction"

2.3.3 Benefit of Electronic medical record

Benefit of EMR can be classified into quality and efficiency. Quality benefit of EMR for example EMR makes data easily accessible and enables doctors to use their own data to improve quality of care such as enhanced patient education materials, quicker turnaround times for results of lab tests and imaging studies, improved diagnostic process, streamlined health maintenance and chronic disease

management, protocol-based treatment, reduced medical errors, improved access to patient records and improved outcomes.In term of efficiency EMR help in cost reduction associated with the management of paper records. Real-time access to a patient records from multiple computers and locations. Multiple locations, and improving workflow in some situations.

2.3.4 Factors for successfully implement electronic medical record.

The EMR adoption among community primary care doctors is increasing. At the end of 2003. Only 9 percent had adopted EMRs. This number was increased to 18 percent at the end of 2004, 34 percent at the end of 2005, and 64 percent at the end of 2006. It was expected that more than 90 percent would have adopted EMRs by the end of 2007. (See Figure 2.2). Sanchez classified the factor for successfully implement the EMR into five categories as follows

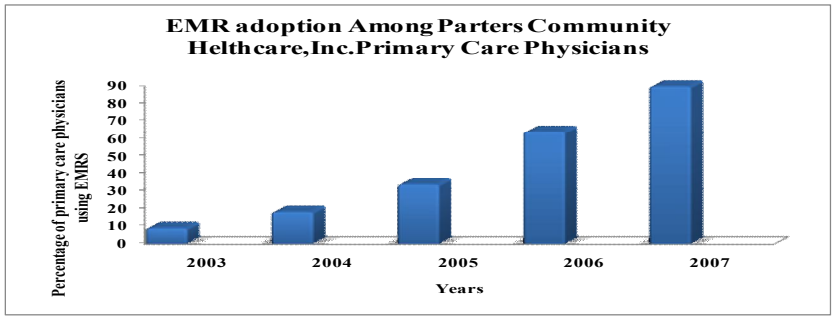

Figure 2.2 EMR adoption among partner community healthcare, INC primary care doctors (Foubister,2007)

1) Organization environment

Including top management support, effective project management, measurable goals, workflow analysis, communication and motivation operation require the complete cooperation of line and staff members from all departments of the hospital. Top management support can play a useful role in setting disputes and in providing clear signals to any doubts. Top management must create an environment for implementing an EMR system and obtained results and must be seen as a participant in the implementation.

2) People characteristics

Including education & training, and user involvement both at system requirements definition and EMR project implementation Education and training refers to the process of providing management and employees with the logic and overall concepts of EMR system. Thus, people can have a better understanding of how their jobs are related to other functional areas within the hospital. The user is the people who produce results and should be held account for making the system perform to expectations.

3) Technical problem

Including suitability of software & hardware and data accuracy Due to the lack of professional expertise and experience on developing EMR systems in-house, many health care organizations prefer to buy "off-the-shelf" systems to shorten the EMR implementation cycle. More or less they can't fully meet the organization's needs, especially when the health processes of the hospitals are unique. Thus, to increase the chance of success, management must choose software that most closely fits its requirements. EMR vendors use different hardware platforms, databases, and operation systems and certain EMR packages are only compatible with some hospitals' databases and operation systems. Thus, health care organizations should conduct requirements analysis first to make sure what problems need to be solved and select the EMR systems that most fit their requirements.

4) EMR vendor commitment including vendor support

Three dimensions of vendor support are classified such as service response time of the software vendor, qualified consultants with knowledge ability; and participation of vendor in EMR implementation. The consultants should possess good interpersonal skills and be able to work with people. Software vendors should be carefully selected since they play a crucial part in shaping the ultimate outcome of the implementation.

5) Culture impact

Organizational culture defined by Schein as "a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation

to those problems". Since organizational culture is embedded in national culture, two aspects related with organizational culture are identified to be associated with EMR implementation success by conflict level of the culture embedded in the EMR package with the customer's organizational culture and level of collectivism in the organizational culture.

Another research from Malaysian Government Hospitals done by Ariffin et al (2008) found that the factor for successfully implementing EMR include Organizational Support and Culture, Patient focus, Staff Focus, Education and Training, Performance and Process Improvement, Information and Information Technology.

2.4 International Hospital Accreditation

Hospital accreditation has been defined as "A self-assessment and external peer assessment process used by health care organizations to accurately assess their level of performance in relation to established standards and to implement ways to continuously improve" (Vurgun,N.2007). The health service standards which are accepted in specific countries include the follows

- Joint Commission International Accredited Organization (JCI) in the United States
- Trent International Accreditation Scheme (TAS) in United Kingdom and Hong Kong.
- The Canadian Council of Health Services Accreditation (CCHSA) in Canada.
- The Australian Council on Healthcare Standards (ACHS) in Australia and New Zealand
- Hospital Accreditation (HA) in Thailand.

All of Accreditation Standards are tools to improve quality of care and patient safety shown in Figure 2.3. Experience and best practices for participating hospitals are incorporating into the accreditation standards as ways to improve the quality of care and safety standard.

Accreditation processes are used in a variety of industries. In recent years, accreditation within the healthcare services industry has gained worldwide attention. The U.S., Australia and the U.K. are among the many countries that have very successful accreditation systems and this concept continues to grow worldwide. Accreditation is defined by JCI as 'a process in which an entity, separate and distinct from the healthcare organization, usually non-governmental, assesses the healthcare organization to determine if it meets a set of standards requirements designed to improve quality of care.

The widey – accepted accredition Standard in Thailand is JCI and HA.From the detail of HA standard use some part of JCI standard.This research will focus on the use of JCI in framework for new EMR and Lean concept into the framework.

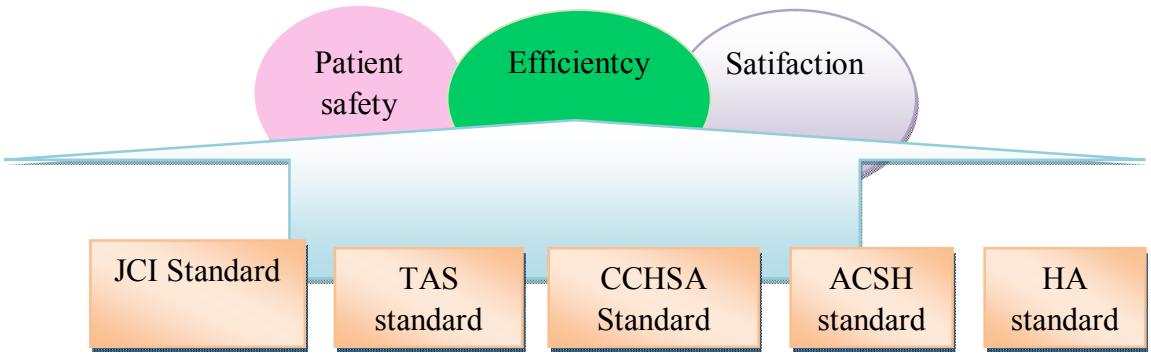

Figure 2.3 The goals of hospital standard

2.4.1 What is Joint Commission International?

Joint Commission International (JCI) Accreditation offers the international community a standards based, objective process for evaluating healthcare organizations (Joint Commission International, 2011). Accreditation is defined as a process in which an entity, separate and distinct from the healthcare organization, usually non-governmental, assesses the healthcare organization to determine if it meets a set of requirements designed to improve quality of care. JCI has refined the hospital accreditation survey process with the approval of Patient-Centered Functions and Health Care Organization Management Standards: International Patient Safety Goals (IPSG), Access to Care and Continuity of Care (ACC), Patient and Family

Rights (PFR), Assessment of Patients (AOP), Care of Patients (COP), Anesthesia and Surgical Care (ASC), Medication Management and Use (MMU) and Patient, Family Education (PFE), Quality Improvement and Patient Safety (GPS), Prevention and Control of Infections (PCI), Governance, Leadership, and Direction (GLD), Facility Management and Safety (FMS), Staff Qualifications and Education (SQE) and Management of Communication and Information(MCI). The details and definition of the standard are shown in the Appendix A.

From the literature review,the workshop focus in planning, development and provision of laboratory services (Karaarslan, 2008, Aslan et al, 2009 and Kilinc,2009). Another literature reviewed the quality of laboratory test. Quality studies are also being spread to newly opened Blood Donation Centers. Accreditation of Regional Blood Centers has been aimed in the scope of Joint Commission International (JCI) Clinical Laboratory Accreditation Standard. (Vurgun, 2009). Ritchard, 1999 studies attempts to provide some clarity for the infection control professionals who are preparing for Joint Commission survey. The standards are designed to allow flexibility to ensure that infection control programs meet the specific needs of the resident population and that these programs can continue to evolve. Poppovich,1997 studied the change of JCI programs 1999-2000. Most of the literature studied for support patient safety and efficiency.

2.4.2 The Value of JCI

Accreditation may benefit hospitals by accomplishing the following (Joint Commission International, 2011):

• Giving hospitals a competitive advantage

Accreditation provides evidence of high-quality patient care that helps level the playing field for hospitals performing the same types of procedures.

• Strengthening community confidence

Achieving accreditation is a visible demonstration to patients and the community that a hospital is committed to providing the highest-quality services.

• Obtaining recognition from insurers, associations, employers, and other stakeholders

Increasingly, accreditation is becoming an eligibility prerequisite for reimbursement, association membership, community awareness, and contracts or grants

• Validating high-quality care to patients

JCI standards are focused on achieving one goal: raising the safety and quality of care to the highest possible level. Achieving accreditation is a strong validation that a hospital has taken the extra steps to meet a high level of safety and quality.

• Helping hospitals organize and strengthen their improvement efforts

Accreditation encompasses state-of-the-art performance improvement concepts that help hospitals continuously improve quality.

• Enhancing staff education

The survey process is designed to be educational, not punitive. JCI surveyors are trained to help hospitals improve their internal procedures and day-to-day operations.

• Improving risk management

By enhancing risk management efforts, accreditation may improve access to or reduce the cost of liability coverage. It can also assist in lowering adverse events or outcomes for the hospital and, more importantly, for the patient.

• Facilitating staff recruitment

As staff recruitment becomes more difficult, achieving accreditation as a demonstration of a hospital's commitment to quality and patient safety will enhance recruitment efforts and retention of staff.

• Promoting team-building skills for staff

The process of obtaining and maintaining accreditation demands a team approach to good patient care. Establishing processes and systems that support good patient care is achieved through strong team activities. The hospitals goals are patient safety, patient satisfaction and efficiency(Maholtha,2009,Lundstrom et al,2002).

From the literature,this research is interested in designing a new EMR using Lean concept within JCI standard framework.

CHAPTER III
RESEARCH METHODOLOGY

This research framework is the design of new EMR using Lean concept and JCI standard. The scope of this study is in the Out-patient process only. The tools used in this study include Lean concept, EMR and JCI standard. Lean concept focuses on workplace Layout, Visual management, Value stream mapping, 5S and standard work. Electronic medical record is evolving from documentation systems into workflow and workflow management systems in order to accomplish set goals (practice productivity,patient safety and satisfaction) and contain visual management such as to create a condition of visual management so the staff could easily identify a problem and create a point-of-use environment so that things are located where they are used. EMR can be instructed in what to do automatically based on who, what, why, when, where, and how follow the requirement of JCI that can improve the standard flow and increase practice productivity. The research framework shows in Figure 3.1. The goals for this research for patient safety, patient satisfaction and efficiency

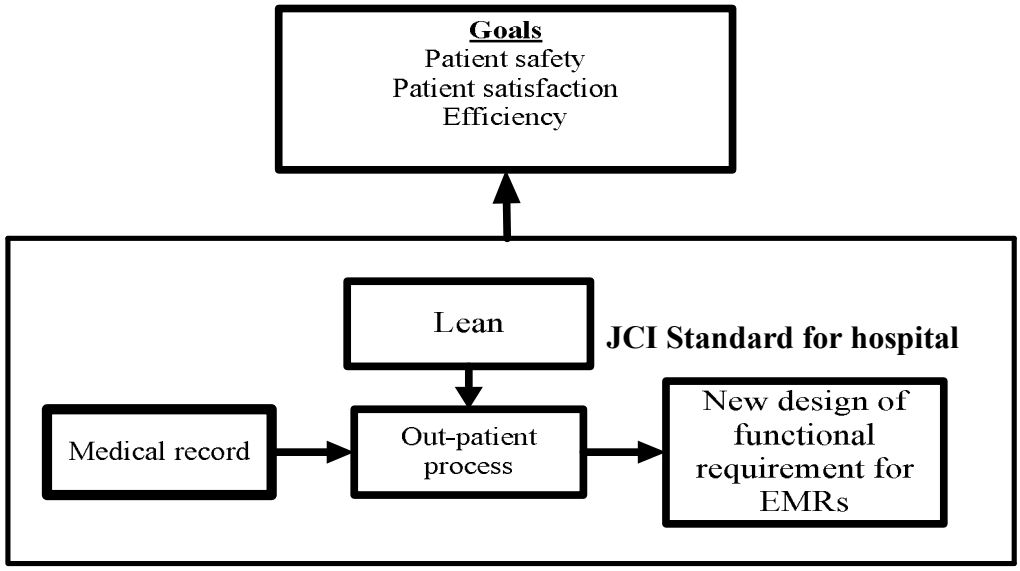

Figure 3.1 Research framework

The research methodology starts from Step 3.1 The Lean process creates the current state mapping, Step 3.2 The Lean process identifying time and distance, Step 3.3 The Lean process: Identifying waste, necessary non-value process and value process, Step 3.4 Improve process by integrating Lean concept with EMR and JCI standard, Step 3.5 Create Future state mapping, Step 3.6 Design of functional requirement, Step 3.7 Design report, Step 3.8 Verification, Step 3.9 Modified and find new EMR. (See Figure 3.2)

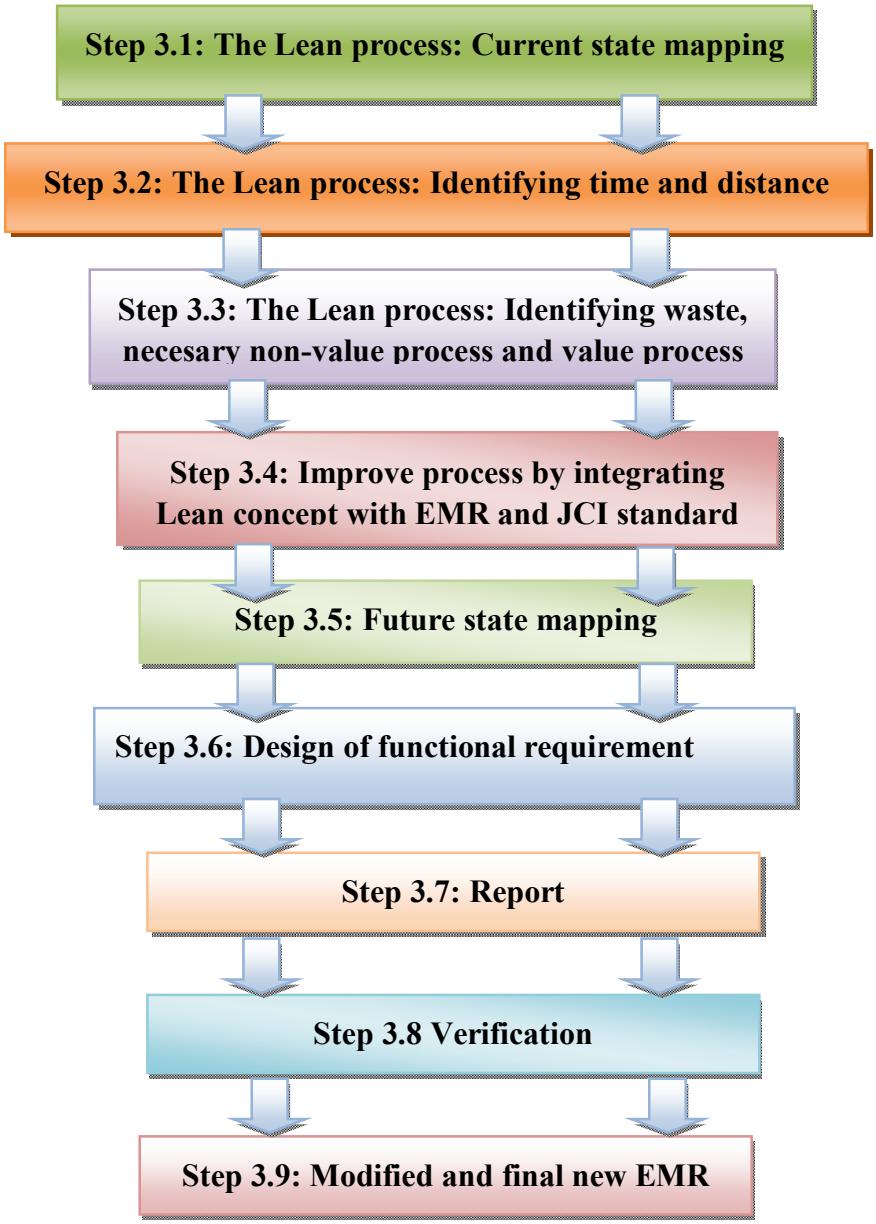

Figure 3.2 Research methodology

3.1 The Lean process: Current state mapping

A case study of a community hospital, the average patient is 150-200 person/day. Community hospital uses paper base (Medical record started from nurse check visual sign), and computer record (Doctor order/write prescribe). Departments in this hospital are outpatient department, inpatient department, emergency department, pediatrics department, Laboratory, X-ray, Pharmacy, Special clinic and Medical record department. Create Layout and the hospital business process involves the service provider information and patient information which have been recorded in paper-based documents. This research look into the improvement of operational process by applies Lean thinking. The scope of this study was to identify value and eliminate or reduce non value added (NVA) activities from the selected process.

3.2 Identifying (Count time, measure the distance)

In a Lean methodology the current system is studied in the process and layout. This is done by studying the current service, product and service variation and demand, in order to develop a flow chart of the process. Show the big picture a service layout. After that critical process were identified for a time and motion study. From the study Value, necessary and non value activities were identified, focusing on operation, transportation, delay and inspection. A value stream map of the current state was constructed. Next, analysis data and using Lean concept was used to eliminate or minimize waste activities. After that a value stream map was draw for the future process. In the final state data was compared to see the improvement. In steps of research should have a planning in each step to achieve a successful research and be in line with objectives of research. From the layout process, Layout process arrangement in the true way helps to reduce procedure and human movement. According to the case study, our studied can be analyzed that the distance is not effect to waiting time while working process and human operation is more effect to waiting time. Therefore, this research focuses on out-patient process only.

3.3 Identifying wastes, necessary non-value added process, and value-added process

According to service process analysis, there are three activities: Value-added (Patient go to see doctor for diagnosis and treatment), Necessary non value-added (Treatment registration) and Non value-added or waste (Waiting time for medical record). Reducing waiting period issue is a patients' expectation and also meet customer satisfaction. The classification of business process activities into three groups including wastes, non-value added, and value-added activities.

3.4 Improve process by integrating Lean concept with EMR and JCI standard

From the first three steps, the waste, necessary non value, value added process have been identified. To improve the process, the waste will be eliminated. Thus, the Lean concept will be find the relation with EMR and JCI standard.

3.5 Future state mapping

Process improvement through the Lean concept can creating value by eliminate waste. The Electronic medical record system is implemented according the JCI's standard requirement. It has benefits to reduce waste time, increase patient's safety level with accurately recording and improve efficiently with high patient's satisfaction. Then show the future state mapping.

3.6 Design of functional requirement

After apply Lean concept and follow JCI standard to the system, design functional requirement concern internal data connection for the hospital by using electronic medical record. The EMR facilitates the process according to arrangement for medical results such as laboratory results, medical results and other testing results

for supporting the medical analysis; arrangement for physical condition data such as medical record for past and present, family medical treatment history, prescribed medicine, clinic treatment information support, electronic communication and data connection; training or supporting to patients continuously, general management data collection such as payment bill of patients in each different medical case.

3.7 Report

Design the report for supporting EMR functional requirement and following JCI standard.

3.8 Verification

The researcher should verify the functional requirement getting input from experts including clerks, nurses,doctor, pharmacist, cashier, IT staff, and management. And Then the specific area is identified in this process for improvement.

3.9 Modifiled and final new EMR

After verification from experts, the researcher edits the new functional requirement following the comments. Then summarize the report from the medical record.

This chapter is outline the research methodology strategies and design used in this study including procedure data collection and methods. The next chapter provide the result of case study and design of functional requirement for EMR by Lean concept and following JCI standard.

CHAPTER IV
RESULTS AND DISSCUSSION

This chapter presents the results of a case study of a community hospital in Thailand and its current and proposed business process of Out-patient department for supporting implementation of Lean, EMR and JCI internally. This research collects data in July 2010 until May 2012

4.1 Application of Lean concept and JCI standard in design EMRs

This research studied a case of a community hospital in Thailand. At present, the method for the storation of the patient's personal data is recorded in paper-based documents.The process starts with assigning hospital number to each patient, screening questions on problems or symptoms, and checking vital sign. The vital sign information including weight, height, blood pressure, and body temperature is then written down in a medical record manually. After that, the patient will bring the paper-based medical record to the clinic area and wait on queue for the nurse to call his/her name. When the queue is met, the patient will see the doctor and be diagnosing based on problems in the past and the current and initial symptoms. Optionally, the doctor will order lab or radiology to support his/her clinical decision. The lab and X-ray results will be reported and recorded in the patient’s individual medical record before the doctor gives treatment and prescribe medicine. The next process is that the nurse provides treatment to the patient as per order and make an appointment for the next visit. Finally, the patient will make payment and getting prescribing medicine before leaving the hospital. All information above are recorded in the paper-based medical record.

4.1.1 The Lean process: Current state mapping

A case study of a community hospital, the average patient is 150-200 person/day. Community hospital uses paper base (Medical record started from nurse check visual sign), and computer record (Doctor order/write prescribe). Departments in this hospital are outpatient department, inpatient department, emergency department, pediatrics department, Laboratory, X-ray, Pharmacy, Special clinic and Medical record department. Layout of community hospital has shown in Figure 4.1

The Pre-Lean identifies the process exactly as it exists today, time for record 8.00 a.m.-15.00 a.m. from Monday to Friday and follows patient path from and identifying time is shown in Table 4.1 and Value stream mapping which include process and activity time is shown in Figure 4.2 and 4.3

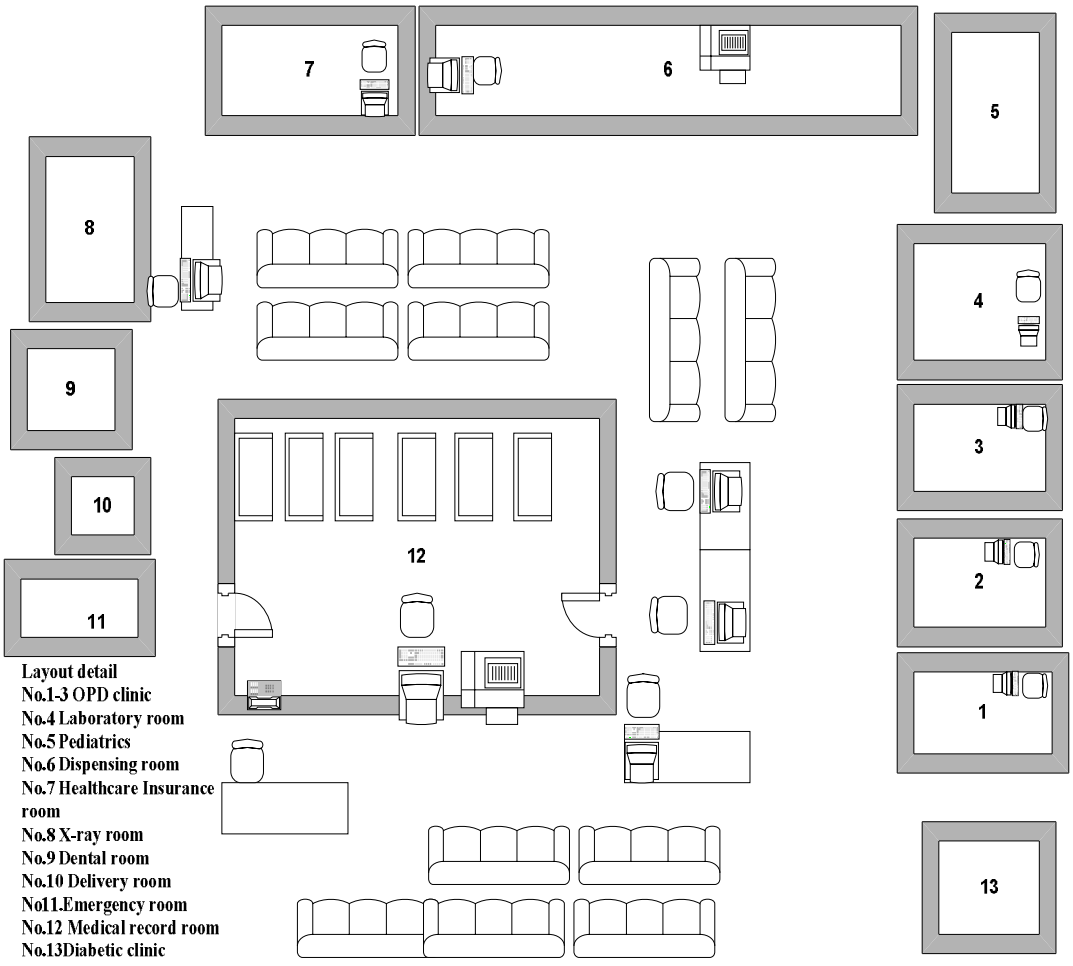

Figure 4.1 Layout Outpatient service

The current study has been carried out with community hospital in Thailand. The hospital business process involves the service provider information and patient information which have been recorded in paper-based documents. This research look into the improvement of operational process by applies Lean thinking.

Table 4.1 Current time in Outpatient process

Activities	Personal	Estimated Time (minutes)
1. Clerk ask for patient information and record by computer	Clerk	15
2. Clerk check up insurance and register patient by computer.	Clerk	20
3. Nurse waiting for paper base medical record.	Nurse	10
4. Nurse check visual sign and record in paper based medical record	Nurse	20
5. Nurse record in electronic system.	Nurse	10
6. Nurse brings patient to see doctor with paper based medical record	Nurse	5
7. Patient waits for call to see doctor.	Nurse	10
8. Doctor diagnosis considering symptom and case history.	Doctor	5
9. Doctor prescribe medicine and order lab and X-ray test (optional)	Doctor	5
10.Nurse wait for order to makes an appointment	Nurse	6
11. Nurse makes an appointment	Nurse	5
12. Pharmacist waits for prescription.	Pharmacist	6
13.Pharmacist check the prescription and calculate cost of medicine	Pharmacist	5
14.Payment	Cashier	5
15.Pharmacist dispenses medicine and gives home advice.	Pharmacist	5
Total		**132**

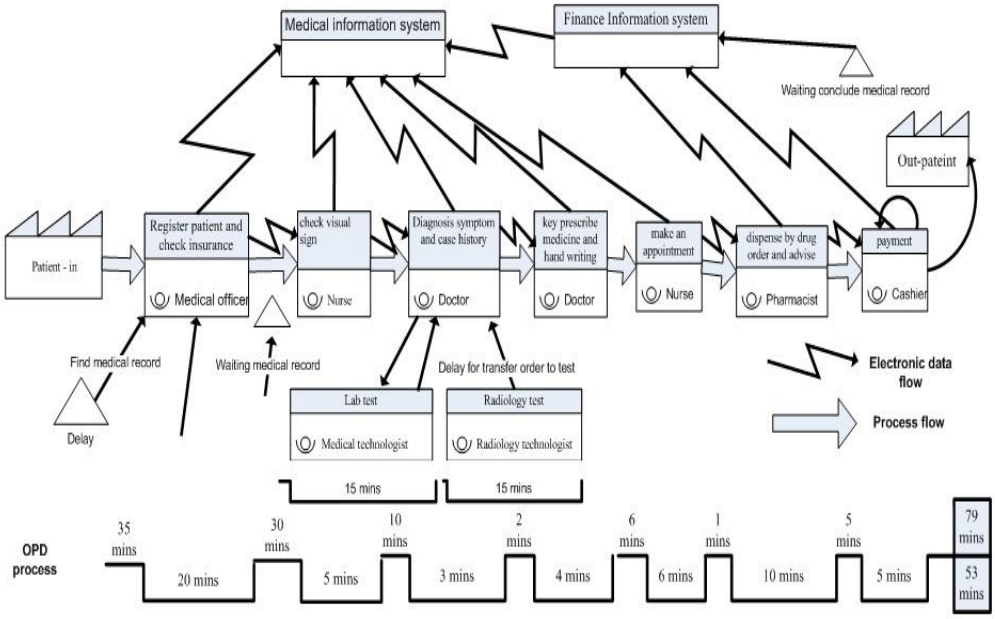

Figure 4.2 Value stream mapping (AS-IS)

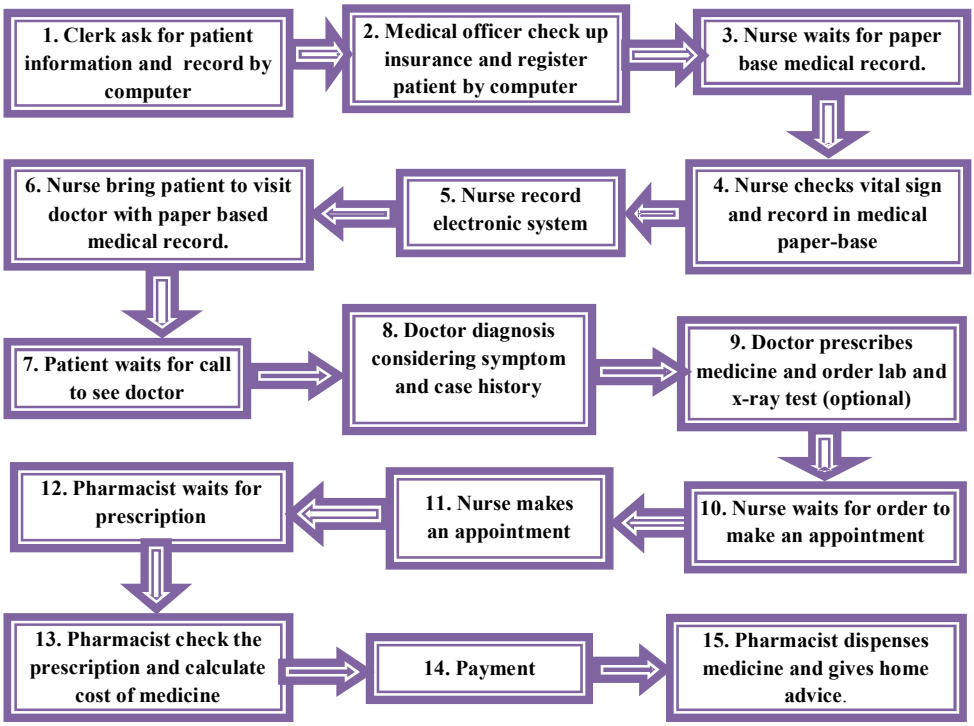

Figure 4.3 Current states mapping in outpatient service process (AS-IS)

4.1.2 Identifying (Count time, measure the distance)

It starts with assigning hospital number in order, and the nurse will ask about the problems or symptoms, and check vital signs. The data including initial problems or symptoms, weight, height, blood pressure, and body temperature will be written down in medical record. Then, the patient will move to the clinical areas with the medical record and wait for the nurse to call their names. Then the doctor will diagnose based on the past, current and initial symptoms that were recorded. In case of need, the doctor will order lab test or radiology check and the results will be recorded in the medical record.

Table 4.2 Identify count time

Process	Times/day	Time (minute)
1.Staff walk to find the medical record	140	5
2.Staff walk to bring the medical record for nurse	140	2
3. Nurse bring patient to doctor with medical record.	140	2
4.Staff walk to sent Lab order to Laboratory room	40(10-140)	5
5.Staff walk to sent Lab order to X-ray room	30(10-140)	6
6. Staff bring prescribe to pharmacist.	140	5

Identify from the case study found the distance not effect for waiting time. System and human work made waiting time than. So this research identify only working process

4.1.3 Identifying wastes, non-value added process, and value-added process

According to service process analysis, there are three activities: Value-added (Patient go to see doctor for diagnosis and treatment), Necessary non value-added (Treatment registration) and Non value-added or waste (Waiting time for medical record). Reducing waiting period issue is a patients' expectation and also meet customer satisfaction. The classification of business process activities into three groups including wastes, non-value added, and value-added activities are shown in Table 4.3.

Table 4.3 The value-added, necessary non value-added and non value-added activities in outpatient service

Activities	Value Added	Necessary non value added	Non-value added
1.Clerk ask for patient information and record by computer		√	
2.Clerk check up insurance and register patient by computer		√	
3. Nurse waiting for paper base medical record.			√
4. Nurse check visual sign and record in paper based medical record	√		√
5.Nurse record in electronic system		√	
6. Nurse brings patient to see doctor with paper based medical record		√	
7. Patient waits for call to see doctor.		√	
8.Doctor diagnosis considering symptom and case history	√		
9. Doctor prescribe medicine and order lab and X-ray test (optional)	√		
10.Nurse wait for order to makes an appointment			√
11. Nurse makes an appointment		√	
12. Pharmacist wait for prescription.			√
13.Pharmacist check the prescription and calculate cost of medicine		√	
14.Payment	√		
15. Pharmacist dispenses medicine and gives home advice.	√		

Lean related to process and document. In addition to the process activity problem related to medical record error and Identify in Table 4.4. Medical record problem identify by Lean concept.

Table 4.4 The problem related to medical record error

Problem related to medical record	Wastes
1. Misidentification	Defect
2.Prescription error	Defect
3. Dispensing error	Defect
4.Drug allergy	Defect
5.Incompatible with patient/Wrong diagnosis	Defect
6.Drug Contra-indication	Defect
7.Drug Interaction	Defect
8. Unreadable	Defect, Waiting
9.Drug administration error	Defect
10.Medical record paper	Inventory
11.Loss of medical record	Waiting, Defect
12.Miss communication	Defect
13.Unnessesary treatment	Over Production
14.Wrong calculate payment/Calculation error	Defect, Waiting
15.Not using qualified staff	Not using talent staff

4.1.4 Improve process by integrate Lean concept with electronic medical record and JCI Standard

After the value-added, necessary non-value-added, and wastes have been identified done, the wastes will be eliminated by all means. Then the business process improvement integrating Lean concept and EMR will be conducted to help the hospital to achieve JCI accreditation standards. How EMR helps the hospital to achieve JCI accreditation standards in all areas is shown in Table 4.5**.** The JCI accreditation standards were categorize to Outpatient department and design in Table 4.8.

Table 4.5 How EMR helps the hospital to achieve JCI accreditation standards

JCI accreditation standards	How EMR helps the hospital to achieve JCI accreditation standards
IPSG	EMR follows the standard goal as identify patients correctly form the function of EMR that include patient picture and patient data sent to other service units in time until finish treatment and improve effective communication by using the same information in the medical record as well as improve safety of high-alert medication. For example, patient allergy information pop-up or a set of medicine and equipment ready for surgery. This helps to ensure correct site, correct procedure, and correct patient surgery.
ACC	EMR shows and records the decision of care and treatment to the patients. In the future, EMR will share data record electronically for the transfer or discharge of the patient to his or her home or to another care setting.
FRM	EMR helps to identify, protect, and promote patient right, inform patient to their right, include the patient family, when appropriate, in decision about the patient's care, obtain inform consent (EMR record consent form) and educate staff about patient rights.
AOP	EMR helps to collect information and data about the patient's physical, psychological, social status, and health care history. The result of laboratory and imagining diagnosis tests and other assessment will be recorded electronically.
COP	EMR record helps planning and delivering care to each patient, monitoring the patient, explaining the results of care, and doing follow up process.
ASC	EMR helps to manage data record for equipment/surgery equipment and record consent data.

Table 4.5 How EMR helps the hospital to achieve JCI accreditation standards (cont.)

JCI accreditation standards	How EMR helps the hospital to achieve JCI accreditation standards
MMU	The record of EMR helps to improve the procurement, inventory management, distribution, preparing, dispensing, administering, documenting, and monitoring of medication therapy..
PFE	The database of EMR can be accessed and classified into groups. When the hospital organizes a seminar in a particular topic, the hospital may contact the direct target groups in the database for their participation.
QPS	EMR records help the management to know the spread out of disease, trend, problems, and other information. These help them to make better decisions and prepare for fighting with the disease or issue protection plan.
PCI	EMR record helps for planning to prevent from disease.
GLD	EMR helps to link and transfer the information among units in the hospital. The correct information provided at the right time improves the overall quality management and results in patient safety and good outcomes.
FMS	The good EMR system helps the hospital to manage its facilities efficiently and thus help to prevent from diseases, reduce and control hazard and risks, prevent from accidents and injuries and maintain safe condition.
SQE	This standard represents staff qualifications. The EMR helps to know the areas where the hospital should train their staff or have the expertise on those areas to give appropriate and sufficient services to the patients.

Table 4.5 How EMR helps the hospital to achieve JCI accreditation standards (cont.)

JCI accreditation standards	How EMR helps the hospital to achieve JCI accreditation standards
MCI	EMR directly helps identifying information needed, designing an information management system, defining and capturing data and information, transforming it into information, transmitting and reporting data and information and integrating and using information efficiently.

The business process improvement using an integration of Lean concept and EMRs will help the hospital to achieve JCI standards. How it involves is shown in Table 4.6. Overall, Improve process by integrate Lean concept with electronic medical record and JCI Standard**.**

Table 4.6 Improve process by integrate Lean concept with electronic medical record and JCI Standard

Activities	Value Added	Necessary non value added	Non-value added	EMR	JCI standard
1.Clerk ask for patient information and record by computer		√		E-register	**IPGS**
2.Clerk check up insurance and register patient by computer		√		E-register	**IPGS,ACC,PFR**
3. Nurse waiting for paper base medical record.			√	E-nurse note	**COP**
4. Nurse check visual sign and record in paper based medical record	√		√	E-nurse note	**COP**

Table 4.6 Improve process by integrate Lean concept with electronic medical record and JCI Standard (cont.)

Activities	Value Added	Necessary non value added	Non-value added	EMR	JCI standard
5.Nurse record in electronic system		√		E-nurse note	**ACC,COP**
6. Nurse brings patient to see doctor with paper based medical record		√		-	
7. Patient waits for call to see doctor.		√		-	
8.Doctor diagnosis considering symptom and case history	√			E-prescribe	**COP,AOP**
9. Doctor prescribe medicine and order lab and X-ray test (optional)	√			E-dispensing	**COP,AOP**
10.Nurse wait for order to makes an appointment			√	E-dispensing	
11. Nurse makes an appointment		√		E-dispensing	**PFE**
12. Pharmacist waits for prescription.			√	E-dispensing	**MMU**
13.Pharmacist check the prescription and calculate cost of medicine		√		**-**	**MMU**
14.Payment	√			E-payment	

Table 4.6 Improve process by integrate Lean concept with electronic medical record and JCI Standard (cont.)

Activities	Value Added	Necessary non value added	Non-value added	EMR	JCI standard
15. Pharmacist dispenses medicine and gives home advice.	√			E-dispensing	**PFE**

4.1.5 Future state mapping

After improve process by Lean concept and get rid of waste process and waste in medical record. Implement Electronic medical record system follow by requirement of JCI standard. That can reduce waste time and make patient safety with correctly record and improve efficiently and patient satisfaction.

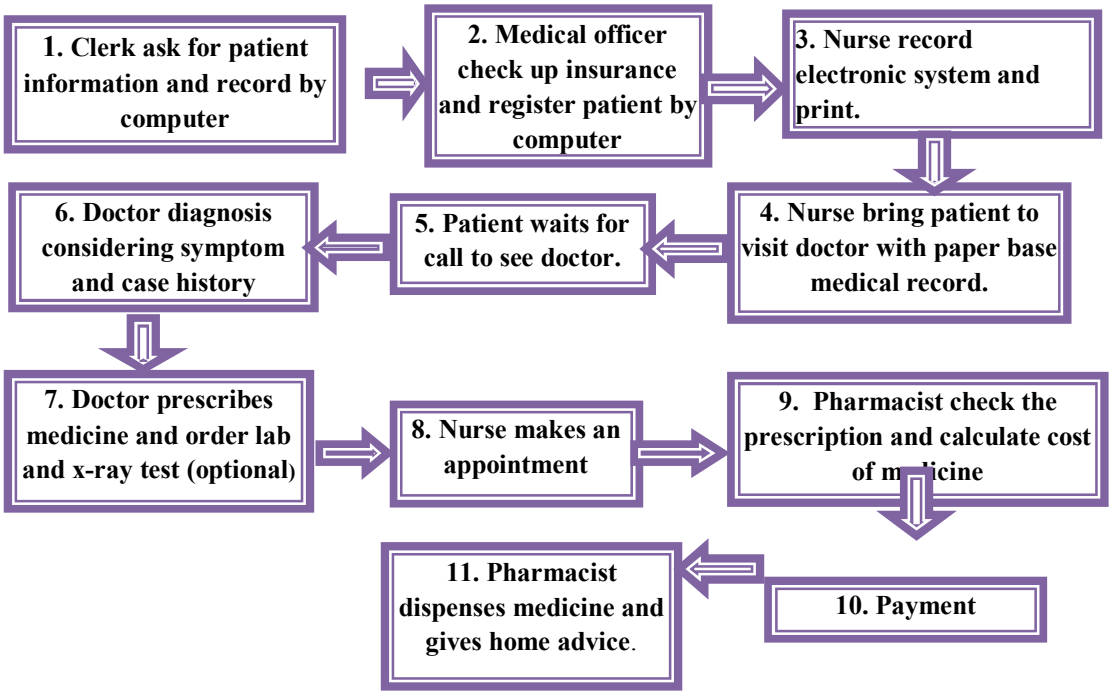

Figure 4.4 Post Lean Process after combining the implementation of Electronic medical record and JCI standards (TO-BE)

The result of business process improvement shows a reduction of four non-value-added activities (activities # 3,4,10, & 12) which is equal to 27 percents of the pre-lean activities and the total average cycle time has been reduced from 132 minutes to 69 minutes or 48 percents reduction from the pre-lean processes.

Table 4.7 Comparison of process efficiency between pre-lean and post-lean.

Value activity	Pre-lean	Post-lean	Efficiency (%)
Number of Activities	15	11	4 actives ↓ 27%
Total cycle time	132 (129-144mins)	69 (67-92mins)	63 (60-110mins) ↓ 48%

4.2 Design

Previous studies of the processes (Figure 4.5) that improve by Lean concept. The design of EMRs for out-patient medical record system from Lean concept and considering JCI standard used for Out-patient department. The process 4 and process 5 were cut (non necessary), the documents that should be available to the process for reference during the patient care are separate and re-identify from 11 processes (Figure 4.5) to 7 subsystems are;

Subsystem 1: Registration related to process 1, 2

Subsystem 2: Screening related to process 3

Subsystem 3: Examination/Diagnosis/Description/Order related to process 4, 5

Subsystem 4: Lab/X-ray report related to process 7

Subsystem 5: Appointment/ follow up related to process 8

Subsystem 6: Payment related to process 10, 11

Subsystem 7: Dispensing related to 9, 11

To design the functional requirement for EMR to link the medical record information for patient care. The functional requirement related to user and identify from user need and considering reducing 7 wastes in process shown in Table 4.8

Table 4.8 Functional requirement for design EMR

ID	Description	Reduce waste	Subsystems
FR01.	Show log in security	Defects	1,2,3,4,5,6,7
FR02.	Show and display essential demographic patient information such as: name, birth date, gender, etc.	Defects	1,2,3,4,7
FR03.	Show patient photo.	Defects	1,2,3,4,7
FR04.	Show past illness.	Defects	1,2,3,4,7
FR05.	Show present illness.	Defects	1,2,3,4,7
FR06.	Show monitor for record visual sign ,weight ,height, calculate BMI	Defects, Motion, Excessive processing	1,2,3
FR07.	Show lab test	Defects,Transportation,Waiting	1,2,3,4
FR08.	Show X ray test	Defects,Waiting	1,2,3,4
FR09.	Show appointment detail	Defects,Waiting	1,2,3,5
FR10.	Show prescription history	Defects,Waiting	1,2,3
FR11.	Show order history	Defects,Waiting, Excessive processing	3
FR12.	Alert system when allergy, high alert, over dose, stock empty etc.	Defects	3
FR13.	Show patient queue for treatment	Defects	1,3
FR14.	Alert system to confirm prescription (DI, allergy, high-alert, repeat, over dose, Insurance)	Defects	3,7

Table 4.8 Functional requirement for design EMR (cont.)

ID	Description	Reduce waste	Subsystems
FR15.	Show patient insurance when doctor prescription (Direct payment/Indirect payment)	Defects	3,7
FR16.	Alert system to confirm before prescription	Defects	3,7
FR17.	Hold prescription until user confirm	Defects	3,7
FR18.	Repeat Medicine	Defects	3,7
FR19.	Adjust detail of prescription	Defects	3
FR20.	Calculate price as doctor prescription	Defects	3
FR21.	Show ICD-10-TM and record.	Defects	3
FR22.	Lab order	Defects	3
FR23.	X-ray order	Defects	3
FR24.	Show waiting time for test order	Defects	3,4
FR25.	Doctor appointment patient and nurse confirm date	Defects	3,5
FR26.	Transcribing by pharmacist	Defects	7
FR27.	Show patient queue for receive medicine	Defects	7
FR28.	Prescription order	Defects Motion, Excessive processing	3
FR29.	Alert when fount DI, allergy, over dose	Defects	1,3,7

Table 4.8 Functional requirement for design EMR (cont.)

ID	Description	Reduce waste	Subsystems
FR30.	Show allergy drug	Defects	3,4
FR31.	Show Lab report	Defects	3,4
FR32.	Show X-ray report	Defects	3,4
FR33.	Show referral orders with details.	Defects	3,4
FR34.	Show prescription (with HN)and print label for dispensing	Defects	7
FR35.	Add dispense/ cancel dispense	Defects	3,7
FR36.	Show medicine history	Defects	3,7
FR37.	Show drug price	Defects	3,7
FR38.	Show pharmacy approval no.	Defects	7
FR39.	Show dispense date	Defects	7
FR40.	Show drug description	Defects	7
FR41.	Show drug name/ form / strength (code all drug form)	Defects	7
FR42.	Show advise giving	Defects	5,7
FR43.	Show monitor patient care support	Defects	5,7
FR44.	Show record dispensing and error dispensing	Defects	7,6
FR45.	Payment system by ICD10	Defects	6
FR46.	Medical record system	Defects	1,2,3,4,5,6,7
FR47.	Show conclude 18 file for reimbursement	Defects	6

Table 4.8 Functional requirement for design EMR (cont.)

ID	Description	Reduce waste	Subsystems
FR48.	All record send back to system	Defects	6
FR49.	Reimbursement	Defects	6

The JCI standard for hospital and subsystems was identify the relation of standard and system design shown in Table 4.9 to support the content of electronic medical record should be designed. Data complexity, volumes of patients served and the desire to have efficient health information systems have defined the need for design Electronic Medical Record (EMR) Systems when well developed and implemented, can improve the process of data collection resulting in better quality and more reliable health information.

Table 4.9 Subsystems design related to Joint commission accreditation standard (Hospital program)

Joint commission accreditation standard	Subsystems
IPGS1 Identify Patients Correctly	1,2,3,4,5,6
IPGS2 Improve Effective Communication	1,2,3,4,5,6
IPGS3 Improve the Safety of High-Alert Medications	1,2,3,7
IPGS4 Ensure Correct-Site, Correct-Procedure, Correct-Patient Surgery	2,3
ACC1Patients are admitted to receive inpatient care or registered for outpatient services based on their identified health care needs and the organization's mission and resources.	2
ACC1.1.1Patients with emergent, urgent, or immediate needs are given priority for assessment and treatment.	1,2,3,4
ACC1.1.3The organization considers the clinical needs of patients when there are waiting periods or delays for diagnostic and/or treatment services.	2,3,4

Table 4.9 Subsystems design related to Joint commission accreditation standard (Hospital program) (cont.)

Joint commission accreditation standard	Subsystems
ACC3.3The clinical records of outpatients receiving continuing care contain a summary of all known significant diagnoses, drug allergies, current medications, and any past surgical procedures and hospitalizations.	1,2,3,4,7
ACC4.2 The receiving organization is given a written summary of the patient's clinical condition and the interventions provided by the referring organization.	1,2,3,4,7
PFR.1.6 Patient information is confidential.	1,2,3,4,5,6,7
PFR2The organization supports patients' and families' rights to participate in the care process.	1,2,3,4,6,7
AOP1.2 Each patient's initial assessment(s) includes an evolution of physical, psychological, social, and economic factor, including a physical examination and health history.	1,2,3,4,5
AOP1.3 The patient's medical and nursing needs are identified from the initial assessments and recorded in the clinical record.	2,3,4
AOP.1.5 Assessment findings are documented in the patient's record and readily available to those responsible for the patient's care.	2,3,4
AOP.5.7 Established norms and ranges are used to interpret and to report clinical laboratory results.	4
AOP.5.9 Quality control procedures are in place, followed, and documented.	1,2,3,4
AOP6Radiology and diagnostic imaging services are available to meet patient needs, and all such services meet applicable local and national standards, laws, and regulations.	4
AOP.6.3 Individuals with proper qualifications and experience perform diagnostic imaging studies, interpret the results, and report the results.	4

Table 4.9 Subsystems design related to Joint commission accreditation standard (Hospital program) (cont.)

Joint commission accreditation standard	Subsystems
COP.2 There is a process to integrate and to coordinate the care provided to each patient.	3
COP2.2 Those permitted to write patient orders write the order in the patient record in a uniform location.	3,4
COP2.3Procedures performed are written into the patient's record.	3,4
MMU.2.1 There is a method for overseeing the organization's medication list and medication use.	3,6,7
MMU.3.3 The organization has a medication recall system.	3,6,7
MMU.4.3 Medications prescribed and administered are written in the patient's record.	2,3,7
MMU.5.1 Medication prescriptions or orders are reviewed for appropriateness.	2,3,6,7
MMU.6.1 Medication administration includes a process to verify the medication is correct based on the medication order.	2,3,6,7
PFE.2 Each patient's educational needs are assessed and recorded in his or her record.	1,2,3,7
MCI7 The patient's record(s) is available to the health care practitioners to facilitate the communication of essential information.	1,2,4
MCI.10 Information privacy and confidentiality are maintained.	1,2,3,4,5,7
MCI11 Information security, including data integrity, is maintained.	1,2,3,4,5,7
MCI12 The organization has a policy on the retention time of records, data, and information.	1,2,3,4,5,7
MCI13 The organization uses standardized diagnosis codes, procedure codes, symbols, abbreviations, and definitions.	3,4

Table 4.9 Subsystems design related to Joint commission accreditation standard (Hospital program) (cont.)

Joint commission accreditation standard	Subsystems
MCI14 The data and information needs of those in and outside the organization are met on a timely basis in a format that meets user expectations and with the desired frequency.	1,2,3,4,5,6,7
MCI.16 Records and information are protected from loss, destruction, tampering, and unauthorized access or use.	1,2,3,4,5,6,7
MCI.19.1 The clinical record contains sufficient information to identify the patient, to support the diagnosis, to justify the treatment, to document the course and results of treatment, and to promote continuity of care among health care practitioners.	1,2,3,4,5,6,7
MCI.19.1.1 The clinical record of every patient receiving emergency care includes the time of arrival, the conclusions at termination of treatment, the patient's condition at discharge, and follow-up care instructions.	1,2,3,4,5,6,7
MCI.19.2 Organization policy identifies those authorized to make entries in the patient clinical record and determines the record's content and format.	1,2,3,4,5,6,7
MCI.19.3 Every patient clinical record entry identifies its author and when the entry was made in the record.	1,2,3,4,5,6,7
MCI.20.1 The organization has a process to aggregate data and has determined what data and information are to be regularly aggregated to meet the needs of clinical and managerial staff in the organization and agencies outside the organization.	1,2,3,4,5,6,7

To identify the Functional requirement related to Joint commission accreditation standard and Lean concept then researcher have developed an outpatient medical record (OMR) system designed to facilitate direct user interaction with the computer-based medical record show as use case model in Figure 4.5 and interface for explanation the detail of EMR content for Out-patient. Requirement model is the functionality of the system specification. Use case is the basic template that used for

collecting user's requirements and show the information for user Use case is the basic template that used for collecting user's requirements. A use case is a list of steps, typically defining interactions between a role (User) and a system, to achieve a goal. The use case setting also presents greater challenges for information transfer.

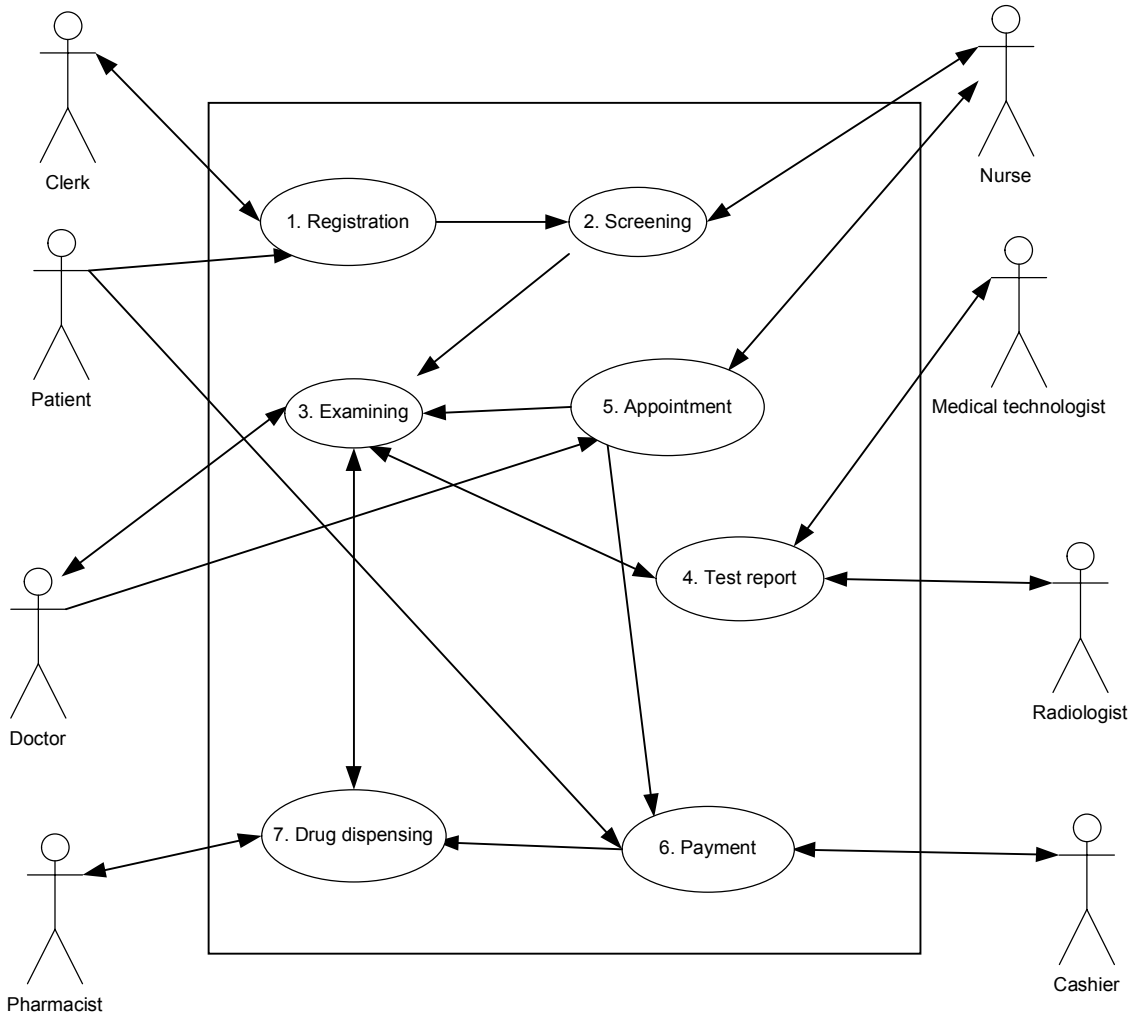

Figure 4.5 The Use case of outpatient electronic medical record system

The best EMRs need to be based on the Lean concept and the JIC standard. The personnel who may have the access to the medical record and registration process link to screening and diagnosis process is shown in Figure 4.6. While the activities between Lab order and lab test report is shown in Figure 4.7. The activities between X-ray order and X-ray report is shown in Figure 4.8. The

Appointment process between doctor and nurse is shown in Figure 4.8. The dispensing medicine process and payment process are shown in Figure 4.10.

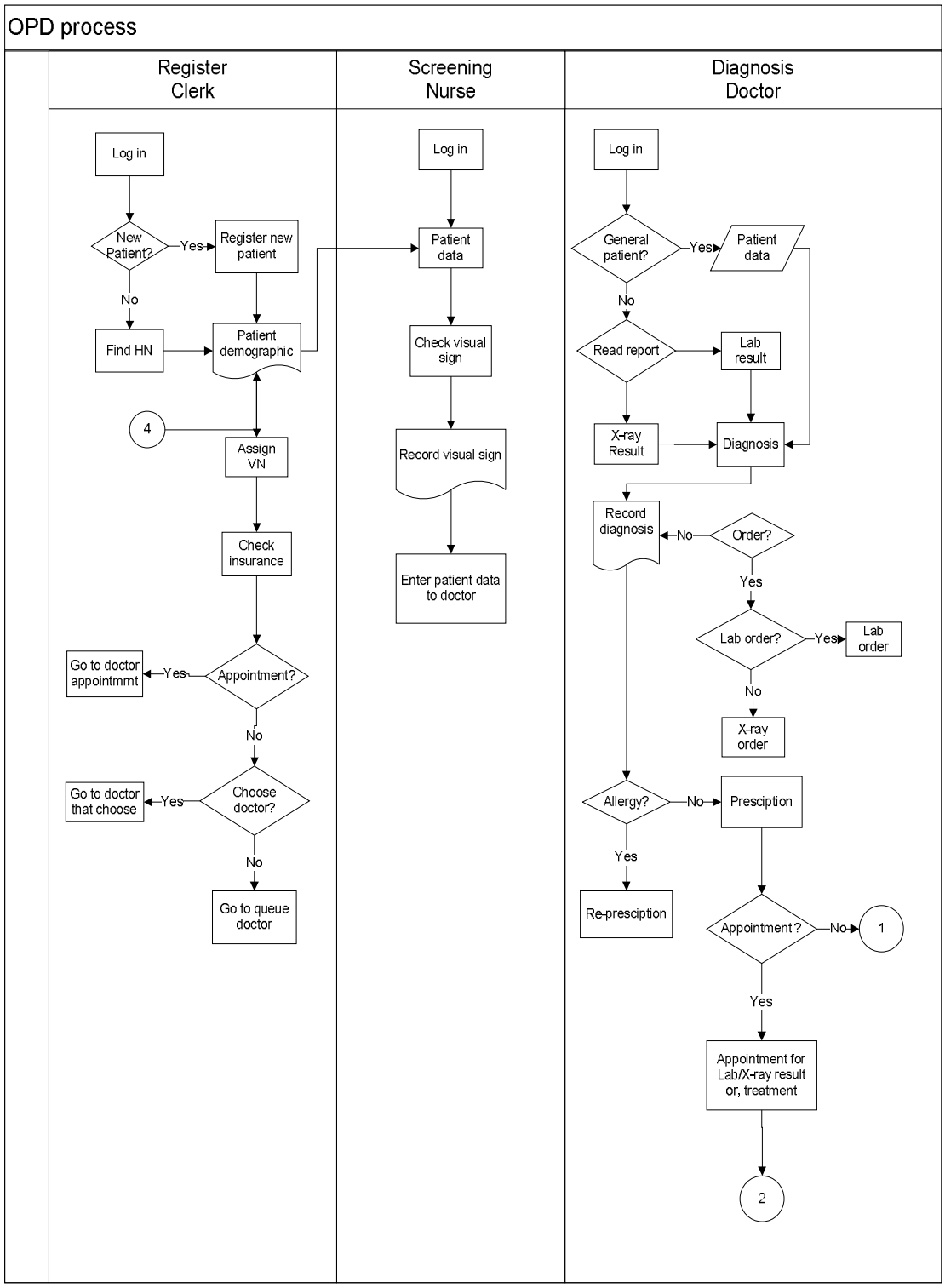

Figure 4.6 The relation of registration, screening and diagnosis process

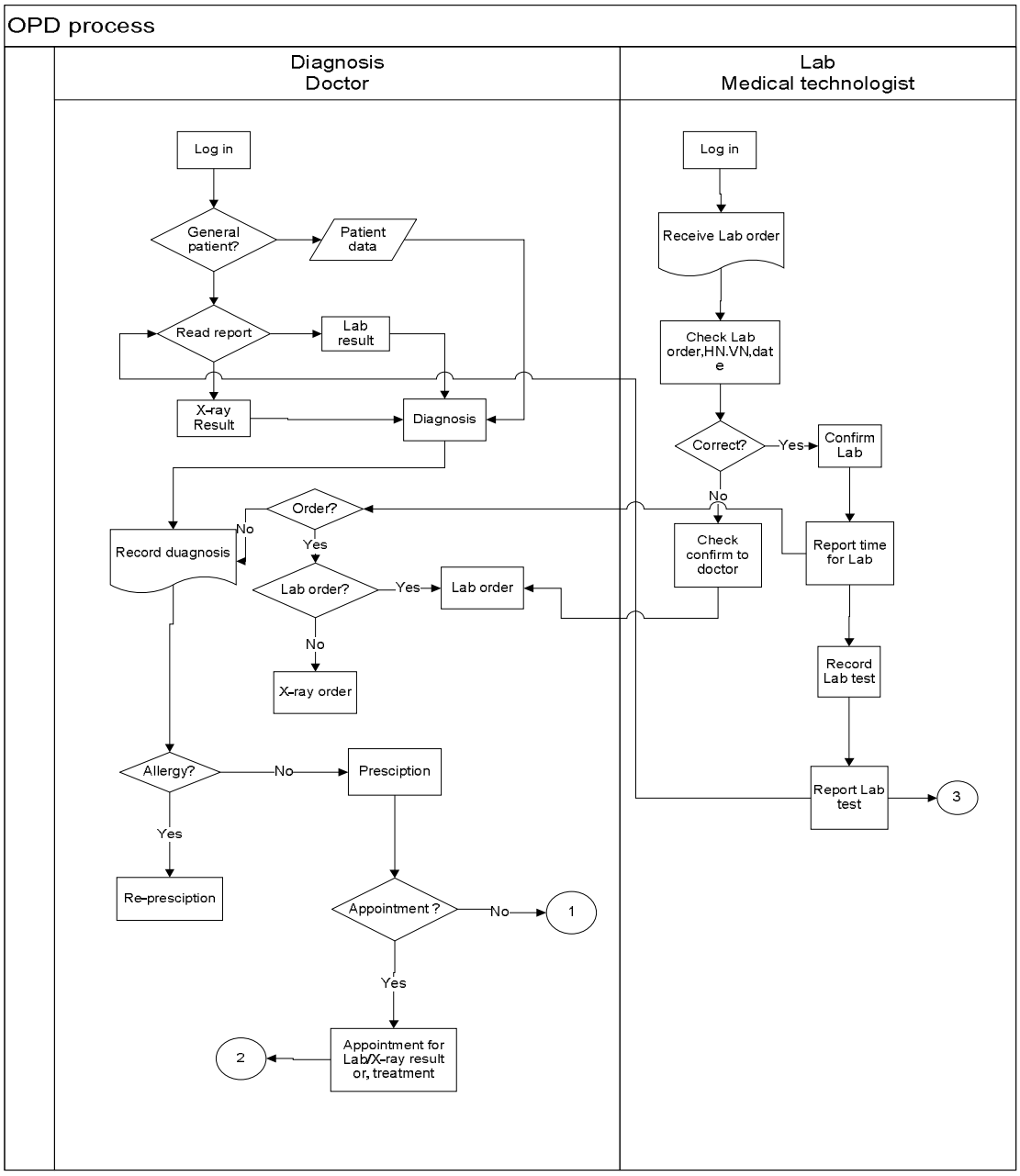

Figure 4.7 Order Lab test and lab report

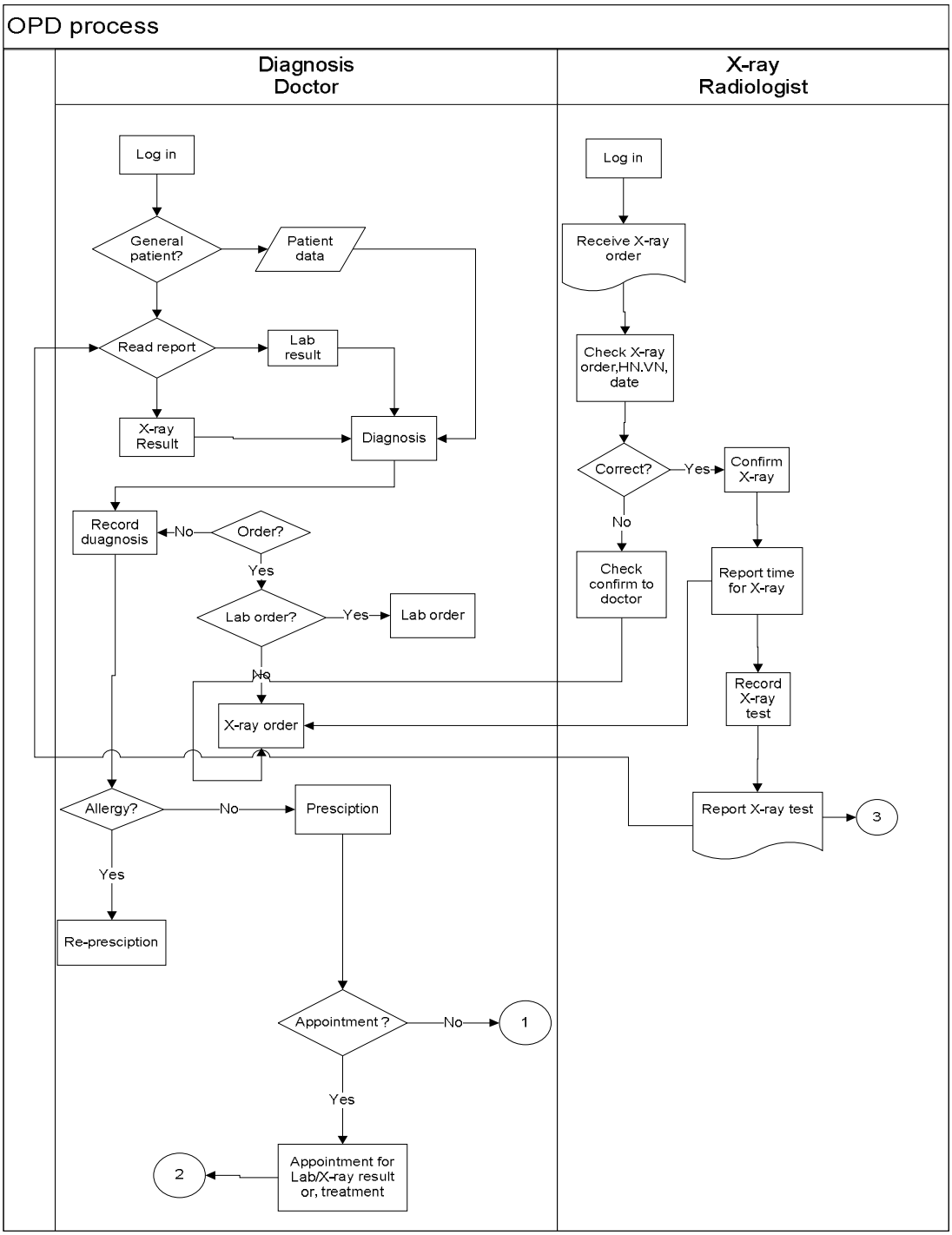

Figure 4.8 Order X-ray test and X-ray report

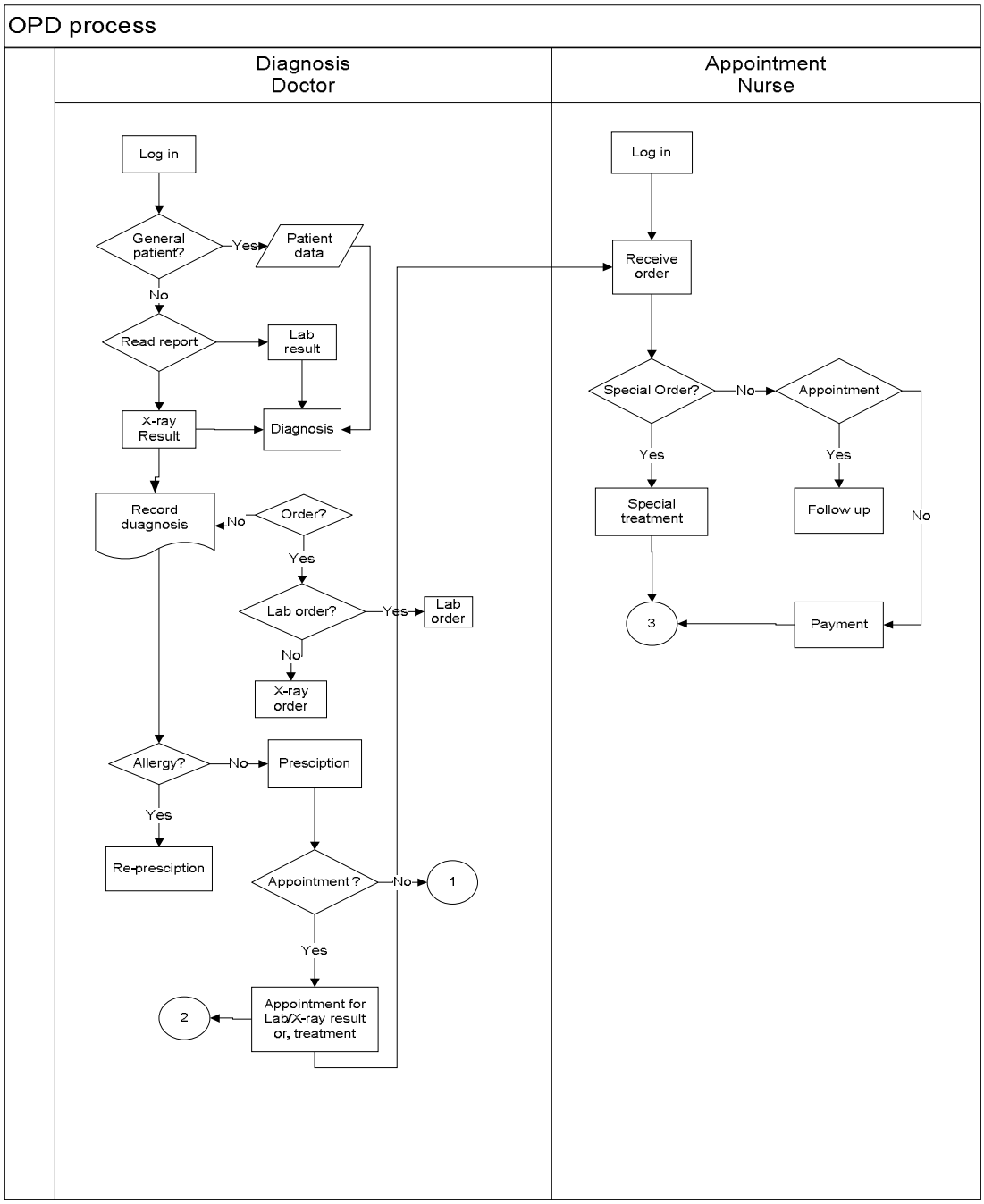

Figure 4.9 Appointment

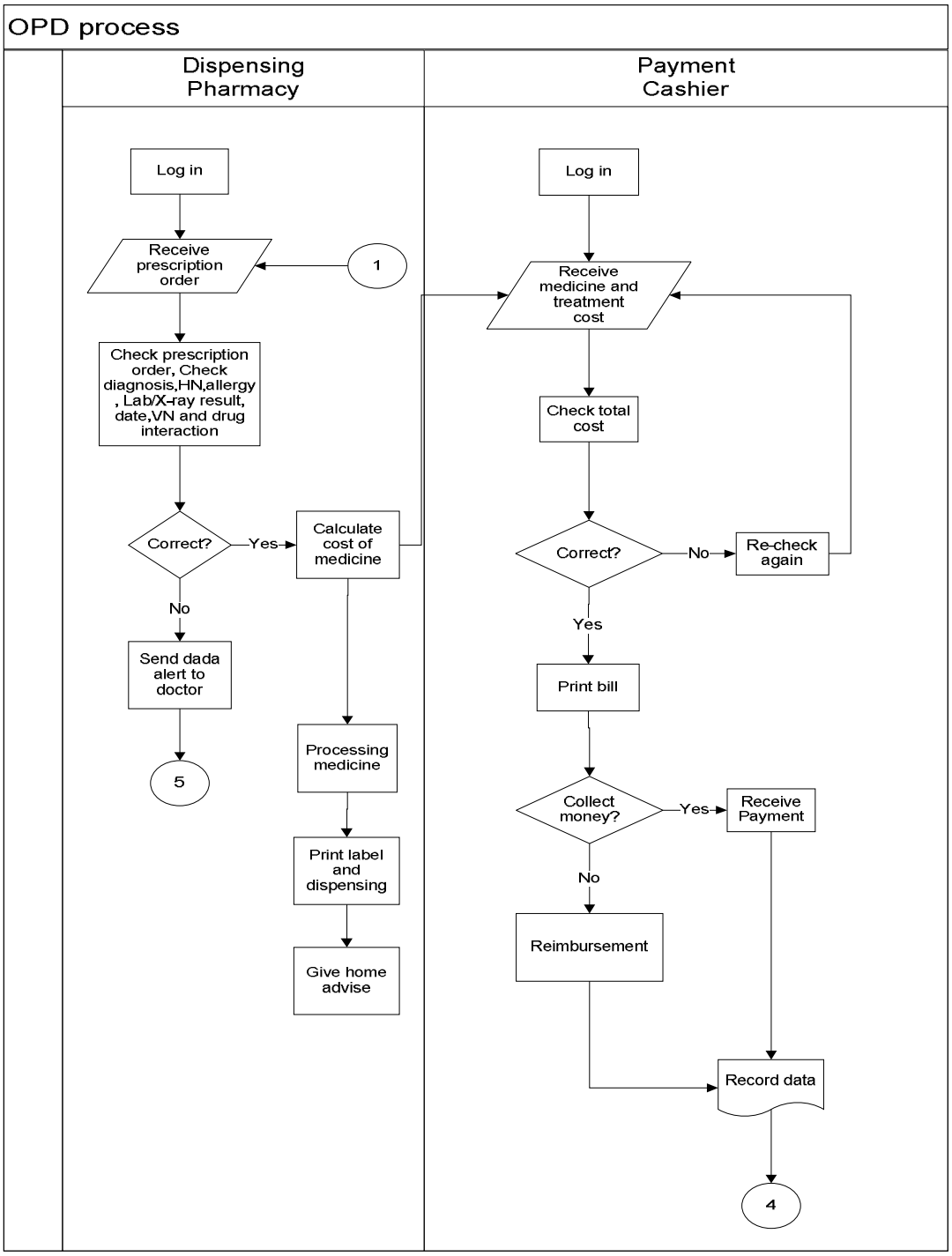

Figure 4.10 Dispensing and payment

4.3 Report

The daily report also specified how some of the conclusions and recommendations were implemented. This list of key capabilities will be used by the National Health Security Office (NHSO) to devise a common industry standard for EMR functionality that will guide the efforts of software developers. Registration subsystem the report from this subsystem show;

- Total number of outpatient who got the treatment service
- Total number of old patients.
- Total number of new patients.
- Total number of out-patient separated by insurance

Figure 4.11 Registration report

Figure 4.12 Insurance report

Nurse appointment

- Total number of out-patient who got appointment
- Total number of out-patient separate by doctor.
-

Figure 4.13 Appointment report

Lab subsystem

- Report number of Lab order
- Report lab result
- Report number of Patient who had lab by insurance

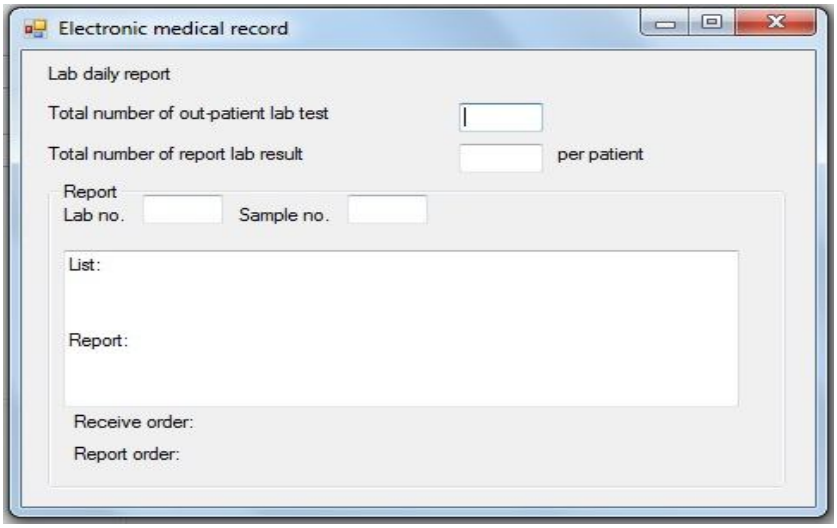

Figure 4.14 Lab report

X-ray subsystem

- Report number of X-ray order
- Report X-ray result
- Report number of Patient who had X-ray by insurance

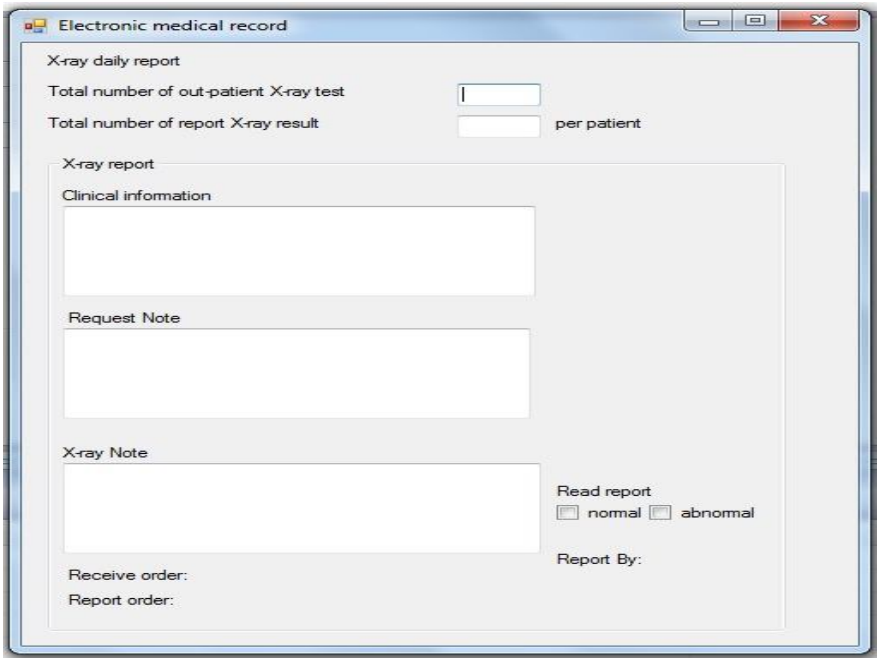

Figure 4.15 X-ray report

Drug dispensing report

- List of medicine
- List of drug code
- List of generic name
- List of route
- List of ICD_10_TM
- Total of medicine

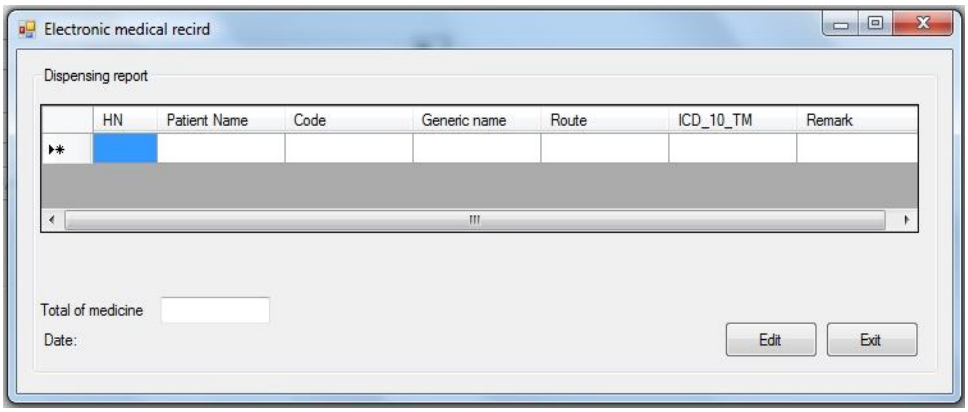

Figure 4.16 Dispensing report

Payment subsystem

- Report payment (Credit)
- Report payment (Cash)
- Report payment by government

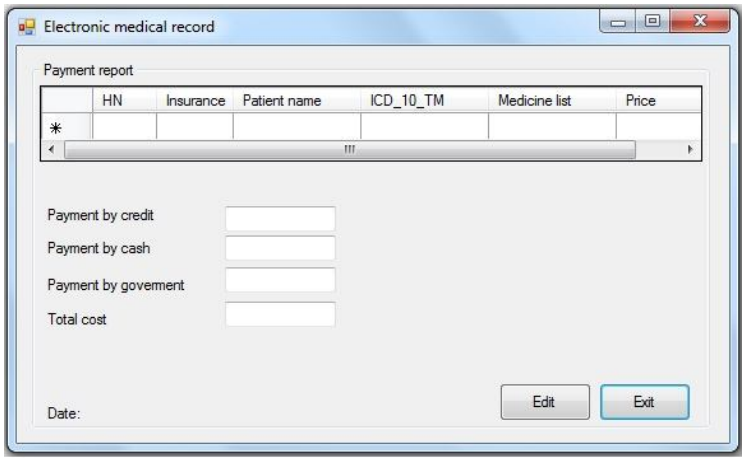

Figure 4.17 Payment report

4.4 Verification

After the EMR is developed, the researchers verify the possibilities with the expert in every department of the hospital and the result is a satisfactory. The outcome answered every purpose of the project which are Patients safety, Efficiency and Patients' satisfaction.

Table4.10 New EMR support goals

Goal	Support
1. Patient safety	Reduce medical error
	Patient was treatment right person
2. Efficiency	Time
	Reduce repetition
	Confidential
3. Patients' satisfaction	Reduce waiting time
	Reduce search error

Patient safety

The system uses at least two ways to identify patients. For example, use the patient's name and date of birth. This method can make sure that each patient gets the correct medicine and treatment.

Efficiency

The model put in place to help the hospital succeed in this regard are to ensure that the clinic treatments are on time and to reduce the medical errors.

Patient satisfaction

The factors that have the greatest impact on overall patient satisfaction, the system focus on the efforts, care plan and resources to improve the potential for the patient satisfaction.

Instructional structure design is the systematic process of translating general principles of learning and instruction into plans that ensure quality instruction, which in turn improves the learners' performance and closes learning gaps. Show in appendix B.

This research was verified by the experts who work in hospital case study as clerk, nurse, doctor, medical technician, radiologist , pharmacist and cashier. Researcher presented the contents of EMRs and explained this model to the expert in hospital. As the objective the EMRs will increase patient safety with the medical record content that considering by the medical council of Thailand but they gave some contents in subsystems.

Screen subsystem by nurse

- Patient Insurance
- Patient information about risk factor;
- Tobacco use and history including number of year and pack per day.
- Alcohol use, history

Diagnosis subsystem by doctor

- Care plan

Dispensing subsystem by the pharmacist

- Drug advice detail
- Chief complain

The Interface and description of the EMRs are shown in appendix A

4.5 Modified and final new EMR

The discuss comprise of Three parts, as follows;

I: The Relation between JCI standard and HA for design Electronic medical record

II: The Relation of Lean concept and EMR

III: The functional requirement of EMR compares with HOSXP

I: 1 The Relation between JCI standard and HA for design Electronic medical record

Hospital Accreditation (HA)

Part 1 Organization management overview

- Leadership
- Measurement,analysis and knowledge management
- Strategic management
- Focus on patient/customer
- Human research focus
- Process Management

Part 2 Key hospital systems

- Risk,safety and quality
- Environment of care
- Infection control
- Medical record system
- Medication management
- Diagnostic Investigation

Part 3 Patient care process

- Access and entry
- Patient assessment
- Planning of care
- Discharge planning
- Patient care delivery
- Education and Empowerment
- Continuity of care

Part 4 organization performance result

- Leadership result
- Human resource result
- Process effectiveness result
- Patient care result
- Patient/customer focus result
- Health promotion result
- Financial result

Joint Commission International (JCI) Standard

Section I: Patient-Centered Standards

- International Patient Safety Goals
    - Goal 1 Identify Patients Correctly
    - Goal 2 Improve Effective Communication
    - Goal 3 Improve the Safety of High-Alert Medications

- Goal 4 Ensure Correct-Site, Correct-Procedure, Correct-Patient Surgery
- Goal 5 Reduce the Risk of Health Care–Associated Infections
- Goal 6 Reduce the Risk of Patient Harm Resulting from Falls

- Access to Care and Continuity of Care
- Patient and Family Rights
- Assessment of Patients
- Care of Patients
- Anesthesia and Surgical Care
- Medication Management and Use
- Patient and Family Education

Section II: Health Care Organization Management Standards

- Quality Improvement and Patient Safety
- Prevention and Control of Infections
- Governance, Leadership, and Direction
- Facility Management and Safety
- Staff Qualifications and Education
- Management of Communication and Information

According to the standard the relationship is Patient-Centered Standards from JCI standard relate to Patient care process from HA and Health Care Organization Management Standards related to Organization management overview, Key hospital system and organization performance result. The relation between JCI standard and HA shown in Table 4.11.

Table 4.11 The relation between JCI standard and HA

JCI standard	HA
Section I: Patient-Centered Standards	**Part 3 Patient care process**
International Patient Safety Goals	-
Goal 1 Identify Patients Correctly	
Goal 2 Improve Effective Communication	-
Goal 3 Improve the Safety of High-Alert Medications	-
Goal 4 Ensure Correct-Site, Correct-Procedure, Correct-Patient Surgery	-
Goal 5 Reduce the Risk of Health Care–Associated Infections	-
Goal 6 Reduce the Risk of Patient Harm Resulting from Falls	-
Access to Care and Continuity of Care	**Part 3 Patient care process** • Access and entry • Planning of care • Discharge planning • Continuity of care
Patient and Family Rights	-
Assessment of Patients	**Part 3 Patient care process** • Patient assessment
Care of Patients	**Part 3 Patient care process** • Planning of care • Patient care delivery
Anesthesia and Surgical Care	-
Medication Management and Use	-

Table 4.11 The relation between JCI standard and HA (cont.)

JCI standard	HA
Patient and Family Education	**Part 3 Patient care process** • Education and Empowerment
Section II: Health Care Organization Management Standards	**Part 1 Organization management overview** **Part 2 Key hospital systems** **Part 4 organization performance result**
Quality Improvement and Patient Safety	**Part 1 Organization management overview** • Leadership • Measurement,analysis and knowledge management • Strategic management • Focus on patient/customer • Human research focus • Process Management
Prevention and Control of Infections	**Part 2 Key hospital systems** • Risk,safety and quality • Environment of care • Infection control
Governance, Leadership, and Direction	**Part 4 organization performance result** • Leadership result • Human resource result • Process effectiveness result • Patient care result • Patient/customer focus result • Health promotion result • Financial result

Table 4.11 The relation between JCI standard and HA (cont.)

JCI standard	HA
Facility Management and Safety	**Part 2 Key hospital systems** • Medical record system • Medication management • Diagnostic Investigation
Staff Qualifications and Education	-
Management of Communication and Information	-

The JCI accreditation process is designed to help organizations meet this challenge through standards that create a culture of safety and quality, while continually improving patient care processes and results. The standards are divided into two sections: patient-centered functions and organization functions. The Patient centered Standard focus on patient care which HA standard link with JCI on HA part2 and HA standard part 3 about access care of the patient. The Organization Management Standards focus on the improved safety and quality of care link to HA standard part 1 and part 2 in an environment of care, infection and organization management but not cover about staff talent. JCI standard cover the goals than HA standard So for design functional requirement for EMR in OPD department. Focusing on JCI standard IPSG, ACC, PFR, AOP, COP, MMU, PFE for cover the goals patient safety , efficiency and patient satisfaction. Except ASC (About surgical) because out of scope and the security of the system follow with MCI.The relationship between JCI and HA shown in Figure 4.18.

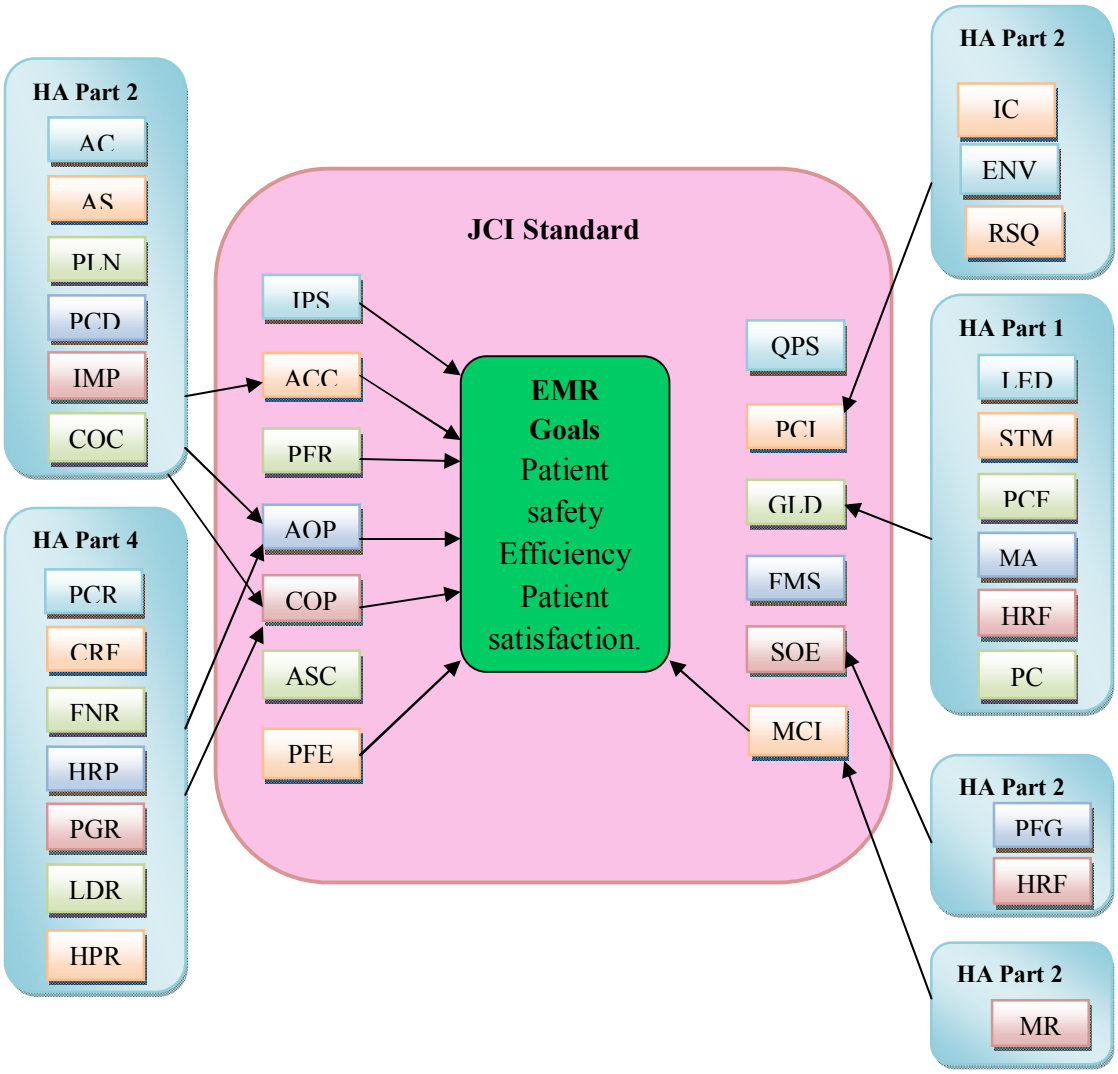

Figure 4.18 The Relationship between hospital standard and EMR design

II: The Relation of Lean concept and EMR

The Lean concept linked with EMR help the process to reduce paperwork, reduce repetition and reduce waiting time but the Lean concept linked with EMR and follow the JCI standard help process to paperless with standard for record data, Identify patient data correctly and reduce repetition, The process flows smoothly by reduce waiting time and identify patient with the right care. The relation of of Lean concept and EMR shown in Table 4.12

Table 4.12 The Relation of Lean concept and EMR

Lean +EMR	Lean+EMR+JCI
1. Paperless	1.Paperless and standard of record by JCI.
2.Reduce repetition	2.The data record can identify patient correctly and reduce repetition.
3.Reduce waiting time	3. The process is smoothly and patient rignt care.

III: The functional requirement of new EMR compares with HOSXP

Comparison of benefits between the new EMRs and the current EMR of Hosxp subsystem found that some interface should add in the EMR of Hosxp sub system such as identify patient to all subsystem, Medication term abbreviation between doctor and nurse, Nurse recheck test order from doctor, Family care guide etc. Hosxp design for monthly report for NHSO not cover for patient safety.The comparision is shown in Table 4.13

Table 4.13 Comparison of benefits between the new EMRs and the current EMR of Hosxp subsystem

Interface	Hosxp	New EMRs
1. Identify patient correctly in every sub system (IPGS1)	Not identify	Identify every subsystem
2. Level of patient education(PFE2)	Not record	Record
3. Medication term abbreviation between doctor and nurse (IPSG2)	Not record	Record
4. High alert drug (IPSG3)	none	High alert drug system
5. Nurse recheck the order test from a doctor.(IPSG3,MMU1)	Not recheck	Recheck
6. Screening process (ACC1.1.1)	screen	screen
7. Follow up care plan when patient finish their treatment (AOP 5.9)	Not record	Record

Table 4.13 Comparison of benefits between the new EMRs and the current EMR of Hosxp subsystem (cont.)

Interface	Hosxp	New EMRs
8. Family care guide (PFR2)	Not record	Record
9.Access of patient information (AOP1.5)	Easily	Easily
10. The EMR has a recall system (MCI13.3)	Yes	Yes
11. The system use diagnosis code(MCI13)	Use	Use

The benefit of new EMR can help to treat more patients, and generate revenue,document patient's needs better and can reduce the likelihood of paper chart related medical errors and help doctors to stay better informed on ways to treat patients and manage their long-term health. Hospitals that targeted specific quality benefits were reportedly much more successful in realizing those benefits.

Before implementation the sofeware or design new system the hospitals need to 1) Set a sufficient budget for investment in Information Technology 2) Hire professional staff who are expert on IT system Development and linkage skills and are able to solve problems when an interruption is occurring and3) the business process and the system must be designed to support the implement smoothly.

As hospitals effort to meet the goals and influence technology in the healthcare environment, Hospital will face several hurdles including: the cost and implementation effort for new EMR and other applications, clinician adoption, and ongoing JCI compliance and patient privacy. The Functional requirement of EMR combined with integrated Lean concept and follow JCI standard can address many of these challenges.The next chapter shown the conclusion and recommendation.

CHAPTER V
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The purpose of this research has been to design functional requirement for supporting EMR implementation after applying lean process tools and following JCI standard in order to help the hospitals to reach its goals of patient safety,patient satisfaction, and overall hospital efficiency. As a result of this research effort, the functional design document has been developed.

The methodology of integrating Lean concept with the new EMR under the JCI framework was applied in a case study of a community hospital in Nakornpatom province. The application was conducted by following the steps of the Methodology specified in Chapter 3. Professionals and experts in healthcare supply chain were asked to give their views on the functional design document. Some adjustment were made in order to have a completed functional design document based on the comments from the experts.

The findings from the case study will be used as a pilot study for further development of the new EMR and for future application in other bigger hospitals.

The new EMR will benefit the healthcare supply in linking information between different departments in the hospitals with shorter lead time, distance, and reduce costs. In addition, the new EMR will help the hospitals be ready to have accreditation from Joint Commission International Accrediation. Several reports were also designed in order to show the performance of each operations effort. The reports include Registration report,Insurance report, Appointment report,Lab report, X-ray report, Dispensing report and Payment report.

5.2 Limitation

The application of the functional design document is limited by the readiness level of each hospital which plan to implement the new EMR. Before implementation,the hospitals need to

1) Set a sufficient budget for investment in Information Technology.

2) Hire professional staff who are expert on IT system Development and linkage skills and are able to solve problems when an interruption is occurring

3) the business process and the system must be designed to support the implement smoothly.

Collaborations among each department is needed to be strengthen so that the information flow can be made seamless by. Last,but not least, the back-up plan needed to be prepare in advance in care the new EMR system cannot function as designed.

5.3 Recommendation

The functional design document for New EMR designed in this study included the Lean concept and designed under the JCI framework. The document was revised several round before final conclusion, however, the proposed new EMR is only conceptual. It is needed to develop future and to be implement in a real hospital. Therefore, it will be interesting to apply this new EMR in other community or bigger hospitals.

Third, the proposed concept can also be applied in other hospital service in various departments. Lessons learned from the application will be benefit for other hospitals.

Finally,other hospital standard , accradiations , or government's regulation considered as an additional framework for the new EMR. Future development of this concept will be accepted extensively if it is supported by government. The end users or customers who are the patients will get the overall benefits of their safety from any avoidable medical error.

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APPENDICES

APPENDIX A
JOINT COMMISSION INTERNATIONAL ACCREDITATION FUNCTIONAL CHAPTERS

Section I: Patient-Centered Standards

The accreditation process is designed to create a culture of safety and quality within an organization that strives to continually improve patient care processes and results.

International Patient Safety Goals (IPSG)

The purpose of the IPSG is to promote specific improvements in patient safety. The goals highlight problematic areas in health care and describe evidence- and expert-based consensus solutions to these problems. Recognizing that sound system design is intrinsic to the delivery of safe, high-quality health care, the goals generally focus on system wide solutions, wherever possible.

Access to Care and Continuity of Care (ACC)

A health care organization should consider the care it provides as part of an integrated system of services, health care professionals, and levels of care, which make up a continuum of care. The goal is to correctly match the patient's health care needs with the services available, coordinate the services provided to the patient in the organization, and then plan for discharge and follow-up.

Patient and Family Rights (PFR)

Each patient is unique, with his or her own needs, strengths, values and beliefs. Health care organizations work to establish trust and open communication with patients and to understand and protect each patient's cultural, psychosocial, and spiritual values. Patient care outcomes are improved when patients and, as appropriate,

their families or those who make decisions on their behalf, are involved in care decisions and processes in a way that matches cultural expectations

Assessment of Patients (AOP)

An effective patient assessment process results in decisions about the patient's immediate and continuing treatment needs for emergency, elective or planned care, even when the patient's condition changes. Patient assessment is an ongoing, dynamic process that takes place in many inpatient and outpatient settings and departments and clinics. Patient assessment is appropriate when it considers the patient's condition, age, health needs, and his or her requests or preferences. These processes are most effectively carried out when the various health professionals responsible for the patient work together.

Care of Patients (COP)

A health care organization's main purpose is patient care. Providing the most appropriate care in a setting that supports and responds to each patient's unique needs requires a high level of planning and coordination. Many physicians, nurses, pharmacists, rehabilitation therapists, and other types of health care providers may carry out these activities. Each provider has a clear role in patient care. That role is determined by licensure; credentials; certification; law and regulation; an individual's particular skills, knowledge and experience; and organization policies or job descriptions. Some care may be carried out by the patient, his or her family or other trained caregivers. The Assessment of Patients (AOP) standards describe the basis for care delivery—a plan for each patient based on an assessment of his or her needs. That care may be preventive, palliative curative or rehabilitative and may include anesthesia, surgery, medication, supportive therapies, or a combination of these. A plan of care is not sufficient to achieve optimal outcomes. The delivery of the services must be coordinated and integrated by all individuals caring for the patient.

Anesthesia and Surgical Care (ASC)

The use of anesthesia, sedation, and surgical interventions are common and complex processes in a health care organization. They require complete and

comprehensive patient assessment, integrated care planning, continued patient monitoring criteria-determined transfer for continuing care, rehabilitation, and eventual transfer and discharge.

Medication Management and Use (MMU)

Medication management is an important component in palliative symptomatic, preventive and curative treatment of diseases and conditions. Medication management encompasses the system and processes an organization uses to provide pharmacotherapy to its patients. This is usually a multidisciplinary coordinated effort of staff of a health care organization, applying the principles of effective process design, implementation, and improvement to the selecting, procuring, storing, ordering/prescribing, transcribing, distribution, preparing, dispensing, administering, documenting, and monitoring medication therapies. While health care providers' roles in medication management vary greatly from one country to another, sound medication management processes for patient safety are universal.

Patient and Family Education (PFE)

Patient and family education helps patients better participate in their care and make informed care decisions. Many different staff in the organization educates patients and families. Education takes place when the patient interacts with his or her physician(s) or the nurse(s). Others provide education as they provide specific services such as rehabilitation or nutrition therapy or prepare the patient for discharge and continuing care. Because many staff help educate patients and families, it is important that staff members coordinate their activities and focus on what patients need to learn. Effective education thus begins with an assessment of the patient and family's learning needs. This assessment determines not only what needs to be learned, but how the learning can best occur. Learning is most effective when it suits an individual's learning preference, religious and cultural values, and reading and language skills, as well as when it occurs at appropriate points in the care process

Section II: Health Care Organization Management Standards

This approach takes into account that most clinical care processes involve more than one department or unit and may involve many individual jobs. This approach also takes into account that most clinical and managerial quality issues are interrelated. Thus, efforts to improve those processes must be guided by an overall framework for quality management and improvement activities in the organization, overseen by a quality improvement and patient safety oversight group or committee.

Quality Improvement and Patient Safety (QPS)

Quality and safety are rooted in the daily work of individual health care professionals and other staff. As physicians and nurses assess patient needs and provide care, this chapter can help them understand how to make real improvements to help their patients and reduce risks. Similarly, managers, support staff, and others can apply the standards to their daily work to understand how processes can be more efficient, resources can be used more wisely, and physical risks can be reduced.

This section emphasizes that continuity planning; designing, monitoring, analyzing, and improving clinical and management processes must be well-organized and have clear leadership to achieve maximum benefit.

Prevention and Control of Infections (PCI)

The goal of an organization’s infection prevention and control program is to identify and reduce the risks of acquiring and transmitting infections among patients, staff, health care professionals, contract workers, volunteers, students, and visitors.

The infection risk and program activities may differ from organization to organization, depending on the organization’s clinical activities and services, patient population(s) served geographic location, patient volume, and number of employees.

Effective programs have in common identified leaders, well-trained staff, methods to identify and proactively address infection risks, appropriate policies and procedures, staff education, and coordination throughout the organization.

Governance, Leadership, and Direction (GLD)

Providing excellent patient care requires effective leadership. That leadership comes from many sources in a health care organization, including governing leaders, leaders, and others who hold positions of leadership, responsibility, and trust. Each organization must identify these individuals and involve them in ensuring that the organization is an effective, efficient resource for the community and its patients. In particular, these leaders must identify the organization's mission and make sure that the resources needed to fulfill this mission are available. For many organizations, this does not mean adding new resources but more efficiently using current resources, even when they are scarce. Also, leaders must work together well to coordinate and integrate all of the organization's activities, including those designed to improve patient care and clinical services. Effective leadership begins with understanding the various responsibilities and authority of individuals in the organization and how these individuals work together. Those who govern, manage, and lead an organization have both authority and responsibility. Collectively and individually, they are responsible for complying with law and regulation and for meeting the organization's responsibility to the patient population served.

Over time, effective leadership helps overcome perceived barriers and communication problems between departments and services in the organization, and the organization becomes more efficient and effective. Services become increasingly integrated. In particular, the integration of all quality management and improvement activities throughout the organization results in improved patient outcomes.

Facility Management and Safety (FMS)

Health care organizations work to provide a safe, functional, and supportive facility for patients, families, staff, and visitors. To reach this goal, the physical facility, medical and other equipment, and people must be effectively managed. In particular, management must strive to

- Reduce and control hazards and risks;
- Prevent accidents and injuries; and
- Maintain safe conditions.

Effective management includes planning, education, and monitoring as follows:

• The leaders plan the space, equipment, and resources needed to safely and effectively support the clinical services provided.

• All staff are educated about the facility, how to reduce risks, and how to monitor and report situations that pose risk.

• Performance criteria are used to monitor important systems and identify needed improvements.

Written plans are developed and consider the following six areas, when appropriate to the facility and the activities of the organization:

1. Safety and Security

Safety - The degree to which the organization's buildings, grounds, and equipment do not pose a hazard or risk to patients, staff, or visitors.

Security - Protection from loss, destruction, tampering, or unauthorized access or use.

2. Hazardous materials

Handling, storage, and use of radioactive and other materials are controlled, and hazardous waste is safely disposed.

3. Emergency management

Response to epidemics, disasters, and emergencies is planned and effective.

4. Fire safety

Property and occupants are protected from fire and smoke.

5. Medical equipment

Equipment is selected, maintained, and used in a manner to reduce risks

6. Utility systems

Electrical, water, and other utility systems are maintained to minimize the risks of operating failures.

Laws, regulations, and inspections by local authorities determine in large part how a facility is designed, used, and maintained. All organizations, regardless of

size and resources, must comply with these requirements as part of their responsibilities to their patients, families, staff, and visitors.

Organizations begin by complying with laws and regulations. Over time, they become more knowledgeable about the details of the physical facility they occupy. They begin to proactively gather data and carry out strategies to reduce risks and enhance the patient care environment.

Staff Qualifications and Education (SQE)

A health care organization (*also see* Glossary) needs an appropriate variety of skilled, qualified people to fulfill its mission and meet patient needs. The organization's leaders work together to identify the number and types of staff needed based on the recommendations from department and service directors. Recruiting, evaluating, and appointing staff are best accomplished through a coordinated, efficient, and uniform process. It is also essential to document applicant skills, knowledge, education, and

Previous work experience. It is particularly important to carefully review the credentials of medical and nursing staff because they are involved in clinical care processes and work directly with patients. Health care organizations should provide staff with opportunities to learn and advance personally and professionally. Thus, in-service education and other learning opportunities should be offered to staff.

Management of Communication and Information (MCI)

Providing patient care is a complex endeavor that is highly dependent on the communication of information. This communication is to and with the community, patients and their families, and to other health professionals. Failures in communication are one of the most common root causes of patient safety incidents. To provide, coordinate, and integrate services, health care organizations rely on information about the

Science of care, individual patients, care provided, results of care, and their own performance. Like human, material, and financial resources, information is a resource that must be managed effectively by the organization's leaders. Every

organization seeks to obtain, manage, and use information to improve patient outcomes , as well as individual and overall organization performance.

Over time, organizations become more effective in

• Identifying information needs;

• Designing an information management system;

• Defining and capturing data and information;

• Analyzing data and transforming it into information;

• Transmitting and reporting data and information; and

• Integrating and using information.

Although computerization and other technologies improve efficiency , the principles of good information management apply to all methods, whether paper based or electronic. These standards are designed to be equally compatible with non-computerized systems and future technologies.

APPENDIX B
DETAIL DESIGN

Interface structure diagram

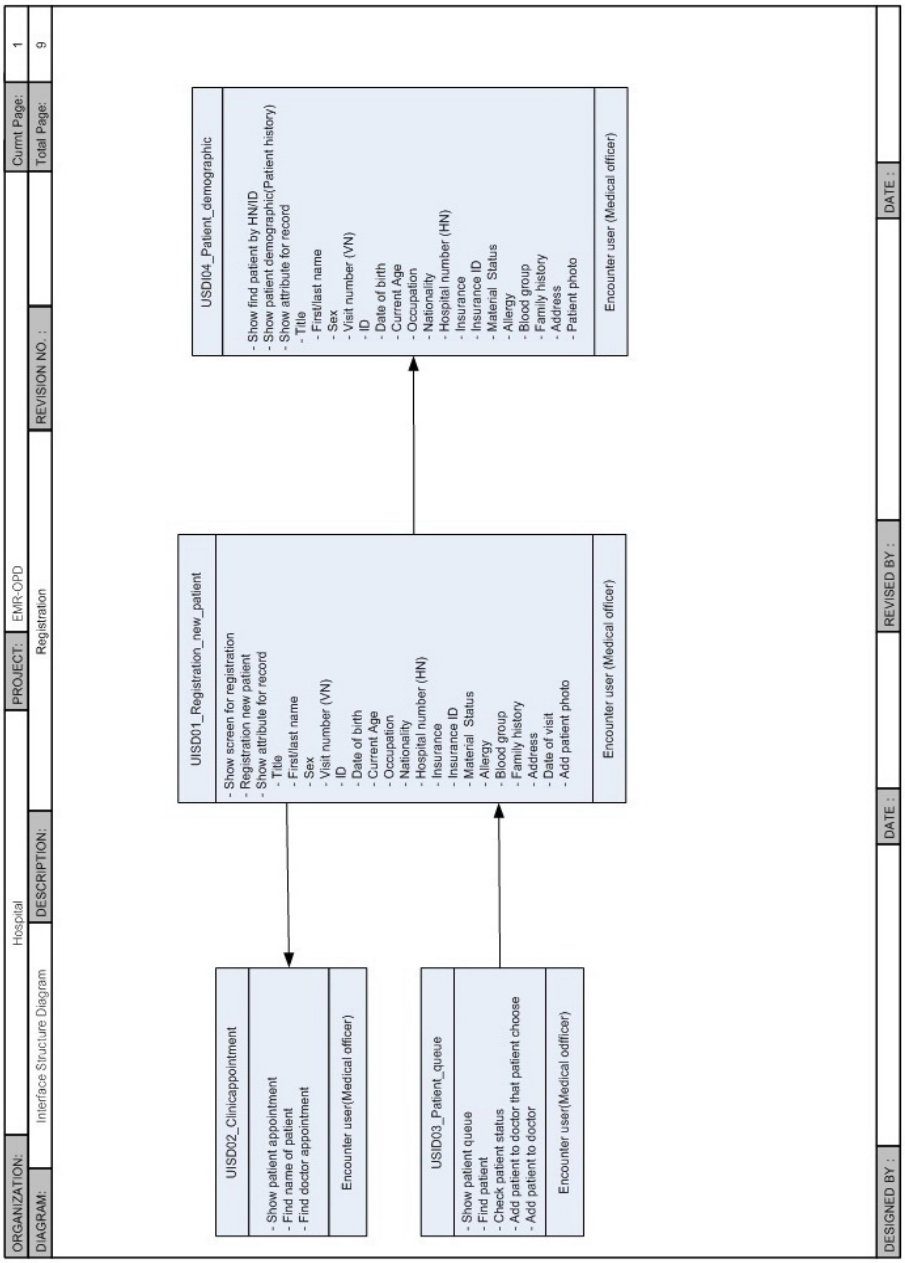


Figure B-1 Registration

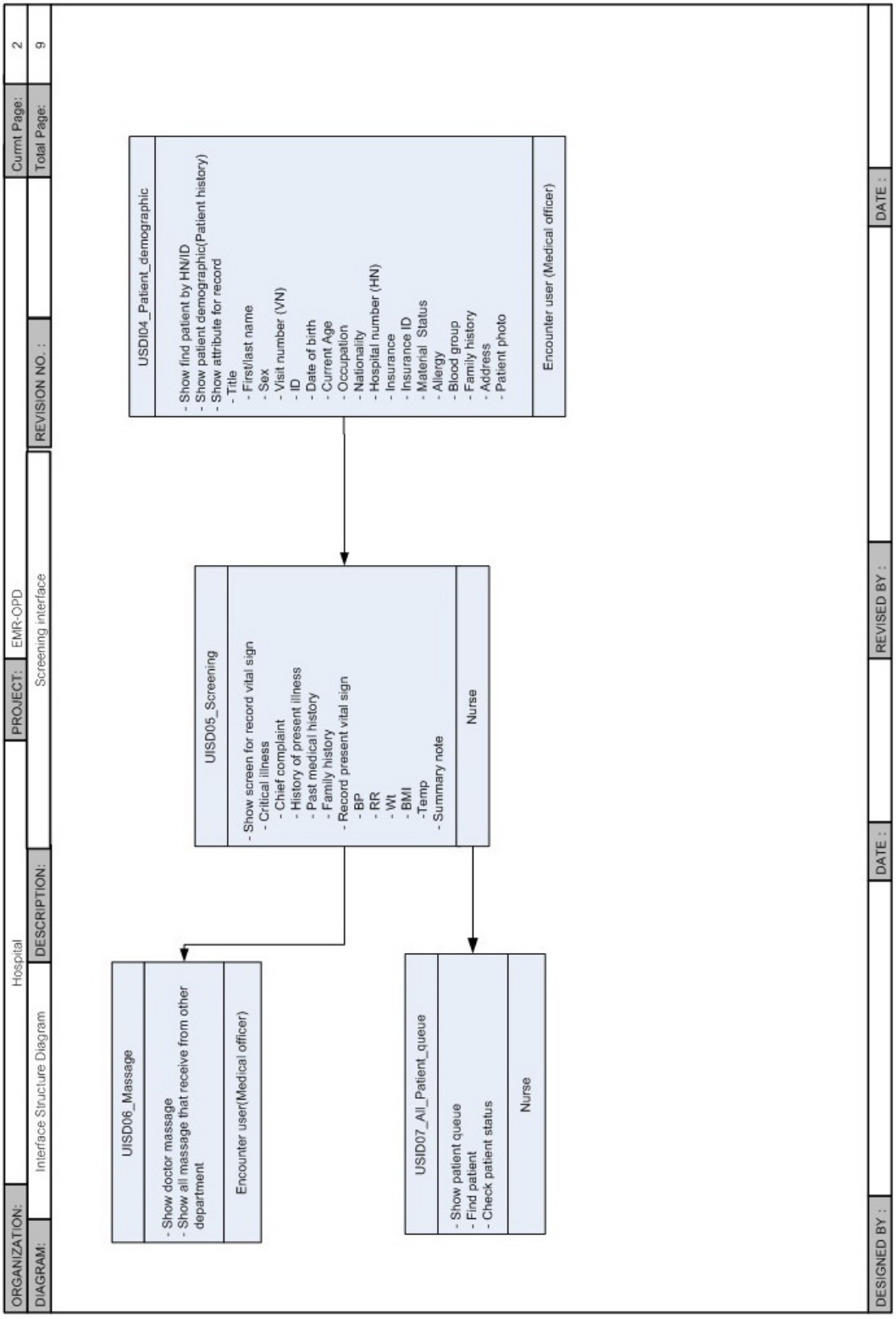


Figure B-2 Screening

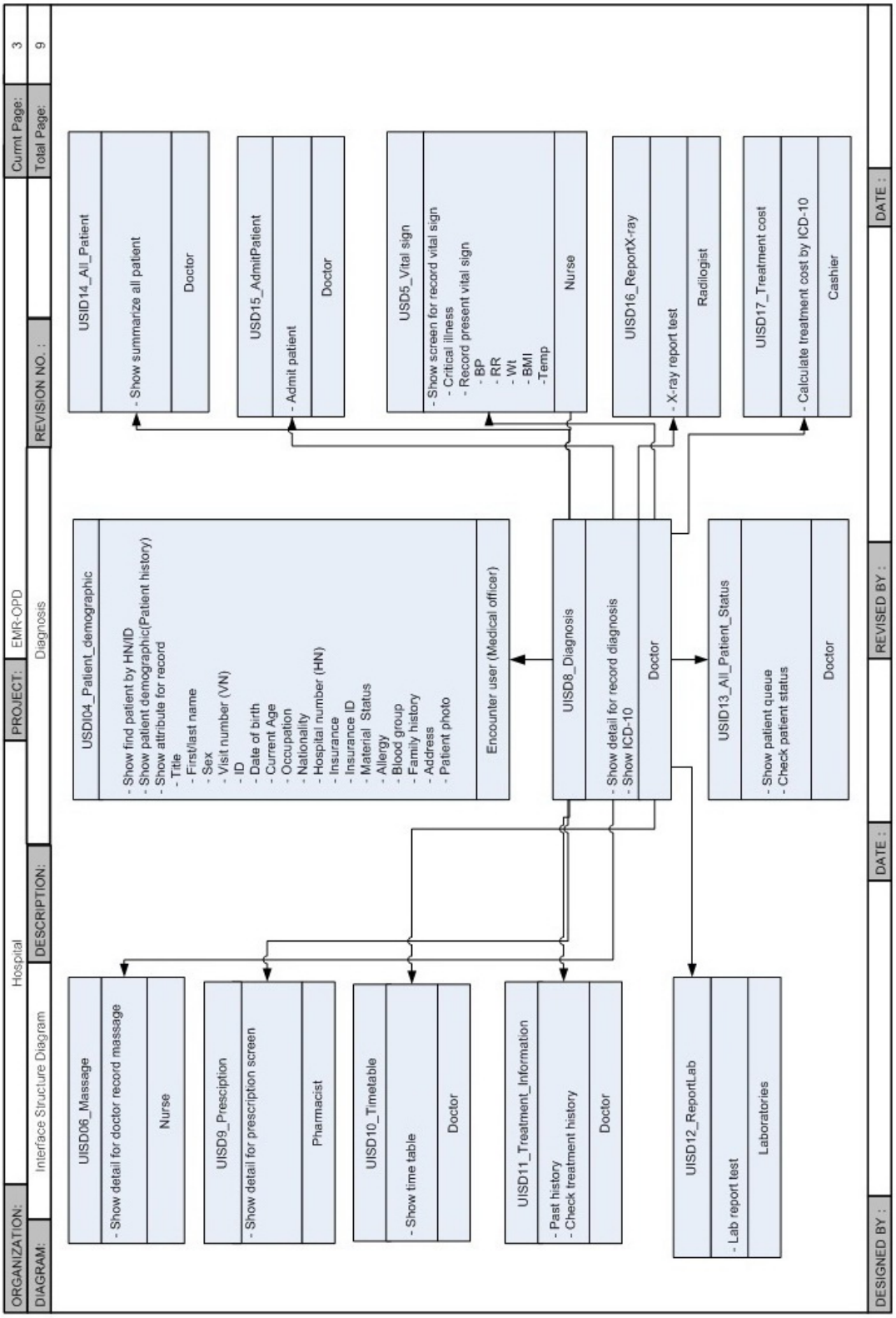


Figure B-3 Diagnosis

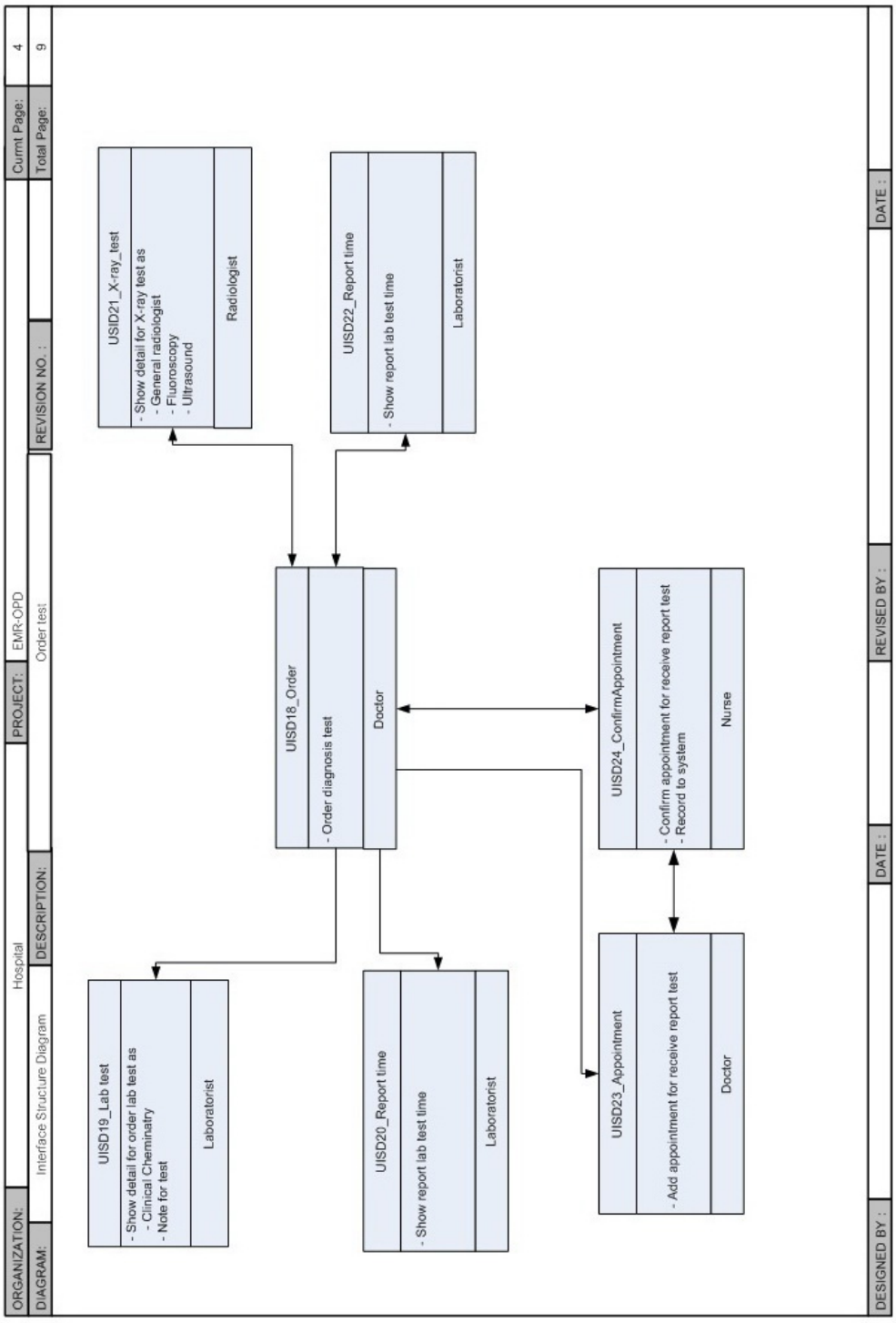


Figure B-4 Order test

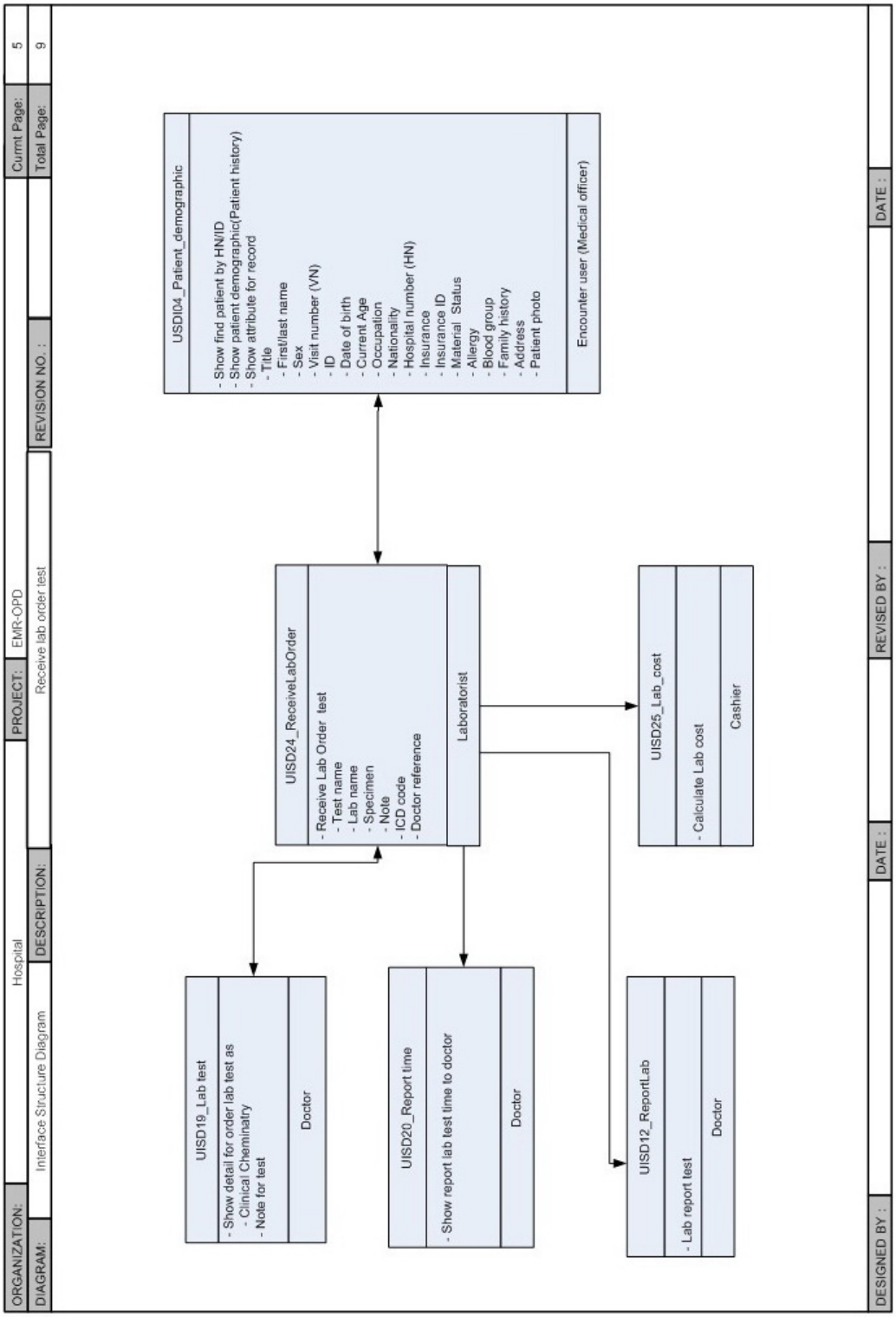


Figure B-5 Receive lab order test

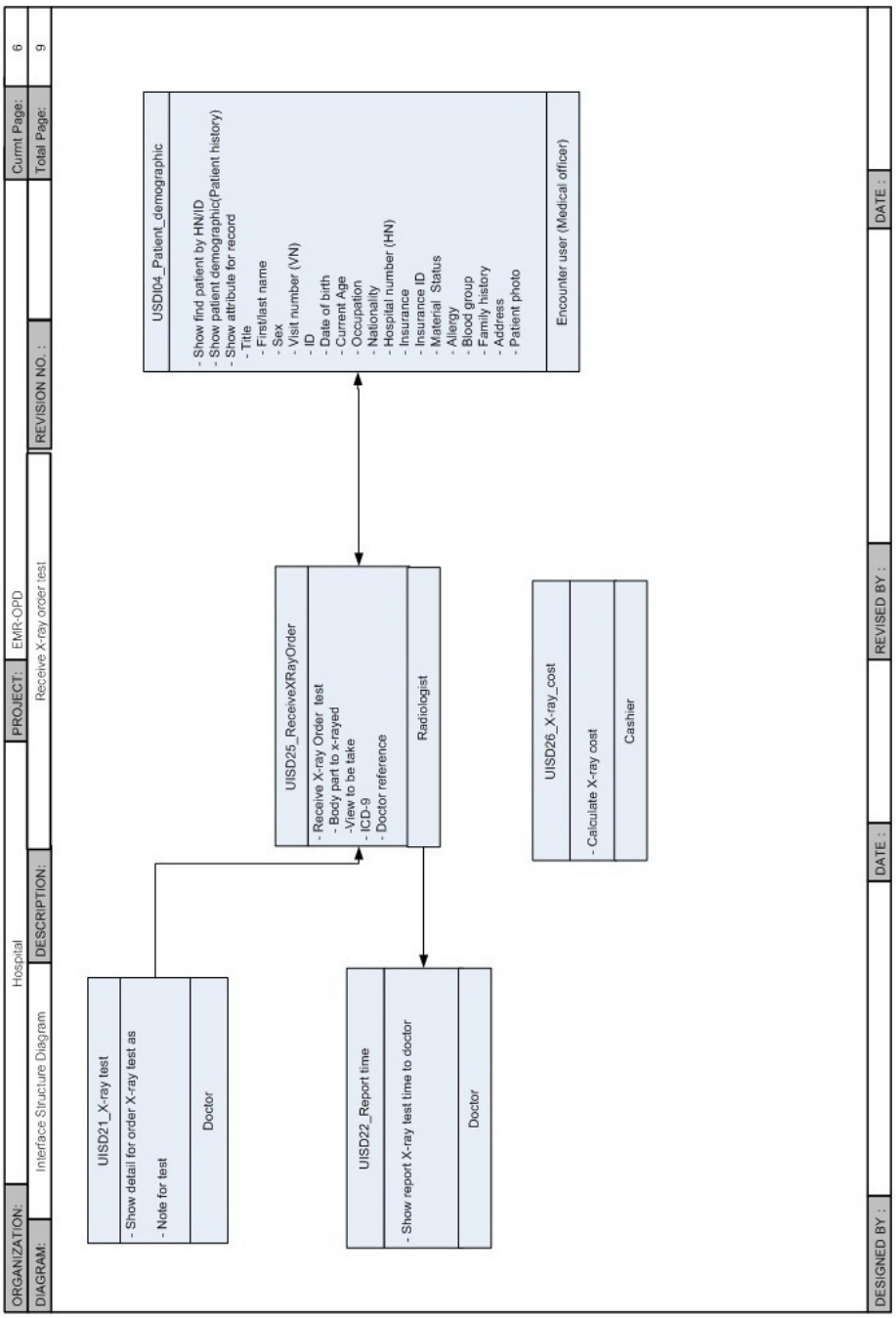


Figure B-6 Receive X-ray order test

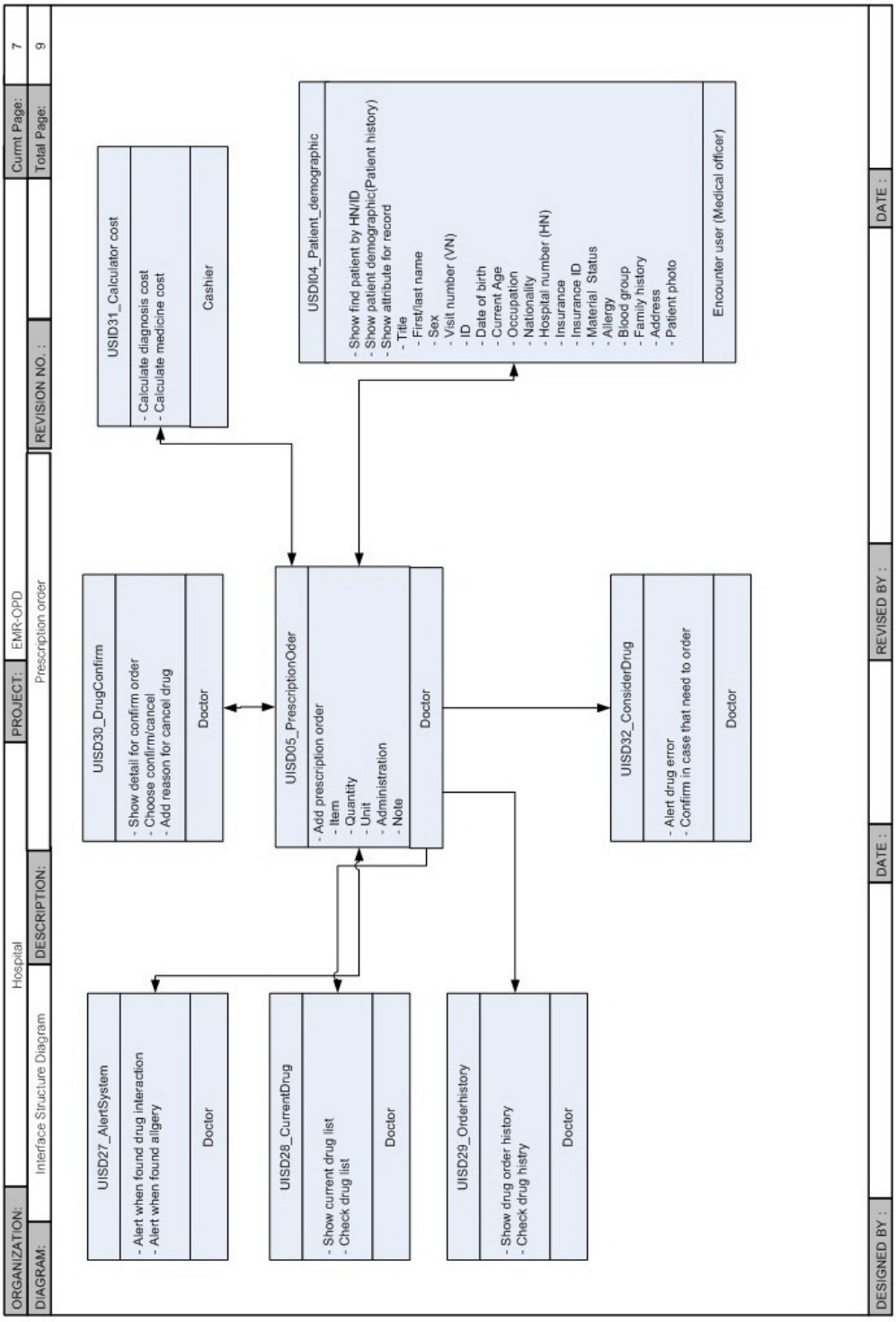


Figure B- 7 Prescription order

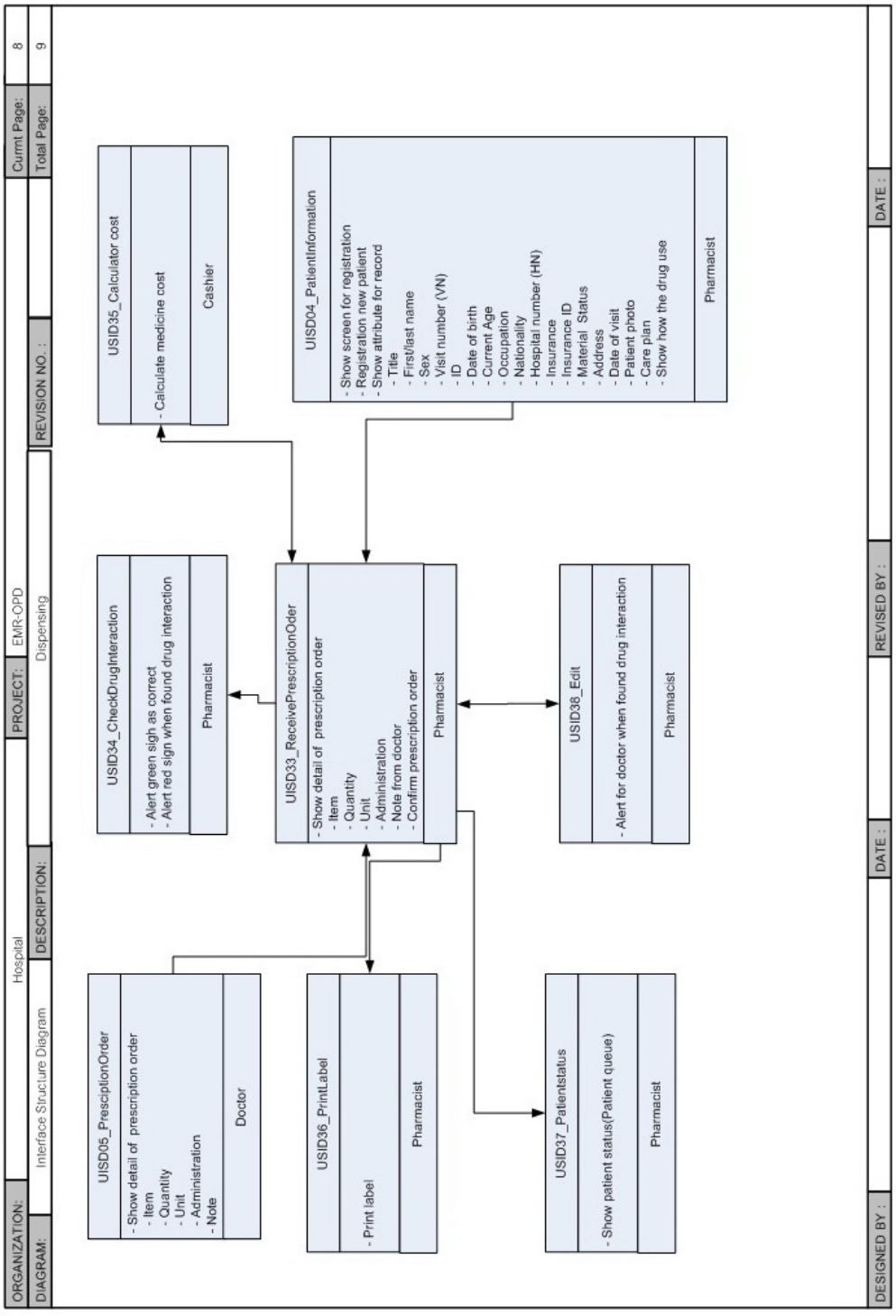


Figure B- 8 Dispensing

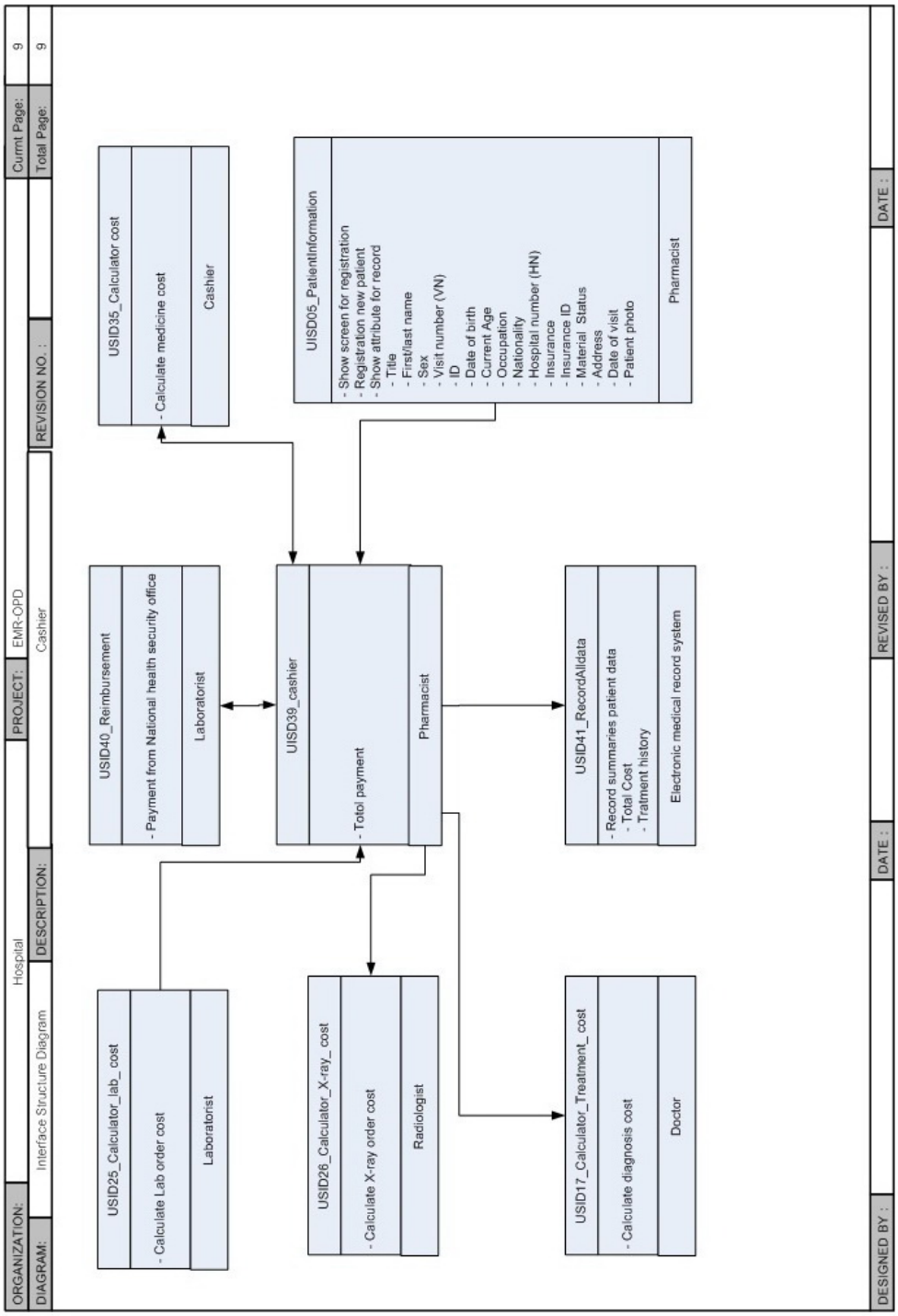
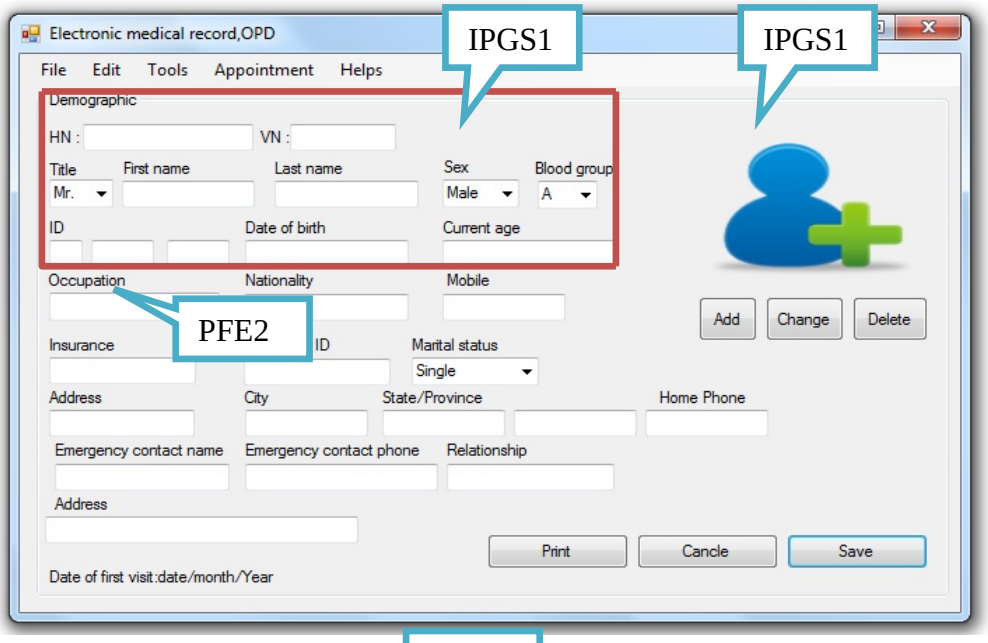


Figure B- 9 Cashier

Table B-1 Interface of Electronic medical record Registration subsystem

Process Element definition	**Registration**



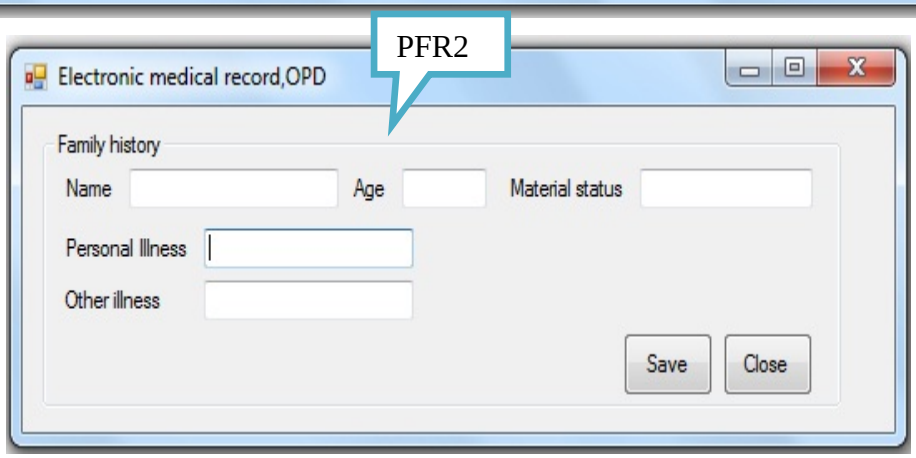
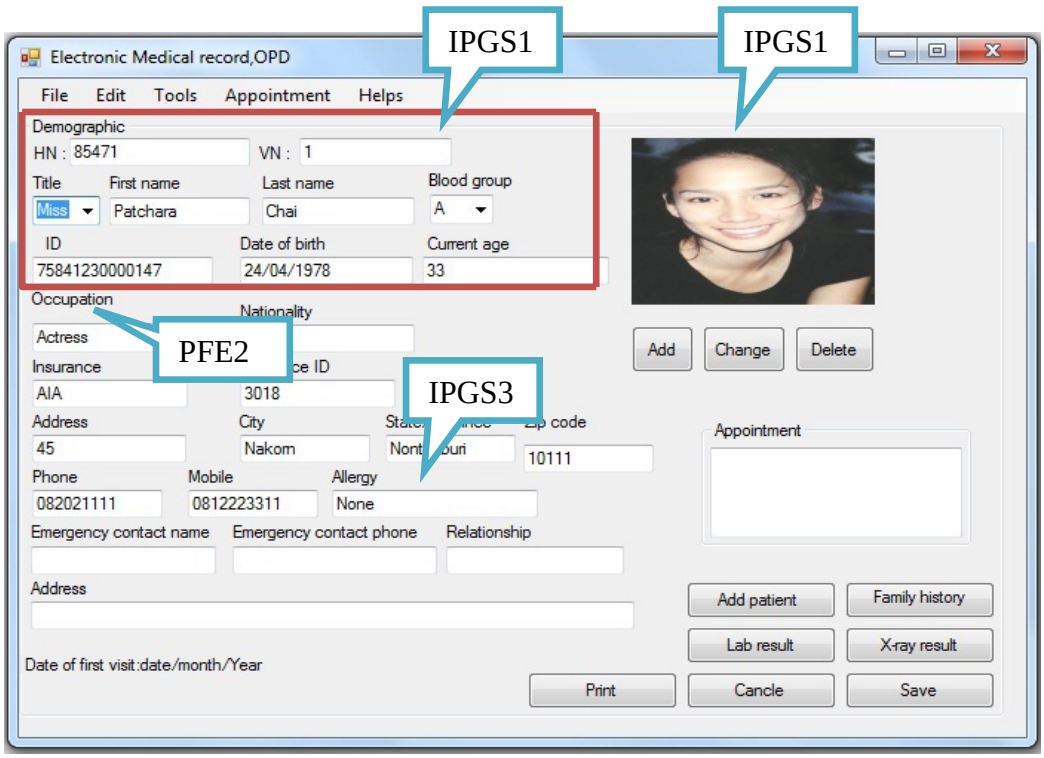


Table B-1 Interface of Electronic medical record Registration subsystem (cont.)

Process Element definition	Registration



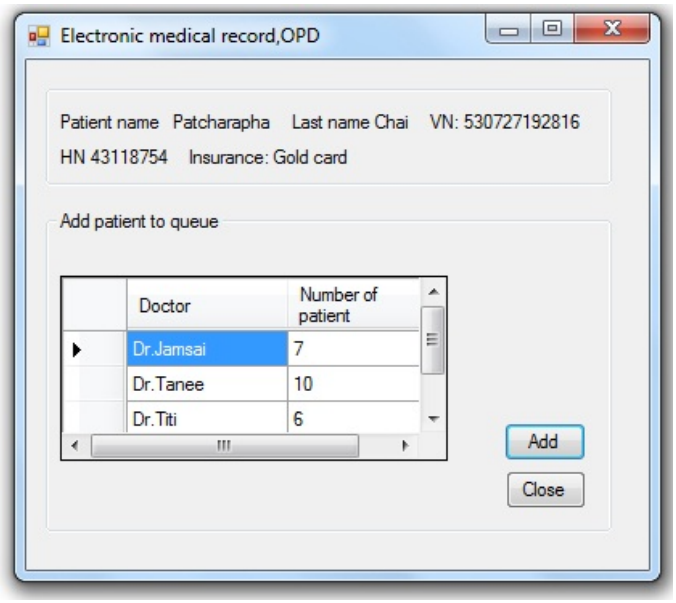


Table B-1 Interface of Electronic medical record Registration subsystem (cont.)

Subsystem	Registration
Goal in context	Registration patient correctly
Related requirement	FR01,FR02,FR03,FR04,FR05,FR06,FR07,FR08,FR09,FR10,FR12.FR13,FR46
Lean	Defect, Waiting
Scope	Outpatient Department
User	Clerk
Success end condition	The patient was registered.
Process	1. User logs in 2. User creates new patient./ Find HN or patient ID. 3.User recorded patient and his/her family data. 4. Patient information recorded. 5. System show doctor schedule.
JCI standard IPSG1 : This standard use all of subsystems. The intent of this goal is twofold: first, to reliably identify the individual as the person for whom the service or treatment is intended; second, to match the service or treatment to that individual.	
IPSG 2 : This standard use all of subsystems. Effective communication, which is timely, accurate, complete, unambiguous, and understood by the recipient, reduces errors, and results in improved patient safety. This interface show identification Section; Treatment history that record by can be electronic, verbal, or written.	
IPSG3 : This standard use all of subsystems. Medications are part of the patient treatment plan, appropriate management is critical to ensuring patient safety - System alert when found irregular. - Record allergy in first time.	

Table B-1 Interface of Electronic medical record Registration subsystem (cont.)

Subsystem	Registration
JCI standard PFR 1.6 Medical and other health information, when documented and collected, is important for understanding the patient and his or her needs and for providing care and services over time. The organization respects such information as confidential and has implemented policies and procedures that protect such information from loss or misuse. - Patients are informed about how their information will be kept confidential and about laws and regulations that require the release of and/or require confidentiality of patient information. Patients are requested to grant permission for the release of information not covered by law and regulation. - The organization respects patient health information as confidential. The medical record confidential follows from the Thai medical records law. In this interface show the common medical record that record in first time that patient come in.	
PFR2 :This standard use all of subsystems. The system supports patients' and families' rights to participate in the care process. Family data was recorded and users can see the data.	
AOP1.2 Understand the care that patient seeking.	
AOP5.9 Quality control was followed and document all the subsystems	
PFE2 Patient education was record in patient data.	

Table B-1 Interface of Electronic medical record Registration subsystem (cont.)

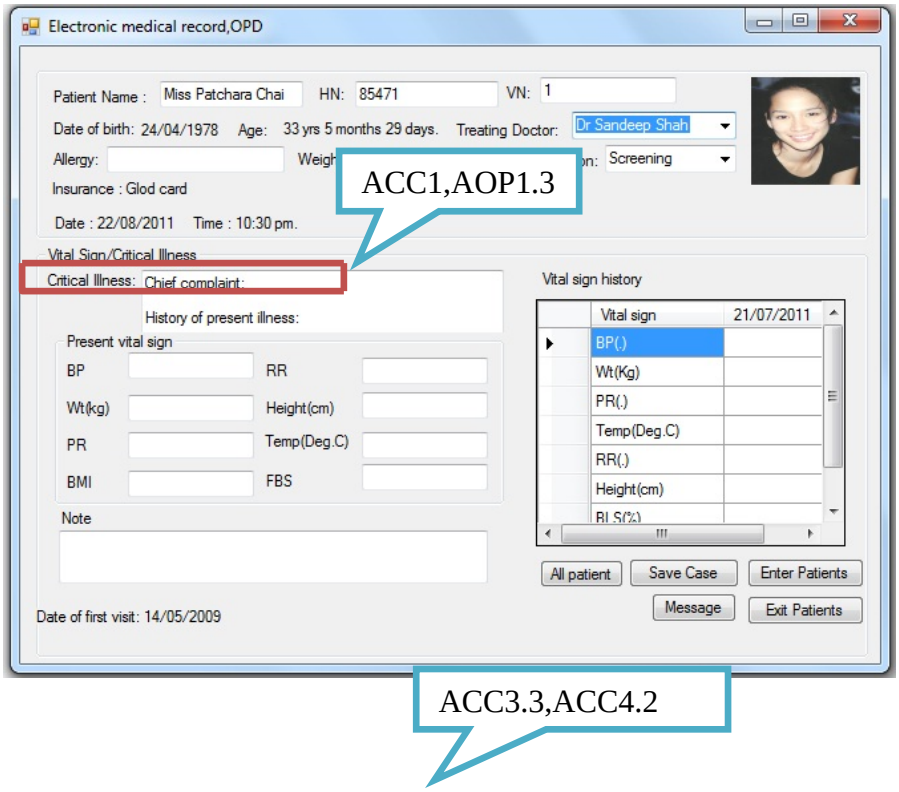
Subsystem	Registration
JCI standard MCI 10: This standard use all of subsystems. Information privacy and confidentiality are maintained. All patient data record with security.	
MCI11 :This standard use all of subsystems. Information security, including data integrity, is maintained.	
MCI12:This standard use all of subsystems. The retention time of records, data, and information. Keep patient record for 5 years.	
MCI14:This standard use all of subsystems. The data and information needs of those in and outside the organization meet on a timely basis in a format that meets user expectations and with the desired frequency. 1. Data and information dissemination meet user needs. 2. Users receive data and information on a timely basis. 3. Users receive data and information in a format that aids its intended use. 4. Staff have access to the data and information needed to carry out their job responsibilities.	
MCI16:This standard use all of subsystems. Records and information are protected from loss, destruction, tampering, and unauthorized access or use. 1. Records and information are protected from loss or destruction. 2. Records and information are protected from tampering and unauthorized access or use.	
MCI19.1:This standard use all of subsystems. The record is assigned an identifier unique to the patient.A clinical record is initiated for every patient assessed or treated by the organization and . Patient clinical records are maintained .	

Table B-1 Interface of Electronic medical record Registration subsystem (cont.)

Subsystem	**Registration**
JCI standard MCI19.2:This standard use all of subsystems. Organization policy identifies those authorized to make entries in the patient clinical record and determines the record's content and format.	
MCI19.3:This standard use all of subsystems. Every patient clinical record entry identifies its author and when the entry was made in the record. -Who has access to information; -The information to which an individual has access -The user's obligation to keep information confidential; and -The process followed when confidentiality and security are violated.	
MCI20.1:This standard use all of subsystems. The organization has a process to aggregate data and has determined what data and information are to be regularly aggregated to meet the needs of clinical and managerial staff in the organization and agencies outside the organization. 1. The organization has a process to aggregate data in response to identified user needs. 2. The organization provides needed data to agencies outside the organization.	

Table B-2 Interface of Electronic medical record Screening subsystem

Process Element definition	**Screening**



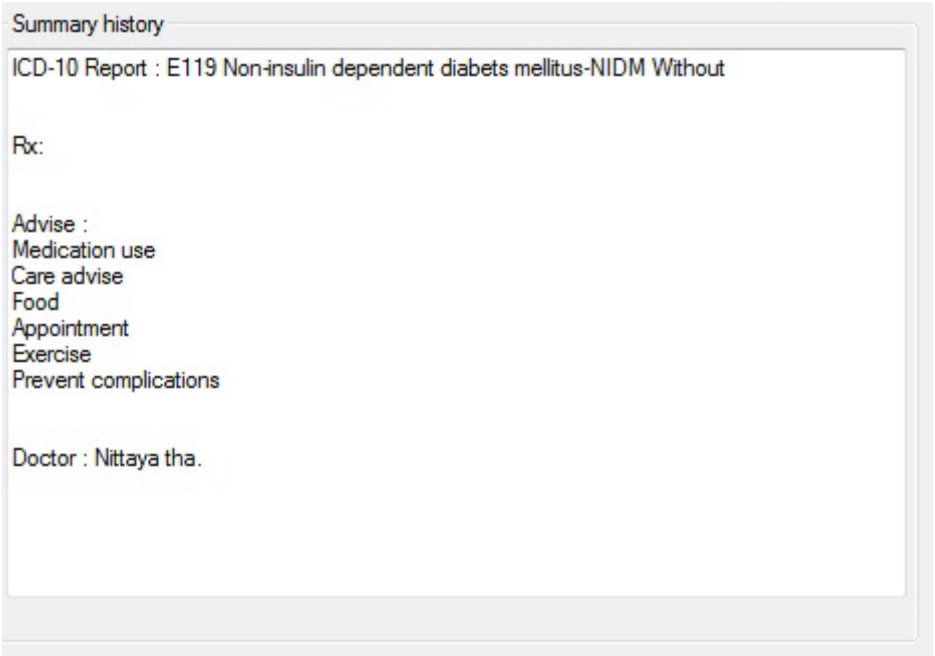


Table B-2 Interface of Electronic medical record Screening subsystem (cont.)

Process Element definition	**Screening**

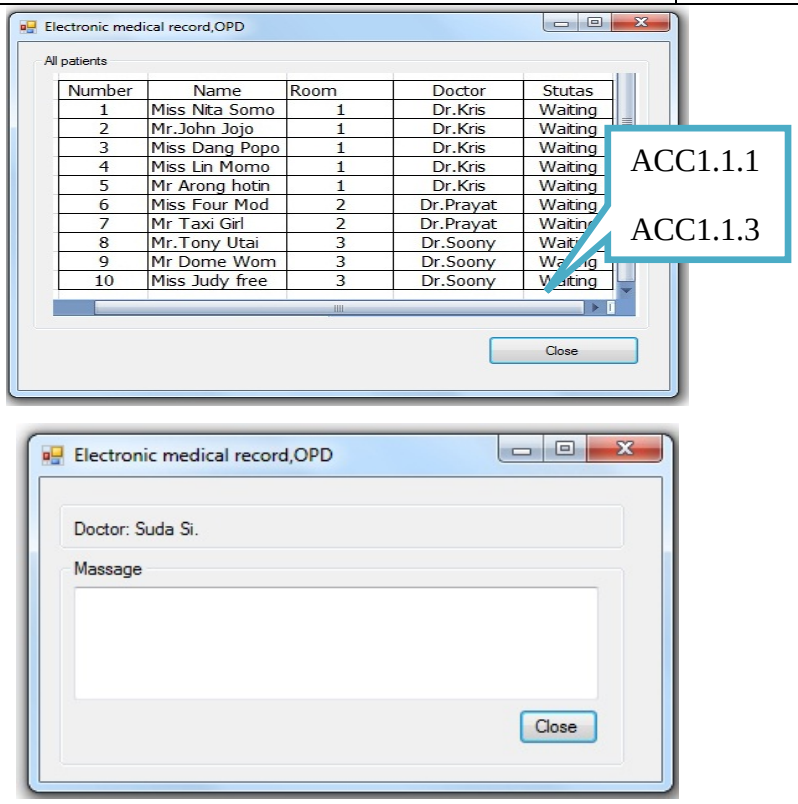


Table B-2 Interface of Electronic medical record Screening subsystem (cont.)

Subsystem	Screening
Goal in context	Patient gets the screening by nurse
Related requirement	FR01,FR02,FR03,FR04,FR05,FR06,FR07,FR08 ,FR09.FR10,FR46
Lean	Defect, Waiting
Scope	Outpatient Department
User	Nurse
Success end condition	The patient was screened

Table B-2 Interface of Electronic medical record Screening subsystem (cont.)

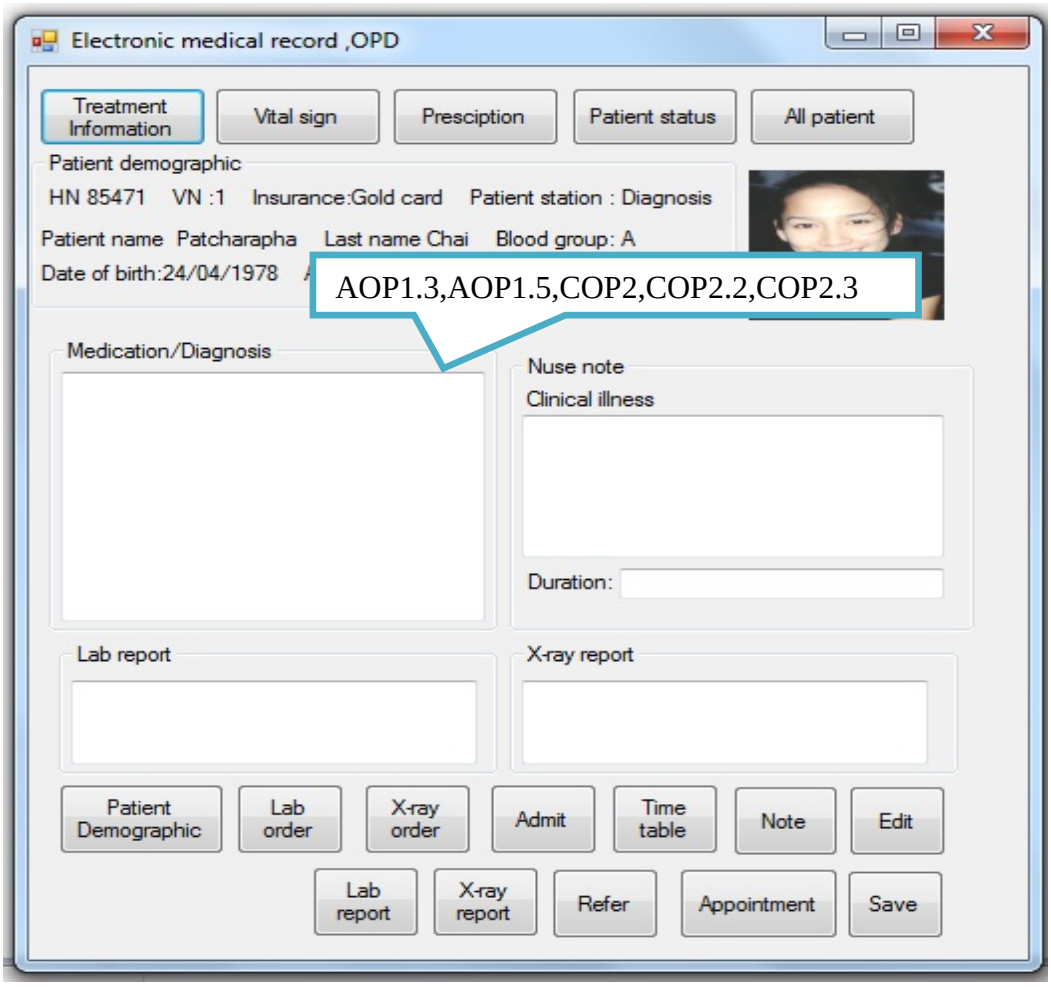
Subsystem	**Screening**
Process	1. Nurse logs in 2. Nurse check patient information. /Doctor messaged. 3. Nurse check patient history. 4. Nurse record vital sign and critical illness. 5. Nurse add patient to doctor.
JCI standard IPS4 : Patient assessment, inadequate medical record review before treatment.	
ACC1: Patients with emergency or immediate needs are given priority for assessment and treatment.	
ACC1.1.3 Considering the clinical needs of patients when there are waiting or delay. The system show time for nurses to manage the queue.	
AOP1.3 Nursing needs are identified from the initial assessments	
AOP1.5 Assessment findings are documented in the patient's record and readily available to those responsible for the patient's care.	
AOP5.9 Quality control is in place, followed and documented. All the report data record as same as standard.	
MMU4.3 Medications prescribed and administered are written in the patient's record.	
MMU5.1 Medication prescriptions or orders are reviewed for appropriateness.	

Table B-2 Interface of Electronic medical record Screening subsystem (cont.)

Subsystem	**Screening**
MMU6.1 Medication administration includes a process to verify the medication is correct based on the medication order.	
PFE2 Each patient's educational needs are assessed and recorded in his or her record.	
MCI17 The patient's record(s) is available to the care providers to facilitate the communication of essential information.	

Table B-3 Interface of Electronic medical record Examining subsystem

Process Element definition	Examination/Diagnosis



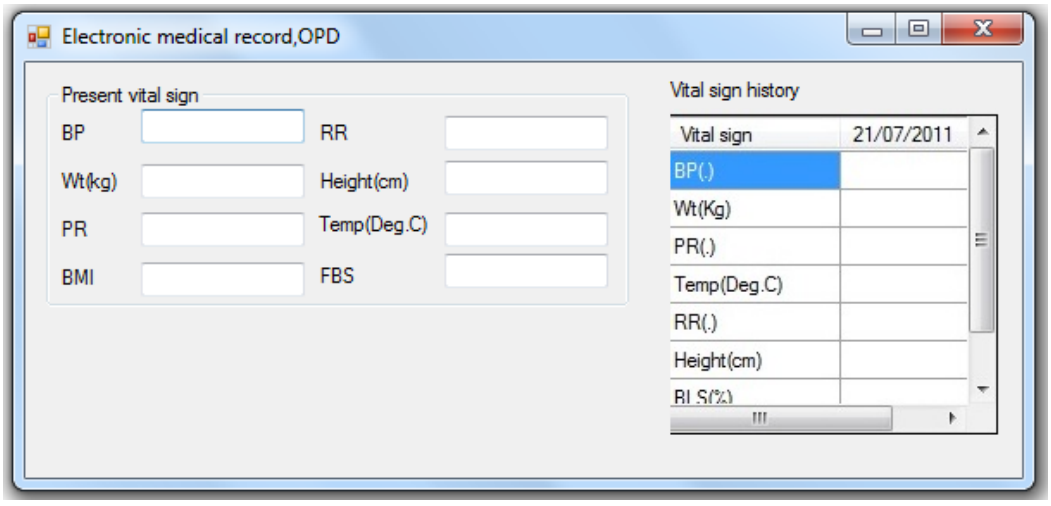
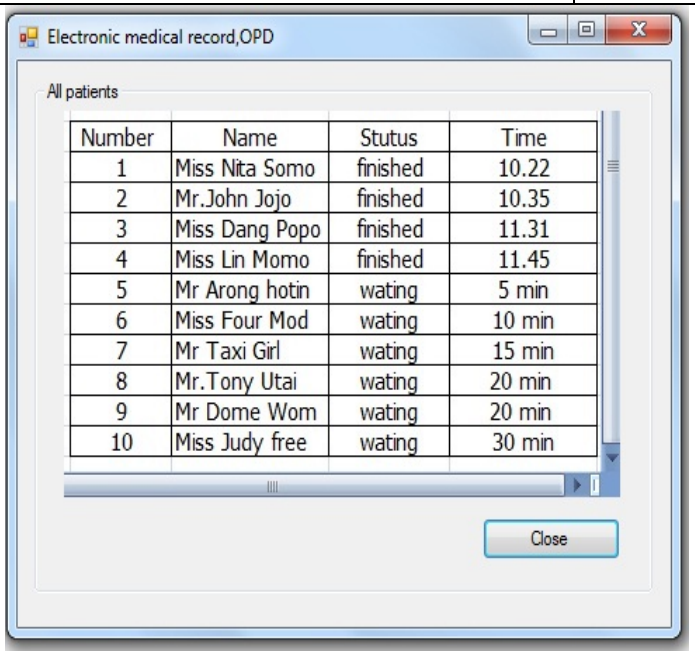


Table B-3 Interface of Electronic medical record Examining subsystem (cont.)

Process Element definition	Examination/Diagnosis



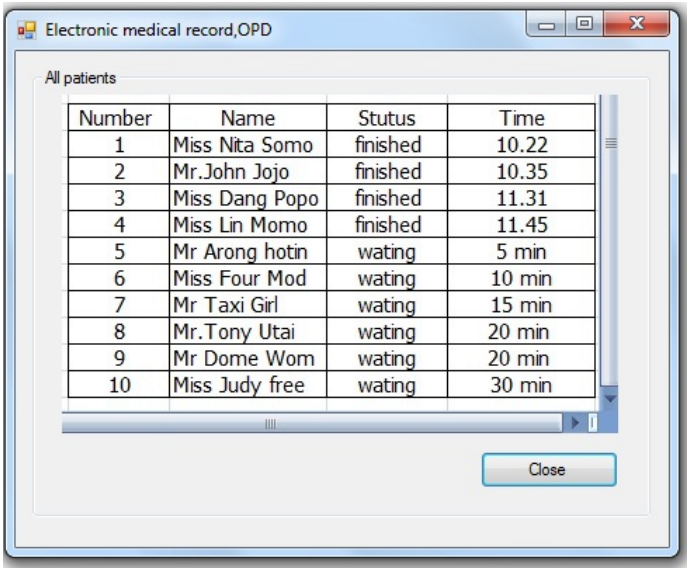
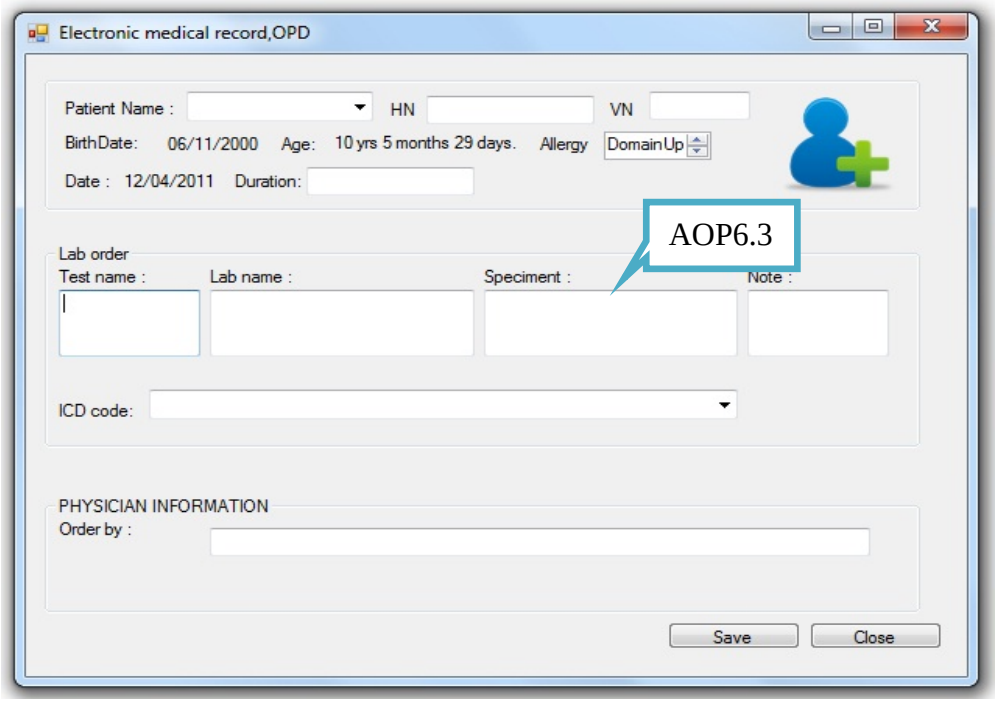


Table B-3 Interface of Electronic medical record Examining subsystem (cont.)

Process Element definition	Examination/Diagnosis



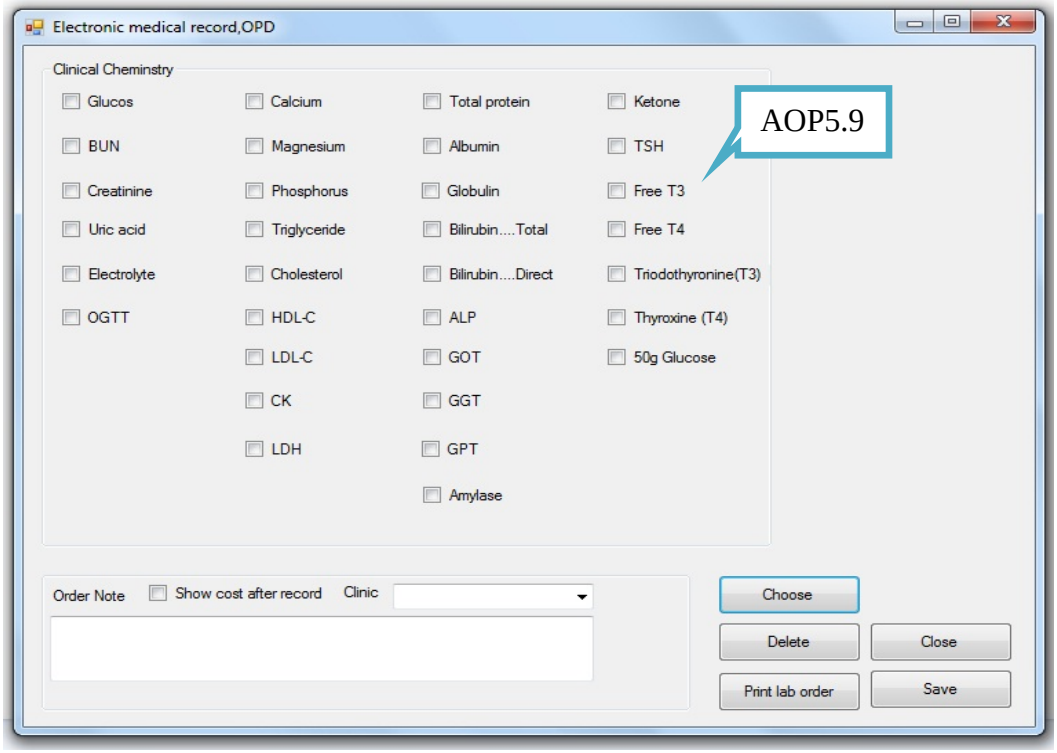
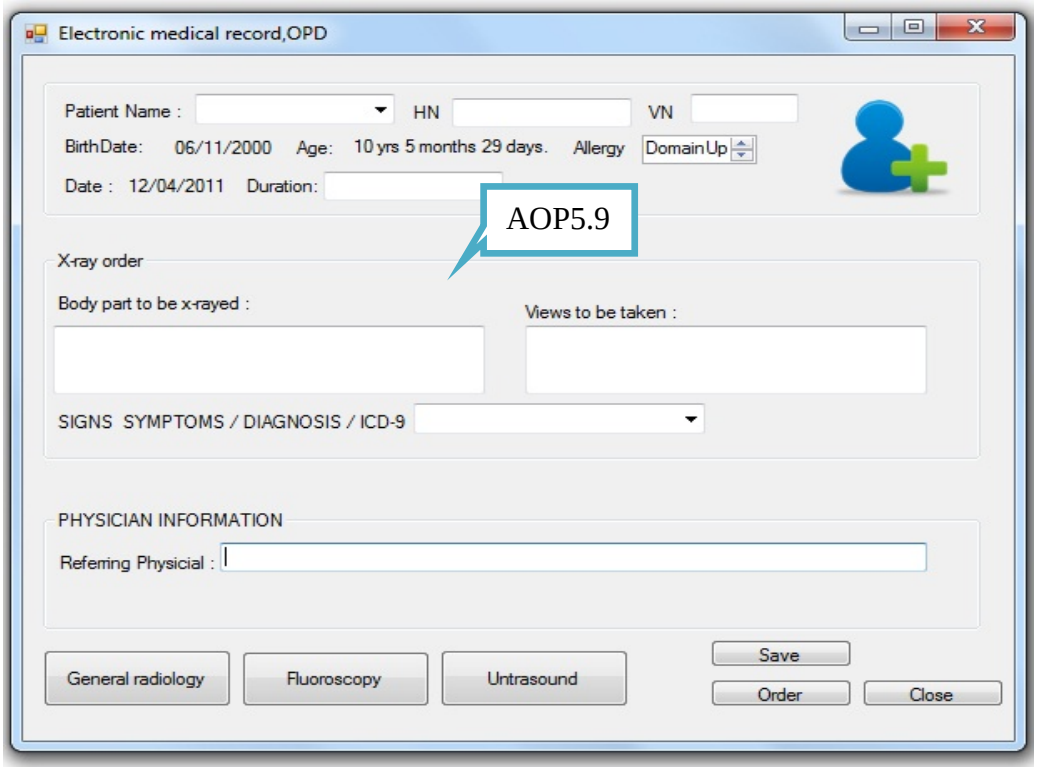


Table B-3 Interface of Electronic medical record Examining subsystem (cont.)

Process Element definition	Examination/Diagnosis



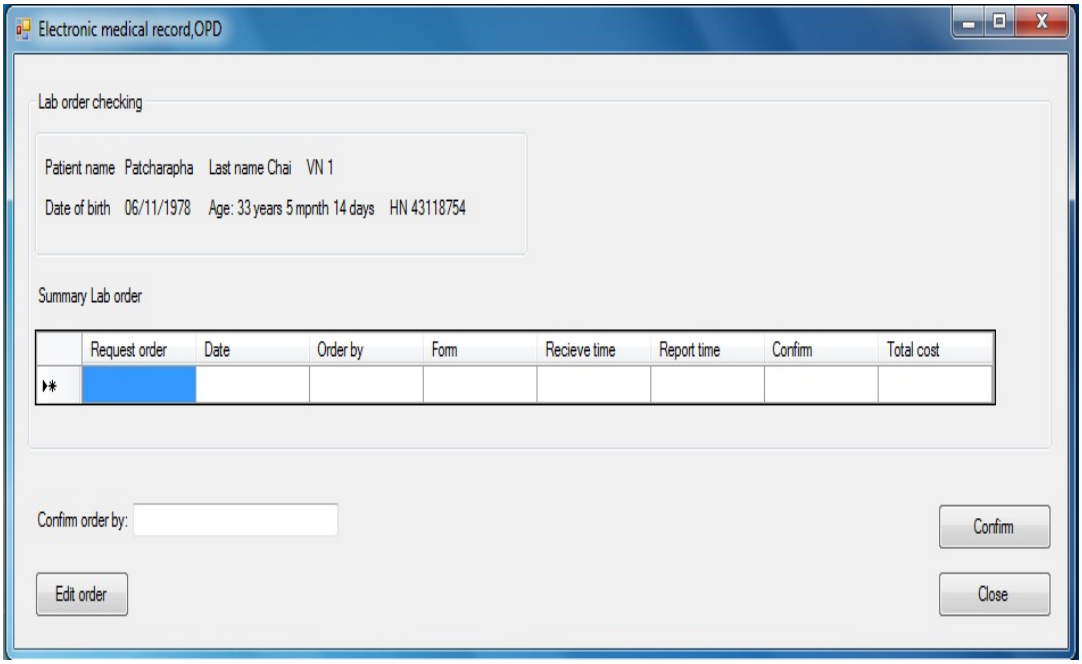


Table B-3 Interface of Electronic medical record Examining subsystem (cont.)

Process Element definition	Examination/Diagnosis

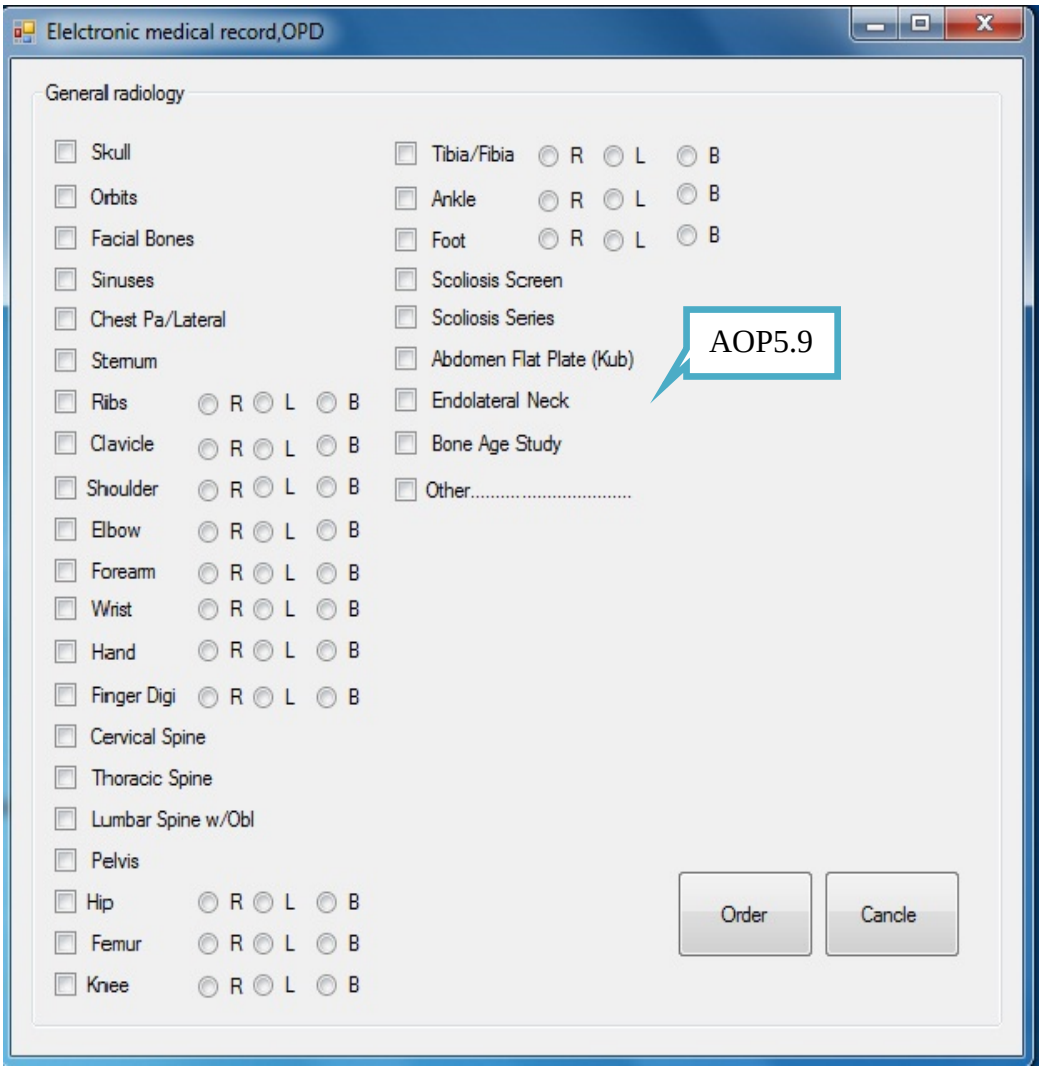


Table B-3 Interface of Electronic medical record Examining subsystem (cont.)

Process Element definition	Examination/Diagnosis

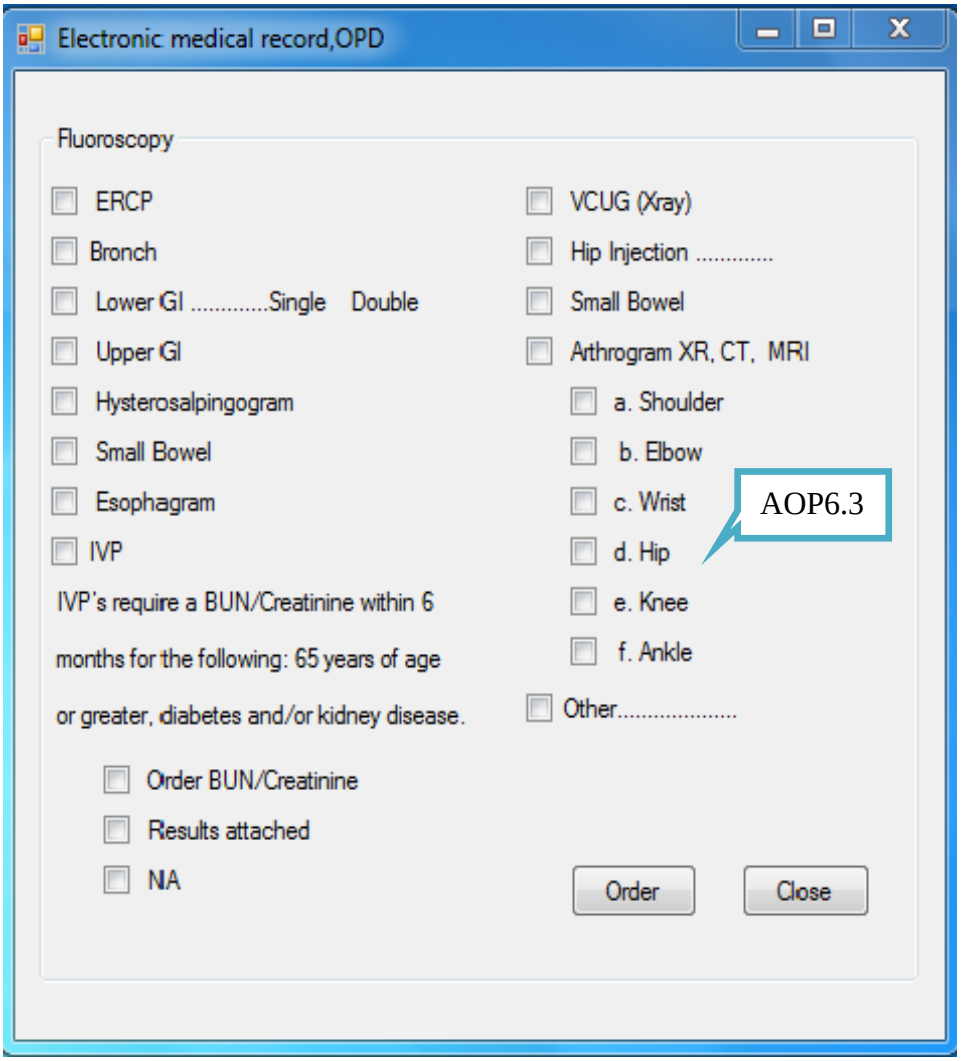


Table B-3 Interface of Electronic medical record Examining subsystem (cont.)

Process Element definition	Examination/Diagnosis

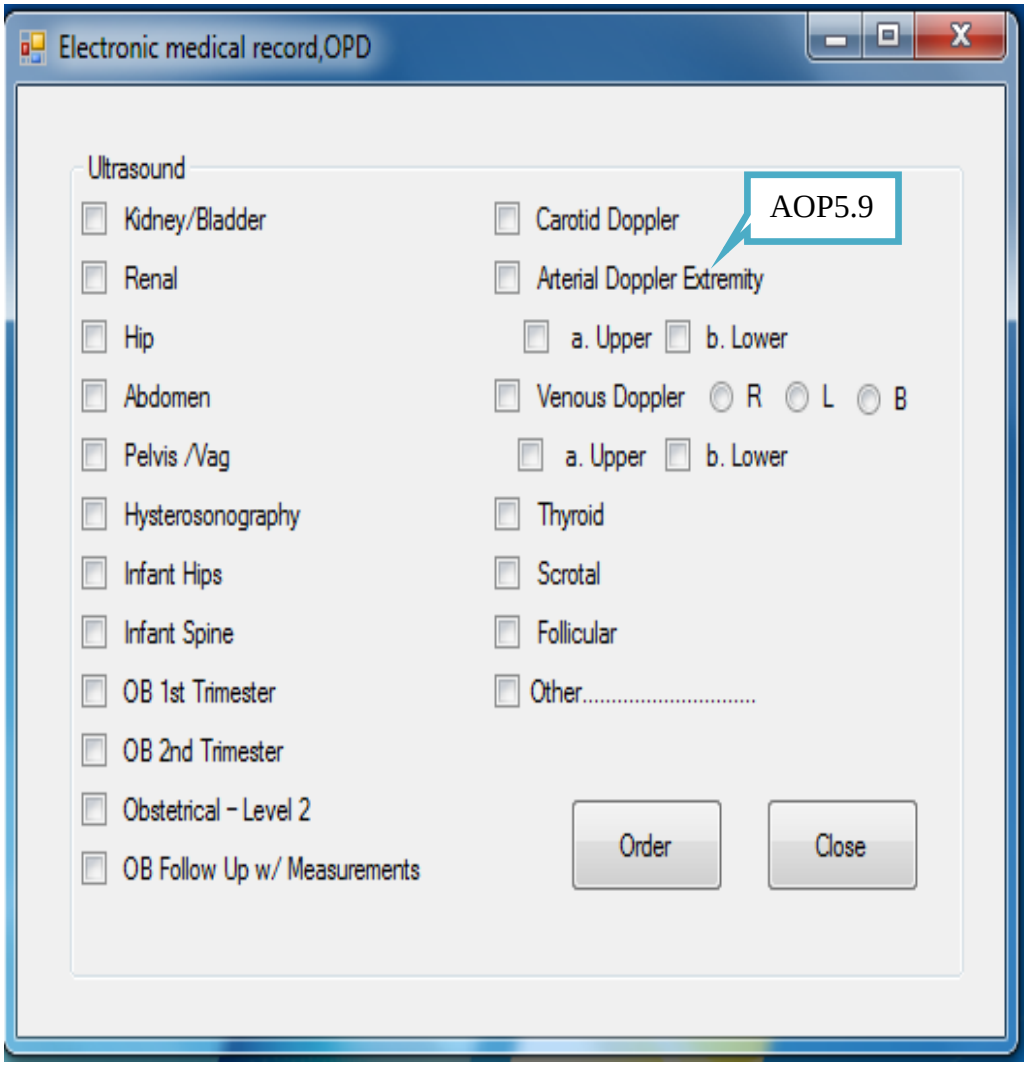


Table B-3 Interface of Electronic medical record Examining subsystem (cont.)

Process Element definition	Examination/Diagnosis

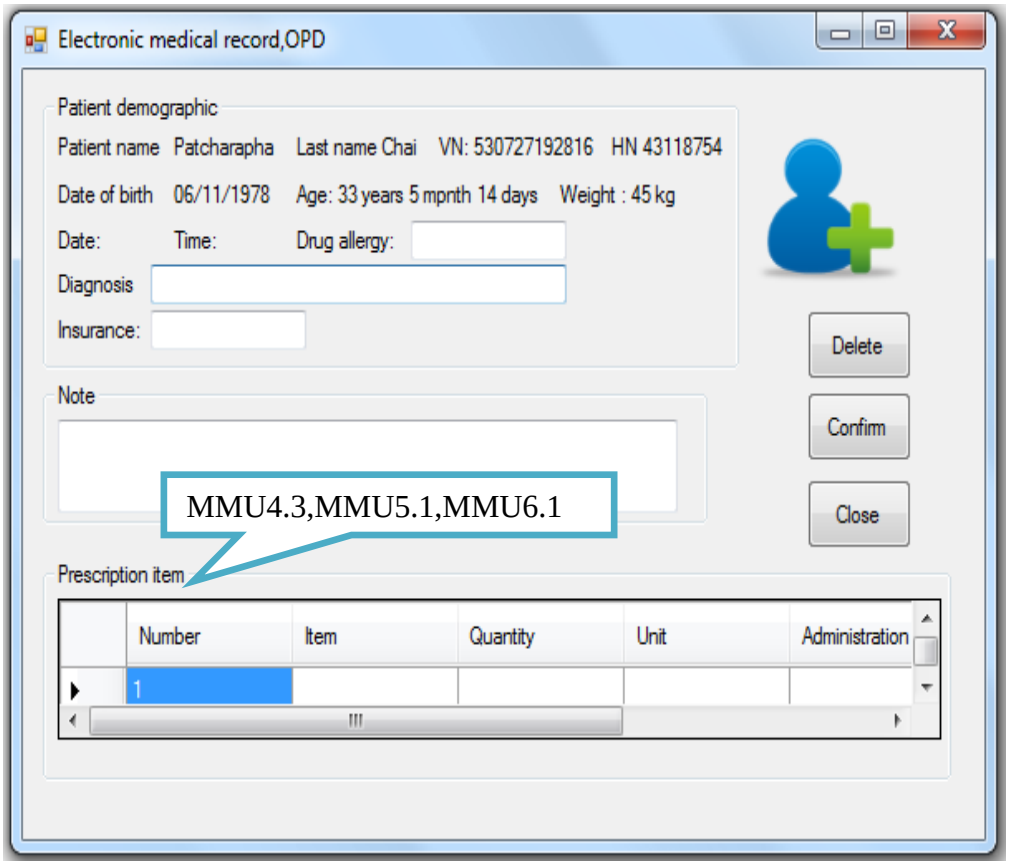


Table B-3 Interface of Electronic medical record Examining subsystem (cont.)

Process Element definition	Examination/Diagnosis

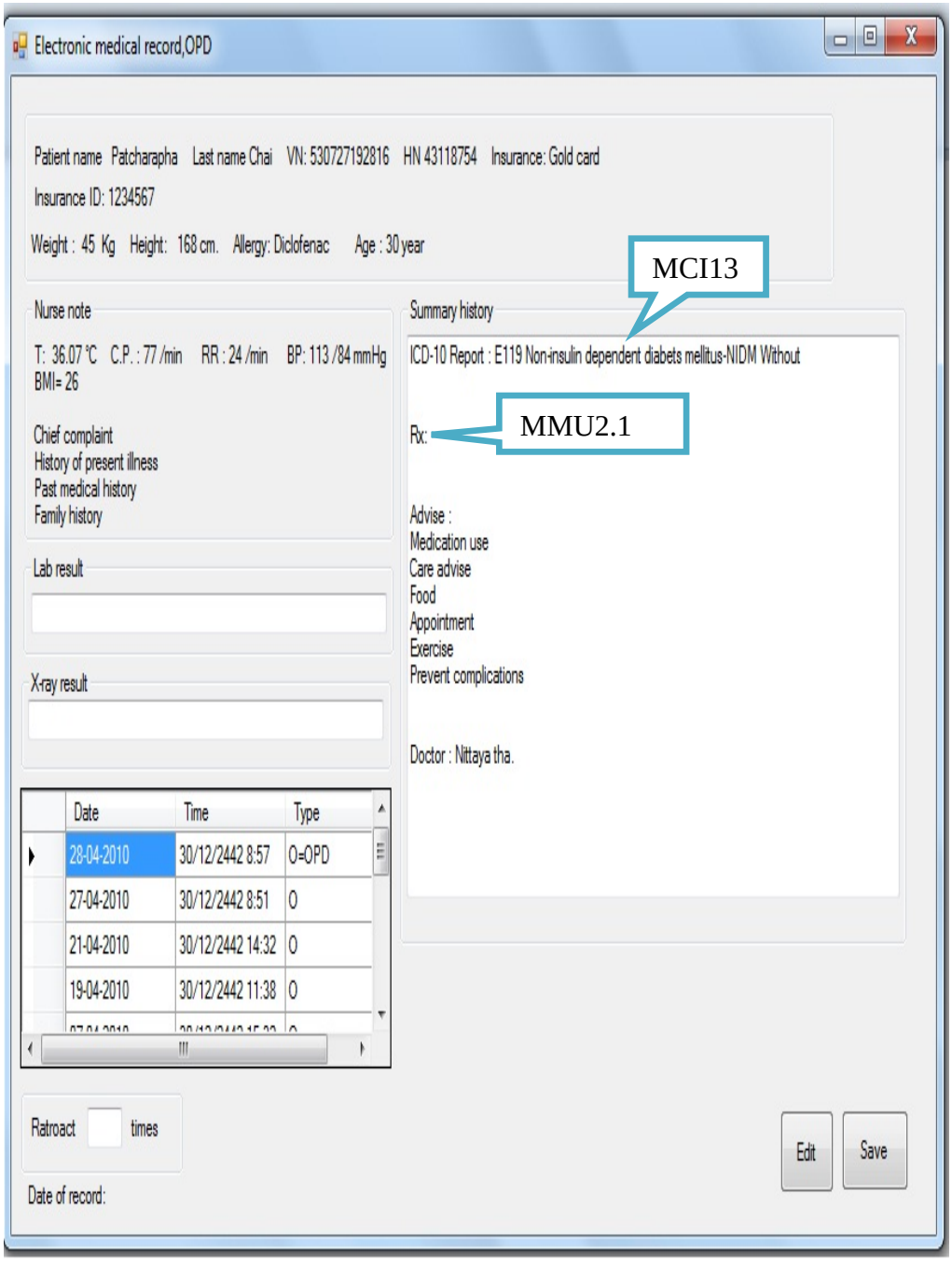


Table B-3 Interface of Electronic medical record Examining subsystem (cont.)

Subsystem	Diagnosis/Examination/Order test/ Prescription
Goal in context	Patient gets the diagnosis by doctor
Related requirement	FR01,FR02,FR03,FR04,FR05,FR06,FR07,FR08 ,FR09.FR10,FR11,FR12,FR13,FR14,FR15,FR1 6,FR17,FR18,FR19,FR20,FR21,FR22,FR23,FR 24,FR25,FR28,FR29,FR30,FR31,FR32, FR33,FR35, FR36,FR37,FR46
Lean	Defect
Scope	Outpatient Department
User	Patient, doctor
Success end condition	Patient was diagnosis by doctor
Process	1. Doctor logs in 2. Doctor check present illness, read result of lab/x-ray test and vital sign. 3. Doctor record examination in patient record. 4.. Doctor order lab or X-ray test. / receive time for test order. 5. Doctor see patient waiting time and can mange time 6. Doctor prescription. 7. Doctor record summarize diagnosis, prescription and care plan.
JCI standard AOP1.3 The primary outcome from the patient's initial assessments is an understanding of the patient's medical and nursing needs so care and treatment can begin.	

Table B-3 Interface of Electronic medical record Examining subsystem (cont.)

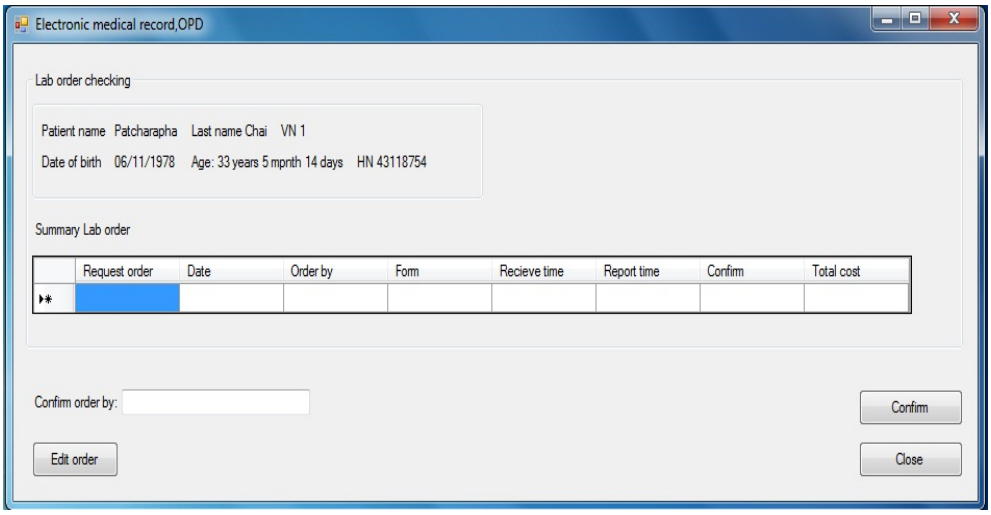
Subsystem	Diagnosis/Examination/Order test/ Prescription
JCI standard ACC 1.1.3 Manage the time for the clinical needs of patients.	
ACC 3.3 The clinical records of outpatient receiving continuing care contain a summary of all diagnoses, drug allergy, current medication and given understandable follow-up instructions.	
ACC4.2 To ensure continuity of care, patient information is transferred with the patient. A copy of the discharge summary or other written clinical summary is provided to the receiving organization with the patient	
MMU 6.1 Medication administration includes a process to verify the medication is correct based on the medication order. Receck prescript ny pharmacist before dispensing.	
MCI13 Standardized diagnosis codes are used and use monitored.	
AOP1.5 Assessment findings are used throughout the care process to evaluate patient progress and understand the need for reassessment. It is therefore essential that the medical, nursing, and other meaningful assessments be documented well and can be quickly and easily retrieved from the patient's record.	
COP 2.3 1. Orders are written when required and follow hospital policy by doctor. 2. Diagnostic imaging and clinical laboratory test orders include a clinical indication/rationale when required for interpretation. 3. Only doctor permitted to write orders do so.	

Table B-3 Interface of Electronic medical record Examining subsystem (cont.)

Subsystem	Diagnosis/Examination/Order test/ Prescription
JCI standard COP 2.2 The orders must be easily accessible if they are to be acted on in a timely manner. Locating orders on a common sheet or in a uniform location in patient records facilitates the carrying out of orders. The system shows the content for order test.	
MMU3.3 The hospital has a process for identifying, any use of or the destruction of medications known to be expired or outdated. (Show in MMU 2.1)	
MMU 4.3 The record of each patient who receives medication contains a list of the medications prescribed or ordered for the patient and the dosage and times the medication was administered.(Show the list of order in summary)	
MMU 5.1 The process to review an order or prescription includes evaluation of - The appropriateness of the drug, dose, frequency, and route of administration.	

Table B-4 Interface of Electronic medical record Test report subsystem

Process Element definition	Test report



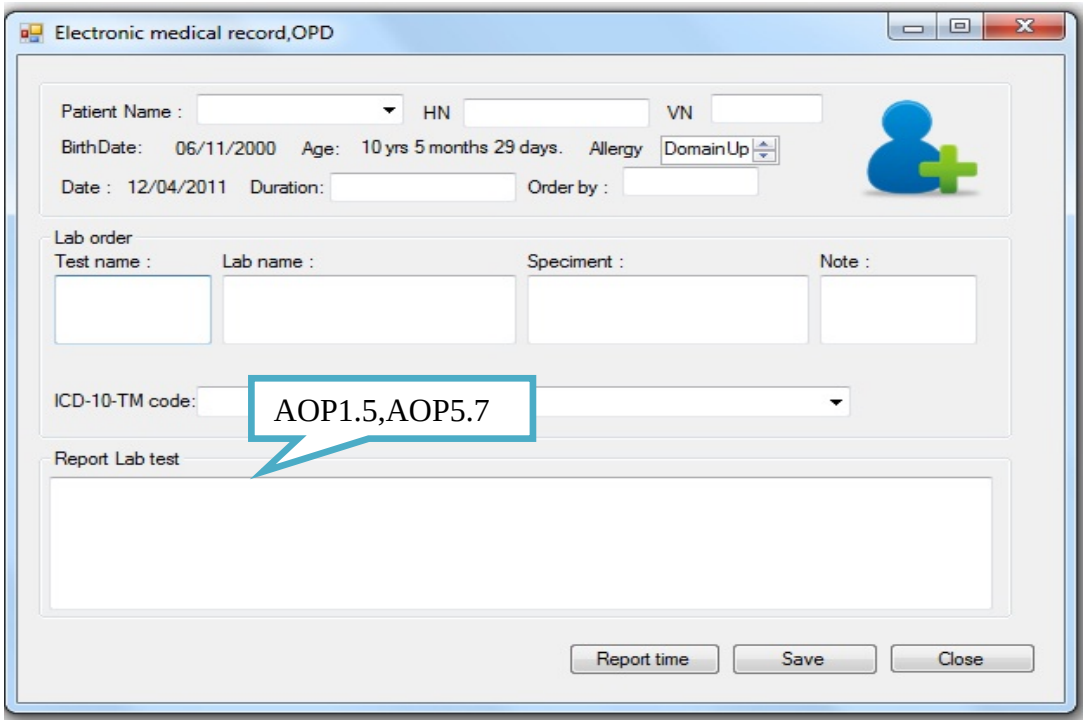


Table B-4 Interface of Electronic medical record Test report subsystem (cont.)

Process Element definition	**Test report**

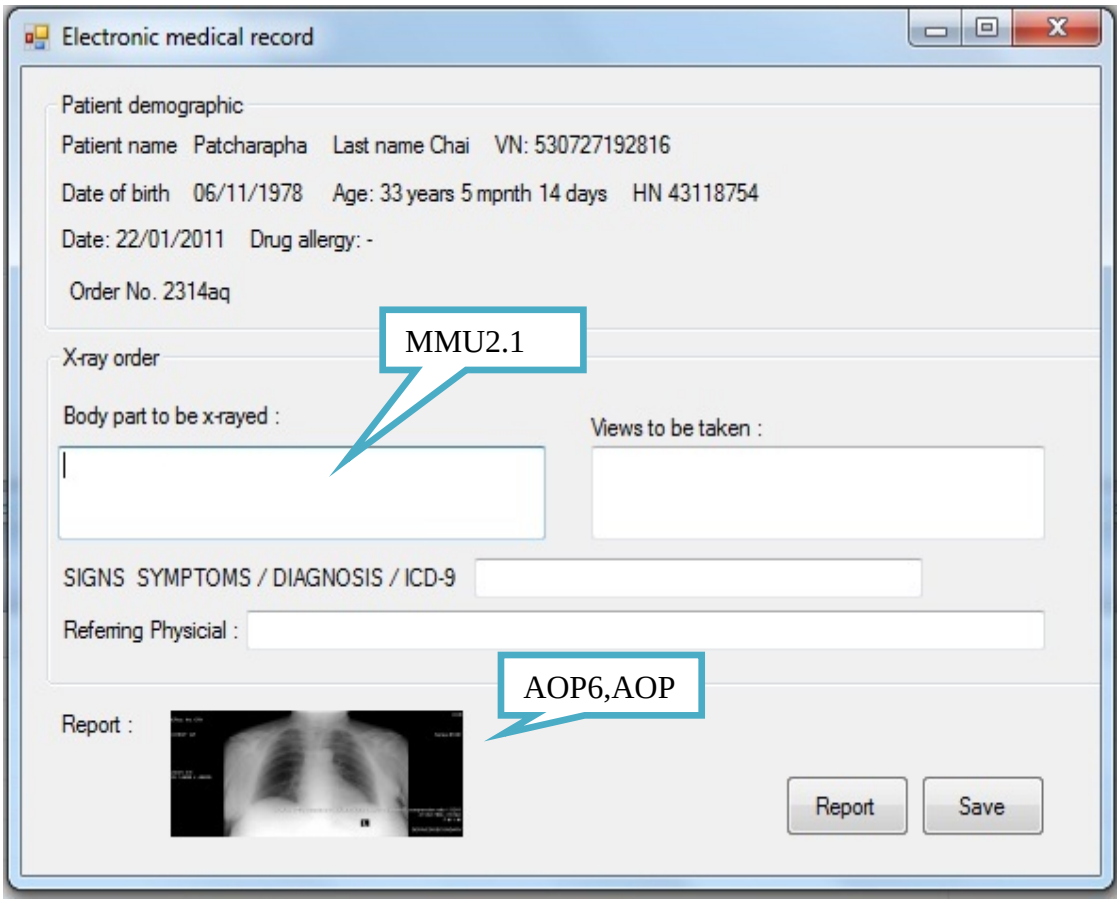
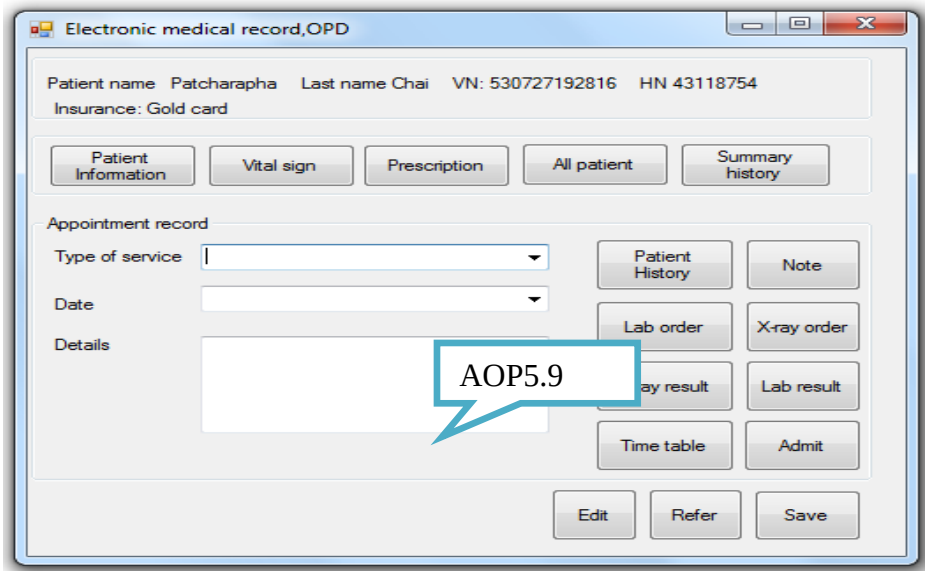


Table B-4 Interface of Electronic medical record Test report subsystem (cont.)

Sub system	**Outpatient report test**
Goal in context	Patient get test report from doctor
Related requirement	FR01,FR02,FR03,FR04,FR05,FR07,FR08FR22,FR23,FR24,FR30,FR31,FR32,FR33, FR46
Lean	Defect
Scope	Outpatient Department
User	Medical technician , radiologist
Success end condition	Doctor read report and examination
Process	1. Medical technician /radiologist receives the test order. 2. Medical technician /radiologist report time for the test. 3. Medical technician /radiologist report test result.
JCI standard AOP 5.7 The laboratory has established reference ranges for each test performed. The clinical record at the time test results is reported.	
AOP 5.9 Quality control procedures include - Validation of the test methods used for accuracy, precision, and reporTable range. - Daily surveillance of results by qualified laboratory staff; - Rapid corrective action when a deficiency is identified; - Testing of reagents - Documentation of results and corrective actions.	
AOP6 The laboratory has established reference ranges for each test performed.	

Table B-5 Interface of Electronic medical record Appointment subsystem

Process Element definition	Appointment



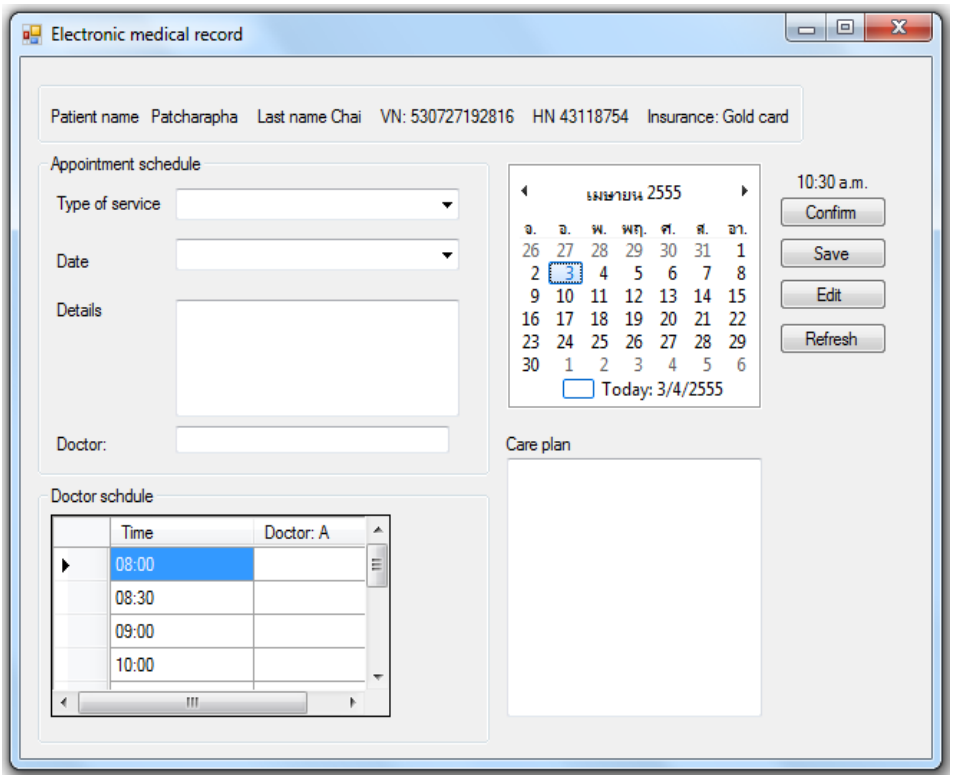


Table B-5 Interface of Electronic medical record Appointment subsystem (cont.)

Subsystem	Appointment
Goal in context	Patient get the appointment by doctor
Related requirement	FR01,FR09, FR25,FR42,FR43,FR46
Lean	Defect
Scope	Outpatient Department
User	Nurse, doctor
Success end condition	Patient was appointed with the doctor
Process	1. Doctor adds appointment patient for the next treatment. 2. Nurse confirms the date and time for doctor and patient.
JCI standard AOP 1.2 The initial assessment(s) provides information to - understand the care the patient is seeking; - select the best care setting for the patient; - form an initial diagnosis; and - understand the patient's response to any previous care. To provide this information, the initial assessment includes an evaluation of the patient's medical status through a physical examination and health history.	

Table B-6 Interface of Electronic medical record Payment subsystem

Process Element definition	**Payment**

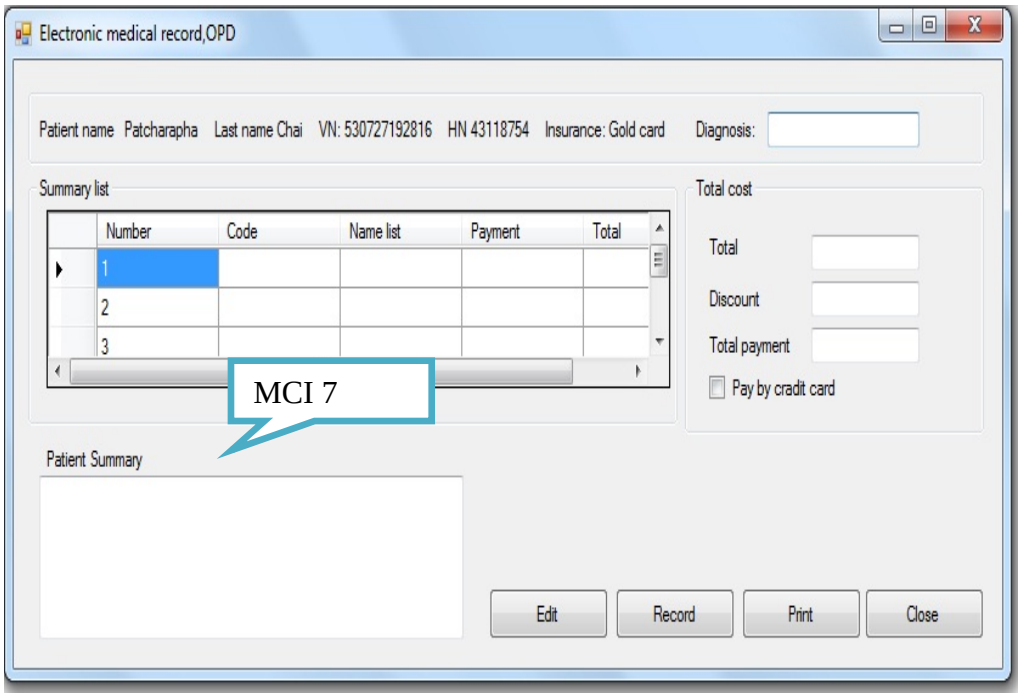


Table B-6 Interface of Electronic medical record Payment subsystem (cont.)

Subsystem	Outpatient payment
Goal in context	Patient payment.
Related requirement	FR01, FR45,FR46,FR47,FR48,FR49
Lean	Defect, waiting
Scope	Outpatient Department
User	Cashier

Table B-6 Interface of Electronic medical record Payment subsystem (cont.)

Subsystem	**Outpatient payment**
Success end condition	The patient was paying
Process	1. Cashier receives all treatment data and check the bill from the patient.
JCI standard MCI 7 For outpatient visits, and at another. 1. There is a process to communicate patient information between the care providers on an ongoing basis or at key times in the care process. 2. Information communicated includes the patient's health status. 3. Information communicated includes a summary of the care provided. 4. Information communicated includes the patient's progress.	

Table B-7 Interface of Electronic medical record Dispensing subsystem

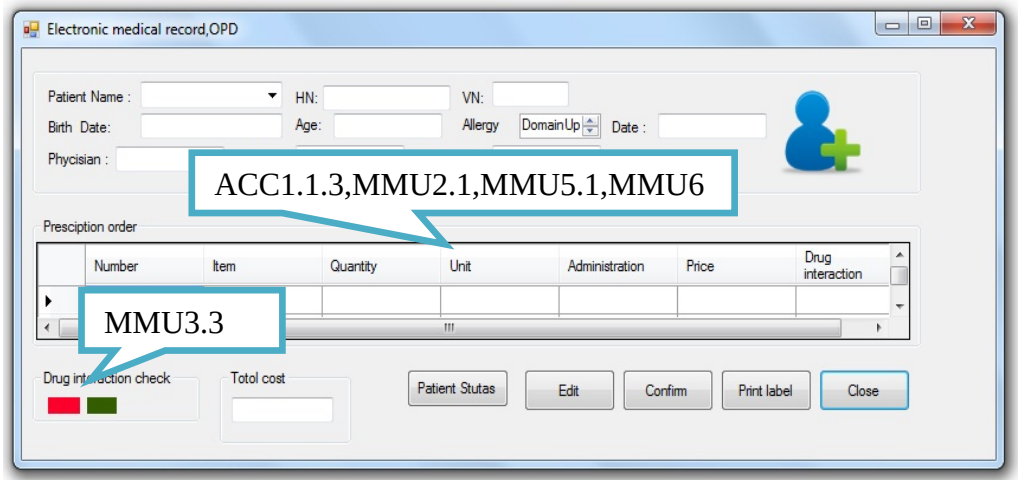
Process Element definition	**Dispensing**
	

Table B-7 Interface of Electronic medical record Dispensing subsystem (cont.)

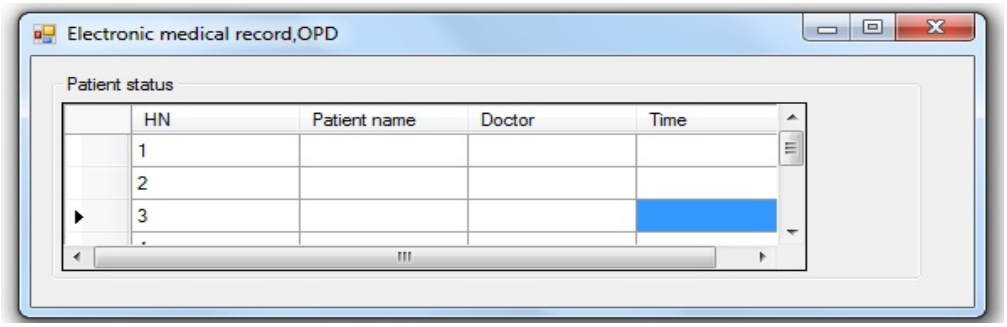
Process Element definition	**Dispensing**
	

Table B-7 Interface of Electronic medical record Dispensing subsystem (cont.)

Subsystem	Outpatient Dispensing
Goal in context	Patients get medicine and home advice.
Related requirement	FR01,FR02,FR03,FR04,FR05,FR06,FR10,FR11 ,FR12,FR14,FR15,FR16, FR17,FR18,FR19,FR20,FR26,FR28MFR35,FR3 6,FR37,FR38,FR39,FR40,FR41,FR42,FR43,FR 44
Lean	Defect
Scope	Outpatient Department
Success end condition	Patients get medicine and home advice.
Subsystem	Outpatient Dispensing
Goal in context	Patients get medicine and home advice.

Table B-7 Interface of Electronic medical record Dispensing subsystem (cont.)

Subsystem	Outpatient payment
JCI standard ACC 1.1.3 Information is provided about the proposed care, the expected outcomes, and any expected cost to the patient or family for the care when not paid for by a public or private source. - The process includes information on the proposed care. - The process includes information on the expected outcomes of care.	
MMU 2.1 - Medications are protected from loss or theft throughout the organization. - Health care practitioners involved in ordering, dispensing, administering, and monitoring processes are involved in monitoring and maintaining the medication list. - There is a process or mechanism to monitor patient response to medications newly added to the list. - The list is reviewed at least annually based on safety and efficacy information.	
MMU 3.3 The hospital has a process for identifying, any use of or the destruction of medications known to be expired or outdated. - There is a medication recall system in place. - Policies and procedures address any use of medications known to be expired or outdated.	
MMU 5.1 The review of the appropriateness of a medication prescription or order.	

Table B-7 Interface of Electronic medical record Dispensing subsystem (cont.)

Subsystem	Outpatient payment
JCI standard MMU 6.1 The safe administration of medications includes verifying the - Medication with the prescription or order; - Time and frequency of administration with the prescription or order; - Dosage amount with the prescription or order; - Route of administration with the prescription or order - Identity of the patient.	

BIOGRAPHY

NAME	Miss Tawinan Simajaruk
DATE OF BIRTH	14 August 1985
PLACE OF BIRTH	Phare, Thailand
INSTITUTIONS ATTENDED	Silapakornt University, 2005-2009: Bachelor of Engineering (Industrial Management Engineering) Mahidol University, 2009-2012: Master of Engineering (Industrial Engineering)
RESEARCH GRANTS	This thesis is partially supported by Graduate Studies of Mahidol University Alumni Association
HOME ADDRESS	62/4 Moo.6 T. Thoong kwaw Amphur Muang Phare 54000 Email: taamtee@hotmail.com
PUBLICATION / PRESENTATION	The The 6th International Congress on Logistic and SCM Systems Conference (ICLS 2011) Ambassador Hotel Kaohsiung Taiwan