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**A DESIGN AND DEVELOPMENT OF  
COMPUTERIZED UNIT-DOSE DRUG DISTRIBUTION SYSTEM**

**CHAINARONG BAURUKSA**

**With compliments  
of**

นายทศพร ขวัญใจ น.ม.น.ค.

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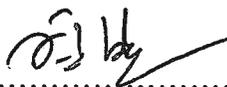
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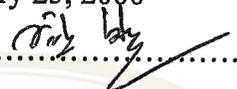
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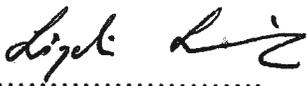
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The purpose of this study is to design and develop a client-server computerized unit-dose drug distribution system, which can overcome the problems of the old system and can be used as a tool to support the unit-dose drug distribution system's operations which is one of the operations in pharmaceutical services. The analysis and the design are based on the object-oriented technique called Rumbaugh's Object Modeling Technique (OMT). Data is stored in a relational database using Microsoft SQL Server 7.0 database management system and programmed by Microsoft Visual Basic 6.0 on microcomputer under Microsoft Windows NT 4.0 as an operating system. The system is developed from the procedures and data collected from the department of medicine at Nongbualumphu Hospital.

This study results in a client-server computerized unit-dose drug distribution system, which is divided into 7 subsystems : patient's admission ; patient's medication ; patient's discharge ; drug inventory ; reporting ; calculating patient's cost and base data. The developed system can eliminate the complexity of data storage, access data quickly, and complete desired reports easily. Including all computers in the system are linked together to provide flexible processing.

The department of pharmacy of the hospital can use this system as a tool to support the unit-dose drug distribution system's operations, which can minimize the disadvantages of the conventional one by minimizing the rate of drug misuse, appropriate drug utilization, reducing the waste in drugs in each step of the operation, maximizing accuracy of calculating cost of used drug; suitable use of person depending on their professional skill and, high quality of patient care.

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วิทยานิพนธ์ฉบับนี้มีจุดประสงค์เพื่อออกแบบและพัฒนาระบบการจ่ายยาแบบ  
ยูนิตโดสด้วยคอมพิวเตอร์ แบบระบบผู้รับและผู้ให้บริการ ซึ่งสามารถแก้ปัญหาของระบบการจ่ายยา  
แบบเดิมได้ และสามารถใช้เป็นเครื่องมือในการสนับสนุนการปฏิบัติงานของระบบการจ่ายยาแบบยูนิต  
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แบบ Object-Oriented ชื่อ Object Modeling Technique (OMT) ของ Rumbaugh โดยใช้  
ฐานข้อมูลและหลักการออกแบบฐานข้อมูลเชิงสัมพันธ์ การพัฒนาโปรแกรมใช้ Microsoft SQL  
Server 7.0 และ Microsoft Visual Basic 6.0 บนเครื่องไมโครคอมพิวเตอร์ และใช้ระบบปฏิบัติการ  
Microsoft Windows NT 4.0 โปรแกรมที่พัฒนาขึ้นอาศัยลักษณะการดำเนินงานและข้อมูล  
ต่างๆ จากกลุ่มงานอายุรกรรม โรงพยาบาลหนองบัวลำภู

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# CHAPTER 1

## INTRODUCTION

### 1.1 Background and statement of problems

Drug distribution is one of the main tasks for pharmaceutical work group which is considered to be important cluster in hospital management since it is related to 'drugs' which is the chief factor of curing. There are 2 parts of drug distribution, which are for out-patient (OPD) and in-patient (IPD).

In-patient drug distribution in Thailand was not well developed because each hospital has different drug distribution systems. However most of the hospitals still use conventional drug distribution system which many research papers confirms its disadvantages as follows : quantities and values of drug stock are very high; errors in drug distribution process because of difficult control, lead to drug-related problems; medical-professional use is inappropriate; loss of drugs, increasing of patient's direct costs and indirect costs especially in government's budgets.

Because of these problems, a new drug distribution system so called 'Unit-Dose Drug Distribution System' had been developed to minimize the disadvantages of the conventional one. Many international research papers on the effectiveness of unit-dose drug distribution system had shown its practicality implementation. Therefore many overseas hospitals adopt this system to use in their day to day operations. The main objectives of unit-dose drug distribution system are : lowest rate of drug miss-using; reduce waste of drugs in each step of operation; economical management;

accuracy in calculating cost of used drug; suitable use of person depends on their professional and skill; and high quality of patient care.

Although many problems occurred in conventional system can be resolved by the unit-dose drug distribution system, but problems are still occurred in the new system operating procedures. Especially time wasting for document preparation such as unit-dose drug labels, patient medication profiles, financial documents, updated inventory documents that will increase operators' workload. From the problems of implementing unit-dose drug system, there is the idea to use computers to eliminate the complexity of data storing, to be able to reach data quickly and to complete desired reports easily.

In Thailand, 2 researches have been published for presenting computerized unit-dose drug distribution system. However, both of them are only used in the environment of 'stand-alone' computers. So only one process, for example, label printing, report generating, can be operated at a time. But in unit-dose drug distribution system, there are many 'dynamic' operations; for example; changing physician's medication orders, requiring for special drugs that are not available in unit-dose sub-stock in patient's wards, requiring for patient's old medical history. Including there are many people and places that are related to this system and distributed to various point of work, both in and out office-time. Some of these operations lead to changing in drug distribution procedures. And if they must be operated at the 'stand-alone' computer (which is usually situated in the main drug-distribution room), operators in patient's wards must waste time for traveling to the main drug-distribution room and waiting for using the 'stand-alone' computer.

One way to solve this problem is to develop computerized unit-dose drug distribution system which can provide users to access data from one or more remote sites. This means the system is addressed by the client/server computing environment. All computers in the system, (including in main drug-distribution room and in patient's wards) are linked together to provide flexible processing.

## **1.2 Objective**

### **1.2.1 Main objective**

To develop client-server application program for unit-dose drug distribution system.

### **1.2.2 Sub-objectives**

1.2.2.1 To study, analyze, and develop a client-server application program for unit-dose drug distribution system.

1.2.2.2 To experimentally use the developed program of unit-dose drug distribution system in the in-patient ward of Nongbualumphu Hospital.

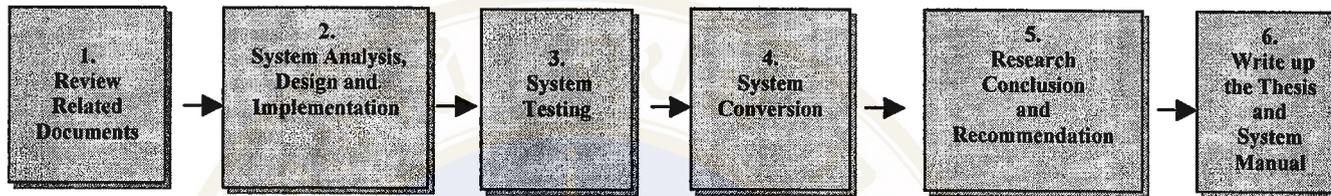
## **1.3 Scope of study**

To study and implement client-server application program for unit-dose drug distribution system and test this program by using data from the department of medicine, Nongbualumphu hospital, Amphur Muang, Nongbualumphu Province which comprises of 34 patient-beds. IBM-compatible personal computer with Microsoft Windows NT operating system will be used to implement proposed system.

Microsoft SQL Server and Microsoft Visual Basic will be used to develop the application.

## 1.4 Steps of approach

Steps of approach for this study is shown in figure 1.1.



**Figure 1.1** Steps of approach for the study of analysis and design of computerized unit-dose drug distribution system.

## 1.5 Expectation of study

1.5.1 A developed unit-dose drug distribution system can overcome the problems of the old system.

1.5.2 A developed client-server application program can be used as a tool to support the unit-dose drug distribution system's operations which is one of operations in pharmaceutical services.

## 1.6 Key words

### **Drug distribution system(1) :**

Is the system set for the purpose of selecting, controlling, inventory managing, dispensing, transferring, preparing and managing of drugs in health-service office, follow to physician's curing command.

### **Unit-dose drug distribution system(2) :**

Is the drug distribution of pharmaceutical department for in-patient, in unit-dose package for 1 day. Drugs for each patient are contained in the same container and collected in medication cart or cassette for each ward.

**Unit-dose package(1) :**

Is packing of drugs in amount equal to 1 dose of medication.

**Dose(3) :**

Is the quantity to be administered at one time, as a specified amount of medication.

**Application program(4) :**

Is a developed computerized program that is used in a desired work.

**Client-Server system(4) :**

Is a network computer system that a 'server' computer will operate many processes; for example, searching data; for 'client' computers. When a process has been done already; for example, finding desired data; a server will send the data to those client computers to continue working.

**Network(4) :**

Is a linkage between 2 or more computers together by communication system for sharing data and resources, for example, data file, printer.

## CHAPTER 2

# LITERATURE REVIEW

This chapter presents a summary of reviewed literature concerning the unit-dose drug distribution system and its computerized applications, the object oriented modeling methodology and relational database, including relationship between the object data model and relational data model.

### 2.1 Drug Distribution System

Pokkrong Maneesin(1) had described that drug distribution system is the system set for the purpose of selecting, controlling, drug collecting, drug dispensing, drug transferring, drug preparing and drug management in health-service office, follow to physician's curing command. For in-patient drug distribution, it must be made-up by co-operation of physicians, pharmacists, and other people from related department, which define formal policy and operation. Drug distribution system in various hospitals are quite different, depend on number of patients, medical staffs, and budgets. The main objective is to serve rapid and effective drug services.

He had also described that there are 2 main types of drug distribution system as follows :

#### 2.1.1 Conventional Drug Distribution System :

There are 3 types of conventional drug distribution system as follows :

##### - Floor Stock Drug Distribution System

Except less amounts and items, nurse station of in-patient wards contains drug stock similar to those in hospital's pharmaceutical department. Nurses can therefore prepare and administrate drugs in-time. Pharmaceutical

department will prepare drugs followed by nurses' orders when they are almost out of order.

#### **- Individual Prescription Order Drug Distribution System**

In this system, pharmaceutical department will prepare drugs follow physician's drug prescription for each patient. The drug quantities are prepared for using in 3-5 days (oral) and 1 day (parenteral) whereas physician's prescription is transferred to pharmaceutical department by patient's relatives or nursing person. In some hospitals, nursing person will copy physician's command from each of patient's profiles into drug prescription, collect and transfer to pharmaceutical department for drug requisitions every single day. Drugs will be stored in nurse station in wards for administration.

#### **- Combination of Floor Stock and Individual Prescription Order Drug Distribution System**

This system will select lists of drugs to be stored in wards, which are frequently used, less dangerous, and low price. For example, disinfectants and antiseptics prepared for using in hospital. Drugs which are out of these lists must be available only at pharmaceutical department. So in practical, the drugs will be distributed based on prescription for each patient and try to apply advantages of both systems.

#### **Disadvantages of conventional drug distribution system**

- a. High quantities and value of drug stock, which include amounts of drug outside main stock : drug stock in wards and sub-stock.
- b. Losses of drugs caused by repeated drug requisitions, in-correct drug storage,

leads to drug expired and quality lose out, because of no drug control outside pharmaceutical department.

c. Waste of cost of drug used of patients and hospital

d. Drug miss-using, caused by

- Nurses must copy physician's prescription many times, for drug prescription transferred to pharmaceutical department and for medical card arranged for each patient administration.
- Unsuitable use of medical professional in reading, interpreting, preparing drugs in wards, especially nursing person who has high workload, so fineness of work decreases.
- There are filling drugs in new storage in wards without identifying drug names, strength and doses

These errors in drug using each time may lead to the decrease of efficiency. Adverse drug reaction or drug toxicity may be occurred. It therefor wastes patient's time to stay longer and increase cost of cure for both patients and government.

### **2.1.2 Unit-Dose Drug Distribution System**

This system has been developed in USA. Since 1960 for solving problems of the conventional drug distribution system.

## **2.2 Unit-Dose Drug Distribution System**

### **2.2.1 Definition and operations in unit-dose drug distribution system**

Apiruedee Hemajuta(2) had defined the definition of unit-dose drug distribution that it means drug distribution of pharmaceutical department for in-patient, in unit-dose package for 1 day. Drugs for each patient are contained in the

same container and collected in medication cart or cassette for each ward. She has also described fundamental compositions of unit-dose drug distribution system

- Drug for patient administration must be in unit-dose package.
- Drug distribution must be done in form of ready to administrate to patients, and there must be labels with the drugs all the time until they are administrated to patients.
- Amount of drugs taken to wards is prepared for 24-hrs uses and can return these drugs in case of no-use.
- There must be patient medication profile for each patient, and always being updated for each of drug distribution.

Moreover unit-dose drug distribution system will focus on allowing to keep necessary reserved drugs in patient wards at least quantities such as emergency drugs, often-used but less dangerous drugs, for example, gargle, antacid.

Operations in unit-dose drug distribution system, which are illustrated in figure 2.1, are able to described as follows :

1 A patient is admitted to be cured in the hospital.

2 Pharmacist prepares patient medication profile and records patient's name, bed or room number and others related to the medication.

3 One copy of physician's drug prescription will be sent to pharmaceutical department.

4 Pharmacist determines the drug prescription with records in patient medication profile as follows : completeness of drug prescription; the degree of drug severity, strength, frequency of drug taking; whether drug is available in hospital; is there any problems of drug interaction; reason to use drugs.

4.1 If any error is found, pharmacist will check drug prescription with references and find options for correcting that error.

4.2 Pharmacist consults the physician about the error that has been found in drug prescription.

4.2.1 If the physician confirms the old drug prescription, it has been ready for recording physician's commands in patient medication profile.

4.3 If the physician corrects the old drug prescription, the new drug prescription will be sent to pharmaceutical department again.

5 Drug prescription will be determined again until any error is not found.

6 Pharmacist records physician's command into patient medication profile.

7 Determine whether drugs must be necessarily used before the next sending-time of the time-schedule for patient's drug administration, that has been set by cooperating with nurses.

7.1 If the drugs must be necessarily used before the next sending-time of the time-schedule.

7.2 Pharmacist controls pharmaceutical people to prepare drugs in amount enough until next sending-time of the time schedule in unit-dose form and fill it in cassettes of medication carts.

8 If the drugs are unnecessarily used before the next sending-time of the time-schedule.

9 Pharmacist controls pharmaceutical people to prepare drugs in unit-dose form and fill it in cassettes of medication cart.

10 Pharmacist records drugs used in patient medication profile

11 Pharmacist checks drugs in each cassette again.

12 Drugs in cassettes or medication carts are transferred to wards according to the determined schedule.

13 Nurse gives drugs to each patient according to the time schedule and records in nursing medication administration.

14 Cassettes are transferred back to pharmaceutical department.

15 Pharmacist checks cassettes whether there are some drugs remained, and finds possible cause of remained drugs.

16 Values of remained drug will be used to recalculate for reducing patient's drug-cost.

#### **Advantages of unit-dose drug distribution system**

**Apiruedee Hemajuta(2)** had described advantages of unit-dose drug distribution system as follows :

- Be able to decrease error-rate caused by drug using displacement.
- Be able to lower cost of drug used.
- More suitable, effective uses of pharmaceutical and nursing people.
- Be able to control all drug using, including better for following results of drug using.
- Be able to calculate cost of drug used correctly and fairly for patients and the hospital.
- Be able to reduce unnecessary, complex steps in returning drugs.
- Pharmacist is able to set time schedule in pharmaceutical department effectively.
- Be able to reduce amounts and values of all drugs stock in hospital.

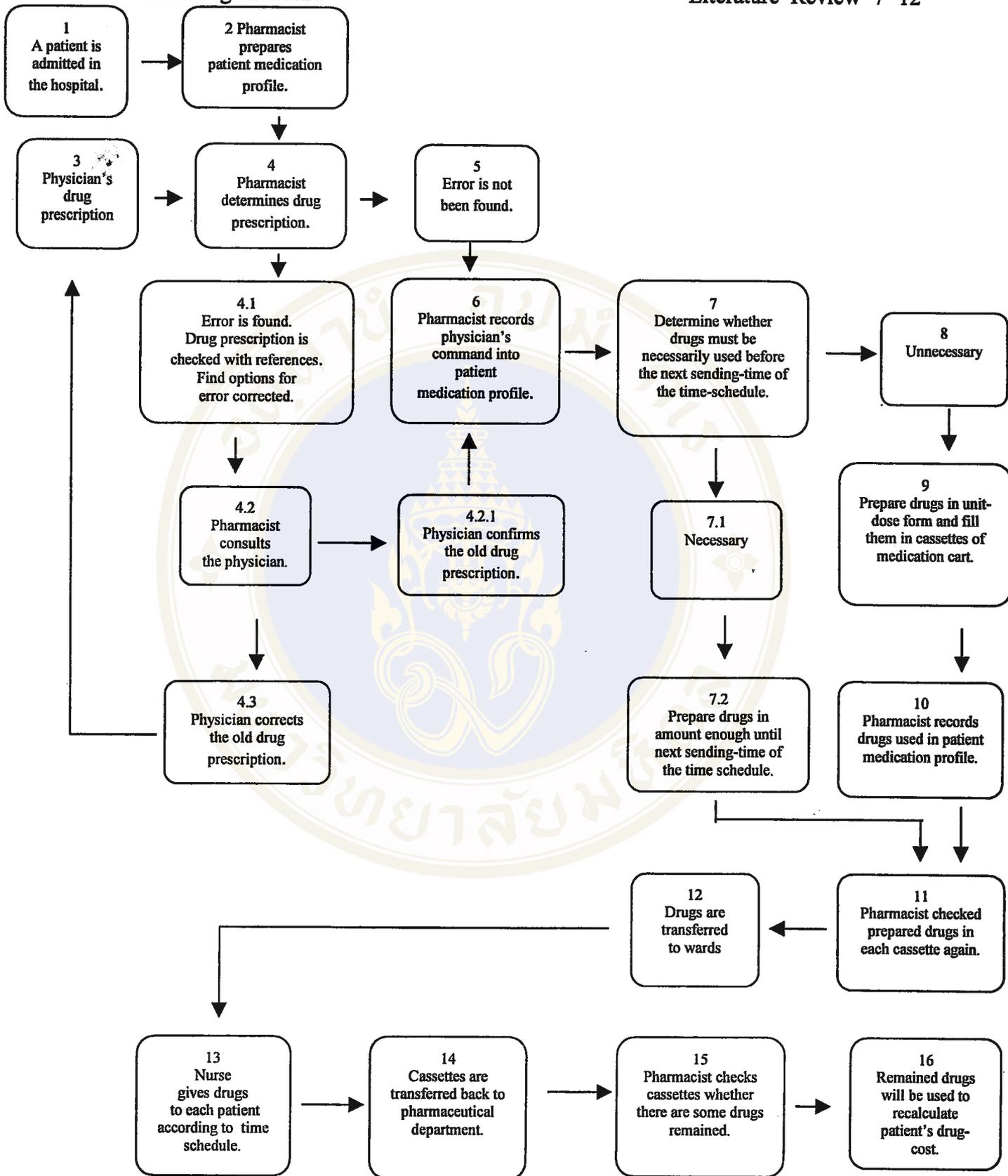


Figure 2.1 Operations in unit-dose drug distribution system(2).

**Jantima Tayakorn(5)** has the opinion that the unit-dose drug distribution system will be useful in reducing amount and value of drugs on floor-stock, but there are some problems in operating the system, for example, delay time in distribution unit-dose drugs to patient-wards. So the system should be improved to be suitable for operations of every medical person.

#### **Disadvantages of Unit-Dose Drug Distribution System**

**Lawan Srattaphut(6)** had described disadvantages of unit-dose drug distribution system as follows :

- Increase workload of pharmaceutical department, because unit-dose drug-products are rarely used in Thailand, so pharmaceutical department's staff must prepare unit-dose drugs and also produce labels themselves.
- Patient medication profile and nurse medication administration record must be updated all the time for minimize errors, return drugs in time, non-repeated drugs. Pharmacist must take more time and skills to check physician's command.
- Because unit-dose drug distribution system provides the easiness of drugs returned to pharmaceutical department, it will impact to the drug quantities in the stock which will change all the time and hard to control.

She also has the opinion that according to unit-dose drug distribution system, there must prepare drugs to each patient enough for 1 day and also allow to return drugs so workload of financial and accounting management will arise and must be done more finely for the fairness of patients.

### **2.2.2 Unit-dose drug distribution system in Thailand**

**Pokkrong Maneesin(1)** had described that in Thailand, hospitals under ministry of public health such as Lampang Hospital, Chacherngsao Hospital, Chiangrai Hospital, and Surin Hospital have experimentally used unit-dose drug dispensing system for their in-patient wards. However from the report of ministry of public health ( on 2<sup>nd</sup> March 1998), only Khonkaen hospital and Lampang hospital has been confirmed a developed pharmaceutical service in unit-dose drug distribution system.

### **2.2.3 Application programs for the unit-dose drug distribution system**

In Thailand, there are 2 researches concerning the computerized applications of the unit-dose drug distribution system:

**Pokkrong Maneesin(1)** has the opinion that using computer is able to use to increase efficiency of works in unit-dose drug distribution system such as record drug dispensing, calculate cost of drug used, reduce errors of drug dispensing, and support clinical pharmacy services.

He had developed computerized system as part of an online hospital information system for drug dispensing, charging and using information as well as for inventory control. The system was divided into 5 sub-systems: profile pharmacy, generate prescription, print prescription, print label for in-patient – IPD, and admission information. However, this system cannot be used to support the real unit-dose drug distribution system because no unit-dose package was involved in the system.

**Lawan Sratthaphut(6)** had also developed computerized system for unit-dose drug distribution system, which was divided into 4 sub-systems: patient admission and discharge, drug dispensing, drug returning and inventory, and unit-dose

package preparation However , because data of the system was stored in a relational database using Microsoft Access database management system and programmed by Microsoft Visual Basic on microcomputer under MS-DOS, it means the system has been set on 'stand-alone, computer, so it cannot be used to support 'client-server' architecture.

## **2.3 Object-Oriented Methodology**

### **2.3.1 Methodology :**

From the paper of 'Pencome' about the topic '**Object-Oriented Methodologies**'(7), the author had described that a methodology is a set of procedures for gathering requirements, analyzing and designing a program. The author has the opinion that a methodology is a way of enforcing self-discipline and ensuring a rigorous and thorough analysis of the problem at hand. It also acts as a checklist making sure nothing has been missed. Finally, since information is usually displayed in a graphic format, problems and concerns may become more easily apparent than they would be from reading an old-fashioned, 'Victorian novel' text specification.

### **2.3.2 Object-Oriented Approach :**

**Bakker(8)** had described that object diagram, which are models(Model : A model is an abstraction of something for the purpose of understanding it before building it), provide the essential framework into which the dynamic & functional models can be placed. The 'goal' in constructing an object diagram is to capture the concepts from the real world that are important to an application. He also has the opinion that the 2 purposes of an object diagram are:

- assist developers in making computer system and application of all kinds

- make communications with the customer easier

Nielsen(9) has the opinion that there are 2 approaches of using tools and methods to describe and support software development steps: 'traditional structured' and 'object-oriented' analysis and design. He also had summarized the differences between both approaches, which are described in table 2.1.

**Table 2.1** The differences between traditional structured and object-oriented analysis and design.

Methods of Analysis & Design	Traditional structured	Object-oriented
1. Pattern	Function	Entity
2. Data & Function	Separate	Abstraction
3. Data Structure	Open/visible	Hidden/encapsulated
4. Re-Design (if any system requirements are changed )	High	Low
5. Code changed (if any data is changed or moved)	Yes	No

Turban, McLean, Wetherbe(10) has described relative advantages for development environments in table 2.2 .

**Table 2.2** Relative advantages for development environments.

Development Environment	Reuse	Speed	Productivity	Platform Independence	Data Independence	Application Architecture compliance
Object-Oriented	High	Medium - High	Medium - High	Medium - High	n/a	High
Traditional	Low	Low	Low	Low	Low	Low

### **2.3.3 Benefits of Object-oriented Approach :**

**Bureson(11)** has the opinion that benefits of object-oriented approach are :

#### **1. Reduce maintenance costs :**

Behaviors are stored within the database and are isolated from the application. Because each 'method' is encapsulated, building blocks are created that may be re-combined to create new behaviors.

#### **2. Improved flexibility :**

Because object can be dynamically called and accessed, new object may be created at any time the new object may inherit data attributes from one/many other object. Behaviors may be inherited from super-classes, and novel behaviors may be added without affecting existing system functions.

**Lam(12)** has the opinion that with the object-oriented approach, people can easily understand the system as objects rather than procedures since people think in objects. For example, people see a car as a system with an engine, gas tank, wheels, etc. But most people would not see a car as a series that make it run. Since it's more natural to think of a system in objects, it is understandable why object-oriented technology is gaining popularity. It's a systematic way to do analysis and design. It enables planning and repeatable development. It provides a basis for developer experience. Also it avoids misunderstanding and avoids different notations for the same thing because everyone is speaking the same language. He has also described the strengths and weaknesses of object-oriented technology in table 2.3 .

**Table 2.3** Strengths and weaknesses of object-oriented technology.

Strengths	Weaknesses
<ol style="list-style-type: none"> <li>1. Programmers can design programs in the context of the kinds of objects and their relationships to be molded in the real-world system.</li> <li>2. Faster development</li> <li>3. Higher quality</li> <li>4. Easier maintenance</li> <li>5. Scalability</li> <li>6. Changes to existing systems can be made without rebuilding the system</li> </ol>	<ol style="list-style-type: none"> <li>1. Lack of established standards</li> <li>2. Conversion requires education and training</li> <li>3. Need time to shift from the structured paradigm to the OO paradigm.</li> <li>4. People do not want to shift</li> </ol>

### 2.3.3 Object-oriented methodologies :

Nielsen(9) has the opinion that different methodologies that are implemented an object technique approach use same models but in different notation. Lam(10) has the opinion that to decide which method is the best, a developer has to look at some selection criteria :

*First*, the method should be suitable for the application requirements, cover the software lifecycle phases, and also fit the programming language.

*Second*, developers' experience with the method affect how well they use the method.

*Third*, the amount of support the method has. The support could be tools for creating models, technical help, or a mentor.

*Finally*, the method should be easy to use and understand.

He had also described the strength and weakness of each methodology in table

**Table 2.4 Strengths and weaknesses of each object-oriented methodology.**

<b>Object – Oriented Methodology</b>	<b>Strengths</b>	<b>Weaknesses</b>
Rumbaugh OMT	Notations are able to support all major concept	Analysis phase has more support than the design
Shlaer-Mellor method	Provide different views of the problem	
Booch's method	Easy conversion from structured methods	
	Very detailed	
	Has a great deal of commercial use	
	Has a rich set of notation and incorporates elements of other methods	
Wirfs-Brock's RDD/CRC	Ease of use and understanding	
	Inexpensive tools of index cards	
	Being used commercially	
	Simple	
Coad/Yourdon method	Intuitive approach	Not widely used, not supported enough
	Easy to understand and use	Include some non OO features
Jacobson's method	Ease of learning(because of simple notation)	
(OO Software Engineering : OOSE )	Cover all development phases with a good support for the analysis phase	

## 2.4 Object Modeling Technique : Rumbaugh's Methodology

Amako(13) had summarized the Object Modeling Technique, which is an object-oriented analysis, design and implementation methodology that has been developed by Rumbaugh. The methodology is divided into 4 phases as follows :

### Phase 1 : Object Analysis Phase

1 Write or obtain an initial description of the problem statement.

2 Build an Object Model :

**Object Model = Object Model Diagram + Data Dictionary**

A description of the structure of the objects in a system including their identity, relationships to other attribute, and operations.

3 Develop a Dynamic Model :

**Dynamic Model = State Diagrams + Global Event Flow Diagram**

A description of aspects of a system concerned with control, including time, sequencing of operations, and interaction of objects.

4 Construct a Functional Model :

**Functional Model = Data Flow Diagrams + Global Event Flow Diagram**

A description of aspects of a system that transform values using functions, mappings, constraints, and functional dependencies.

5 Verify, iterate, and refine the three models

**Analysis Document = Problem Statement + Object Model**

**+Dynamic Model + Functional Model**

### Phase 2 : System Design Phase

The first stage of design, during which high-level decisions are made about the overall structure of the system, its architecture, etc.

**System Design Document = Structure of basic architecture for the system  
as well as high level strategy decisions.**

**Phase 3 : Object Design Phase**

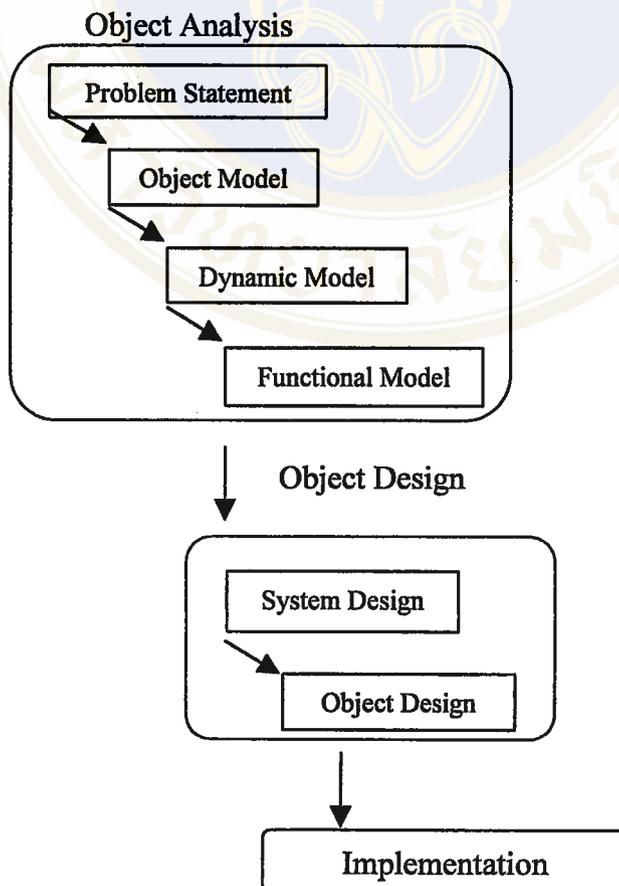
In this stage, shift away from the real-world orientation of the analysis model towards the computer orientation required for a practical implementation.

**Design Document = Detailed Object Model + Detailed Dynamic Model  
+ Detailed Functional Model**

**Phase 4 : Implementation Phase**

In this stage, the design established in the OOA/OOD is realized in an executable form.

The OMT methodology is illustrated in figure 2.2



**Figure 2.2** The OMT methodology

**Gulya Chatbusayamas(14)** had summarized the basic object modeling concepts that are described by Rumbaugh and his team as follows :

**Objects:**

An object is a concept, abstraction, or thing with crisp boundaries and meaning for the problem at hand.

**Classes:**

A class or an object class describes a group of objects with similar properties (attributes), common behavior(operation), common relationships to other objects and common semantics.

**Attributes:**

An attribute is a data value held by the objects in a class. Each attribute has a value for each object instance.

**Operations:**

An operation is a function or transformation that may be applied to or by objects in a class.

**Methods:**

A method is the implementation of an operation for a class

**Links:**

A link is a physical or conceptual connection between object instances.

**Associations:**

An association describes a group of links with common structure and common semantics.

**Example of Associations**

**Aggregation:**

Aggregation is special type of association that represents the “part-whole” or “a-part-of” relationship. The objects representing the components of something are associated with an object representing the entire assembly.

**Generalization:**

Generalization is the relationship between a class and one or more refined versions of it. The class being refined is called the super-class and each refined version is called a subclass. Generalization is sometimes called the “is-a” relationship because each instance of a subclass is an instance of the super-class.

**Inheritance:**

Inheritance is a mechanism for sharing attributes and operations using a generalization relationship.

Multiple inheritance permits a class to have more than one super-class and to inherit features from all parents. This permits mixing of information from two or more sources.

**Qualifications:**

A qualified association relates two object classes and qualifier. The qualifier is a special attribute that reduces the effective multiplicity of an association

**Multiplicity:**

Multiplicity specifies how many instances of one class may relate to a single instance of an associated class.

**Constraints:**

Constraints are functional relationships between entities of an object model.

**Derived objects, links and attributes:**

A derived object is defined as a function of one or more objects, which in turn may be derived.

She also has the opinions that OMT provides a useful abstraction for relational database design. With its strong support for analysis and design it gives many advantages which allow some problems of organization to be successfully solved.

- Reduce cost such in the case of redesign because the object-oriented concept supports re-usability.
- Reduce time because it promotes database integrity. Mapping from object model to table will be in the third normal form.
- Increase design performance.
- Reduce gap between designer and user and a richer set of constructs for modeling data.

## 2.5 Relational Data Model

Elmasri and Navathe(15) had described that relational data model represents the database as a collection of relations, as a 'Table' of values. A table is consisted of rows and columns. Each row in the table represents a collection of related data values. The table names and column names are used to help in interpreting the meaning of the values in each row of the tables. The column names specify how to interpret data values in each row, based on the column each value is in.

In relational model terminology, a row is called a tuple, column header is called an attribute, and the table is called a relation. The data type describing the types of values that can appear in each column is called domain.

They has also described about '*Normalization*' that is the process of refinement to resolve relational schema before implementation or to break up larger tables into smaller tables because there may be ambiguous or redundant information in tables. This is to avoid update anomalies.

- **First normal form (1NF)** – A relation is in first normal form if it contains no repeating data items. So it requires a flat table, that is every attribute value is an atomic, non decomposable data item.
- **Second normal form (2NF)** – A relation is in second normal form if and only it is in first normal form and each non-key attribute is fully functionally dependent on the entire primary key.
- **Third normal form (3NF)** – A relation is in third normal form if and only if it is in second normal form and there are no transitive dependencies between non-key data items.

## **2.6 Relationship between Object-Oriented Models and Relational Models:**

**Hanson & Hanson (16)** have the opinion that it is generally agreed that object-oriented models provide a more accurate representation of the complexities of an application problem than do the relational and other early data models. However, few systems exist at present on which object-oriented models are implemented. Thus, it needs some method for translating object-oriented models to relational models that

can be implemented. It means transforming *'objects, relationships, attributes, aggregation, and so forth'* to *'relations'*.

**Gulya Chatbusayamas(14)** has the opinion that the simple rules in mapping the object models to tables are:

**Mapping object classes to tables**

- Each class maps to one or more tables.

**Mapping associations to tables**

- Each many-to-many association maps to a distinct table.
- Each one-to-many association maps to a distinct table or may be buried as a foreign key in the tables for the many classes.
- Each one-to-one association maps to a distinct table or may be buried as a foreign key in the tables for either class.
- Role names are incorporated as part of the foreign key attribute name.
- N-ary ( $n > 2$ ) associations map to a distinct table.

**Mapping aggregation to tables.**

- Follows the same rules as association.

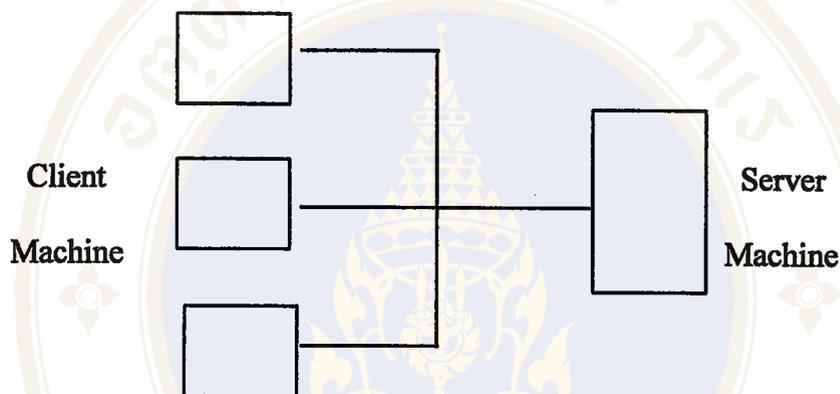
**Mapping single inheritance generalization to tables.**

- The superclass and each subclass map to tables.
- No superclass table, superclass attributes are replicated for each subclass.
- No subclass table, bring all subclass attributes up to the superclass level.

She also has the opinion that the tables resulting from mapping tend to be in the third normal form, so there would be no need for further normalization, which is a benefit of an object modeling.

## 2.7 Client-Server Architecture and Database system :

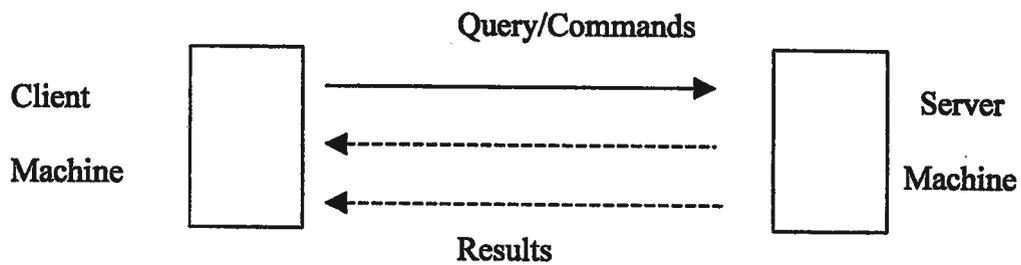
**Khoshofian(17)** has the opinion that a major requirement of a corporation's database system today is to provide uses with access to data from one or more remote sites. This need is addressed by the client/server computing environment, which is illustrated in figure 2.3. The responsibility of data representation and access is divided between the client and the server.



**Figure 2.3** The client/server computing environment

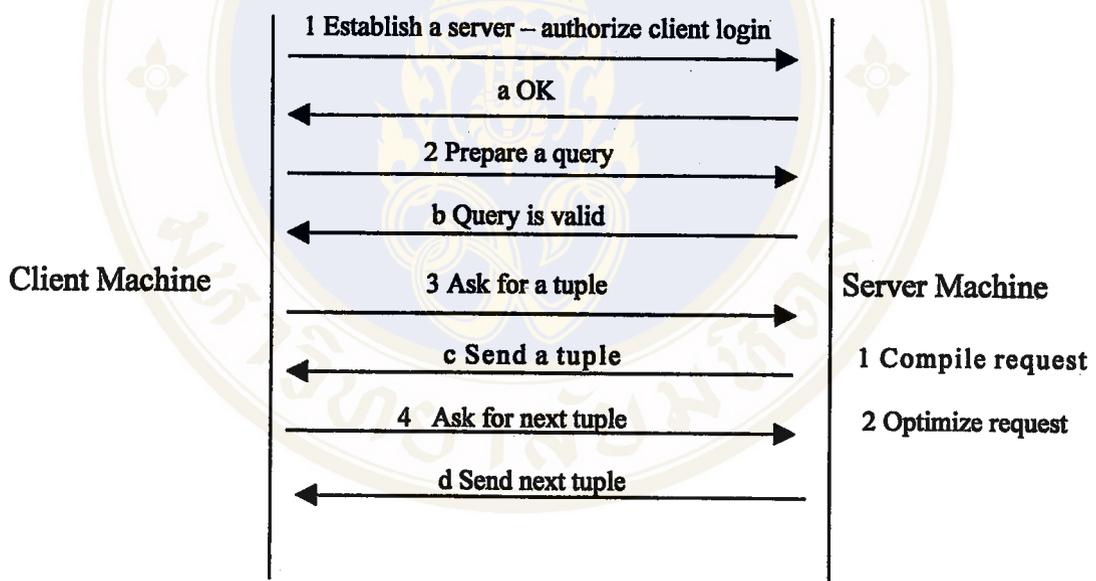
Steps in client-server architecture protocol, which is illustrated in figure 2.4, are :

- 1 User queries database.
- 2 Client machine presents query to the server machine.
- 3 Database system
  - accepts query
  - compiles query
  - selects best optimization strategies
- 4 Database management system
  - collects the result of query
  - transfers to client machine



**Figure 2.4** Client-server architecture protocol

Most database systems provide an application interface(API), which is used by client application to access database stored on a remote server. The typical protocol followed by a client machine and database server providing the API is summarized in figure 2.5.



**Figure 2.5** The typical protocol followed by a client machine and database server providing the API.

## 2.8 Software used in the research :

### 2.8.1 Rational Rose :

Is a product of **Rational Software Corporation(18)**. It provides support for object-oriented modeling. Rose's model-diagram architecture

facilitates use of the Booch'93 method, Object Modeling Technique(OMT), and Unified Modeling Language(UML) for object-oriented analysis and design.

Rational Rose provides the following features to facilitate the analysis design and iterative construction of applications :

- Use case analysis
- Object-oriented modeling
- User configurable support for Booch 93, OMT, and UML
- Semantic checking
- Support for controlled iterative development
- Round-trip engineering
- Parallel multi-user development through repository and private support
- DDL generation and integration with data modeling tools
- Forward engineering of COBRA-2 Compliant IDL
- Documentation Generation
- Rose scripting for integration and extensibility
- OLE linking
- OLE automation
- Multiple platform availability

### 2.8.2 Microsoft SQL Server :

**Khoshofian(17)** has described that SQL Server is a relational database system supporting client/server architecture. It provides very good coverage of client/server architecture through SQL language and programming interface extension.

**Banthit Jamornphut(19)** had described that Microsoft SQL Server is a relational database management system product of Microsoft Corporation. It supports 'Two-phase commit/Tight consistency' to keep situation of data between servers in the system by using 'commit' for transaction of data(which is sent and received between servers) must be recorded in database of both servers correctly and concurrency, or 'roll back' back to the same situation.

SQL Server is composed of the following components :

- ISQL/W(Interactive SQL) : is used for writing statement transact-SQL. It is able to be run on both server and client.
- SQL Enterprise Manager : is used to create devices, objects, configuration, grant users.
- ODBC(Open database connectivity) : is used to replicate data to other database system, for example, ORACLE, Access.
- MS DTC(MS distributed transaction coordinator) : is used to manage routine of transact-SQL in updating data of servers within a same transaction.

### 2.8.3 Microsoft Windows NT :

**Banthit Jamornphut(20)** had described that Microsoft Windows NT is a network operating system product of Microsoft Corporation. The architecture of Windows NT is composed of client/server architecture and layer architecture, which is divided into 2 modes. **Annop Kantikul, Porapat Suthidara, Sajja Jaradrungraweeworn(19)** had described these modes in details :

#### (1) Kernal mode(NT Executive)

Is the mode of system working. It is divided into 4 parts :

a. **System service** : is composed of 5 components.

- Security reference monitor(SRM) : for managing security.
- Object manager(OM) : for creating and deleting objects : files, devices, share memory.
- Local procedure call(LPC) : for managing communication between application(clients) and protected system(Server).
- Process manager(PM) : for managing process(application in execution) and threads(sub-components of application) to run into processor for SMP(Symmetric multiple processing).
- Virtual memory manager(VMM) : for protecting memory one process from the other and managing requirements for memory in parts of excess of RAM of the system by swapping to hard disk.

b. **Input/Output (I/O) manager** : manages file system, network equipment. It is composed of 4 components.

- File system : for supporting operation with file system : FAT < NTFS.
- Cache manager : for managing cache : improve access to disk, CD-ROM efficiently.
- Network driver : for managing input/output of network.
- Device drivers : is composed of 32-bit code used to manage hardware – interface between hardware and other components call for using hardware.

c. **Kernel** : is a lower component, used for managing interrupt, exception handling, execution of threads, and processing.

d. **Hardware abstraction layer** : is a code between processor and kernel. The function is changing code from kernel to order processors to run operations, for example, manage input/output, manage stack, control interrupt.

## **(2) User mode(Protected subsystems)**

Is an interface between application program or subsystems(DOS, Windows 16bit&32bit, OS/2, POSIX/UNIX) and kernel mode. Each subsystem has application program interface. Windows NT has environment subsystem for applications in different environments.

### **2.8.4 Microsoft Visual Basic :**

Is a product of **Microsoft Corporation(22)** which is designed for teams of developers creating distributed, client/server or internet/intranet application. **Wisarn Kamjornwed(23)** has the opinion that visual basic can be

used to operate with other database management system(DBMS), for example, ORACLE, SQL Server, Infomix. A program which is created for operating in a kind of database can be changed to use another kind of database conveniently because database is separated from commands or methods for using database. Visual basic can be used for developing object-oriented programming because it separates designing of user-interface from set of commands for processing.

**Tharin Sithithammasharee, Tananchai Jamnongphakdee(24)** had described that using visual basic, which basic language is used, for creating application is followed the steps :

1 design user interface by choosing control which response desired using application on the screen. Set position and size of the control.

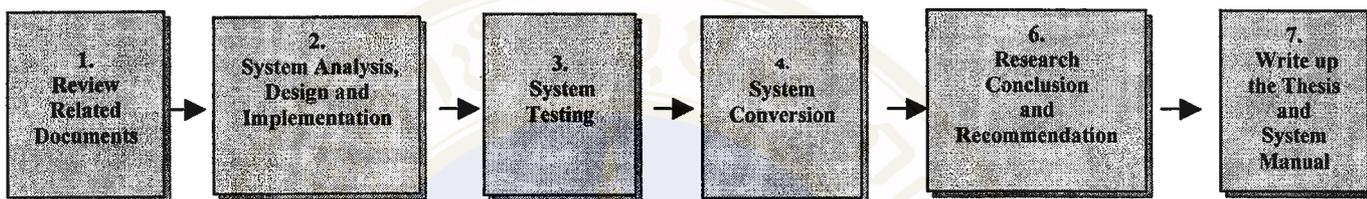
2 Write programming commands response to event happening. For example, response to user, this is called 'Event-driven programming'



## CHAPTER 3

# RESEARCH METHODOLOGY

### 3.1 Steps of Approach



**Figure 3.1** Steps of approach for the study of analysis and design of computerized unit-dose drug distribution system.

#### 3.1.1 Review related documents :

The student will review the books and documents related to the proposed thesis as follows:

##### 3.1.1.1 Drug Distribution System

The student will study 2 types of drug distribution systems : *conventional* and *unit dose* drug distribution system about definition, operations, advantages and disadvantages , including computerized applications used in each system.

##### 3.1.1.2 Object-oriented methodology

The student will study about methodology, object-oriented approach, strengths and weaknesses of objected-oriented approach, object-oriented methodology, object modeling technique (OMT) or Rumbaugh's methodology, the basic object modeling concepts that are described by Rumbaugh.

### 3.1.1.3 Relational Data Model

The student will study about definition and terminology of relational data model, also the process of normalization.

### 3.1.1.4 Relationship between object-oriented models to relational models

The student will study about the difference between object-oriented models and relational models, also rules in mapping the object models to tables.

### 3.1.1.5 Client-server architecture and database system

The student will study about the role and importance of client-server architecture that supports the requirement of a corporation's database system in providing uses with access to data from one or more remote sites.

### 3.1.1.6 Software

The student will study about software used to develop the application : Network Operating System-Microsoft Windows NT; Relational Database Management System-Microsoft SQL Server; Interface to user-Microsoft Visual Basic; also Computer Aid System Engineering(CASE) tools used for object-oriented representation-Rational Rose.

## 3.1.2 System analysis, design & implementation

The Object Modeling Technique (OMT) strategy of system development, which was presented by **Rumbaugh(23)**, is as follows :

### 3.1.2.1 Conceptualization

Conceive a problem to be solved and a system approach that solves it. Make an initial cut at the problem statement by writing use cases or listing requirements. The steps are : identifying a need from the users' viewpoint, a general approach to meeting the need, taking into account the available technology, market situation, resources, time available, and existing approaches, describe the requirements, external constraints, and concept in natural language.

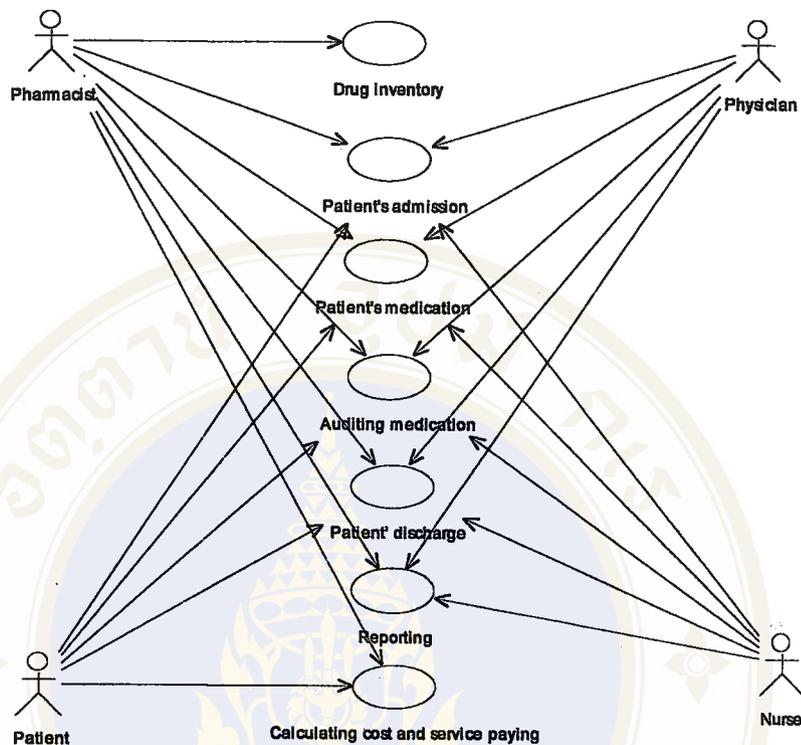
#### Use Cases

One way to capture a user's view of a system is to construct use cases of the system. A use case is a category of interactions between the system and an actor (an outside object in a particular role) about a particular way or purpose of using the system from the user's point of view. Each interaction starts with an initial event from the actor to the system and proceeds through a series of events between the actor, the system, and possibly other actors, until the interaction initiated by the original event reaches its logical conclusion (this is a matter of judgment). Some people use the word "story" to emphasize that a use case has a beginning, a middle, and an end. An example of a use case is presented in figure 3.2.

Follow these steps to produce a use case:

- a. Determine the boundary of the system. Determine which objects are parts of the system, which ones interact with it, and which ones are disconnected from it. Develop the use case by considering the system itself as a single object, that is, a black box.

**Use case : Unit-dose drug distribution system**



**Figure 3.2** An example of a use case.

b. Determine the actors that interact with the system. An actor is one role that outside objects play with respect to the system. Start by examining physical objects that interact with the system, but in many cases each one plays multiple roles. For example, a given person might be a User, an Operator, and an Administrator of a computer operating system. Each role is a different actor.

c. For each actor, determine the fundamentally different ways in which the actor uses the system. Each of these is a use case. It must be able to enumerate the use cases. If there are too many, approach things at a higher level.

d. Identify the initial event that starts each use case.

e. Determine the termination condition that concludes the use case.

Often a use case can be approached at several different levels, so pick the level of detail that is compatible with other use cases in the system.

f. List a prototypical scenario that describes the typical transaction.

g. If there are variations, list additional prototypical scenarios or describe the variations in words. Feel free to use ordinary language; a use case is not meant to be highly formal.

h. Identify and describe all the exceptions that are logically associated with a given use case. After that, check that the set of use cases encompasses all the functionality of the system.

### 3.1.2.2 Object Analysis Phase

Describe the external behavior of a system as a "black box" by building OMT models of it in user-meaningful terms. The steps are :

a. Write or obtain an initial description of the problem statement.

b. Build an Object Model :

- Identify object classes.
- Begin a data dictionary containing descriptions of classes, attributes, and association.
- Add associations between classes.
- Organize and simplify object classes using inheritance.
- Test access paths using scenarios and iterate the above steps as necessary.
- Group classes into modules, based on close coupling and related function.

An example of a class diagram and a data dictionary are presented in figure 3.3 and 3.4.

**c. Develop a Dynamic Model :**

- Prepare scenarios of typical interactions sequences.

An example of a scenario diagram is presented in figure 3.5.

- Identify events between objects and prepare an event trace for each scenario.
- Prepare an event flow diagram for the system.

An example of an event flow diagram is presented in figure 3.6.

- Develop a state diagram for each class that has important dynamic behavior.

An example of a state diagram is presented in figure 3.7.

- Check for consistency and completeness of events shared among the state diagrams.

**d. Construct a Functional Model :**

- Identify input and output values.
- Use data flow diagrams as needed to show functional dependencies.

An example of a data flow diagram is presented in figure 3.8.

- Describe what each function does.
- Identify constraints.
- Specify optimization criteria.

**Class diagram : Unit-dose drug distribution system**

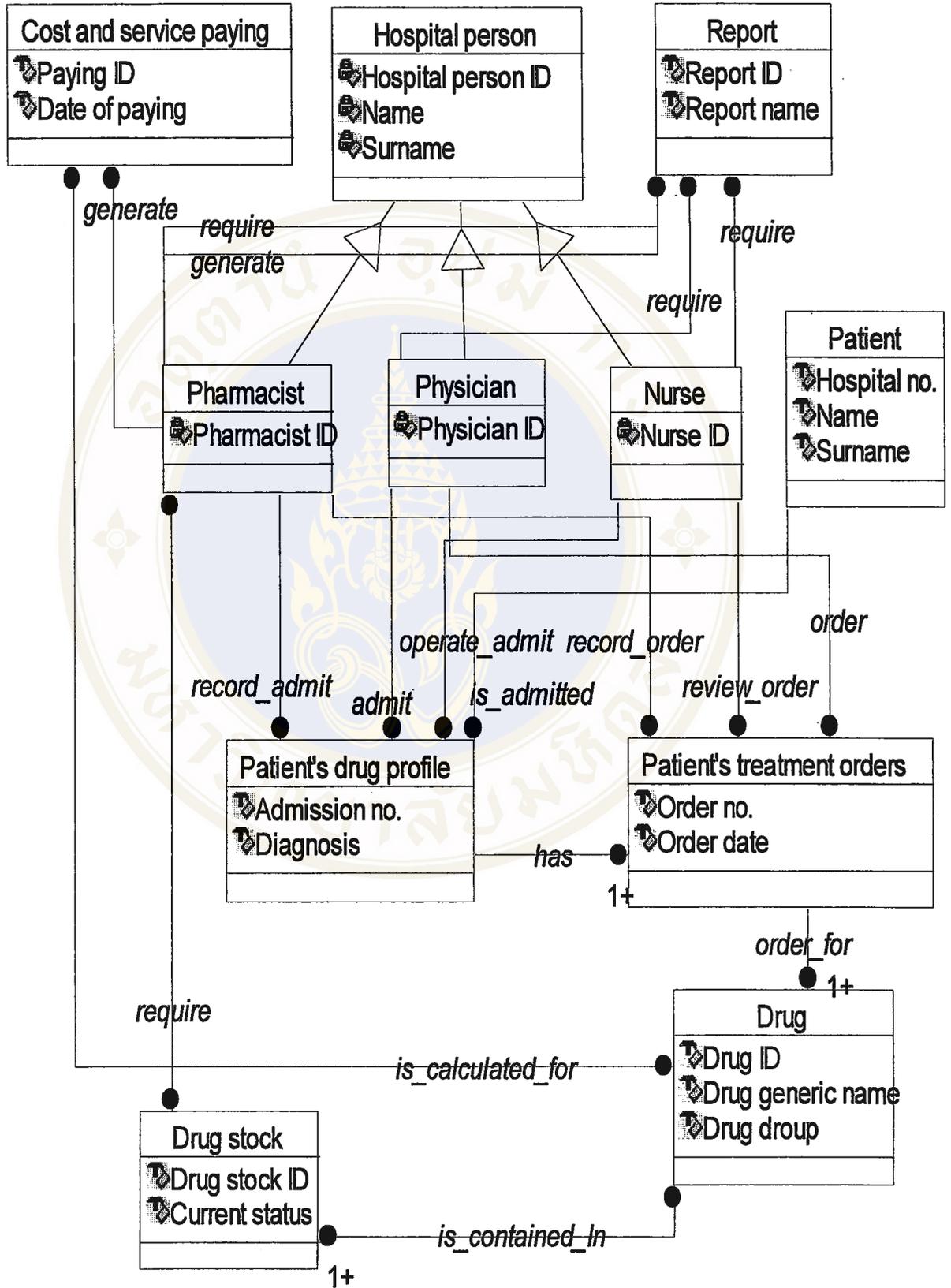
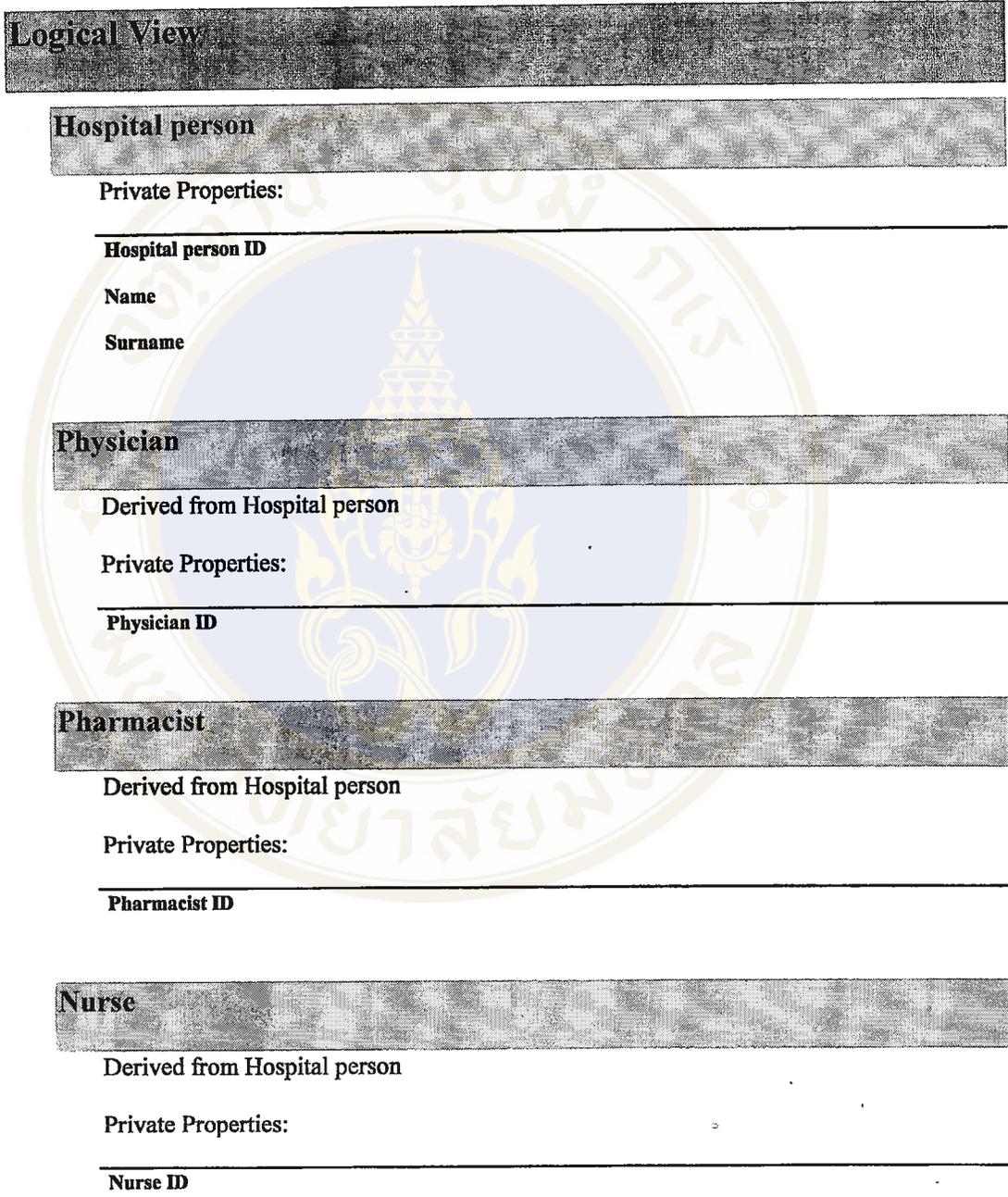


Figure 3.3 An example of a class diagram.

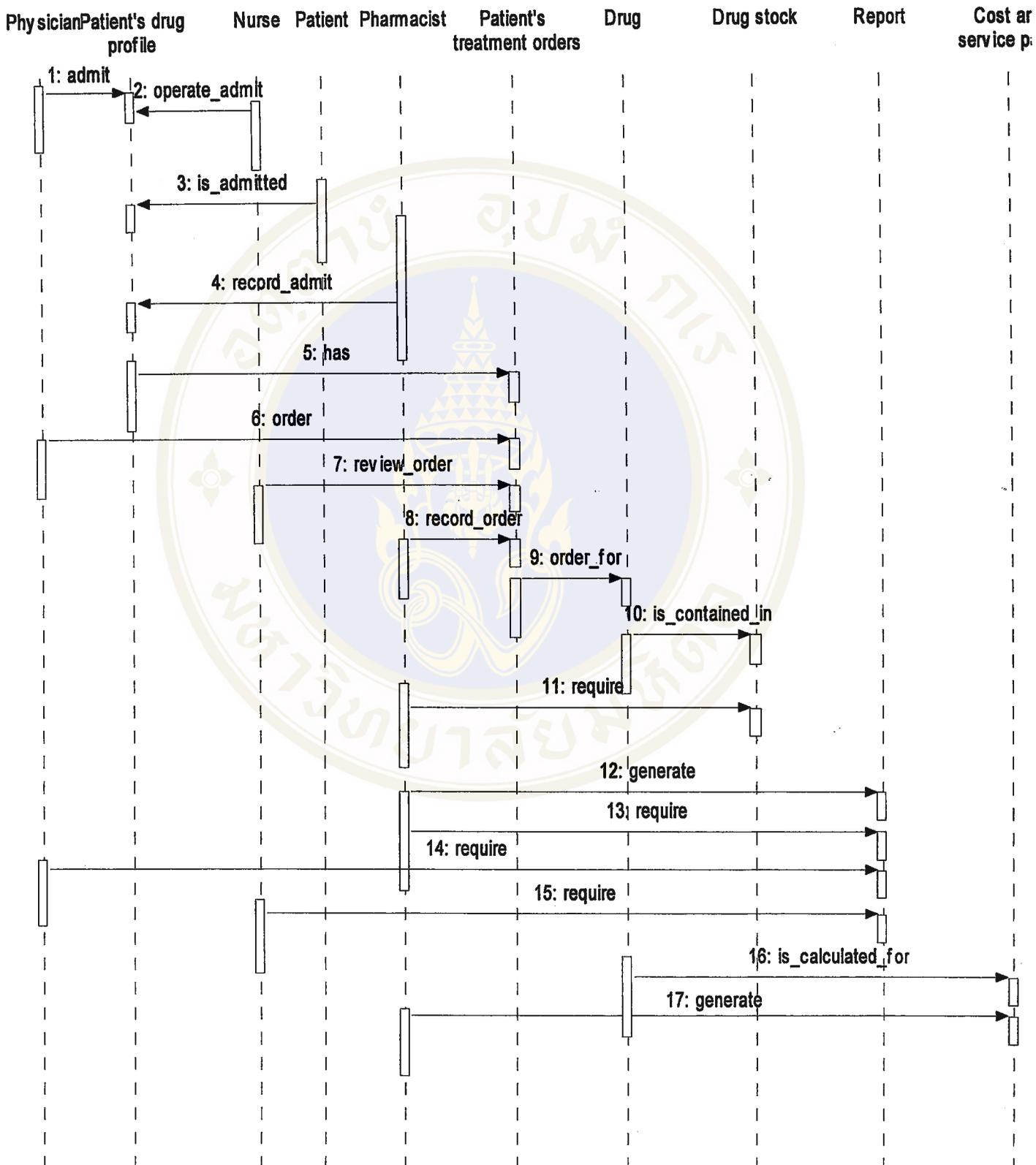
**Data dictionary : Unit-dose drug distribution system**

**Logical View Report**



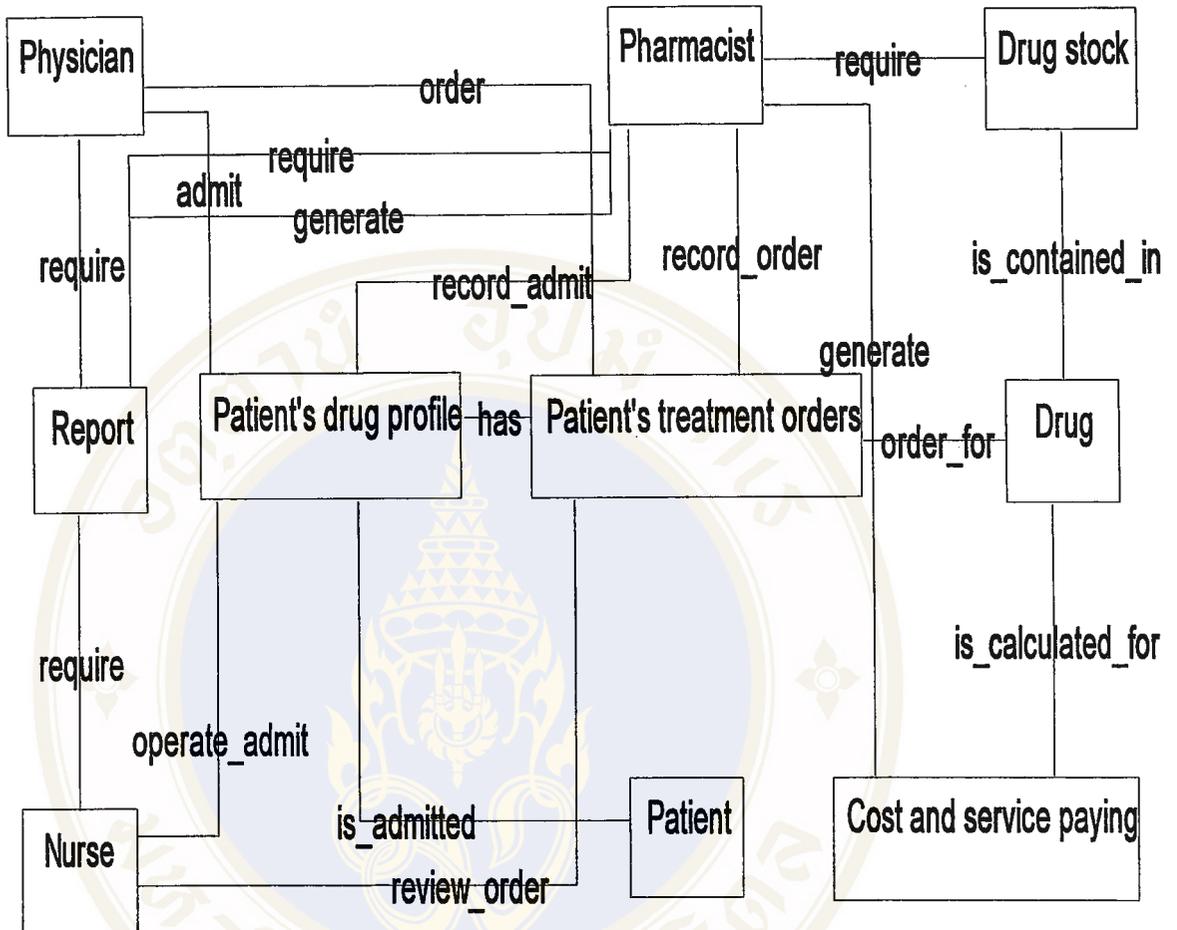
**Figure 3.4** An example of a data dictionary.

**Scenario diagram : Unit-dose drug distribution system**



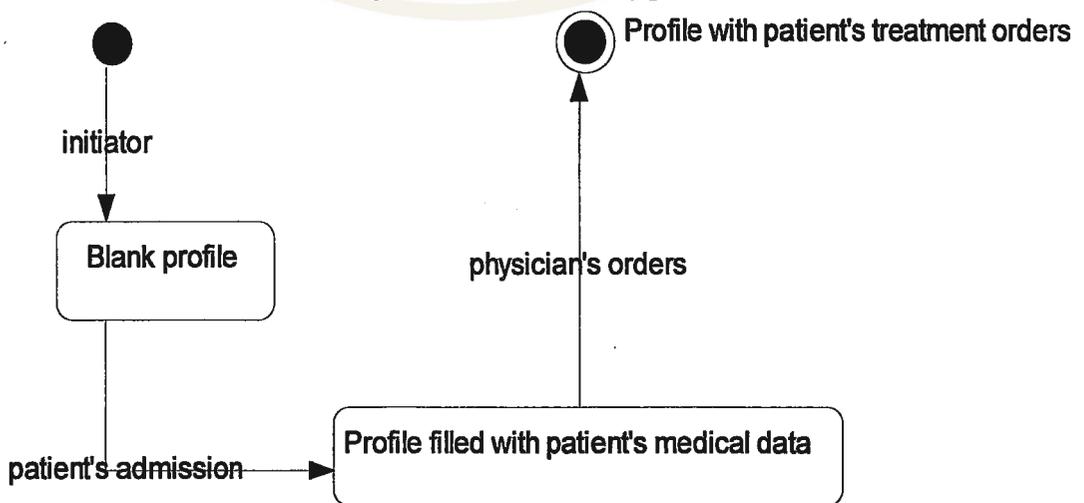
**Figure 3.5** An example of a scenario diagram.

**Event flow diagram : Unit-dose drug distribution system**



**Figure 3.6** An example of an event flow diagram.

**State diagram : Patient's drug profile class**



**Figure 3.7** An example of a state diagram.

**Data flow diagram : Unit-dose drug distribution system**

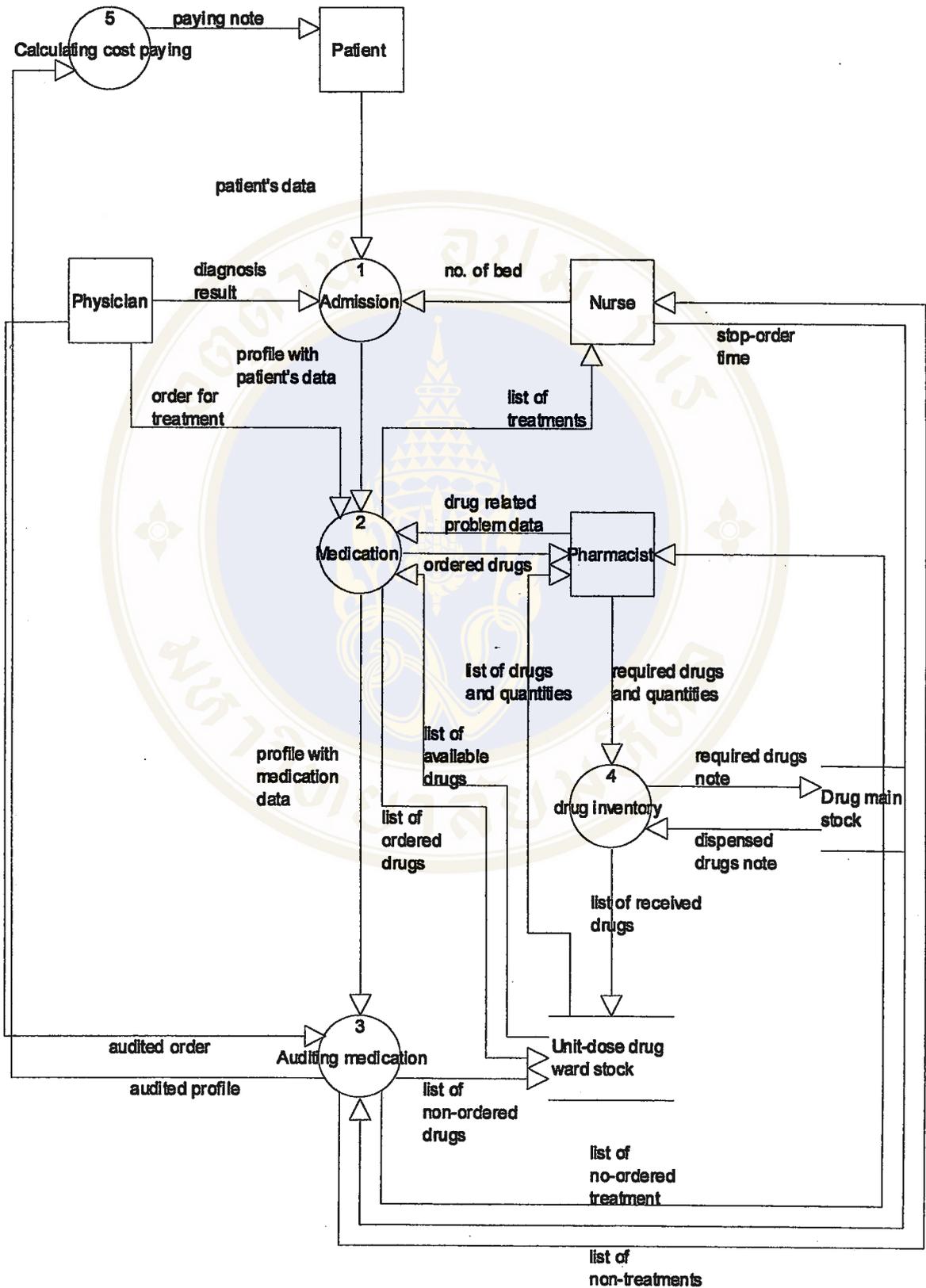


Figure 3.8 An example of a data flow diagram.

**e. Verify, iterate, and refine the three models**

- Add key operations that were discovered during preparation of the functional model to the object model.
- Verify that the classes, associations, attributes, and operation are consistent and complete at the chosen level of abstraction. Compare the three models with the problem statement and relevant domain knowledge, and test the models using scenarios.
- Develop more detailed scenarios (including error conditions) as variations on the basic scenarios. Use these ‘what if’ scenarios to further verify the three models.
- Iterate the above steps as needed to complete the analysis.

**3.1.2.3 System Design Phase**

Make the high-level global decisions about the system implementation, including its overall structure. The steps are :

- 3.1.2.3.1 Organize the system into subsystem.
- 3.1.2.3.2 Identify concurrency inherent in the problem.
- 3.1.2.3.3 Allocate subsystems to processors and tasks.
- 3.1.2.3.4 Choose the basic strategy for implementing data stores in terms of data structures, files, and databases.
- 3.1.2.3.5 Identify global resources and determine mechanisms for controlling access to them.
- 3.1.2.3.6 Choose an approach to implementing software control :

- Use the location within the program to hold state, or
- Directly implement a state machine, or
- Use concurrent tasks.

3.1.2.3.7 Consider boundary conditions.

3.1.2.3.8 Establish trade-off priorities.

An example of system design phase is presented in figure 3.9.

#### 3.1.2.4 Object Design Phase

Elaborate the analysis models by expanding high-level operations into available operations. The steps are :

3.1.2.4.1 Obtain operations for the object model from the other models :

- Find an operation for each process in the functional model.
- Define an operation for each event in the dynamic model, depending on the implementation of control.

3.1.2.4.2 Design algorithms that minimize the cost of implementing operations:

- Choose algorithms that minimize the cost of implementing operations.
- Select data structures appropriate to the algorithms.
- Define new internal classes and operations as necessary.
- Assign responsibility for operations that are not clearly associated with a single class.

## System Design of

### Computerized Unit-dose Drug Distribution System

#### Department of Pharmacy Nongbualumphu Hospital

#### 1 Organization of the system.

The system is organized into 7 subsystem :

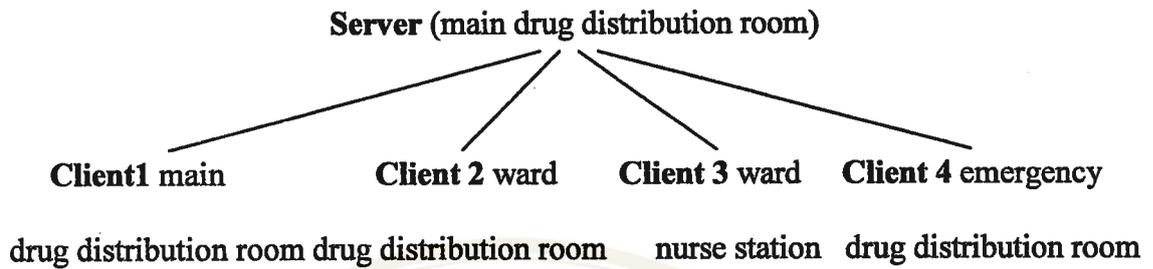
- 1.1 Patient's admission
- 1.2 Patient's medication
- 1.3 Patient's discharge
- 1.4 Auditing medication
- 1.5 Drug inventory
- 1.6 Reporting
- 1.7 Calculating cost and service paying

#### 2 Identification of concurrency inherent in the problem.

Subsystem	Operation time
Patient's admission	Anytime
Patient's medication	08.00am-04.00pm
Patient's discharge	Anytime
Auditing medication	Anytime
Drug inventory	08.00am-04.00pm
Reporting	Anytime
Calculating cost and service paying	08.00am-12.00am

**Figure 3.9** An example of system design phase.

### 3 Allocation of subsystems to processors and tasks.



#### Managing clients and times to operate for each subsystem :

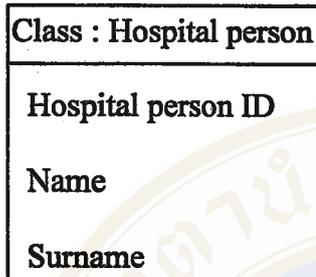
Time	Admission	Medication	Discharge	Auditing	Inventory	Report	Cost
08.00	Client 1	Client 2	Client 3	Client 3			
08.30	Client 1	Client 2	Client 3	Client 3			
09.00	Client 1		Client 3	Client 3	Client 2		
09.30	Client 1		Client 3	Client 3			Client 2
10.00	Client 1		Client 3	Client 2 / 3			
10.30	Client 1		Client 3	Client 3	Client 2		
11.00	Client 1		Client 3	Client 3	Client 2(wk)		
11.30	Client 1		Client 3	Client 3	Client 2(wk)		
12.00	Client 1		Client 3	Client 3			
13.00	Client 1	Client 2	Client 3	Client 3			
13.30	Client 1	Client 2	Client 3	Client 3			
14.00	Client 1		Client 3	Client 3	Client 2		
14.30	Client 1	Client 2	Client 3	Client 3			
15.00	Client 1	Client 2	Client 3	Client 3			
15.30	Client 1	Client 2	Client 3	Client 3			
16.00	Client 1	Client 2	Client 3	Client 3			
16.00 - 08.00	Client 4			Client 3			

Figure 3.9 An example of system design phase.(Continue)

#### 4 Implementation of data stores.

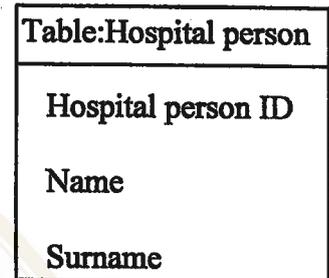
##### Object oriented model

(Rational Rose)



##### Relational model

(SQL Server)



##### DDL generation

(by Rational Rose)

```
CREATE TABLE T_Hospital person(  
    Hospital person ID VARCHAR(),  
    Name VARCHAR(),  
    Surname VARCHAR(),  
    Hospital personId NUMBER(5),  
    PRIMARY KEY(Hospital person ID)).
```

go

Figure 3.9 An example of system design phase.(Continue)

**Object oriented model**

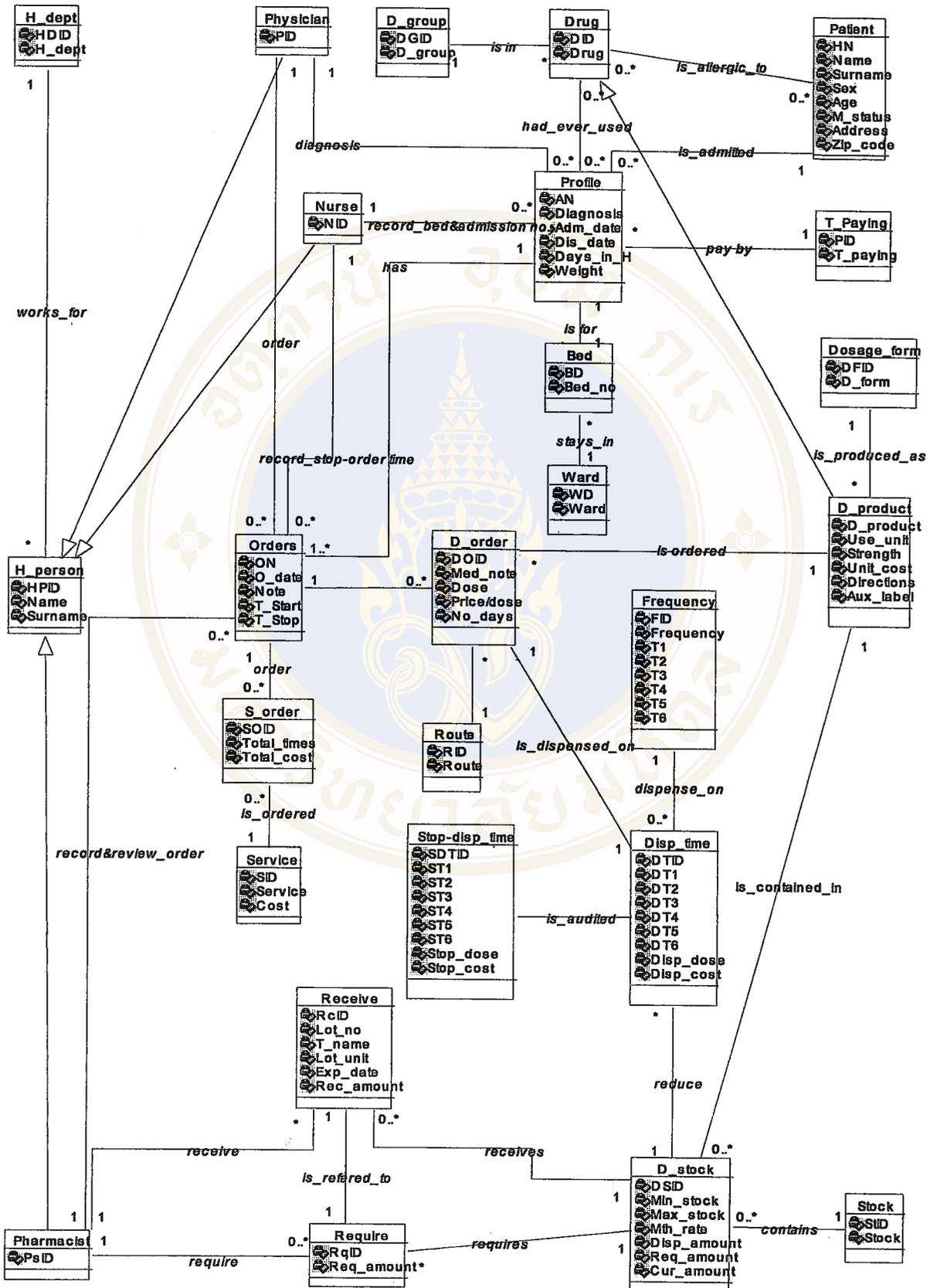


Figure 3.9 An example of system design phase.(Continue)



Physician_V (*)	
T_Physician.PID	VARCHAR()
T_Orders.ON	
T_Profile.AN	
T_H_person.HPID	VARCHAR()
T_H_person.Name	VARCHAR()
T_H_person.Surname	VARCHAR()
T_H_dept.HDID	
<input type="checkbox"/> T_Physician	
<input type="checkbox"/> T_H_person	

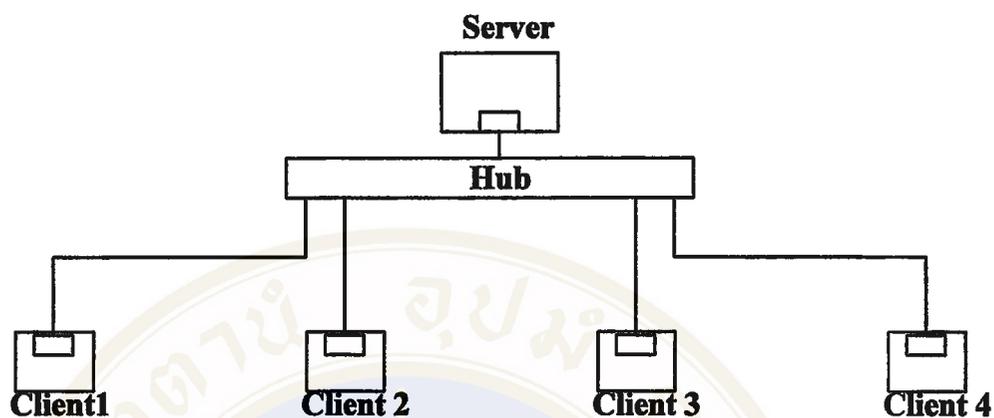
Nurse_V (*)	
T_Nurse.NID	VARCHAR()
T_Orders.ON	
T_Profile.AN	
T_H_person.HPID	VARCHAR()
T_H_person.Name	VARCHAR()
T_H_person.Surname	VARCHAR()
T_H_dept.HDID	
<input type="checkbox"/> T_Nurse	
<input type="checkbox"/> T_H_person	

Pharmacist_V (*)	
T_Pharmacist.PsID	VARCHAR()
T_Receive.RcID	
T_Require.RqID	
T_Orders.ON	
T_Receive.RcID	
T_H_person.HPID	VARCHAR()
T_H_person.Name	VARCHAR()
T_H_person.Surname	VARCHAR()
T_H_dept.HDID	
<input type="checkbox"/> T_Pharmacist	
<input type="checkbox"/> T_H_person	

D_product_V (*)	
T_D_product.D_product	VARCHAR()
T_D_product.Use_unit	VARCHAR()
T_D_product.Strength	VARCHAR()
T_D_product.Unit_cost	VARCHAR()
T_D_product.Directions	VARCHAR()
T_D_product.Aux_label	VARCHAR()
T_Dosage_form.DFID	
T_D_stock.DSID	
T_D_order.DOID	
T_Drug.DID	VARCHAR()
T_Drug.Drug	VARCHAR()
T_D_group.DGID	
T_Patient.HN	
T_Profile.AN	
<input type="checkbox"/> T_D_product	
<input type="checkbox"/> T_Drug	

Figure 3.9 An example of system design phase.(Continue)

### 5 Identification of global resources.



#### 5.1 Computers :

5.1.1 Server : back-end file and database server

5.1.2 Client stations

#### 5.2 LAN cable system :

**10BaseT** : IEEE for Ethernet on UTP

- Media Access Control : CSMA/CD
- 10 Mbps
- baseband
- UTP with Star topology

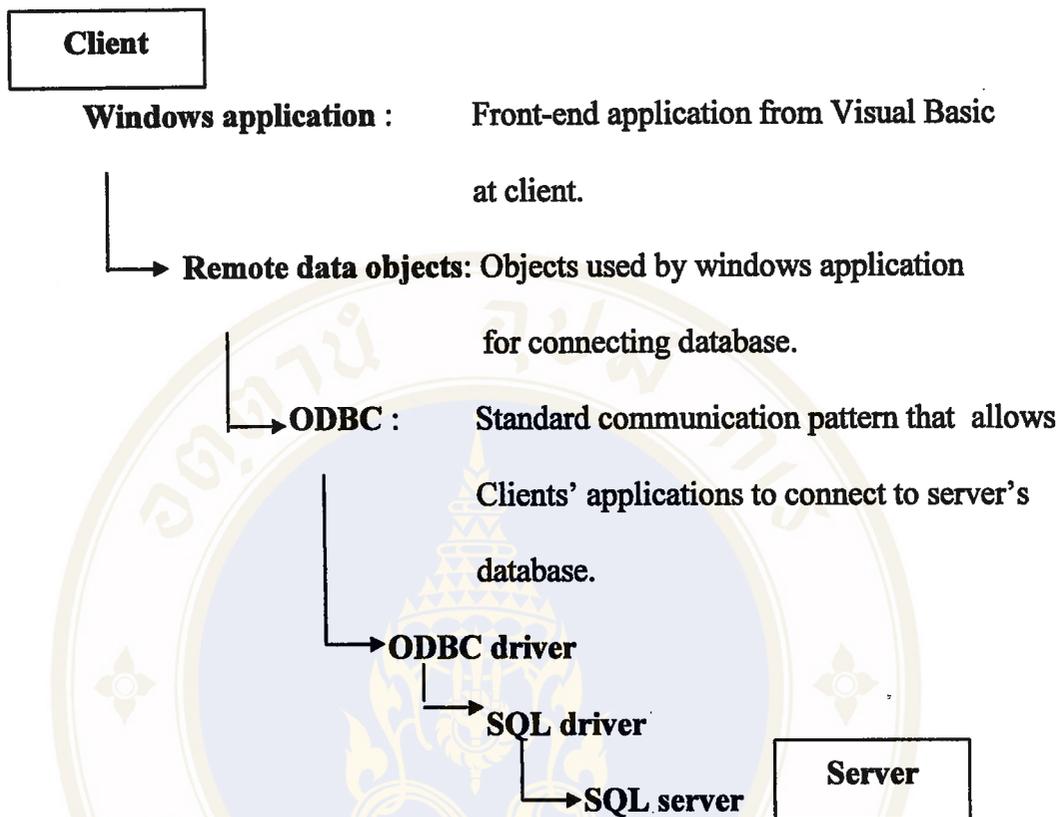
5.2.1 Network adapter card : Ethernet card

5.2.2 Network media : unshielded-twisted pair Category 5  
(22/24 AWG with impedance 100  $\Omega$ .)

5.2.3 Connector : RJ-45

5.2.4 Hub : Ethernet Hub  
(10BaseT Standard Hub)

Figure 3.9 An example of system design phase.(Continue)

**Controlling access from clients to server :****6 Implementation of software control :****6.1 Server software : File and database server**

6.1.1 Network Operating System

6.1.2 Network communication software for standard network protocol

6.1.3 Driver for network adapter card

**6.2 Client software :**

6.2.1 Operating system

6.2.2 Network communication software for standard network protocol

6.2.3 Application Program Interface (API)

6.2.4 Driver for network adapter card

**Figure 3.9** An example of system design phase.(Continue)

**3.1.2.4.3 Optimize access paths to data :**

- Add redundant associations to minimize access cost and maximize convenience.
- Rearrange the computation for greater efficiency.
- Save derived values to avoid re-computation of complicated expressions.

**3.1.2.4.4 Implement software control by fleshing out the approach chosen during system design.**

**3.1.2.4.5 Adjust class structure to increase inheritance :**

- Rearrange and adjust classes and operations to increase inheritance.
- Abstract common behavior out of groups of classes.
- Use delegation to share behavior where inheritance is semantically invalid.

**3.1.2.4.6 Design implementation of associations :**

- Analyze the traversal of associations.
- Implement each association as a distinct object or by adding object-values attributes to one or both classes in the association.

**3.1.2.4.7 Determine the extract representation of object attributes.**

**3.1.2.4.8 Package classes and associations into modules.**

### 3.1.2.5 System Implementation

Map the design into a particular language. Coding should be a localized process, as all the global design decisions should have been made already. During this stage many additional "junk methods" are added for convenience and information hiding: methods to encapsulate attribute access, traverse associations, construct objects, and provide convenient calls to more basic operations. It is usually best to omit these operations from the design model as they are easily generated automatically or programmed mechanically.

### 3.1.3 System testing

Once the application program for the new system has been developed, the student will test the program in 4 steps :

3.1.3.1 Unit test : The student will test each unit or group of the program as implemented in source code.

3.1.3.2 Integration test : The student will test the program by Focusing on design and construction of the software architecture.

3.1.3.3 Validation test : The student will test the program by validating requirements against the software.

3.1.3.4 System test : The student will test the program and other system as a whole.

### **3.1.4 System conversion**

#### **3.1.4.1 System manual & form documenting**

Once the application has been designed, the student will prepare to create manual for using the application, including all forms that will be used in the developed system.

#### **3.1.4.2 User training**

The new unit-dose drug distribution system, including its computerized application, will be introduced to all users to prepare for using, especially medical persons in department of pharmacy and nurse. The student will describe changes and operations of the new system in details, including computer system involved, to those users.

#### **3.1.4.3 Data input**

Before using the computerized application of the new unit-dose drug distribution system, basic data of the application, for example, names of medical persons, pharmacological data of drugs, will be input to the application.

#### **3.1.4.4 System conversion**

The student will set a plan for system conversion. This plan must be approved by physicians, nurses and pharmacists. After that, begin using the developed application program for duration 1 month.

### 3.1.5 Research conclusion and recommendation

Once the developed application program has been used, The student will summarize the research and recommend for advantages and disadvantages of the developed system.

### 3.1.6 Write up the thesis and system manual

## 3.2 Tools used for Research :

### 3.2.1 Hardware

#### 3.2.1.1 File Server

(with main memory not less than 32 Mbytes)

#### 3.2.1.2 Work Stations

(with main memory not less than 16 Mbytes)

#### 3.2.1.3 Equipment for Network Connectivity

### 3.2.2 Software

**Table 3.1** Software used for the study of analysis and design of computerized unit-dose drug distribution system.

Software	Function
Rational Rose	Object representation
Microsoft SQL Server	Relational representation
Microsoft Windows NT	Network operating system
Microsoft Visual Basic	User-interface application

## CHAPTER 4

### RESULTS

#### 4.1 System Analysis, design & implementation

By using the Object Modeling Technique(OMT) , a design and development of computerized unit-dose drug distribution system is as follows :

##### 4.1.1 Conceptualization

A user's view of a computerized unit-dose drug distribution system is captured by 'Use Case', which is presented in figure 4.1

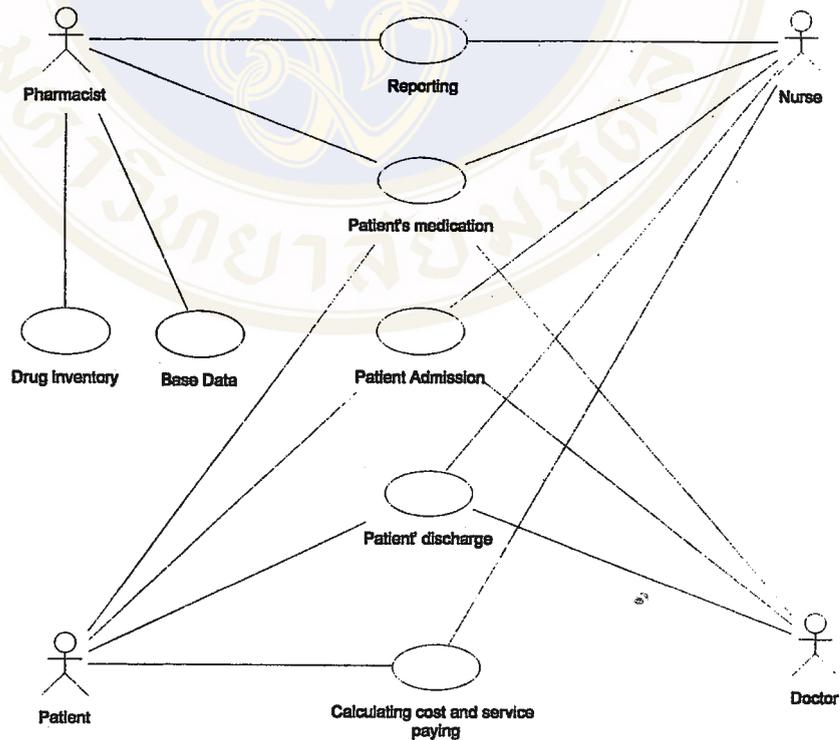
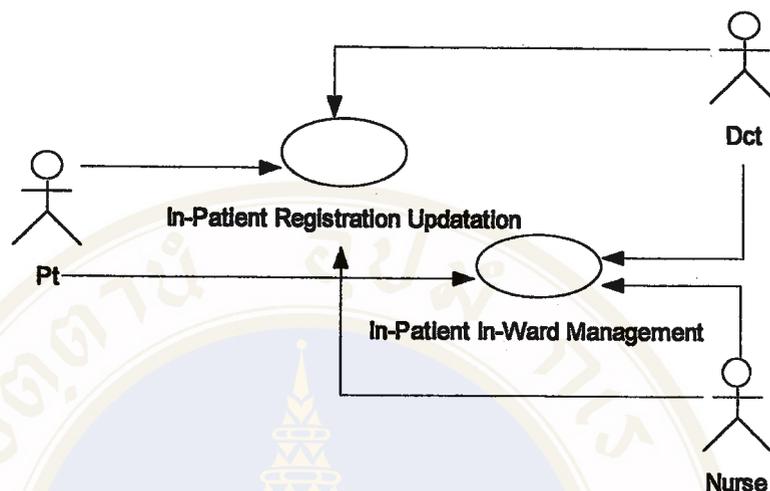


Figure 4.1 A use case of a computerized unit-dose drug distribution system

From figure 4.1

#### 4.1.1.1 Sub-system 1 : Patient's admission



**Figure 4.2** A use case of a computerized unit-dose drug distribution for sub-system 1 : Patient's admission

##### 4.1.1.1.1 sub-system 1.1 : In-Patient's registration updatation

- boundary : Updating patient's registration data, and sending back to be stored in Unit-Dose database.
- actors : Patient, Doctor, Nurse
- The use of system for each actor
  - a. Patient : is admitted to be an in-patient of the hospital.

- b. Doctor : diagnoses patient.
- c. Nurse : operates patient's admission.
- Initial event

A patient is taken to the hospital and is diagnosed by doctor to be stayed in the hospital.

- Termination condition

A patient is registered as an in-patient and is updated in-patient's data.

- The typical transaction

- a. New in-patient is registered for hospital number and admission number at admission center.
- b. Patient is diagnosed by doctor and is admitted to ward by nurse.
- c. New in-patient's data is updated at nurse-station's client in patient's ward. After that updated data is sent back to be stored in unit-dose database in the another server.

- Variations

If a patient has already a hospital number, he is not necessary registered for a new hospital number.

#### 4.1.1.1.2 sub-system 1.2 : In-Patient's in-ward management

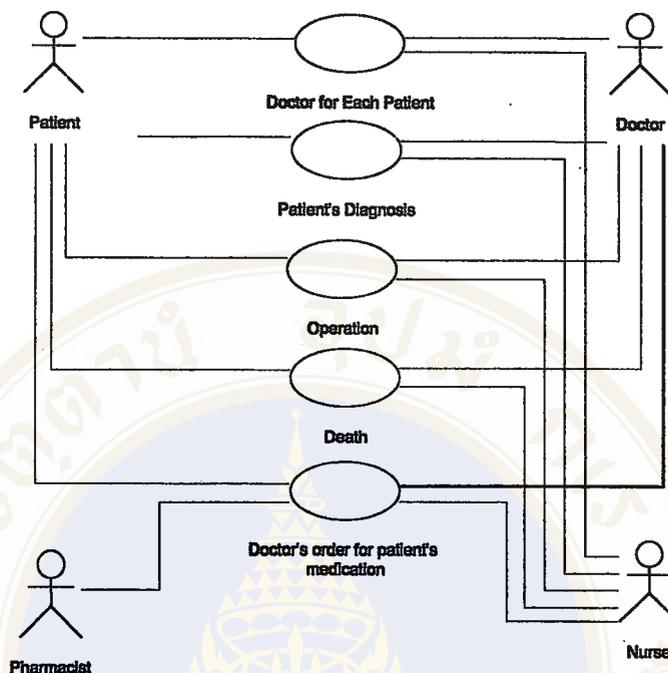
- boundary : Managing an in-patient to stay in a patient's bed in a patient's ward.
- actors : patient, nurse
- The use of system for each actor
  - a. Patient : is managed to stay in a patient's bed.
  - b. Nurse : manages a patient's bed.
- Initial event

An in-patient is taken to a patient's ward.
- Termination condition

A patient is taken to stay in a bed in patient's ward.
- The typical transaction
  - a. Nurse at nurse-station's client searches for free-patient's bed and choose it for new in-patient.
  - b. Nurse at nurse-station's client searches for in-patient's registration data by using patient's data about hospital number, admission number or name, and retrieves data from unit-dose database.
  - c. Nurse inputs details about in-patient's admission in ward and send it back to be stored as in-patient admission data in unit-dose database.
- Variations

An in-patient may be moved to another bed as required by a nurse or a doctor for suitable reason.

4.1.1.2 Sub-system 2 : Patient's medication



**Figure 4.3** A use case of a computerized unit-dose drug distribution system for sub-system 2 : Patient's medication

4.1.1.2.1 Sub-system 2.1 : Doctor for each in-patient

- boundary

Gathering details about a doctor and an in-patient in his responsibility.

- Actors

Patient, doctor, nurse

- The use of system for each actor

a. An in-patient is cured by doctor.

b. A doctor cures an in-patient.

c. A nurse gathers details about curing each in-patient by doctors.

- Initial event

A doctor diagnoses an in-patient.

- Termination condition

A patient's doctor data is recorded by a nurse.

- The typical transaction

- a. nurse retrieves in-patient's data.

- b. Nurse inputs doctor's data for each in-patient.

- Variations

- The exceptions

#### 4.1.1.2.2 Sub-system 2.2 : Patient's diagnosis

- boundary

Gathering details about a doctor and his diagnosis for an in-patient in his responsibility.

- Actors

Patient, doctor, nurse

- The use of system for each actor

- a. An in-patient is diagnosed by doctor.

- b. A doctor diagnoses an in-patient.

- c. A nurse gathers details about diagnosis each

in-patient by doctors.

- Initial event

An in-patient is diagnosed by doctor.

- Termination condition

A diagnostic result is recorded by a nurse.

- The typical transaction

a. Nurse retrieves in-patient's data.

b. Nurse inputs diagnostic data about doctor,

ICD10 and specialty.

- Variations
- The exceptions

#### 4.1.1.2.3 sub-system 2.3 : Patient's operation

- boundary

Gathering details about a doctor and his operation for an in-patient in his responsibility.

- Actors

Patient, doctor, nurse

- The use of system for each actor

a. An in-patient is operated by doctor.

b. A doctor operates an in-patient.

c. A nurse gathers details about an operation for each in-patient by doctors.

- Initial event

An in-patient is operated by doctor.

- Termination condition

An operation data is recorded by a nurse.

- The typical transaction
  - a. Nurse retrieves in-patient's data.
  - b. Nurse inputs operation data about date, time, doctor and ICD9CM.

- Variations
- The exceptions

#### 4.1.1.2.4 Sub-system 2.4 : Patient's death

- boundary

Gathering details about a doctor and his diagnosis for death of an in-patient in his responsibility.

- Actors

Patient, doctor, nurse

- The use of system for each actor
  - a. A dead in-patient is diagnosed by doctor.
  - b. A doctor diagnoses a dead in-patient.
  - c. A nurse gathers details about diagnosis for a death of each in-patient by doctors.

- Initial event

A dead in-patient is diagnosed by doctor.

- Termination condition

Diagnosis of a dead in-patient data is recorded by a nurse.

- The typical transaction

- a. Nurse retrieves in-patient's data.

b. Nurse inputs death-diagnostic data about ICD10 and specialty.

- Variations
- The exceptions

4.1.1.2.5 sub-system 2.5 : Doctor's orders for patient's medication

- boundary

Gathering details about a doctor and his diagnosis for death of an in-patient in his responsibility.

- Actors

Patient, doctor, nurse

- The use of system for each actor

a. An in-patient is ordered for drug and service medication by doctor.

b. A doctor orders drugs and services medication.

c. A pharmacist / nurse gathers details about drug and service medication of each in-patient by doctors.

- Initial event

An in-patient is ordered for medication by doctor.

- Termination condition

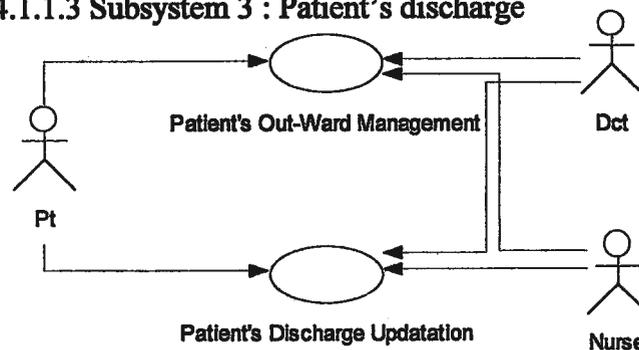
Medication is recorded by a pharmacist / nurse.

- The typical transaction
  - a. Nurse / Pharmacist retrieves in-patient's data.
  - b. Nurse / Pharmacist inputs details about doctor's order for patient's medication.
  - c. Nurse / Pharmacist chooses doctor's order type : Order for drugs is recorded by a pharmacist.(Pharmacist chooses drug's order type : Order for one day, Order for continuous, Order for home medication), Order for other services is recorded by a nurse.
  - d. Nurse / Pharmacist records doctor's order for each in-patient.
- Variations

Order for drugs, which is recorded by a pharmacist, must be approved by another pharmacist.

- The exceptions

#### 4.1.1.3 Subsystem 3 : Patient's discharge



**Figure 4.4** A use case of a computerized unit-dose drug distribution system for sub-system 3 : Patient's discharge

#### 4.1.1.3.1 Sub-system 3.1 : Patient's out-ward management

- boundary

Managing an in-patient to be moved out of an old patient's bed in a patient's ward.

- actors

patient, nurse

- The use of system for each actor

- a. Patient : is managed to be moved out of an old patient's bed.

- b. Nurse : manages a movement of a patient from an old bed.

- Initial event

An in-patient is determined to be moved from an old patient's bed.

- Termination condition

An in-patient is moved out of an old bed in patient's ward.

- The typical transaction

- a. Nurse retrieves in-ward in-patient's data.

- b. Nurse updates in-ward in-patient's data about date and time in-patient is taken out of ward.

- Variations

- The exceptions

## 4.1.1.3.2 Sub-system 3.2 : Patient's discharge updation

- boundary

Retrieving patient's discharge data from Stat-2 database , updating and sending back to be stored in unit-dose database.

- actors

Patient, Doctor, Nurse

- The use of system for each actor

a. Patient : is discharged from the hospital.

b. Doctor : discharges patient.

c. Nurse : operates patient's discharge.

- Initial event

A patient is diagnosed by doctor to be discharged from the hospital.

- Termination condition

A patient is discharge-registered from the hospital and is updated in-patient's data.

- The typical transaction

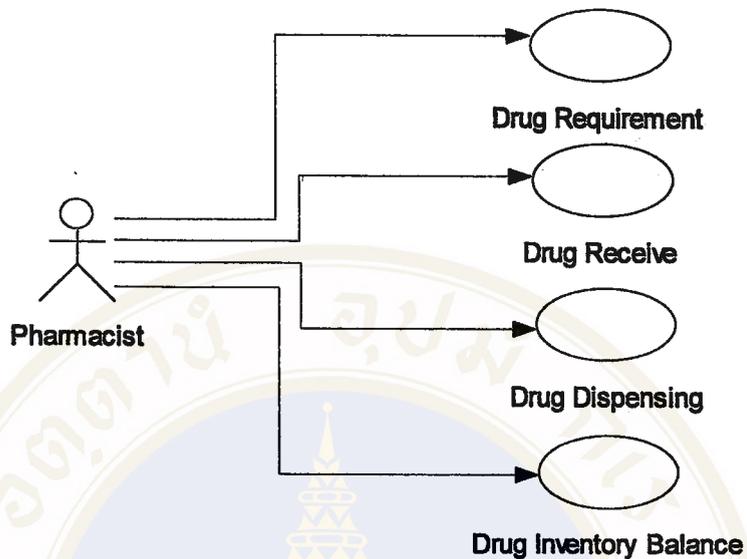
a. Nurse retrieves in-ward in-patient's data.

b. Nurse updates in-patient's registration data about date and time in-patient is discharged from hospital.

- Variations

- The exceptions

#### 4.1.1.4 Sub-system 4 : Drug inventory



**Figure 4.5** A use case of a computerized unit-dose drug distribution system for sub-system 4 : Drug Inventory

##### 4.1.1.4.1 Sub-system 4.1 : Drug requirement

###### - Boundary

Creating a drug requirement note and sending to main stock for drug requirement of a unit-dose sub-stock.

###### - Actors

Pharmacist

###### - The use of system for each actor

A pharmacist generates a drug requirement note by using an inventory data of a unit-dose sub-stock.

###### - Initial event

A pharmacist searches for a drug which is required for a unit-dose sub-stock.

- Termination condition

A drug requirement note is sent to main stock.

- The typical transaction

a. Pharmacist searches for required drugs by using report of inventory drug with quantity on hand is lower than minimum level.

b. Pharmacist inputs details about required drug note and required drugs.

c. Pharmacist prints required drug note and sends to main stock.

- Variations

- The exceptions

#### 4.1.1.4.2 Sub-system 4.2 : Drug receive

- Boundary

Receive drugs following a receiving note from main stock, refer to a drug requirement note and keeping those drugs in a unit-dose sub-stock. Including updating an inventory data of a unit-dose sub-stock.

- Actors

Pharmacist

- The use of system for each actor

A pharmacist receives required drugs from main stock, generates a drug receiving note refer to a drug

requirement note, updates an inventory data, and keeps those receiving drugs in a unit-dose sub-stock.

- Initial event

A pharmacist receives required drugs from main stock.

- Termination condition

A pharmacist keep received drugs in a unit-dose sub-stock.

- The typical transaction

- a. Pharmacist receives drugs and required drug note from main stock

- b. Pharmacist inputs details about required drug note and required drugs in received drug note.

- c. Pharmacist updates inventory data.

- d. Pharmacist prints received drug note for keeping received drugs in unit-dose sub-stock.

- Variations

- The exceptions

#### 4.1.1.4.3 Sub-system 4.3 : Drug dispensing

- Boundary

Creating drug dispensing note (following a doctor's order by drugs for each in-patient), getting

those drugs out of a unit-dose sub-stock. Including updating an inventory data of a unit-dose sub-stock.

- Actors

Pharmacist, nurse

- The use of system for each actor

A nurse confirms a doctor's order for drugs, which is recorded by a pharmacist.

- Initial event

A nurse retrieves data about a doctor's order for drugs.

- Termination condition

A nurse confirms those data about a doctor's order for drugs.

- The typical transaction

After details of doctor's order for drugs is confirmed by nurse, a drug dispensing note is generated and an inventory data about dispensed drugs are updated automatically.

- Variations

- The exceptions

#### 4.1.1.4.4 Sub-system 4.4 : Drug inventory balance

- Boundary

Creating a drug balance note for updating an inventory data of a unit-dose sub-stock.

- Actors

Pharmacist

- The use of system for each actor

A pharmacist generates a drug balance note by using an inventory data of a unit-dose sub-stock.

- Initial event

A pharmacist searches for a drug which is imbalance with an inventory data of a unit-dose sub-stock.

- Termination condition

A drug balance note is generated.

- The typical transaction

a. Pharmacist searches for imbalance data between real drug stock and inventory unit-dose sub-stock data .

b. Pharmacist inputs details to update inventory data to be a real drug stock.

- Variations

- The exceptions

#### 4.1.1.5 Sub-system 5 : Reporting

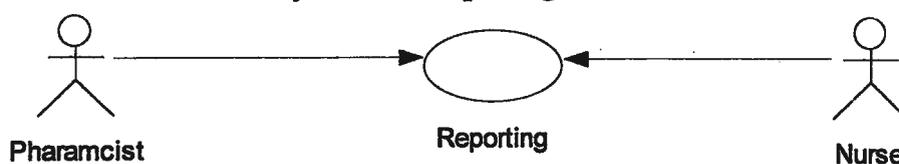


Figure 4.6 A use case of a computerized unit-dose drug distribution system for sub-system 5 :Report

- boundary

Generating a required report following a given parameter.

- Actors

Nurse, pharmacist

- The use of system for each actor

Nurse / pharmacist inputs a parameter to generate a required report.

- Initial event

Nurse / pharmacist inputs a parameter.

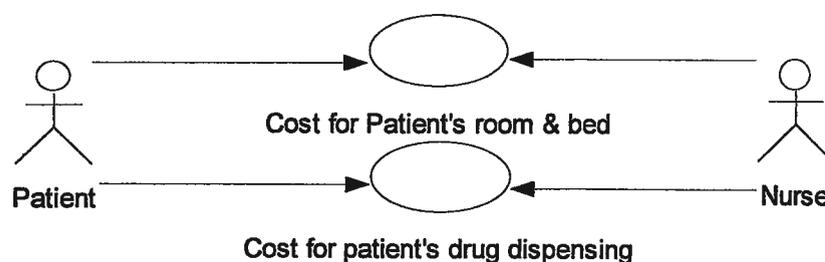
- Termination condition

A required report is generated.

- The typical transaction

- Nurse / Pharmacist choose required type of reports.
- Nurse / Pharmacist inputs details about required reports to be displayed.
- Nurse / Pharmacist views desired reports and prints .

#### 4.1.1.6 Sub-system 6 : Calculating Cost



**Figure 4.7** A use case of a computerized unit-dose drug distribution system for sub-system 6 : Calculating Cost

4.1.1.6.1 Sub-system 6.1 : Cost for Patient's room & bed

- Boundary

Creating a cost note for patient's room and bed.

- Actors

Nurse, patient

- The use of system for each actor

a. A nurse generates a cost note for patient's room and bed.

b. A patient receives that cost note and uses it for paying.

- Initial event

An in-patient is moved from his old bed.

- Termination condition

An in-patient receives a cost note for patient's room and bed.

- The typical transaction

a. Nurse generates cost note.

b. Nurse retrieves about in-ward in-patient data.

c. Nurse updates in-ward in-patient's data with cost note.

d. Nurse views or prints cost note (as require).

e. Nurse gives that note to an in-patient.

## 4.1.1.6.2 Sub-system 6.2 : Cost for patient's drug dispensing

- Boundary

Creating a cost note for patient's drug dispensing.

- Actors

Nurse, patient

- The use of system for each actor

- a. A nurse generates a cost note for patient's drug dispensing.

- b. A patient receives cost note and pay for it.

- Initial event

An in-patient is receiving drugs following a doctor's order.

- Termination condition

An in-patient receives a cost note for patient's drug dispensing.

- The typical transaction

- a. Nurse generates cost note.

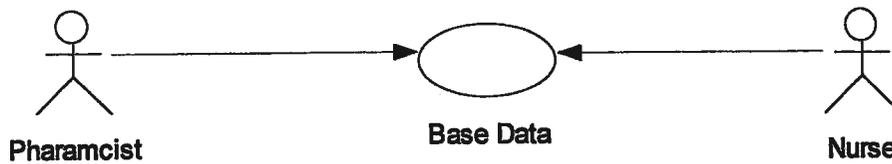
- b. Nurse retrieves about doctor's order for in-patient's medication.

- c. Nurse updates doctor's order for in-patient's medication with cost note.

- d. Nurse views or prints cost note (as require).

- e. Nurse gives that note to an in-patient.

#### 4.1.1.7 Sub-system 7 : Base data



**Figure 4.8** A use case of a computerized unit-dose drug distribution system for sub-system 7 : Base Data

- **boundary**

Creating base data for a computerized unit dose drug distribution system.

- **Actors**

Nurse, pharmacist

- **The use of system for each actor**

Nurse / pharmacist generates base data which is necessary for a computerized unit dose drug distribution system.

- **Initial event**

Nurse / pharmacist cannot find required base data

- **Termination condition**

Required base data is generated.

- **The typical transaction**

- a. Nurse / pharmacist searches for required base data but cannot find.

- b. Nurse / pharmacist generates required base data.

### 4.1.2 Object Analysis Phase

This phase describes the external behavior of a system by using OMT models, which are created from use-case in the previous phase.

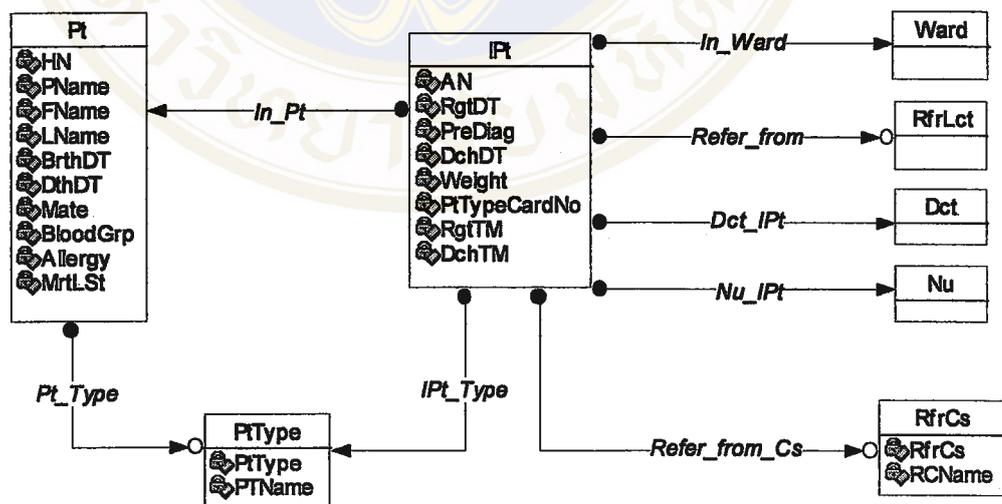
#### 4.1.2.1 Object Model

##### 4.1.2.1.1 Class diagram

Class diagrams contain icons representing classes. These diagrams show the relationship between classes, association, inheritance of classes. Each class diagram provides a logical view of the model, displaying icons representing logical packages, classes, and relationships contained in the model.

Sub-system 1 : Patient's admission

- Sub-system 1.1 : Patient's registration updation



**Figure 4.9** A class diagram of a computerized unit-dose drug distribution system for sub-system 1.1 : Patient's registration updation

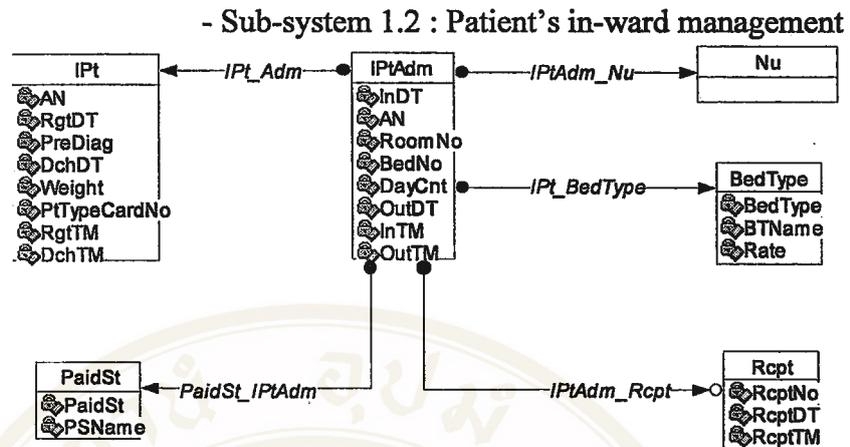


Figure 4.10 A class diagram of a computerized unit-dose drug distribution system for sub-system 1.2 : Patient's in-ward management

Sub-system 2 : Patient's medication

- Sub-system 2.1 : Doctor for each in-patient

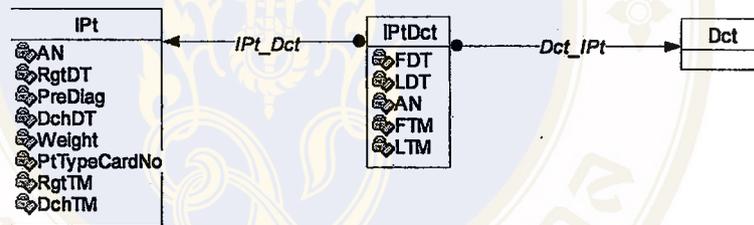


Figure 4.11 A class diagram of a computerized unit-dose drug distribution system for sub-system 2.1 : Patient's medication

- Sub-system 2.2 : Patient's diagnosis

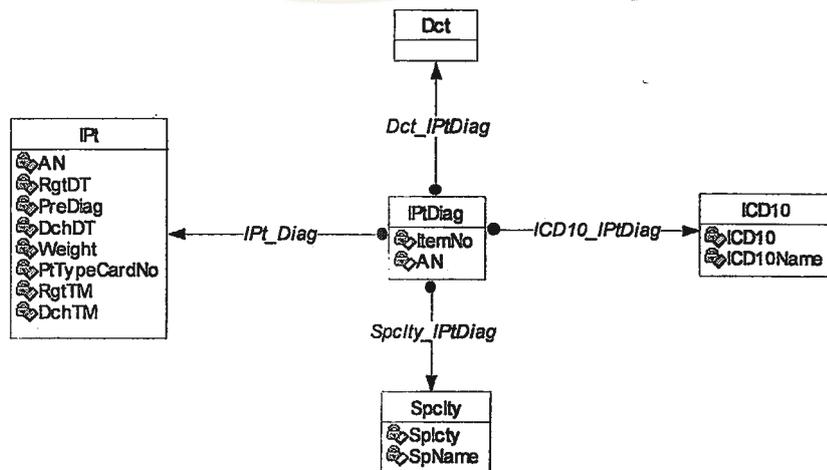


Figure 4.12 A class diagram of a computerized unit-dose drug distribution system for sub-system 2.2 : Patient's diagnosis

- Sub-system 2.3 : Patient's operation

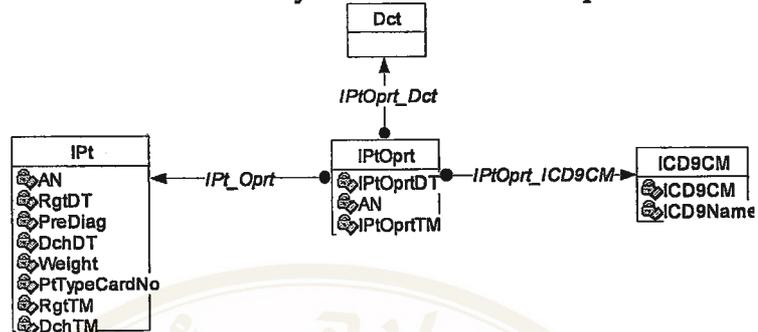


Figure 4.13 A class diagram of a computerized unit-dose drug distribution system for sub-system 2.3 : Patient's operation

- Sub-system 2.4 : Patient's death

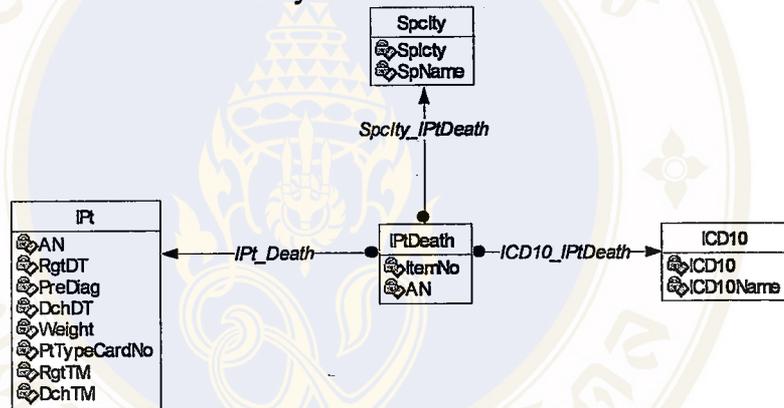


Figure 4.14 A class diagram of a computerized unit-dose drug distribution system for sub-system 2.3 : Patient's death

- Sub-system 2.5: Doctor's orders for patient's medication

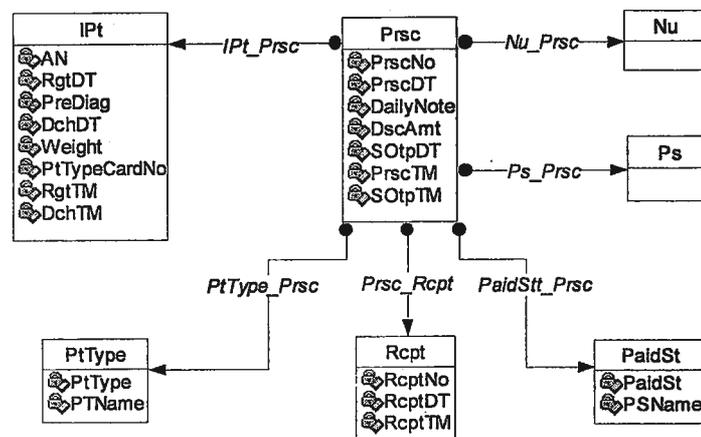


Figure 4.15 A class diagram of a computerized unit-dose drug distribution system for sub-system 2.5 : Doctor's orders for patient's medication : Prescription

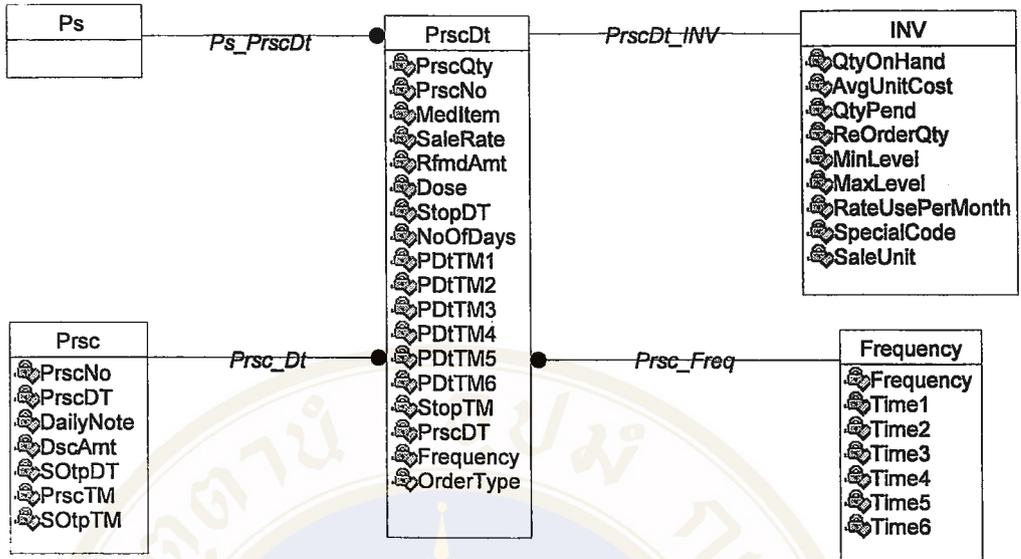


Figure 4.16 A class diagram of a computerized unit-dose drug distribution system for sub-system 2.5 : Doctor’s orders for patient’s medication : Order for Drugs and Services

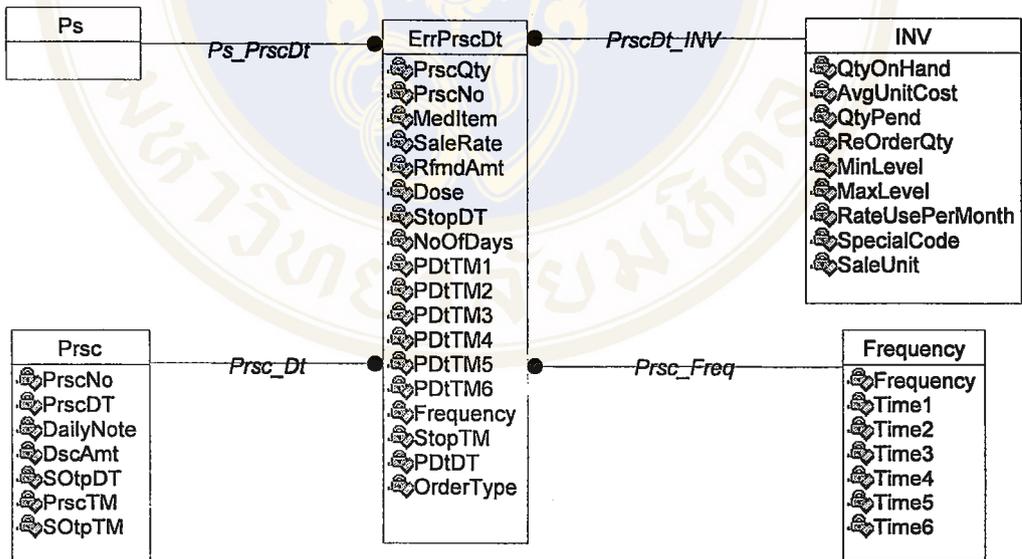


Figure 4.17 A class diagram of a computerized unit-dose drug distribution system for sub-system 2.5 : Doctor’s orders for patient’s medication : Order for Drugs with Errors

Subsystem 3 : Patient's discharge

- Sub-system 3.1 : Patient's out-ward management
- Sub-system 3.2 : Patient's discharge updation

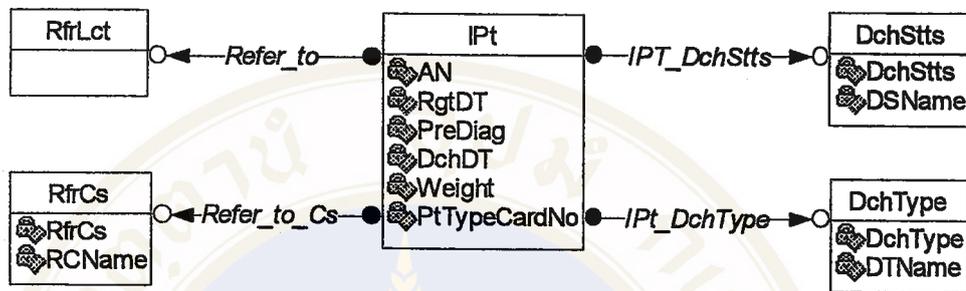


Figure 4.18 A class diagram of a computerized unit-dose drug distribution system for sub-system 3.2 : Patient's discharge updation

Sub-system 4 : Drug inventory

- Sub-system 4.1 : Drug requirement

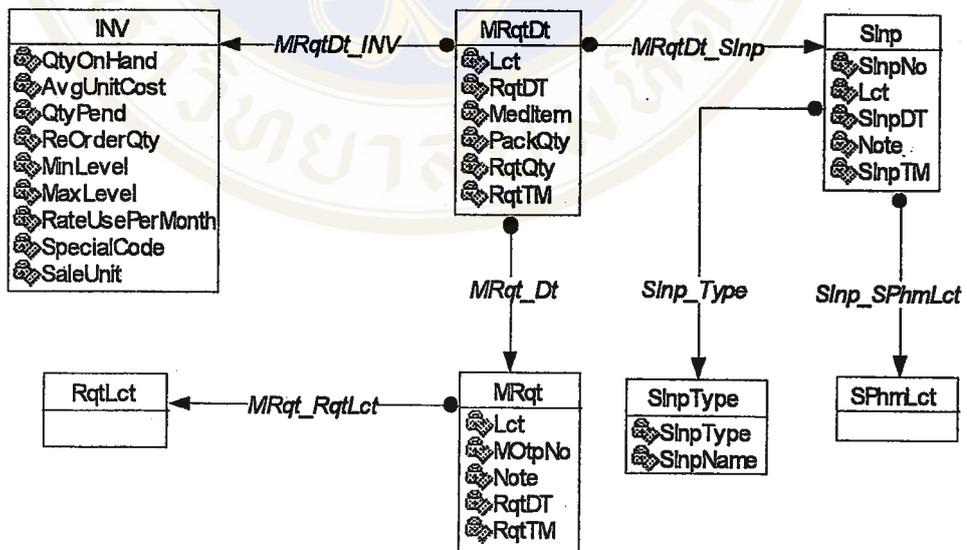


Figure 4.19 A class diagram of a computerized unit-dose drug distribution system for sub-system 4.1 : Drug requirement

- Sub-system 4.2 : Drug received for unit-dose sub-

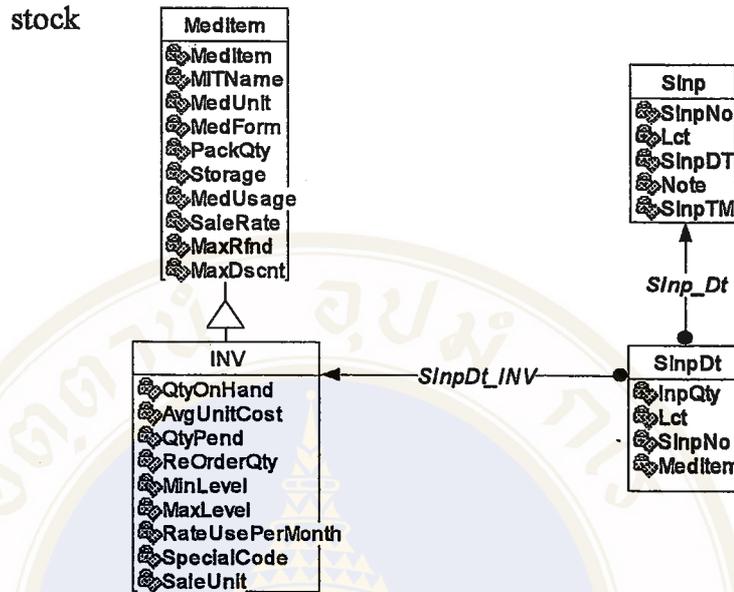


Figure 4.20 A class diagram of a computerized unit-dose drug distribution system for sub-system 4.2 : Drug received for unit-dose sub-stock

- Sub-system 4.3 : Drug dispensing

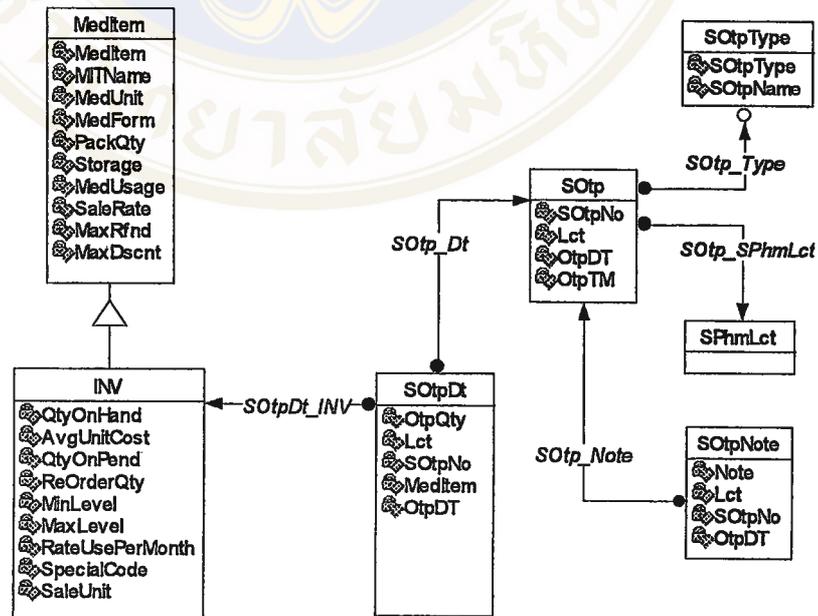


Figure 4.21 A class diagram of a computerized unit-dose drug distribution system for sub-system 4.3 : Drug dispensing

Sub-system 5 : Report

- Sub-system 5.1 : Patient report

- Sub-system 5.2 : Drug dispensing report

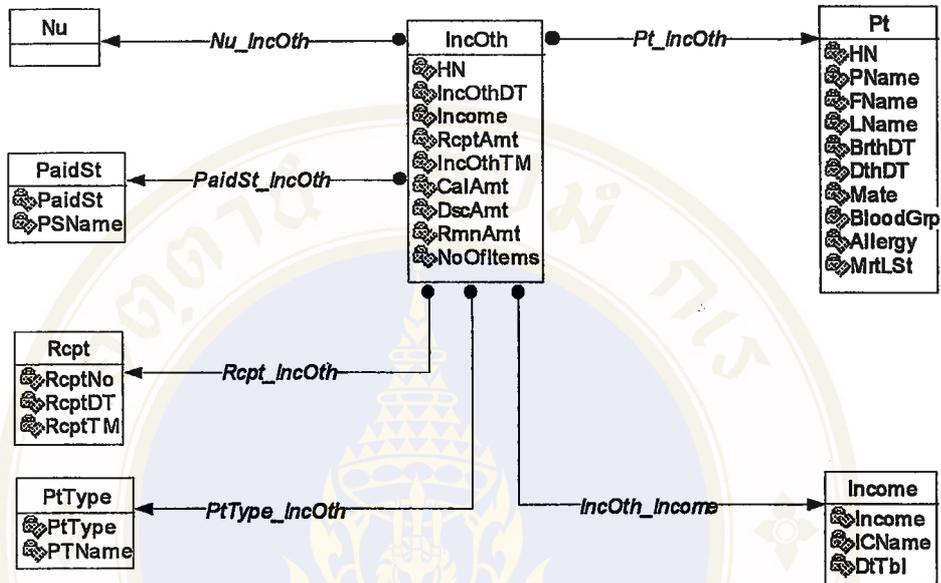


Figure 4.22 A class diagram of a computerized unit-dose drug distribution system for sub-system 5.1.6 : Value of Patient's Medication

Sub-system 6 : Cost

- Sub-system 6.1 : Cost for Patient's room & bed

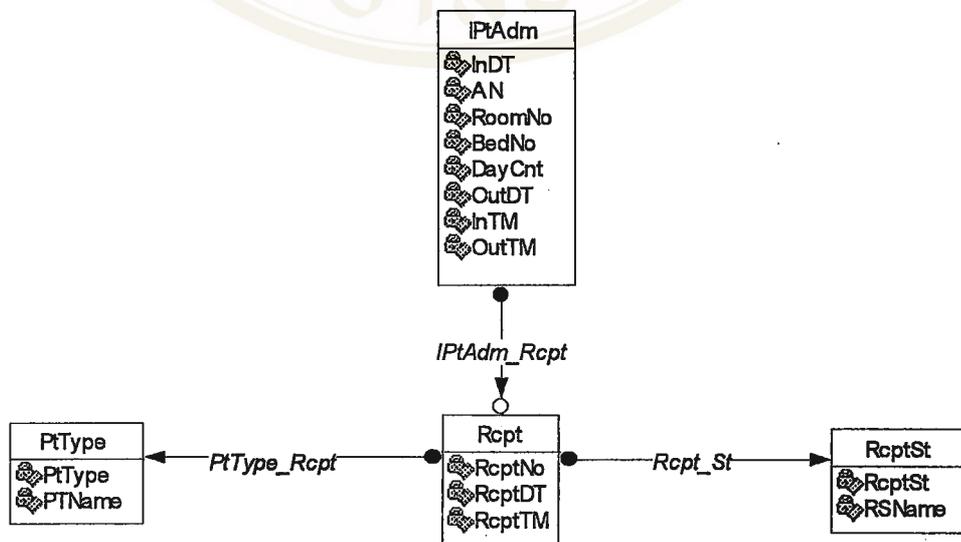


Figure 4.23 A class diagram of a computerized unit-dose drug distribution system for sub-system 6.1 : Cost for Patient's room & bed

- Sub-system 6.2 : Cost for patient's drug dispensing

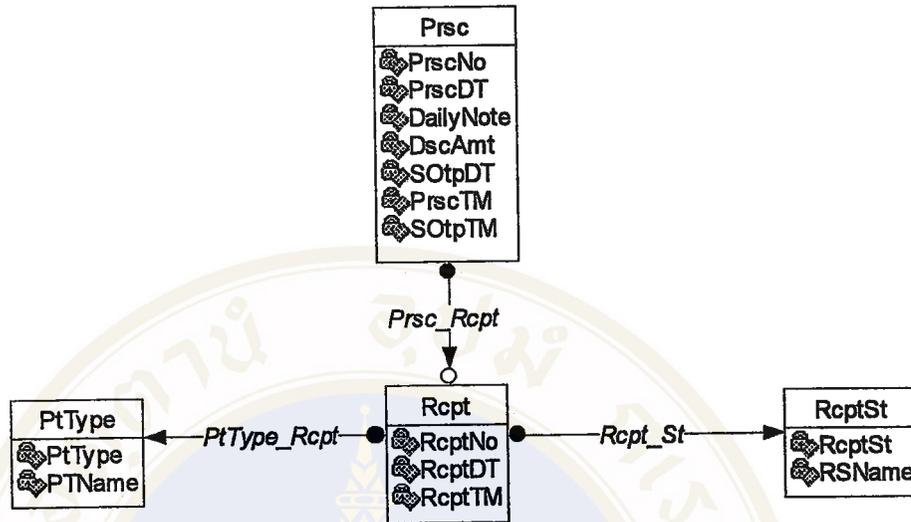


Figure 4.24 A class diagram of a computerized unit-dose drug distribution system for sub-system 6.2 : Cost for patient's drug dispensing

Sub-system 7 : Base data

- Sub-system 7.1 : Personal data

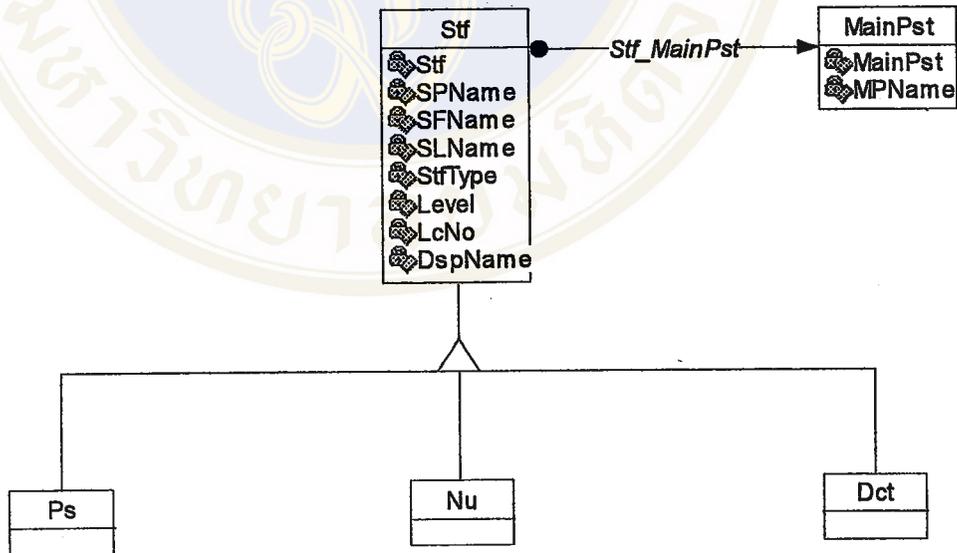


Figure 4.25 A class diagram of a computerized unit-dose drug distribution system for sub-system 7.1 : Personal data

- Sub-system 7.2 : Department data

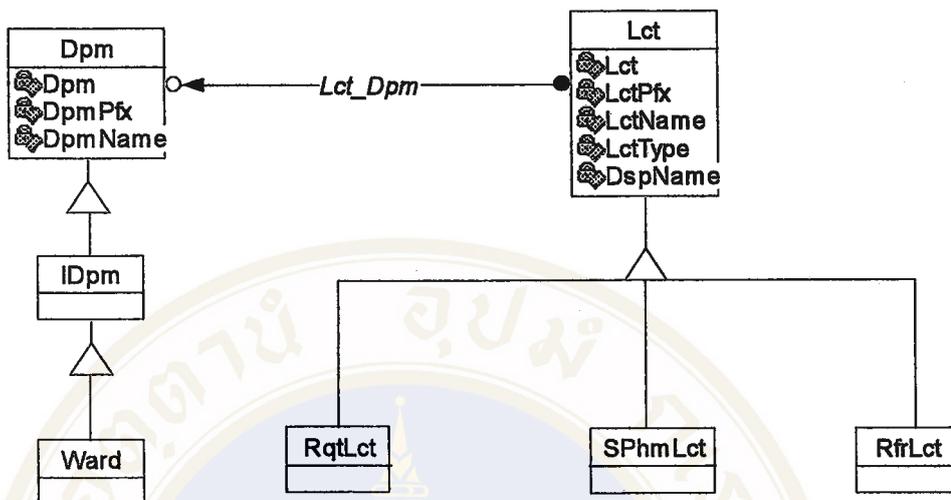


Figure 4.26 A class diagram of a computerized unit-dose drug distribution system for sub-system 7.2 : Department data

- Sub-system 7.3 : Diagnostic data

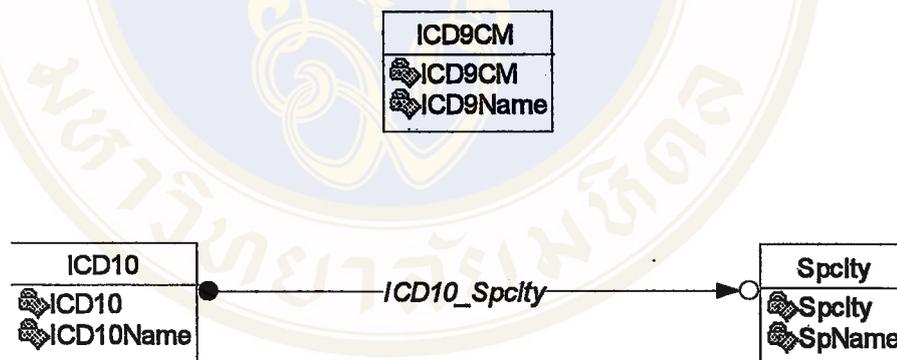


Figure 4.27 A class diagram of a computerized unit-dose drug distribution system for sub-system 7.3 : Diagnostic data

- Sub-system 7.4 : Discharge data



Figure 4.28 A class diagram of a computerized unit-dose drug distribution system for sub-system 7.4 : Discharge data

- Sub-system 7.5 : Payment data

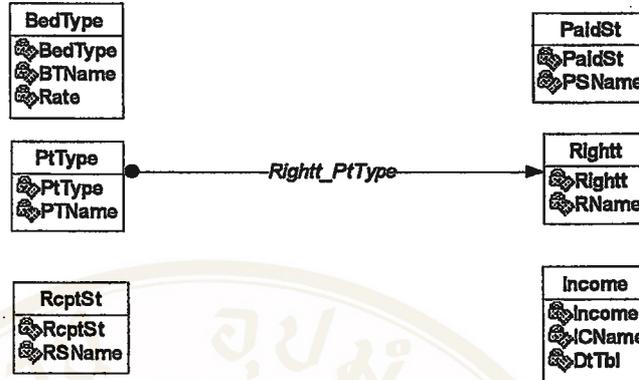


Figure 4.29 A class diagram of a computerized unit-dose drug distribution system for sub-system 7.5 : Payment data

- Sub-system 7.6 : Dispensing data

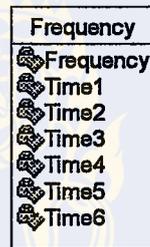


Figure 4.30 A class diagram of a computerized unit-dose drug distribution system for sub-system 7.6 : Dispensing data

- Sub-system 7.7 : Drug data

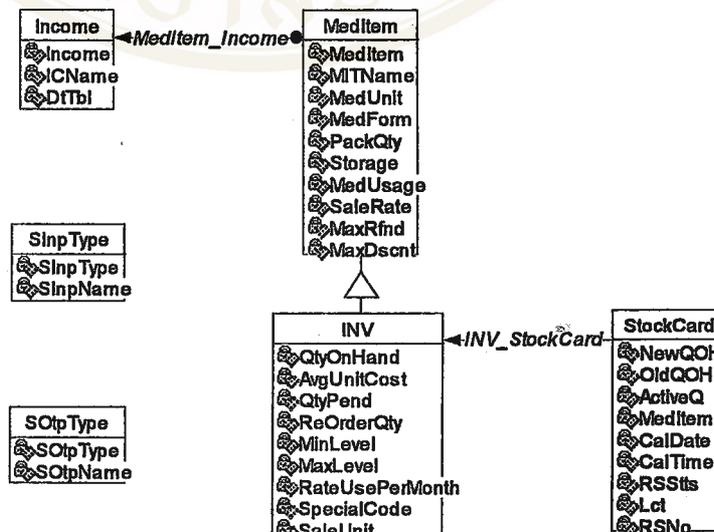


Figure 4.31 A class diagram of a computerized unit-dose drug distribution system for sub-system 7.7 : Drug data

## 4.1.2.1.2 Data Dictionary

A data dictionary contains descriptions of classes attributes and associations.

<i>Logical view</i>	<b>ICD10</b>	<b>DchType</b>
<b>Ward</b>	<b>Private Properties:</b>	<b>Private Properties:</b>
<b>Derived from IDpm</b>	ICD10 :	DchType :
<b>IDpm</b>	ICD10Name :	DTName :
<b>Derived from Dpm</b>	<b>Spclty</b>	<b>PtType</b>
<b>RfrLct</b>	<b>Private Properties:</b>	<b>Private Properties:</b>
<b>Derived from Lct</b>	Spclty :	PtType :
<b>SPhmLct</b>	SpName :	PTName :
<b>Derived from Lct</b>	<b>RfrCs</b>	<b>Rightt</b>
<b>RqtLct</b>	<b>Private Properties:</b>	<b>Private Properties:</b>
<b>Derived from Lct</b>	RfrCs :	Rightt :
	RCName :	RName :
<b>ICD9CM</b>	<b>DchStts</b>	<b>BedType</b>
<b>Private Properties:</b>	<b>Private Properties:</b>	<b>Private Properties:</b>
ICD9CM :	DchStts :	BedType :
ICD9Name :	DSName :	BTName :
		Rate :

Figure 4.32 A data dictionary of a class diagram of a computerized unit-dose drug distribution system

<b>PaidSt</b>	<b>MedItem</b>	<b>Income :</b>
<b>Private Properties:</b>	<b>Private Properties:</b>	<b>ICName :</b>
<b>PaidSt :</b>	<b>MedItem :</b>	<b>DtTbl :</b>
<b>PSName :</b>	<b>MITName :</b>	<b>INV Derived from</b>
<b>RcptSt</b>	<b>MedUnit :</b>	<b>MedItem</b>
<b>Private Properties:</b>	<b>MedForm :</b>	<b>Private Properties:</b>
<b>RcptSt :</b>	<b>PackQty :</b>	<b>QtyOnHand :</b>
<b>RSName :</b>	<b>Storage :</b>	<b>AvgUnitCost :</b>
<b>Income</b>	<b>MedUsage :</b>	<b>QtyPend :</b>
<b>Private Properties:</b>	<b>SaleRate :</b>	<b>ReOrderQty :</b>
<b>Income :</b>	<b>MaxRfnd :</b>	<b>MinLevel :</b>
<b>ICName :</b>	<b>MaxDscnt :</b>	<b>MaxLevel :</b>
<b>DtTbl :</b>	<b>SInpType</b>	<b>StockCard</b>
<b>Frequency</b>	<b>Private Properties:</b>	<b>Private Properties:</b>
<b>Private Properties:</b>	<b>SInpType :</b>	<b>NewQOH :</b>
<b>Frequency :</b>	<b>SInpName :</b>	<b>OldQOH :</b>
<b>Time1 :</b>	<b>SOtpType</b>	<b>ActiveQ :</b>
<b>Time2 :</b>	<b>Private Properties:</b>	<b>MedItem :</b>
<b>Time3 :</b>	<b>SOtpType :</b>	<b>CalDate :</b>
<b>Time4 :</b>	<b>SOtpName :</b>	<b>CalTime :</b>
<b>Time5 :</b>	<b>Income</b>	<b>RSSsts :</b>
<b>Time6 :</b>	<b>Private Properties:</b>	<b>Lct :</b>
		<b>RSNo :</b>

**Figure 4.32** A data dictionary of a class diagram of a computerized unit-dose drug distribution system(continue)

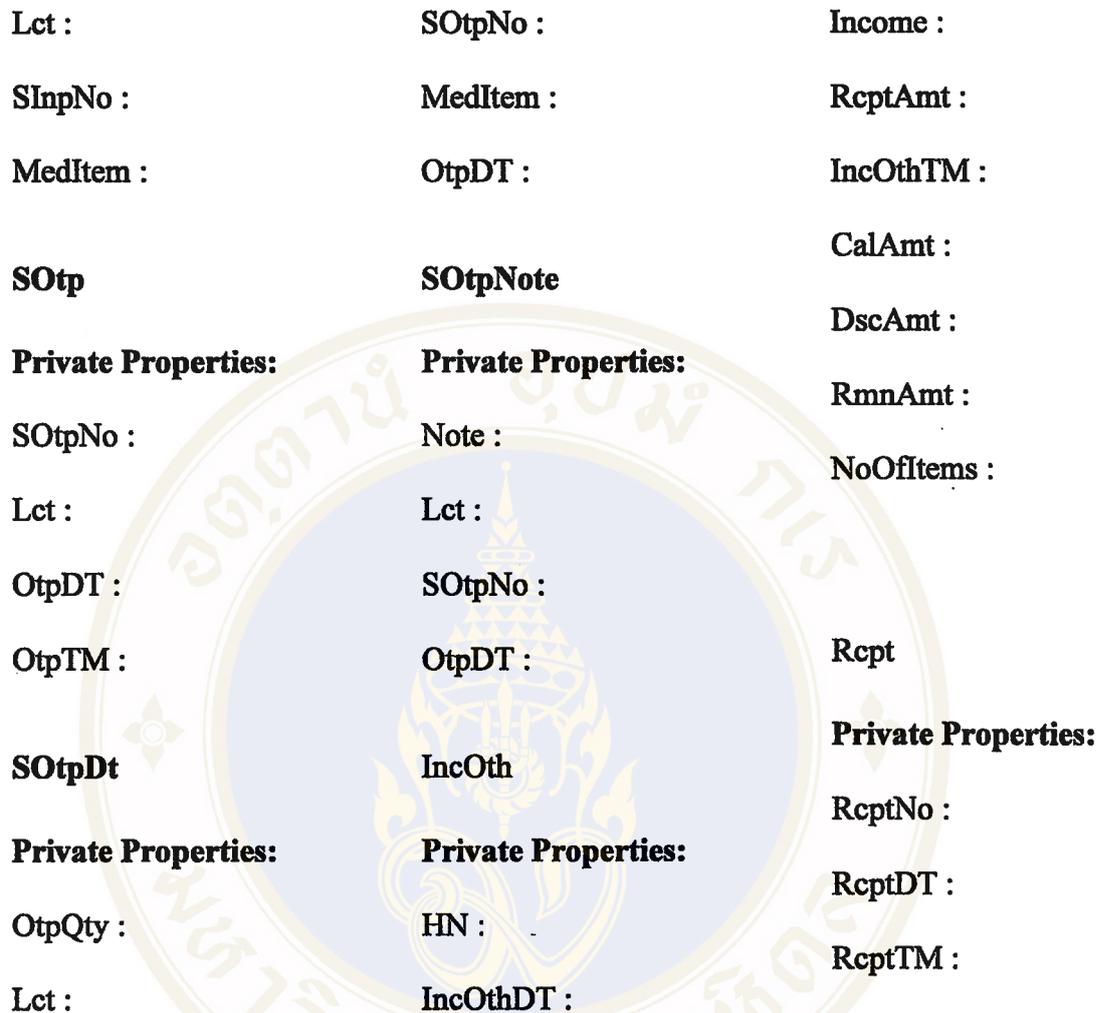
<b>Pt</b>	<b>IPtAdm</b>	<b>IPtOprrt</b>
<b>Private Properties:</b>	<b>Private Properties:</b>	<b>Private Properties:</b>
HN :	InDT :	IPtOprrtDT :
PName :	AN :	AN :
FName :	RoomNo :	IPtOprrtTM :
LName :	BedNo :	<b>IPtDeath</b>
BrthDT :	DayCnt :	<b>Private Properties:</b>
DthDT :	OutDT :	ItemNo :
Mate :	InTM :	AN :
BloodGrp :	OutTM :	<b>Prsc</b>
Allergy :	<b>IPtDct</b>	<b>Private Properties:</b>
MrtLSt :	<b>Private Properties:</b>	PrscNo :
<b>IPt</b>	FDT :	PrscDT :
<b>Private Properties:</b>	LDT :	DailyNote :
AN :	AN :	DscAmt :
RgtDT :	FTM :	SOtpDT :
PreDiag :	LTM :	PrscTM :
DchDT :	<b>IPtDiag</b>	SOtpTM :
Weight :	<b>Private Properties:</b>	
PtTypeCardNo :	ItemNo :	
RgtTM :	AN :	
DchTM :		

**Figure 4.32** A data dictionary of a class diagram of a computerized unit-dose drug distribution system (continue)

<b>PrscDt</b>	<b>PrscQty :</b>	
<b>Private Properties:</b>	<b>PrscNo :</b>	<b>SInpDT :</b>
<b>PrscQty :</b>	<b>MedItem :</b>	<b>Note :</b>
<b>PrscNo :</b>	<b>SaleRate :</b>	<b>SInpTM :</b>
<b>MedItem :</b>	<b>RfmdAmt :</b>	<b>MRqt</b>
<b>SaleRate :</b>	<b>Dose :</b>	<b>Private Properties:</b>
<b>RfmdAmt :</b>	<b>StopDT :</b>	<b>Lct :</b>
<b>Dose :</b>	<b>NoOfDays :</b>	<b>MOtpNo :</b>
<b>StopDT :</b>	<b>PDtTM1 :</b>	<b>Note :</b>
<b>NoOfDays :</b>	<b>PDtTM2 :</b>	<b>RqtDT :</b>
<b>PDtTM1 :</b>	<b>PDtTM3 :</b>	<b>RqtTM :</b>
<b>PDtTM2 :</b>	<b>PDtTM4 :</b>	<b>MRqtDt</b>
<b>PDtTM3 :</b>	<b>PDtTM5 :</b>	<b>Private Properties:</b>
<b>PDtTM4 :</b>	<b>PDtTM6 :</b>	<b>Lct :</b>
<b>PDtTM5 :</b>	<b>Frequency :</b>	<b>RqtDT :</b>
<b>PDtTM6 :</b>	<b>StopTM :</b>	<b>MedItem :</b>
<b>StopTM :</b>	<b>PDtDT :</b>	<b>PackQty :</b>
<b>PrscDT :</b>	<b>OrderType :</b>	<b>RqtQty :</b>
<b>Frequency :</b>	<b>SInp</b>	<b>RqtTM :</b>
<b>OrderType :</b>	<b>Private Properties:</b>	
<b>ErrPrscDt</b>	<b>SInpNo :</b>	<b>SInpDt</b>
<b>Private Properties:</b>	<b>Lct :</b>	<b>Private Properties:</b>



Figure 4.32 A data dictionary of a class diagram of a computerized unit-dose drug distribution system (continue)

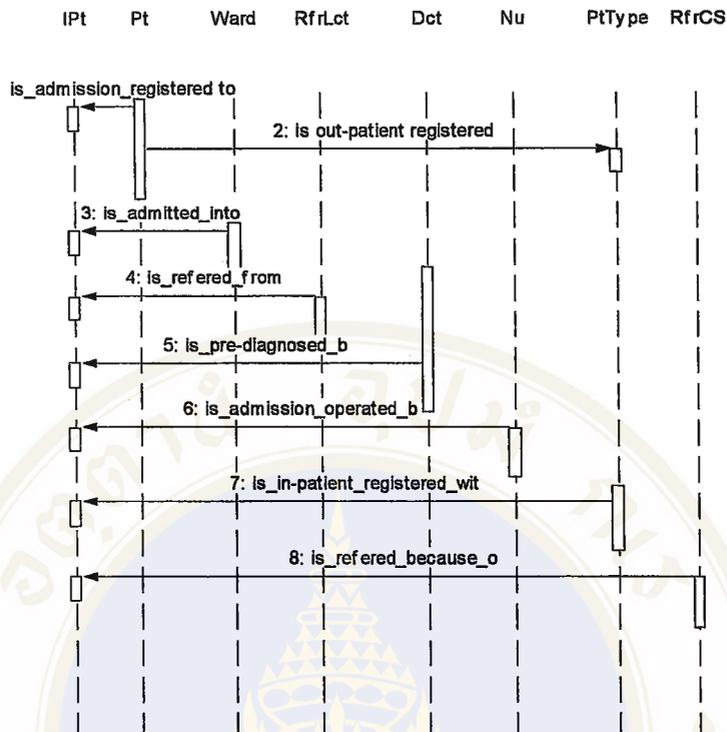


**Figure 4.32** A data dictionary of a class diagram of a computerized unit-dose drug distribution system (continue)

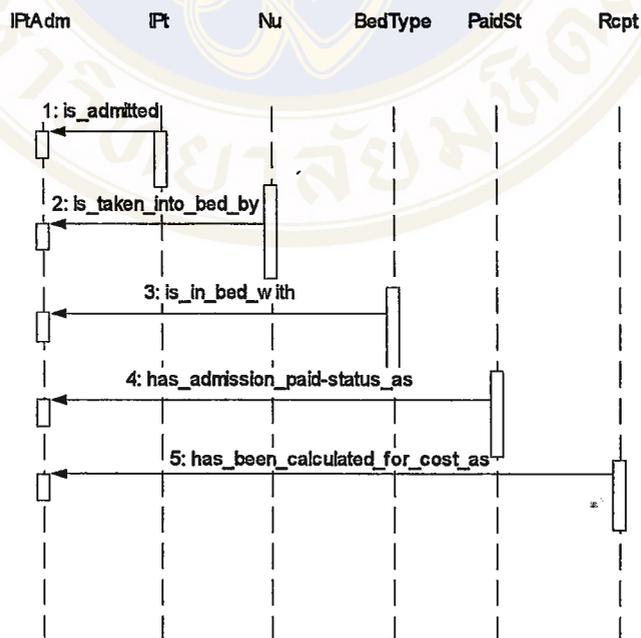
#### 4.1.2.2 Dynamic Model

##### 4.1.2.2.1 Scenario Diagram

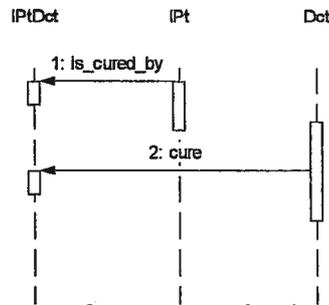
A scenario diagram represents the relative time that the flow of control is focused in an object thereby representing the time an object is deirecting messages.



**Figure 4.33** A scenario diagram of a computerized unit-dose drug distribution system for sub-system 1.1 : Patient’s admission

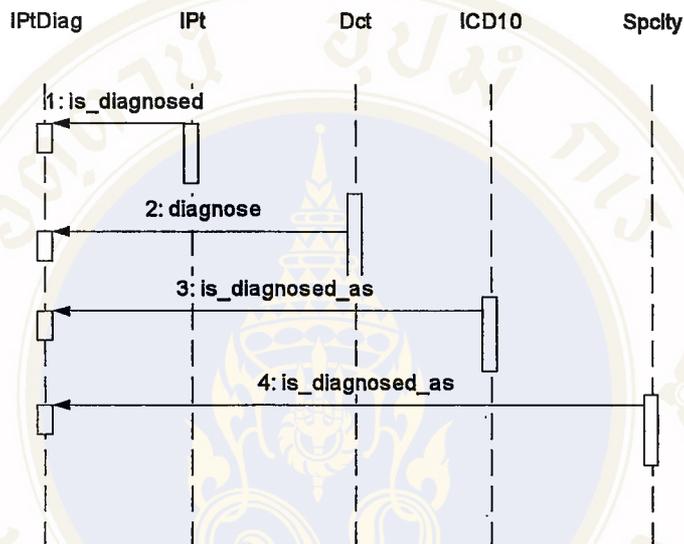


**Figure 4.34** A scenario diagram of a computerized unit-dose drug distribution system for sub-system 1.2 : Patient’s in-ward management



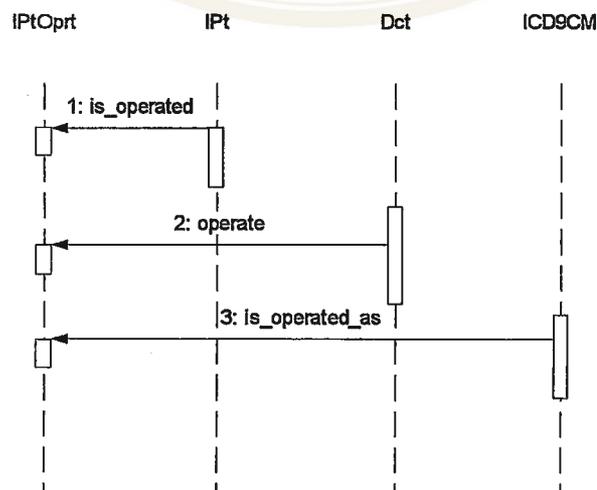
**Figure 4.35** A scenario diagram of a computerized unit-dose drug distribution system

for sub-system 2.1 : Doctor for In-Patient



**Figure 4.36** A scenario diagram of a computerized unit-dose drug distribution system

for sub-system 2.2 : Patient's Diagnosis



**Figure 4.37** A scenario diagram of a computerized unit-dose drug distribution system

for sub-system 2.4 : Patient's Operation

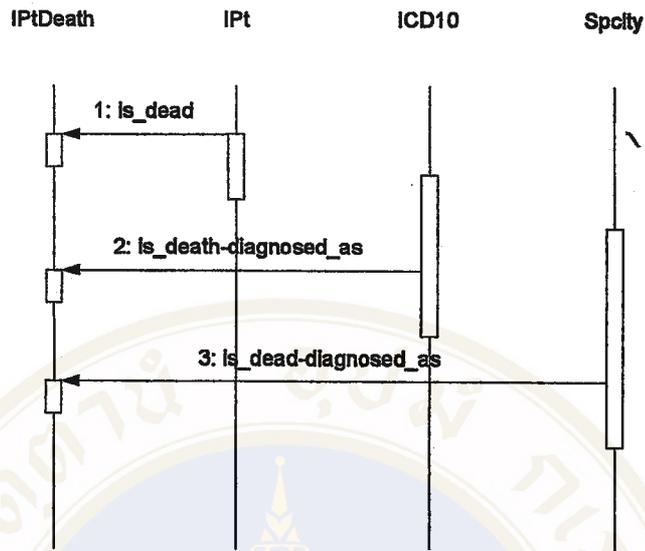


Figure 4.38 A scenario diagram of a computerized unit-dose drug distribution system for sub-system 2.5 : Patient's Dead diagnosis

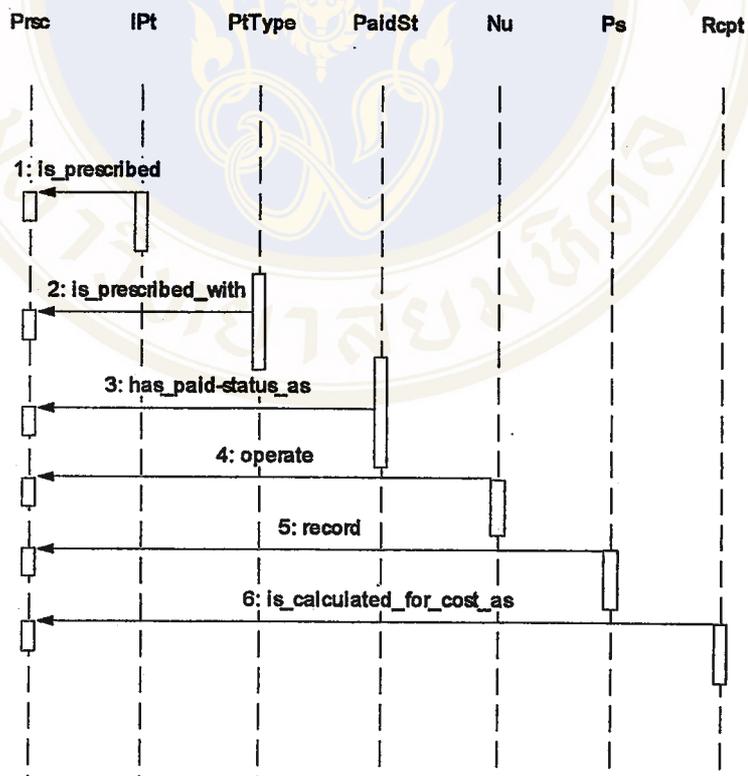
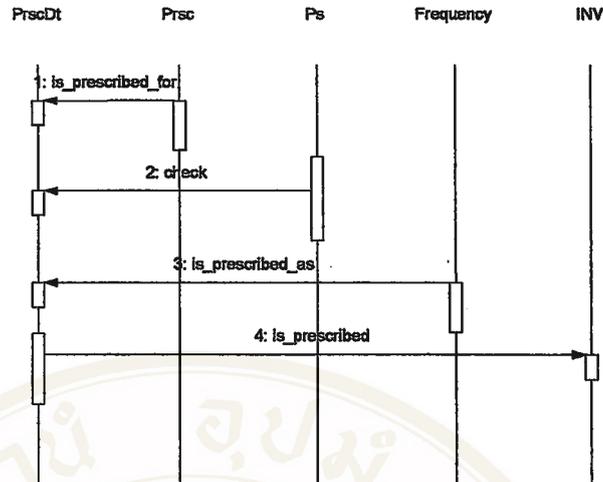
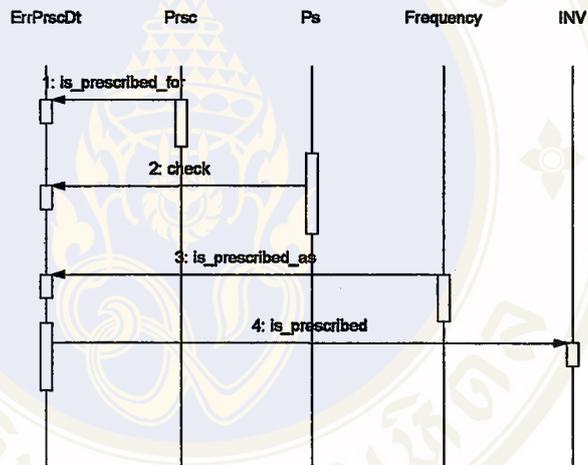


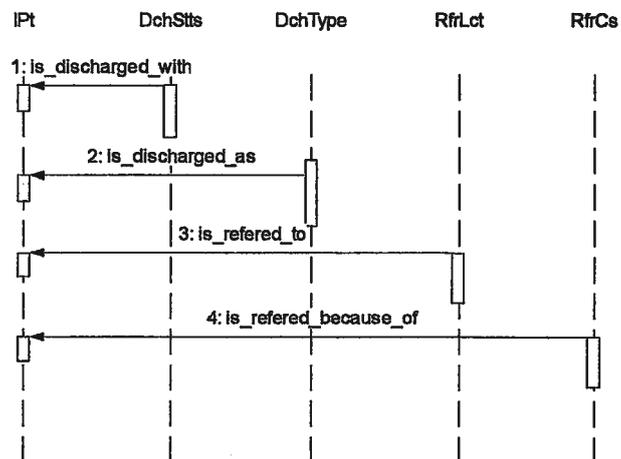
Figure 4.39 A scenario diagram of a computerized unit-dose drug distribution system for sub-system 2.6 : Patient's Medication : Prescription



**Figure 4.40** A scenario diagram of a computerized unit-dose drug distribution system for sub-system 2.6 : Patient’s Medication : Order for Drugs and Services



**Figure 4.41** A scenario diagram of a computerized unit-dose drug distribution system for sub-system 2.6 : Patient’s Medication : Order for Drugs and Services with Error



**Figure 4.42** A scenario diagram of a computerized unit-dose drug distribution system for sub-system 3 : Patient’s discharge

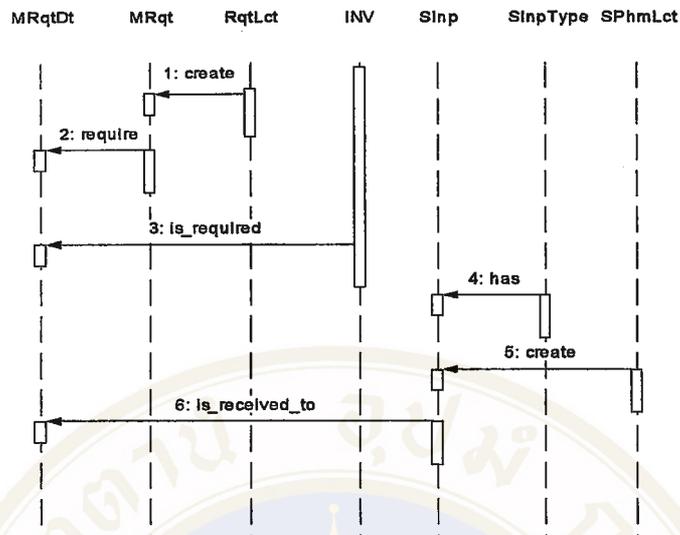


Figure 4.42 A scenario diagram of a computerized unit-dose drug distribution system or sub-system 4.1 : Drug requirement

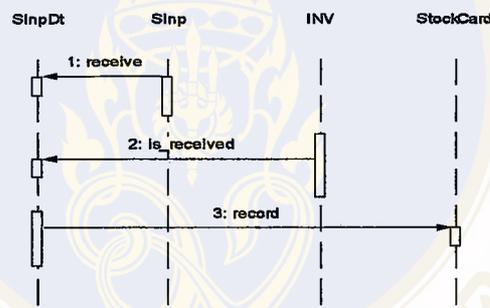


Figure 4.43 A scenario diagram of a computerized unit-dose drug distribution system for sub-system 4.2 : Drug receive

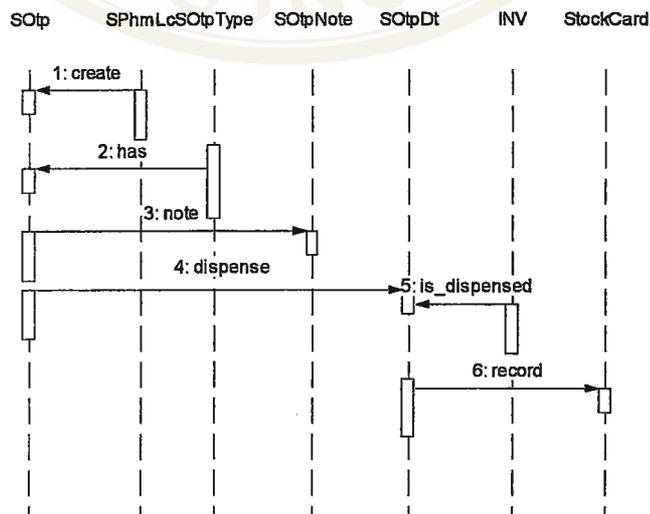
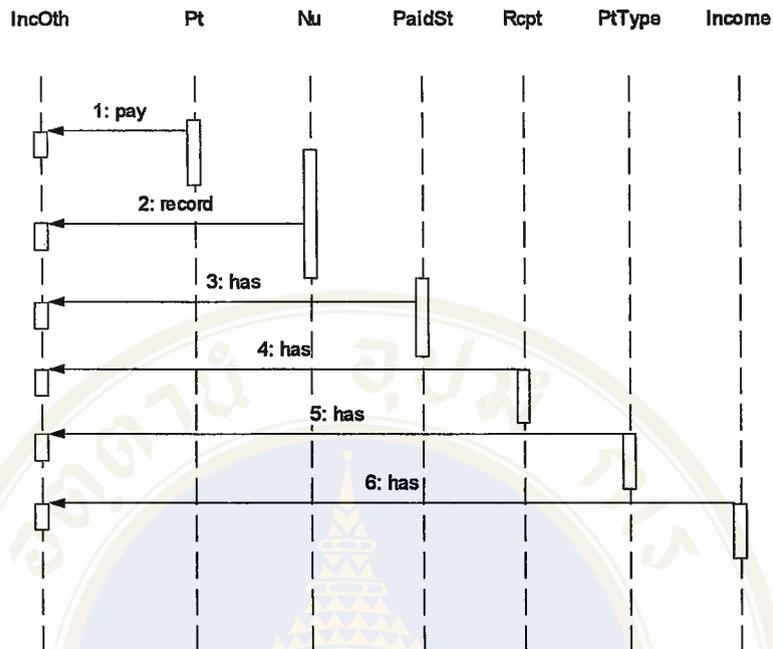
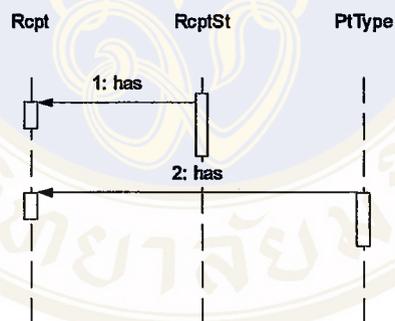


Figure 4.44 A scenario diagram of a computerized unit-dose drug distribution system for sub-system 4.3 : Drug dispense



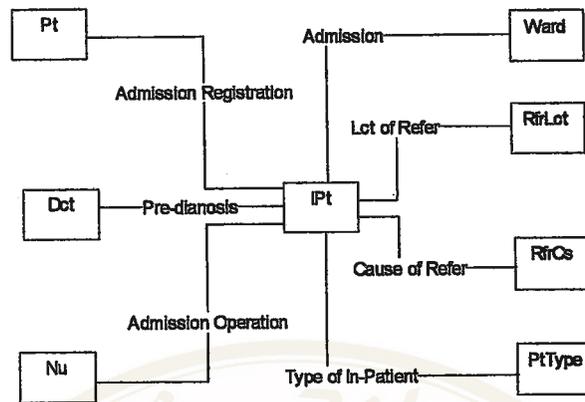
**Figure 4.45** A scenario diagram of a computerized unit-dose drug distribution system for sub-system 5.6 : Reporting for value of patient's medication



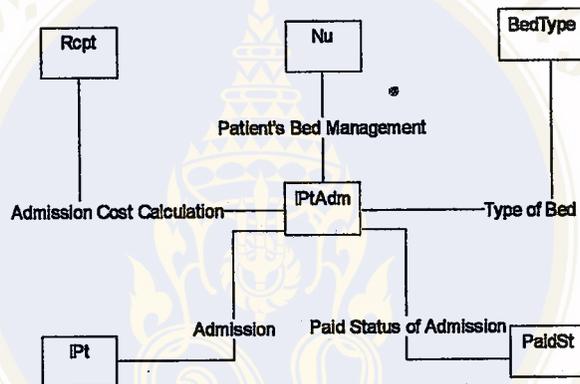
**Figure 4.46** A scenario diagram of a computerized unit-dose drug distribution system for sub-system 5 : Calculating cost

#### 4.1.2.2.2 Event flow diagram

An event flow diagram provides a view of the interactions or structural relationships that occur between objects and object-like entities in the current model.



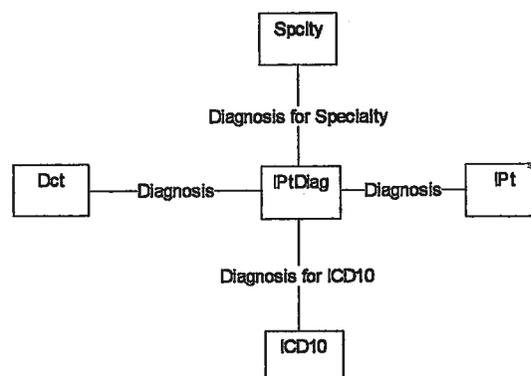
**Figure 4.47** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 1.1 : In-Patient's registration updation



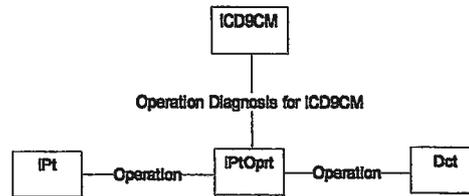
**Figure 4.48** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system1. 2 : In-Patient's in-ward management



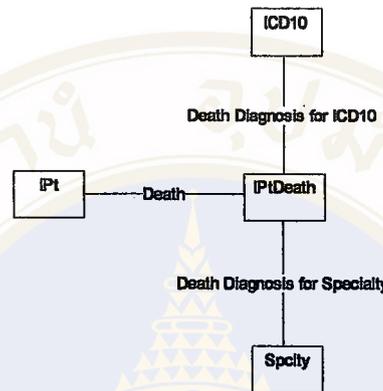
**Figure 4.49** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 2.1 : Doctor for In-Patient



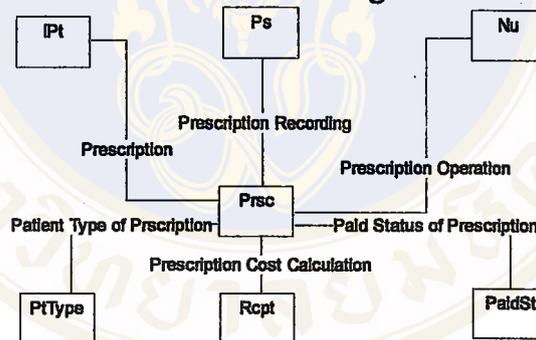
**Figure 4.50** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 2.2 : Patient's Diagnosis



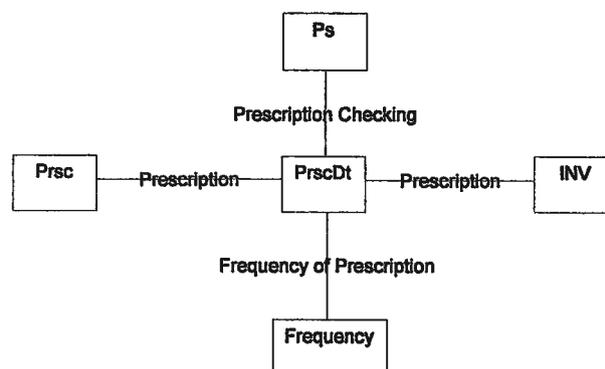
**Figure 4.51** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 2.3 : Patient's Operation



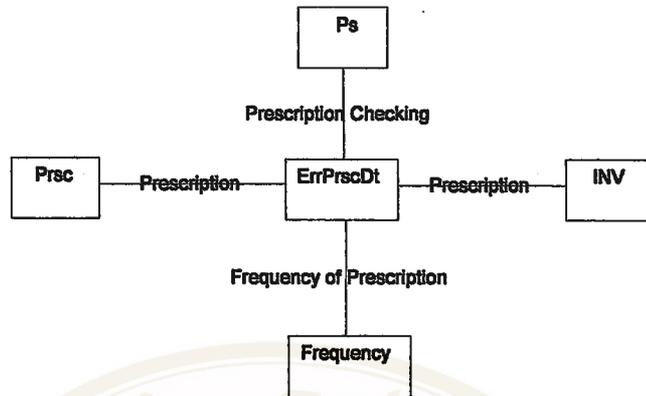
**Figure 4.52** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 2.4 : Patient's Death Diagnosis



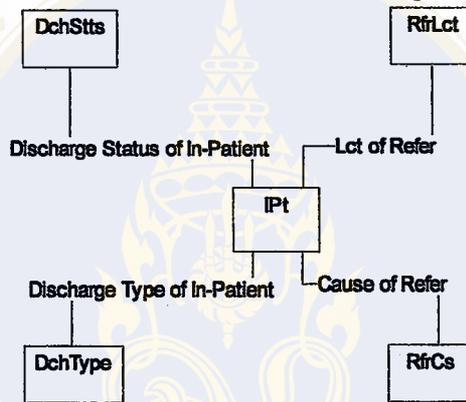
**Figure 4.53** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 2.5 : Patient's Medication: prescription



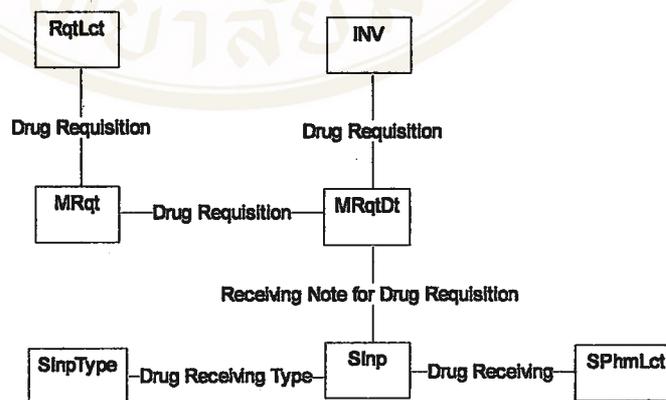
**Figure 4.54** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 2.5 : Patient's Orders for Drugs and Services



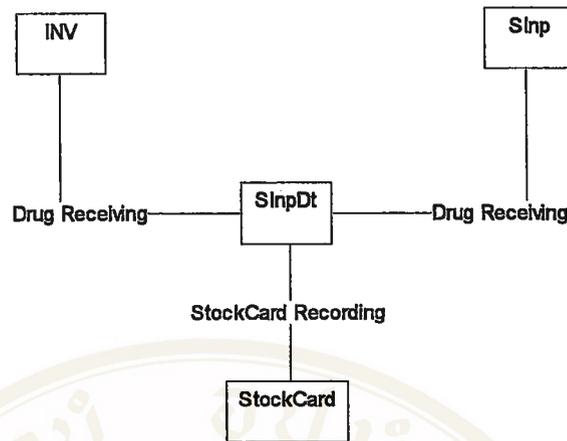
**Figure 4.55** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 2.5 : Patient's Orders for Drugs and Services with Errors



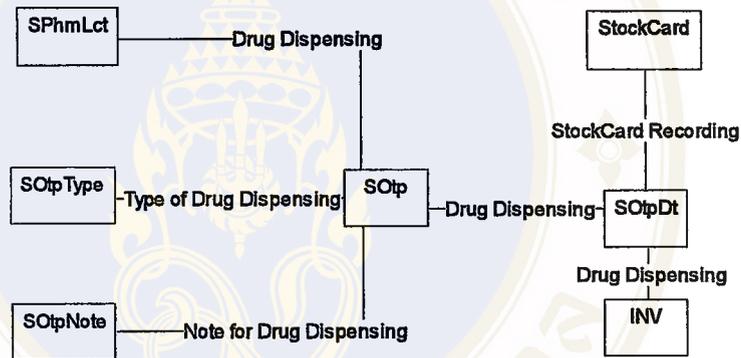
**Figure 4.56** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 3 : Patient's Discharge



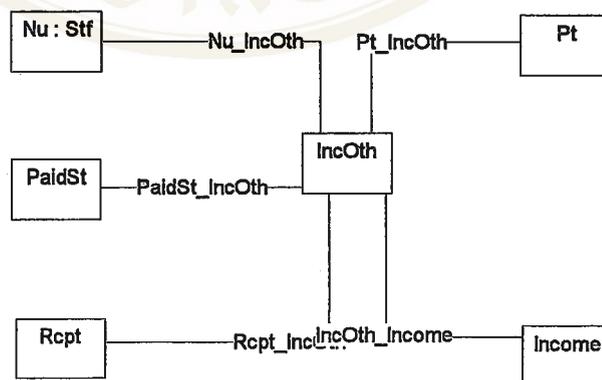
**Figure 4.57** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 4.1 : Drug Requirement



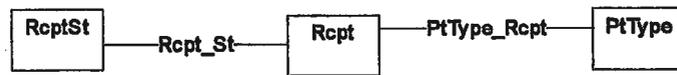
**Figure 4.58** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 4.2 : Drug Receive



**Figure 4.59** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 4.3 : Drug Dispense



**Figure 4.60** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 5.6 : Value for Patient's Medication

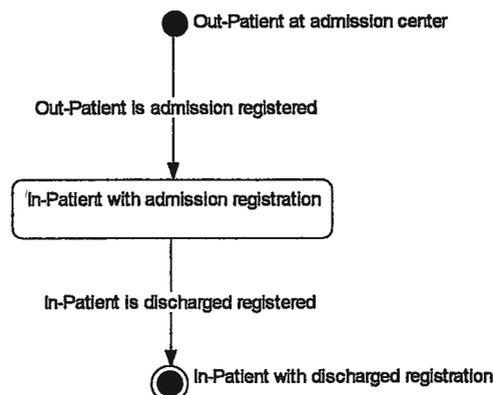


**Figure 4.61** An even-flow diagram of a computerized unit-dose drug distribution system for sub-system 5.6 : Calculating Cost

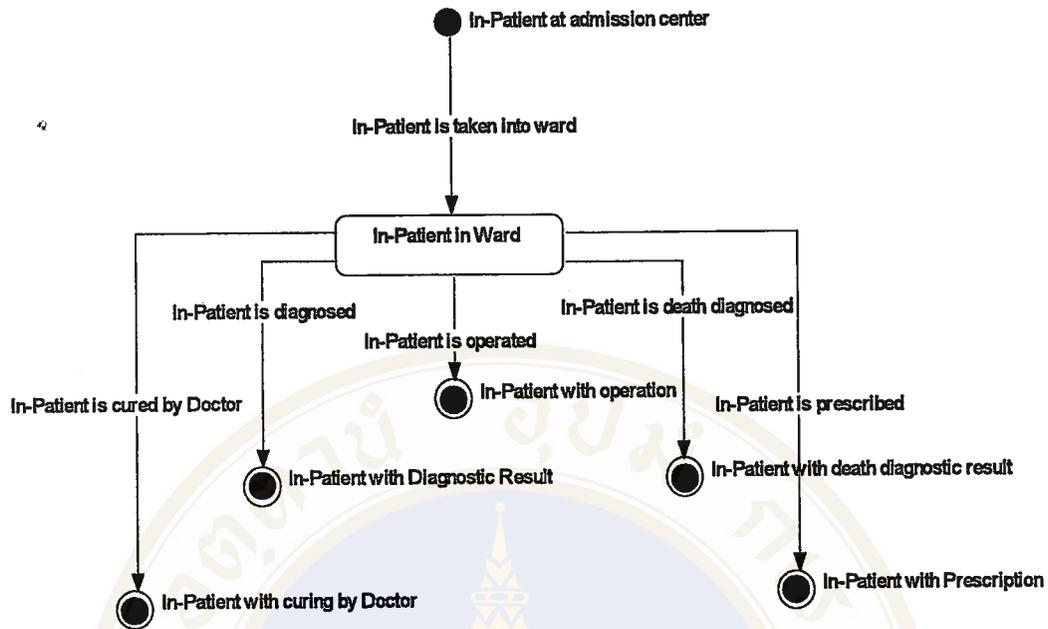
#### 4.1.2.2.3 State transition diagram

A state diagram is used to show the state of a given class, the events that cause a transition from one state to another, and the actions that result from a state change. Each state diagram is associated with one class or one use case. During design, state diagrams are useful for capturing the dynamic behavior of individual classes.

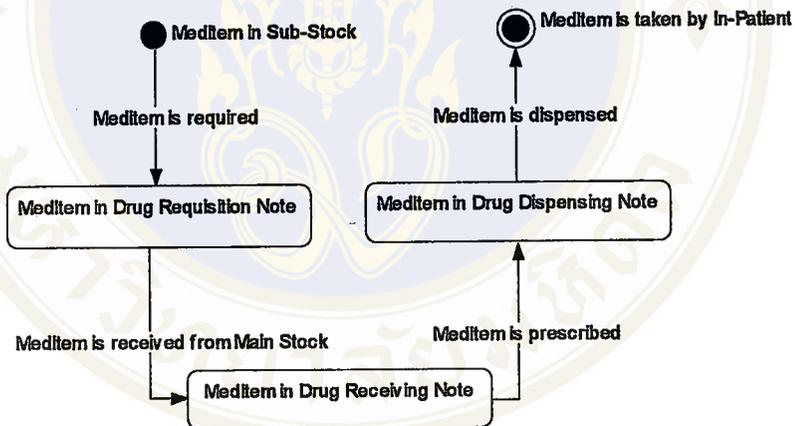
A state diagram consists of states connected by transitions and describes the life history of objects of a given class. A state diagram show exactly one start state, one or more states, one or more end states, and the state transitions between them. Each class in the current model that possesses significant event-ordered behavior can contain a single state diagram to describe that behavior.



**Figure 4.62** A state transition diagram of a computerized unit-dose drug distribution system for Class : Pt



**Figure 4.63** A state transition diagram of a computerized unit-dose drug distribution system for Class : IPT



**Figure 4.64** A state transition diagram of a computerized unit-dose drug distribution system for Class : Inv

### 4.1.2.3 Functional Model

#### 4.1.2.3.1 Data Flow Diagram

A data flow diagram shows functional dependencies of the system, including identify input and output values.

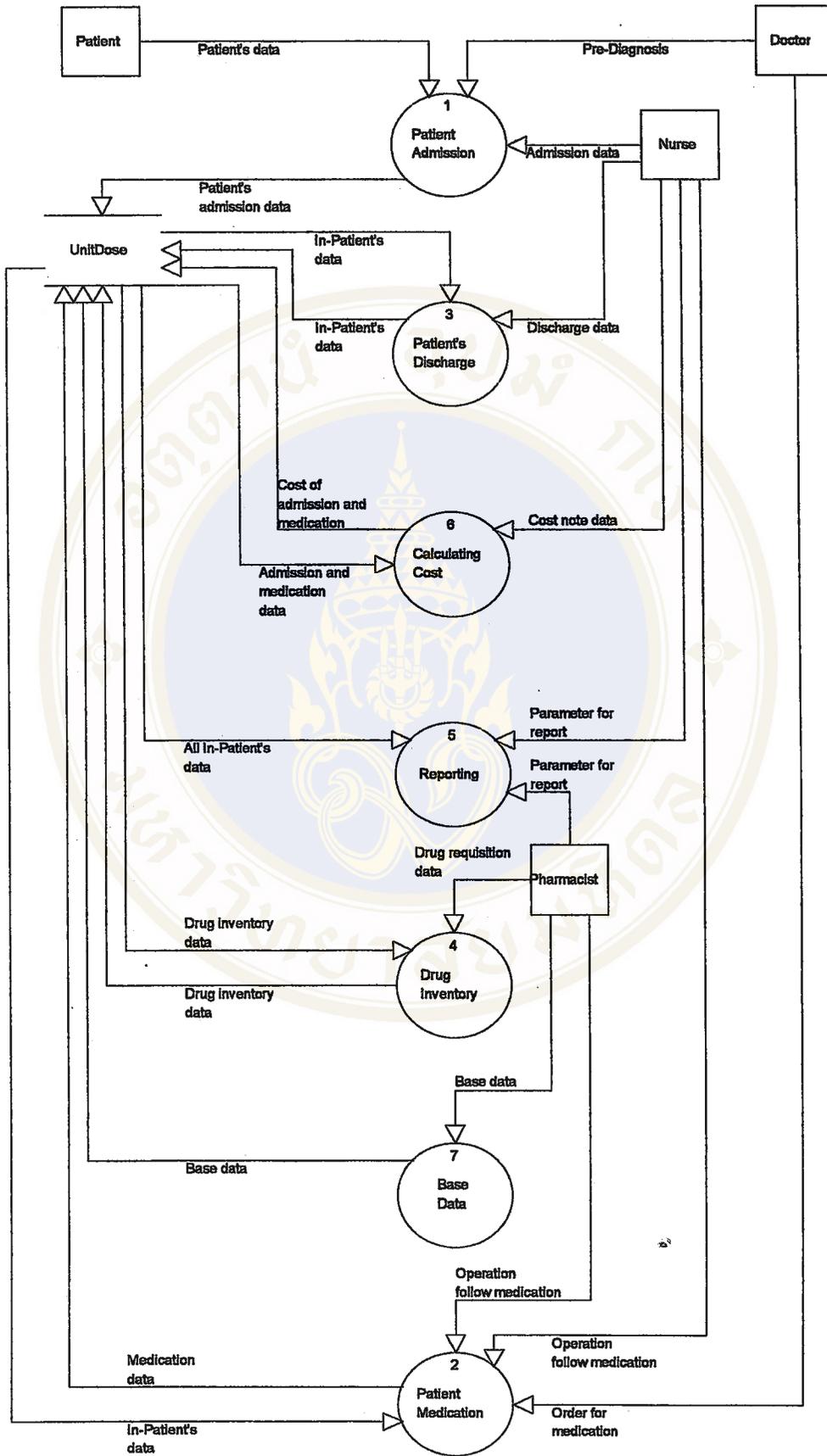


Figure 4.65 A data flow diagram of a computerized unit-dose drug distribution system

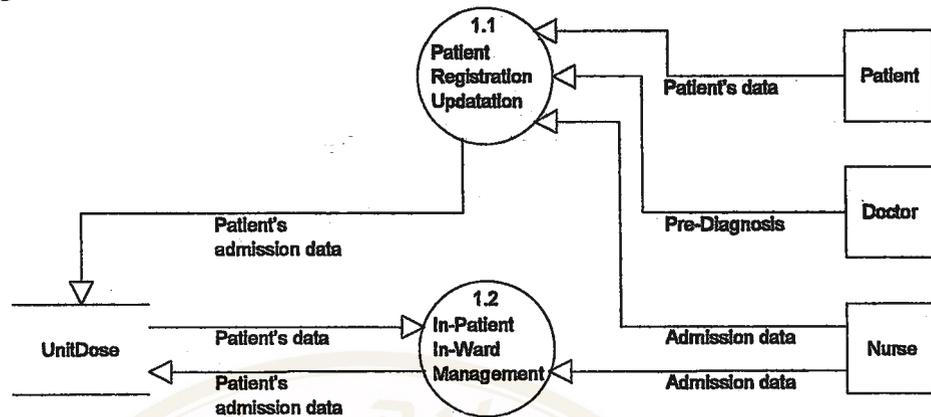


Figure 4.66 A data flow diagram of a computerized unit-dose drug distribution system for sub-system 1 : Patient's admission

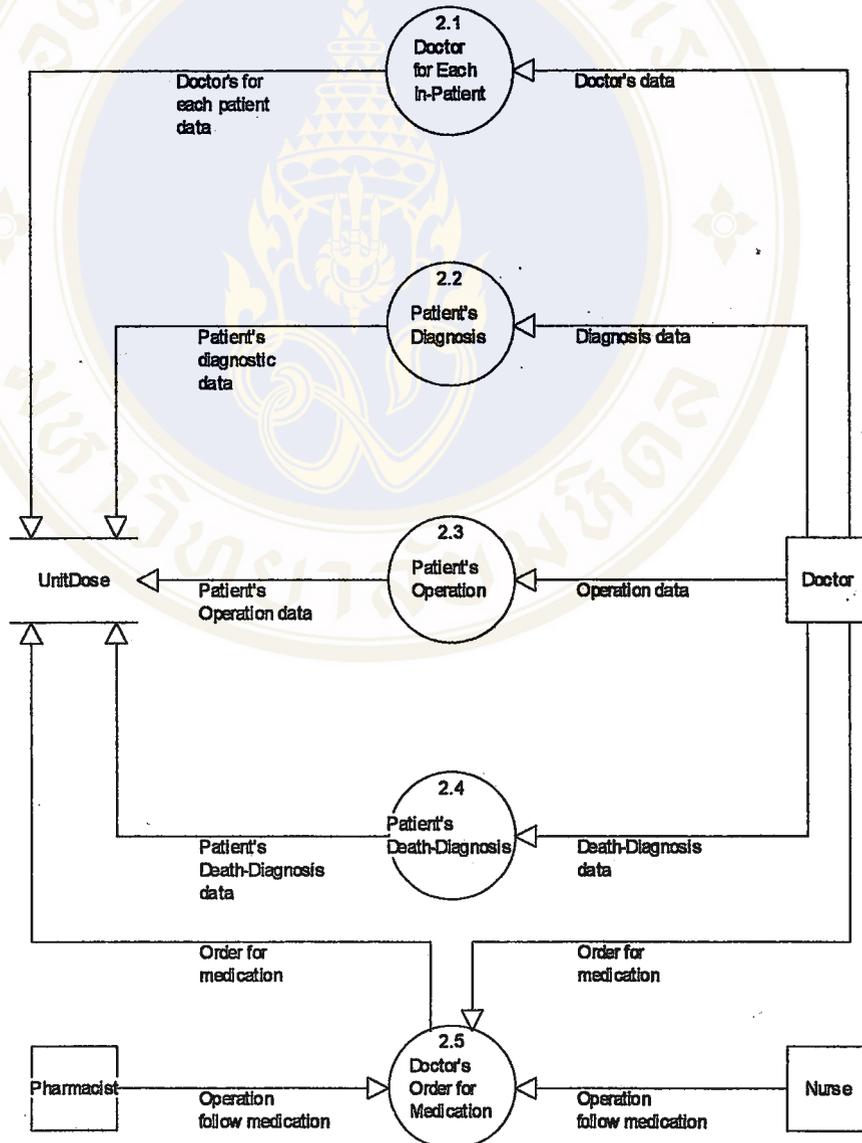
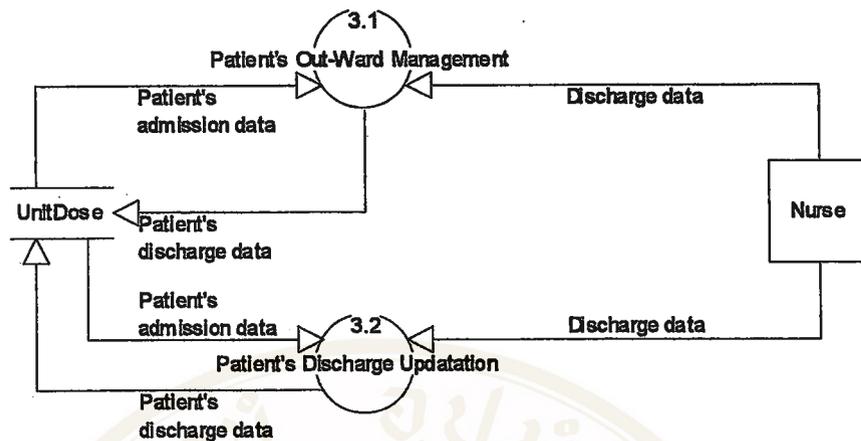
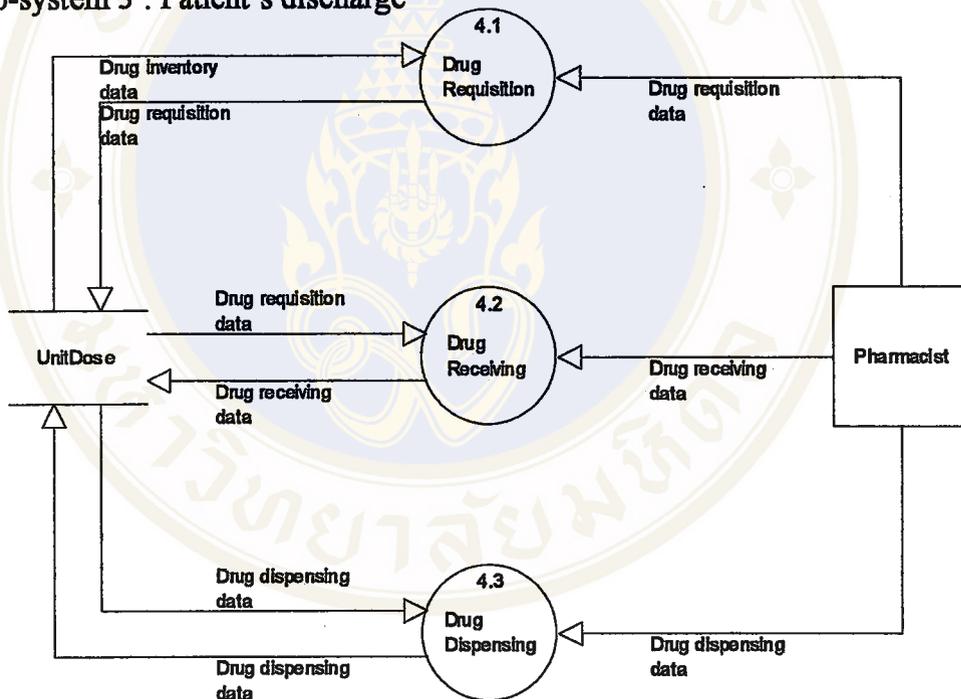


Figure 4.67 A data flow diagram of a computerized unit-dose drug distribution system for sub-system 2 : Patient's medication



**Figure 4.68** A data flow diagram of a computerized unit-dose drug distribution system for sub-system 3 : Patient's discharge



**Figure 4.69** A data flow diagram of a computerized unit-dose drug distribution system for sub-system 4 : Drug Inventory

#### 4.1.3 System Design Phase

This phase describes the high-level decisions about the system implementation, including its overall structure.

The steps of system design of computerized unit-dose drug distribution system are :

a. Organization of the system.

The system is organized into 7 subsystem :

- Patient's admission
- Patient's medication
- Patient's discharge
- Drug inventory
- Reporting
- Calculating cost
- Base data

b. Identification of concurrency inherent in the problem.

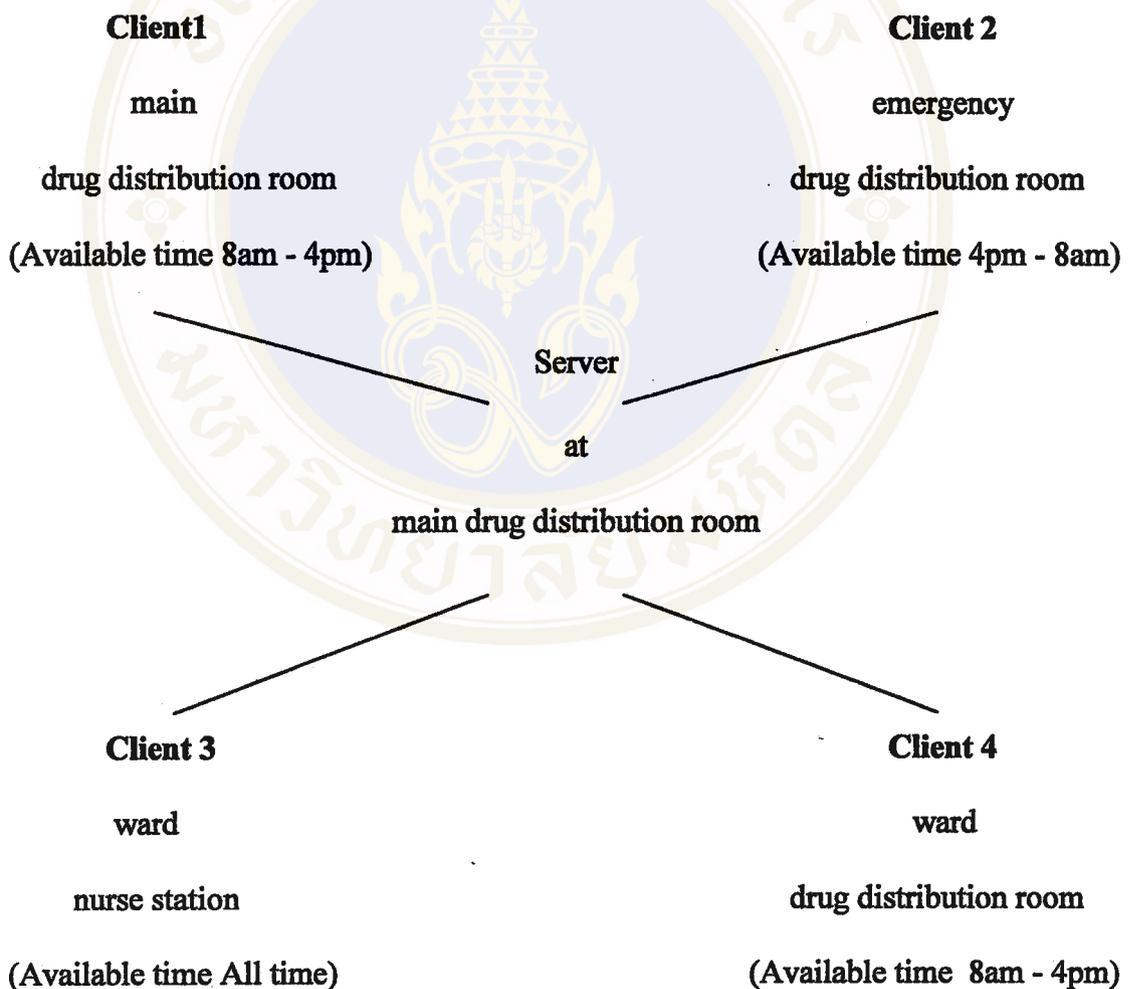
**Table 4.1.** Each subsystem with its operation time.

<b>Subsystem</b>	<b>Operation time</b>
Patient's admission	Anytime
Patient's medication	Anytime
Patient's discharge	Anytime
Drug inventory	08.00am-04.00pm
Reporting	Anytime
Calculating cost	08.00am-12.00am
Base data	Anytime

Subsystems and operation time in tables 4.1. indicates that some operations may be happened at the same time. So it's impossible to operate all subsystems in the same machine. It's necessary to find the way to solve this concurrency inherent problem.

c. Allocation of subsystems to processors and tasks.

Because of concurrency inherent problem in the previous step, each subsystem will be allocated to various computers of the system, which is shown in figure 4.70 and table 4.2. The allocation of subsystems includes managing processors for each subsystem, identifying tasks which each subsystem will operate, including times to operate each subsystem at each processor.



**Figure 4.70** Allocation of subsystems to processors and tasks of a computerized unit-dose drug distribution system.

**Table 4.2** Managing clients and times to operate for each subsystem.

Time	Admission	Medication	Discharge	Inventory	Report	Cost	Base Data
8am	Client 3	Client 1,3,4	Client 3	Client 4	Client 1,3,4	Client 3	Client 1,3,4
9am	Client 3	Client 1,3,4	Client 3	Client 4	Client 1,3,4	Client 3	Client 1,3,4
10am	Client 3	Client 1,3,4	Client 3	Client 4	Client 1,3,4	Client 3	Client 1,3,4
11am	Client 3	Client 1,3,4	Client 3	Client 4	Client 1,3,4	Client 3	Client 1,3,4
12am	Client 3	Client 1,3,4	Client 3	Client 4	Client 1,3,4	Client 3	Client 1,3,4
1pm	Client 3	Client 1,3,4	Client 3	Client 4	Client 1,3,4	Client 3	Client 1,3,4
2pm	Client 3	Client 1,3,4	Client 3	Client 4	Client 1,3,4	Client 3	Client 1,3,4
3pm	Client 3	Client 1,3,4	Client 3	Client 4	Client 1,3,4	Client 3	Client 1,3,4
4pm	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
5pm	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
6pm	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
7pm	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
8pm	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
9pm	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
10pm	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
11pm	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
12pm	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
1am	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
2am	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
3am	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
4am	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
5am	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
6am	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3
7am	Client 3	Client 2,3	Client 3		Client 2,3	Client 3	Client 2,3

d. Implementation of data stores.

For this computerized unit-dose drug distribution system, the relational database model is chosen to be used to store data of the system. One of the greatest advantages of the relational model is its conceptual simplicity and the ability to link records in a way that is not predefined( that is, they are not explicit as in the hierarchical and network models). This provides great flexibility. The relational or tabular model of data can be used in a variety of applications. Most people can easily visualize the relational model as a table, but the model does use some unfamiliar terminology.

There are traditionally two different approaches to relational database design. The first is to identify all the attributes in the problem and place them together to create and preserve the stability of the attributes. This follows a series of rules known as normalization. The other approach is to identify the entities that exist in the problem. The entities are explored and refined in terms of properties(attributes) and the relationships between them, in a process referred to as Entity-Relationship modeling. This process also employs the rules of normalization.

Object modeling is as evolutionary process that incorporates entity design. This allows the ability to perform object modeling and produce as a by-product, a data model or schema. The concepts of entity design and normalization are assumed to be baseline information and knowledge in this discussion.

Object models focus upon the structure and behavior of objects, and their relationships among objects. Objects models are an effective way of communicating with domain experts and users to reach an understanding of the problem. From this basis of understanding it is able to derive a correct database design by understanding the mapping of objects to tables, and the relation of the generated data model to the overlying three schema architecture of relational database design.

The three schema architecture is the standard architecture for data model, first proposed by the ANSI/SPARC committee on databases. The concept is that the design consists of three layers : external, conceptual and internal. The external level is concerned with the global overall application and how the user interacts with these data. The internal level is the one closest to the physical storage, occasionally referred to as the physical view. The conceptual level is the mapping between these two layers. It is expressed in terms of conceptual **DDL(Data Definition Language)**. The ability to use Rational Rose application program with relational databases is expressed primarily in terms of the conceptual level. The lowest level design decisions which are part of the physical implementation of the database, such as tablespaces and clustering, are not mapped nor discussed. Some physical layer topics, i.e. indexes, are mapped and discussed.

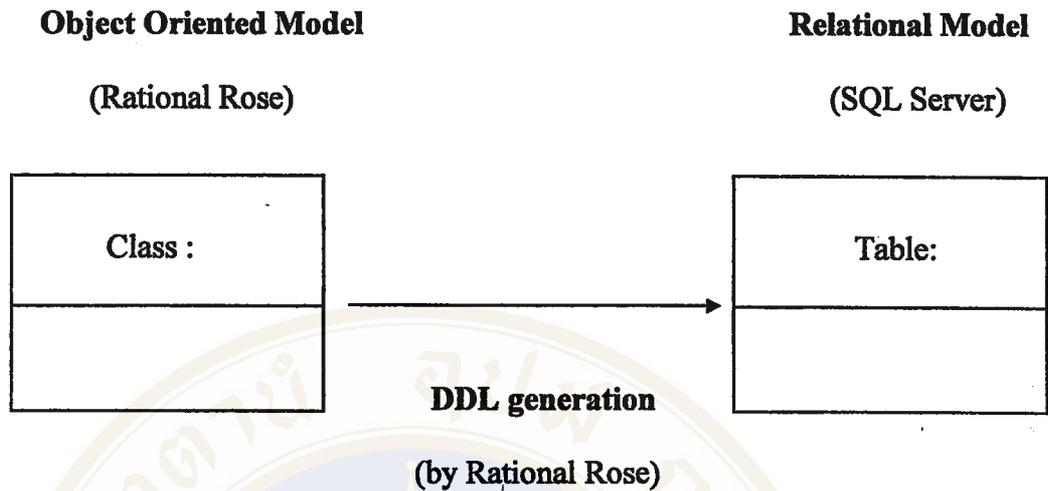


Figure 4.71 Mapping of object oriented model to relational model.

The steps of mapping of object oriented model to relational model are :

- Generating DDL, by selecting the desired classes to generate and executing the generate DDL option from the Tools menu of Rational Rose. A dialog will appear with the default database and script file name that are set by the project properties. For this dialog, choose target database as SQL Server and choose the name of script file.
- The DDL will then be generated to the specified file, as shown in figure 4.72.

```

CREATE TABLE T_MainPst(
    MainPst VARCHAR(5) NOT NULL,
    MPName VARCHAR(25) NOT NULL,
    PRIMARY KEY(MainPst))
go

CREATE TABLE T_Ps(
    Stf VARCHAR(5) NOT NULL,
    PRIMARY KEY(Stf),
    FOREIGN KEY (Stf) REFERENCES T_Stf
)
go

CREATE TABLE T_Stf(
    Stf VARCHAR(5) NOT NULL,
    SPName VARCHAR(15),
    SFName VARCHAR(25) NOT NULL,
    SLName VARCHAR(25) NOT NULL,
    StfType VARCHAR(2) NOT NULL,
    Level NUMERIC(2),
    LcNo VARCHAR(5),
    DspName VARCHAR(50),
    MainPst VARCHAR(5) NOT NULL,
    FOREIGN KEY (MainPst) REFERENCES
T_MainPst,
    PRIMARY KEY(Stf))
go

CREATE TABLE T_Nu(
    Stf VARCHAR(5) NOT NULL,
    PRIMARY KEY(Stf),
    FOREIGN KEY (Stf) REFERENCES T_Stf
)
go

CREATE VIEW Dct_V(
    Stf,
    SPName,
    SFName,
    SLName,
    StfType,
    Level,
    LcNo,
    DspName,
    MainPst)
)

```

**Figure 4.72** DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose.

```

T_Stf.SPName,
T_Stf.SFName,
T_Stf.SLName,
T_Stf.StfType,
T_Stf.Level,
T_Stf.LcNo,
T_Stf.DspName,
T_MainPst.MainPst
FROM T_Dct,T_Stf
WHERE T_Dct.Stf=T_Stf.Stf
go

CREATE VIEW Ps_V(
Stf,
SPName,
SFName,
SLName,
StfType,
Level,
LcNo,
DspName,
MainPst)
AS SELECT
T_Stf.Stf,
T_Stf.SPName,
T_Stf.SFName,
T_Stf.SLName,
T_Stf.StfType,
T_Stf.Level,
T_Stf.LcNo,
T_Stf.DspName,
T_MainPst.MainPst
FROM T_Ps,T_Stf
WHERE T_Ps.Stf=T_Stf.Stf
go

CREATE VIEW Nu_V(
Stf,
SPName,
SFName,
SLName,
StfType,
Level,
LcNo,
DspName,
MainPst)
AS SELECT
T_Stf.Stf,
T_Stf.SPName,
T_Stf.SFName,
T_Stf.SLName,
T_Stf.StfType,
T_Stf.Level,
T_Stf.LcNo,
T_Stf.DspName,
T_MainPst.MainPst
FROM T_Ps,T_Stf
WHERE T_Ps.Stf=T_Stf.Stf
go

```

**Figure 4.72** DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose. (Continue)

```

T_Stf.Level,
T_Stf.LcNo,                                FOREIGN KEY (Dpm) REFERENCES
T_Stf.DspName,                             T_Dpm )
T_MainPst.MainPst                          go
FROM T_Nu,T_Stf
WHERE T_Nu.Stf=T_Stf.Stf                   CREATE TABLE T_Ward(
                                           Dpm VARCHAR(2) NOT NULL,
go                                           PRIMARY KEY(Dpm),
                                           FOREIGN KEY (Dpm) REFERENCES
CREATE TABLE T_Lct(                        T_Dpm)
Lct VARCHAR(5) NOT NULL,                   go
LctPfx VARCHAR(15),
LctName VARCHAR(25) NOT NULL,
LctType VARCHAR(2) NOT NULL,              CREATE TABLE T_RftLct(
DspName VARCHAR(30),                       Lct VARCHAR(5) NOT NULL,
Dpm VARCHAR(2) NOT NULL,                   PRIMARY KEY(Lct),
FOREIGN KEY (Dpm) REFERENCES                FOREIGN KEY (Lct) REFERENCES T_Lct
T_Dpm,                                     )
Dpm VARCHAR(2) NOT NULL,                   go
FOREIGN KEY (Dpm) REFERENCES
T_Dpm,                                     CREATE TABLE T_RqtLct(
PRIMARY KEY(Lct))                           Lct VARCHAR(5) NOT NULL,
go                                           PRIMARY KEY(Lct),
                                           FOREIGN KEY (Lct) REFERENCES T_Lct
CREATE TABLE T_IDpm(                       )
Dpm VARCHAR(2) NOT NULL,                   go
PRIMARY KEY(Dpm),

```

**Figure 4.72** DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose. (Continue)

```

CREATE TABLE T_SPhmLct(
    Lct VARCHAR(5) NOT NULL,
    PRIMARY KEY(Lct),
    FOREIGN KEY (Lct) REFERENCES T_Lct
)
go

CREATE TABLE T_Dpm(
    Dpm VARCHAR(2) NOT NULL,
    DpmPfx VARCHAR(10) NOT NULL,
    DpmName VARCHAR(20) NOT NULL,
    PRIMARY KEY(Dpm))
go

CREATE VIEW Ward_V(
    Dpm,
    DpmPfx,
    DpmName)
AS SELECT
    T_Dpm.Dpm,
    T_Dpm.DpmPfx,
    T_Dpm.DpmName
FROM T_Ward,T_IDpm,T_Dpm
WHERE T_Ward.Dpm=T_IDpm.Dpm
AND T_IDpm.Dpm=T_Dpm.Dpm
go

CREATE VIEW RfrLct_V(
    Lct,
    LctPfx,
    LctName,
    LctType,
    DspName,
    Dpm,
    Dpm)
AS SELECT
    T_Lct.Lct,
    T_Lct.LctPfx,
    T_Lct.LctName,
    T_Lct.LctType,
    IDpm_V.Dpm,
    IDpm_V.Dpm)
AS SELECT
    T_IDpm.Dpm,
    T_IDpm.DpmPfx,
    T_IDpm.DpmName
FROM T_IDpm,T_Dpm
WHERE T_IDpm.Dpm=T_Dpm.Dpm
go

```

Figure 4.72 DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose.(Continue)

```

T_Dpm.Dpm,
T_Dpm.Dpm
FROM T_RfrLct,T_Lct
WHERE T_RfrLct.Lct=T_Lct.Lct

CREATE VIEW SPhmLct_V(
Lct,
LctPfx,
LctName,
LctType,
DspName,
Dpm,
Dpm)
AS SELECT
T_Lct.Lct,
T_Lct.LctPfx,
T_Lct.LctName,
T_Lct.LctType,
T_Lct.DspName,
T_Dpm.Dpm,
T_Dpm.Dpm
FROM T_SPhmLct,T_Lct
WHERE T_SPhmLct.Lct=T_Lct.Lct

go

CREATE VIEW RqtLct_V(
Lct,
LctPfx,
LctName,
LctType,
DspName,
Dpm,
Dpm)
AS SELECT
T_Lct.Lct,
T_Lct.LctPfx,
T_Lct.LctName,
T_Lct.LctType,
T_Lct.DspName,
T_Dpm.Dpm,
T_Dpm.Dpm
FROM T_RqtLct,T_Lct
WHERE T_RqtLct.Lct=T_Lct.Lct

go

CREATE TABLE T_ICD9CM(
ICD9CM VARCHAR(7) NOT NULL,
ICD9Name VARCHAR(200) NOT NULL,
PRIMARY KEY(ICD9CM))

go

```

**Figure 4.72** DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose.(Continue)

```

CREATE TABLE T_Spclty(
    Spclty VARCHAR(4) NOT NULL,
    SpName VARCHAR(40) NOT NULL,
    PRIMARY KEY(Spclty))
go

CREATE TABLE T_DchType(
    DchType VARCHAR(4) NOT NULL,
    DTName VARCHAR(40) NOT NULL,
    PRIMARY KEY(DchType))
go

CREATE TABLE T_ICD10(
    ICD10 VARCHAR(7) NOT NULL,
    ICD10Name VARCHAR(200) NOT NULL,
    Spclty VARCHAR(4) NOT NULL,
    FOREIGN KEY (Spclty) REFERENCES
T_Spclty,
    PRIMARY KEY(ICD10))
go

CREATE TABLE T_DchStts(
    DchStts VARCHAR(4) NOT NULL,
    DSName VARCHAR(40) NOT NULL,
    PRIMARY KEY(DchStts))
go

CREATE TABLE T_Rightt(
    Rightt VARCHAR(20) NOT NULL,
    RName VARCHAR(20),
    PRIMARY KEY(Rightt))
go

CREATE TABLE T_PtType(
    PtType VARCHAR(4) NOT NULL,
    PTName VARCHAR(40) NOT NULL,
    Rightt VARCHAR(20) NOT NULL,
    FOREIGN KEY (Rightt) REFERENCES
T_Rightt,
    PRIMARY KEY(PtType))
go

CREATE TABLE T_RfrCs(
    RfrCs VARCHAR(4) NOT NULL,
    RCName VARCHAR(40) NOT NULL,
    PRIMARY KEY(RfrCs))
go

CREATE TABLE T_BedType(
    BedType VARCHAR(2) NOT NULL,
    BTName VARCHAR(20) NOT NULL,
    Rate NUMERIC(9,5),
    PRIMARY KEY(BedType))

```

Figure 4.72 DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose. (Continue)

```

CREATE TABLE T_RcptSt(
    RcptSt VARCHAR(4) NOT NULL,
    RSName VARCHAR(40) NOT NULL,
    PRIMARY KEY(RcptSt)
go

CREATE TABLE T_SInpType(
    SInpType VARCHAR(2) NOT NULL,
    SInpName VARCHAR(30) NOT NULL,
    PRIMARY KEY(SInpType)
go

CREATE TABLE T_PaidSt(
    PaidSt VARCHAR(4) NOT NULL,
    PSName VARCHAR(40) NOT NULL,
    PRIMARY KEY(PaidSt)
go

CREATE TABLE T_SOtpType(
    SOtpType VARCHAR(3) NOT NULL,
    SOtpName VARCHAR(30) NOT NULL,
    PRIMARY KEY(SOtpType)
go

CREATE TABLE T_Income(
    Income VARCHAR(4) NOT NULL,
    ICName VARCHAR(40) NOT NULL,
    DtTbl VARCHAR(15),
    PRIMARY KEY(Income)
go

CREATE TABLE T_MedItem(
    MedItem VARCHAR(10) NOT NULL,
    MITName VARCHAR(5) NOT NULL,
    MedUnit VARCHAR(7),
    MedForm VARCHAR(7),
    PackQty NUMERIC(5) NOT NULL,
    Storage VARCHAR(7),
    MedUsage VARCHAR(7) NOT NULL,
    SaleRate NUMERIC(9,2),
    MaxRfnd NUMERIC(9,2),
    MaxDscnt NUMERIC(9,2),
    Income VARCHAR(4) NOT NULL,
    FOREIGN KEY (Income) REFERENCES
    T_Income,
    PRIMARY KEY(MedItem)
go

```

**Figure 4.72** DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose. (Continue)

```

CREATE TABLE T_INV(
    QtyOnHand NUMERIC(20,2),
    AvgUnitCost NUMERIC(20,2),
    QtyPend NUMERIC(20,2),
    ReOrderQty NUMERIC(20,2),
    MinLevel NUMERIC(20,2),
    MaxLevel NUMERIC(20,2),
    RateUsePerMonth NUMERIC(20,2),
    SpecialCode VARCHAR(4),
    SaleUnit VARCHAR(10),
    MedItem VARCHAR(10) NOT NULL,
    PRIMARY KEY(MedItem),
    FOREIGN KEY (MedItem) REFERENCES
T_MedItem
)
go

CREATE TABLE T_INV(
    MedItem VARCHAR(10) NOT NULL,
    FOREIGN KEY (MedItem) REFERENCES
T_INV,
    PRIMARY
KEY(MedItem,CalDate,CalTime,RSSSts,Lct,R
SNo), UNIQUE(
MedItem,CalDate,CalTime,RSSSts,Lct,RSNo))
go

CREATE TABLE T_Pt(
    HN VARCHAR(9) NOT NULL,
    PName VARCHAR(15) NOT NULL,
    FName VARCHAR(25) NOT NULL,
    LName VARCHAR(25) NOT NULL,
    BrthDT DATETIME() NOT NULL,
    DthDT DATETIME(),
    Mate VARCHAR(4) NOT NULL,
    BloodGrp VARCHAR(4),
    Allergy VARCHAR(30),
    MrtLSt VARCHAR(4),
    PtType VARCHAR(4) NOT NULL,
    FOREIGN KEY (PtType) REFERENCES
T_PtType,
    PRIMARY KEY(HN))
go

CREATE TABLE T_StockCard(
    NewQOH NUMERIC(9,2),
    OldQOH NUMERIC(9,2),
    ActiveQ NUMERIC(9,2),
    MedItem VARCHAR(10) NOT NULL,
    CalDate DATETIME() NOT NULL,
    CalTime NUMERIC(9,2) NOT NULL,
    RSSSts VARCHAR(1) NOT NULL,
    Lct VARCHAR(5) NOT NULL,
    RSNNo NUMERIC(9,0) NOT NULL,

```

**Figure 4.72** DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose. (Continue)

```

AN VARCHAR(9) NOT NULL,
RgtDT DATETIME() NOT NULL,
PreDiag VARCHAR(30),
DchDT DATETIME(),
Weight NUMERIC(3,0),
PtTypeCardNo VARCHAR(10),
RgtTM NUMERIC(8,0) NOT NULL,
DchTM NUMERIC(8,0),
Dpm VARCHAR(2) NOT NULL,
FOREIGN KEY (Dpm) REFERENCES
T_Ward,
PtType VARCHAR(4) NOT NULL,
FOREIGN KEY (PtType) REFERENCES
T_PtType,
Lct VARCHAR(5) NOT NULL,
FOREIGN KEY (Lct) REFERENCES
T_RfrLct,
Lct2 VARCHAR(5) NOT NULL,
FOREIGN KEY (Lct) REFERENCES
T_RfrLct,
RfrCs VARCHAR(4) NOT NULL,
FOREIGN KEY (RfrCs) REFERENCES
T_RfrCs,
RfrCs2 VARCHAR(4) NOT NULL,
FOREIGN KEY (RfrCs) REFERENCES
T_RfrCs,
DchStts VARCHAR(4) NOT NULL,
FOREIGN KEY (DchStts) REFERENCES
T_DchStts,
DchType VARCHAR(4) NOT NULL,
FOREIGN KEY (DchType) REFERENCES
T_DchType,
Stf VARCHAR(5) NOT NULL,
FOREIGN KEY (Stf) REFERENCES
T_Dct,
Stf2 VARCHAR(5) NOT NULL,
FOREIGN KEY (Stf) REFERENCES T_Nu,
Stf3 VARCHAR(5) NOT NULL,
FOREIGN KEY (Stf) REFERENCES T_Nu,
HN VARCHAR(9) NOT NULL,
FOREIGN KEY (HN) REFERENCES T_Pt,
PRIMARY KEY(AN)
go
CREATE TABLE T_IPtAdm(
InDT DATETIME() NOT NULL,
RoomNo VARCHAR(5) NOT NULL,
BedNo VARCHAR(5),
DayCnt NUMERIC(4),
OutDT DATE(),
InTM NUMERIC(8,0) NOT NULL,
OutTM NUMERIC(8,0),

```

**Figure 4.72** DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose. (Continue)

```

AN VARCHAR(9) NOT NULL,
FOREIGN KEY (AN) REFERENCES
T_Ipt,
BedType VARCHAR(2) NOT NULL,
FOREIGN KEY (BedType) REFERENCES
T_BedType,
PaidSt VARCHAR(4) NOT NULL,
FOREIGN KEY (PaidSt) REFERENCES
T_PaidSt,
RcptNo VARCHAR(9) NOT NULL,
FOREIGN KEY (RcptNo) REFERENCES
T_Rcpt,
Stf VARCHAR(5) NOT NULL,
FOREIGN KEY (Stf) REFERENCES T_Nu,
PRIMARY KEY(InDT,AN,InTM),
UNIQUE( InDT,AN,InTM))
go
CREATE TABLE T_IptDct(
FDT DATETIME() NOT NULL,
LDT DATETIME(),
FTM NUMERIC(8,0) NOT NULL,
LTM NUMERIC(8,0),
AN VARCHAR(9) NOT NULL,
FOREIGN KEY (AN) REFERENCES
T_Ipt,
FOREIGN KEY (Stf) REFERENCES
T_Dct,
PRIMARY KEY(FDT,AN,FTM),
UNIQUE( FDT,AN,FTM))
go
CREATE TABLE T_IptDiag(
ItemNo NUMERIC(2) NOT NULL,
AN VARCHAR(9) NOT NULL,
FOREIGN KEY (AN) REFERENCES
T_Ipt,
Stf VARCHAR(5) NOT NULL,
FOREIGN KEY (Stf) REFERENCES
T_Dct,
ICD10 VARCHAR(7) NOT NULL,
FOREIGN KEY (ICD10) REFERENCES
T_ICD10,
Splcty VARCHAR(4) NOT NULL,
FOREIGN KEY (Splcty) REFERENCES
T_Splcty,
ICD10 VARCHAR(7) NOT NULL,
FOREIGN KEY (ICD10) REFERENCES
T_ICD10,
PRIMARY KEY(ItemNo,AN),
UNIQUE( ItemNo,AN))
go

```

**Figure 4.69** DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose. (Continue)

```

CREATE TABLE T_IPtOprt(
    IPtOprtDT DATETIME() NOT NULL,
    IPtOprtTM NUMERIC(8,0) NOT NULL,
    ICD9CM VARCHAR(7) NOT NULL,
    FOREIGN KEY (ICD9CM) REFERENCES
    T_ICD10,
    PRIMARY KEY(ItemNo,AN),
    UNIQUE( ItemNo,AN))
T_ICD9CM,
Stf VARCHAR(5) NOT NULL,
FOREIGN KEY (Stf) REFERENCES
T_Dct,
AN VARCHAR(9) NOT NULL,
FOREIGN KEY (AN) REFERENCES
T_IPt,
PRIMARY
KEY(IPtOprtDT,AN,IPtOprtTM),
UNIQUE( IPtOprtDT,AN,IPtOprtTM))
go

CREATE TABLE T_Prsc(
    PrscNo NUMERIC(9) NOT NULL,
    PrscDT DATETIME() NOT NULL,
    DailyNote VARCHAR(200),
    DscAmt NUMERIC(9,2),
    SOtpDT DATETIME(),
    PrscTM NUMERIC(9,2) NOT NULL,
    SOtpTM NUMERIC(8,0),
    AN VARCHAR(9) NOT NULL,
    FOREIGN KEY (AN) REFERENCES
    T_IPt,
    PtType VARCHAR(4) NOT NULL,
    FOREIGN KEY (PtType) REFERENCES
    T_PtType,
    PaidSt VARCHAR(4) NOT NULL,
    FOREIGN KEY (PaidSt) REFERENCES
    T_PaidSt,
    RcptNo VARCHAR(9) NOT NULL,
    FOREIGN KEY (RcptNo) REFERENCES
    T_Rcpt,
go

CREATE TABLE T_IPtDeath(
    ItemNo NUMERIC(2) NOT NULL,
    AN VARCHAR(9) NOT NULL,
    FOREIGN KEY (AN) REFERENCES
    T_IPt,
    Splcty VARCHAR(4) NOT NULL,
    FOREIGN KEY (Splcty) REFERENCES
    T_Splcty,
    ICD10 VARCHAR(7) NOT NULL,

```

**Figure 4.72** DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose.(Continue)

```

FOREIGN KEY (Stf) REFERENCES T_Nu,
Stf2 VARCHAR(5) NOT NULL,
FOREIGN KEY (Stf) REFERENCES T_Ps,
RcptNo VARCHAR(9) NOT NULL,
FOREIGN KEY (RcptNo) REFERENCES
T_Rcpt,
PRIMARY KEY(PrscNo))
go
CREATE TABLE T_PrscDt(
PrscQty NUMERIC(9) NOT NULL,
SaleRate NUMERIC(9,2),
RfmdAmt NUMERIC(9,2),
Dose NUMERIC(5),
StopDT DATETIME(),
NoOfDays NUMERIC(2),
PDtTM1 NUMERIC(8,0),
PDtTM2 NUMERIC(8,0),
PDtTM3 NUMERIC(8,0),
PDtTM4 NUMERIC(8,0),
PDtTM5 NUMERIC(8,0),
PDtTM6 NUMERIC(8,0),
StopTM NUMERIC(8,0),
PrscDT DATETIME() NOT NULL,
OrderType VARCHAR(1) NOT NULL,
PrscNo NUMERIC(9) NOT NULL,
FOREIGN KEY (PrscNo) REFERENCES
T_Prsc,
Frequency VARCHAR(5) NOT NULL,
FOREIGN KEY (Frequency)
REFERENCES T_Frequency,
Stf VARCHAR(5) NOT NULL,
FOREIGN KEY (Stf) REFERENCES T_Ps,
MedItem VARCHAR(10) NOT NULL,
FOREIGN KEY (MedItem) REFERENCES
T_INV,
PRIMARY
KEY(PrscNo,MedItem,PrscDT,Frequency,Ord
erType),
UNIQUE( PrscNo,MedItem,PrscDT,
Frequency,OrderType))
Go
CREATE TABLE T_ErrPrscDt(
PrscQty NUMERIC(9,0) NOT NULL,
SaleRate NUMERIC(9,2),
RfmdAmt VARCHAR(),
Dose NUMERIC(5,0),
StopDT DATETIME(),
NoOfDays NUMERIC(2,0),
PDtTM1 NUMERIC(8,0),
PDtTM2 NUMERIC(8,0),
PDtTM3 NUMERIC(8,0),
PDtTM4 NUMERIC(8,0),
PDtTM5 NUMERIC(8,0),
PDtTM6 NUMERIC(8,0),

```

Figure 4.72 DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose. (Continue)

```

StopTM NUMERIC(8,0),
PDtDT NUMERIC(8,0) NOT NULL,
OrderType VARCHAR(1) NOT NULL,
PrscNo NUMERIC(9) NOT NULL,
FOREIGN KEY (PrscNo) REFERENCES
T_Prsc,
Frequency VARCHAR(5) NOT NULL,
FOREIGN KEY (Frequency)
REFERENCES T_Frequency,
Stf VARCHAR(5) NOT NULL,
FOREIGN KEY (Stf) REFERENCES T_Ps,
PrscNo NUMERIC(9) NOT NULL,
FOREIGN KEY (PrscNo) REFERENCES
T_Prsc,
Frequency VARCHAR(5) NOT NULL,
FOREIGN KEY (Frequency)
REFERENCES T_Frequency,
MedItem VARCHAR(10) NOT NULL,
FOREIGN KEY (MedItem) REFERENCES
T_INV,
PRIMARY
KEY(PrscNo,MedItem,Frequency,PDtDT,Order
rType), UNIQUE(
PrscNo,MedItem,Frequency,PDtDT,OrderType
))
go

CREATE TABLE T_Sinp(
SinpNo NUMERIC(9) NOT NULL,
SinpDT DATETIME() NOT NULL,
Note VARCHAR(40),
SinpTM NUMERIC(8,2) NOT NULL,
Lct VARCHAR(5) NOT NULL,
FOREIGN KEY (Lct) REFERENCES
T_SPhmLct,
SinpType VARCHAR(2) NOT NULL,
FOREIGN KEY (SinpType) REFERENCES
T_SinpType,
PRIMARY KEY(SinpNo,Lct), UNIQUE(
SinpNo,Lct))
go

CREATE TABLE T_MRqt(
MOtpNo NUMERIC(9),
Note VARCHAR(40),
RqtDT DATETIME() NOT NULL,
RqtTM NUMERIC(8,2) NOT NULL,
Lct VARCHAR(5) NOT NULL,
FOREIGN KEY (Lct) REFERENCES
T_RqtLct,
PRIMARY KEY(Lct,RqtDT,RqtTM),
UNIQUE( Lct,RqtDT,RqtTM))
go

```

**Figure 4.72** DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose. (Continue)

```

CREATE TABLE T_MRqtDt(
    RqtDT DATETIME() NOT NULL,
    MedItem VARCHAR(10) NOT NULL,
    PackQty NUMERIC(5) NOT NULL,
    RqtQty NUMERIC(5) NOT NULL,
    RqtTM NUMERIC(8,2) NOT NULL,
    Lct VARCHAR(5) NOT NULL,
    RqtDT DATETIME() NOT NULL,
    RqtTM NUMERIC(8,2) NOT NULL,
    FOREIGN KEY (Lct) REFERENCES
T_MRqt,
    FOREIGN KEY (RqtDT) REFERENCES
T_MRqt,
    FOREIGN KEY (RqtTM) REFERENCES
T_MRqt,
    SInpNo NUMERIC(9) NOT NULL,
    Lct2 NUMERIC(5) NOT NULL,
    FOREIGN KEY (SInpNo) REFERENCES
T_SInp,
    FOREIGN KEY (Lct) REFERENCES
T_SInp,
    MedItem VARCHAR(10) NOT NULL,
    FOREIGN KEY (MedItem) REFERENCES
T_INV,
    PRIMARY
KEY(Lct,RqtDT,MedItem,RqtTM),
    UNIQUE( Lct,RqtDT,MedItem,RqtTM))
go

CREATE TABLE T_SInpDt(
    InpQty NUMERIC(9),
    SInpNo NUMERIC(9) NOT NULL,
    Lct NUMERIC(5) NOT NULL,
    FOREIGN KEY (SInpNo) REFERENCES
T_SInp,
    FOREIGN KEY (Lct) REFERENCES
T_SInp,
    MedItem VARCHAR(10) NOT NULL,
    FOREIGN KEY (MedItem) REFERENCES
T_INV,
    PRIMARY KEY(Lct,SInpNo,MedItem),
    UNIQUE( Lct,SInpNo,MedItem))
go

CREATE TABLE T_SOtp(
    SOtpNo NUMERIC(9) NOT NULL,
    OtpDT DATETIME() NOT NULL,
    OtpTM NUMERIC(8,2) NOT NULL,
    SOtpType VARCHAR(3) NOT NULL,
    FOREIGN KEY (SOtpType)
REFERENCES T_SOtpType,
    Lct VARCHAR(5) NOT NULL,
    FOREIGN KEY (Lct) REFERENCES
T_SPhmLct,
    PRIMARY KEY(SOtpNo,Lct), UNIQUE(
SOtpNo,Lct))
go

```

**Figure 4.72** DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose.(Continue)

```

CREATE TABLE T_SOtpDt(
    OtpQty NUMERIC(9),
    OtpDT DATETIME() NOT NULL,
    SOtpNo NUMERIC(9) NOT NULL,
    Lct NUMERIC(5) NOT NULL,
    FOREIGN KEY (SOtpNo) REFERENCES
T_SOtp,
    FOREIGN KEY (Lct) REFERENCES
T_SOtp,
    MedItem VARCHAR(10) NOT NULL,
    FOREIGN KEY (MedItem) REFERENCES
T_INV,
    PRIMARY KEY(Lct,SOtpNo,MedItem),
UNIQUE( Lct,SOtpNo,MedItem))
go

CREATE TABLE T_SOtpNote(
    Note VARCHAR(40),
    OtpDT DATETIME() NOT NULL,
    SOtpNo NUMERIC(9) NOT NULL,
    Lct NUMERIC(5) NOT NULL,
    FOREIGN KEY (SOtpNo) REFERENCES
T_SOtp,
    FOREIGN KEY (Lct) REFERENCES
T_SOtp,
    PRIMARY KEY(Lct,SOtpNo), UNIQUE(
Lct,SOtpNo))
go

CREATE TABLE T_IncOth(
    IncOthDT DATETIME() NOT NULL,
    RcptAmt NUMERIC(9,2),
    IncOthTM NUMERIC(9,2) NOT NULL,
    CalAmt NUMERIC(9,2) NOT NULL,
    DscAmt NUMERIC(9,2) NOT NULL,
    RmnAmt NUMERIC(9,2) NOT NULL,
    NoOfItems NUMERIC(9) NOT NULL,
    RcptNo VARCHAR(9) NOT NULL
UNIQUE,
    FOREIGN KEY (RcptNo) REFERENCES
T_Rcpt,
    PaidSt VARCHAR(4) NOT NULL
UNIQUE,
    FOREIGN KEY (PaidSt) REFERENCES
T_PaidSt,
    PtType VARCHAR(4) NOT NULL
UNIQUE,
    FOREIGN KEY (PtType) REFERENCES
T_PtType,
    HN VARCHAR(9) NOT NULL UNIQUE,
    FOREIGN KEY (HN) REFERENCES T_Pt,
    Income VARCHAR(4) NOT NULL
UNIQUE,
    FOREIGN KEY (Income) REFERENCES
T_Income,
    Stf VARCHAR(5) NOT NULL UNIQUE,

```

**Figure 4.72** DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose. (Continue)

```

FOREIGN KEY (Stf) REFERENCES T_Nu,
PRIMARY
KEY(HN,IncOthDT,Income,IncOthTM),
UNIQUE(
HN,IncOthDT,Income,IncOthTM))
go
CREATE TABLE T_Rcpt(
RcptNo VARCHAR(9) NOT NULL ,
RcptDT DATETIME(),
PRIMARY KEY(RcptNo))
FOREIGN KEY (RcptSt) REFERENCES
T_RcptSt,
FOREIGN KEY (PtType) REFERENCES
T_PtType,
RcptSt VARCHAR(4) NOT NULL
UNIQUE,
FOREIGN KEY (RcptSt) REFERENCES
T_RcptSt,
PRIMARY KEY(RcptNo))

```

Figure 4.72 DDL script file, which is generated from classes of computerized unit-dose drug distribution system by Rational Rose.(Continue)

- The resultant DDL will be verified and then be taken to and imported into database : Microsoft SQL Server version 7.0. And then a conceptual data model of a computerized unit-dose drug distribution system will be created as shown in figure 4.73 - .

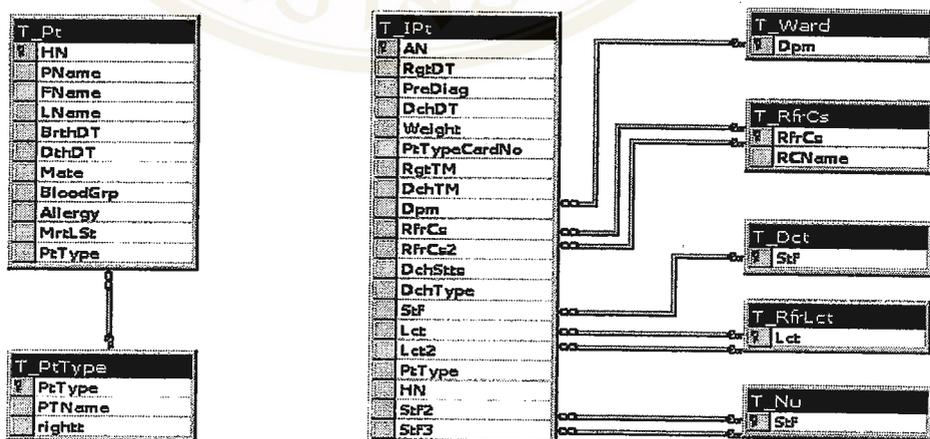


Figure 4.73 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 1.1 : Patient's registration updation.

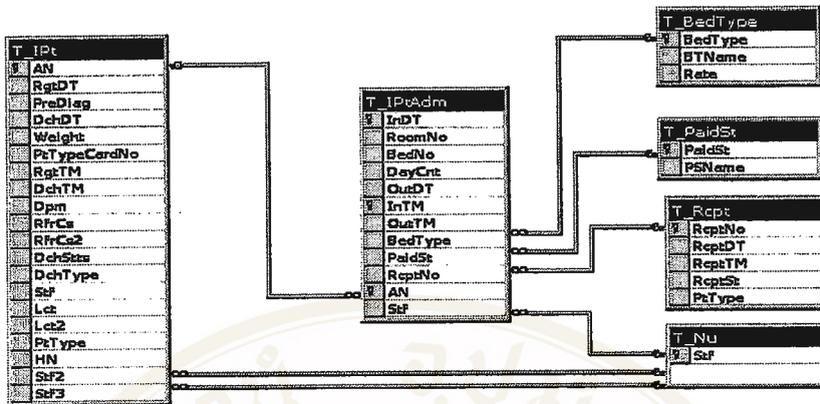


Figure 4.74 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 1.2 : Patient's in-ward management.

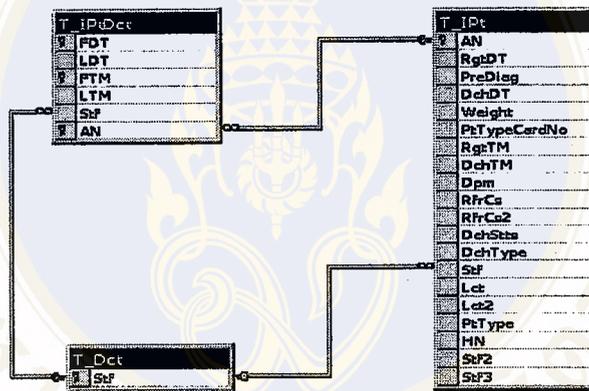


Figure 4.75 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 2.1 : Doctor for each patient.

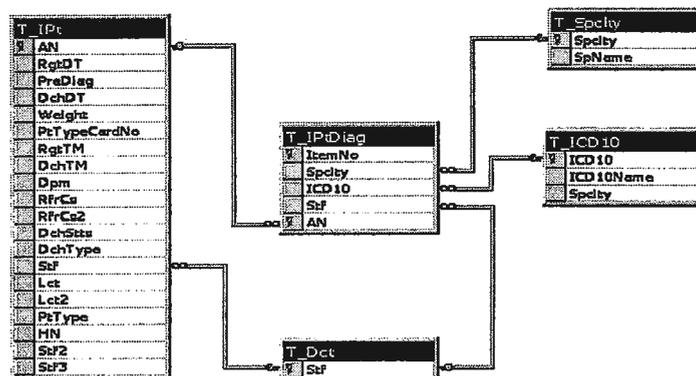


Figure 4.76 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 2.2 : Patient's diagnosis.

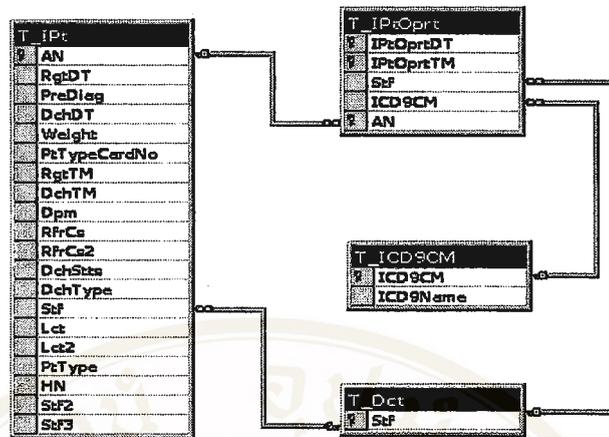
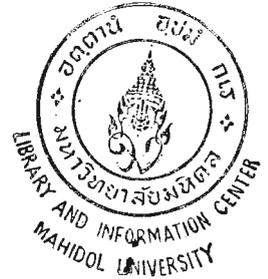


Figure 4.77 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 2.3 : Patient's Operation.

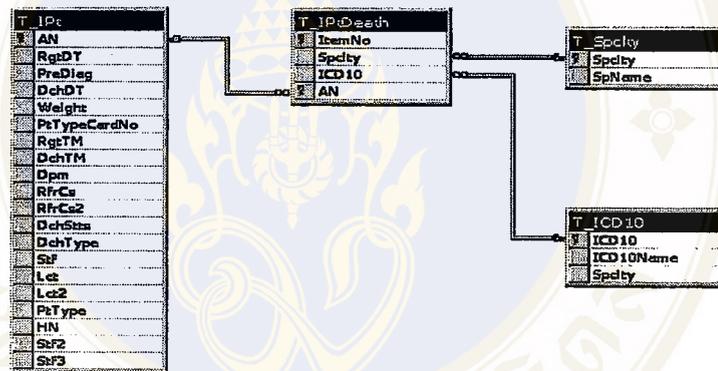


Figure 4.78 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 2.4 : Patient's Death diagnosis.

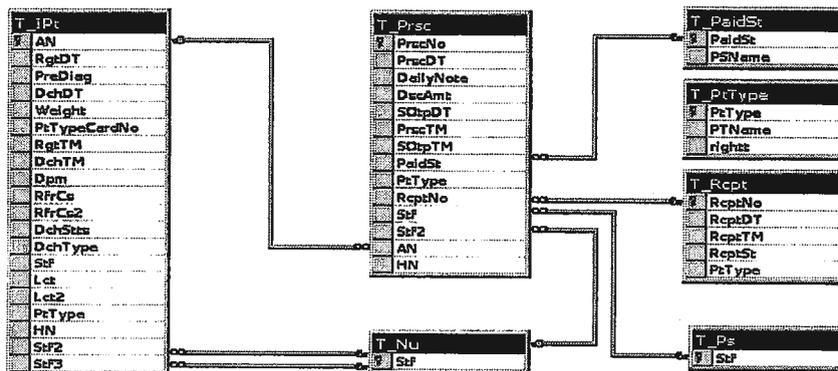


Figure 4.79 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 2.5 : Patient's Medication : Prescription.

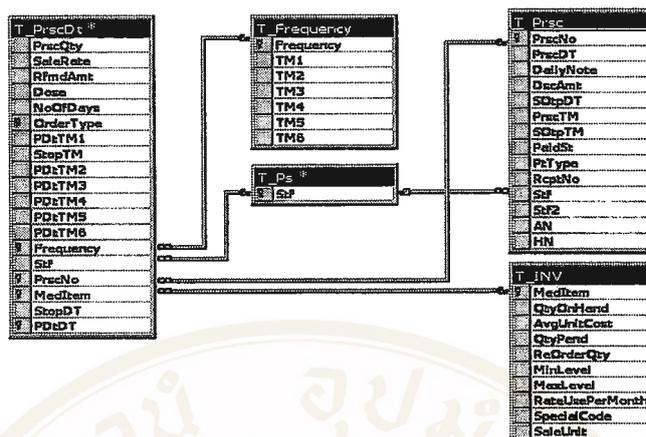


Figure 4.80 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 2.5 : Patient’s Medication : Drugs and Services.

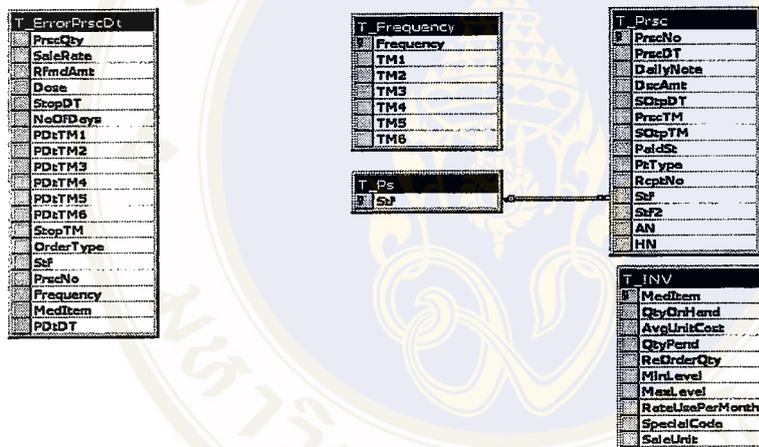


Figure 4.81 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 2.5 : Patient’s Medication : Drugs and Services with Errors.

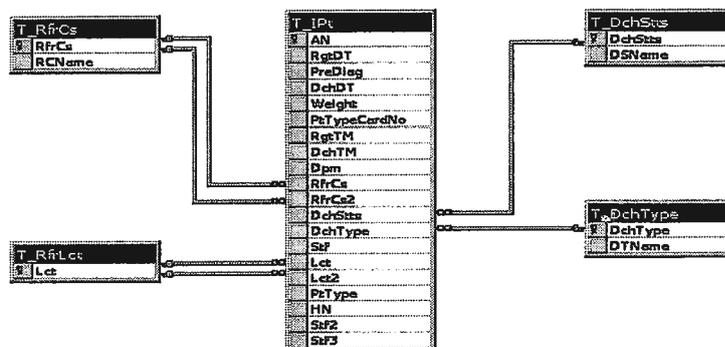


Figure 4.82 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 3.2 : Patient’s Discharge Updation

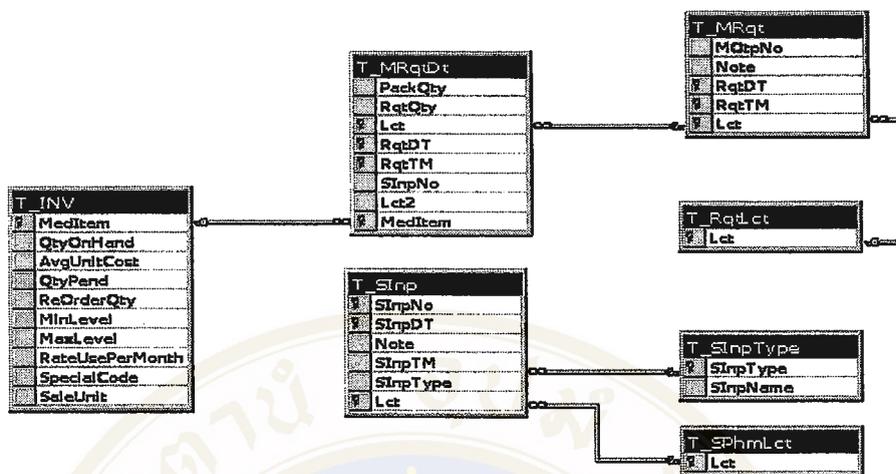


Figure 4.83 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 4.1 : Drug Requirement.

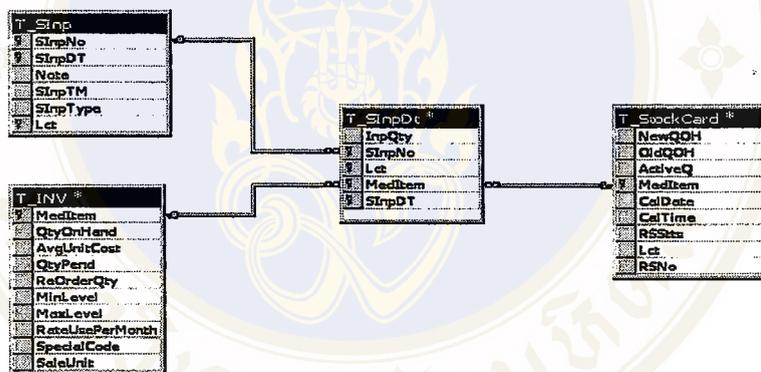


Figure 4.84 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 4.2 : Drug Receive.

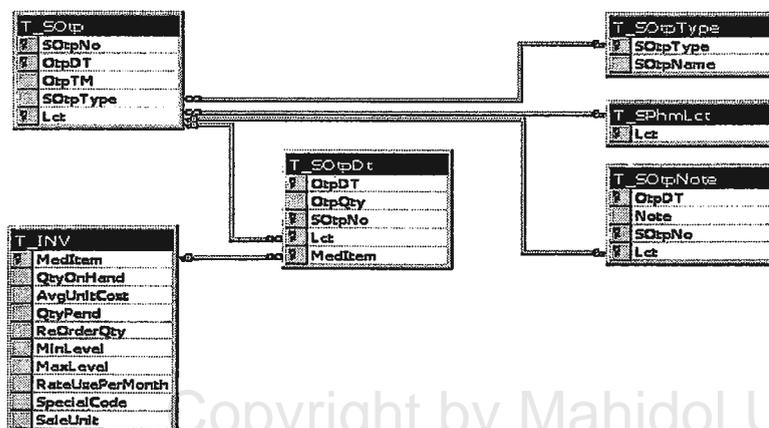
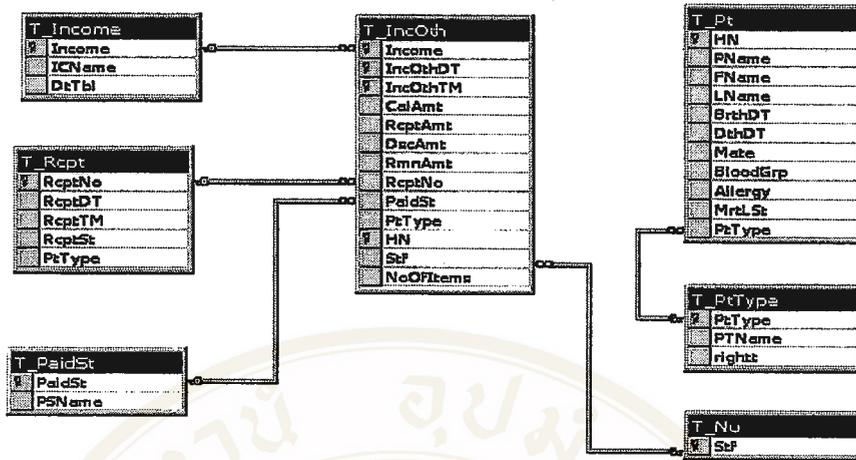


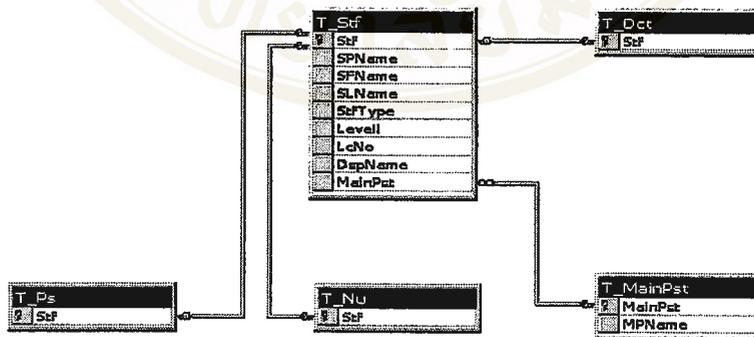
Figure 4.85 Conceptual data model of a computerized unit-dose drug distribution system for sub-system 4.3 : Drug Dispense.



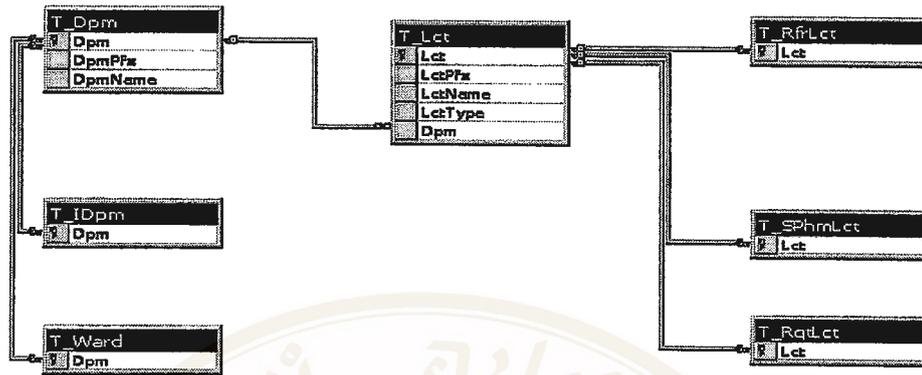
**Figure 4.86** Conceptual data model of a computerized unit-dose drug distribution system for sub-system 5.6 : Value for Patient's Medication.



**Figure 4.87** Conceptual data model of a computerized unit-dose drug distribution system for sub-system 6 : Calculating Cost.



**Figure 4.88** Conceptual data model of a computerized unit-dose drug distribution system for sub-system 7.1. : Personal data.



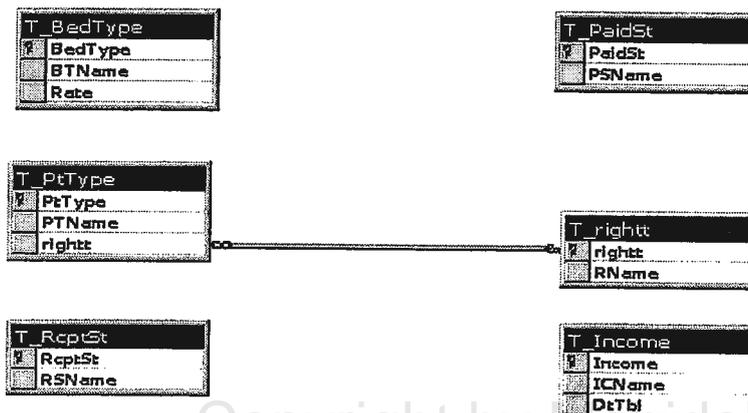
**Figure 4.89** Conceptual data model of a computerized unit-dose drug distribution system for sub-system 7.2. : Department data.



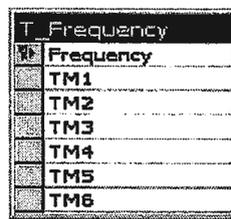
**Figure 4.90** Conceptual data model of a computerized unit-dose drug distribution system for sub-system 7.3. : Diagnostic data.



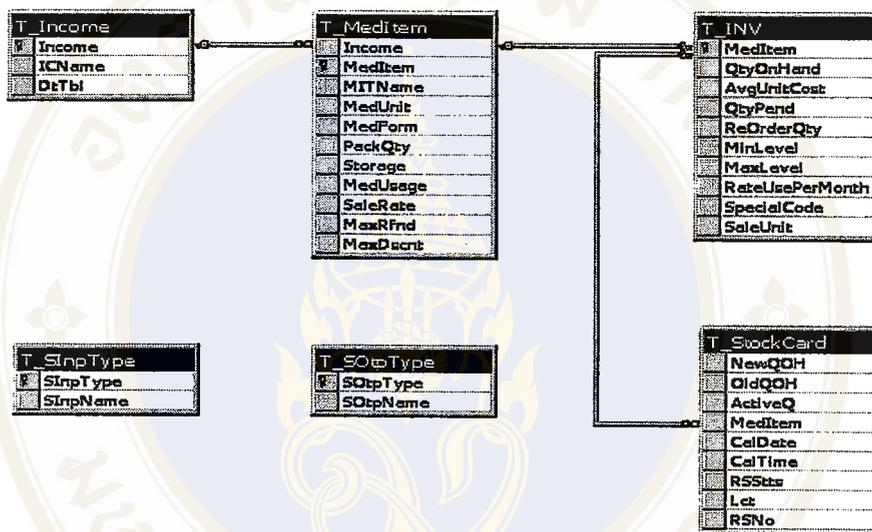
**Figure 4.91** Conceptual data model of a computerized unit-dose drug distribution system for sub-system 7.4. : Discharge data.



**Figure 4.92** Conceptual data model of a computerized unit-dose drug distribution system for sub-system 7.5. : Payment data.



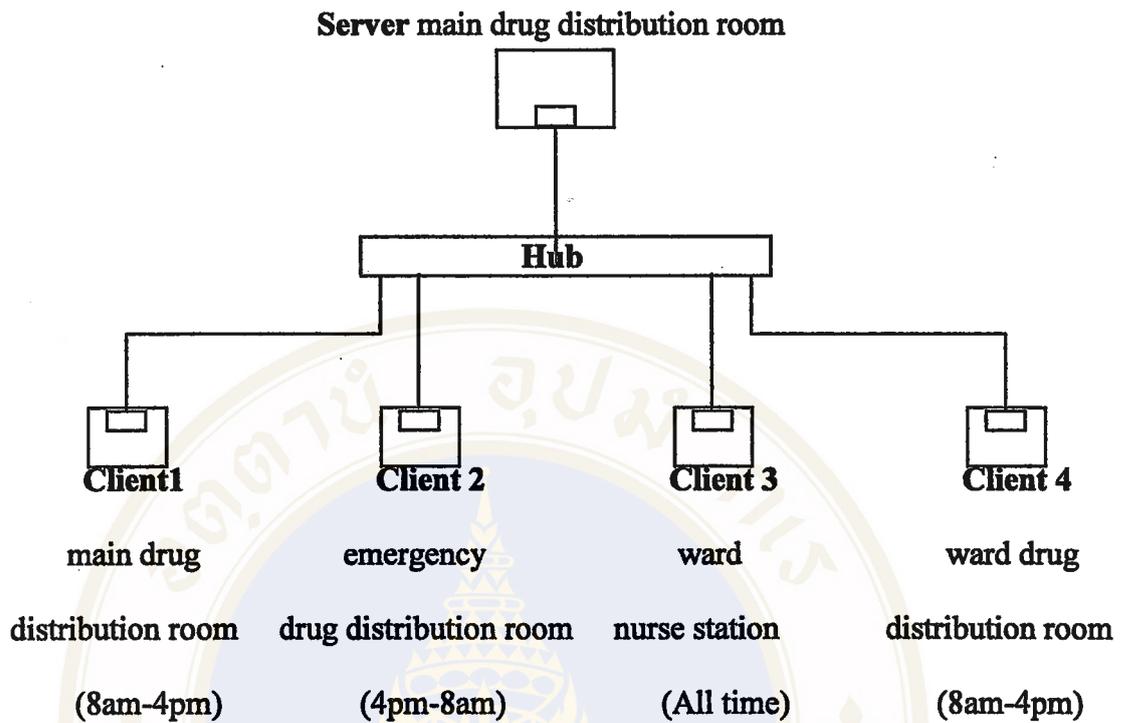
**Figure 4.93** Conceptual data model of a computerized unit-dose drug distribution system for sub-system 7.6. : Dispense data.



**Figure 4.94** Conceptual data model of a computerized unit-dose drug distribution system for sub-system 7.7. : Drug data.

e. Identification of global resources.

Resources that will be used in computerized unit-dose drug distribution are described in figure 4.95.

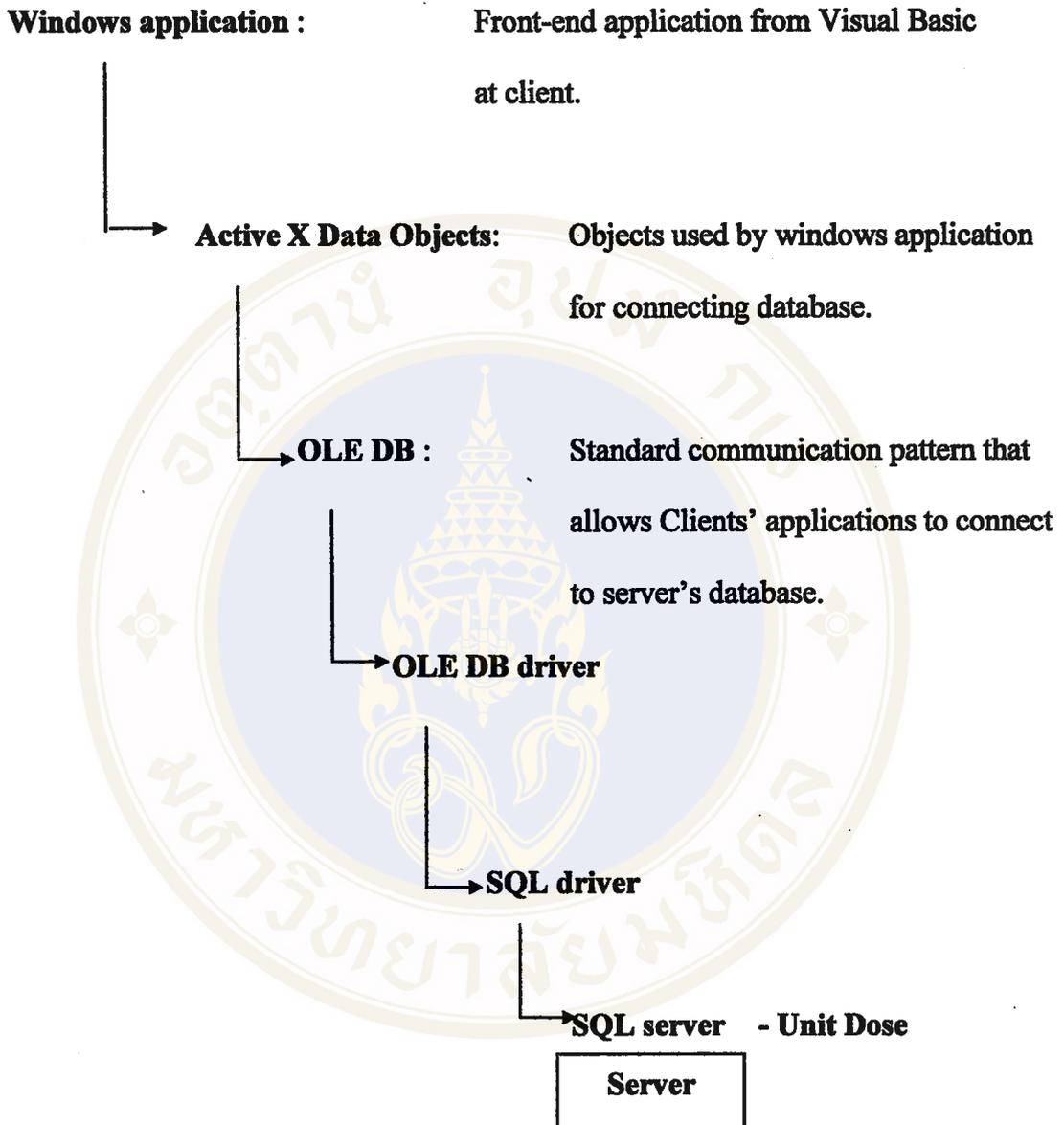


**Figure 4.95** Resources that will be used in computerized unit-dose drug distribution.

Resources that will be used in computerized unit-dose drug distribution are consisted of .:

- **Computers :**
  - **Server :** back-end file and database server
  - **Client stations**
- **LAN cable system :**
  - **10BaseT :** IEEE 802.3 for Ethernet on UTP, 10 Mbps, baseband
  - **Media Access Control :** CSMA/CD, UTP with Star topology
  - **Network adapter card :** Ethernet card
  - **Network media :** unshielded-twisted pair Category 5  
(22/24 AWG with impedance 100 Ω.)
  - **Connector :** RJ-45
  - **Hub :** Ethernet Hub(10BaseT Standard Hub)

Controlling access from clients to server is described in figure 4.96.



**Figure 4.96** Controlling access from clients to server in computerized unit-dose drug distribution.

f. Implementation of software control :

- Server software : File and database server
- Network Operating System
- Network communication software for standard network protocol

- Driver for network adapter card
- Client software :
  - Operating system
  - Network communication software for standard network protocol
  - Application Program Interface (API)
  - Driver for network adapter card

#### 4.1.4. Object design phase

#### 4.1.5 System implementation

From all of the design models from the previous phases, these design models are mapped into a particular language; **coding**; which is a localized process, as all the global decisions have been made already. In this computerized unit-dose drug distribution system, Microsoft Visual Basic 6.0 is chosen to create front-end window application. Users at client stations will interact with the system by using this application, which uses 'Active-X Data Object : ADO' for connecting database, which is stored in a server machine with Microsoft SQL Server 7.0 as database management system. This connecting must use standard communication patterns called 'OLE DB', that allows clients applications to connect to server's database.

When a user opens an application, log-in form is shown for the user to input user name and pass word as figure 4.97.

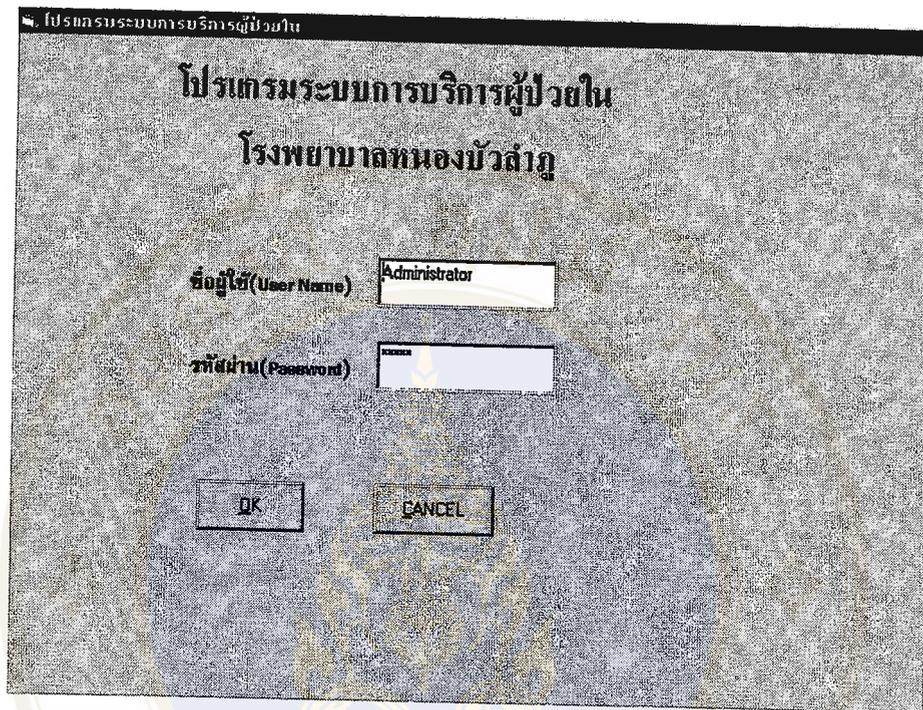


Figure 4.97 Front-end application of computerized unit-dose drug distribution : log-in form.

If the user input a right user ID and a right password. The message box will display for successfully database connecting as figure 4.98. And if user clicks 'OK' button, MDI form is appeared as figure 4.99.

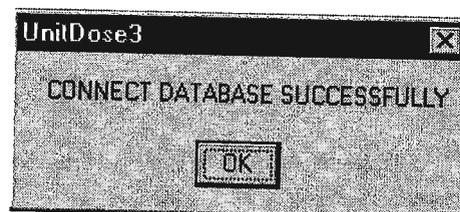
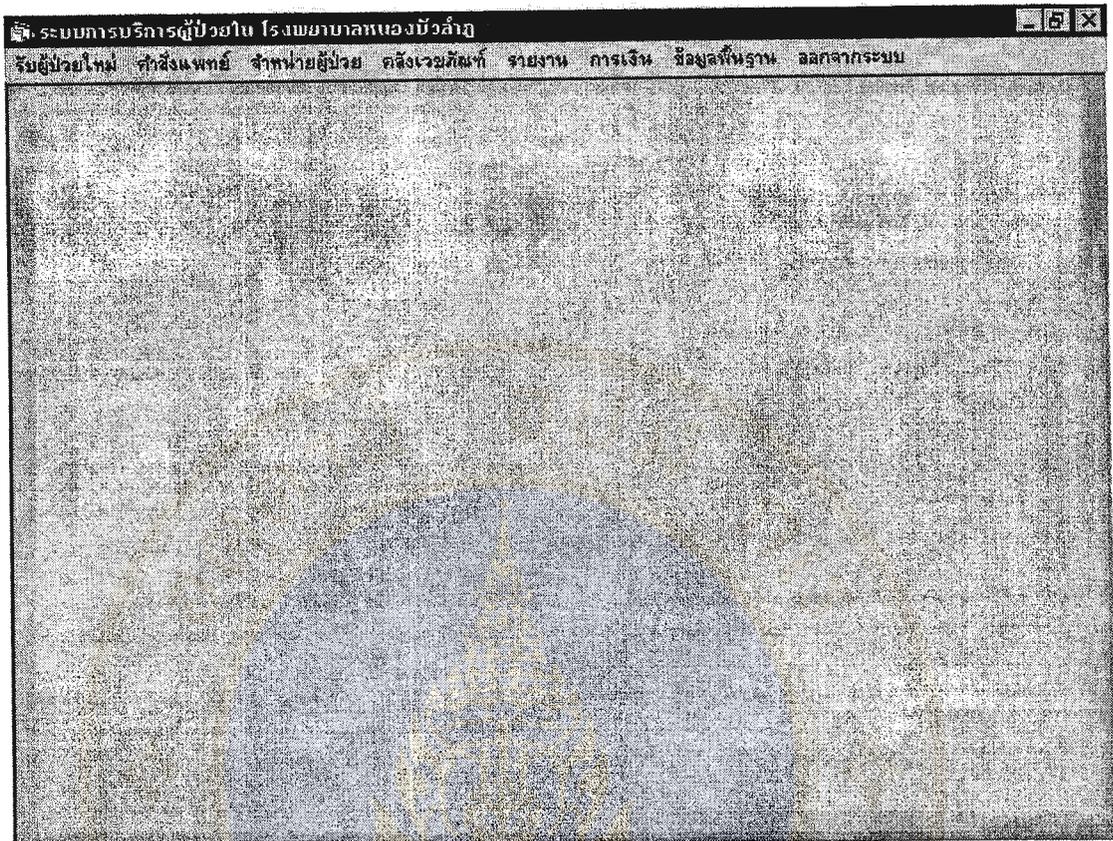


Figure 4.98 Front-end application of computerized unit-dose drug distribution : message box for successfully database connecting .



**Figure 4.99** Front-end application of computerized unit-dose drug distribution : MDI form.

The application is divided into 7 menus, each includes sub-menu as follows :

Menu 1 : Patient's admission

Menu 2 : Doctor's order for patient's medication

Menu 3 : Patient's discharge

Menu 4 : Drug inventory

Menu 5 : Reporting

Menu 6 : Calculating cost

Menu 7 : Base data



Figure 4.100 Front-end application of computerized unit-dose drug distribution :

Menu 1 : Patient's admission.

ระบบการบริการผู้ป่วยใน โรงพยาบาลหนองบัวลำภู - [ข้อมูลการลงทะเบียนผู้ป่วยใน]

รับผู้ป่วยใหม่ คำสั่งแพทย์ จำนวนผู้ป่วย คลังเวชภัณฑ์ รายงาน การเงิน ข้อมูลพื้นฐาน ลอกจากระบบ

ค้นหาผู้ป่วยในตามเงื่อนไข

HN  AN  ชื่อผู้ป่วย  นามสกุล  ค้นหา

ข้อมูลการลงทะเบียนรับผู้ป่วยใน

HN  AN  ชื่อ-สกุล  ว/ด/ป  เวลา   
ลงทะเบียน

กลุ่มงาน  ประเภท  เลขที่บัตร   
ลงทะเบียน

การวินิจฉัย  แพทย์ที่รับผู้ป่วยใน   
เบื้องต้น  พยาบาลที่รับผู้ป่วยใหม่

สถานที่  เหตุผล   
รับต่อ  การรับต่อ

ข้อมูลการลงทะเบียนจำหน่ายผู้ป่วยใน

สถานะ  ว/ด/ป  เวลา   
การจำหน่าย  จำหน่าย

ประเภท  พยาบาลที่จำหน่ายผู้ป่วย   
การจำหน่าย

สถานที่  เหตุผล   
ส่งต่อ  การส่งต่อ

จบหน้าจอ  ยืนยันผลการลงทะเบียนผู้ป่วยใน  แก้ไขการลงทะเบียนผู้ป่วยใน  ยืนยันผลการจำหน่ายผู้ป่วยใน  จบการทำงาน

Figure 4.101 Front-end application of computerized unit-dose drug distribution :

Patient's registration updation form.

ระบบการบริการผู้ป่วยใน โรงพยาบาลทองบึงลำภู - [การรับผู้ป่วยใน]

รับผู้ป่วยใหม่ คำสั่งแพทย์ คำนำส่งผู้ป่วย คลังเวชภัณฑ์ รายงาน การเงิน วัสดุพื้นฐาน ออกจากระบบ

ค้นหาผู้ป่วยในตามเงื่อนไข

Hospital Number  Admission Number

ชื่อ - สกุล รับผู้ป่วย  ค้นหา

---

HN  AN  ชื่อ - สกุล  ภาควิชา

---

วันเดือนปีที่เข้าพัก  เวลาที่เข้าพัก  จำนวนวัน

หมายเลขเตียง  หมายเลขเตียง  ประเภทเตียง

วันเดือนปีที่ที่ออก  เวลาที่ออก

พยาบาลที่รับผู้ป่วย  สถานะการชำระเงิน

รับใบ  บัตรคิว  นกใจ  สม  ลอก

Figure 4.102 Front-end application of computerized unit-dose drug distribution : Patient's in-ward management form.

ระบบการบริการผู้ป่วยใน โรงพยาบาลทองบึงลำภู - [สถานะเตียงผู้ป่วย]

รับผู้ป่วยใหม่ คำสั่งแพทย์ คำนำส่งผู้ป่วย คลังเวชภัณฑ์ รายงาน การเงิน วัสดุพื้นฐาน ออกจากระบบ

เตียงผู้ป่วย  ร/ต/บ  เวลา  จำนวนเตียงที่มีผู้ป่วยอยู่  จำนวนเตียงว่าง

เตียงสามัญ

1	2 นางดา อวยสินทร์	3	4 นางทองปาน นาม่าง
5 นางคำ ประดับมงคล	6 นางฉวีพร วงษา	7 นางจันทร์ใจดี ศิริจันทร์	8 นางศรีสม ศิริจันทร์
9	10	11	12 นางศรี พิทยา
13 นางพนม สีธาราม	14 นางสาวฉวีระจนะ ไชยศิริ	15 นางพลอย ทองนาค	16 นางนงน พานฉัตรินทร์
17 นายอดุล พงษ์สงวน	18	19 นายศักดิ์ มีงศพาน	20 นายสงวน รื่นกา
21 นายสุนทลง พงษ์ศิริพจน	22	23	24 นายคำ พิทยา
25 นายอดุล สงคพจน	26 นายศุภพร สันพันธ์ทอง	27 นายพิเชิฐ สุตาภิเศก	28 นายเรวัตวิธ มาพหศิริ
29	30 นายประชา พงษ์ศักดิ์	31	32

Figure 4.103 Front-end application of computerized unit-dose drug distribution : Patient's in-ward bed status.

Figure 4.104 Front-end application of computerized unit-dose drug distribution : Patient's new medication.

รายนามแพทย์ที่ดูแลผู้ป่วยใน ผลการวินิจฉัยผู้ป่วย การผ่าตัดของผู้ป่วย การเสียชีวิตของผู้ป่วย คำสั่งการรักษาผู้ป่วย บันทึกการใช้ยาของผู้ป่วย	

Figure 4.105 Front-end application of computerized unit-dose drug distribution : Menu 2 : Doctor's orders for patient's medication.

ระบบการบริการผู้ป่วยใน [โรงพยาบาลทองบวัก] - [รายชื่อยาที่ออกให้ผู้ป่วย]

โรงพยาบาลทองบวัก 42000001 42000001 นายชัยณรงค์ เป้าจิกษา

HN: 420000001 AN: 420000001 ชื่อ-สกุลผู้ป่วย: นายชัยณรงค์ เป้าจิกษา

หอผู้ป่วย: กลุ่มงานอายุรกรรม หมายเลขเตียง: 1 หมายเลขเตียง: 3

ชื่อ-สกุลแพทย์	วันที่เริ่มจ่าย	เวลาที่เริ่มจ่าย	วันสุดท้ายที่จ่าย	เวลาที่สุดท้ายที่จ่าย
แพทย์ ทมล	6/24/99	10	6/24/99	20
แพทย์ ทมล	6/25/99	11	6/26/99	21
แพทย์ ทมล	6/26/99	12	6/27/99	22
แพทย์ ทมล	6/27/99	13	6/28/99	23
จินตนา นาสือ	6/28/99	14	6/29/99	24

Figure 4.106 Front-end application of computerized unit-dose drug distribution : Doctor for each in-patient.

ระบบการบริการผู้ป่วยใน [โรงพยาบาลทองบวัก] - [ผลการวินิจฉัยผู้ป่วย]

โรงพยาบาลทองบวัก 42000001 42000001 นายชัยณรงค์ เป้าจิกษา

HN: 420000001 AN: 420000001 ชื่อ-สกุลผู้ป่วย: นายชัยณรงค์ เป้าจิกษา

หอผู้ป่วย: กลุ่มงานอายุรกรรม หมายเลขเตียง: 11 หมายเลขเตียง: 11

ลำดับผลการวินิจฉัย	ชื่อ-สกุลแพทย์	ICD10	สาขาเฉพาะทาง
1	แพทย์ ทมล	Love	อายุรกรรม

Figure 4.107 Front-end application of computerized unit-dose drug distribution : Patient's diagnosis.

ระบบการบริการผู้ป่วยใน โรงพยาบาลทองบวคลักษ์ - [การถ่ายเอกสาร]

โรงพยาบาลทองบวคลักษ์ 42000001 42000001 42000001

ชื่อ - สกุล ของผู้ป่วย นายสิริพงษ์ ใจใจใจ

HN 42000001 AN 42000001 ชื่อ - สกุล ผู้ป่วย นายสิริพงษ์ ใจใจใจ

กลุ่มผู้ป่วย กลุ่มงานอายุรกรรม พยาบาลห้อง 11 พยาบาลเตียง 11

วันที่ทำหัตถการ	เวลาที่ทำการ	ชื่อ - สกุล แพทย์	ICD9CM
6/27/99	12	จินตนา พาสุง	PP
6/28/99	13	จินตนา พาสุง	PP
6/28/99	14	จินตนา พาสุง	PP

คืนใหม่ บันทึก แก้ไข อนุมัติ/ปฏิเสธ ลาก

Figure 4.108 Front-end application of computerized unit-dose drug distribution : Patient's operation.

ระบบการบริการผู้ป่วยใน โรงพยาบาลทองบวคลักษ์ - [การเสียชีวิตของผู้ป่วย]

โรงพยาบาลทองบวคลักษ์ 42000001 42000001 42000001

ชื่อ - สกุล ของผู้ป่วย นายสิริพงษ์ ใจใจใจ

HN 42000001 AN 42000001 ชื่อ - สกุล ผู้ป่วย นายสิริพงษ์ ใจใจใจ

กลุ่มผู้ป่วย กลุ่มงานอายุรกรรม พยาบาลห้อง 11 พยาบาลเตียง 11

ลำดับของการวินิจฉัย	ICD10	สาเหตุของการตาย
1	Love	อายุรกรรม

คืนใหม่ บันทึก แก้ไข อนุมัติ/ปฏิเสธ ลาก

Figure 4.109 Front-end application of computerized unit-dose drug distribution : Patient's death diagnosis.

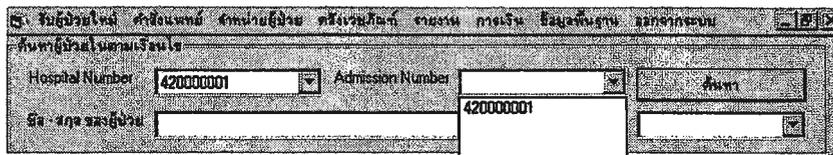


Figure 4.110 Front-end application of computerized unit-dose drug distribution : Searching for admission number by using hospital number.



Figure 4.111 Front-end application of computerized unit-dose drug distribution : Searching for prescription number by using admission number.

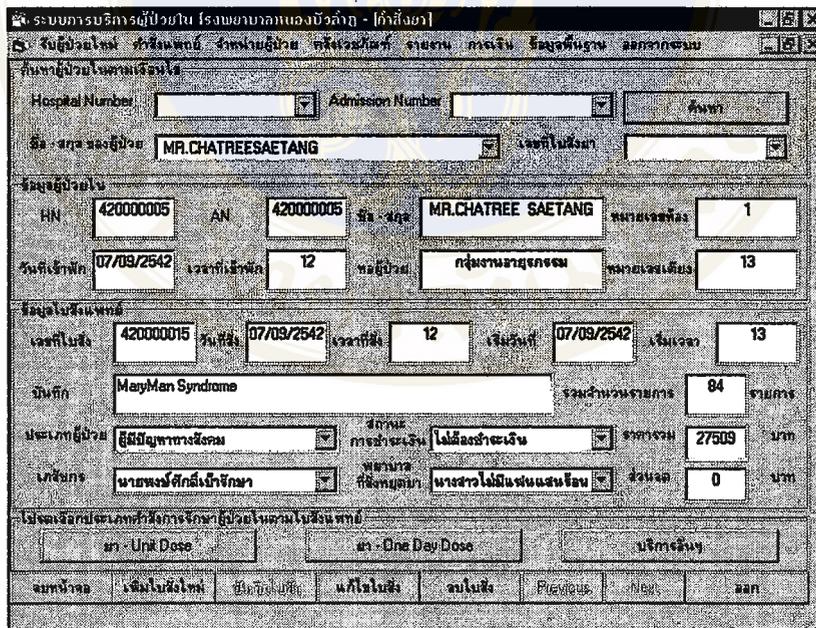


Figure 4.112 Front-end application of computerized unit-dose drug distribution : Prescription for doctor's order for patient's medication.

ระบบการบริการผู้ป่วยใน โรงพยาบาลหนองบัวลำภู - [รายละเอียดยาไปรับส่งยาตามคำสั่งแพทย์]

รับผู้ป่วยใหม่ คำสั่งแพทย์ จากนายผู้ป่วย คลังเวชภัณฑ์ รายงาน การเงิน ข้อมูลพื้นฐาน ออกจากระบบ

เลขที่ใบสั่งยา 43000663 HN 4037678 AN 4037678 ชื่อ-สกุลผู้ป่วย นายเรวัติ ทองเพ็ชร์

วันที่ให้ยา 1/25/00 เวลา 12 ทายผู้ป่วย กลุ่มงานอายุรกรรม ทายเลขห้อง 1 ทายเลขเตียง 1

วันที่ปัจจุบัน 2/22/00 เวลา 1:46:46 PM ประเภทคำสั่งการรักษารองแพทย์ Order for Continuous

ชื่อผู้ส่งยา ชื่อผู้รับยา ผู้ตรวจสอบคำสั่งการรักษารองแพทย์

Order for Continuous

รื้อเวชภัณฑ์	ความถี่	Dose	หน่วย	จำนวนจ่าย
1 ACTIVATED CHARCOAL TAB 325 MG	TID	1	เม็ด	3
2 KAYEXALATE POWDER(กซิม)	QID	15	กรัม	60
3 NEOMYCIN TAB 350 MG	BID	2	เม็ด	4
4 SALBUTAMOL 2 MG TAB (VENTOLIN)	Q12H	1	เม็ด	2
5 TRAMADOL HCL 50 MG.TAB.(TRAMOL)	Q8H	1	เม็ด	3
6 VITAMIN B COMPLEX TAB	Q6H	1	เม็ด	4

จบหน้าจล ฐานหน้าใหม่ มีบันทึก / แก้ไขรายการ ประมวลผลจ่ายเวชภัณฑ์ เวลาหยุดยา มีรหัสยา Previous Next จบ

**Figure 4.113** Front-end application of computerized unit-dose drug distribution : Details in Prescription for doctor's order for patient's medication : Drugs in order for continuous.

รับผู้ป่วยใหม่ คำสั่งแพทย์ จากนายผู้ป่วย คลังเวชภัณฑ์ รายงาน การเงิน ข้อมูลพื้นฐาน ออกจากระบบ

เลขที่ใบสั่งยา 42000015 HN 42000005 AN 42000005 ชื่อ-สกุลผู้ป่วย MR.CHATREE SAETANG

วันที่ให้ยา 9/7/99 เวลา 13 ทายผู้ป่วย กลุ่มงานอายุรกรรม ทายเลขห้อง 1 ทายเลขเตียง 13

วันที่ปัจจุบัน 10/2/99 เวลา 19 : 21 ประเภทคำสั่งการรักษารองแพทย์ Order for Continuous

ชื่อผู้ส่งยา ชื่อผู้รับยา ผู้ตรวจสอบคำสั่งการรักษารองแพทย์

Order for Continuous

Order for One Day  
Order for Continuous  
Order for Home Medication

**Figure 4.114** Front-end application of computerized unit-dose drug distribution : Details in Prescription for doctor's order for patient's medication : Combo Box for choosing order type.

ระบบการบริการผู้ป่วยใน โรงพยาบาลทองบึงลำภู - [รายละเอียดยาในใบสั่งยาตามคำสั่งแพทย์]

โรงพยาบาลทองบึงลำภู สำนักแพทย์ สำนักจ่ายยา คห.เวชภัณฑ์ รายงาน การเงิน ข้อมูลพื้นฐาน ลอการระบบ

เลขที่ใบสั่งยา 43000663 HN 4037678 AN 4037678 ชื่อ - สกุลผู้ป่วย นายเจริญ ทองเหลือง

วันที่ให้ยา 1/25/00 เวลา 12 ทลผู้ป่วย กลุ่มงานอายุรกรรม พนายเจตีส พนายเวรเตียง 1

วันที่มีจุดรับ 2/22/00 เวลา 1:46:46 PM ประเภทคำสั่งการรักษารวมแพทย์ Order for One Day

Order for One Day

ชื่อเวชภัณฑ์	ความถี่	Dose	หน่วย	จำนวนจ่าย
1 ACTIFED TAB	TID	1	เม็ด	3
2 BISACODYL TAB 5 MG	QHS	2	เม็ด	2
3 CALCIUM TAB 250 MG	TID	1	เม็ด	3
4 DOMPERIDONE TAB 10 MG (MOTILUM)	QID	1	เม็ด	4
5 ERYTHROMYCIN TAB 250 MG	QID	2	เม็ด	8
6 VITAMIN B1 50MG/ML INJECTION	OD	1	หลอด	1

อนุมัติจ่าย อนุมัติให้รับ อนุมัติ / แก้ไขรายการ ประมวลผลจ่ายเวชภัณฑ์ เวลาหยุดยา หมายเหตุ Printout Next จบ

Figure 4.115 Front-end application of computerized unit-dose drug distribution : Details in Prescription for doctor’s order for patient’s medication : Drugs in order for one day.

ระบบการบริการผู้ป่วยใน โรงพยาบาลทองบึงลำภู - [รายละเอียดยาในใบสั่งยาตามคำสั่งแพทย์]

โรงพยาบาลทองบึงลำภู สำนักแพทย์ สำนักจ่ายยา คห.เวชภัณฑ์ รายงาน การเงิน ข้อมูลพื้นฐาน ลอการระบบ

เลขที่ใบสั่งยา 43000663 HN 4037678 AN 4037678 ชื่อ - สกุลผู้ป่วย นายเจริญ ทองเหลือง

วันที่ให้ยา 1/25/00 เวลา 12 ทลผู้ป่วย กลุ่มงานอายุรกรรม พนายเจตีส พนายเวรเตียง 1

วันที่มีจุดรับ 2/22/00 เวลา 1:46:46 PM ประเภทคำสั่งการรักษารวมแพทย์ Order for Home Medication

Order for Home Medication

ชื่อเวชภัณฑ์	ความถี่	Dose	จำนวนวัน	จำนวนจ่าย
1 ACETAZOLAMIDE TAB. 250 MG.	QD	1	10	10
2 CEFALEXIN TAB 500 MG	QID	1	5	20
3 FYBOGEL_NED	QHS	1	10	10
4 IBUPROFEN TAB 400 MG	TID	1	5	15
5 OMEPRAZOLE TAB 20 MG (LOSEC)	BID	1	14	28
6 ยานทีโงร่าค้ำ (180) ML	TID	15	10	450

อนุมัติจ่าย อนุมัติให้รับ อนุมัติ / แก้ไขรายการ ประมวลผลจ่ายเวชภัณฑ์ เวลาหยุดยา หมายเหตุ Printout Next จบ

Figure 4.116 Front-end application of computerized unit-dose drug distribution : Details in Prescription for doctor’s order for patient’s medication : Drugs in order for home medication.

ระบบการบริการผู้ป่วยใน โรงพยาบาลของบิวส์ - [คำสั่งการให้บริการ]

รพ. รามธิบดี โรงพยาบาล รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี

เลขที่ใบสั่งยา 420000011 HN 420000004 AN 420000004 ชื่อ - สกุลผู้ป่วย นางสาวปวีณจิตต์ แงกลีพทธร

วันที่ให้บริการ 8/16/99 รพ. รามธิบดี รพ. รามธิบดี

เวลา	การบริการ	ผู้ให้บริการ	ราคา	จำนวนครั้ง	เบิกได้	รายการ
12	X-Ray	นางพยาบาลพยามา	500	1	0	500
13	CBC	นางพยาบาลจิตอาสา	100	2	0	200
15	Injection	นางพยาบาลจิตอาสา	10	10	0	100
14	Operation	นางสาวไล่มั่นทน	2000	1	0	2000
16	Food	นางพยาบาลจิตอาสา	20	3	0	60

รับใหม่ มีบันทึก บันทึกใหม่ รวบรวมข้อมูล Print/Setup Next ออก

**Figure 4.117** Front-end application of computerized unit-dose drug distribution : Details in Prescription for doctor's order for patient's medication : Orders for other services.

รพ. รามธิบดี โรงพยาบาล รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี

เลขที่ใบสั่งยา 420000015 HN 420000005 AN 420000005 ชื่อ - สกุลผู้ป่วย MR.CHATREE SAETANG

วันที่ให้ยา เวลา 13 รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี รพ. รามธิบดี

วันที่จัดจ่าย 10/2/99 เวลา 19 : 29 ประเภทคำสั่งการรักษารวมแพทย์ Order for Continuous

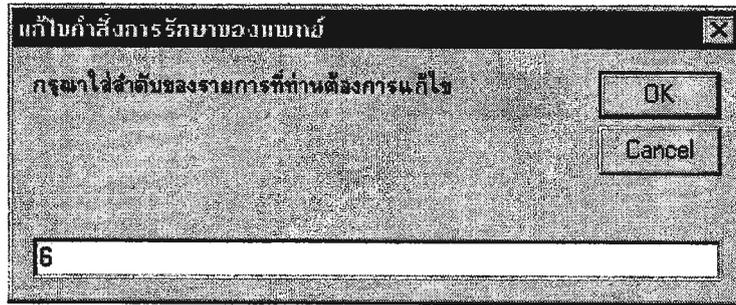
ยืนยันออกคั้ง ยืนยันแก้ไข ผู้ดูแลระบบคำสั่งการรักษารวมแพทย์

ชื่อรพ. รามธิบดี ความถี่

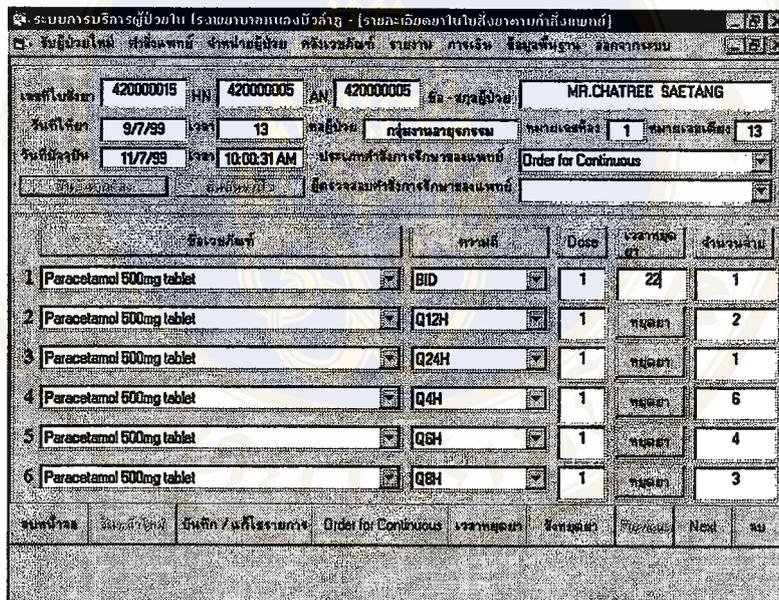
1	Paracetamol 500mg tablet	BID
2	Paracetamol 500mg tablet	Q12H

นางพยาบาลจิตอาสา  
นางพยาบาลพยามา  
นางสาวไล่มั่นทนชนใจ

**Figure 4.118** Front-end application of computerized unit-dose drug distribution : Details in Prescription for doctor's order for patient's medication : Combo box for choosing the second pharmacist for verifying order for drugs, which is recorded by the first pharmacist.



**Figure 4.119** Front-end application of computerized unit-dose drug distribution : Details in Prescription for doctor’s order for patient’s medication : Input box for input an item of drugs which must be corrected.



**Figure 4.120** Front-end application of computerized unit-dose drug distribution : Details in Prescription for doctor’s order for patient’s medication : Stopping drug order for medication.

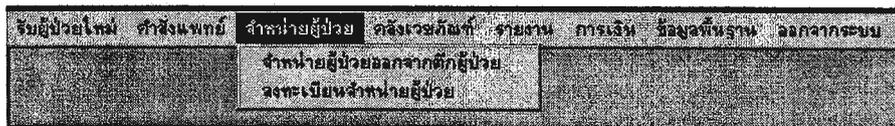


Figure 4.121 Front-end application of computerized unit-dose drug distribution :

Menu 3 : Patient's discharge.

The screenshot displays a form titled 'ระบบการบริการผู้ป่วยใน โรงพยาบาลหนองบัวลำภู - [ตารางรับผู้ป่วยใน]'. The form contains the following fields and data:

- Hospital Number: [Dropdown]
- Admission Number: [Dropdown]
- ชื่อ - สกุล ของผู้ป่วย: นางจิตติฉันทิโกภ
- HN: 420000003
- AN: 420000003
- ชื่อ - สกุล: นางจิตติ ฉันทิโกภ
- คลินิกผู้ป่วย: หน่วยงานอายุจรตง
- วันเดือนปีแรกที่เข้ารักษา: 02/09/2542
- เวลาที่เข้ารักษา: 11
- จำนวนวัน: 2
- หมายเลขเตียง: 1
- หมายเลขเตียง: 25
- ประเภทเตียง: สามัญ
- วันเดือนปีที่ที่ออก: 04/09/2542
- เวลาที่ออก: 12
- พยาบาลที่รับผู้ป่วย: นายพยอมพยาบาลจิ
- สถานะการชำระเงิน: ยังไม่ชำระเงิน

At the bottom, there are five buttons: 'จบพบทาง', 'บันทึกข้อมูล', 'แก้ไขข้อมูล', 'ลบข้อมูล', and 'จบการทำงาน'.

Figure 4.122 Front-end application of computerized unit-dose drug distribution :

Patient's out-ward management.

ระบบการบริการผู้ป่วยใน โรงพยาบาลหนองบัวลำภู - [ข้อมูลการลงทะเบียนผู้ป่วย]

รับผู้ป่วยใหม่ คำสั่งแพทย์ จ่าหน้าผู้ป่วย คลังเวชภัณฑ์ รายงาน การเงิน ข้อมูลพื้นฐาน ลอกจากระบบ

ค้นหาผู้ป่วยในตามเงื่อนไข

HN  AN  ชื่อผู้ป่วย  นามสกุล  ค้นหา

---

ข้อมูลการลงทะเบียนรับผู้ป่วยใน

HN  AN  ชื่อ - สกุล

รหัสผู้ป่วย  ว/ด/ป  เวลาลงทะเบียน

ประเภทผู้ป่วย  เลขที่บัตรตามประเภท  อายุ  ปี

ประวัติผู้ป่วยเบื้องต้น

แพทย์ที่รับผู้ป่วยใน

สถานที่รับตัว  พยาบาลที่รับผู้ป่วยใน

เหตุผลการรับตัว  เหตุผลการรับตัว

---

ข้อมูลการลงทะเบียนจำหน่ายผู้ป่วยใน

สถานะการจำหน่าย  ว/ด/ปจำหน่าย  เวลาจำหน่าย

ประเภทการจำหน่าย  พยาบาลที่จำหน่ายผู้ป่วยใน

สถานที่ส่งต่อ  เหตุผลการส่งต่อ

สมทบด้วย  ผู้รับผลประโยชน์  มีบันทึกการจำหน่ายผู้ป่วยใน  จบการทำงาน

Figure 4.123 Front-end application of computerized unit-dose drug distribution : Patient's discharge updation.

รับผู้ป่วยใหม่	คำสั่งแพทย์	จ่าหน้าผู้ป่วย	คลังเวชภัณฑ์	รายงาน	การเงิน	ข้อมูลพื้นฐาน	ลอกจากระบบ
			เบิกเวชภัณฑ์จากคลังไทย				
			รับเวชภัณฑ์จากคลังไทย				
			จ่ายเวชภัณฑ์ตามใบสั่งยา				
			ปรับยอดเวชภัณฑ์				

Figure 4.124 Front-end application of computerized unit-dose drug distribution : Menu 4 : Drug Inventory.

ระบบการบริหารผู้ป่วยใน โรงพยาบาลของบิวส์ - [ใบเบิกเวชภัณฑ์จากคลังยาหลัก]

รับผู้ป่วยใหม่ คำสั่งแพทย์ คำสั่งจ่ายผู้ป่วย คลังเวชภัณฑ์ รายงาน การเงิน ข้อมูลพื้นฐาน ออกจากระบบ

ค้นหาใบเบิกเวชภัณฑ์ตามเงื่อนไข

หน่วยงานที่เบิกเวชภัณฑ์: **งานอายุรกรรมโรงพยาบาลทอนงวีร์สว่าง** เดือน/วัน/ปี: **12/27/99** เวลา: **12**

รหัสหน่วยงาน: **NPI** ชื่อหน่วยงานที่เบิกเวชภัณฑ์: **งานอายุรกรรมโรงพยาบาลทอนงวีร์สว่าง**

เลขที่ใบอนุมัติ: **1** ว/ด/ป ที่ขอเบิก: **12/27/99** เวลาที่ขอเบิก: **12** หมายเลข: **223**

เวชภัณฑ์ที่ขอเบิก	ขนาดบรรจุ	จำนวนที่ขอเบิก
ACETATE RINGER 5% DEXTROSE INJ	10	8
ACETAZOLAMIDE TAB. 250 MG.	100	1
ADRENALINE INJ 1 MG/ML	10	6
ALUMMILK ML	240	180
ALLOPURINOL 100MG TAB	100	1

จบหน้าจอ **เพิ่มใบเบิกใหม่** บันทึก/แก้ไขรายการเบิกเวชภัณฑ์ พิมพ์ใบเบิก Previous Next จบ

Figure 4.125 Front-end application of computerized unit-dose drug distribution : Drug Requirement.

ระบบการบริหารผู้ป่วยใน โรงพยาบาลของบิวส์ - [บันทึกการรับเวชภัณฑ์จากคลังยาหลัก]

รับผู้ป่วยใหม่ คำสั่งแพทย์ คำสั่งจ่ายผู้ป่วย คลังเวชภัณฑ์ รายงาน การเงิน ข้อมูลพื้นฐาน ออกจากระบบ

ค้นหาใบรับเวชภัณฑ์ตามเงื่อนไข

หน่วยงาน: **งานอายุรกรรม** เดือน/วัน/ปี: **12/27/99** เลขที่ใบรับ: **1**

ตั้งชื่อผู้ส่งจากใบเบิกเวชภัณฑ์ เดือน/วัน/ปี: เวลา:

รหัสหน่วยงาน: **NPI** ชื่อหน่วยงาน: **งานอายุรกรรมโรงพยาบาลทอนงวีร์สว่าง** เลขที่ใบรับ: **1**

ว/ด/ป ที่รับเวชภัณฑ์: **12/27/99** เวลาที่รับเวชภัณฑ์: **9** หมายเลข: **จับเวชภัณฑ์เข้าคลังยูนิตโดสครั้งแรก**

เวชภัณฑ์ที่รับเข้าคลังเวชภัณฑ์	ขนาดบรรจุ	จำนวนเบิก	จำนวนรับ	ก้างเบิก	คงคลังเดิม	คงคลังใหม่	ราคา/หน่วย	วันหมดอายุ
ACETATE RINGER 5% DEXTROSE INJ	10	8	8	0	0	80	60	1/1/02
ACETAZOLAMIDE TAB. 250 MG.	100	1	1	0	0	100	5	1/1/03
ADRENALINE INJ 1 MG/ML	10	6	6	0	0	60	5	1/1/02
ALUMMILK ML	240	180	180	0	0	43200	.12	1/1/03
ALLOPURINOL 100MG TAB	100	1	1	0	0	100	1	1/1/03

จบหน้าจอ บันทึกใบเบิกเวชภัณฑ์ บันทึกข้อมูลรับเวชภัณฑ์เข้าคลังยูนิตโดส บันทึก พิมพ์ใบรับ Previous Next จบ

Figure 4.126 Front-end application of computerized unit-dose drug distribution : Drug Receive.

เวชภัณฑ์ที่รับมรดก	หน่วยเวชภัณฑ์	จำนวน คงเหลือเดิม	จำนวนคงเหลือ ที่รับมรดก	จำนวนที่ รับมรดก
Paracetamol 100mg Injection	amp	10456	20000	9548
Paracetamol 500mg tablet	tab	104769	10000	94769

Figure 4.127 Front-end application of computerized unit-dose drug distribution : Drug Balance.

Figure 4.128 Front-end application of computerized unit-dose drug distribution : Menu 5 : Reporting.

Figure 4.129 Front-end application of computerized unit-dose drug distribution : Patient's report.

### รายงานการครองเตียง

HN	420000001	ชื่อ-สกุลผู้ป่วย	นาย	ชัยณรงค์	แม้รักษา			
AN	420000001	ว/ดป admit	22/6/99	ว/ดป discharge	30/6/99	เตียงผู้ป่วยใน	กลุ่มงาน	อายุกรรม
หมายเลขห้อง	หมายเลขเตียง	ว/ดป เข้า	เวลาเข้า	ว/ดป ออก	เวลาออก	BTName	จำนวนวัน	
11	11	23/6/99	16.00	29/6/99	20.00	สามัญ	6	
1	8	24/6/99	20.00	26/6/99	21.00	พิเศษ 3	0	
1	3	26/6/99	20.00			พิเศษ 3	0	
รวมจำนวนวันทั้งสิ้น								6 วัน

**Figure 4.130** Front-end application of computerized unit-dose drug distribution :  
Patient's in-bed report.

### รายงานแพทย์ที่ดูแลผู้ป่วย

HN	420000001	ชื่อ-สกุลผู้ป่วย	นาย	ชัยณรงค์	แม้รักษา			
AN	420000001	ว/ดป admit	22/6/99	ว/ดป discharge	30/6/99	เตียงผู้ป่วยใน	กลุ่มงาน	อายุกรรม
		ชื่อ - สกุลแพทย์ที่ดูแลผู้ป่วย		ว/ดป เริ่มต้น	เวลาเริ่มต้น	ว/ดป สิ้นสุด	เวลาสิ้นสุด	
นายแพทย์	หมอ			24/6/99	10.00	24/6/99	20.00	
				26/6/99	11.00	26/6/99	21.00	
				28/6/99	12.00	27/6/99	22.00	
				27/6/99	13.00	28/6/99	23.00	

**Figure 4.131** Front-end application of computerized unit-dose drug distribution :  
Doctor for each in-patient report.

### รายงานการวินิจฉัยผู้ป่วย

HN	420000001	ชื่อ-สกุลผู้ป่วย	นาย	ชัยณรงค์	แม้รักษา			
AN	420000001	ว/ดป admit	22/6/99	ว/ดป discharge	30/6/99	เตียงผู้ป่วยใน	กลุ่มงาน	อายุกรรม
ลำดับผลการวินิจฉัย		ชื่อ - สกุลแพทย์ผู้ทำการวินิจฉัยผู้ป่วย				ICD10		สาขาเฉพาะทาง
1		นายแพทย์ หมอ				Hate		ต้อกระจก
2		นางจินตรา พาสูข				Love		จักษุ
3		นางจินตรา พาสูข				Beleive		สูติกรรม
4		นางจินตรา พาสูข				Love		ทันตกรรม
6		นางจินตรา พาสูข				Beleive		จิตเวช

**Figure 4.132** Front-end application of computerized unit-dose drug distribution :  
Patient's diagnostic report.

### รายงานการผ่าตัดผู้ป่วย

HN	420000001	ชื่อ-สกุลผู้ป่วย	นาย ชัยณรงค์	แพ่งรักษา			
AN	420000001	ว/ด/ป admit	22/6/99	ว/ด/ป discharge	30/6/99	ตั้งผู้ป่วยใน	กลุ่มงาน
		ว/ด/ป ที่ทำหัตถการ	เวลาที่ทำการ	ชื่อ - สกุล แพทย์ ผู้ทำการผ่าตัดผู้ป่วยใน			อายุกรรม
		27/6/99	12.00	นางจินตรา พาสุข			ICD9
		28/6/99	13.00	นางจินตรา พาสุข			PP
		28/6/99	14.00	นางจินตรา พาสุข			PP

Figure 4.133 Front-end application of computerized unit-dose drug distribution : Patient's operation report.

### รายงานการวินิจฉัยการตายของผู้ป่วย

HN	420000001	ชื่อ-สกุลผู้ป่วย	นาย ชัยณรงค์	แพ่งรักษา			
AN	420000001	ว/ด/ป admit	22/6/99	ว/ด/ป discharge	30/6/99	ตั้งผู้ป่วยใน	กลุ่มงาน
		ลำดับผลการวินิจฉัยการเสียชีวิตของผู้ป่วยใน				ICD10	อายุกรรม
		1				Love	สาขาเฉพาะทาง
							อายุกรรม

Figure 4.134 Front-end application of computerized unit-dose drug distribution : Patient's dead diagnostic report.

### รายงานมูลค่าการรักษาผู้ป่วย

HN	420000004	ชื่อ-สกุลผู้ป่วย	นางสาว ปิรจิษฐ์	นศ.ชั้นหนึ่ง					
AN	420000004	ประเภทผู้ป่วย	ผู้ป่วยรายใน						
		เลขที่ใบแจ้งชำระค่าเงิน	วันที่คืนเงิน	เวลา	สถานะชำระค่าเงิน	รายการ	จำนวนใบชำระ	มูลค่า	ชำระ
		420000008	6/9/99	18.00	ยังไม่ชำระเงิน	ห้อง	1	1,100.00	
								รวมทั้งสิ้น(บาท)	1,100.00
		420000011	6/9/99	18.00	ยังไม่ชำระเงิน	ลำดับ	1	2,000.00	
						ฉีดสาร	1	100.00	
						อาหาร	1	60.00	
						ยานและเวชภัณฑ์	4	10,032.00	
						รังสีวินิจฉัย	1	500.00	
						วินิจฉัยโรค	1	200.00	
								รวมทั้งสิ้น(บาท)	12,892.00
		420000017	29/9/99	13.00	ไม่ชำระค่าเงิน	ห้อง	1	2,000.00	
								รวมทั้งสิ้น(บาท)	2,000.00

Figure 4.135 Front-end application of computerized unit-dose drug distribution : Value of patient's medication report.

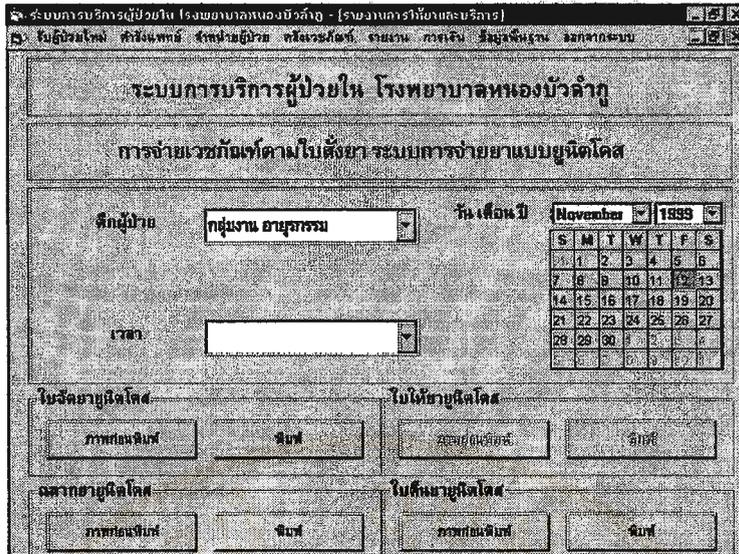


Figure 4.136 Front-end application of computerized unit-dose drug distribution : Drug dispensing report.

ใบสั่งยาวันที่ 15/11/00      ชื่อผู้ป่วย      กลุ่มงาน      อายุรกรรม

**ผู้ป่วยรายวัน**

ชื่อผู้ป่วย	ACETYL CYSTEINE POWDER 200 MG_MED	หน่วยผู้ป่วย	รวม
เลขที่	HN    AN	ชื่อ-สกุล    ผู้ป่วย	ขนาดให้ซ้ำ    ครั้ง
2	41272    109	นาง    อ.    อ.    อ.    อ.    อ.	1    OD    14    22    6    3
15	142357    388	พ.    พ.    พ.    พ.    พ.    พ.	1    TID    14    22    6    3

**ชื่อผู้ป่วย**    ALUTAB    **หน่วยผู้ป่วย**    เบ็ด

ชื่อผู้ป่วย	ALUTAB	หน่วยผู้ป่วย	รวม
เลขที่	HN    AN	ชื่อ-สกุล    ผู้ป่วย	ขนาดให้ซ้ำ    ครั้ง
13	143260    329	นาง    พ.    พ.    พ.    พ.    พ.	1    TID    14    22    6    3

**ชื่อผู้ป่วย**    AMINOPHYLLINE INJ 250 MG/10ML    **หน่วยผู้ป่วย**    พ.    พ.

ชื่อผู้ป่วย	AMINOPHYLLINE INJ 250 MG/10ML	หน่วยผู้ป่วย	รวม
เลขที่	HN    AN	ชื่อ-สกุล    ผู้ป่วย	ขนาดให้ซ้ำ    ครั้ง
24	97321    432	นาง    พ.    พ.    พ.    พ.    พ.	1    OD    12    1

Figure 4.137 Front-end application of computerized unit-dose drug distribution : Drug preparing note.

**PARACETAMOL TAB 500 MG**

ขนาดให้ซ้ำ    1    เบ็ด

นาง    ต.    พ.    พ.    พ.    พ.

เลขที่    6    กลุ่มงาน    อายุรกรรม

วิธีใช้    รับประทาน

วันเดือนปี    15/11/00    เวลาให้ซ้ำ    22.00

วันที่หมดอายุ(ยาชนิดโดส)    14/2/00

Figure 4.138 Front-end application of computerized unit-dose drug distribution : Drug label.

**ใบให้ยามแก่ผู้ป่วย**

**วันเดือนปีที่ให้ยา 15/1/00 เวลา 14.00**

นาม	ศร	ส่วนรับยา	HN 41272	AN 109	เตียง 2	ผู้ป่วยนอก	ตาสฤงครน
		<b>ชื่อยา</b>	<b>ขนาดที่รับประทาน</b>	<b>ขนาดให้ยา</b>	<b>จำนวน</b>	<b>หน่วย</b>	<b>วิธีให้ยา</b>
		ACETYLCYSTEINE POWDER 200 GM_NED	08H	1	ซอง	พ่นในช่องคอหรือน้ำในแก้วดื่ม	
		CEFAZOLIN INJ 1 GM	06H	1	ขวด	ฉีดเข้าหลอดเลือด	
		DOMPERIDONE TAB 10 MG (MOTIUM)	TID	1	เม็ด	ฉีดเข้าหลอดเลือด	
		ORAL REHYDRATION SALT ฟูโตลู(O.R.S.)	TID	1	ซอง	พ่นในช่องคอหรือน้ำในแก้วดื่ม	
		SALBUTAMOL 2 MG TAB (VENTOLIN)	TID	1	เม็ด	ฉีดเข้าหลอดเลือด	
นาม	ภูษ	พญกมล	HN 13566	AN 14817	เตียง 17	ผู้ป่วยนอก	ตาสฤงครน
		<b>ชื่อยา</b>	<b>ขนาดที่รับประทาน</b>	<b>ขนาดให้ยา</b>	<b>จำนวน</b>	<b>หน่วย</b>	<b>วิธีให้ยา</b>
		ISOSORBIDE DINITRATE TAB 10 MG(ISOORDI)	QID	1	เม็ด	ฉีดเข้าหลอดเลือด	
		VITAMIN B1-6-12 TAB_NED	TID	2	เม็ด	ฉีดเข้าหลอดเลือด	
		NIFEDIPINE TAB 5 MG (ADALAT)	TID	1	เม็ด	ฉีดเข้าหลอดเลือด	
		SALBUTAMOL 2 MG TAB (VENTOLIN)	TID	1	เม็ด	ฉีดเข้าหลอดเลือด	
		BERODUAL SOLUTION (ซีอี)	06H	1	ซีซี	พ่นในปากครั้งละ	

Figure 4.139 Front-end application of computerized unit-dose drug distribution : Drug dispensing note.

**ใบคืนเวชภัณฑ์จากคำสั่งทางหยุดให้เวชภัณฑ์แก่ผู้ป่วย**

ชื่อผู้ป่วย	นาม	ภูษ	HN	AN	เตียง	วันที่	ชื่อ-สกุล	ผู้รับ	ชื่อ-สกุล	ผู้รับ	วันที่	จำนวน
พญกมล	HTNDI	ชื่อผู้ป่วย	METRONIDAZOLE INJ 500MG/100ML	พญกมล	ผู้ป่วยนอก	ตาสฤงครน						
HN	AN	เตียง	ชื่อ-สกุล	ผู้รับ	ชื่อ-สกุล	ผู้รับ	วันที่	จำนวน				
127872	437	16 พย	พญกมล	พญกมล	พญกมล	พญกมล	14/1/00	2				
							รวมจำนวนคืน	2				

Figure 4.140 Front-end application of computerized unit-dose drug distribution : Drug returning note.

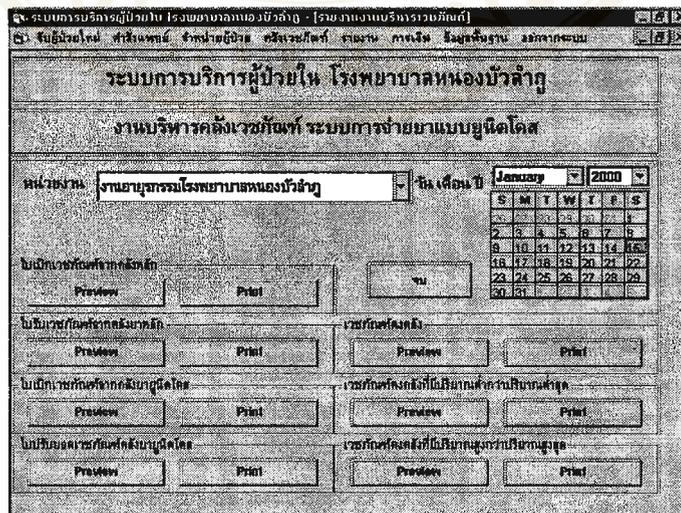


Figure 4.141 Front-end application of computerized unit-dose drug distribution : Drug inventory report.

## ใบเบิกเวชภัณฑ์จากคลังเวชภัณฑ์หลัก

เลขที่ใบอนุมัติ 42000002 หน่วยงาน งานอายุกรรม โรงพยาบาลหนองบัวลำภู กลุ่มงาน อายุกรรม  
วันเดือนปี 5/10/99 เวลา 9.00 หมายเหตุ Test

รหัสเวชภัณฑ์	ชื่อเวชภัณฑ์	หน่วยนับ	ขนาดบรรจุ	จำนวนที่ขอเบิก
1101000110	Paracetamol 500mg tablet	tab	100	1,000
1101000120	Paracetamol 100mg Injection	amp	100	100
1101000130	Paracetamol 125 mg/5ml Syrup	ml	1,000	10
2101000110	Proscar Inhaler	bott	1	100
2101000120	Lover cream	tube	100	10
3101000110	Elastic bandage 5 inches	piece	100	10

Figure 4.142 Front-end application of computerized unit-dose drug distribution :  
Drug requirement note.

## ใบรับเวชภัณฑ์จากการเบิกจากคลังเวชภัณฑ์หลัก

เลขที่ใบรับเวชภัณฑ์	42000002	หน่วยงาน	งานอายุกรรม	โรงพยาบาลหนองบัวลำภู	กลุ่มงาน	อายุกรรม
วันเดือนปี	8/10/99	เวลา	9.00	หมายเหตุ	Test SlnpDt	
รหัสเวชภัณฑ์	ชื่อเวชภัณฑ์	หน่วยนับ	ขนาดบรรจุ	จำนวนรับ	คงคลังเดิม	คงคลังใหม่
1101000110	Paracetamol 500mg tablet	tab	100	1,000	4,769	104,769
1101000120	Paracetamol 100mg Injection	amp	100	100	466	10,466
1101000130	Paracetamol 125 mg/5ml Syrup	ml	1,000	10	0	10,000
2101000110	Proscar Inhaler	bott	1	100	77	177
2101000120	Lover cream	tube	100	10	84	1,084
3101000110	Elastic bandage 5 inches	piece	100	6	800	1,300

Figure 4.143 Front-end application of computerized unit-dose drug distribution :  
Drug receive note.

## ใบเบิกเวชภัณฑ์จากคลังเวชภัณฑ์ย่อยตามใบสั่งเวชภัณฑ์

เลขที่ใบเบิกเวชภัณฑ์	420000012	หน่วยงาน	งานอายุกรรม	โรงพยาบาลหนองบัวลำภู	กลุ่มงาน	อายุกรรม
วันเดือนปี	23/8/99	เวลา	12.00			
รหัสเวชภัณฑ์	ชื่อเวชภัณฑ์	หน่วยนับ	จำนวนเบิก	คงคลังเดิม	คงคลังใหม่	
2101000120	Lover cream	tube	11	95	84	
1101000110	Paracetamol 500mg tablet	tab	14	4,912	4,898	
1101000120	Paracetamol 100mg Injection	amp	17	472	465	
2101000110	Proscar Inhaler	bott	16	93	78	

Figure 4.144 Front-end application of computerized unit-dose drug distribution :  
Drug dispensing note.

**ใบพิมพ์ยอดค่ารักษาพยาบาล**

เลขที่ใบพิมพ์ยอดค่ารักษาพยาบาล	420000016	วันเดือนปี	9/10/99	เวลา	24.00
หน่วยงาน	งานเภสัชกรรม โรงพยาบาลทพมจ.ม.ร.ร.ว.	กลุ่มงาน	เภสัชกรรม		
<b>รายการพิมพ์ยอดของสงฆ์ในเวชภัณฑ์</b>			<b>รายการพิมพ์ยอดของสงฆ์ในเวชภัณฑ์</b>		
ชื่อเวชภัณฑ์	พ่น้ำ	สงฆ์ก่อน	สงฆ์หลัง	จำนวนพิมพ์ยอด	
Paracetamol 500mg tablet	tab	104,769	10,000		94,769
			Paracetamol 100mg injection amp	10,455	20,000
					9,545

**Figure 4.145** Front-end application of computerized unit-dose drug distribution : Drug balance note.



**Figure 4.146** Front-end application of computerized unit-dose drug distribution : Menu 6 : Calculating cost.

ระบบการบริการผู้ป่วยใน โรงพยาบาลของบว.ร.ว. [ค่าห้องและเตียงผู้ป่วย]

โรงพยาบาลในตามเงื่อนไข Hospital Number Admission Number ค้นหา

ชื่อ - สกุล ของผู้ป่วย

รายละเอียดผู้ป่วย

HN	<input type="text" value="13566"/>	AN	<input type="text" value="14817"/>	ชื่อ - สกุล	<input type="text" value="นายกุด ทยุกกลาง"/>	หมายเลขห้อง	<input type="text" value="1"/>
วันที่เข้าพัก	<input type="text" value="12/29/99"/>	เวลาที่เข้าพัก	<input type="text" value="9"/>	กลุ่มงานเภสัชกรรม		หมายเลขเตียง	<input type="text" value="43"/>

รายละเอียดใบเสร็จรับเงิน

เลขที่ใบเสร็จรับเงิน	<input type="text" value="29129943"/>	วันที่ออกใบเสร็จรับเงิน	<input type="text" value="29/12/2542"/>	เวลาที่ออกใบเสร็จรับเงิน	<input type="text" value="12"/>
ประเภทผู้ป่วย	<input type="text" value="ชำระเงินคน"/>	สถานะใบเสร็จรับเงิน	<input type="text" value="รับเงินครบทุกรายการ"/>		

รายละเอียดการพักรักษาตัวในโรงพยาบาลของสงฆ์

วันที่ออก	<input type="text" value="12/29/99"/>	เวลาที่ออก	<input type="text" value="12"/>	จำนวนวัน	<input type="text" value="0"/>
สถานะการชำระเงิน	<input type="text" value="ไม่ตั้งชำระเงิน"/>	ประเภทเตียง	<input type="text" value="สามัญ"/>	อัตราวันละ	<input type="text" value="100"/> บาท
พยาบาลที่รับผู้ป่วย	<input type="text" value="นางสาวโกจรรย์ เทพคู่"/>			รวมทั้งเงิน	<input type="text" value="0"/> บาท

ลบหน้าจอ    ปิดหน้าต่าง    แก้ไขใบเสร็จ    พิมพ์    Next    จบการพิมพ์



**Figure 4.147** Front-end application of computerized unit-dose drug distribution : Patient's room and bed cost.

ระบบการบริการผู้ป่วยใน โรงพยาบาลแห่งบัวคำ - (ภายใต้ระบบกึ่งอัตโนมัติ)

HN: 13886 AN: 14817 ชื่อ-สกุล: นายชุต ชุตกลาง หมายเลขเตียง: 1

วันที่รับฝาก: 1/10/00 เวลาที่รับฝาก: 18 หมู่ผู้ป่วย: กลุ่มงานอายุรกรรม จำนวนเตียง: 17

เลขที่ใบเสร็จรับเงิน: 43000047 วันที่ออกใบเสร็จรับเงิน: 30/12/2542 เวลาที่ออกใบเสร็จรับเงิน: 12

ประเภทผู้ป่วย: ส่วนโรคระบบ... จำนวนเตียงรับเงิน: เงินที่คงเหลือจากรายการ: ...

จำนวนรายการ: 15 จำนวน: จำนวน: ... บาท จำนวนใบเสร็จ: ... บาท

จำนวนใบเสร็จรับเงิน: ส่วนของ/ทั้งหมดผู้ป่วย: 0 บาท รวมยอดชำระ: 1254 บาท

ปุ่ม: ย้อนกลับ, แก้ไขใบเสร็จ, ปิดระบบ, Next, จบการบริการ

Figure 4.148 Front-end application of computerized unit-dose drug distribution : Patient’s drug cost.

ระบบการบริการผู้ป่วยใน โรงพยาบาลแห่งบัวคำ - (ภายใต้ระบบกึ่งอัตโนมัติ)

ระบบการบริการผู้ป่วยใน โรงพยาบาลแห่งบัวคำ

การแจ้งการชำระเงินค่าบริการทางกายภาพ ระบบการจ่ายยาแบบยูนิตโดส

เลือกผู้ป่วย: กลุ่มงาน อายุรกรรม วันที่: November 1999

S	M	T	W	T	F	S
31	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	1	2	3	4
5	6	7	8	9	10	11

ส่วนห้องพักผู้ป่วย: ... ส่วนบริการ: ...

ปุ่ม: Preview, Print, Preview, Print

Figure 4.149 Front-end application of computerized unit-dose drug distribution : Report for Patient’s room-bed, drug cost.

**ใบแจ้งการชำระเงินค่าห้องและเตียงผู้ป่วยใน**

เลขที่ใบแจ้งการชำระเงิน	420000016	วันที่ออก	29/9/99	เวลา	12.00
ชื่อ-สกุล ผู้ป่วย	MR. CHATREE SAETANG	HN	420000005	AN	420000005
ประเภทผู้ป่วย	20	หมู่ผู้ป่วย	อายุรกรรม	ยาชุด	
หมายเลขเตียง	1	หมายเลขเตียง	13	วันที่รับเงิน	7/9/99
		จำนวนเตียง	12.00	วันที่รับเงิน	17/9/99
		จำนวนเตียง	2.100	วันที่รับเงิน	10
		จำนวนเตียง	200.00	วันที่รับเงิน	200.00
		รวมทั้งหมด(บาท)	2,000.00		

Figure 4.150 Front-end application of computerized unit-dose drug distribution : Report for Patient’s room and bed cost.

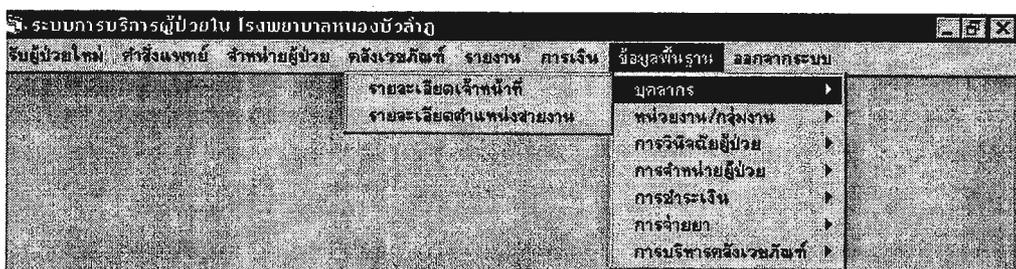
**ใบแจ้งการชำระเงินค่าเวชภัณฑ์และบริการ**

เลขที่ใบแจ้งการชำระเงิน	420000011	วันเดือนปี	6/9/99
ชื่อ-สกุลผู้ป่วย	นางสาว ปิยจิตต์	แมคอินทอซ	HN 420000004 AN 420000004
เลขที่ใบสั่งยา/บริการ	420000011	รายการ	จำนวนรายการ
		ยาและเวชภัณฑ์	4
		รังสีวินิจฉัย	1
		ชั้นสูตโรค	1
		ผ่าตัด	1
		ฉีดยา	1
		อาหาร	1
		<b>รวมทั้งสิ้น</b>	<b>12,892.00 บาท</b>

**Figure 4.151** Front-end application of computerized unit-dose drug distribution :  
Report for Patient’s room and bed cost.



**Figure 4.152** Front-end application of computerized unit-dose drug distribution :  
Menu 7 : Base data.



**Figure 4.153** Front-end application of computerized unit-dose drug distribution :  
Menu 7.1 : Personal data.



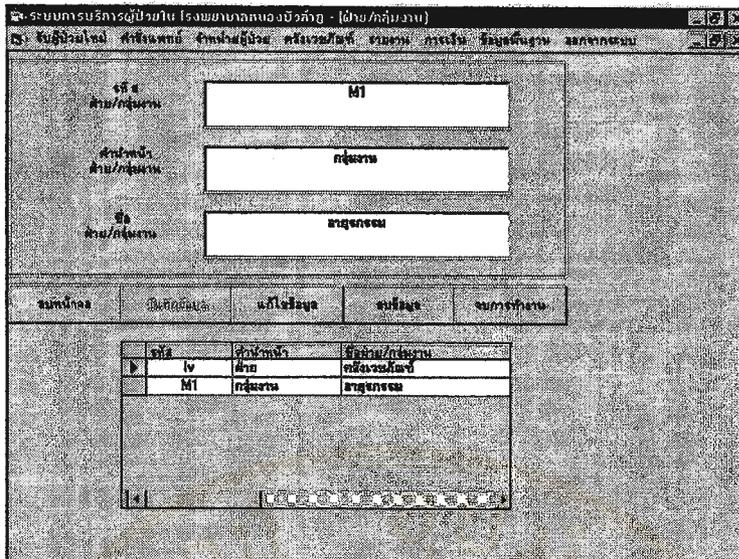


Figure 4.157 Front-end application of computerized unit-dose drug distribution : Department data.

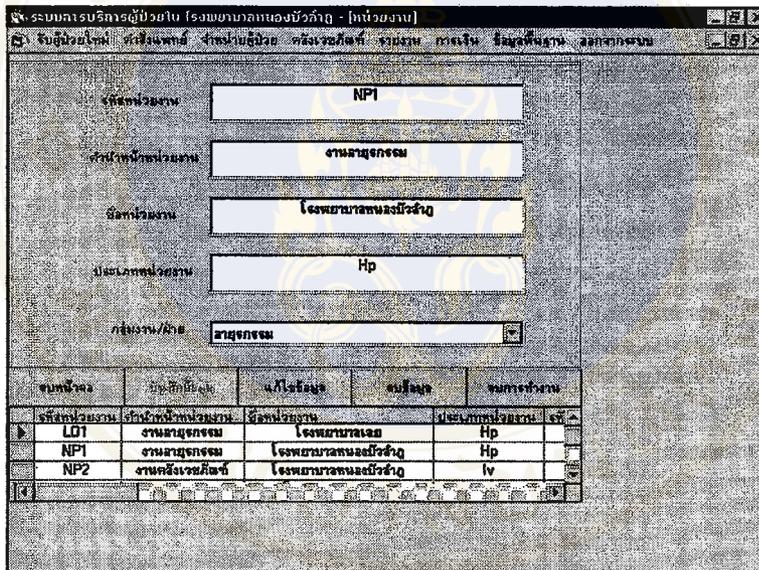


Figure 4.158 Front-end application of computerized unit-dose drug distribution : Part of department data.



Figure 4.159 Front-end application of computerized unit-dose drug distribution : Menu 7.3 : Diagnostic data.

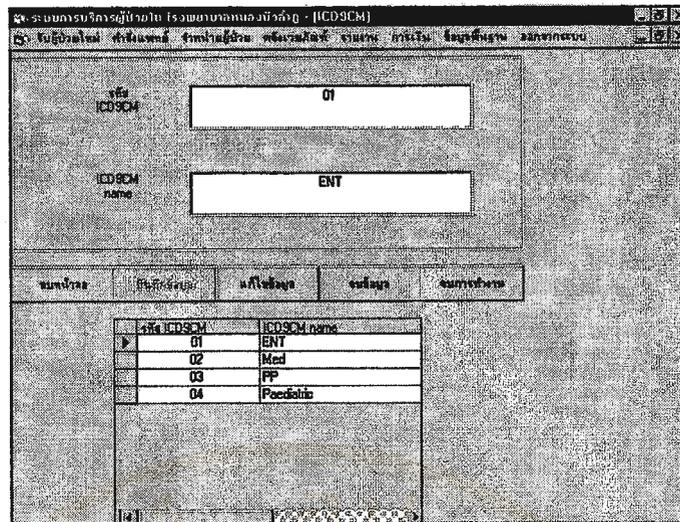


Figure 4.160 Front-end application of computerized unit-dose drug distribution : ICD9CM data.

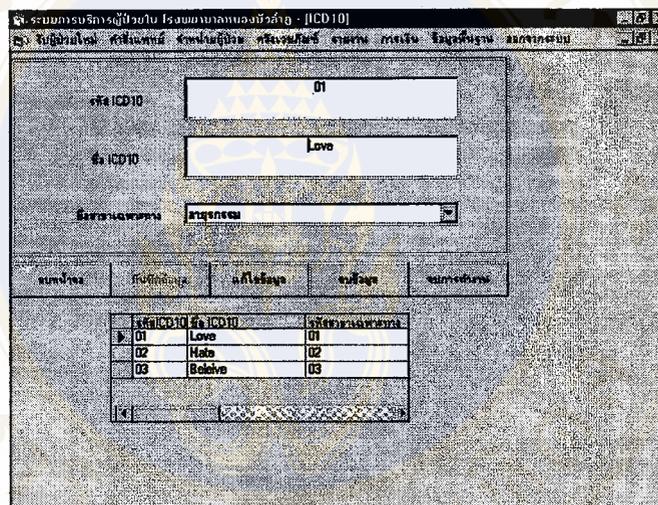


Figure 4.161 Front-end application of computerized unit-dose drug distribution : ICD10 data.

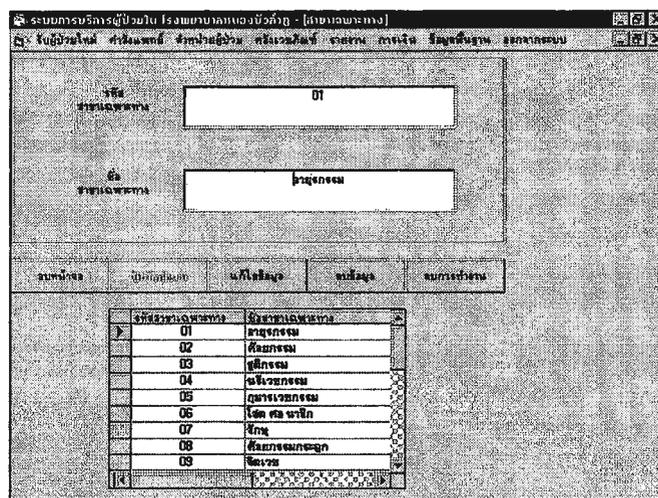


Figure 4.162 Front-end application of computerized unit-dose drug distribution : Specialty data.

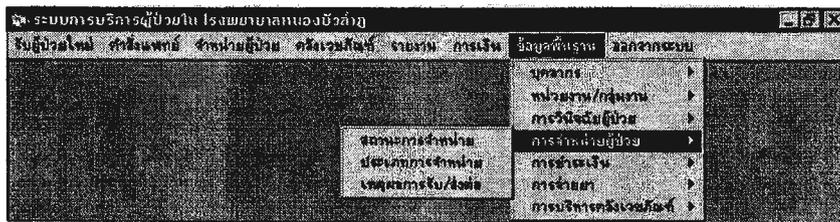


Figure 4.163 Front-end application of computerized unit-dose drug distribution :

Menu 7.4 : Discharge data.

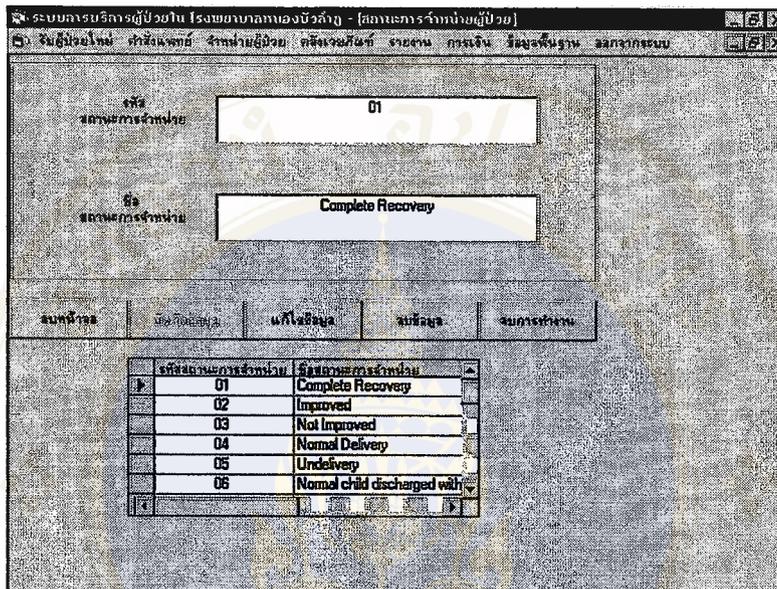


Figure 4.164 Front-end application of computerized unit-dose drug distribution :

Discharge status data.

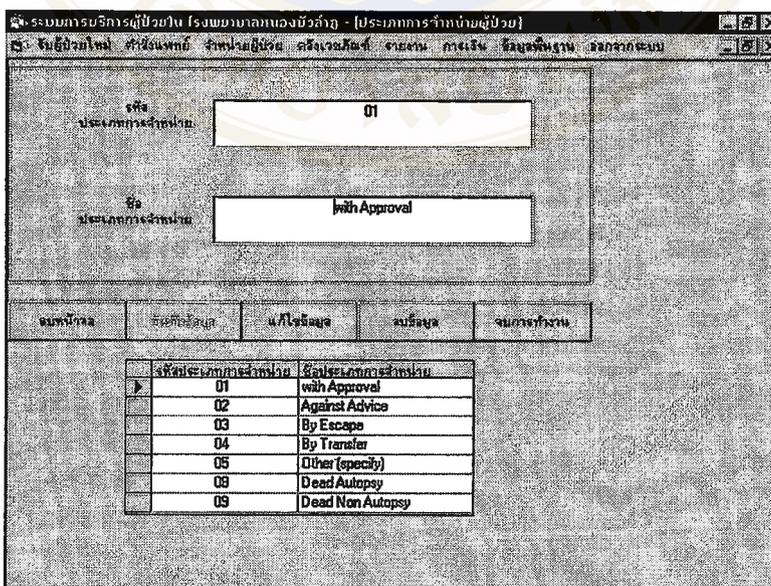


Figure 4.165 Front-end application of computerized unit-dose drug distribution :

Discharge type data.

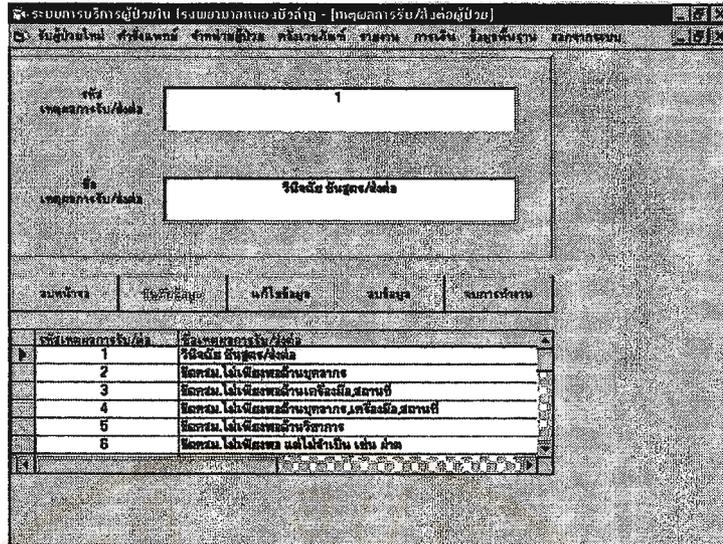


Figure 4.166 Front-end application of computerized unit-dose drug distribution : Cause of refer data.

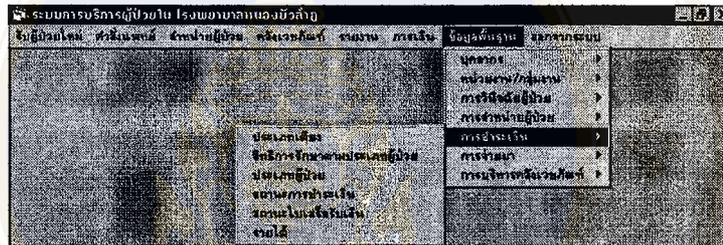


Figure 4.167 Front-end application of computerized unit-dose drug distribution : Menu 7.5 : Payment data.

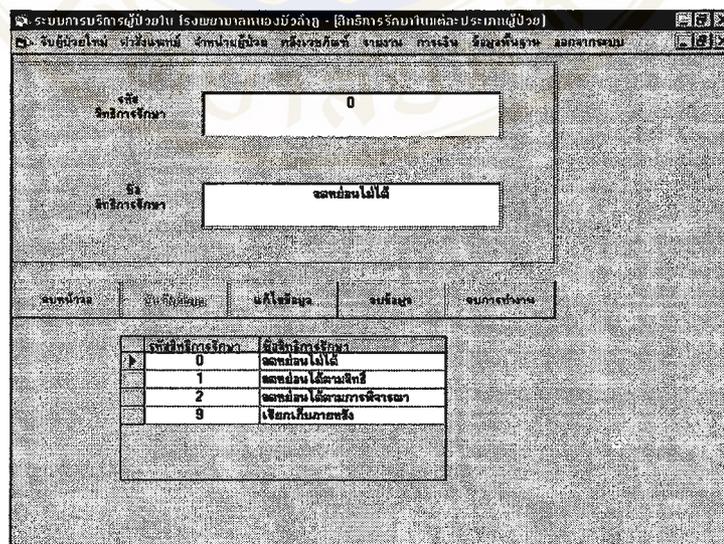


Figure 4.168 Front-end application of computerized unit-dose drug distribution : Right data.

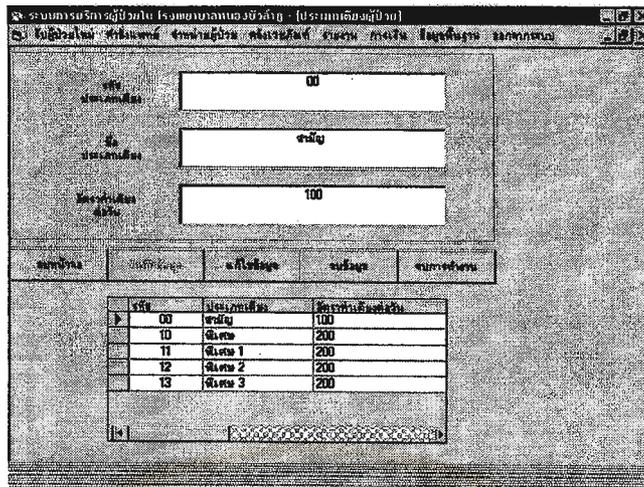


Figure 4.169 Front-end application of computerized unit-dose drug distribution : Bed type data.

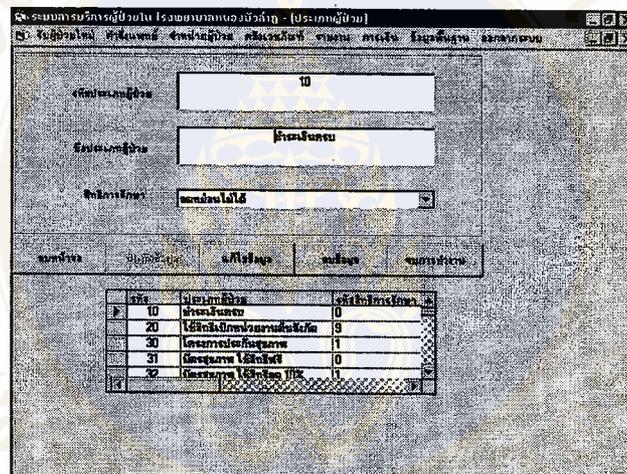


Figure 4.170 Front-end application of computerized unit-dose drug distribution : Patient's type data.

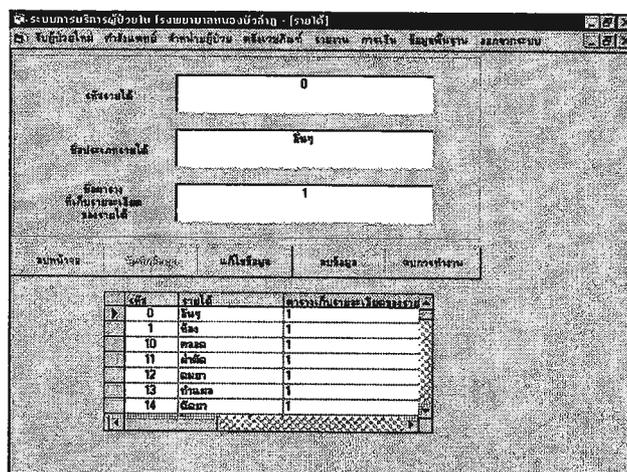


Figure 4.171 Front-end application of computerized unit-dose drug distribution : Income data.

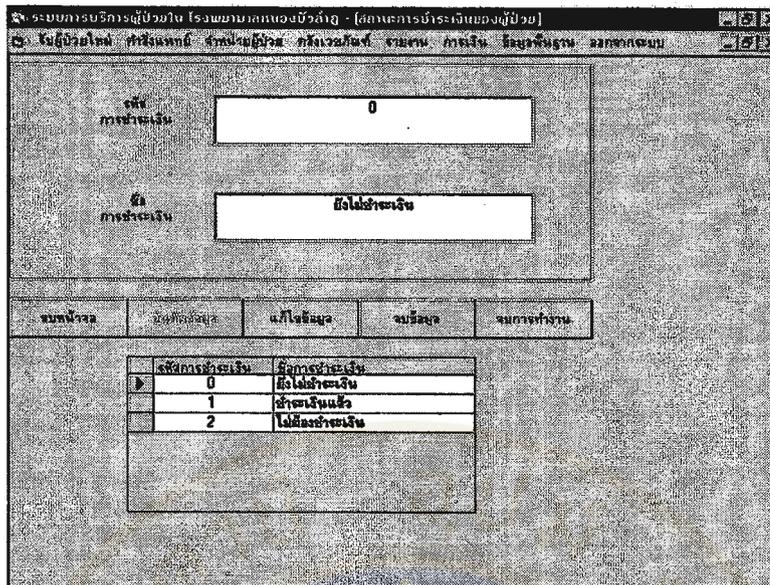


Figure 4.172 Front-end application of computerized unit-dose drug distribution : Paid status data.

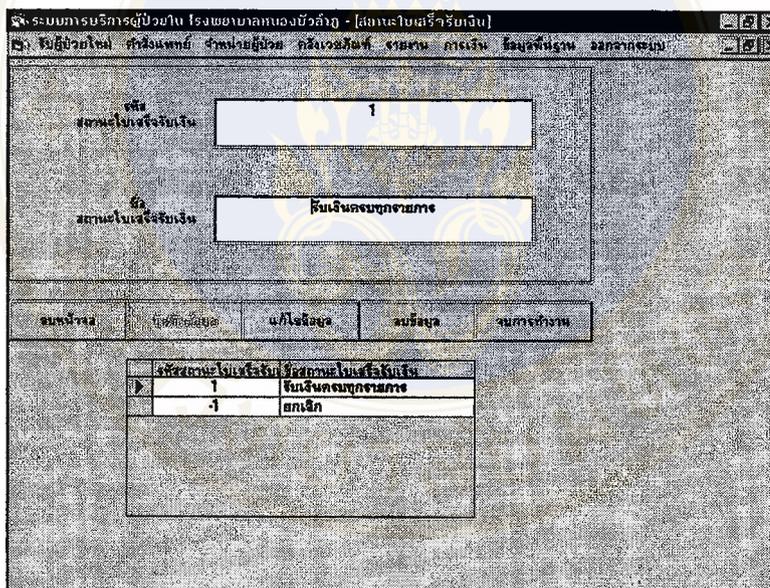


Figure 4.173 Front-end application of computerized unit-dose drug distribution : Receipt status data.



Figure 4.174 Front-end application of computerized unit-dose drug distribution :

Menu 7.6 : Dispensing data.

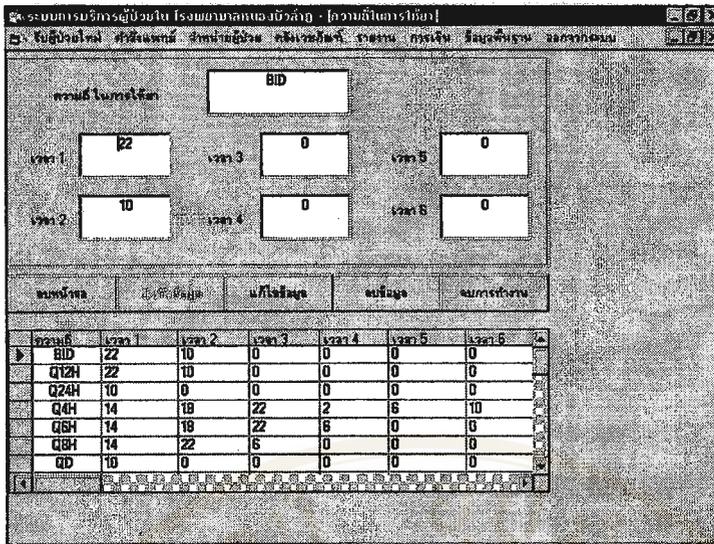


Figure 4.175 Front-end application of computerized unit-dose drug distribution :  
Frequency data.

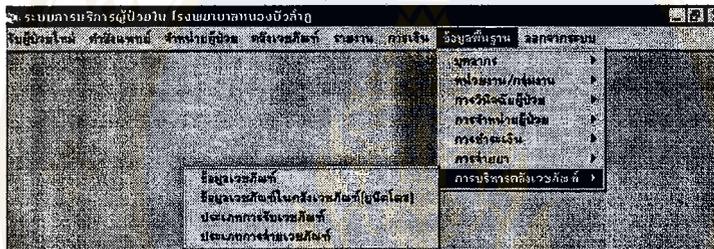


Figure 4.176 Front-end application of computerized unit-dose drug distribution :  
Drug data.

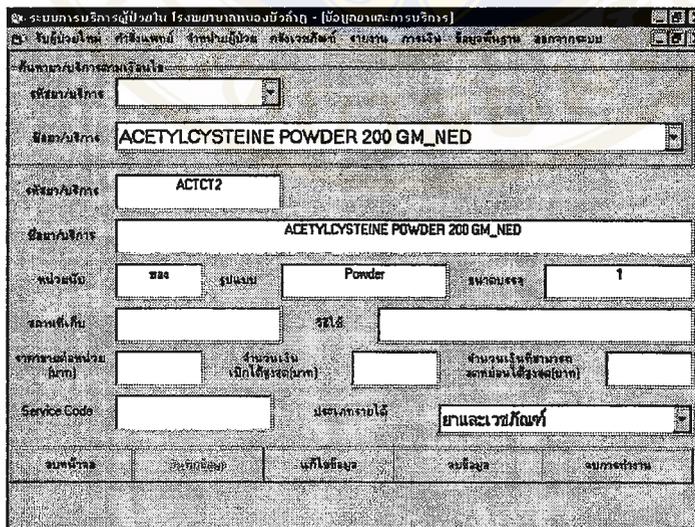


Figure 4.177 Front-end application of computerized unit-dose drug distribution :  
Drug data.

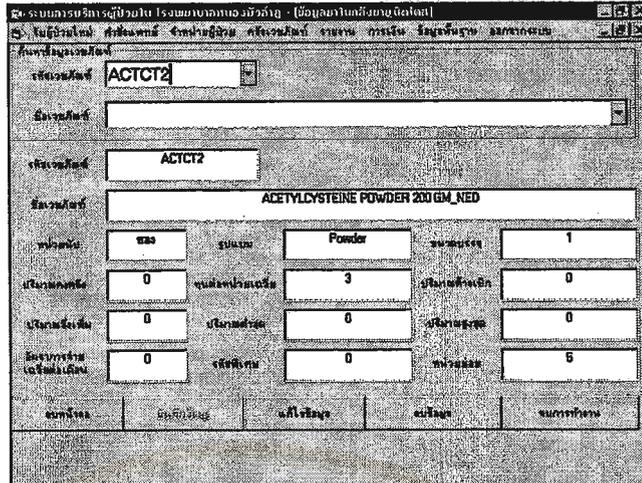


Figure 4.178 Front-end application of computerized unit-dose drug distribution : Drug inventory data.

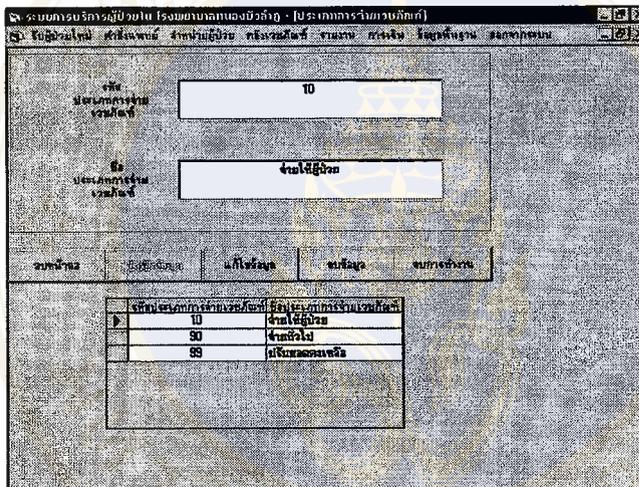


Figure 4.179 Front-end application of computerized unit-dose drug distribution : Drug dispense type data.

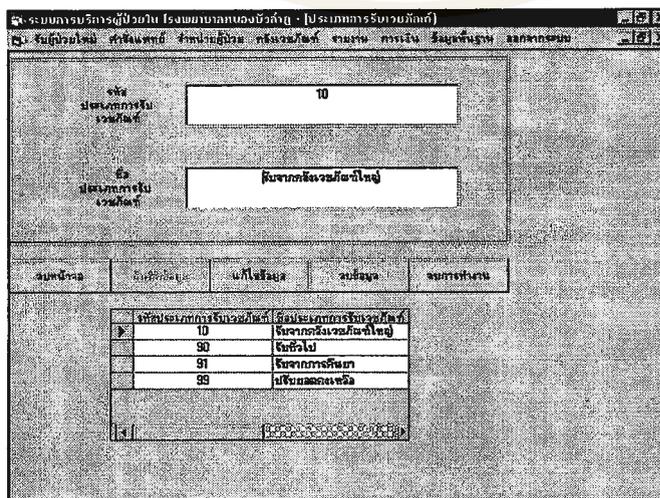


Figure 4.180 Front-end application of computerized unit-dose drug distribution : Drug receive type data.



Figure 4.181 Front-end application of computerized unit-dose drug distribution : Patient's drug Profile.

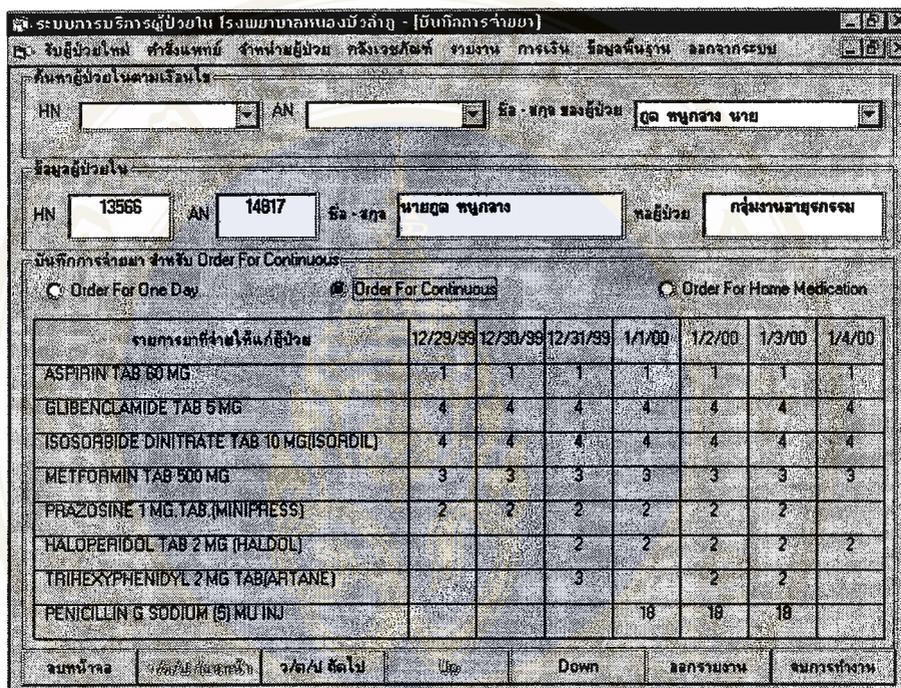


Figure 4.182 Front-end application of computerized unit-dose drug distribution : Patient's drug Profile(details).

### **Data concurrency and consistency control**

A processing in client-server environment is a multi-user processing which various processors will be processed at the same time. So DBMS will must be able to manage queues of processes which will be processed with efficiency. This calls 'Concurrency Control'. And about 'Consistency', it means consistency of data when multi-user processing happens. Each user can insert, update or delete data all the time. So data in database must be updated every time it is retrieved.

In this client-server computerized unit-dose drug distribution system, transaction is used for data concurrency and consistency control. Processing in transaction is called 'Unit of work' or 'Atomic transaction'. It means many SQL statements will be processed after the command 'Begin Trans'. And SQL statement command will update data only at database buffer. Data will not be updated at database space until the command 'Commit Trans' will be executed, and after that data which has been updated at database buffer will be sent to be updated at database space. And if any command in the atomic transaction has errors, all commands should be cancelled, or rolled back to re-start at the beginning.

An example of transaction is presented in figure 4.183.

### **System security**

Data protection is necessary and must be defined for controlling security of the system. For this computerized unit-dose drug distribution, 2 levels of security has been set as followed :

```

Private Sub cmdDelete_Click()

    strCnn = "driver={SQL Server};server=NHUM;" & "uid=" & UID & ";pwd=" & PW &
";database=UnitDose"

    Set cnADO = New ADO.DB.Connection

    cnADO.Open strCnn

    On Error GoTo DBError

    cnADO.BeginTrans

    If txtAN.Enabled = True And txtAN.Text <> " " Then

        Set rs = New ADO.DB.Recordset

        rs.CursorLocation = adUseClient

        rs.CursorType = adOpenKeyset

        rs.LockType = adLockOptimistic

        rs.Open "SELECT * FROM T_IPt WHERE AN=" + txtAN + "", strCnn, , , adCmdText

        rs.Delete

        rs.MoveNext

    End If

    cnADO.CommitTrans

    Exit Sub

DBError:

    cnADO.RollbackTrans

    MsgBox Err.Description

End Sub

```

**Figure 4.183** An example of transaction in coding of computerized unit-dose drug distribution system.

### 1. User interface level

When a user inputs user ID and password in a log-in form of the application, both will be verified by the application in four cases.

Case 1 : No UserID



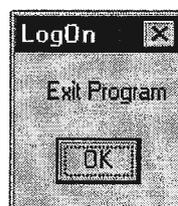
Case 2 : Wrong UserID



Case 3 : Wrong Password



Case 4 : Exit Program after 3 wrong passwords



If user ID and password are right, the use can pass into the application and the MDI form will be shown. But if they are wrong, the log-in form will not disappear. And the user must input only his right user ID and password so he can pass through the application.

## 2. *Database level*

The right user ID and pass word from user's interface are sent by the application to unit-dose database, which is managed by Microsoft SQL Server. The DBMS will verify this user ID and password to define permission to unit-dose database, which had been already established in the database(by using 'roles' and 'users' object). The permission to unit-dose database has been established for 3 groups of users as followed :

*Group 1 : Administrator*

*Group 2 : Pharmacist*

*Group 3 : Nurse*

Including, all users in the system will have their own user name and password, which can be added or updated by administrator.

**Table 4.3.** Permission to unit-dose database for each group of users.

Permission to Subsystem	Group 1 : Administrator	Group 2 : Pharmacist	Group 3 : Nurse
1. Patient's admission	Yes	No	Yes
2. Patient's medication			
2.1. Doctor for each patient	Yes	No	Yes
2.2. Patient's diagnosis	Yes	No	Yes
2.3. Patient's operation	Yes	No	Yes
2.4. Patient's death diagnosis	Yes	No	Yes
2.5. Patient's medication	Yes	Yes	Yes
3. Patient's discharge	Yes	No	Yes
4. Drug Inventory	Yes	Yes	No
5. Reporting	Yes	Yes	Yes
6. Calculating Cost	Yes	Yes	Yes
7. Base data	Yes	Yes	Yes

## System testing

### 1. Unit test

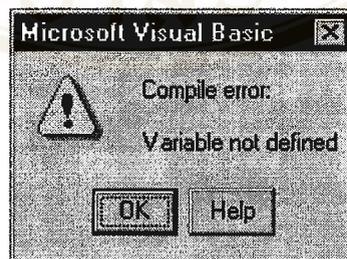
Each unit or group of the program as implemented in source code has been tested for the purpose of no errors. For coding of this unit-dose drug distribution application, which MicroSoft Visual Basic 6.0 has been used for implementation, the program has been analyzed while it's actually running so that the programmer can figure out how and why something went wrong. This calls 'Debugging a program'.

For example, coding from the application about loading form is shown in figure 4.184.

```
Private Sub Form_Load()
    Set cnADO = New ADODB.Connection
    LogonString = "driver={SQL Server};server=NHUM;" & "uid=" & UID & ";pwd=" & PW &
";database=UnitDose"
    cnADO.ConnectionString = LogonString
    cnADO.CommandTimeout = 20
    cnADO.CursorLocation = adUseClient
    cnADO.Open
End Sub
```

**Figure 4.184** An example of coding from computerized unit-dose drug distribution system.

When this code is running, Microsoft Visual Basic will send the message box to the user like in figure 4.185.



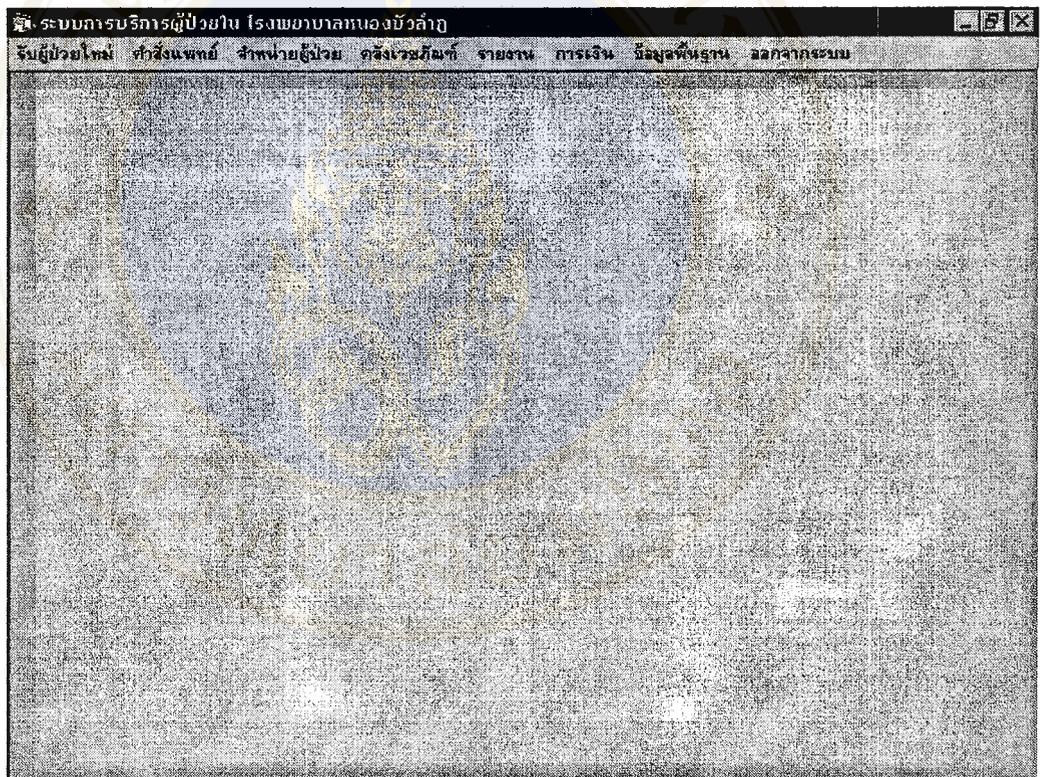
**Figure 4.185** Message box happening during running coding from computerized unit-dose drug distribution system.

So the researcher will correct this coding and run it again until nothing goes wrong.

## 2. *Integration test*

The program has been tested by focusing on design and construction of the software architecture.

For example, this computerized unit-dose drug distribution system is organized into 7 subsystem : patient's admission, patient's medication, patient's discharge, drug inventory, reporting, calculating cost and base data, which is shown to users as in figure 4.186.



**Figure 4.186** Testing program by focusing on design and construction of the software architecture : Organization of the system.

## 3. *Validation test*

The program has been tested by validating requirements against software.

For example, from searching part of patient's admission updation form. which is shown to users as in figure 4.183.

**Figure 4.187** Searching part of patient's admission updation form of computerized unit-dose drug distribution system.

If the users hadn't input data in any text boxes of searching part, when he pressed the command "ค้นหา" then the application will send the message to tell the user as shown in figure 4.188.



**Figure 4.188** Message box from searching in-patient without inputting data in any text boxes of searching part.

This message will make the user to understand that he must input data in any text boxes of searching part before he will get data of in-patient.

#### 4. System test

The program and other system have been tested as a whole. The application will be tested by implementing to use as a tool for the new unit-dose drug distribution system's operations. After that all errors and recommendation will be recorded and analyzed by the researcher for improving the efficacy and the effectiveness of the application.

Including, for this studying, the application has been tested by 2 groups of users, both a pharmacist(1 person : the researcher) and nurses(6) . The test has been set for the operations of unit-dose drug distribution system in department of medicine, Nongbualumphu hospital from December 25<sup>th</sup> 1999 to January 15<sup>th</sup> 2000. After each day of the test the user has evaluated the application by answering a questionnaire, which is shown in figure 4.189. This questionnaire has been created by using the concept of “Quantitative Descriptive Analysis”, which is described by Herbert Stone(26). Subjects are instructed to place a vertical line at that point on the horizontal line that represents the intensity for that attribute; if none is detected, the mark is placed to the far left, and strength increases to the right. The distance from the left end is measured, and this value is the intensity for that attribute. The minimum intensity for each attribute is 0 and the maximum is 15. For computational purposes, the decimal point is moved one place to yield whole numbers.

## แบบสอบถามความคิดเห็นของผู้ใช้ ที่มีต่อโปรแกรมระบบการจ่ายยาแบบยูนิตโดสด้วยคอมพิวเตอร์

หลังจากที่ท่านได้ทำการทดสอบโปรแกรมระบบการจ่ายยาแบบยูนิตโดสด้วยคอมพิวเตอร์เป็นที่เรียบร้อยแล้ว ขอให้ท่านแสดงความคิดเห็นของท่านที่มีต่อโปรแกรมดังกล่าว ตามหัวข้อต่างๆ ด้านล่างนี้ โดยการเขียนเครื่องหมาย / ลงบนเส้นตรง

<b>1.</b>	<b>ความชอบของท่านที่มีต่อโปรแกรม</b>	
	ชอบน้อย	ชอบมาก
<b>2.</b>	<b>ความชัดเจน เข้าใจได้ง่ายของโปรแกรม</b>	
	ชัดเจนน้อย	ชัดเจนมาก
<b>3.</b>	<b>ความสะดวกในการใช้โปรแกรม</b>	
	สะดวกน้อย	สะดวกมาก
<b>4.</b>	<b>ความรวดเร็วในการทำงานของโปรแกรม</b>	
	รวดเร็วน้อย	รวดเร็วมาก
<b>5.</b>	<b>ความถูกต้องในการทำงานของโปรแกรม</b>	
	ถูกต้องน้อย	ถูกต้องมาก
<b>6.</b>	<b>ความแม่นยำในการทำงานของโปรแกรม</b>	
	แม่นยำน้อย	แม่นยำมาก
<b>7.</b>	<b>ความสามารถในการนำมาประยุกต์ใช้กับระบบการจ่ายยาแบบยูนิตโดสของโปรแกรม</b>	
	นำมาประยุกต์ใช้ได้	นำมาประยุกต์ใช้ได้

**Figure 4.189** A questionnaire for the test of the application of computerized unit-dose drug distribution system.

## 8. ประโยชน์ของโปรแกรม

มีประโยชน์น้อย

มีประโยชน์มาก

## 9. ความสวยงามของโปรแกรม

สวยงามน้อย

สวยงามมาก

## 10. ความน่าสนใจ-ดึงดูดใจของโปรแกรม

น่าสนใจน้อย

น่าสนใจมาก

## 11. ข้อเสนอแนะอื่นๆ

Figure 4.189 A questionnaire for the test of the application of computerized unit-dose drug distribution system(continue).

After the test, the results of the 15 questionnaires(all answered by nurses) have been analyzed by SPSS version 9.0 as shown in figure 4.190.

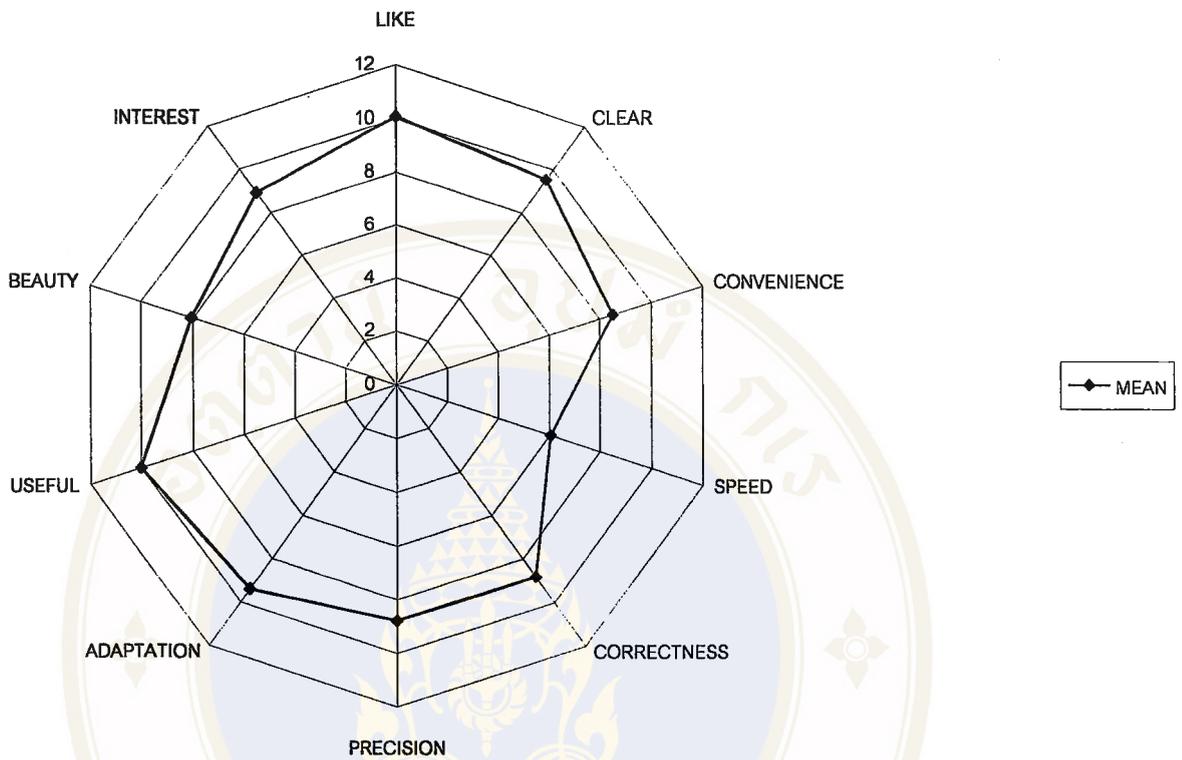
## Descriptives

**Descriptive Statistics**

	N	Minimum	Maximum	Mean	Std. Deviation
LIKE	15	4.50	14.90	10.0900	3.3132
CLEAR	15	3.05	13.00	9.5500	2.6866
CONVENIE	15	3.35	11.20	8.5167	2.4570
SPEED	15	2.00	11.90	6.0567	3.7954
CORRECT	15	4.40	12.80	8.8167	2.9803
PRECISIO	15	1.00	12.90	8.7833	3.4207
ADAPT	15	4.90	12.45	9.4000	2.0129
USEFUL	15	4.60	14.90	10.0000	2.8618
BEAUTY	15	5.10	11.25	8.0533	2.0507
INTEREST	15	4.00	14.90	8.9100	2.7855
Valid N (listwise)	15				

**Figure 4.190** Results for the analysis of questionnaires for the test of the application of computerized unit-dose drug distribution system.

From figure 4.190, Means of each attribute have been placed on each line and joined to create the picture referred to as a spider-web plot. As shown in figure 4.191.



**Figure 4.191** Spider-web plot of means for each attribute from the results of the questionnaires.

## CHAPTER 5

### CONCLUSION AND RECOMMENDATION

#### 5.1. Conclusion

In the last, this computerized unit-dose drug distribution system is useful as the followings :

5.1.1 Using for the operations in 'Unit-Dose Drug Distribution System', which had been developed to minimize the disadvantages of the conventional one by :

5.1.1.1 Minimizing drug miss used rate, good drug utilization.

Because this system, pharmacists have a major role in management of doctor's drug related orders for patient's medication by recording drugs himself, the first pharmacist is able to check doctor's orders for any drug-related problems that might happened and consult doctors if necessary. Moreover another pharmacist will approve these orders again, and if any errors happened, the second pharmacist will tell the first pharmacist to correct these orders. Finally the patient will receive right drugs with no errors and no drug-related problems.

5.1.1.2 Reducing the waste of drugs in each step of operation.

For 2 reasons :

- All of drugs taken from unit-dose sub-stock are prepared in the amount of 24 hrs use.
- In case of drug not being used, for example, doctor's stop order, they may be returned to unit-dose drug-stock.

5.1.1.3 Maximizing accuracy of calculating cost of used drug; suitable use of person depends on their professional and skill.

Only drugs really used by patient will be calculated for these cost of payment(they are calculated after patient had used them). This is different from the conventional system that patient must pay for drugs which are dispensed for patient before they will really take them.

5.1.1.4 High quality of patient care.

5.1.2 Correcting any problems which may occur in the new computerized unit-dose drug distribution procedures can :

5.1.2.1 Reduce time wasting for documentation such as unit-dose drug labels, patient medication profiles, financial documents.

This computerized unit-dose drug distribution system will generate all documents for operation including :

- Patient related documents : hospital number, admission number, patient's bed, doctor for each patient, diagnosis, operation, death, value of medication.
- Patient profile : age, weight, sex.
- Drug dispensing related documents : drug preparing note, drug labels, drug dispensing note, drug returning note.

#### 5.1.2.2 Updated inventory documents which increase operators' workload.

By this system, any of drugs which have been taken in and out of unit-dose sub stock will be recorded automatically. So it is unnecessary for users to update drug inventory data when drugs are taken out of stock for dispensing to patient by doctor's orders and checked in stock when drugs are stopped. This system will generate all drug inventory documents including drug requirement note, drug receiving note, drug dispensing note and drug inventory balance note. These will decrease all workload in drug inventory control.

5.1.3 This computerized unit-dose drug distribution system can be implemented, the following factors must be concerned :

5.1.3.1 Drug for patient administration must be in unit-dose package.

5.1.3.2 Drug distribution must be done in package which ready to dispense to patients, and there must be labels with the drugs(for example; name of drugs, name of patient, quantity, dose) all the time until they are administrated to patients.

This computerized system will automatically generated drug labels for each dose of drugs for patient, and they will be stored in unit-dose container. With these labels and drug dispensing note, which also generated by the system, nurse can use them for drug administration to patient with accuracy and efficiency.

5.1.3.3 Amount of drugs taken to wards is prepared for 24-hrs uses and can return these drugs in case of no-utilization.

The system will automatically generate quantity of ordered drugs in the amount enough for 24-hrs uses. Users record only drug frequency and quantity for each dose of drug medication for each patient. And if these orders are changed to stop, the system will automatically update quantity of drugs used and quantity of drugs which must be returned to unit-dose sub stock, including updating drug inventory data and cost for drug exactly dispensed to patient.

5.1.3.4 There must be patient medication profile for each patient, and always being updated for each of drug distribution.

The system will automatically generate patient medication profile from doctor's order for medication, which have been recorded by pharmacist.

5.1.4 All of concurrency problems for each sub system will be disappeared by using client-server computerized unit-dose drug distribution system, which can provide users to access data in the same server from 4 remote sites as follows :

Client 1 : Main drug distribution system

Client 2 : Emergency drug distribution room

Client 3 : Patient's ward nurse station

Client 4 : Patient's ward drug distribution room

All computers in the system are linked together to provide flexible processing for all of 7 sub system in the same time.

## 5.2. Recommendations

- 5.2.1 Although this application is used for unit-dose drug distribution system, it may be applied to another types of drug distribution system. For example, one day dose drug distribution system, which doesn't necessary to prepare drugs for in-patient in unit-dose form, this application can be applied in the part of calculating quantity of drugs ordered by doctors for each in-patient, which must be enough for one day using.
- 5.2.2 The researcher has chosen Rumbaugh's Object Modeling Technique (OMT) for the design and development of this application. However, other techniques such as Booch, OOSE can be useful for the design and development of this application too.
- 5.2.3 Using MicroSoft SQL Server 7.0, which must be run on MicroSoft Windows NT operating system, as DBMS of the application must use high potential computerized resources, for example, high speed CPU, high RAM, which leads to high cost for implementation. So other DBMS can be used instead of MicroSoft SQL Server 7.0 to reduce this high cost of implementation.
- 5.2.4 Other programs, for example, C++, PowerBuilder, can be used for user interface development of the application.
- 5.2.5 The new system of computerized unit-dose drug distribution system may be developed to retrieve data from Stat-2 database, but there may cause problems in lag time of retrieving data.
- 5.2.6 The coding of this system may be modified to improve response time.

5.2.7 This application is only used as a 'tool' for operations in unit-dose drug distribution system, which although can cover all procedures, but in the same time the application may lead to higher complexity of the system. So the success of unit-dose drug distribution will be not happened if users in the system cannot understand all the procedures in the system. So it is very important to train all users to understand what the new system is used for, and how it will be operated. It must be take some times to do this but it can be guaranteed that this system can be really useful for drug distribution system.

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