CHAPTER II

THEORETICAL CONSIDERATION

In this chapter, after analysing the statement of the problems, we will discuss many similarities between industrial practices attributes and the hospital practice, where they can provide framework for the hospital best practice's requirements. And focus on the foundation of production systems and operations management (OM), to address areas of improvement to the hospital. In this case, the emphasis is to compare existing healthcare management practice, to the industrial practices.

2.1 HEALTHCARE PRODUCTION SYSTEM:

In general, the hospital system can be described as a production system, in which can be transformed into set of inputs; ranging from materials, labours, equipment, procedures, and facilities to the outputs (Martinich, 1997). These outputs can be called products and in this case, it is a combination of products and services, as a healthcare service:

Production System	*Tangible Component*	*Service Component*
Hospital system	Medical equipment and drugs	Healthcare services

Figure 2.1: Combination Products

Therefore, the hospital can be operated as a health manufacturing system, in which provides many healthcare services (machines and operators). Service cost is labour, which in this case, it is predominantly doctor fee (DF). Its raw materials is the patients; most of the time, entering and incoming into the front process and be conveyed into medical processes during the non-stop operation (24 hours and 7 days per week). From this area, the patients are to be pulled forward through the hospital resources transformation system by the mean of the public healthcare programs as a function in this system. At the time, the patient is considered as a product, created by the hospital services. The final construction of this finished product will be a full satisfaction (CRM) of healthy individuals. Therefore, it can be realised that the hospital system process permeates a typical manufacturing system, as it can be shown:

System ➡	Inputs ➡	Resources Transformation ➡	Function(s) ➡	Output
Hospital Management (CRM)	Patients	MDs, Nurses, Medical Supplies, and Equipment	Public Healthcare Programs in a form of Regulatory Framework (CPDB)	Healthy Individuals

Figure 2.2: Hospital System Process Permeates a Typical Manufacturing System

In contrast, in a typical manufacturing system, lowest operations cost is focused; inventories and machine operations and likewise medical operations. This principle exhibits no different than a system of production line, from the input (patients; and as in this specific case, it is considered highly regulated inputs) through resources transformation process and functions and existing as the output in the form of healthy individuals. Therefore, in this case, the healthcare service process concentrates on creating output from inputs, for this instance, a patient may receive service from resource transformation (e.g. MDs, nurses, and medical supplies and equipment) and as well as marketing mix. And subsequently, be conveyed with the demanding of maximum care throughout the whole processes.

As a result of these services, he/she obtains improved health and satisfaction as healthy individual as the output. This can also be viewed as a pull system where the demand; patients who need to get treated by the hospital through the use of healthcare functions, and as in this case number of register patients, are to be received (registered) from suppliers and distributors (national healthcare authorities). And the hospital management could serve as a quality control system (QC) and marketing mix context as well; where the patients are being properly examined, treated, operated, medicated, cured, and restore to health along the production process.

2.2 DEVELOP THE OPERATIONS MANAGEMENT:

In principle, production systems that produce more in services are referred to as service systems (Stevenson, 1996). However, if most of these services require close contact of customers with the production process, in which it is a highly

physical contact (and highly regulated in operations), this can be matched up to how workers in the manufacturing plant handing highly specific parts to another along the production line (Martinich, 1997). As well as in the practice of healthcare inputs, the healthcare service requires the patients to participate in close contact with nurses, technicians, doctors, and medical specialists, and highly trained surgical teams, and nothing that this degree of interaction can be more complex. As of the healthcare service and treatments consist of waiting time, medical examinations, and operation processes before a period of recovery and then restore to healthy individuals. And in a healthcare service environment, every assembling line and workstations (from front reception to nurses, doctors, and technicians) are required to response in more complex process in production process planning (Chase, 1995).

Healthcare service is thus, a high customer contact service which consumes a large variety and volume of profession care. Thus, this production of services can be resemble to the production line, in point of fact that the patients must be pull toward the production line and it cannot take place without their participation. From this point, production planning and operations management have become important issues for the healthcare management. Therefore, there is a clear link between these two related disciplines between typical manufacturing system and the hospital system.

Porter's Generic Competitive Strategy:

As to date, to response better to the competitiveness of the hospital industry, Porter (1994) also insists on regular basis of redefining healthcare that "*Although healthcare is unique in some ways, in this case, it is no different than any other industries...the overall problem is that we haven't defined healthcare as the delivery of value to patients.*" (Porter, 1994, p. 65). As he believes that the healthcare service can certainly add value to the patients and should be provided in three areas; corrected information, helping support patients decision, and efficient claims processes. Where these common information protocols needs to be developed, and patients need to be able to understand the choices they make, based on good information (Porter, 1994).

Essentially, when we compare these with most industries, the customers can make purchasing decision and pays for the service or product they are satisfied, as well as they can compare product quality and price with wide range of competing products. As for instance, for the automotive industry, buyers of automobiles can go on test drives, compare prices at different dealers; choose colours, engine specifications, exterior/interior options, and select the types and levels of financing, whereby in healthcare service, he affirms, could hardly be more different (Porter, 2004). At this point the boundary between healthcare services and other industries are becoming blur (Suomi, 2001).

Therefore, the hospital specific treatments are needed to promote value in healthcare, while also the hospital can offer more quality in terms of choices toward best benefits, and eliminate fragmentation of healthcare programs, by aggregating the programs into framework (Sriratanaban, 2001). In which, it can improve the management efficiency and reducing in cost containment by shortening the ALOS and eliminating unnecessary admission. Where the consultation tool in this case is considered, since the front reception personnel refers to those who presently authorise the highly regulated inputs but provide no consultation mean in details to classify the inputs. Thus this tool should be developed and implement to streamlining the production process; from start through finish process (throughput time), based on number of registered patients and number of visits of each program to the hospital. From that, the quality of services mix can be contributed to the arrival of healthcare patient registrations (Wibulpolprasert, 2004).

Porter's Value Chain Model:

From Porter's value chain model (1990), as the role of healthcare industry illustrates the value chain. The primary activities are those involved in the healthcare service, while the supporting activities are the existing and ongoing management. And the consumer's perspective was measured in terms of satisfaction with respect of choices of available healthcare programs (priorities). What patients also want is the information about their available treatment options, and reliable consultation between healthcare personnel and the patients. And also ability to understand the

official regulations and requirements, and medical prescriptions distributed by the hospital. In the view of that, the healthcare industry can permeates Porter's value chain model as shown:

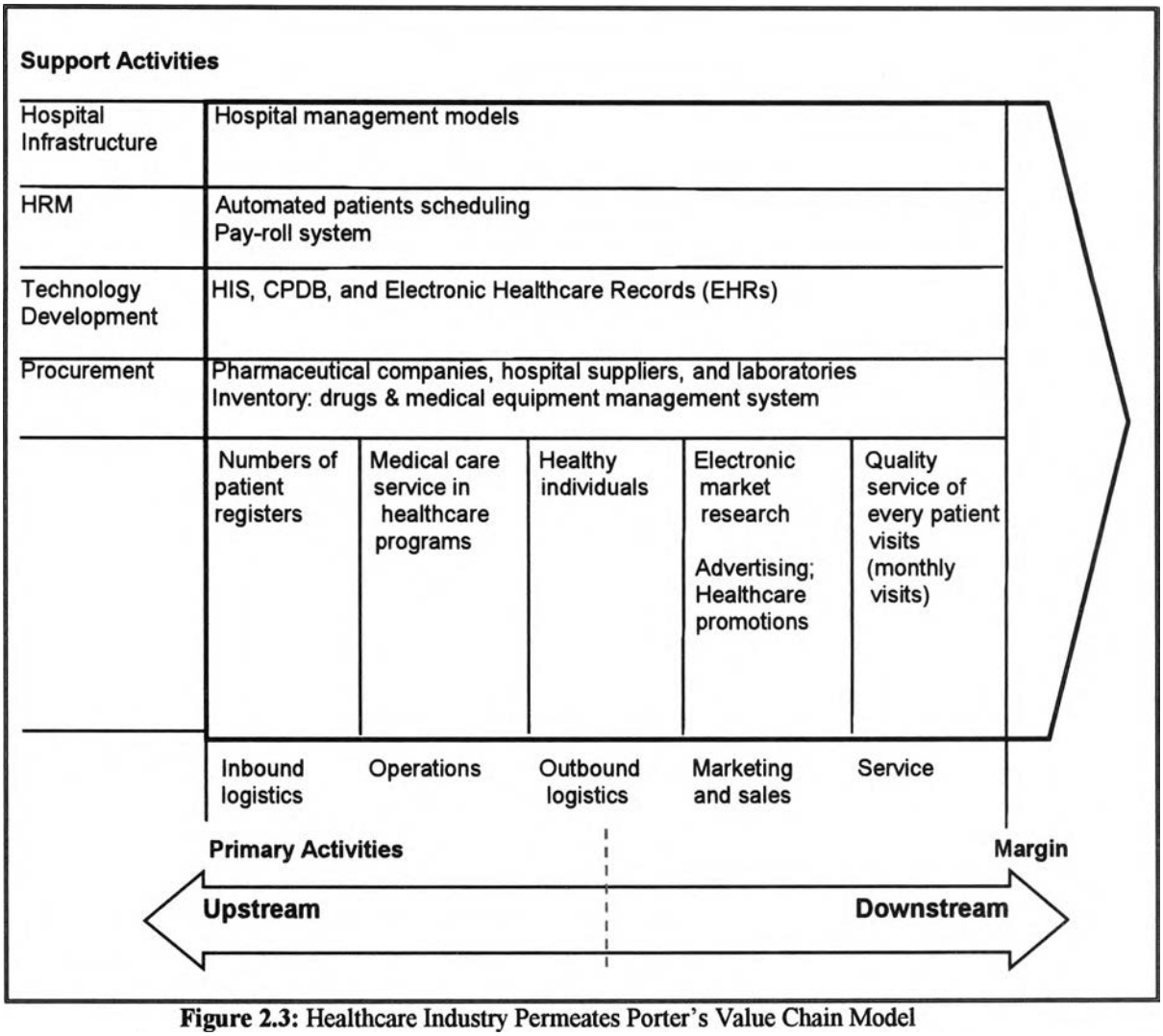

Figure 2.3: Healthcare Industry Permeates Porter's Value Chain Model

From the value chain above, when we consider the chains of customers in the healthcare service, there are multiple established tiers of customers; employers who purchase healthcare coverage for their employees, insurance companies who pay for their insured patients, and national healthcare authorities who collect premiums and contribute to the healthcare service. Thus, the role of hospital in healthcare management unquestionably encounters both demand and supply sides. Where the demand side, depends on the number of patient registers, while on the supply side, is the increase of production system and capacity of the hospital.

Demand side: Inbound

- Healthcare demand; increasing numbers of patient registers and monthly visits from each healthcare program.

Supply side: Outbound

- Increase of production system and capacity; increasing of the throughput of healthcare patients, sufficient to response to the national healthcare authorities' increasing requirements. As well as the quality of healthcare service is the ongoing competitive advantage concern.

2.3 INFORMATION REQUIREMENTS:

This section identifies production systems, which can be applied to the hospital management in term of information required to improve efficiency for the healthcare management. Operations management is one discipline that has been practiced ranging from people, plant, parts, process, and to planning and control system (Figure 2.4). Thus, management of the production systems also involves issue of plant design (functional layout) and as well as business process reengineering (BPR) in a form of process design, as to efficiently cope with the increasing demands. This also distinct the role of hospital management from other disciplines, especially in term of use medical operations resources to transform from inputs stage to the output. Once information requirements are established, the production planning can be determined what requirements and resources need to be set up in planning the process.

Business Process Reengineering (BPR):

In BPR, it is defined as redesign of processes to achieve a significant improvement in processes implementation (Stevenson, 1996). In which in our case, to improve the healthcare' process throughout, from the front reception through the end process. And as part of its goal, is to remove the bottleneck from the front-reception process, and reduce the unnecessary admission where it is a main element of cost containment, by redesigning steps of processes based on the proposed

regulatory framework of regulations and requirements. As in this case, there are four BPR tools and techniques (Stevenson, 1996) which illustrates the applicability that we use throughout the entire scope of thesis:

i) Inductive Thinking
ii) Flowcharting
iii) Creative Process Redesign
iv) Process Benchmarking

2.4 PRODUCTION PLANNING:

For development of the production planning, as it can be established from improving healthcare quality, while reducing costs and determine the priorities of patients in the front reception. Then in this case, it must be in consistent with in hospital system, and can be describes its functions from getting raw materials (inputs) to finished products (output), with clear line of management responsibilities, as shown:

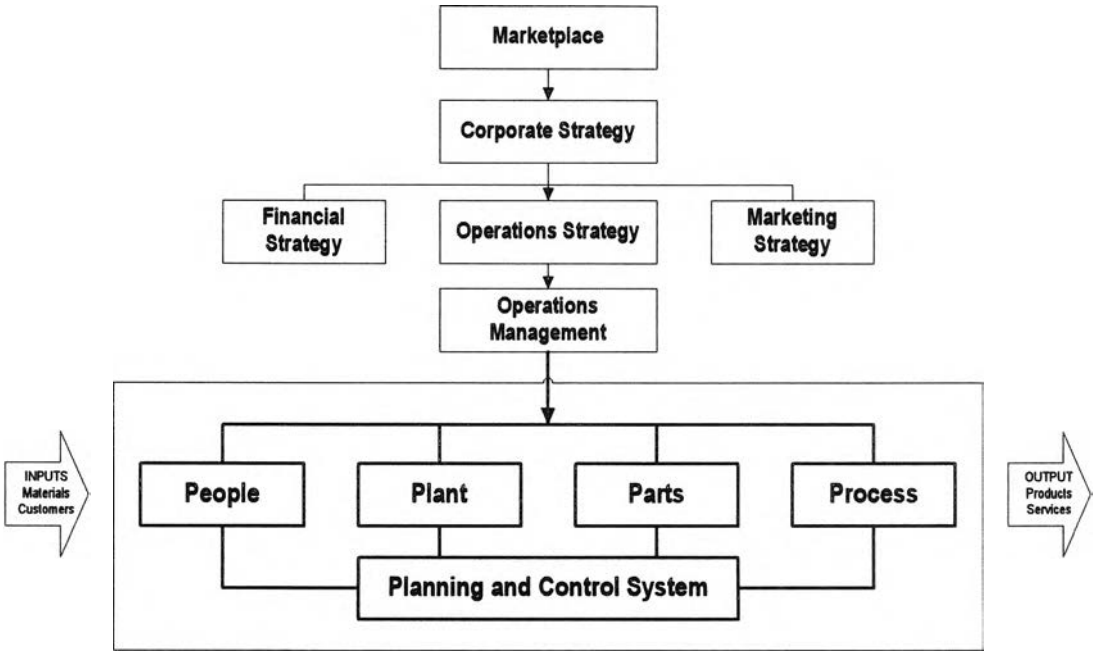

Figure 2.4: Summary Model of the Operations Management (Chase, 1996, p. 5)

Base on these elements, to improve efficiency in the hospital system, development of production planning and control of improving resources transformation and functions must be made. Then these can be arranged in a comparative production planning and control framework between two disciplines as shown:

Information Needs in Industrial Practices:	***Information Needs in Healthcare Management:***
• *What product to products* • *Volume, Types* • *Time*	• *What product and service to produce* • *Volume, Types* • *Time*
i) Production Planning:	***i) Production Planning:***
• Classification of raw materials input (types) • Routing allocation between each department involved in the production of products	• Classification of highly regulated inputs (public healthcare patients) • Routing allocation of each department and each programs input throughout output
ii) Process Planning:	***ii) Process Planning:***
• JIT Production • Production mix • Toyota Production System (TPS) • Direction of production flow • Lead time (cut transaction)	• Functional layout (efficiency layout) • Cases mix and services mix • Number of patient registers with respect to number of patient visits on each program • Routing of processes of each program • Cycle time of each program(cut transaction)
iii) Shop-Floor Control:	***iii) Shop-Floor Control:***
• Job shop process • Workstations • Raw materials (input rate: work in process) • Line of production • Kanban	• Patients uniform loading (job shop) • Reception, filing room, and gatekeeper nurse; Workstations • Equipment position • OPD card and healthcare files
iv) Output:	***iv) Output:***
• Quality control (QC) • Completed order of patients (output)	• Waiting/response time • ALOS • Unnecessary Admission

Table 2.1: Comparative Production Planning and Control Framework

Form comparative table above, classification of highly regulated inputs in this manner, is considered the most essential area. Therefore, from the industrial practices, the hospital should find a better system to cope with such variable input and remove the bottleneck of the front process, by eliminating variation and classifying each type of patients and track down its cost containment thoroughly (Johannesson, 1998). The objective of this comparative framework is to consider and focus on front-reception process reengineering.

After that, quality control can be served as management tool to the front-reception process reengineering, which referred to '*quality at the source*' (Kurogane, 1993). This activity must be executed by each department, where this links to the concept of empowerment of personnel, nurses, and medical staff who will be given authority to stop the production line if the quality output (patient services) cannot meet with certain standard process. As the patients simply want more than better clinical competency from the hospital, they want adequate information on their status, priorities, and treatment options. From this perspective, good quality control of healthcare means providing trustworthy information in a way that works for them, and at the time they want it. This perceived quality, in turn will influence the patients' decision and promote customer network, to register for healthcare service with the hospital.

Also, it is a mean of communication, which contain amount of information for the front-reception personnel. Thus, this reinforces '*do it right at first time*' concept (Chase, 1995). As of healthcare management goal, is aimed to reducing medical errors, and cutting waste by getting procedures right at the first time. Process quality is then considered quality at source, and can be consistent with the adoption of Deming's cycle: PDCA (Kurogane, 1993), in which includes inspection to improve in quality of routine processes and to address on how to reduce the number of defects, as in this case; malpractice, mistreat, and medical error, which are very crucial in practice. Thus, these quality control tools, require additional elements and measures as shown:

Industrial Practice Outputs		***Current Practices Used in the Hospital; Healthcare Mangement***
Elements	***Measures***	• Identify and eliminate unnecessary activities • Recognise inefficiency of physical layout • Redesign processes, clarify process flow, and process layout • Smoothing production flow in each healthcare program • Establish standard operations flow in each workstation. Develop functional layout for information flow
• Cost	• Cost containment	
• Quality	• Number of defects	
• Performance	• Cycle time	
• Delivery	• Throughput time	
• Flexibility	• Lead time	
• Innovativeness	• Reduce overlap	

Table 2.2: Industrial Practice Outputs between Two Disciplines

2.5 PROCESS PLANNING:

In this process planning context, it is to be based upon results of monthly reviews and claim disposition. The process planning can be explained by the concept of demand pull production (Chase, 1995), in which the number of patient visits are pulled through the production process, through the workstations. Production is controlled by the workstations and only occurred as needed, as to facilitate the flow of services. To illustrate this application, lot size can be addressed in term of how many patints should be executed at the time, and this benefits in reducing in paperwork, queue, and lead time, where the formation of bottleneck and long waiting/respone time are occurred. Thus, process planning represents tool for reducing inventory and improve service operations, through encompassing process design and therefore improving productivity.

Then, what aspects of process planning should be eliminated or enhanced as to reduce waiting/response time in case of complex profile of patients, will be shown. In which, requires doctor to evaluate[3] the healthcare type before examining, and at the same time retrieve medical procedure especially for the AE case patients.

Process Planning Systems	***Measures:** Manufacturing Outputs*	***Equivalent Process Planning System in Hospital System:** Healthcare Management*
i. Shop-Floor Control: Job shop (Functional Layout)	Cost and Quality Performance Flexibility	High variety of patients in single case can be characterised by job-shop execution
ii. Just-in-time (JIT)	Design and clarify flow process, link operation, Layout for flow, Balance workstation capacities	Design block-flow diagram for each type of process. Establish standard operations flow in each workstation. Develop functional layout for information flow
iii. Toyota Production System (TPS)	A total mix of model in each colour	Highly regulated input, variation of patients priorities and requirements
iv. Kanban: Demand pull	Demand pull, Reduce lot size to one	OPD card, Discharge summary (IPD), and Admission Forms
v. Quality Control (QC)	Plan, Do, Check, Act (PDCA)	Do it right at first time and quality at the source

Table 2.3: Comparative Process Planning Systems and Hospital System

[3] Evaluate: This procedure could take up to hour and furthermore it has been practiced with the manner of hassle to use the healthcare services.

Moreover, for JIT, as it was originally invented for manufacturing system, but the current practice, it has been successfully applied to other discipline as well (Chase, 1995). In this case, the hospital is no different, where the control of information flow can be achieved through implementation of JIT technique. As the bottlenecks can be eliminated and be dealt with production planning and control. In fact, the principle of JIT production is to produce the necessary products, in the necessary quantities in every process of an orgnisation. Where practically, every modern hospital has been using at least some JIT concepts in its design of facility layout and processes (Sirinivasan, 2002).

Kanban is an essential aspect of JIT, where it refers to the smoothing of production such that the production operations can be corresponded to the assembly line. By which the production processes must be redesigned to allow cycle time and lead time to be considerably reduced. Several aspects of JIT production can be realised through smoothing of the production and rearranging of the shop floor for efficient facility layout:

Production Systems	***Industrial Practices***	***Healthcare Management***
Facility Layout	Facility focuses on production efficiency	Facility accommodate patients needs
Process Design	Customer is not contacted in processing steps	Production process has direct effect on patients
Production Planning and Control	Production smoothing	Smoothing production flow in each healthcare program
Quality Control (QC)	Quality control standards are measurable and fixed	Quality standard in the administration is variable

Table 2.4: Comparative Production Systems between Two Disciplines

The goals are to improve the hospital's ability to satisfy the patients, increase productivity, and reduce inventory costs. Thus, these aspects can be simplified as shown:

i) Job-shop processing:

Under job-shop processing, operations requires distinctive processing, transferring, and verifying to be developed, and also address the functions of the systems.

ii) ***Shop floor control:***

JIT concepts can be applied to various elements, as they relate to shop floor Control in this case, ranging from quality control to process flow, which should be evaluated to established optimal functional layout.

iii) ***Routings: Simplification of Production Flow***

Simplification of routings and reduce number of workstations is an element of JIT, as well as the transportation can be reduced as to increase efficient of plant layout and this leads to increase in efficiency.

2.6 SHOP FLOOR CONTROL: Job-shop execution

A job shop is defined as a group of manufacturing operations where the production system are organised according to functions and its routes (Toomy, 1996). It is charaterised by low volume and high variety, and low standardisation of its standard process. Sepehri (1985) states that kanban is the most primary source for shop-floor control process, which works as traveling cards containing detailed information used in provide control requirements. This card is to be constantly modified to cover necessary information and to travel all over the necessary routes of workstation and department. However, job shop execution must be designed for flexibility to also accommodate variation of demand. Since the assembly operation in the job shop, is make-to-order environment. Then when apply to the hospital, production activities in the front reception must be divided into workstations, then functional layout can then be designed to promote efficiency and flexibility movement.

In addition, in the job-shop process, shop floor control is to maintaining the operation status and its routes. These operations are used to be planned by the hospital senior manager. The key to this is individual queue control, which can be monitored by especially inputs and output control techniques (Toomy, 1996). Where the larger variety of products are to be made by the process, the more flexible the process must be and the same idea goes to the hospital that this leads to the use of

job-shop process, especially in handling each case of healthcare patients throughout the process. The service required is to be made by various order (highly regulated inputs) thus the production process requires design of job-shop process, to allow hospital personnel to decide which healthcare process's routes to process through and in which order. As a result, the detail process design and the functional layout of the front reception and its activities can influence the efficiency of the hospital production process.

Job-Shop Execution Areas:

As in our case, the front reception circulates 400-500 OPD card per day (derived from Table 1.1). Goddard (1982) states that this capacity requires the kanban to be circulated as such, through daily output volume. Whereas, it is defined with a first come/first serve system, that basically whenever patients arrived first it will identify the job shop process that should be worked on. Also, colour codes system, is to be applied to indicate stages of manufacturing and types of raw materials. Likewise, in this concept, the classified OPD cards are to be colour coded (by colour stickers) which requires amount of manual classification, as to indicate its routing standard.

In this specific step, immediate patient records such as critical diseases or AE cases can be recorded and become a potential list of patient admission record, then patient record will be monitored and list the number of admission which would allow the front-reception to permit ALOS for certain patients. Then, printing of admission and registration forms can be done at the time of admission, and the patient will have the form when they need it (greater productivity and accuracy). The scope of improvement of each workstation (reception, filing room, and gatekeeper nurses) are as shown in cause and effect diagrams:

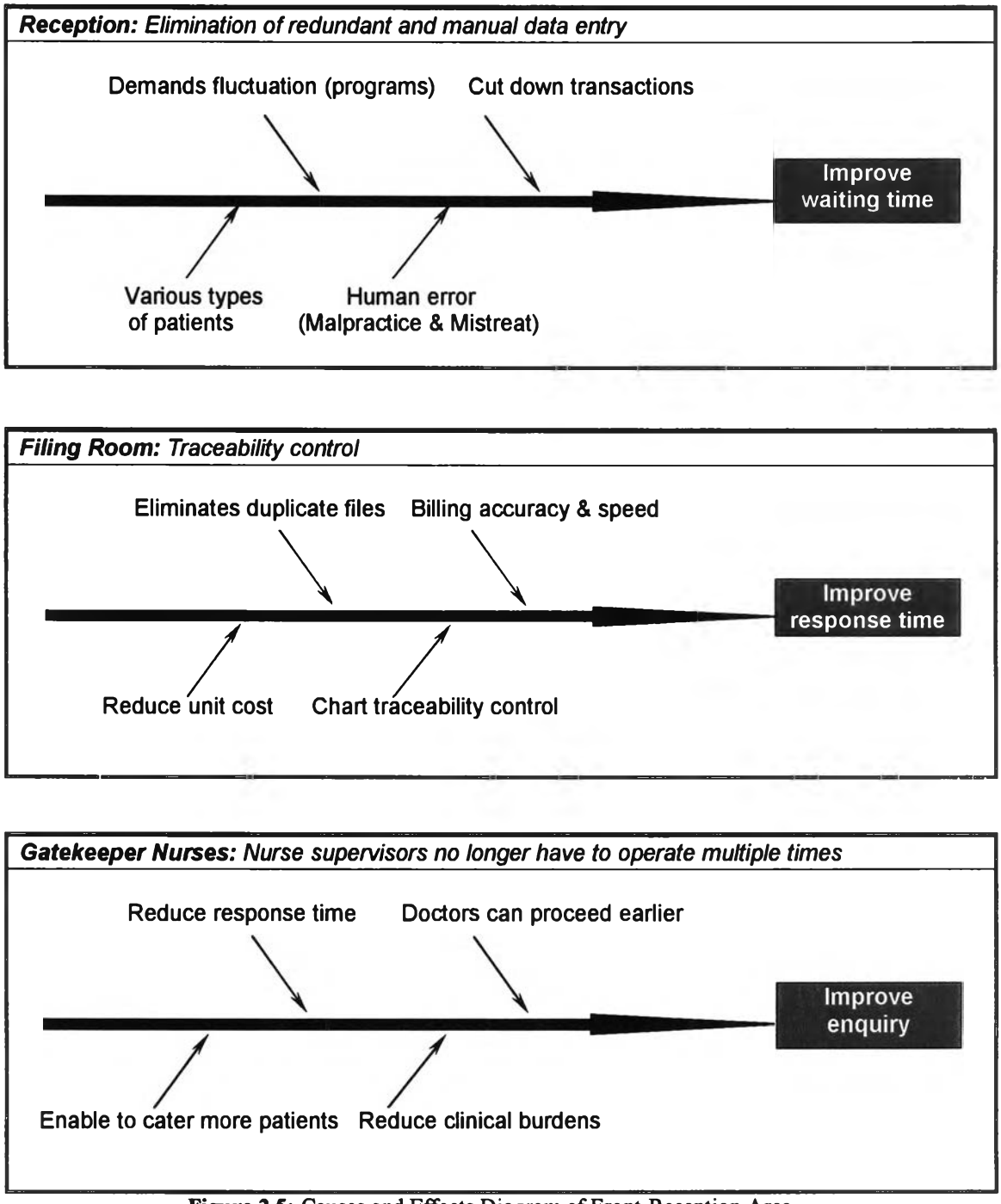

Figure 2.5: Causes and Effects Diagram of Front-Reception Area

Elimination of Variation:

In contrast to the hospital production line approach, from such patient registers and monthly visits, the personnel of each workstation have to arrange the necessary workforce for the monthly capacity. However, as the hospital using JIT production, the mean for adapting production to variable demand is called production smoothing. It is a preparation of each day's sequential production

schedule, which specifies the assembly order of various product types coming through the assembly line. Thus, production smoothing enables the system to adapt to daily and monthly fluctuations in demand in terms of quantities and variety. Through that, a production line is no longer committed to the manufacture of a single type of product, instead, routing must be in response to cope with patient demands. Then, smooth production must then be extend into two areas; the average total production of a product per day and the averaged quantity of each variety of products.

In our case, as to improve the condition of the hospital, such information change is being made through constructing the regulatory frameworks to be used with the existing processes. Where under the pull system of kanban, the variation of quantities of each program's patients will be minimised. The information on incoming patients of each program must be fed into the production planning, and a weekly plan must be generated. Then, the level of demand to be aggregated over time period will be reduced, with reduction in the safety stock required, then variability in inventory levels can be matched up with the incoming demand. As to improve process flow and reducing service process variability in the hospital as shown:

i. Eliminate special causes of problem by correcting (classifying) the patient inputs at first time, then front reception personnel will have ideas for dealing with common causes, and then enable to set up standard process.

ii. Reduce common variation, require process redesign and substantial implementation. Reduce hospital service uncertainty and service process variability (Li, 1997).

Toyota Production System (TPS):

The TPS was originally invented by Toyota Motor Company (Ohno, 1988) and aims to use as few resources (materials, labour, and space) as possible to produce desirable amount of product at highest possible level of quality. Slightly research has been done on the transferability of the TPS on other related discipline (Monden, 1993). In fact, the philosophy behind industrial practices lies behind the TPS, by which TPS has designed its production system in term of rules-in-use (Spear, 1999): redesign activities, direct connection, and smooth pathways for delivery of goods and services. Given that, the following rules can be applied to healthcare management as shown:

TPS	***Healthcare Management***
1. Specified Activities	1. Redesign Activities
2. Direct connection	2. Make connection between workstations and departments
3. Smooth pathways for delivery of good and services.	3. Define routing of each program as to effectively deliver of healthcare service.

Table 2.5: Comparative Practices between TPS and Healthcare Management

As it to improve healthcare quality while reducing cost containments and responsiveness in consistent with the goal of TPS. Where the both disciplines want faster response, from the patient needs to medical treatments as quick as possible. TPS and healthcare management appear to be an applicable fit. Thus, by the principle of TPS, the hospital can be more flexibility in performing a variety of operation without reducing its availability, such as reduction of operating room (OR) set up time.

As for instance, in OR set up time, the hospital can realise that most of the operation time was instead spent on waiting for operation equipment and tests that were not available during the operation. Then, the OR department is suggested to redesign activity (equipment and tests required), necessary for its specific task, instead of routing patients all over the building for X-ray, laboratory test, and microclinics (e.g. nursery, physical therapy) before the operation. This principle can

organise departmental services into working groups based on the type of the programs and type of its specific disease's problems.

Thus far, due to the problems of inadequate information and imperfect healthcare market, patients cannot make their own rational choices and in other instance, they do not have adequate choice of healthcare service, while at the same time the cost containment of healthcare is rising, due to the highly regulations, where causing difficulties in private hospitals to maintain profits. The strategy of correctively enhance revenues and reducing of cost containment has led to an increasing emphasis on efficiency measures; reduction on ALOS and unnecessary admission (Bates, 1999). The hospital is thus under greater pressure to increase the throughput of patients and reduce waiting/response time, suggesting that there has been a lack of information flow in the steps of processes. These has been the overall points of theoretical consideration based on attributes of industrial practices, especially the production planning and control, in which they are expected to incorporate into this hospital system, through eliminating the operational process wastes in the front reception.