CHAPTER IV

INDUSTRIAL PRACTICES AND HOSPITAL PROCESS

4.1 APPLYING INDUSTRIAL PRACTICES TO THE HOSPITAL:

In this chapter we develop a detail to illustrate the basic industrial practice to be used in the hospital process, where it is a set of guideline, standard processes, process chart, and flow of activity in the front reception process that supports all facets of healthcare patients. Having said that, there are needs of standardisation of operations and quality improvement management as a whole. This will look at the role of hospital management whether it leads to greater efficiency and improvement in classifying patients or creating burden in the front reception. The approach to implementation will be set by industrialise the healthcare services; change in process flow (Block-flow diagrams). This practice will be used as a result of implementing manufacturing principles for the purposes of measuring patients' ALOS and unnecessary admission, which impacts on lead time and inventory.

4.2 JIT CONCEPT: Demand pull concept in hospital management

JIT application in the hospital system, will be benefited in the most two aspects; in reducing average throughput times, and reducing of variation in the process of throughput time (Stevenson, 1996). In which, it is the ALOS and unnecessary admission, as they has consistence often important for customer satisfaction and service performance consistency (Suomi, 2001). To delivery short throughput time, JIT must fill this role by improving register queuing. Since daily operation is based on an analysis of information flow, production is then based on current demand of each healthcare program. The front reception should have a complete summary of demand information about different types of healthcare service volume, then, they can prepare set up time properly how many of each type of services should be prepared.

In fact, the front reception operation is based on the repetitive manufacturing practices (Martinich, 1997) where JIT and QC should be embraced in the system. JIT

should be used to quickly release the flow, while the Navaminthra 2 hospital has a limited front area capacity. Equipment should be positioned close together in order to minimise amount and motion of personnel and operators, where physical transactions is able to passed to each others and also capable of every personnel to get involved in any occurring problems. This will allow level of patients/personnel (operators) interaction, from registration all the way through discharges, and healthily leave the hospital.

JIT Philosophy: The applicable areas are as follows

JIT requires plant layout to ensure a balanced work flow and reduce work-in-processes patient case, where each workstation is a part of production line. This is essential to synchronise the overall services and production flow, which focuses on rearrangement, modification of front-reception layout, and assess input of unclassified patients. The hospital will have to evaluate and adjust them to compatible with the JIT philosophy, which the ideal lot size is one. Also, synchronise production with demand, leveling demand so that they can avoid patients waiting for service and be responded better. In the front reception area, by JIT, nothing will be activated until it is needed, this triggers collection of OPD/IPD where pulling toward orders will be placed on workstation—needed is created, to enable this pull process to flow smoothly. This transformation is contemplated in the pull system.

Lead Time and Cycle Time Reduction:

Chase (1995) states that lead time in JIT environment will enable the organisation such as hospital to response quickly to patient needs, simply by reducing the time required to make registration. Whereas, the manufacturing lead time that applicable to the healthcare management consists of two elements; waiting/response time before registration and in between each workstation. This can done by reducing cumulative lead time, which can facilitate quick response time, as to eliminate processing waste, transportation waste, and waste of waiting time (Chase, 1995).

This intends to apply repetitive tasks in order to keep waiting line short and specifically run on hospital prepared inventories, meaning that the process types will have to be reshuffled many times a day. The solution is to make adjustments as small as possible by setting a hospital monthly production plan for fixed amount of output rate—enable to meet the need for a stable demand. This attribute can be specifically matched up with the Toyota Production System (TPS), whereas a total mix of model in each colour is demanded and will be responded in time to the variation (Ohno, 1988). In this case, TPS views JIT production as information system, where it is also a technique for material flows and can authorise production in a form of production kanban (Vollman, 1992). It follows that high variety is to be characterised by job shop, and at the same time, JIT can be used if the various demands can be stabilised to permit allowable number of visits.

Accordingly, reductions in inventories can be accompanied by shorten in cycle times, especially in this non-repetitive type of manufacturing—job shop. The inventory issue in healthcare industry can be viewed as large issue of doctor fee (DF), where the hospital has to standby almost all kind of doctors and specialists within its operation time where not knowing exactly number of patients of each type to meet with this specific supply. In this case, according to Cheng (1996), manufacturing lead time is consisted of waiting time and response time, these corresponds to maintaining balance between different workstations. By creating uniform facility load, by eliminate step that does not add value.

This method is set to meet with postponeable diseases, where certain diseases may require multiple and sequential specialists. Therefore, healthcare service delivering at random times can also be reduced. One element of JIT production control which standout and most frequently used is the production kanban (Cheng, 1996). In this instance, production kanban card can be best used to establish the scheduling of operations, quantity to produce, and the direction (routing) of production flow.

4.3 **PRODUCTION KANBAN:** Demand Pull (patients-driven)

A kanban card is resemble to the OPD card and will be transferred to the centre cell (workstations), waiting to be sequentially called. Generally, the functions of the kanban and the OPD card can be used as a mean for production control. Container in the form of shelf is used in numbers of patient control system. The system requires personnel to do exactly what is authorised to follow each program's operations and procedures (as will be shown in the next chapter). Withdrawn quantities equal to the number of OPD card held by amount withdrawn from the bin, where kanban card tells what and how many to forward to next workstation. Printed information on the kanban are item name, stock number, quantity, user, provider, and card number (Schonberger, 1994). When an assembler takes the first desk drawer from the card, the card is pulled, to be sent to each workstation drawer.

Similarly, each patient is manually executed, authorised by OPD card, in which they are transported with the nurses or physicians who own the single case, to circulate in the loop of different departments around the building facility. This OPD card requires every single department to do exactly what is authorised and to follow the specific procedures described in the card. Thus, in this similar manner, its procedures are parts that displayed with information on the kanban used in workstations to making parts. Cards, which displays certain information; place where it is used, parts number, name of parts, description of parts, kanban number, the number of parts, description codes number, and workstation locations are as shown in the example of production kanban:

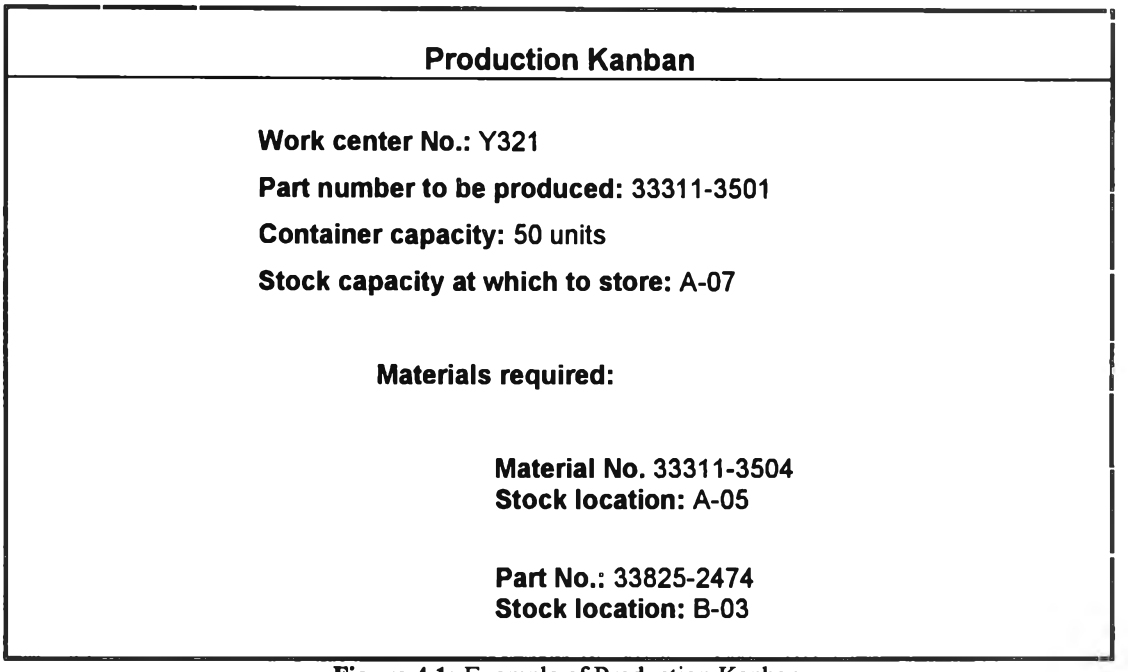
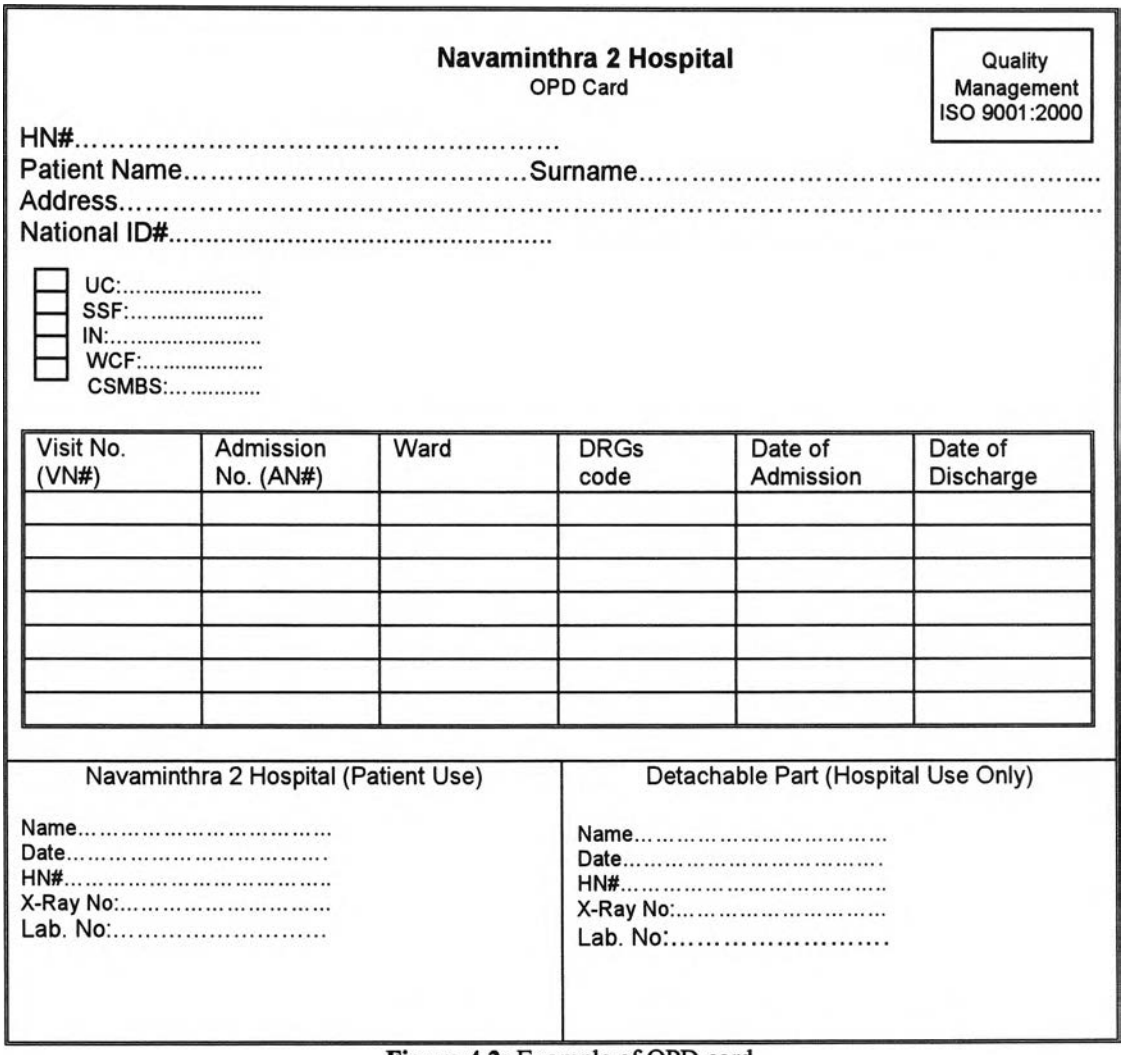


Figure 4.1: Example of Production Kanban
Source: R. W. Hall, Driving the Productivity Machine: *Production Planning and Control in Japan* (Vollman, 1992, p. 92)

According to Cheng (1996), production kanban is appropriate system in the organisation and it is essentially a production management information system through which the pull system of production control is accomplished. The production kanban authorises the preceding process to produce the number of parts. There are a number of workstations in this case which must be shared piece of information colour codes labels, where kanban can link between various departments e.g. X-ray, Lab, and OR (see Figure 4.3). As it will determine the size of work-in-process inventory level, which in turn, will affect the throughput time of the system. Below is the OPD card, used in nearly all similarity with kanban card, only it has been used in different discipline and contain more parameter categories and array of descriptions. The OPD card example is as shown:



Navaminthra 2 Hospital
OPD Card

Quality Management ISO 9001:2000

HN#.....
Patient Name.....Surname.....
Address.....
National ID#.....

☐ UC:.....
☐ SSF:.....
☐ IN:.....
☐ WCF:.....
☐ CSMBS:.....

Visit No. (VN#)	Admission No. (AN#)	Ward	DRGs code	Date of Admission	Date of Discharge

Navaminthra 2 Hospital (Patient Use)

Name.....
Date.....
HN#.....
X-Ray No:.....
Lab. No:.....

Detachable Part (Hospital Use Only)

Name.....
Date.....
HN#.....
X-Ray No:.....
Lab. No:.....

Figure 4.2: Example of OPD card

Simplification of Process Flow: Direction of production flow (Routing)

In the pull system, production and the flow of materials are called into action by the demand of customers. This principle, when applied to the hospital will allow the front reception to produce only the quantity of service that is required. As to presenting information, design to assist shop floor personnel, once the OPD card is received by the shop floor personnel, all the parts and paperwork required are transferred to the assembly areas where the paperwork and parts are completed, accompanying work-in-process parts. OPD card is to be attached to that patients and placed into a kanban post. The shop floor personnel is then picked up and placed OPD card to assigned workstations which are then transported to the designated examining rooms. Production will occur nearly the same way, in the quantity specified by the production kanban card. Once this production is complete, OPD

cards are attached and the patients are transported back to the front reception shelf. This can be realised by designating locations within the department, as to arrange these elements in a way that ensures a smooth work flow. Figure 4.3 illustrate how the direction of production flow works in the plant and execution in a job-shop environment (Vollman, 1992).

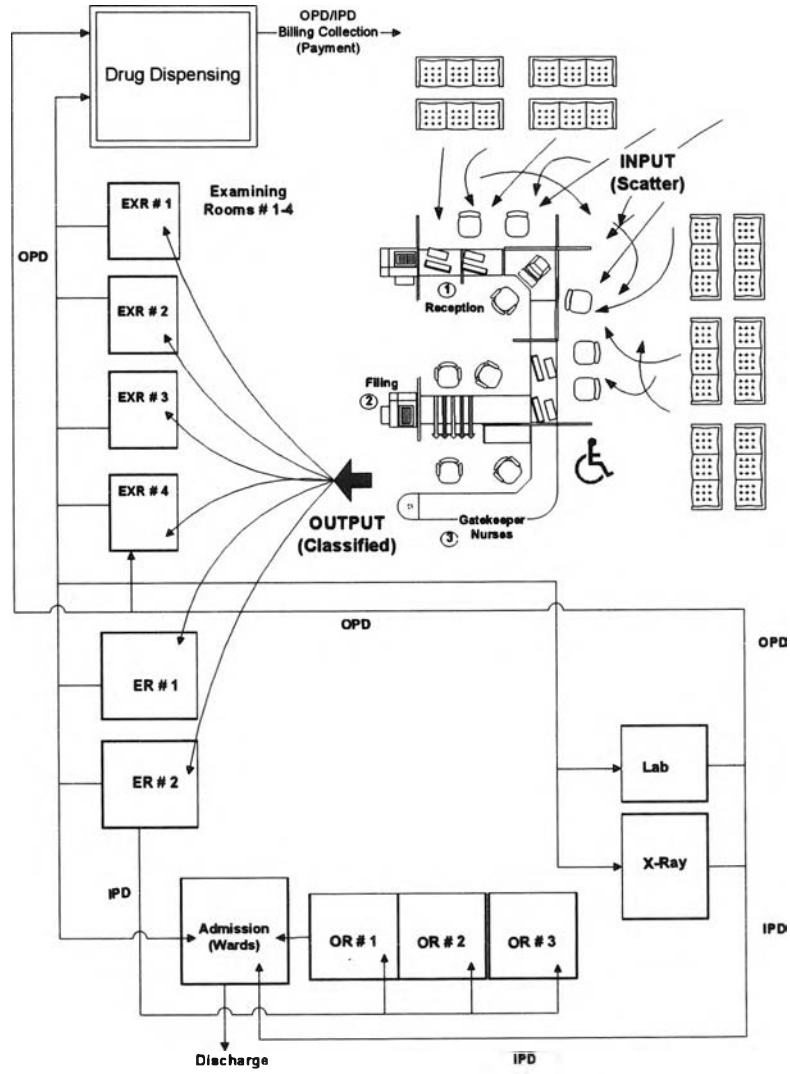


Figure 4.3: Process Flow Diagram and Routing of the Front-Reception Area
Note: This drawn schematic is not to scale

In this production flow system, we develop a detail to illustrate the basic concept of JIT production, including the fast throughput time. In the hospital practice, the workstation and routes arrangement are adjusted by concerning queues of patients and the programs' categories, to develop a repetitive routes of travel. Thus, the nurse supervisor could supervise across transitional departments. Thus, the idea is to eliminate bottleneck concept application in the hospital's front reception.

Smoothing Production:

This major area is to be used as a mean to cope with the leveling of production. The use of the production kanban can be applied to follow fluctuations which exist in the production process, to response to the change in demand by adjusting the number of units to be produced. Thus, the change in demand can be adjusted by leveling the production process as soon as possible to meet the various changes. The kanban accompanying these products will specify the amount of products to be processed. The use of kanban required that the production process be smoothed, and this involves minimising the amount of programs variation, in the withdrawn quantity of each programs.

Production in healthcare service used to be based on an economic batch size; registered patients with respect to monthly visits, which effectively smoothed incoming demand and maximise the use of the hospital assets, in monthly visits. Therefore, production will be leveled, with inventory varying according to customer demand by standardisation of benefits package. However, the hospital has to correctively enhance their revenue through effective healthcare programs and control of cost containment. As of the hospital monthly visits, embodies high frequent visits of AE—high cost containment. And the yellow portion represents largest volume of monthly visits due to largest number of registered patients (Figure 4.4). And this is also being overlapped with each other programs' demands, as shown:

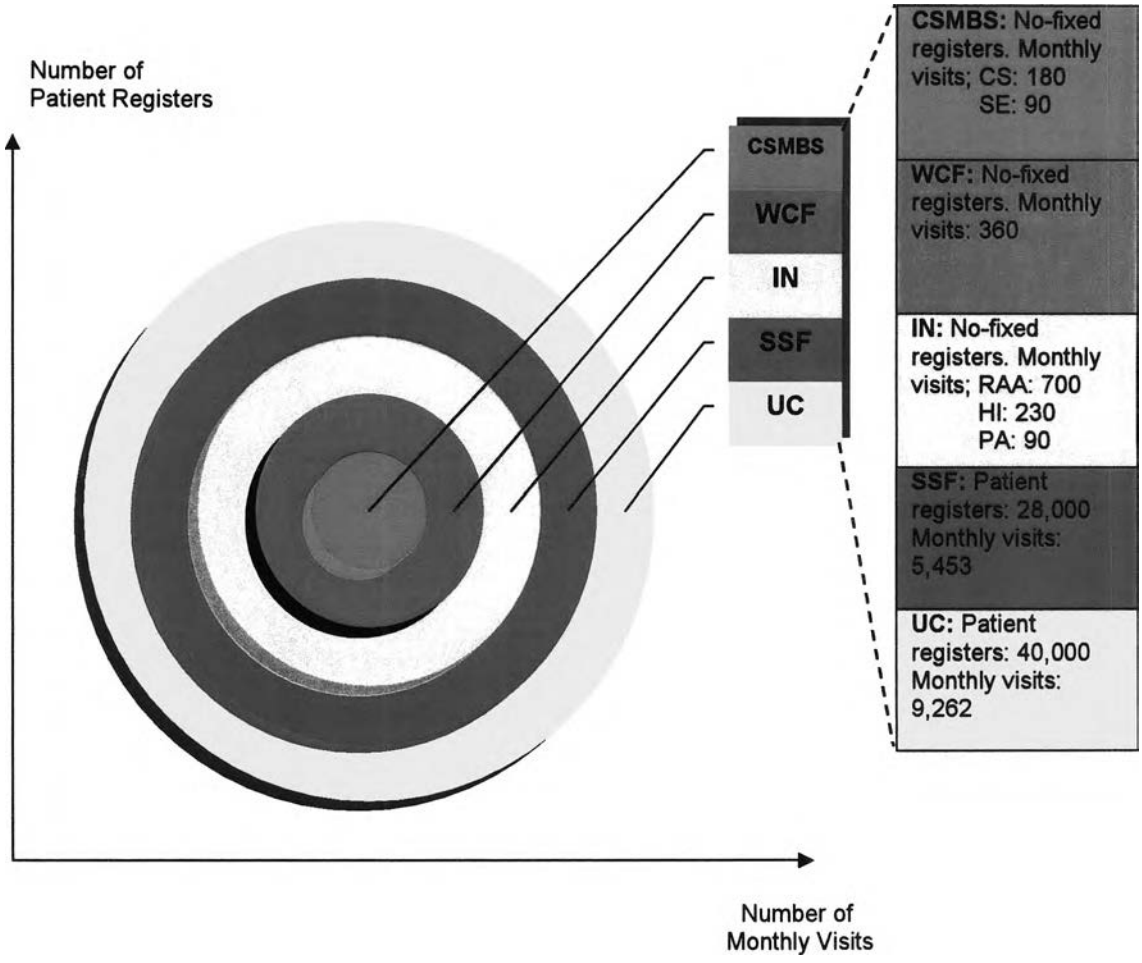


Figure 4.4: Schematic of Hospital Services Mix; Based on number of patient registers VS. number of monthly visits (program colours corresponded)

The strategy of correctively enhancing the revenue and reducing of cost containment has led to better classifying each type of patients properly and this will affects the ALOS promptly (Shortell, 1983). In contrast, the smoothing of production goal is to leveraging variation, while inventory built up during high demand periods and thus maintain a relatively stable level of production planning.

In term of industrial practices, independent demand, as the demand of those programs (monthly visits) which are unrelated and unassimilated to the number of patient registers. Due to that the independent demand is uncertain, while the dependent demand (fixed revenue) is relatively straightforward in quantity based on the number needed in each program's monthly visits and also varying with time period—seasonal demand. In dependent demand, the need for any one item is a direct result of the need for some other item, usually a higher-level item of which it

is part. The independent demand, it comes from many external sources and it is unrelated to the demand of other programs.

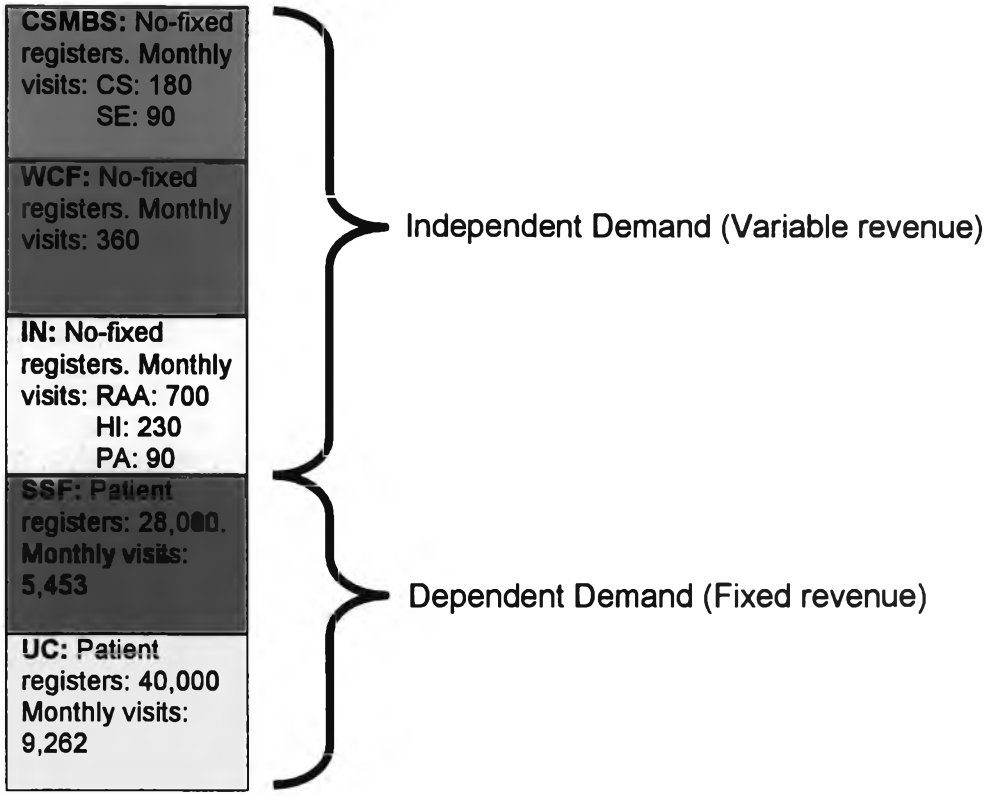


Figure 4.5: Dependent and Independent Demand Portions

As the patients aren't able to obtain complete information necessary to make a good decision, thus the regulatory framework can provide complete and accurate lists of benefits to the patients, as to assist both parties' relationship between patients. Some hospitals have to downsize their healthcare service to increase their management efficiency. Where leveling required the production functions to be moderated while ensuring there is enough of a required part produced to meet with the demand. Also, smoothed production involves leveling the schedule of production processes, which this helps to reduce sudden changes in production to meet the changes in demand, or in other word to react faster to the demand changes. Smoothing flow to damper the reaction, which normally occur in response to variation of demands. This principle can be illustrated in the Figure 4.6:

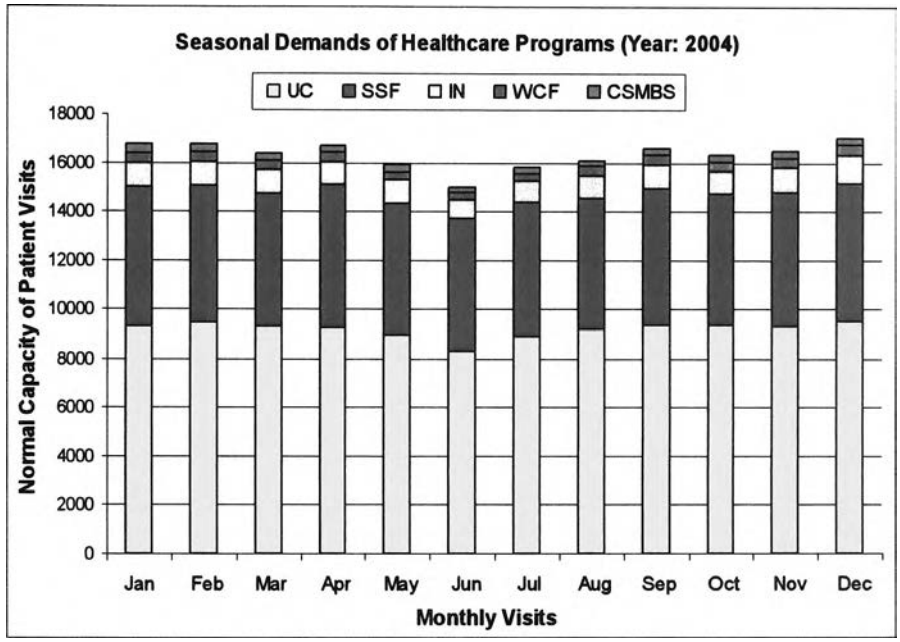


Figure 4.6: Seasonal Demand of Public Healthcare Programs; monthly visits

Due to seasonal variation, seeing that, throughputs of previous years in terms of numbers of monthly visits of each program with respect to normal capacity of patient visits. Nevertheless, we have attempted to estimate demand for each program service, which would reduce waiting time for process's transactions. The hospital intends to leveling each demand and smooth out the fluctuations in demand over a period of time. In a mix production levelling, this will ensure many impacts in medical staff, equipments, and resources that available for use. Thus, the idea of cycle time control becomes important in levelling the production. Production can be made more efficient by reducing the average cycle time, or decreasing the amount of variation within each cycle time. By, identify the longest cycle time program which it can be eliminated. And identify the shortest cycle time that could be leveling or adapted to other cycle times.

4.4 FRONT-RECEPTION'S PROCESS DESCRIPTIONS

In process description, as it facilitates front-reception steps of process. In especially, non-medical processes in relation to serve the healthcare patients and proportionally involved all scope of the front reception area (Cheng, 1996). In which, can be explained by concept of demand pull production, where raw materials are pulled through the production process, through the workstations. To perform

assigned process on healthcare patients, there can be variation in processing time, this can impact the throughput rate. Figure 4.7 depicts the front-reception's throughput rate, with three workstations making assemblies and transactions to transfer to the next assembly line; uniform and variety mix of different high-regulation programs. Facility layout plays important role in this service operations, the goal in this role is to serve customers as quick as possible, and also focusing on balancing the amount of variation at each workstations. The maximum time of execution per each personnel, approximating work time of each workstation are as shown:

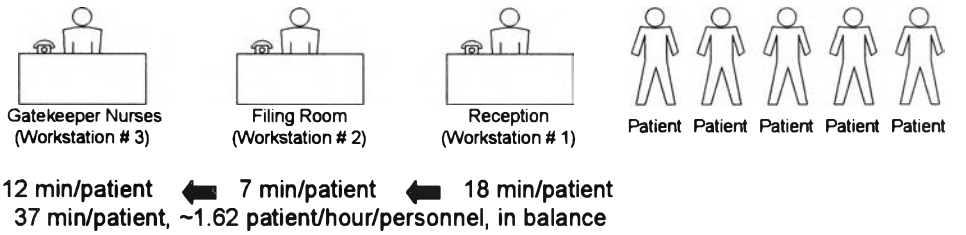


Figure 4.7: Three Workstations in Balance; single entry—FIFO

Thus, process of doctors examination can also be performed in assembly line fashion. And this can estimate established work-time standards, and determine the precedence requirements for each workstation. Therefore, we must decompose the three workstations' production process into individual tasks, as in this case, assigned into three workstations; reception, filling room, and gatekeeper nurses as shown:

1. **Reception:** Workstation # 1

1.1 Patient Information:

First step, registration, to check whether patient has a record with the hospital and register. After the registration, patients' profile; prior medical record: names, addresses, relatives, and related medical institutes are to be registered with the hospital number (HN#) and issued as an OPD card.

1.2 Patient Visits:

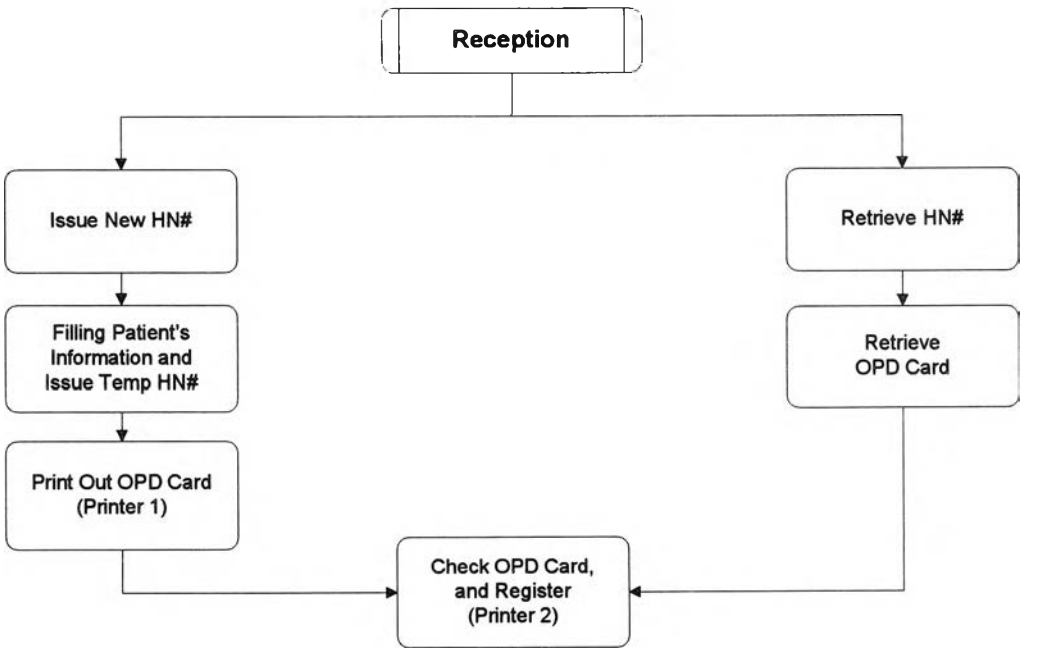
After retrieving the HN#, there will be a need to classify OPD card by its priorities; healthcare programs, in order to also issue visit number (VN#) for the purpose of the management to monitoring transaction revenues, drug dispensing, and activities by the end of each day. And these will be useful information to the admission.

1.3 Admitting:

From OPD card, there will be a need to issue admitting number (AN#) and change status into in-patient directory (IPD) admission, as in-ward patients and issue bed status.

1.4 Temporary Patient:

In order to create temporary patient file, temporary hospital number (Temp HN#) must be issued to the patient database before the patient visits, for the purpose of retrieving the real HN#. This will schedule appointments and pay bills based on access to their revenue cycle management, work process improvement, implementation techniques, and document identification.



2. Filing Room: Workstation # 2

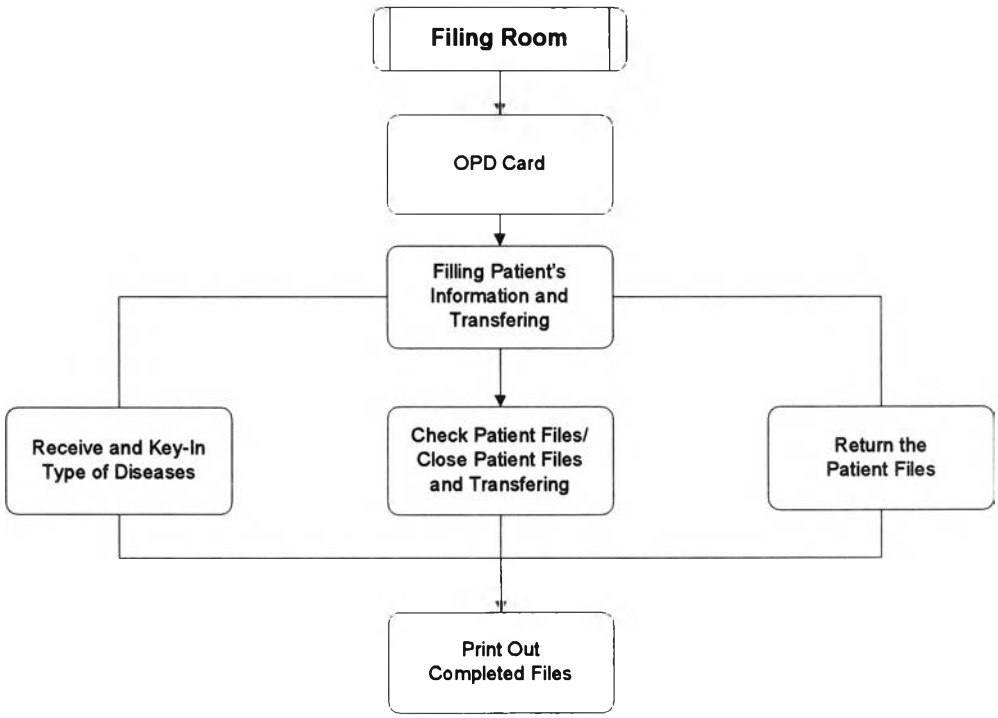
In general, filing room is in charge to follow up and tract down the OPD card whether it circulates around from the front-reception to doctor discharges (in-ward patients). Noting, the physical filing room is located directly above the front-reception area (second floor), and accessed by spiral staircase. The filing room tasks include:

2.1 Keep medical record of each patient

2.2 Keep record of OPD cards

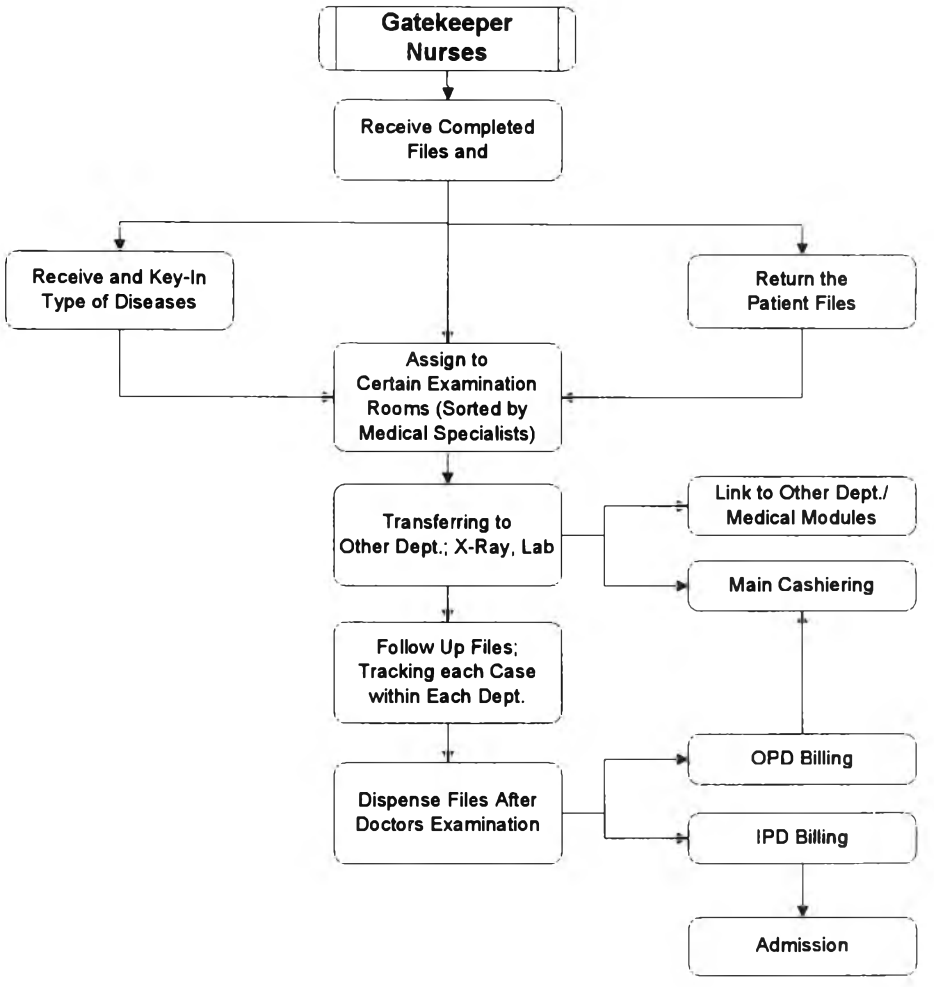
2.3 Documenting the descriptions of each patient's symptom (OPD/IPD)

2.4 Documenting the official record for CSMBS patients



3. Gatekeeper Nurses: Workstation # 3

Gatekeeper nurses are in charge of recording necessary information required to meet with examination criterion. This nursing task is located in front of the examining rooms and separated in convenient to control and tracking each patient within each workstation. As shown by scope of front-reception, this would increase efficiency in OPD cashier—tracking No. of doctors' prescriptions.



4.5 PROCESS LAYOUT CHARTS:

With process layout chart, in this manner, it is accounted for the front-reception's service blueprint (Chase, 1995) in which optimise the flow within the front-reception department, and accounted for patients registration's transaction. While also specify the work activities for each personnel, as to shorten transport distance and identify delay, and flow of activities process by block-flow diagrams, and flow of activity process. Therefore, by simplify method through minimising motion of processing time requirements to simplify the entire operation, as to eliminate any steps that does not add value to the service. It suggests some applicable activities in production systems, which has been use in this healthcare management:

Productive System	*Industrial Practices*	*Healthcare Management*
Activities	Eliminate or combine steps; shorten transport distance, processes, processing time requirements, and identify delays	Block-flow diagram, Process chart, and Flow of activities in the front reception's processes

Table 4.1: Comparative Work Methods Design

The work is divided among separate workstations; activities, transport, and amount of time, and ease of movement of personnel. This general process flow chart mixed activities, to find the best combination for requires processes and workstations. At the time of measurement, each step was assigned to different personnel during the maximum demand period. In this, the following step cannot be performed until all other steps were completed.

Front-Reception Process Chart:

Distance (Meter)	Time (~Min)	Chart Symbols	Process Description
-	4	● ⇨ □ D ▽	Issue New HN#
-	3	● ⇨ □ D ▽	Retrieve HN#
-	5	○ ⇨ □ D ▼	Filing patients Information and Issue Temp HN#
0.65	4	○ ➡ □ D ▽	Retrieve OPD card
0.65	1	● ⇨ □ D ▽	Print out OPD card (Printer 1)
0.25	1 [18]	● ⇨ □ D ▽	Print out OPD card, and register (Printer 2)
3.50	1	○ ➡ □ D ▽	To filling room (OPD card)
3.50	2	○ ➡ □ D ▽	Filing patients information and transferring
0.50	1	● ⇨ □ D ▽	Receive and key in type of diseases
0.50	1	○ ⇨ ■ D ▽	Check patient files/Close patient files and transferring
0.50	1	○ ➡ □ D ▽	Return the patient files
0.25	1 [7]	● ⇨ □ D ▽	Print out completed files (Printer 2)
1.80	1	○ ➡ □ D ▽	Receive completed files
-	2	● ⇨ □ D ▽	Receive and key in type of diseases
-	1	○ ➡ □ D ▽	Return the patient files
4.00	2	○ ⇨ □ ◗ ▽	Assign to certain examination rooms (Sorted by medical specialists)
30-40 (~35)	3	○ ➡ □ D ▽	Transferring to other Dept; X-Ray, Lab
~20	2	○ ⇨ □ ◗ ▽	Follow up files; tracking each case within each Dept.
2.50	1 [12]	○ ➡ □ D ▽	Dispense files after doctors examination
73.6	~37	7 8 1 2 1	**TOTAL**

Table 4.2: Front-Reception Process Chart
Note: Chart symbol annotation is in the Appendix A

The measuring of time of personnel in performing each routinised process were made by a stopwatch, and collected from several repetitions. As a result, the hospital discovers that during the registration time was spent waiting for the front personnel who was not available when the reception process began. An activity chart is useful in plotting each personnel' activities on sequential scale to specify operating cycle in repetitive process, which it is valuable in developing a standardised procedure, for front-reception routines in performing registration of healthcare patients. In addition, it should develop the flow of activities in reception process required for each transaction of operation, for seeking compressed lead time, and using operations-lapping as standard procedure to eliminate disrupt of production process and the information flow. And this can be put in a flow of activities process form and the front-reception process chart altogether, as follows:

Flow of Activities in the Front-Reception Process:

Steps	Reception	First Personnel	Filing Room	Second Personnel	Gatekeeper Nurses	Nurse Supervisor
0	Issue new HN#					
1						
2	Retrieve HN#	Filing patients information and issue Temp HN#				
3						
4						
5	Retrieve OPD card	Check OPD card, and register (Printer 2)				
6	Print out OPD card (Printer1)					
7		Transfer to filing room	OPD card			Move to set up equipment
8			Filing patients information and transferring			
9				Check patient files/Close patient files and transferring		
10			Receive and key-in type of diseases	Return the patient files		
11				Print out completed files	Receive completed files	Return the patient files; link to other dept./medical modules, main cashiering
12					Receive and key-in type of diseases	
13					Assign to certain examination rooms	
14					Transferring to other dept; X-Ray, Lab	
15					Dispense files after doctors examination	OPD Billing and IPD Billing and make justification to admission

Table 4.3: Flow of Activities in the Front-Reception Process

4.6 FRONT-RECEPTION LAYOUT:

To redesign front-reception layout with work-flow improvement and to speed up congestion area and processes, this requires the functional-layout arrangement, including establish rework line plan to help correcting the problem (negotiate complaints). Thus, this features the functional layout, in job-shop arrangement where the demand is vary.

Functional Layout: Job-shop arrangement

At present time, functional layouts is positioned in a way that work is divided into three workstations within the department, this is the typical configuration of the job-shop process for the general hospital. Also change the overall function of the new front reception, but similar to process layout that, working centre is designed to perform a specific set of processes as classifying the type of healthcare service and dispatching into specific departments and areas. The clusters of various tasks into workstations are set to reduce movement and waiting/response time between operations. This must be flexible in design to run several service processes at the same time.

Because when problems occur, the senior manager (nurse supervisors) can be able to stop the process and manually reprocess the rework line. It has also been arranged to ensure smoothness of work flow and removal of the bottleneck, improve line balancing, and prevent personnel running into each other or having to move more than necessary, and enable to deliver the service to the patients within the limited space.

Registration Centre: Front-reception counter

In practice, for normal operations time, the front-reception counter operates around the clock with 8 personnel (5 full time and 3 part time). The department process approximately 16,000 patients monthly for overall transactions. The counter layout under JIT philosophy requires patients to follow the same information. Then, U-shape's front counter has been rearranged to face both side entrances (Figure 4.8)

with three workstations. These redesign of front-reception counter and service flow criterion (as shown below) has been planned to implement.

- Adequate waiting facilities
- Easy communication with the patients
- Easily maintained patients surveillance
- Departments and processes arranged
- Balance between waiting areas and service areas
- Minimum walling and material movement

Figure 4.8: Existing Condition of the Front Reception Area

- **Functionality:**

Circulation path around the front-reception counter is intended to keep face-to-face interaction between patients and personnel. This can enhance in clarifying of process flow.

- **Workplace organisation:**

The goal of workplace organising is to bring hidden problems and information up to the surface where the personnel units could carrying out and eliminate throughout the process. In which, require minimum quantities of items in the workplace, this allows focused view of only patients' activities.

- **Clearing and simplifying:** Visibility

This step involves removing any unnecessary equipment, machines, storage bins, rack, and drawer for placing operator's instruction. Only administrative tools which are to be readily accessed for serving healthcare transactions are needed. In the area which provides easy access with short traveling time. The goal is to include only what is necessary to be present on the front reception area.

- **Locating:**

In this case, locating can be referred to the layout of operations by healthcare functions. This is to redesign for proper storage places, as to provide only necessary information and tools. Improve communication between waiting patients and reception personnel and involved parties in the process flow.

- **Cleaning:**

In the hospital front area, the cleaning involves directly in promote visibility and preventive maintenance.

- **LCD displaying board:**

The idea of wall-mounted LCD projection display has already been implemented to displaying queuing with sequential called number of patients. And also it has been planned to identify status of queuing with healthcare programs' call, and during peak hour period, can display promotional figures to all access.

- **Diagram and sign:** Signs and symbols

These are to be designed to serve two purposes, to allow the reception personnel to readily identify when the process flow is out of control. Colour coding label can also be used as a fail-safe method for each programs' patients, to designate service used in specific area of operation. Also, establish picture-based instructions to indicate procedure of daily start-up routine especially in the case of AE.

Register Queuing: Service rate

Register queuing serves two basic customers needs; by shorten average waiting/response time and enhance service time invariability (Chase, 1995). In existing condition, the front reception counter is normally overcrowded by especially the AE case patients, who frequently holdup (delay) long waiting and permit very short consultation time, in which resulting in unsatisfactory services. According to Cheng (1996), in many types of organisation, waiting time is responsible for more than 80% of total manufacturing lead time. Then in our case, the AE case patients strike into an emergency counter with no schedules (arrival unnoticed), and these cases require extensive setup time for preparing equipment and facility arrangement (e.g. X-ray, Lab, and in-wards admissions).

On the other hand, healthcare priority patients arrive in the front-reception counter, on a first-come/first-served basis, but in some priorities such as UC and SSF, permit only priority queue as it can be referred to special clinics; for some listed diseases that most patients have to go through further tests such as X-Ray, laboratory room (on the far side of the building). This maximises amount of time for

typical AE patients emergency discipline, with the doctors and surgeries. These will establish two types of patient groups; AE case patients (ambulatory-care) is which it is first in first out (FIFO), and patients arriving with priorities preferred/informed choices. Thus, schedule of doctor examination for admission can be set from limited programs, as to gain benefit in the job-shop type of each service, and follow a common sequence of steps and policy as shown:

Arrival Services Policy:

Healthcare Programs:	Priority queues
AE:	FIFO discipline
Admission:	Planned arrivals and selected service
Healthcare Surgery:	Based on the decision of senior doctors only

And since the hospital has only four examining rooms for non-AE cases, these will be served only after the queue has been screened by the nurse supervisor. And leave a waiting time for non-critical patients, while releasing congestion.

Workstations: Multiple inlets and outlets

Consider three workstations, the goal will be to maximise net profit per square foot of front reception area, generally speaking, reduce the working area, while increasing in serving area (space optimisation). By increasing capacity of window workstations for front personnel, and encourage high sales volume per square foot of facility. Thus, the traffic intensity of healthcare service facility is set as average number of waiting patients.

In conducting waiting/response time performance, for arrival rate, which should be noted to neglect the day/night different shifts. Thus, the figures shown, has been derived from the monthly OPD of the existing condition (from Table 1.1) in which it equals to 13,528 patients/ 30 days/ 24 hours = 18.79 patients/hours. And the *service rate*—as the capacity in units per time period (Chase, 1995), was calculated and commenced by the process chart (Table 4.2) that the average time for one personnel completing the reception tasks is approximately 18 minutes, then the cycle time is 18 minutes per unit, and the production rate is P = 1/(18 minutes per patient)

= 1/18 unit per minute or 3.33 units per hour. Thus in one hour the reception would be able to complete healthcare patients' transaction approximately 3 patients per personnel. The throughput formula used, can illustrate the patients registration flow as shown:

$\frac{a}{s}$; a: arrival rate (18.79 patients/hour)

s: service rate (3.33 patients/hour)

The lower the value (including average time in minutes), mean the higher in the operational service efficiency. Thus, in order to determine this valuable more accurately, historical data need to be properly collected. The adequate acquisition numbers was calculated and summarised as existing condition of the front-reception's throughput time shown:

Existing Condition: Condition before

Register Model Results	Condition Before
Average number of patients arrival in the reception	18.79
Average number of waiting patients (Traffic intensity value)	5.64
Average time spent in reception (workstation # 1) (min)	18
Average time spent in filing room (workstation # 2) (min)	7
Average time spent in gatekeeper nurses (workstation # 3) (min)	12
Average time spent in the system—throughput time (min)	37†

Table 4.4: Existing Results Condition of the Front Reception
Note: 37† minutes is cumulative time from 18, 7, and 12 minutes; from the process chart (Table 4.2)

These results have suggested that the arriving pattern of the patient, can reveal opportunities to control queue in healthcare services, This also leads to improvement of quality by reducing variation between healthcare operations by cut down unnecessary transactions, and standardise operational processes to ensure the hospital ability to meet with customer demands; negotiation in complicate situations e.g. RAA accidental case. The goal is to make front reception's transactions as easy as possible, owing to that the ongoing of public healthcare programs has increasingly confused and frustrated the patients with its complicate patterns, Its major duty is to provide as much as consultation time and guideline on decision making (discussed in the next chapter) for the patients.