

Benefits to Hospital Finance from Hospital Pharmacy's Vendor Management Inventory

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Abstract

Objective: To assess outcomes from the application of Vendor Management Inventory (VMI) system between the warehouse and the dispensing rooms according to the following indicators: pharmacy inventory value, service level, and days of stock. **Method:** The study procedure was composed of 3 parts; 1) analysis of existing activity in inventory control, 2) design of the internal VMI model between pharmacy warehouse and OPD dispensing room 3) assessment of internal VMI model. The study began in October 2014 through May 2015 at Somdech Phra Debaratana Medical Center (SDMC) Building, Ramathibodhi Hospital. Thirty model drugs were chosen to assess the outcomes of VMI, with ten drugs representing each of the following three groups: 1) class A drugs (according to ABC analysis method) 2) drugs with frequent out of stock and 3) frequently dispensed drugs. **Results:** The pattern of utilization of the drug sample was categorized into three groups 1) regular (7 items): utilization pattern almost repeated in every week 2) Irregular (18 items): utilization pattern in each week differed and 3) by patient case (5 items): utilization pattern was related to patient visit and required case by case management. Along the downstream VMI model, amount of stock value at pharmacy dispensing at floor 1 of SDMC building declined for 30.98% and 25.73% in drug with regular and irregular pattern of use, respectively. Average days of stock in drugs with regular and irregular pattern of utilization reduced from 10 days to 6 and 8 days, respectively. Service rate was found nearly 100% at the same level as that of the pre-VMI period. However, due to different consumption patterns of drugs (regular or irregular), the efficacy of VMI to reduce the inventory volume and days of stock differed between groups. Pharmacist in charge should steadily monitor drugs with irregular pattern of use to prevent shortage. **Conclusion:** The implementation of a VMI system can lead to significant stock reduction and other benefits. Moreover, VMI reduces the working steps allowing pharmacists to concentrate more on other patient-care activities and also creates time available for the warehouse to plan a delivery.

Keywords: vendor management inventory, hospital finance, stock value, pharmacy administration, pharmacy management

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ผลประโยชน์ด้านการเงินที่เกิดกับโรงพยาบาลจากการใช้ Vendor Management Inventory ของฝ่ายเภสัชกรรมโรงพยาบาล

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บทคัดย่อ

วัตถุประสงค์: เพื่อประเมินผลของการจัดการคลังยาแบบ Vendor Management Inventory (VMI) ระหว่างคลังยาและห้องจ่ายยาในประเด็นมูลค่ายาคงคลัง ระดับการให้บริการ และจำนวนวันที่ยาคงอยู่ในคลัง **วิธีการ:** การศึกษาแบ่งเป็น 3 ขั้นตอน คือ 1) การวิเคราะห์กิจกรรมของระบบการจัดการคลังยาแบบเดิม 2) การออกแบบกระบวนการ VMI ภายในองค์กรระหว่างคลังยาและห้องจ่ายยาผู้ป่วยนอก 3) การประเมินผล VMI แบบภายใน การศึกษาดำเนินการระหว่าง ตุลาคม 2557 ถึงพฤษภาคม 2558 ณ ศูนย์การแพทย์สมเด็จพระเทพรัตนราชสุดา โรงพยาบาลรามาริบัติ การศึกษาเลือกยาต้นแบบ 30 รายการเป็นตัวแทนยา 3 กลุ่ม กลุ่มละ 10 ตัว ได้แก่ 1) ยากลุ่ม A (ตามการจัดกลุ่มยาในวิธีการ ABC analysis) 2) ยากลุ่มที่มีขนาดคลัง และ 3) ยากลุ่มที่มีการส่งจ่ายบ่อย **ผลการศึกษา:** รูปแบบการใช้ยาแบ่งเป็น 3 รูปแบบได้แก่ 1) แบบสม่ำเสมอเป็นรูปแบบการใช้ที่สม่ำเสมอซ้ำกันในทุกสัปดาห์ (7 รายการยา) 2) แบบไม่สม่ำเสมอเป็นกลุ่มยาที่มีการใช้ไม่สม่ำเสมอในทุกสัปดาห์ (มี 18 รายการ) และ 3) แบบที่ขึ้นกับผู้ป่วย (5 รายการ) รูปแบบการใช้ยาขึ้นกับการมาพบแพทย์ของผู้ป่วย และต้องมีการจัดการคลังยาแบบจำเพาะแต่ละรายการยา การจัดการคลังยาแบบ VMI ที่ห้องจ่ายยาชั้น 1 ศูนย์การแพทย์สมเด็จพระเทพรัตนฯ ทำให้มูลค่ายาคงคลังมีค่าลดลง โดยในกลุ่มที่มีรูปแบบการใช้ยาแบบสม่ำเสมอและไม่สม่ำเสมอลดลงร้อยละ 30.98 และ 25.73 ตามลำดับ จำนวนวันเฉลี่ยที่ยาคงอยู่ในคลังลดลงจาก 10 วัน เป็น 6 และ 8 วันในกลุ่มยาที่มีรูปแบบการใช้แบบสม่ำเสมอและไม่สม่ำเสมอ ตามลำดับ ส่วนระดับการให้บริการอยู่ที่เกือบร้อยละ 100 ไม่แตกต่างกับระดับก่อนใช้ VMI อย่างไรก็ตาม ผลของ VMI ต่อการลดมูลค่ายาและจำนวนวันที่มียาคงอยู่ แตกต่างกันระหว่างกลุ่มยาที่มีรูปแบบการใช้แตกต่างกัน เภสัชกรผู้รับผิดชอบควรติดตามยากลุ่มที่มีการใช้แบบไม่สม่ำเสมออย่างใกล้ชิดเพื่อป้องกันยาขาดคลัง **สรุป:** การใช้ระบบ VMI ส่งผลให้มูลค่ายาคงคลังลดลงอย่างมากและยังมีประโยชน์ในด้านอื่น VMI ช่วยลดขั้นตอนการทำงาน ทำให้เภสัชกรสามารถให้เวลากับการทำงานที่เกี่ยวข้องกับผู้ป่วยมากขึ้น ทั้งยังทำให้เพิ่มเวลาให้แก่คลังยาในการวางแผนจัดการส่งยามายังห้องจ่ายยาได้ดีขึ้น

คำสำคัญ: การจัดการคลังแบบ vendor management การเงินโรงพยาบาล มูลค่ายาคงคลัง บริหารเภสัชกิจ การจัดการทางเภสัชกรรม

Introduction

In line with the mission of hospital, availability of medicines is important to meet the quality of the healthcare services. Hospitals in Thailand have to supply medicines to both in-patients and out-patients, so inventory management is one of major hospital pharmacist's responsibilities. Inventory cost, which includes values of medicines in hospital warehouses, is the major cost of hospital inventory.(1, 2) Reduction of medicine inventory value while maintaining high service rate is a desirable goal for all hospital administrators. An efficient inventory control system should reduce costs, improve service delivery, return on investment, liquidity, service provided, efficiency of man and machine and patient's satisfaction.

At present, pharmacy warehouse delivers medicines according to the requests from dispensing rooms. Manual information flows between pharmacy warehouse and dispensing rooms leading to wrong prediction of medicine supply and utilization, drug shortage and overstocking. (3, 4) Vendor Management Inventory (VMI) can improve supply chain performance by decreasing inventory-related costs and increasing customer service. Unlike the traditional supply chain in which each member manages its own inventories and makes individual stocking decisions, VMI is a collaborative initiative where a downstream customer (dispensing rooms in our study) shifts the controllability of inventories to the upstream supplier (pharmacy warehouse) and allows the pharmacy warehouse to access their demand information in return. (5-7)

VMI is an alternative for the traditional order-based replenishment practices.(8) VMI changes the approach for solving the problems of supply chain in hospital.(9) VMI gives the warehouse both responsibility and authority to manage the entire replenishment process. Dispensing rooms provide the warehouse the access to inventory and demand information and allowing the warehouse to set the target for replenishment. Therefore, pharmacy warehouse

decides when and how much to deliver by agreement with dispensing rooms. This is a fundamental change that will affect the operational mode for both pharmacy warehouse and dispensing rooms. In this system, the pharmacy warehouse controls the stock levels instead of the pharmacist. The new system allows the pharmacists to concentrate more on other patient-care activities and also creates the time available for the warehouse to plan a delivery. (6,10)

To successfully implement a VMI, the hospital is required to consider about two layers of VMI, internal and external. Internal VMI deals with the internal supply chain in the hospital, where the pharmacy warehouse acts as the supplier that delivers medicines to various dispensing rooms. To operate the customer's inventory effectively, the supplier requires accurate information regarding inventory and the actual demand. Therefore, for the internal VMI, the pharmacy warehouse needs to see the stock inventory at all dispensing rooms in the hospital and monitors stock levels to be able to respond to the actual demand (4). IT system is an enabling factor that drives both trading partners (the warehouse and the dispensing rooms) to integrate and collaborate effectively for successful implementation of VMI. (4, 11) Inaccurate demand information is a great barrier and can lead to failure of VMI.

The inventory management indicators as suggested by Bureau of Logistics, Department of Primary Industries and Mines are cost, time, and reliability (12). Cost is the indicator required measurements for activities in the inventory including logistics cost, purchasing cost, warehouse cost and inventory carrying cost. Time indicator focuses on time saving in specific activities which improves the overall supply chain performance. Reliability reflects performance of a specific activity and common logistics indicator about the accuracy including order accuracy, inventory accuracy, and picking accuracy.

This study designed a model of the VMI system between the warehouse and the dispensing rooms to

replace the present system and assessed the outcomes of the change in terms of pharmacy inventory value, service level, and days of stock.

Method

An internal VMI model was designed between the pharmacy warehouse and the main dispensing room at Somdech Phra Debaratana Medical Center (SDMC) Building, Ramathibodhi Hospital. Drug dispensing and transferring information from hospital electronic database during August 2013 to September 2014 were retrieved to run the model and assess for the efficiency. This study began in October 2014 through May 2015.

Drug items studied

This study divided all drug items into three categories in order to focus the study on drugs requiring high workload from hospital pharmacists. These three groups were 1) class a drugs according to the activity based Costing (ABC analysis) which was defined in the study as high value and turnover rate of drug utilization, 2) drugs with high frequency of shortage which was defined in the study as being poor quality in forecasting and purchasing system, and 3) drugs with high frequency of dispensing which was defined in the study as high number of service demand. Top ten of each group was selected as the sample to run the VMI model.

Procedure and outcomes

The study was composed of 3 parts. First, existing activities were analyzed by observing and interviewing the responsible staff to gain understanding of the existing system. Second part involved the design of the internal VMI model between the pharmacy warehouse and the OPD dispensing room. Third part was the assessment of internal VMI model at the OPD pharmacy dispensing floor 1 in terms of average inventory, days of stock (DOS), and service level.

Inventory value is the value of medicines stored at the study site, calculated by the product of balance stock in volume and value of medicines. Average inventory value is summation of inventory value in every day divided by number of days Average of DOS was is the average number of days that holds inventory before the inventory is dispensed. The hospital set the goal of DOS to be less than 14 days. Daily days of stock is daily balance stock in volume divided by average amount dispensed per day. Average DOS in a month is summation of Daily DOS divided by number of days in a month.

Service rate is the ability of the OPD dispensing rooms to serve the patients. The value of 95% service rate indicates an acceptable good performance. Service rate was calculated from number

Table 1. List of model drugs included in the study

Top 10 drugs in class A	Top 10 drugs with high frequency of shortage	Top 10 drugs with high frequency of dispensing
cellcept® 250 mg	revlimid® capsule 25 mg	folic acid 5 mg
glivec® 100 mg	sildenafil 50 mg	omeprazole 20 mg
tasigna® 200 mg	zanidip® 10 mg	aspirin tablets 81 mg
prograf® 1 mg	clethane® 60 mg 0.6 ml	simvastatin 10 mg
sandimmun neoral® 25 mg	combid® 300 mg	simvastatin 20 mg
lipitor® 40 mg	innohep prefilled syringe® 0.5 ml	amlopine® 5 mg
plavix® 75 mg	recombinant® 500 IU 10 ml	calcium carbonate 1250 mg
tarceva® 150 mg	revlimid® capsule 15 mg	metformin 500 mg
ezetrol® 10 mg	senokot® 7.5 mg	amlopine® 10 mg
afinitor® tablet 10 mg	singulair® 10 mg	losartan® 50 mg

of medicines patient received * 100, divided by numbers of medicines prescribed.

Results

There were 1,547 stock keeping units (SKUs) in the main OPD pharmacy during August, 2013 to September, 2014. The number of prescription dispensed per year was 265,848 with an average per month of 22,154 and average per day of 853. When classified the medicines by ABC analysis, there were 96 SKUs in class A, 195 SKUs in class B, and 1,252 SKUs in class C.

At present, the service level of this main OPD pharmacy was 99% and the average DOS was 10.28

days within the optimal levels set by the hospital (the service level of 95%-100% and average day of stock 14 days). The total value of inventory was 13,472,512 Baht which was mandatory to decrease by 20 percent according to the hospital policy.

Activity analysis

The business process was the interaction between the pharmacy warehouse and dispensing rooms. The current internal work flow between dispensing unit and pharmacy warehouse was shown in Figure 1.

Workflow started from pharmacy assistant who checked the quantity of medicines in the cabinet,

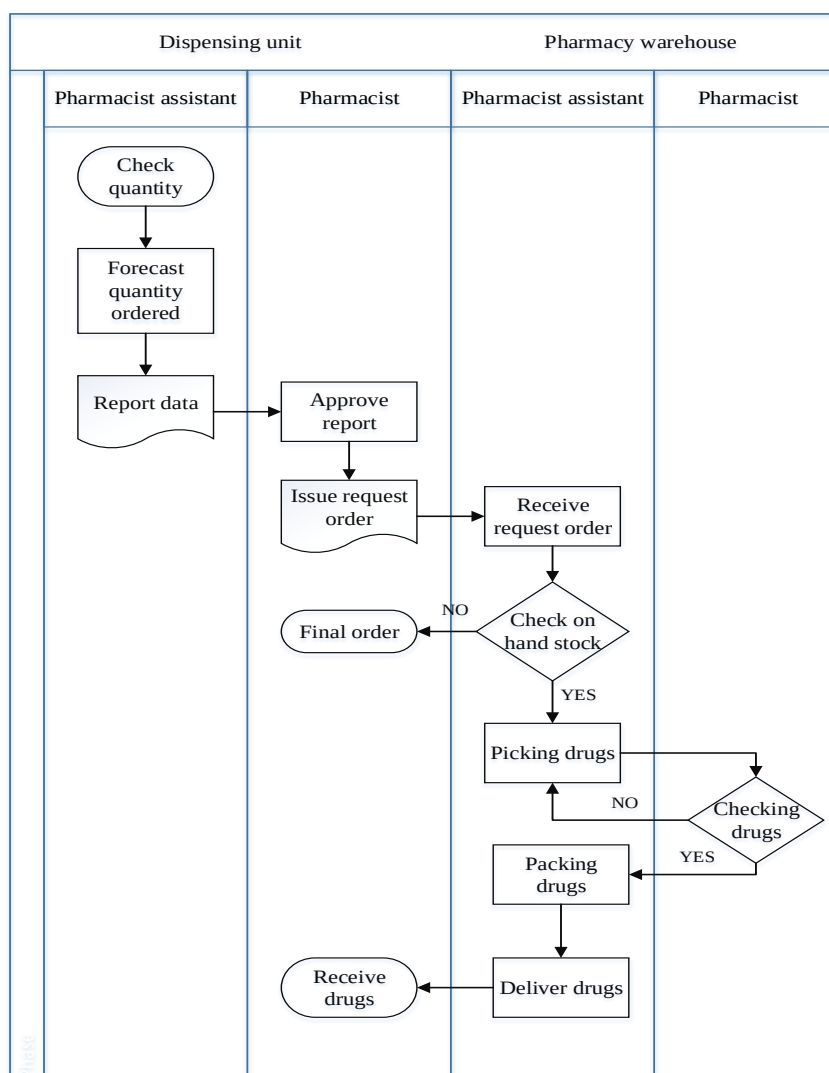


Figure 1. Work flow between dispensing unit and pharmacy warehouse

forecasted order quantity based on their experience, and then reported to pharmacist. The pharmacist at dispensing room then approved report and issued request order to pharmacy assistant at warehouse.

The warehouse checked on hand availability of the order and then sent the requested drugs to a pharmacist for checking and delivering to dispensing room. The order was stopped when the medication was out of stock.

Design the internal VMI model

The new process, VMI, was designed with responsibility of decision to replenish the stock at the

dispensing rooms reallocated to pharmacy warehouse. Instead of waiting for the requests from the dispensing rooms, the pharmacist at the pharmacy warehouse analyzed actual drug consumption levels and updated the stock daily. The replenishment rate was decided based on actual demand. Workflow between the dispensing unit and the pharmacy warehouse after applying VMI model was shown in Figure 2.

The replenishment was scheduled to be once a week on the day prior to the day of high consumption in the week which was not stable due to the schedule of OPD special clinics. Calculation of the maximum inventory level was done every week by

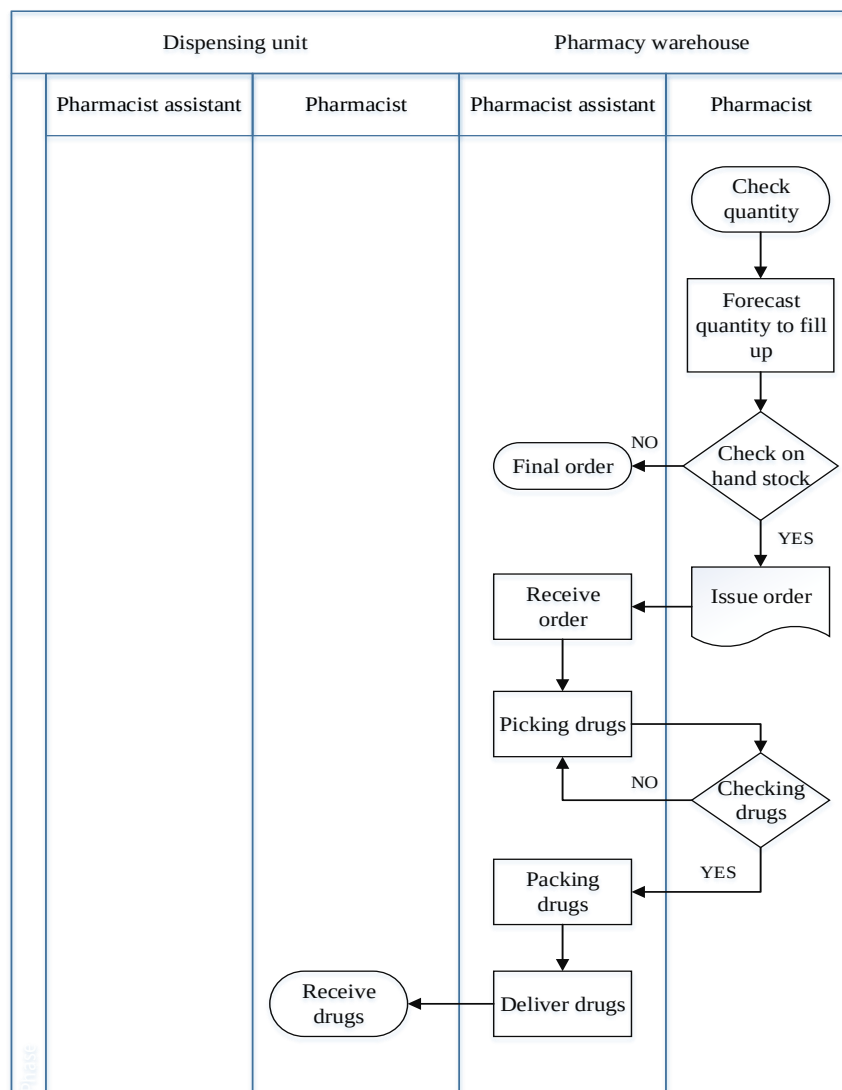


Figure 2. Work flow between the dispensing unit and the pharmacy warehouse after applying the VMI

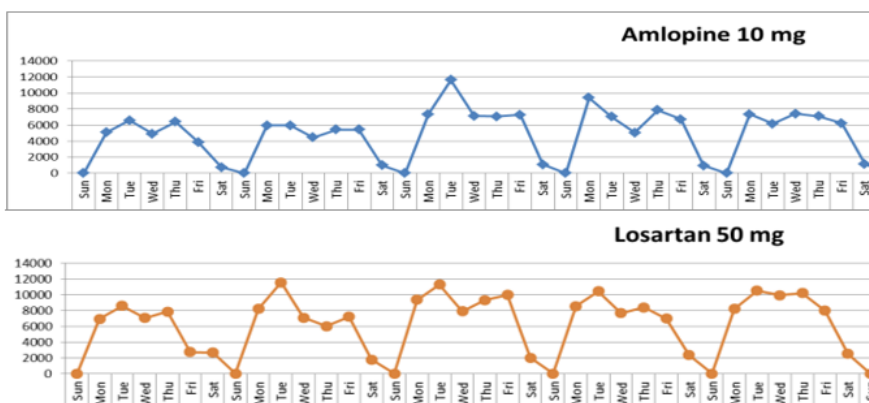
summation of one week drug utilization during the prior 2 months and selected the highest volume of weekly utilization. The amount of replenished medicine was equal to the maximum level minus the amount on hand. It was found that the patterns of utilization of each drug were different, some were regular, some were irregular and some needed management by patient case because of infrequent consumption. As a result, calculation for the drug replacement volume could not

apply to the last category which required close monitoring of patients' appointment schedules.

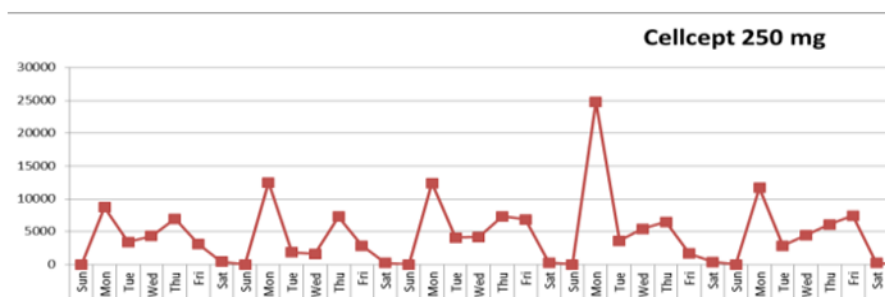
Utilization pattern of drugs

The pattern of utilization of the drug sample was classified into three groups (Figure 3) as: 1) regular pattern (7 items): The utilization pattern almost repeated in every week, 2) Irregular pattern (18 items): The utilization pattern in each week differed and 3) by patient case (5 items): The utilization pattern was

Regular pattern



Irregular pattern



By patient case pattern

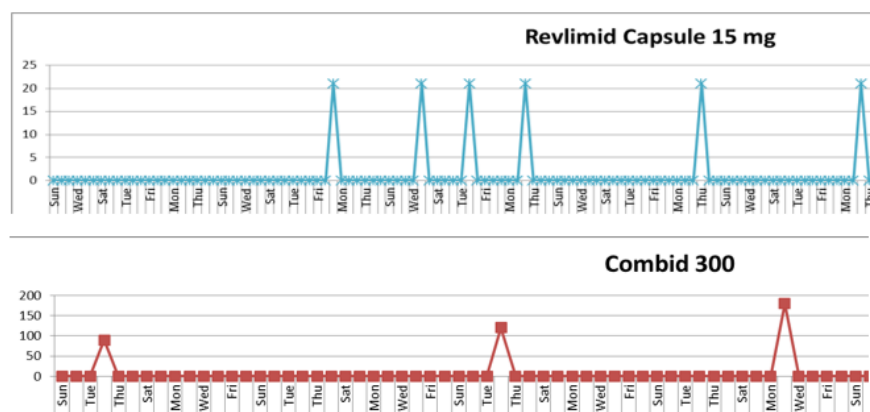


Figure 3. Pattern of drug utilization

related to patient visit and required case by case management (Table 2). These category included combid[®] 300 mg, innohep prefilled syringe[®] 0.5 ml, recombinate[®] 500 iu 10 ml, revlimid[®] capsule 15 mg, and revlimid[®] capsule 25 mg. All were in the group of high frequency of shortage as confirmed by the pharmacists at the warehouse. Therefore, Twenty-five items from 30 samples excluding those in the last group (by patient cases) were managed by the VMI.

VMI performance

Three indicators to assess the performance of VMI model were 1) average inventory value 2) days of stock (DOS) and 3) service level at the OPD dispensing room. The results were shown in Table 3.

After VMI implementation, one year stock level of 7 drugs with regular utilization pattern reduced

from 469,930 Baht to 324,333 Baht or 30.98 %, and from 12,926,183 Baht to 9,600,005 Baht or 25.73% reduction in 18 drugs with irregular pattern. According to the sample in this research, drugs with regular and irregular utilization patterns accounted for 80.00% of drug items (24 out of 30 drugs) in which the VMI model could be applied.

After VMI implementation, average DOS of drugs with regular and irregular pattern reduced from 10 to 6 and 8 days, respectively. Moreover, none of the item in both groups had DOS over 14 days.

VMI maintained the service rate at nearly.100% which was the same level as that of the pre-VMI period. VMI reduced the number of items with service rate of 95% from 3 items to 1 item in the group with irregular pattern of use

Table 2. Classification of drug samples by utilization patterns

utilization pattern	class A	high frequency dispense	high frequency shortage
regular		amlopine [®] 10 mg amlopine [®] 5 mg folic acid 5 mg losartan [®] 50 mg omeprazole 20 mg simvastatin 10 mg simvastatin 20 mg	
irregular	tasigna [®] 200 mg celcept [®] 250 mg prograf [®] 1 mg sandimmun neoral [®] 25 mg ezetrol [®] 10 mg plavix [®] 75 mg glivec [®] 100 mg tarceva [®] 150 mg lipitor [®] 40 mg,	calcium carbonate 1250 mg metformin 500 mg aspirin 81 mg	singulair [®] 10 mg clexane [®] 60 mg 0.6 ml senokot [®] 7.5 mg sildenafil [®] 50 mg zanidip [®] 10 mg
by patient case	afinitor [®] 10 mg		combid [®] 300 mg innohep prefilled syringe [®] 0.5 ml recombinate [®] 500 IU 10 ml revlimid [®] 15 mg revlimid [®] 25 mg

Implementation of a VMI system can lead to significant stock reduction and other benefits. Through VMI, the flow of information and materials becomes seamless, improving service levels, inventory and transportation costs, the co-ordination of supply process and transport optimization.(13) The main goals of the VMI are to lower inventory level and to improve service level at the same time.(14)

The existing replenishing system used personal judgment to order medicines from the warehouse without looking at the patient consumption rate. Under and over-estimation led to shortage and high inventory value.

The pharmacists at the research site mentioned three groups of medicines having inventory problems including those with high value, high shortage frequency and, high dispensing frequency. These three groups of medications were selected to test if VMI model really worked for these "difficult to manage" drugs. Utilization rate of drugs within these three groups were forecasted using moving average. However, the utilization patterns of drugs were different and caused difficulty in forecasting. The moving average was applicable for regular drug utilization pattern and even

to the irregular pattern, but not for the "by patient case" group because the demand depended on the appointment schedule. As a result, the VMI model was applicable to medicines with utilization patterns, either regular or irregular, but worked better for those with regular utilization pattern

The key to success of VMI implementation was the redesign of workflow allowing the pharmacist at the warehouse (or vendor of medicines in the hospital) to use the OPD consumption rate and pattern to manage the inventory for OPD dispensing room (or customer of medicines in the hospital). The process of forecasting the replenishing rate and volume was conducted by the vendor, thus reduced the workload of staff at the OPD dispensing room.

However, these two goals are compromised to some extent since both the warehouse and dispensing rooms hold a certain level of inventory in their own warehouses to secure medicine availability. Keeping safety stock is a traditional way to minimize the occurrence of stock outs. Inventory value and customer service level are usually negatively correlated. Thus, lowering the inventory level and increasing the service level cannot possibly be achieved at the same

Table 3. Performance of existing system and VMI

	regular pattern (n=7)	irregular pattern (n=18)
average inventory value (Baht)		
existing performance	469,930	12,926,183
VMI	324,333	9,600,005
%change	- 30.98%	- 25.73%
average days of stock (range)		
existing performance	10 days (4-17 days)	10 days (2-26 days)
	> 14 days = 1 drug (14.28 %)	> 14 days = 3 drugs (16.67 %)
VMI	6 days (6-7 days)	8 days (6-11 days)
average service rate (range)		
existing performance	100% (97%-100%)	99% (92%-100%)
		<95% = 3 (16.67%)
VMI	100 %	99 % (94%-100%)
		<95% =1 (5.55%)

time through any traditional management techniques. VMI overcomes limitation of traditional management. In the VMI system, the customers can reduce or even eliminate their inventory. The vendors also reduce their cost and increase the service level by controlling the dispensing room's inventory according to their best delivery schedule, leading to a win-win relationship. (15-18) However, due to different consumption patterns of drugs as regular and irregular, the efficacy of VMI to reduce the inventory volume and DOS differed. Pharmacist in charge should steadily monitor drugs with irregular consumption pattern to prevent shortage.

However, utilization pattern of 20% of drugs in the study was categorized as "by patient case" (6 out of 30 drugs) in which the VMI model was not applicable because of the difficulty to forecast the consumption rate. However, the dispensing rooms can send the required order in advance to the warehouse, acquisition of drugs can be done.

Conclusion

The result from the study assures that the VMI model is a promising approach for improving stock and inventory management in the hospital pharmacy service. The VMI reduces the cost of inventory while increases service rate. The fundamental change of work process will affect the operational mode of both the pharmacy warehouse and dispensing rooms. VMI allows the pharmacists to concentrate more on other patient-care activities and service improvement.

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