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Comparison of unit cost of pharmacy service using automatic and manual dispensing system

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Objectives: To assess and compare the unit cost of inpatient prescriptions between manual and automated dispensing machine (ADM) systems.
Methods: The unit cost per prescription was calculated using a standard or conventional method for the inpatient department of the 2,100-bed university hospital. The unit cost calculation was comprised of five steps including 1) identifying and classifying cost centers into transient cost center (TCC) and absorbing cost center (ACC); 2) determining all direct costs that covered the labor cost (LC) of medical staff and supporting staff, material cost (MC), and capital cost (CC); 3) allocating indirect costs from TCCs to ACCs using a direct method; 4) adding up direct and indirect costs of each ACC; and 5) calculating the unit cost per prescription of the inpatient service by dividing the total cost of the inpatient service by the number of prescriptions. The additional indirect cost of cost centers outside the pharmacy department was added to the unit cost at the rate of 10%. All costs and the number of prescriptions were in fiscal year 2014. A sensitivity analysis was conducted to estimate the unit cost at different scales if the system was expanded.
Results: The total costs of the inpatient service under 100% manual and ADM systems dispensing 22.8% of inpatient prescriptions were 82.7 and 89.8 million baht/year, respectively. The unit cost of inpatient prescriptions using the ADM system was 60.34 baht/prescription, which accounted for 8.5% higher than 55.59 baht/prescription of the traditional manual system. The proportions of LC:MC:CC for the manual and ADM systems were 87.8:12.1:0.1 and 88.0:9.3:2.8, respectively. The sensitivity analysis result illustrated that the lower unit cost could be achieved if the ADM system covered at least 75% of all prescriptions. At the 75% coverage, the unit cost was 53.95 baht/prescription and the proportion of LC:MC:CC was 83.6:13.3:3.1.
Conclusion: Dispensing using the ADM system required higher investment than the traditional manual system on the capital cost of ADM machine and equipment. The hospital would benefit from the lower unit cost per inpatient prescription if the ADM system dispensed beyond 75% of all prescriptions.

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Introduction

To improve medication distribution system, automated dispensing machine (ADM) was implemented on selected wards at the university hospital and planned as a part of an inpatient service. Work processes and roles of pharmacists and pharmacy technicians could be changed after ADM implementation. ADM implementation was believed to increase the system capacity and improve the quality of patient care in the hospital. Not only the quality of care was needed but the sustainability of financing system was also important. Before implementation of ADM system throughout the hospital, the operational cost of dispensing system should be studied as a baseline information and used for future planning. A unit cost was analyzed to assess the situation which indicated the efficient use of resource. For the inpatient service under the pharmacy department, unit cost per inpatients prescription was calculated annually. This research was conducted to assess unit cost per prescription of the inpatient dispensing service and compare the cost between manual and automated dispensing systems. The results of this research will be used to support policy decision on replacing the manual dispensing with the ADM system.

Methods

The research was conducted at the inpatient department of the 2,100-bed university hospital. The unit cost per inpatient prescription was studied and compared between manual and automated dispensing machine (ADM) systems. Patient medications were prepared by pharmacy technicians under the manual system but by automated machine under the ADM system. Under the ADM system work processes needed to be redesigned. A unit cost per prescription in the inpatient service was calculated by standard or conventional method from provider perspective[1, 2].

The process of unit cost calculation comprised of

1) identifying cost centers and classifying into either transient cost center (TCC), whose responsibilities were to support other cost centers, or absorbing cost center (ACC), which absorbed the allocated cost from TCC,

2) determining all direct costs, which covered labor cost (LC), material cost (MC), and capital cost (CC) and totaling all direct costs in each cost center,

3) assigning indirect costs by allocating costs from TCCs to ACCs with direct method, as shown in figure 1,

4) adding direct and indirect costs to obtain the total cost of each ACC,

5) calculating the unit cost per prescription of the inpatient service by dividing the total cost of inpatient service by the number of prescriptions.

Indirect costs from other cost centers outside the pharmacy department were also allocated to inpatient service by adding 10% onto the unit cost. Cost data of fiscal year 2014 were retrieved from the unit cost division and the number of prescription of the same period was provided from business intelligence program of the hospital. For inpatient service, the data on number of staff, the labor cost of medical staff, material cost, and capital cost were reanalyzed according to workload and resources utilized for each dispensing system. The proportion of labor cost (LC): material cost (MC): capital cost (CC) under manual and ADM systems was also evaluated. Sensitivity analysis was conducted at different volumes of prescription dispensed. The unit cost at different proportions of prescription covered by the ADM system was compared.

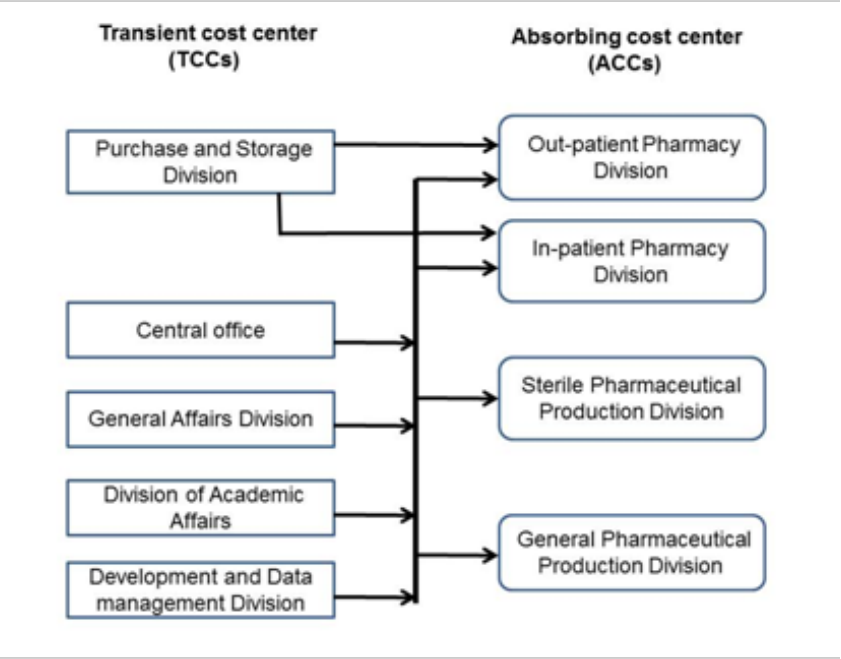

Figure 1. Cost allocation from transient cost centers to absorbing cost centers by direct method

Results

Nine cost centers in the pharmacy department were classified into TCCs and ACCs. Five TCCs included Central Office, General Affairs Division, Division of Academic Affairs, Development and Data management Division, and Purchase and Storage Division. Four ACCs were Sterile Pharmaceutical Production Division, General Pharmaceutical Production Division, In-patient Pharmacy Division, and Out-patient Pharmacy Division. Direct cost was accumulated from the labor cost of medical staff and of supporting staff, material cost, and capital cost. Unit cost of inpatient service of manual and ADM systems were calculated as shown in the table 1. Direct cost of manual and ADM systems of the inpatient service were 53.42 and 60.20 million baht/year, respectively. Allocation of indirect cost was started by distributing costs from Purchase and Storage Division (18.94 million baht/year) to In-patient Pharmacy Division and Out-patient Pharmacy Division according to the proportion of drug expenditures dispensed. Drug expenditures dispensed by In-patient Pharmacy Division was about 12.66% of all drug expenditures. The same number of prescriptions was used for both manual and ADM systems thus the indirect cost of 2.40 million baht from Purchase and Storage Division

was allocated to In-patient Pharmacy Division. Second allocation included 63.55 million baht/year of indirect cost from other TCCs, Central Office (49.13 million baht/year), General Affairs Division (3.47 million baht/year), Division of Academic Affairs (7.49 million baht/year), and Development and Data management Division (3.46 million baht/year) was transferred to Sterile Pharmaceutical Production Division, General Pharmaceutical Production Division, Out-patient Pharmacy Division, and In-patient Pharmacy Division according to the proportion of staff. The number of staff under In-patient Pharmacy Division was accounted for 42.36% of all staff in ACCs for the manual system and 42.81% for the ADM system. The indirect cost in the amount of 26.92 and 27.21 million baht from other TCCs was allotted to In-patient Pharmacy Division for manual and ADM system, respectively. The total cost of manual and ADM systems including direct and indirect costs were 82.74 and 89.81 million baht/year, respectively. The estimated number of the inpatient prescriptions when the ADM was implemented was 1,637,277 prescriptions/year. The indirect cost from supporting units outside pharmacy department was estimated to be 10% of total costs of In-patient Pharmacy Division. The unit cost of inpatient prescription under manual and ADM systems were finalized at 55.59 and 60.34 baht/prescription. The result showed that inpatient prescription dispensed by the ADM system contained 8.5% higher cost when compared with the manual system. The analysis of labor cost (LC), material cost (MC), and capital cost (CC) showed that the proportion of LC:MC:CC for the manual system was 87.8:12.1:0.1 as compared to 87.9:9.3:2.8 under the ADM system. Under the pilot study, the ADM system covered only 22.83% or approximately 23% of all in-patient prescriptions.

Table 1. Unit cost analysis in manual and ADM systems

Cost (baht)	Manual system	ADM system
Direct cost	53,422,488.61	60,200,510.83
1st allocation by drug expenditure (from Purchase and Storage Division cost center)	2,397,595.59	2,397,595.59
2nd allocation by the number of staff (from other TCCs)	26,922,725.45	27,207,501.63
Total cost (direct and indirect costs)	82,742,809.65	89,805,608.05
Number of inpatient prescriptions	1,637,277	1,637,277
Unit cost	50.54	54.85
Plus 10% for indirect cost	5.05	5.49
Unit cost plus 10%	**55.59**	**60.34**

The sensitivity analysis was conducted by varying different proportions of prescription dispensed under the ADM system as shown in table 2 and 3, labor cost and unit cost were decreased when the ADM system dispensed more prescriptions. The result reflected that the cost saving of the ADM over the manual system could be achieved when at least 75% of all prescriptions were handled by the ADM. At the 75% of prescription dispensed, the unit cost of the ADM system was 53.95 baht per prescription.

Table 2. Sensitivity analysis: the proportion of LC: MC: CC and the proportion of prescriptions covered by ADM

ADM : Manual prescription	LC: MC: CC	
	Manual system	ADM system
0:100	87.75:12.13:0.12	
22.83:77.17		87.95:9.28:2.77
25:75		87.79:9.43:2.78
50:50		85.81:11.27:2.92
75:25		83.62:13.30:3.08
100:0		81.20:15.56:3.25

Table 3. Sensitivity analysis: unit cost and the proportion of prescriptions covered by ADM

ADM : Manual prescription	Unit cost (baht/prescription)	
	Manual system	ADM system
0:100	55.59	
22.83:77.17		60.34
25:75		60.08
50:50		57.07
75:25		53.95
100:0		50.72

\Discussion

Many approaches have been used to estimate unit cost of prescription dispensing. This study selected standard or conventional method which was quite flexible when working with hospital database for cost allocation as well as unit cost calculation. The result on proportion of LC:MC:CC revealed that over 80% of inpatient medication dispensing cost was contributed to labor cost for both systems, manual and ADM. This reflected the nature of large university hospitals providing very specialized tertiary care. A previous study showed the proportion of LC:MC:CC at 31.0:62.0:7.0 for a medical school[3] while another study compared the proportion of LC:MC:CC among regional hospital, provincial hospital, and community hospital as 46.46:48.76:4:78, 53.62:40.58:5.79, and 56.13:37.60:6.27, respectively[4]. The variation could result from how each study defined costs, different methods of cost estimation, and/or different characteristics of hospitals. The large proportion of labor cost in the inpatient medication dispensing system was related to job and workflow design which demanded more manpower than other functions of the hospital. Workflow was changed when the ADM was implemented. Labor cost and unit cost of the ADM system were shown to be higher than those of the manual system when small proportion of prescription was dispensed. Increasing the proportion of prescription managed by the ADM could lower the proportion of labor cost as well as unit cost. The result showed that increase of prescription volume from 25% to 75% lead to approximately only 4.2% reduction (from 87.8% to 83.6%) of labor cost. Even the hospital investment on the ADM could not substantially lower cost of dispensing but indirect benefits from reduced dispensing errors as well as other risks associated with dispensing system would raise the standard and increase quality of care provided by the hospital. The results of this research could guide the hospital policy decision on resource management and allocation for pharmacy services. However some limitations and constraints need to be mentioned and considered. This study used secondary data of cost and number of prescriptions in fiscal year 2014 from the hospital database. The data retrieved from the hospital for fiscal year 2014 was available only for 9 months at the time of study. The annual data were thus extrapolated and could be different from the actual data. Sensitivity analysis was conducted by varying the proportion of prescriptions covered by the ADM from 22.83% under the current system to 100% meaning that all in-patient prescription would be dispensed under the ADM system. However in the real situation the ADM could only dispense medications in tablet dosage form, and could not cover all prescriptions.

Conclusion

The unit cost per prescription of manual and ADM systems with 22.83% of prescription was 55.59 and 60.34 baht per prescription, respectively. Dispensing using ADM system required higher investment than traditional manual system on capital cost of ADM machine and equipment. The unit cost under ADM system was lower when more prescriptions were covered. The hospital would benefit from lower unit cost per inpatient prescription if the ADM system dispensed beyond 75% of all prescriptions.

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References

1. Riewpaiboon A. Standard Cost Lists for Health Technology Assessment.
2. Thianjaruwatthana W ST, Pongpattrachai D, Chiangchaisakulthai K. Study on cost of health institute under Ministry of Public Health. 2011.
3. Khiaocharoen O PS, Zungsontiporn C, Riewpaiboon A. Patient-Level Cost for Thai Diagnosis Related Groups: Micro-Costing Method. Journal of Health Science. 2011;20:572-85.
4. Chiangchaisakulthai K KO, Wongyai D, Sornsilp D, Sangwanich U. Hospital Costing Study in the Hospitals Under Ministry of Public Health, 2010-2011. Journal of Health Science. 2013;22:1062-8.