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The impact of pharmacists' interventions in female internal medicine ward at university-based hospital on cost savings and cost avoidance

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ABSTRACT

Background: Several studies have been conducted regarding the role of clinical pharmacist in the reduction of medical costs, the impact of clinical pharmacists in internal medicine wards on cost saving had been rarely studied. **Objective:** The objective of this study was to define the characteristics of drug-related problem (DRPs) and evaluate the effect on cost savings and cost avoidance by clinical pharmacists in female internal medicine ward at Songklanagarind Hospital. **Materials and Methods:** A retrospective analysis of pharmacists' interventions recorded for 6 months was conducted. DRPs were categorized based on Pharmaceutical Care Network Europe V9.00. The interventions that were accepted then calculated for cost saving and cost avoidance using the perspective of the healthcare institution. **Results:** A total of 117 DRPs were evaluated. More than 50% of DRPs only had potential of harm, were detected, and managed by clinical pharmacist before reach the patient. The 97 cases were accepted and implemented by team. The cost saving and cost avoidance were 214.26 United States Dollar (USD) and 21,697.35 USD, respectively. The highest total saving was from medication reconciliation, followed by dose adjustment. The largest cost reductions recorded were from antibiotic agents. **Conclusions:** Medication reconciliation and dose adjustment, especially antibiotic agents, were the major role of clinical pharmacists for cost saving.

Keywords: Cost avoidance, cost saving, drug-related problems, internal medicine ward, pharmacists' intervention

INTRODUCTION

Drug-related problem (DRP) is an event involving drug therapy that interferes with the patient's treatment outcomes.[1] DRPs impact the efficacy of treatment and adverse drug event (ADE). These problems unnecessarily prolong the duration of hospital stay, emergency department visits, or hospital admissions and increase healthcare cost.[2] In the United States, DRPs accounted for 76.6 United States Dollar (USD) billion in hospital costs, 17 million emergency department visits, and 8.7 million hospital admissions annually.[2] In Thailand, the incidence of DRPs in hospital varied between 1.7 and 22.6%.[3] It reportedly increased length of hospital stay by 5.46 days and costs 2087 baht per ADE.[4]

Pharmaceutical care as part of a multidisciplinary team has an essential role in preventing medication errors, limiting inappropriate prescription, and optimizing patient's medication therapy[5-7] which resulted in major reduction in the healthcare costs. The previous studies demonstrated that pharmacists in the emergency department generated 7,531,862 USD of cost avoidance,[8] also pharmacists in intensive care units of Thailand could reduce the length of stay from 7.16 to 6.18 days and the medication cost due to DRPs by 86,926 Baht in 5 weeks,[9] and 192,602.05 Baht in 6 months.[10]

Although several studies have been conducted regarding the role of clinical pharmacist in the reduction of medical costs, most of these were focused on critical care settings. Studies that evaluated the impact of economic benefit of the clinical pharmacist in internal medicine settings are rare. The internal medicine ward, especially in university hospitals, handles a lot of complicated diseases and treatments. Sometimes, this may result in DRPs. The incidence of DRPs in Thailand was 15.5–23.6%. Improper dosage regimen and untreated indication were the common cause of DRPs;[11] thus underscoring the essential role of pharmacists in this ward in enhancing treatment outcome.

Clinical pharmacist on internal medicine ward is the new role, especially developing country. For several years, pharmacy residencies or pharmacy teacher practitioner have provided services in the female internal medicine ward at Songklanagarind Hospital, a university teaching hospital in Southern Thailand. Until now, there has not been any study or evidence demonstrating the economic impact of clinical pharmacists in the internal medicine ward. This information is important for policy-makers, the hospital leadership, or healthcare staff and could have implications in terms of hiring more pharmacist, supporting pharmacist as part of multidisciplinary treatment teams, or even providing a clearer view of the role of pharmacists.

The objective of this study was to define the characteristics of DRPs and evaluate cost saving and cost avoidance arising from the intervention of clinical pharmacists in female internal medicine ward at university-based hospital.

MATERIALS AND METHODS

A retrospective and interventions recorded study was conducted in the female internal medicine ward at Songklanagarind Hospital, a university-based hospital in Thailand. This study was conducted in accordance with the Declaration of Helsinki and the Institution Review Board of the institute approved the study protocol (REC.63-015-19-6).

Songklanagarind Hospital is a university-based hospital. There are 40 beds in female internal medicine ward. The new admission rate is about 3–4 patients/day. Pharmacy residencies or pharmacy teacher practitioner were the clinical pharmacist in female internal medicine setting at a period of the study. Routine activity of clinical pharmacists in female internal medicine setting included patient's medication review, morning rounds, drug information service, medication reconciliation, and counselling. Every DRP detected and managed by the pharmacy residencies or pharmacy teacher practitioner was documented as an intervention for 6 months (May–October 2019). The documented information included date of detected DRPs, type of DRPs, regimen of medications causing DRPs, details of DRPs, details of intervention made by clinical pharmacists, intervention acceptance by physicians, and patient demographic data.

Each DRP was reviewed and categorized based on Pharmaceutical Care Network Europe (PCNE) V9.00[12] and analyzed for acceptance (intervention accepted and fully implemented), acceptance with modified (intervention accepted, partially implemented), or non-acceptance by the treating physician. The interventions that were accepted and implemented by the team were then calculated for cost saving and cost avoidance using the perspective of the healthcare institution. The details of calculation are described below.

Data Analysis

Baseline patient characteristics and information of DRPs were analyzed using descriptive analysis. The data were presented as number and percentages.

Cost Analysis

Cost saving of each intervention is calculated by the difference of direct medication costs between the initial therapy that had no clinical pharmacist's intervention and the new therapy that was recommended by the clinical pharmacist. The costs of medications were calculated from the database of Songklanagarind Hospital. We assumed that if there were no interventions by the clinical pharmacist, the physician would detect DRPs and change medication regimen within 2 days.[13,14]

Cost avoidance was evaluated for every ADE that might have occurred in the absence of pharmacist's intervention. Probability of ADE in the absence of the pharmacist's intervention multiplied with cost of ADE treatment was calculated for cost avoidance. Probability of ADE was estimated using data from literature. If there were no data available from the literature, the probability would be based on Nesbite *et al*. (probability of 0, 0.001, 0.1, 0.4, and 0.6 for no harm to high probability of ADE, respectively).[15] The probability data in each case were, then, discussed by a physician and clinical pharmacist. Cost of ADE treatment consisted of medication cost, laboratory cost, and service cost. The medication and laboratory cost were calculated from Songklanagarind Hospital's cost database. The service cost (Inpatient hospitalization) including room and meal was calculated based on data from standard cost of government hospital (38.98 USD/day).

Cost saving and cost avoidance were reported using USD in 2019 (conversion rate: 32.17 Thai baht = 1 USD).

Example: A patient was receiving imipenem/cilastatin 500 mg every 6 h. Five day later, the patient's renal function was worsening. The pharmacist gave the intervention to adjust dose of antibiotic as patient's renal function (500 mg every 12 h). The duration of treatment was 14 days, the physician would detect DRPs and change medication regimen within 2 days (about day 7 of this case) if there were no interventions by the clinical pharmacist. The cost of 500 mg vial of imipenem/cilastatin was 17.10 USD.

Cost saving = Direct medical cost of initial therapy – Direct medical cost of new therapy, [((17.10 USD × 4 times/day × 7 days) + (17.10 USD × 2 times/day × 7 days)) – ((17.10 USD × 4 times/day × 5 days) + (17.10 USD × 2 times/day × 9 days))]

Cost avoidance = Probability of ADE x Cost of ADE treatment, (0.4% × 445.36 USD)

RESULTS

According to the documented clinical pharmacists' interventions, a total of 117 DRPs were documented and evaluated on 485 individual patients (24.13%). Majority of

interventions occurred in the elderly patient (≥60 years old, 64.10%). Most of patients had body weight 40–60 kg (67.53%) and cardiovascular disease was the highest underlying disease (30.55%) [Table 1].

According to PCNE Classification for DRPs V9.00 [Table 2], the high cases of DRPs was due to treatment effectiveness (35.90%) and treatment safety (35.90%). The top three possible causes for DRPs were dose adjustment (38.46%), drug selection (38.46%), and patient transfer related (8.55%). More than 50% of DRPs only had potential of harm but were not relevant for the given patient. Almost clinical pharmacist's activities for DRPs management were dose adjustment (43.59%) and medication reconciliation (16.24%). Antibiotic agents (33.33%), antithrombotic agents (16.24%), and electrolyte supplements (10.26%) were the main causes DRPs [Table 2]. The top five of potential of ADE in the absence of pharmacists' interventions are sepsis/septic shock 14 events (11.97%), recurrent atherosclerotic cardiovascular disease (11 events, 9.40%), seizure (ten events, 8.55%), major bleeding (eight events, 6.84%), and minor bleeding (six events, 5.13%).

The overall acceptance rate by physicians included acceptance with modified was more than 80% [Figure 1].

Table 1: Characteristics of patients (*n*=117 events)

Characteristics	Number (%)
Age of patient (years)	
18–30	5 (4.27)
31–45	17 (14.54)
46–60	20 (17.09)
61–75	37 (31.62)
>75	38 (32.48)
Body weight (kilograms)	
<40	9 (7.69)
40–60	79 (67.53)
61–80	24 (20.51)
>80	1 (0.85)
No data	4 (3.42)
Underlying disease count on organ system	
Cardiovascular disorders	62 (30.55)
Renal disorders	35 (17.24)
Endocrinologic disorders	32 (15.76)
Gastrointestinal disorders	20 (9.85)
Hematologic disorders	16 (7.88)
Respiratory disorders	15 (7.39)
Other	12 (5.91)
Neurologic disorders	9 (4.43)
No underlying disease	2 (0.99)
Number of diseases at the date of DRPs detection	
0–2	35 (29.91)
3–4	71 (60.69)
>5	11 (9.40)

DRPs: Drug-related problems

A total of 97 DRPs accepted and implemented by team were evaluated for cost saving and cost avoidance [Table 3]. The interventions by clinical pharmacists resulted in cost savings of 214.26 USD and cost avoidance of 21,697.35 USD during the study period. Sum of total saving per month was 3651.93 USD.

Table 2: Characteristics of drug-related problems (*n*=117 events)

Characteristics	Total (*n*=117) (number [%])
Type of DRPs[a]	
Treatment effectiveness	42 (35.90)
Treatment safety	42 (35.90)
Other	33 (28.20)
Possible causes for DRPs[a]	
Drug selection (code C1)	45 (38.46)
Drug form (code C2)	2 (1.71)
Dose adjustment (code C3)	45 (38.46)
Treatment duration (code C4)	0 (0.00)
Dispensing (code C5) b	0 (0.00)
Drug use process (code C6)	8 (6.84)
Patient related (code C7)	0 (0.00)
Patient transfer related (code C8)	10 (8.55)
Other (code C9)	7 (5.98)
Severity of DRPs[c]	
DRPs are not relevant for the given patient	43 (36.75)
DRPs will not reach the patient	21 (17.95)
DRPs occurred that may reach the patient but will not cause patient harm	38 (32.48)
DRPs that may reach the patient and will require monitoring to confirm that it resulted in no harm to the patient and/or required intervention to preclude harm	15 (12.82)
Pharmacist's activity for DRPs management	
Dose adjustment	51 (43.59)
Medication reconciliation	19 (16.24)
Untreated symptoms or indication	15 (12.83)
Drug administration	11 (9.40)
Unnecessary drug/treatment	8 (6.84)
Laboratory monitoring	7 (5.98)
Dosage regimen/preparation	3 (2.56)
Drug interaction	3 (2.56)
Top five of drug classes addressed by pharmacist's intervention	
Antibiotic agents	39 (33.33)
Antithrombotic agents	19 (16.24)
Electrolyte supplements	12 (10.26)
Acid suppressing agents	11 (9.4)
Antihypertensive agents	9 (7.69)

[a]Type of DRPs and possible causes for DRPs were classified by Pharmaceutical Care Network Europe V9.00. [b]Code C5 of DRPs was not included in clinical pharmacist's interventions recorded. [c]Divided by NCC MERP Index for Categorizing Medication Errors. https://www.nccmerp.org/sites/default/files/indexColor2001-06-12.pdf. DRPs: Drug-related problems

From all accepted interventions (n = 97), dose adjustment was the highest intervention given by the pharmacists (n = 43), followed by medication reconciliation and untreated symptoms/indication (n = 16, n = 14, respectively). The highest savings were from medication reconciliation, followed by dose adjustment and untreated symptoms/indication which cost 10,467.46 USD, 4218.58 USD, and 2098.48 USD, respectively [Table 4].

According to the drug classes, pharmacist interventions the led to the most reduction in cost involved antibiotic agents (9376.15 USD), antithrombotic agents (3652.27 USD), antihypertensive agents (2980.62 USD), electrolyte supplementations (1953.66 USD), and lipid lowering agents (1235.01 USD), as shown in Table 5.

DISCUSSION

This study revealed the impact of interventions by clinical pharmacists in the female internal medicine ward in a university hospital in Southern Thailand on cost savings and cost avoidance. Within the period of the study (6 months), 117 cases of DRPs on 458 individual patients (24.13%) were identified with more than 70% acceptance rate, resulting in a total saving in medication and adverse event treatment of 21,911.61 USD (3651.93 USD/month).

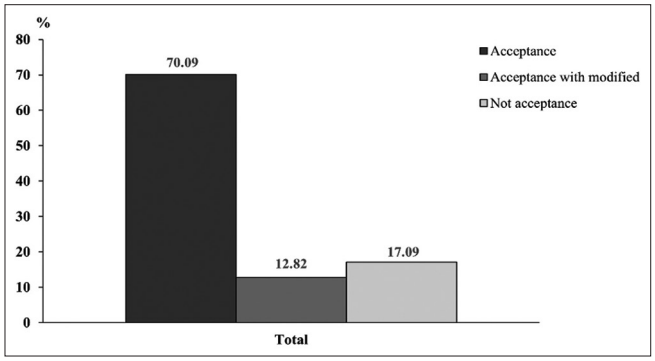

Figure 1: Acceptance rate of drug-related problem (n = 117 events)

Table 3: Cost saving and cost avoidance by pharmacist's intervention (n=97 events)

Cost analysis	For 6 months (USD)	Average per month (USD)
Cost saving[a]	214.26	35.71
Cost avoidance	21,697.35	3616.22
Total saving	21,911.61	3651.93

[a]Cost saving=Direct medical cost of initial therapy–Direct medical cost of new therapy. USD: United States Dollar

Herein, the pharmacy residencies or pharmacy teacher practitioner were not the full-time service on the ward, so there was quite low DRPs (24.13% of 458 patients). The overall acceptance rate was 82.91% (accepted 70.09% and accepted with modified 12.82%). There were higher acceptance rates in other previous studies (more than 85%),[9,11,16,17] while Movva *et al*. noted a lower acceptance rate (accepted 30.04% and 68.26% accepted but no action taken).[18] A putative explanation for the lower rate of acceptance in the current study might be due to the differences in hospital settings and the complicated characteristic of patients. Sometime, the pharmacist interventions were not significant with patient's recent major clinical condition perceived by the physicians.

The most common types of interventions in our study were dose adjustment which was similar to other studies in internal medicine ward in Thailand[11,16] and another countries.[19,20] The patients in medicine ward were in a several complicated conditions such as renal or hepatic impairment, multiple diseases, and multiple drug use. These conditions often call for complex pharmacotherapeutic approaches which increase the risk of DRPs.[21] The DRPs could be avoided, minimized, or managed by pharmacists' interventions.

Antibiotic agents and antithrombotic agents were the most common class of medications involved in DPRs; and this observation was similar to that of another study in medicine ward. Lombardi *et al*. reported that antibacterial agents for systemic use constituted the one of most common drug class involved in pharmacist's interventions in internal medicine ward in Italy.[17] Moreover, other studies also documented that those similar common drugs were used in intensive care unit, namely anti-infective, cardiovascular drugs, electrolytes trace elements, and anticoagulants.[9,13] The results from Saokaew *et al*. also indicated high amount of total saving from pharmacist interventions in antibiotic agents and antithrombotic agents (1958.61 USD and 132.36 USD, respectively).[9] The adverse events related to the DRPs of these two drug classes can be fatal and require intensive medication which may prolong the treatment duration and result in higher economic burden to both the hospital and patients.

Table 4: Cost saving and cost avoidance classified by interventions (n=97)

Interventions	Number of interventions	Cost saving[a] (USD)	Cost avoidance (USD)	Total saving[b] (USD)
Medication reconciliation	16	-2.39	10,469.85	10,467.46
Dose adjustment	43	125.77	4092.81	4218.58
Untreated symptoms or indication	14	-2.73	2101.21	2098.48
Drug administration	9	1.69	1516.02	1517.71
Laboratory monitoring	4	-0.10	1248.14	1248.04
Drug interaction	3	2.63	1103.96	1106.59
Dosage regimen/preparation	1	9.30	260.73	1106.59
Unnecessary drug/treatment	7	80.08	904.64	984.71

[a]Cost saving=Direct medical cost of initial therapy–Direct medical cost of new therapy. [b]Total saving=Cost saving+Cost avoidance. USD: United States Dollar

Table 5: Cost savings and cost avoidance classified by drug classes (n=97)

Drug classes	Number of interventions	Cost saving[a] (USD)	Cost avoidance (USD)	Total saving[b] (USD)
Antibiotic agents	26	126.65	9249.50	9376.15
Antithrombotic agents	17	63.94	3588.33	3652.27
Antihypertensive agents	7	0.55	2980.07	2980.62
Electrolyte supplementations	10	-4.40	1958.05	1953.66
Lipid lowering agents	5	-0.34	1235.35	1235.01
Acid suppressing agents	10	-0.23	1180.54	1180.31
Diuretic agents	2	-0.16	744.61	744.45
Antiepileptic agents	2	24.16	278.87	303.03
Analgesic agents	1	0.06	247.45	247.51
Antiarrhythmic agents	3	-0.38	91.14	90.75
Antidiabetic agents	2	1.57	40.91	42.48
Laxative agents	4	1.70	25.62	27.32
Antiemesis agents	1	0.03	26.67	26.70
Inhaler agents	1	-1.91	25.74	23.83
Hematopoietic agents	1	0.00	22.08	22.08
Antiviral agents	4	2.98	2.41	5.39
Mucolytic agents	1	0.03	0.00	0.03

[a]Cost saving=Direct medical cost of initial therapy–Direct medical cost of new therapy. [b]Total saving=Cost saving+Cost avoidance. USD: United States Dollar

The interventions by clinical pharmacist in this study resulted in cost savings of 214.26 USD and cost avoidance of 21,697.35 USD. Until now, most of the studies in cost savings and cost avoidance for pharmacist's intervention were conducted in critical care setting,[8,9,22-24] so there is no comparative study in the context of internal medicine ward. However, this study presented the impact of pharmacists in cost savings/avoidance in the same way as previous studies such as the overall 432–263,500 USD cost saving in critical care setting per year,[23,24] 2266.05 USD in the net cost saved and avoided,[9] also the mean cost avoidance of €166 per pharmacist's intervention[20] and 875.60 USD per patient.[8] Several factors might account for the differences in total savings. First, we used 2 days as the period wherein that physician would detect DRP or change medication regimen if the pharmacist did not intervene. The other studies that used this duration were based on critical care settings,[9,13,14] which are apparently different from internal medicine setting. Second, disparity in the probability of ADE used. Most studies relied on estimates from the literature reviews, while some were based on Nesbit *et al*.[9,20,22] Finally, the total cost of potential ADE treatment in this study was calculated based on data from Songklanagarind hospital, while the cost of each ADE in other studies was set at 53 USD[9] or 7108.16–7561.18 USD.[23] Limitation of this study, first, there was the limitation of data collection to show the body mass index (BMI) of patient characteristics. We reported the patient's body weight instead of BMI. Second, the pharmacist's salary, the benefit versus cost ratio were not included in our study. We did not record the time of each intervention. Although in other studies, it was pointed out that majority of pharmacists' interventions in a university hospital setting took between 15 and 30 min to complete.[22,25] Third, we did not record the benefit of clinical outcome from the pharmacists' interventions such as decreased length of hospitalization which is one of major factors influencing the economic benefits to both hospital and patients. Moreover, this study was conducted in the context of internal medicine ward of a university teaching hospital, and with the special skills of pharmacist which might account for the higher or lower total saving from the pharmacist intervention. Hence, referencing or extrapolating the results from this study should be done with caution.

CONCLUSIONS

More than 50% of DRPs only had potential of harm but were not relevant for the given patient, the DRPs were detected and managed by clinical pharmacist before reach the patient. Dose adjustment and medication reconciliation were the major activities of the clinical pharmacists with regard to management of DRPs in the female internal medicine ward at Songklanagarind Hospital, Thailand. Clinical pharmacists play key roles as part of multidisciplinary care teams, and their intervention result in reduced incidence of DRPs, ADEs and cost of potential ADEs treatment.

CONFLICTS OF INTEREST

The authors declared that there is no conflicts of interest.

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