OPEN SUBMISSIONS

mhc MENTAL HEALTH CLINICIAN

ORIGINAL RESEARCH Open Access

Quantitative and economic analysis of clinical pharmacist interventions during rounds in an acute care psychiatric hospital

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How to cite: Gunterus A, Lopchuk S, Dunn C, Floyd R, Normandin B. Quantitative and economic analysis of clinical pharmacist interventions during rounds in an acute care psychiatric hospital. Ment Health Clin [Internet]. 2016;6(5):242-7. DOI: 10.9740/mhc.2016.09.242.

Abstract

Introduction: Clinical pharmacists have become an integral part of multidisciplinary medical teams, including in the area of psychiatry. Previous studies have shown that having pharmacists in multidisciplinary medical teams has led to improved medication use, reduction of adverse drug events, and improved patient outcomes. The purpose of this study is to conduct a quantitative and economic analysis of the impact of clinical pharmacist interventions during hospital rounds in an acute care psychiatric hospital setting.

Methods: This is a retrospective analysis of 200 clinical pharmacist interventions documented between September 2013 and September 2014. Clinical pharmacist interventions were classified into several categories and types. Only clinical pharmacist interventions made during multidisciplinary team rounds were included in the study. Descriptive statistics were used for the quantitative analysis of clinical pharmacist interventions. The acceptance rate was calculated. Only the accepted clinical interventions were included in the economic analysis. Economic outcome involved an assessment of cost saving and cost avoidance.

Results: The most frequent types of clinical pharmacist interventions were discontinuation of medications (38.5%), laboratory monitoring (26%), and medication order modification (13.5%). The most common reason for drug discontinuation was polypharmacy. Clinical pharmacist interventions were associated with a 92.5% acceptance rate. Two hundred clinical pharmacist interventions were associated with $6760.19 medication cost saving and $62 806.67 cost avoidance.

Discussion: Clinical pharmacist interventions during rounds in an acute care psychiatric hospital setting mostly involve medication order modification and laboratory monitoring. They are also associated with significant cost saving and cost avoidance.

Keywords: pharmacist intervention, acceptance rate, acute psychiatry, psychiatric hospital, cost saving, cost avoidance, psychiatric pharmacist, cost analysis

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Introduction

Clinical pharmacists have become an integral part of multidisciplinary treatment teams, including in the area of psychiatry. Polypharmacy is common among patients with psychiatric illnesses; the drugs involved often have narrow therapeutic indexes. Individuals diagnosed with mental illnesses often have medical comorbidities that put them at risk for drug–disease and drug–drug interactions.[1]

Furthermore, psychosocial problems and the lack of social support serve as major barriers to adherence in this patient population.[1] Saklad et al[2] found that the introduction of clinical pharmacy services in an acute adult psychiatric facility was associated with a significant decrease in the total number of drugs and number of antipsychotic drugs prescribed per patient. The clinical pharmacy services were also shown to reduce the readmission rate.[2]

In a study done by Lee et al[3] at a Veterans Affairs medical center, of the 600 pharmacist interventions (250 interventions in the inpatient setting, 250 interventions in the outpatient setting, and 100 interventions in the nursing home setting), dosage adjustment accounted for over 40% of the interventions. Acceptance rate of pharmacist interventions was 92.4%.[3] The total cost avoidance associated with 250 inpatient interventions was $264 363.[3] In another study by Mutnick et al[4] in an 849-bed acute care institution, 4050 pharmacist interventions resulted in a cost saving of $487 833 and avoidance of 371.9 hospital days, which was equivalent to $158 000 cost avoidance. The cost analysis study by Lada et al[5] done in an emergency department setting showed $1 029 776 in cost avoidance associated with 1393 clinical pharmacist interventions. These studies included interventions made by pharmacists regardless of their titles or board certification designations.

There have been very few studies to date exploring the cost savings and cost avoidance associated with clinical pharmacist interventions specifically in an acute care psychiatric hospital setting. Although pharmacist roles have been shown to improve medication use and maximize health outcomes, the limitation of monetary resources may have hindered expansion of pharmacy services in this setting.

The purpose of this study is to conduct a quantitative and economic analysis of the impact of clinical pharmacist interventions during hospital rounds in an acute care psychiatric hospital. This is the first study to date to assign cost saving and cost avoidance values to clinical pharmacist interventions in an inpatient psychiatric hospital setting and may add more evidence to further justify clinical pharmacist role in this setting.

Methods

Study Site

Sharp Mesa Vista Hospital (SMV) is a 149-bed inpatient psychiatric facility. As part of the Sharp HealthCare system based in San Diego, California, SMV is a privately operated psychiatric hospital serving the pediatric, adolescent, adult, and geriatric populations. Hospital rounding at SMV involves a collaborative, multidisciplinary approach. The multidisciplinary treatment team is comprised of various dedicated mental health care professionals and includes an attending psychiatrist, clinical pharmacist, nurse(s), social worker, nutritionist, psychologist, and recreation therapist. Additional hospital staff members may also be involved in rounds as well as residents and students (eg, pharmacy, psychology, medicine, psychiatry). The treatment teams round regularly in the mornings to address and individualize the medical and psychiatric care for their patients. Sharp Mesa Vista Hospital currently employs 1 clinical psychiatric pharmacy specialist and 2 clinical staff pharmacists who attend these rounds. Only the clinical psychiatric pharmacy specialist has the board-certified psychiatric pharmacist (BCPP) designation. Clinical pharmacists play a central role in the treatment teams by contributing their expertise through pharmacotherapeutic recommendations and by designing and monitoring treatment plans.

Study Design

This is a retrospective study of clinical pharmacist interventions at SMV. This study focuses on interventions made during rounds because the majority of clinical pharmacist interventions at SMV are presented and documented during hospital rounds.

Two hundred clinical pharmacist interventions documented between September 2013 and September 2014 were evaluated. As part of the standard of care, clinical interventions were presented directly to physicians during hospital rounds or through the messaging system. The interventions were then documented utilizing the clinical intervention entry form available on the SharpNET database, the internal network (intranet) at Sharp Healthcare system (San Diego, CA). Data entered into this form include patient name, visit number, hospital floor, category and type of intervention, physician name, and the medication involved. The physicians might respond directly during rounds or through the messaging system. These interventions were tracked in the pharmacy, and open interventions were reviewed within 7 days by either the clinical pharmacist or student to determine if the intervention had been addressed. Interventions were then classified into one of the following: accepted, rejected, N/A, or unknown. An intervention was considered to have been accepted if it was implemented within 1 week. If the physician clearly documented that the intervention was not accepted, then the intervention was classified as *rejected*. The intervention was classified as *unknown* if the patient was discharged prior to implementation of the recommendation and no clear documentation stating intervention was either accepted or rejected. Interventions that did not require outcomes to be accepted/rejected (ie,

TABLE 1: Intervention classes and types

Intervention Class	Intervention Type
Medication order modification	Increase dose/frequency
	Decrease dose/frequency
	Change duration of therapy
Initiation of medication	Untreated condition
Discontinuation of medication	Drug not indicated
	Polypharmacy
	Medication duplication
Therapeutic switch	Switch medication
Laboratory monitoring	Drug level monitoring
	Other laboratory request
Drug interaction	Drug–drug interaction
	Drug–disease interaction
Adverse drug event	Allergic reaction
	Adverse reaction
	Unintentional therapeutic overdose

educational items per request of providers) were classified as *N/A*.

Study data were collected utilizing an intervention report generated through prebuilt reporting tools available in the SharpNET database. At SMV, the clinical psychiatric pharmacy specialist and 2 other clinical pharmacists joined the rounds. In addition, all interventions made by students and residents were reviewed by the clinical pharmacists. We collected interventions documented by those pharmacists and their respective students and residents. We included interventions marked as either accepted or rejected in this study. Interventions closed as N/A or unknown were excluded.

Quantitative Analysis

Pharmacist interventions were classified into several intervention classes and were further subclassified into several intervention types as shown in Table 1. For example, an intervention that resulted in shorter antibiotic duration would be classified as *medication order modification* in the intervention class and further subclassified as *changing duration of therapy* in the intervention type. An intervention that resulted in discontinuation of nitrofurantoin in a patient without symptomatic urinary tract infection would be classified as *discontinuation of medication* in the intervention class and subclassified as *drug not indicated* in the intervention type. Descriptive statistics were used for the quantitative analysis of clinical pharmacist interventions. The overall physician acceptance rate of clinical pharmacist interventions during the study period was calculated by dividing the total number of accepted interventions by the total number of included clinical pharmacist interventions. The monthly physician acceptance rate of clinical pharmacist interventions was calculated per each calendar month of the study period similarly. The 1-sample *t* test was used to compare the mean monthly acceptance rate with a hypothesized acceptance rate of 90%. The 90% hypothesized acceptance rate was selected based on our clinical experience and literature.[3,7]

Cost Analysis

Economic analysis involved an assessment of cost saving and cost avoidance following the method described by Lee et al.[3] The cost saving analysis focused on medication-related cost saving associated with the following intervention classes: discontinuation/initiation of medication, therapeutic switch, and medication order modification. Laboratory monitoring, drug interaction, and adverse drug events that did not likely impact medication costs were not included in the cost saving analysis.

A primary cost saving was calculated by subtracting the original drug cost from the recommended drug cost. Original drug cost is the drug cost before the pharmacist intervention, and recommended drug cost is the drug cost after the pharmacist intervention. Drug cost was calculated by multiplying drug acquisition cost by the duration of therapy. If an intervention resulted in discontinuation of medication, then the original drug cost would be the cost of that discontinued medication and the recommended drug cost would be zero. However, if a particular intervention resulted in initiation of a new medication, the original drug cost would be zero and the recommended drug cost would be the cost of the new medication. A secondary cost saving analysis was also done by adding the associated cost for a pharmacist to process and fill the order (dispensing fee) and to make the recommendation (recommendation fee). If an intervention involved laboratory monitoring, a local laboratory fee schedule was used.

The cost avoidance analysis focused on interventions that might avoid or shorten duration of hospitalization. In this study, cost avoidance was calculated for the following classes of interventions: initiation of medication, laboratory monitoring, adverse drug event, and drug interaction. Cost avoidance was calculated by multiplying the length of stay avoided with a probability of harm and local bed cost per day at SMV. Probability of harm is a number from a scale of 0 to 1, representing the potential of a particular intervention to prevent harm. A score of 0 means a particular intervention is not likely to prevent harm whereas a score of 1 means there is a high likelihood that a harmful event would have occurred without the pharmacist's recommendation. The probability of harm number was obtained from Lee's study, and length of stay numbers were obtained from Medicare 2014 MS-DRG

TABLE 2: Cost saving and cost avoidance formula

Type of Analysis	Formula
Primary cost saving	Primary cost saving = recommended drug cost – original drug cost
	Drug cost = drug acquisition cost × duration of therapy
Secondary cost saving	Secondary cost saving = cost of recommended therapy – cost of original therapy
	Cost of recommended therapy = drugs cost + dispensing fee + recommendation fee
	Cost of original therapy = drug cost + dispensing fee
	Dispensing fee = average RPh salary at SMV × average time to dispense
	Recommendation fee = average RPh salary at SMV × average time to make a recommendation
Cost avoidance	Cost avoidance = length of stay avoided × probability of harm × bed cost per day

RPh = registered pharmacist; SMV = Sharp Mesa Vista Hospital.

table.[3,6] Unit-specific bed cost per day at SMV was used. Please see Table 2 for more details of cost saving and cost avoidance formula used in this study.

Results

A total of 273 pharmacist interventions were screened to reach a study goal of 200 clinical pharmacist interventions. A total of 73 interventions (27%) were excluded. Fifty-two interventions (19%) were excluded because they were marked as N/A or unknown, and 21 interventions (8%) were excluded because they did not fall into any intervention classes used in this study.

TABLE 3: Quantitative analysis results

Intervention Class and Type	Total
Discontinuation of medication	77
Drug not indicated	27
Medication duplication	16
Polypharmacy	34
Laboratory monitoring	52
Drug level monitoring	20
Other laboratory request	32
Medication order modification	27
Change duration of therapy	9
Decrease dose/frequency	11
Increase dose/frequency	7
Initiation of medication	25
Untreated condition	25
Drug Interaction	10
Drug–disease interaction	6
Drug–drug interaction	4
Therapeutic switch	5
Switch medication	5
Adverse drug event	4
Adverse reaction	4
Grand total	200

Table 3 shows the distribution of the 200 clinical pharmacist interventions by intervention class and type. The majority of clinical pharmacist interventions involved discontinuation of medication (n = 77, 38.5%), followed by laboratory monitoring (n = 52, 26%), medication order modification (n = 27, 13.5%), and initiation of medication (n = 25, 12.5%). The most common reason for medication discontinuation was polypharmacy. More laboratory monitoring involved other laboratory requests than drug level monitoring (eg, basic metabolic panel, urinalysis). We did not detect any adverse drug events due to allergic reaction or unintentional therapeutic overdose in this study.

Out of 200 clinical pharmacist interventions included in the study, 15 interventions were rejected, making the overall acceptance rate 92.5%. Most rejected interventions involved recommendation to initiate a medication. The mean of the 12 monthly acceptance rates was 91% (range: 75% to 100%) with a 95% confidence interval of 84% to 98%. As one would expect, the mean monthly acceptance rate of 91% did not significantly differ from the hypothesized rate of 90% ($P = .74$, $t = 0.34$, $df = 11$).

The result of the cost saving analysis is summarized in Table 4. Discontinuation of medication accounted for the majority of clinical pharmacist interventions and was associated with medication cost saving of $5678.82. In the primary cost saving analysis, total medication cost saving associated with 134 clinical pharmacist interventions was $6760.19. In the secondary cost saving analysis, after taking dispensing and recommendation fees into account, total cost saving went down to $6310.69.

Table 5 shows the result of cost avoidance analysis. Ninety-one clinical pharmacist interventions were associated with avoidance of 199 hospital days and cost avoidance of $62 806.67. Although laboratory monitoring was associated with additional laboratory cost of $1078.09, laboratory monitoring accounted for the majority of projected cost avoidance ($39 567.64).

TABLE 4: Cost saving results (n = 134)[a]

Intervention	Number of Interventions	Primary Cost Saving[b]	Secondary Cost Saving[c]
Discontinuation of medication	77	$5678.82	$5595.92
Initiation of medication	25	$–547.46[d]	$–748.86[d]
Medication order modification	27	$1569.09	$1433.39
Therapeutic switch	5	$59.74	$30.24
Total	134	$6760.19	$6310.69

[a]Only medication-related cost saving was calculated. Laboratory monitoring, drug interaction, and adverse drug events that did not likely impact medication costs were not included in our cost saving analysis.

[b]Primary cost saving involved only drug cost.

[c]Secondary cost saving involved dispensing and recommendation fees.

[d]Initiation of medication resulted in additional drug cost, hence less cost saving.

Discussion

Discontinuation of medication and laboratory monitoring accounted for the majority of clinical pharmacist interventions in this study (n = 129, 64.5%). This is consistent with a study done by Alderman,[7] who, during a 6-month study period in an acute psychiatric inpatient unit, documented a total of 204 clinical pharmacist interventions. The most common types of interventions included initiation of therapy, alteration to patient monitoring, and discontinuation of therapy.[7] This result supports the clinical pharmacist's role in optimizing dose and drug selection as well as monitoring serum drug concentration and other laboratory values.

The overall acceptance rate of clinical pharmacist interventions (92.5%) in this study is similar to rates reported in the literature. In the study conducted by Lee et al,[3] the acceptance rate observed across 600 clinical pharmacist interventions was 92.4%. Additionally, in the study by Alderman,[7] the acceptance rate was 91.7% for the 204 pharmacist interventions. Furthermore, the mean monthly acceptance rate for clinical pharmacist interventions in this study did not differ statistically from a hypothetical rate of 90%. This is consistent with the foregoing performance noted in the literature and attainable, on the average, by the clinical pharmacists at SMV. However, out of the initially screened 273 interventions, 73 interventions (27%) were excluded; this might have caused a sampling bias in this study.

The cost saving value in this study is lower than others reported in the literature. In this study, only medication-related cost saving was calculated. Laboratory monitoring, drug interaction, and adverse drug events that did not likely impact medication costs were not included in the cost saving analysis. The exclusion of those interventions might underestimate the cost saving value and served as a limitation for this study.

The cost avoidance value in this study is also lower than ones reported in the literature. This is due to the conservative method used in this study. Medication order modification, discontinuation of medication, and therapeutic switches would more likely impact medication costs and hence were included in the cost saving analysis but excluded from the cost avoidance analysis. Furthermore, the use of subjective probability values lowered the cost avoidance values by approximately 50%, and those probability values were yet to be validated. Although medication discontinuation made up the majority of clinical interventions in this study, it was not included in

TABLE 5: Cost avoidance results (n = 91)[a]

Intervention	Number of Interventions	Probability of Harm[3]	Cost Avoidance
Initiation of medication	25	0.47	$12 412.75
Laboratory monitoring	52	0.47	$39 567.64
Drug interaction	10	0.54	$8893.80
Adverse drug event	4	0.44	$1932.48
Total	91		$62 806.67

[a]We calculated cost avoidance associated with avoidance of length of stay in the hospital. Medication order modification, discontinuation of medication, and therapeutic switches will more likely impact medication costs and, hence, were included in the cost saving analysis but excluded from the cost avoidance analysis.

the cost avoidance analysis. The cost avoidance value reported in this study is conservative and may well be higher than reported. The use of unvalidated probability values also served as a limitation to this study.

This study reviewed the interventions made by clinical pharmacists during hospital rounds. However, cost saving and cost avoidance values might be underestimated due to small sample size and exclusion of some interventions from the cost analysis. Being a retrospective study, the data collected in this study was limited to the interventions documented in the SharpNET database. Thus, this study was not able to capture undocumented interventions. In addition, the clinical intervention form did not require providers to respond directly to the intervention, resulting in more difficult follow-up and consequently more interventions classified as unknown.

This study was not limited to interventions made by BCPP-designated pharmacists. Considering the higher degree of clinical expertise, interventions made by clinical pharmacists with BCPP designation might be associated with higher cost saving and cost avoidance values; this needs to be further studied. A return of investment analysis and expansion of cost analysis to other clinical pharmacist interventions outside hospital rounds could further justify the value of clinical pharmacy services in the acute psychiatric hospital setting, and these too require further investigation.

Conclusion

The majority of clinical pharmacist interventions during rounds were associated with medication order modification and laboratory monitoring, supporting the pharmacist's role in optimizing dose and drug selection as well as monitoring serum drug level and other laboratory values. Two hundred clinical pharmacist interventions in an acute care psychiatric hospital setting were associated with $6760.19 medication cost saving and $62 806.67 cost avoidance. The cost saving and cost avoidance values might be underestimated due to the conservative methods used in this study. A return of investment analysis or expansion of the cost analysis to other interventions outside hospital rounds may further justify the value of clinical pharmacists in an inpatient psychiatric hospital setting; these need to be further studied.

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