

Short Communication

Clinical and economic impact of comprehensive medication management implementation by clinical pharmacists in an intensive care unit: a cost–benefit analysis

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Received May 3, 2021; Accepted May 6, 2021.

Abstract

Objectives Critically ill patients are at risk of drug-related problems (DRPs) and healthcare-related cost. Clinical pharmacists are specifically trained in pharmacotherapy evaluation; they can identify and prevent DRPs. We aim to evaluate clinical and economic impact of clinical pharmacist by cost–benefit analysis in intensive care unit.

Methods This was a prospective, interventional study from healthcare provider perspective which conducted over 6 months in a neurosurgery intensive care unit (ICU) of a university hospital on 162 patients. A clinical pharmacist was dedicated to implement comprehensive medication management. All pharmacotherapy problems were categorized and economic impact of clinical pharmacist's interventions including cost–benefit ratio and net benefit in the ICU was assessed.

Key findings A total of 1524 interventions were done. The top five pharmacotherapy-related problems were defined as, drug selection (33.3%), dose adjustment (17.32%), fluid and electrolyte management (12.99%), drug discontinuation (12.07%) and therapeutic drug monitoring (6.75%). The minimum and maximum benefit–cost ratio was 8.4:1 to 12.7:1 and net benefit was \$169,205 to \$266,633, respectively over the 6-month period.

Conclusions The participation of a clinical pharmacist in a multidisciplinary ICU team by implementation of comprehensive medication management may reduce healthcare expenditures and improve drug safety.

Keywords: clinical pharmacy; cost–benefit analysis; intensive care unit; drug-related problems; comprehensive medication management

Introduction

Global healthcare cost is increasing at an unstable rate, particularly spending on medicines and managing drug-related problems (DRPs) are constantly growing. There is a reasonable opportunity for clinical pharmacists to have a significant impact on reducing healthcare costs, since they have the expertise to identify, resolve and prevent medication errors and DRPs.^[1]

Economic evaluations of clinical pharmacy services will help policy makers make informed decisions on whether they are a worthwhile investment. This study aims to evaluate clinical interventions and economic impact of clinical pharmacists in a neurocritical care unit.

Methods

This was a prospective study in a 6-month period from October 2019 to April 2020 in a neurocritical care unit of a university hospital in Tehran. A dedicated clinical pharmacist visited all the patients who stayed at least 24 h in the ICU after obtaining written consent from patient or family, then interventions recorded on a pharmacotherapy form which was appraised by two expert clinical pharmacists.

Clinical analysis

Patients' medication therapy reviewed according to the Comprehensive Medication Management (CMM) program. CMM is defined as the standard of care that ensures each patient's medication is appropriate, safe and effective for the medical condition given the comorbidities and other medications. We made a collaborative practice agreement between clinical pharmacists and physicians which permitted the clinical pharmacist to assume professional responsibility for performing patient's medication assessments.^[2]

Economic analysis

Cost-benefit analysis (CBA) was performed to estimate the economic impact of the clinical pharmacist intervention from provider perspective.

Cost was defined as the expenses of clinical pharmacist time which included time for pharmacotherapy evaluation, intervention, monitoring and education; we used the average monthly salary.

Benefit was estimated through the total financial consequences of the intervention which calculated as the sum of the cost savings and the cost avoidance associated with the interventions.

Cost saving

It is obtained by reducing direct cost, including cessation of unnecessary medication or changing it to less expensive medicine and reduction in length of stay by clinical pharmacist intervention which collected through the information system of the hospital's pharmacy.

Cost avoidance

It was the cost avoided by eliminating the occurrence of adverse drug event (ADE) because of the clinical pharmacist interventions.

According to the method of Nesbit *et al.*^[3] utilizing an expert panel of three specialist clinical pharmacists and an expert neurosurgeon under supervision of two pharmacoeconomic specialists, the likelihood of ADEs in the absence of the interventions was investigated.

For the intervention with the potential to prevent an ADE, cost avoidance was calculated by multiplying the probability of an ADE in the absence of the intervention (calculated via the Nesbit method) by the cost of an ADE. The overall cost avoidance was the sum of avoided cost with all interventions.

This study utilized a range of previously published ADE costs estimates from other studies (range: \$272–\$6486) adjusted to present value considering inflation rate, alongside a deep discussion within the panel to justify the cost of ADE based on the situation in Iran.^[4–8]

Sensitivity analyses were conducted for the cost of the ADE as the result of the discussion in the panel as a range of minimum to maximum cost.

Cost-benefit analysis

The benefit-to-cost ratio was the sum of cost savings and cost avoidance divided by cost of the clinical pharmacy service. The net benefit of the intervention was the sum of cost savings and cost avoidance minus cost of the interventions.

Results

In this study 162 patients were followed up by clinical pharmacists and 1524 interventions were done.

Sixty-nine (42.59%) patients were female and 93 were male (57.40%). Most prevalent diagnosis was brain tumour and intracerebral haemorrhage, respectively. Type and frequency of pharmacotherapy interventions are given in [Table 1](#).

Medication reconciliation was applicable for 67.9% of patients and 38.8% of patients received at least one nutritional recommendation; finally 96.5% of the clinical pharmacist's interventions was accepted by the medical team.

Economic analysis

Overall cost avoidance in a range of \$115,365–\$212,793 was generated over a 6-month period from the perspective of the healthcare provider.

Mean cost avoidance was in a range of \$75.69–\$139.62 per intervention. The cost of providing these interventions was \$22,800. Substantial net cost benefits of \$169,205–\$266,633 and

Table 1 Type and frequency of pharmacotherapy interventions

Type of clinical pharmacist interventions	No (%)
1. Drug selection	508 (33.33%)
2. Dose adjustment	264 (17.32%)
3. Fluid and electrolyte management	198 (12.99%)
4. Drug discontinuation	184 (12.07%)
5. TDM	103 (6.75%)
6. IV to Oral switching	88 (5.77%)
7. Medication error management (including drug interaction, prescription errors, etc.)	55 (3.6%)
8. Side effect management	49 (3.21%)
9. Glycaemic control	43 (2.82%)
10. PAD	32 (2.09%)
Total	1524 (100%)
Acceptance rate	1472 (96.58%)

IV, intravenous; PAD, pain, agitation and delirium; TDM, therapeutic drug monitoring.

Table 2 Cost–benefit analysis of clinical pharmacist interventions (over 6 months)

1. Cost of service (monthly)	\$3,800	Total: \$22,800
2. Cost saving	\$76,640	
3. Cost avoidance	Min: \$115,365	Max: \$212,793
4. Benefit–cost ratio: 2 + 3/1	Min: 8.4:1	Max: 12.7:1
5. Net benefit: (2 + 3)-1	Min: \$169,205	Max: \$266,633

a benefit–cost ratio of 8.4:1–12.7:1 were generated based on this evaluation of clinical pharmacist interventions (Table 2).

Discussion

The results of this study demonstrated that presence of a clinical pharmacist may improve drug safety and favourable outcome in economic areas, including a high return on investment and substantial net cost benefits in a range of \$169,205–\$266,633 and a benefit–cost ratio of 8.4:1–12.7:1 over 6 months which justifying the incorporation of clinical pharmacists in neurocritical care unit.

The economic aspects of having a clinical pharmacist in adult ICUs have been evaluated in previous studies.^[8, 9]

The benefit–cost ratio is a documented mean of expressing the expected monetary gains from provision of clinical pharmacy service in relation to the cost of that investment.^[10] The benefit–cost ratio in this study was in a range of 8.4:1–12.7:1 over 6 months.

Limitations

This study has some limitations. Since ADEs' costs have not been measured in Iran, we calculated cost avoidance based on other countries' studies, followed by a deep discussion through panel justifying the cost within a range based on the situation in Iran. The study was identified as a CBA because outcomes were valued in monetary units as cost savings and cost avoidance, but intangibles and indirect costs were not included.

The generalizability of pharmacoeconomic analysis is uncertain. Calculation of cost avoidance will have inter-study variations in the cost assigned to an ADE, healthcare settings, methodologies, duration of study and number of clinical pharmacists.

Conclusion

Enrollment of clinical pharmacists in the multi-disciplinary medical team may reduce the cost of health system and implementation of CMM program can decrease the rate of DRPs by pharmacotherapy evaluation.

Funding

No funding was received to assist with the preparation of this manuscript.

Conflict of Interest

All authors declare that they have no conflict of interests.

Ethics Approval

Ethics approval was obtained before the commencement of the research from the ethics committee of Tehran University of medical sciences Faculty of Pharmacy (Ethics Code: IR.TUMS.TIPS.REC.1398.159).

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