ASIAN JOURNAL OF PHARMACEUTICAL AND CLINICAL RESEARCH

INNOVARE ACADEMIC SCIENCES
Knowledge to Innovation

Vol 14, Issue 10, 2021

Online - 2455-3891
Print - 0974-2441

Research Article

REDUCTIONS IN MEDICATION WASTAGE AND COSTS IN A PEDIATRIC INTENSIVE CARE UNIT BY CHANGING THE ORDER ENTRY SYSTEM

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Received: 23 June 2021, Revised and Accepted: 10 September 2021

ABSTRACT

Objective: The intensive care unit (ICU) drug therapies have a significant impact on hospital costs, and reducing these costs has become a critical concern for hospitals. In this study, the researchers tested the theory on whether changing the ordering system of medications in the pediatric ICU (PICU)[1], reduces drug wastage so that the nurse can request a fraction of one vial or ampule. More precisely, the study aimed to reduce the medication cost and wastage in our pediatric center.

Methods: This study was conducted in the 16-bed PICU of Imam Hossein Hospital, which is a referral tertiary care teaching pediatric hospital with 185 beds in ten wards. A fractional ordering alternative was added to the hospital information system of the PICU of the pediatric hospital. Nurses were taught by the hospital pharmacist to understand the new way of ordering the drugs. Several highly used drugs were chosen for the intervention. The data were analyzed by an independent sample t-test using SPSS software.

Results: Based on the results, changing the method of requesting medications for PICU patients and the random checking of floor stocks and the expired drugs in PICU reduced the number and cost of all medications.

Conclusion: Overall, the collaboration of nurses and pharmacists can lead to cost savings in hospitals.

Keywords: Hospital, Medication, Pharmacists.

 DOI: http://dx.doi.org/10.22159/ajpcr.2021v14i10.42577. Journal homepage: https://innovareacademics.in/journals/index.php/ajpcr

INTRODUCTION

The intensive care unit (ICU) drug therapies have a significant impact on hospital costs [1], and reducing these costs has changed into a vital concern for hospitals. Accordingly, multidisciplinary collaboration programs are necessary for optimizing ICU pharmacotherapy. Clinical and hospital pharmacists in hospitals are also considered as implementing methods for reducing the cost of drug therapy while maintaining safety and efficacy.

In the pediatric ICU (PICU) of Imam Hossein Children's Hospital, the nurses were requesting the full amount of a vial because the hospital information system (HIS) did not allow the request of less than one vial. Nonetheless, a half or a quarter of one vial was practically used for one patient. Although the remaining amount of medicine in the vial would have been applied if required for another patient, it was not a predicted and systematic service. The previous evidence indicated that there are non-standard vials and more than the allowable amount of unused ones in the PICU stock. Unfortunately, the majority of such vials were never used and discarded by the nurses. This dumping of drugs imposes various costs on the hospital, leading to an increase in hospital costs.

In this study, the researchers tested the theory on whether changing the ordering system of medications in the PICU, reduces the drug cost and wastage in a way that the nurse can request a fraction of one vial or ampule.

METHODS

Imam Hossein Hospital, Isfahan, Iran is a referral tertiary care teaching pediatric health center with 185 beds in ten wards, and this study was conducted in the 16-bed PICU of the above-mentioned hospital.

1. Pediatric Intensive Care Unit

The PICU was selected for the intervention considering its importance in this pediatric center with ten other wards, and the applied medications by this unit include 25% of hospital costs on average.

Intervention

A fractional ordering option was added to the HIS (Pooya Samaneh Diva Company, Sari, Iran). In addition, several highly used drugs were chosen for the intervention. It should be noted that these drugs had the most surplus and wastage due to the primary assessments of the pharmacist in random checks in the PICU. Therefore, it was considered for the selection of these drugs. The drugs were pantoprazole 40 mg vial, heparin 1000 unit ampule, NaCl 5% boxter, KCl 15% boxter, ampicillin 500 mg vial, aminoacid 10% infant boxter, intralipid 20% boxter, phenobarbital 200 mg ampule, acetaminophen 1 g ampule and vancomycin 500 mg vial.

A part-time pharmacist was assigned to the ICU for 4 months to educate the nurses, who were taught by the hospital pharmacist to understand the new way of ordering the drugs. Further, nurses found that some multiple-dose drugs or drugs with large doses should be shared between patients and they cannot discard them in this new approach. This new ordering system was named the fractional system of ordering medications. In this new system, the nurse could order a fraction of the drug rather than a full vial or ampule. It is noteworthy that educating the nurses was a continuous process while not being limited to one or two session(s), and the hospital pharmacist daily followed the track of the ordering pattern of nurses.

The drug usage data during 2019–2020 were extracted by the HIS and then compared with those of 2018–2019 when there was no fractional system implementation. Moreover, the hospital pharmacist

gathered the data of the expired drugs during 1 year before and after the intervention.

The following formula was used for calculating the percentage of reductions in the number and cost of each drug before and after the intervention:

The cost or number of drugs per patient admitted before the intervention - the cost or number of drugs per patient admitted after the intervention/The cost or number of drugs per patient admitted before the intervention * 100

The data were analyzed with SPSS software. The percentage of reductions in the cost and number of drugs per bed, as well as the p-value for comparing the number and cost of PICU drugs per bed, before and after the intervention, was calculated by an independent sample t-test.

RESULTS

In general, 1050 and 1080 patients were admitted in 2019–2020 and 2018–2019, respectively. As shown in Table 1, the entire number and cost of the selected drugs per admitted patient reduced after the intervention.

Although the number and cost of the applied medications in the PICU of Imam Hossein Hospital reduced with the intervention, this reduction was not statistically significant. An independent sample t-test was performed on the data of all drugs. The p-values for changes in the number of drugs per patient admitted and the cost were 0.86 and 0.87, respectively.

Fig. 1 shows changes in the number of applied medications in a year per admitted patient before and after the intervention. The number of all applied drugs per patient has reduced after the intervention except for heparin.

The changes in the cost of the used medications in a year per admitted patient before and after the intervention are depicted in Fig. 2 (Prices are calculated in rials).

The percentage of medication number and cost reduction due to the intervention is summarized in Table 2.

In addition to these results, the cost of the expired drugs was lowered by 13562360 rials in 1 year. It was further found that the expired drugs were completely eliminated due to a rotation of drug stocks and the regular monitoring of expiration dates. Thus, reducing floor stocks by this system and random checking by the hospital pharmacist can effectively reduce expired drugs.

DISCUSSION

Based on the findings of our study, changing the way of requesting medications for PICU patients and the random checking of floor stocks and expired drugs in PICU reduced the number and cost of all medications. Moreover, minimizing prescription costs while maintaining quality is a core element of delivering high-value healthcare.

There are various strategies to achieve savings although, no research, to the best of our knowledge, has so far focused on determining the most effective approach in this regard. Therefore, finding a way to reduce costs in PICU will lead to cost savings and reduce the problems associated with drug storage. Several methods exist for decreasing the costs and wastage of medications in hospitals. For example, one of the most effective ways is to warn when prescribing expensive drugs in computerized provider order entry systems, which could reduce drug costs in some studies [2,3].

In one study aiming at reducing hospital costs, a computer-assisted drug medication alert system was used to alert physicians to several expensive drugs when requesting medication and announce prices, reducing hospital costs [4]. Although using a computer system reduces common drug errors, new errors are simultaneously created using this method. Duplicate orders, unit errors, the use of free text, parameterization flaws, and poor usability of software are probably the root of many prescribing errors [5,6]. The results of a similar study revealed that changing the computerized ordering system could significantly reduce costs [7].

Another study found that changes in the cancer drug ordering system decreased both error and drug wastage rates. Overall, the safety of their parenteral chemotherapy ordering processes within their electronic health records improved after the implementation of automated dose-banding. By standardizing the administered doses for three chemotherapy agents, they were also able to increase total drug savings and associated drug cost savings [8].

Table 1: The cost and number of all medications per patient before and after the intervention and the reduction percentage

Medication usage/cost	Before intervention	After intervention	Percentage of reduction
Number of used medications per patient	19.70	17.62	10.55
Cost of used medications per patient (Rials)	1488040	1330567	10.58

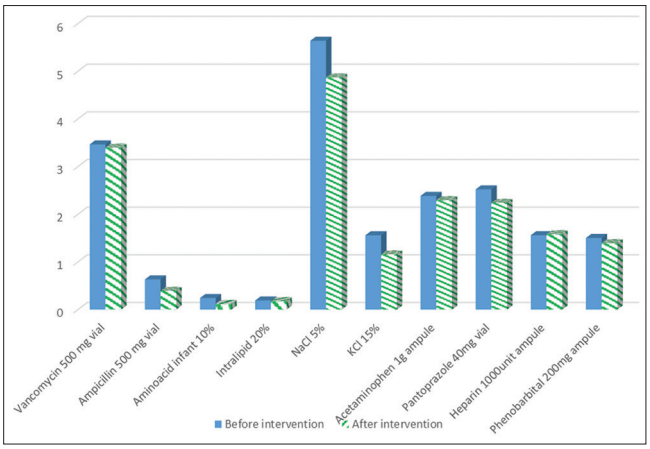

Fig. 1: Changes in the number of the applied medications in a year per admitted patient before and after the intervention

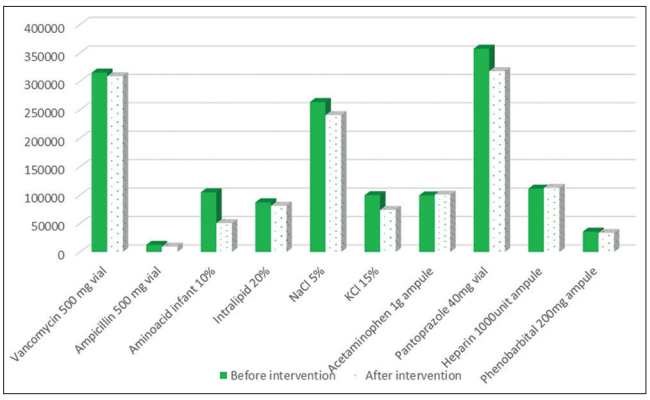

Fig. 2: Changes in the cost of the applied medications in a year per admitted patient before an after the intervention. Prices are computed in rials

Table 2: Percentage of medication number and cost reduction with the intervention

Medication name	Percentage of reductions in the number per patient with intervention	Percentage of reductions in costs per patient with intervention
Vancomycin 500 mg vial	1.98	1.97
Ampicillin 500 mg vial	38.11	25.40
Aminoacid infant 10%	51.02	51.60
Intralipid 20%	7.41	6.90
NaCl 5%	13.65	8.73
KCl 15%	25.84	25.84
Acetaminophen 1 g ampule	3.82	-1.41
Pantoprazole 40 mg vial	11.18	11.04
Heparin 1000 unit ampule	−1.22	−1.21
Phenobarbital 200 mg ampule	7.22	6.45

NaCl: Sodium chloride; KCl: Potassium chloride

The problem of wasting and not using drugs in children's hospitals is not unique to our hospital and has been reported in other studies as well. For example, one study measured the number of surplus drugs in the pediatric ward. The study aimed to determine the amount of unused intravenous and intramuscular drugs and the financial burden that these drugs impose on the system. The total wastage cost/total drug cost ratio was 0.495, meaning that about half of the drugs are wasted, it was concluded that appropriate formulations for the pediatric population should be developed if commercial intramuscular and intravenous drugs are used by the pediatric population. The production of multiple-dose formulations by pharmaceutical companies will also be helpful in this regard. Finally, reducing drug wastage will automatically decrease drug costs [9].

One similar study assessed the reasons for antibiotic wastage in a pediatric hospital and reported patient discharge, medication order discontinuation or change, and misplaced doses as the main reasons for antibiotic wastage. In addition, meropenem, micafungin, and amphotericin B liposomal were among the antibiotics with the highest wasted costs. To reduce this drug waste and hospital costs, they proposed four process improvement measures [10]. Based on the results of a study regarding pediatric anesthesia care for determining the cost of the used drugs without documentation, the uncontrolled availability of drugs in floor stocks and their undocumented use were important causes of increasing drug costs and wastage [11]. In a 17-month study in Texas Children Hospital, medication errors reduced after the implementation of the workflow management system and led to significant decreases in cost and wastage [12].

According to Weinger [13], the incomplete use of vials and syringes of anesthetic drugs was the reason for an increase in the cost of routine anesthesia care. In another study, the technique of drug pooling and unit dose dispensing for antibiotics was used to reduce the waste of antibiotics in a hospital, and this technique was able to reduce drug costs [14]. To reduce the cost of medication and the waste of anticancer drugs, in one study, the calculated dose was rounded upward to the full next vial if the calculated dose exceeded above 50% of the next appropriate vial strength while it was rounded downward to the full previous vial if the calculated dose did not exceed above 50% of the next appropriate vial strength. This reduced drug costs without reducing effectiveness [15].

According to Hess, pharmacists and physicians have an important role in reducing drug wastage and costs by optimizing vial combination and sharing among patients [16]. The results of a study in a hospital in Kualampur showed that the deterioration of a patient's clinical conditions is the most important cause of returned parental chemotherapy regimens and wastage [17].

Based on the findings of a 6-week study in the operation room of a hospital, drug wastage and cost could be controlled by the behavioral changes of physicians, the preparation of standard doses from single-dose preparations, and cost training programs [18]. As shown by previous research, the pharmacist has a critical role in drug-related problem monitoring and cost savings in hospitals [19].

Many studies have shown the effectiveness of the presence of a pharmacist or a clinical pharmacist in hospitals using a computer system to request medication for reducing medication errors and hospital costs [20-25]. The findings of one study demonstrated the effectiveness of the presence of a clinical pharmacist in reducing medication errors when using a computer system [26]. The results of a systematic review and meta-analysis on the cost-effectiveness of entering a pharmacist in the clinical wards of the hospital represented that it is effective in improving drug treatment and it is a cost-effective process [27]. In another study, the consultation of pharmacists with physicians reduced the number and cost of antipsychotic medications [28]. Pharmacist's interventions in the ICU of a Malaysian hospital resulted in significant cost savings in terms of drug expenses [29].

As mentioned in another study, the pharmacist can significantly contribute to cost savings and a clinical pharmacist is an important and cost-effective member of the PICU team [30].

CONCLUSIONS

In this single-center before-after study, the new ordering system (fractional ordering) reduced costs in the PICU. The implementation of new ordering systems and the collaboration of pharmacists with nurses can reduce drug costs in hospitals. The application of this approach for managing medications in the ICU may improve efficiency, outcomes, and the cost of care for critically ill patients.

ACKNOWLEDGMENTS

We would like to thank the nurses who took part in the project. In addition, we are thankful to the IT manager of the hospital, Mrs. Zahra Abtahi who helped us in performing the new Order Entry System.

AUTHORS' CONTRIBUTIONS

Dr. Zahra Allameh was involved in planning the study and writing the manuscript. Dr. Iman Khorshidi-malahmadi collected and analyzed the data and reviewed the manuscript. Dr. Setareh Sima assisted in collecting data and editing the manuscript.

CONFLICTS OF INTEREST

The authors affirm no conflicts of interest, finance, or otherwise.

FUNDING

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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