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Optimization of Health Transformation Plan by Drug Utilization Review Strategy in a Pediatric Teaching Hospital

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Abstract

Background: Health transformation plan was implemented in 2014 in Iran with the aim of reducing healthcare expenditures. Transformation plans always have a financial impact on healthcare expenditures because of potential to increase the utilization. Drug utilization review is one of the effective solutions to explore consumption and improve rational use. This study aimed to evaluate the medicine utilization after health transformation with implementation of an evidence-based protocol in a tertiary hospital.

Materials and Methods: This is a before-after study which was conducted in a tertiary children's hospital with 400 beds in Iran. At first, costly medications were identified by ABC analysis in drug and therapeutic committee meetings of the hospital. Increased use of these medications was measured after the implementation of the health transformation plan. Then, the pattern of prescription, its appropriateness and impact of protocol implementation on the health expenditures reduction and rational use was evaluated.

Results: Initial estimation of the usage showed that before protocol implementation, in six-month, albumin, pantoprazole, and Apotel® increased by 31.9%, 22.6%, and 21.9%, respectively following the health transformation plan. Medical records of 6,554 patients were evaluated for target medications. The frequency of inappropriate prescription reduced significantly from the first to the second phase for albumin (65.5%-35.8%, P=0.001), pantoprazole (58.9%-22%, P<0.001), and Apotel® (66%-17%, P<0.001), respectively. Health expenditures also reduced significantly for albumin (P=0.003), pantoprazole (P=0.001) and acetaminophen (P<0.001), respectively.

Conclusion

Timely implementation of medication prescription protocols can provide health benefits to patients and cost savings to the health service provider that could lead the health transformation plan to reach the aim of reduction in health expenditures with rational use.

Key Words: Cost reduction, Drug Utilization Review, Health Care Reform, Protocol implementation.

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1- INTRODUCTION

Health transformation plans are assessed to ensure access to needed healthcare services; improve the quality of healthcare and its outcomes; allocate an "appropriate" level of public sector and economy-wide resources to healthcare; and ensure that services are provided in a cost-efficient and cost-effective manner. Following the implementation of health transformation plan in Iran in 2014, controlling costs and assuring the quality of health services has become a very serious issue. Generally, in low- and middle-income countries, every dollar saved and wise purchases, make for better use of the limited available resources (1). Likewise, one of the aims of health transformation plan in Iran was to reduce out-of-pocket expenditures, so consideration of appropriate medication use may help to achieve this goal. According to other countries experiences, the reform plans in the healthcare policy always have animpact on the drug utilization because of the potential to increase the availability of health services to patients (2-4). Also, studies which were done in Iran after the health transformation plan suggested this increase in medication usage (5-7). The drug utilization reviews (DUR), and constructed practice protocols are two available methods to supervise the proper consumption of limited resources (8). The DUR is a continuous, systematic procedure designed to maintain the appropriate and effective use of medications (9). High priority areas for this type of study include high-volume medication use, expensive medications or medications used for off-label or controversial indications (10). There are previous studies in this regard in our country that assess the implementation of practice protocols to increase rational use of medication (11-16), but there is no specific strategy for implementing the clinical practice protocols. In this study, we designed a DUR model to develop and implement protocols to examine the influence of them on decreasing inappropriate use and consequently direct medication expenditures in a tertiary referral hospital. We implement the protocols that resulted from designed strategy for three costly medications in a pediatric referral hospital and report the results of this intervention.

1-1. Aim of the study

Briefly, dedicated goals of this study were optimization of healthcare expenditures and improving the rational administration of medications after health transformation plan by Drug Utilization Review strategy.

2- MATERIALS AND METHODS

2-1. Study design

A before and after DUR study was performed at inpatient wards of Children's Medical Center Hospital, Tehran, Iran from March 2016 to March 2017. This hospital is a general teaching hospital with 20 wards and 400 beds with most medical specialties, affiliated to Tehran University of Medical Sciences.

2-2. Population

The study population included neonates and children up to 12 years old (based on the American Academy of Pediatrics age limit (17) admitted to this center for whom target medications were prescribed during their hospital stay.

2-3. Drug selection

To identify the medication to be studied, utilization data on medications that were on the hospital's formulary list from the hospital information system (HIS) were collected. Then the raw data obtained from the preliminary report were analyzed by ABC method (18). After specifying the costly medications, the results were submitted to the drug and therapeutic (D&T) committee, and members analyzed the data. The medications that were

targeted for protocol implementation were human albumin 20% vial, pantoprazole 40 mg vial, and acetaminophen 1g ampoule (Apotel®). These three medications were among the top ten costly medications of hospital during the study period.

2-4. Protocol development and study phases

In the first study phase, before implementation of protocols, patterns of prescriptions over 6 months were analyzed. According to evidence-based guidelines, prescriptions appropriateness was evaluated. The results were reported to D&T committee members and then an expert panel of different specialists (including general pediatricians, gastroenterologist, heart surgeons, neurologists, neonatologists, and clinical pharmacists) was formed to choose updated international consensus guidelines in the literature that best matched local conditions for the above-mentioned medications. Prescription protocols were developed accordingly for these medications.

All of these reports were sent to all residents, other physicians and nurses who were involved in the administration of these medications in all wards of hospital in order to receive comments from them before finalizing the prepared protocols. These comments were reviewed by a clinical pharmacist and approved by the D&T committee of hospital in order to have permission to implement protocols in hospital. In the second study phase, designed intervention was implemented according to protocols over the next 6 months. When the prescription indication was in accordance with the protocol, treatment continued, and when it was not, physician-pharmacist collaboration decided whether to stop or continue the treatment. Analysis and reporting of healthcare cost reductions resulting from the implementation of the protocol followed. To maximize physicians' adherence to the protocols, several strategies including the application of a computerized decision support program according to order protocols, periodic audit and feedback-based on one-on-one consulting, telephone calls and interactive educational meetings were performed. All steps of the method for DUR strategy of used implementation were explained in **Figure.1**.

2-5. Data collection and analysis

During the hospitalization, if the patient received medications more than one time with different indications, the information about each session was recorded separately. But if the patient received medication several times with similar indications, the information was recorded only once. The following data were collected: baseline characteristics, sex of patients, prescription patterns and indications for administration, daily dose, the overall number of patients taking the medication, the overall number of vials used, the number of patients taking the medication on each ward, the number of vials used on each ward, expenditure of each ward on medication use, the overall number of hospitalized patients, laboratory test results (serum albumin and total protein). All data were collected before and after implementation of protocols in the way of a pre-prepared form by the researcher.

2-6. Calculating costs

To calculate the cost of medication, only the cost paid per unit was utilized. Indirect and intangible costs associated with the use of these costly medications were not included. The data of the Central Bank of the Islamic Republic of Iran have been used to calculate currency exchange rate. The price for each vial of studied medication was extracted from the Iran Food and Drug Administration (IrFDA) official website. This price was assumed to be fixed during the study period.

2-7. Statistical analysis

The chi-squared test and Student's t-test were applied for continuous and nominal data, where appropriate. A paired t-test was used to assess the significance of differences between pre- and post-intervention values. The results were compiled with SPSS software version 20.0 (Systat Software, Inc., Chicago, IL), and descriptive statistics were analyzed. Results were considered significant at $P<0.05$.

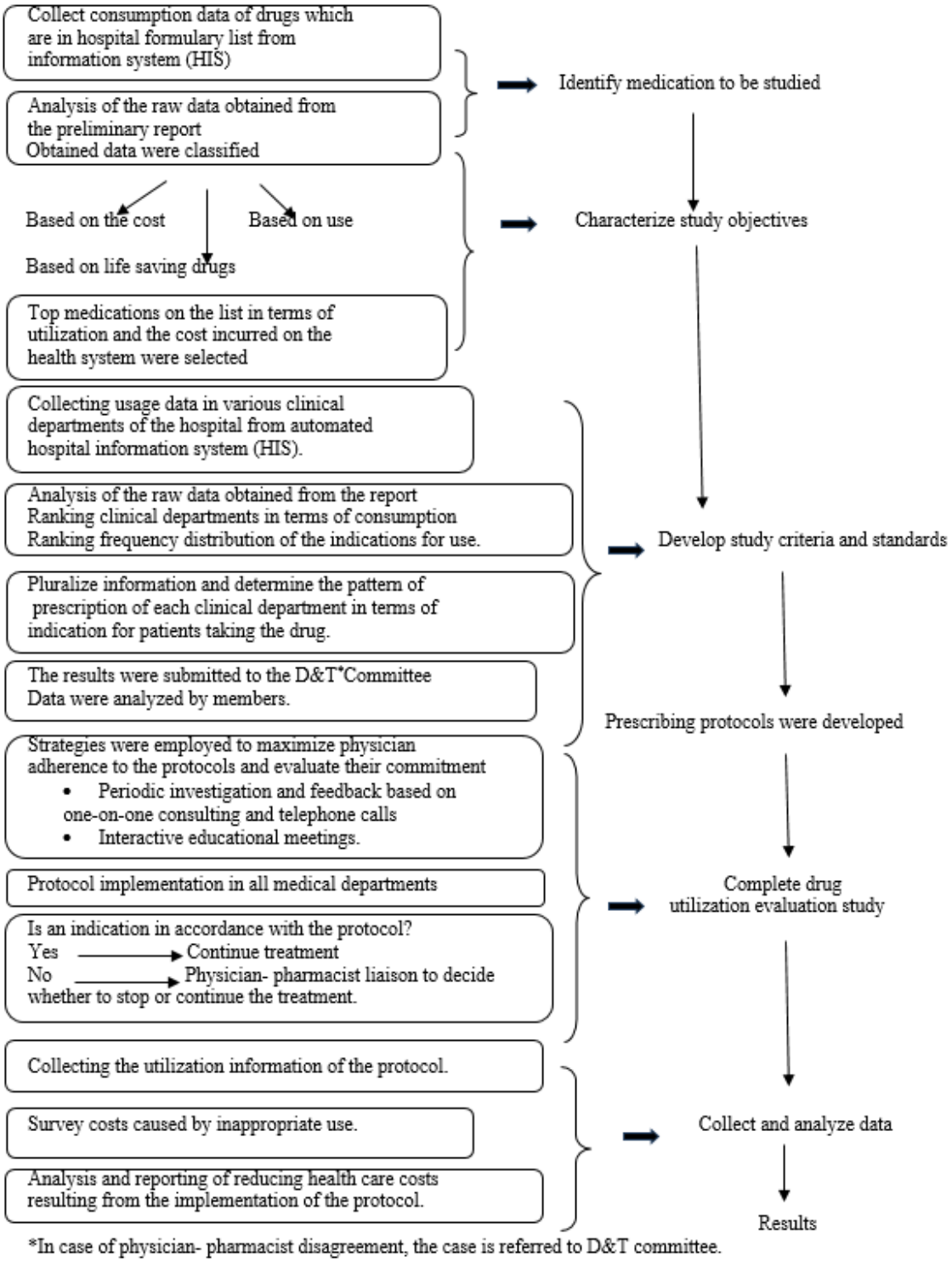

Fig.1: Steps of the method for DUR strategy of used implementation.

3- RESULTS

Three medications, including human albumin 20% vial (10g/50ml), pantoprazole 40 mg vial, acetaminophen 1g ampoule (Apotel®), were evaluated in this study. The initial estimates of targeted medication's use showed that, in the six-month period following the health transformation plan, albumin, pentoprazole, and Apote® increased by 31.9%, 22.6%, and 21.9%, respectively, before protocol implementation. All results related to protocol implementation were reported separately.

3-1. Albumin

In the first and second phases, 3,027 and 2,016 albumin vials were recorded for 843 and 541 patients, respectively. No significant differences in age and sex distribution were found between the patients of both phases. In the first phase of study the highest use of albumin was seen in cardiac surgery room and Intensive Care Unit after cardiac surgery (ICU-OH and NICU-OH= 41.1%). The most common inappropriate indications in both phases of study were, use of albumin as volume expander after cardiac surgery (27.73%- 13.40% in first and second phase, respectively), and hypoalbuminemia (23.01%- 11.31% in first and second phase, respectively). The pattern of use in hospital during the study and the reduction of use are shown in **Table.1**. Pattern of albumin prescription is shown in **Table.2**. Results showed that, based on the verified protocol, 65.55% (1,984 vials) of albumin prescriptions were inappropriate. After implementation of the verified protocol, this amount was reduced to 35.82% (722 vials) that was statistically significant (P= 0.003) (**Figure.2**).

Table-1: Baseline characteristics for human albumin vial.

Variables	Section 1	Section 2	Reduction of use in each ward (%)	Reduce the costs involved USD	P- value
Number of patients who get albumin	843	541			0.001
Female	50%	46%			
Male	50%	54%			
Overall number of hospitalized patients	12792	12768			0.720
The overall number of vials used in hospital	3027	2016	-29.7	-34980.6	0.001
Utilization distribution in hospital wards based on number of vials					
ICU-OH	795	223	-71.9	-19791.2	0.002
Nephrology	467	561	20.1	3252.4	0.260
Gastroenterology	255	270	5.9	519	0.520
Heart Surgery Room	254	73	-71.3	-6262.6	0.006
NICU-OH	226	148	-34.5	-2698.8	0.001
Immunology-rheumatology	168	102	-39.3	-2283.6	0.003
PICU	133	125	-6.0	-276.8	0.300
EICU	127	120	-5.5	-242.2	0.200
Emergency	125	26	-79.2	-3425.4	0.000
CICU	124	77	-37.9	-1626.2	0.001
Inpatient emergency	115	55	-52.2	-2076	0.010
NICU	71	86	21.1	519	0.200
Oncology	46	37	-19.6	-311.4	0.500
Neurology	30	10	-66.7	-692	0.020
Surgery 2	22	16	-27.3	-207.6	0.040
Infectious diseases	20	5	-75.0	-519	0.020

Cardiology	19	15	-21.1	-138.4	0.600
Surgery 1	16	47	193.8	1072.6	0.200
Urology	9	1	-88.9	-276.8	0.040
Neonatal	5	19	280.0	484.4	0.200

Section 1= First 6 months, before implementation protocol, section 2= second 6 months, after implementation protocol, ICU-OH: Intensive care unit after heart surgery (Intensive Care Unit- Open Heart), NICU-OH: Intensive Care Unit After Heart Surgery for Neonates (Neonate Intensive Care Unit- Open Heart), CICU= Coronary Intensive Care Unit, PICU= Pediatric Intensive Care Unit, EICU= Emergency Intensive Care Unit, NICU= Neonatal Intensive Care Unit. USD= United States Dollars. Cost per vial= 34.6 USD. 1 USD= 3902 Rial.

Table-2: Baseline characteristics for Pantoprazole vial.

Variables	Section 1	Section 2	Reduction of use in each ward (%)	Reduce the costs involved USD	P- value
Number of patients who received pantoprazole	763	741			0.312
Female	50%	46%			
Male	50%	54%			
Overall number of hospitalized patients	12792	12768			0.722
The overall number of vials used in hospital	6652	4540	-31.75	-7392	0.006
Utilization distribution in hospital wards based on number of vials					
Gastroenterology	1275	879	-31.06	-1386	0.023
PICU	819	655	-20.02	-574	0.028
Surgery 1	724	272	-62.43	-1582	<0.0001
EICU	548	401	-26.82	-514.5	0.049
Oncology	468	264	-43.59	-714	0.003
Immunology-Rheumatology	438	225	-48.63	-745.5	<0.0001
Neurology	415	437	5.30	77	0.060
Inpatient Emergency	379	378	-0.26	-3.5	0.500
Nephrology	358	232	-35.20	-441	<0.0001
CICU	342	195	-42.98	-514.5	<0.0001
Surgery 2	212	168	-20.75	-154	0.059
Emergency	179	111	-37.99	-238	0.007
Infectious diseases	130	117	-10.00	-45.5	0.220
ICU-OH	117	42	-64.10	-262.5	<0.0001
Urology	104	21	-79.81	-290.5	<0.0001
Cardiology	97	102	5.15	17.5	0. 601
NICU-OH	47	41	-12.77	-21	0.400

Section 1= First 6 months, before implementation protocol, section 2= second 6 months, after implementation protocol, ICU-OH: Intensive care unit after heart surgery (Intensive Care Unit- Open Heart), NICU-OH: Intensive Care Unit After Heart Surgery for Neonates (Neonate Intensive Care Unit- Open Heart), CICU= Coronary Intensive Care Unit, PICU= Pediatric ICU, EICU= Emergency ICU, NICU= Neonatal ICU. USD= United States Dollars.
Cost per vial = 3.5 USD. 1 USD= 3902 Rial.

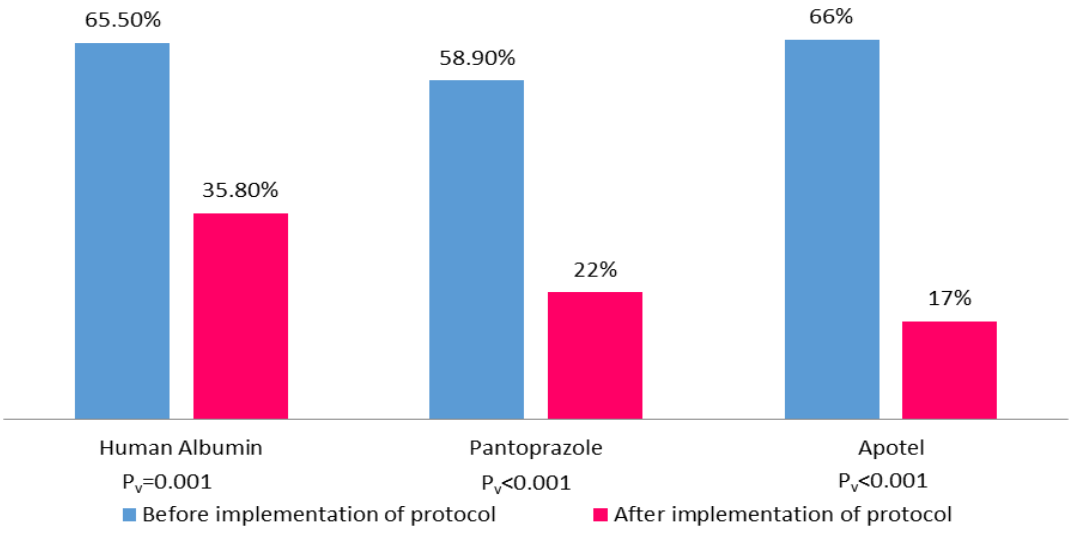

Fig.2: Trend of inappropriate prescription for target drugs (%) before and after the protocol implementation.

3-2. Pantoprazole

In the first and second phases, 6,652 and 4,540 pantoprazole vials were recorded for 763, and 741 patients, respectively. No significant differences in age and sex distribution were found between the patients of both phases. In the first phase of study the highest use of pantoprazole was seen in gastroenterology (19.2%) followed by Pediatric Intensive Care Unit (PICU) with 12.31%. Prevention of stress-related mucosal damage in patients with a history of ulcer, gastrointestinal bleeding or coagulopathy within the past year was recorded as the most frequent reason for pantoprazole use (64.46%). The pattern of use in hospital during the study and the reduction of use were shown in **Table.3**. Reasons for pantoprazole use and related indications during both phases of the study are summarized in **Table.2**. Results showed that, based on the verified protocol, 58.9% (3,918 vials) of pantoprazole was prescribed with an inappropriate dosing. After implementation of the verified protocol, this amount was reduced to 22% (998 vials) that was statistically significant (P= 0.001) (**Figure.2**).

3-3. Apotel®

In the first and second phases, 10,954 and 3,302 pantoprazole vials were recorded for 2,354 and 749 patients, respectively. No significant differences in age and sex distribution were found between the patients of both phases. The surgery wards were responsible for the highest utilization (33.37%), followed by PICU with 12.31%. Results showed that, based on the verified protocol, 66% (7,229 ampoules) of injectable form of acetaminophen prescriptions were inappropriate (inappropriate route of administration). After implementation of the verified protocol, this amount was reduced to 17% (561) that was statistically significant (P<0.0001) (**Figure.2**). The pattern of use in hospital during the study and the reduction of use are shown in **Table.4**. Trend of inappropriate prescription for target medications (%) before and after the DUR and implementation of protocols are provided in **Figure.2**. The comparison of phases revealed that the frequency of inappropriate indications for albumin, inappropriate dosing for pantoprazole and inappropriate route of administration for

Apotel® reduced significantly between two phases of the study.

3-4. Calculated Costs

Each vial of studied medications in the supply chain of our country was sold at 34.6, 3.5 and 2.5 USD for albumin, pantoprazole and Apotel®, respectively. This price was fixed during the study period. According to amount of consumed medications, overall costs of three target medications during the 6 month period were calculated to be 155,402 USD, in the first phase (from March to August 2016). After the implementation of protocols, the expenditure was reduced to 93,899 USD from September 2016 to March 2017 in second phase. It means 61,503 USD cost savings during 6 months (costs are calculated in USD and they are not adjusted to inflation). The comparison of medications expenditure in both phases of study is shown in **Table.5**.

Table-3: Baseline characteristics for Acetaminophen ampoule.

Variables	Section 1	Section 2	Reduction of use in each ward (%)	Reduce the costs involved USD	P-value
Number of patients who received acetaminophen	2354	749			0.0001
Female	50%	46%			
Male	50%	54%			
Overall number of hospitalized patients	12792	12768			
The overall number of vials used in hospital	10954	3302	-69.9	-19130	0.001
Utilization distribution in hospital wards based on number of vials					
Surgery 1	2083	342	-83.58	-4352.5	0.000
Surgery 2	1572	521	-66.86	-2627.5	0.000
Urology	983	203	-79.35	-1950	0.000
Oncology	926	246	-73.43	-1700	0.000
Emergency	851	122	-85.66	-1822.5	0.000
EICU	683	250	-63.40	-1082.5	0.000
PICU	621	412	-33.66	-522.5	0.001
Inpatient Emergency	603	123	-79.60	-1200	0.000
Infectious Diseases	518	233	-55.02	-712.5	0.000
Neurology	461	127	-72.45	-835	0.000
Immunology-Rheumatology	392	241	-38.52	-377.5	0.000
Gastroenterology	349	121	-65.33	-570	0.000
Nephrology	304	115	-62.17	-472.5	0.000
CICU	194	124	-36.08	-175	0.002
Cardiology	190	77	-59.47	-282.5	0.001
ICU-OH	150	31	-79.33	-297.5	0.000
NICU-OH	61	4	-93.44	-142.5	0.000
Neonatal	13	10	-23.1	-7.5	0.518

Section 1= First 6 months, before implementation protocol, section 2= second 6 months, after implementation protocol, ICU-OH: Intensive care unit after heart surgery (Intensive Care Unit- Open Heart), NICU-OH: Intensive Care Unit After Heart Surgery For Neonates (Neonate Intensive Care Unit- Open Heart), CICU= Coronary Intensive Care Unit, PICU= Pediatric ICU, EICU= Emergency ICU, USD= United States Dollars. Cost per vial = 2.5 USD. 1 USD= 3902 Rial.

Table-4: Reasons for target medications use and related indications before and after implementation of protocols.

Medication		Sub-group	Phase 1: Before protocol implementation	Phase 2: After protocol implementation
			Percentage	Percentage
Human Albumin 20%	Appropriate indications			
		• Paracentesis (>100ml/kg at every turn)	0	3.34
		• Plasmapheresis	1	3.93
		• Diuretic resistant/intolerant • Edema (serum Alb < 2.5)	3.01	8.73
		• Crystalloid resistant Hypovolemia	2	8.92
		• Nephrotic Syndrome with oedema	19.23	27.20
		• During the cardiac surgery	6.39	6.62
		• Major GI surgery (with hemodynamic instability and serum Alb < 2.5)	1.82	3.01
		• After cardiac surgery (hemodynamic instability and serum Alb < 2.5)	1	2.43
		• Total	34.45	64.18
	Inappropriate indications	• Hypoalbuminaemia	23.01	11.31
		• Volume expander after cardiac surgery	27.73	13.40
		• Nutritional Support	7.19	4.02
		• Cirrhotic ascites (Alb>2)	2.2	2.01
		• Edema (without sufficient diuretic • Therapy and albumin check)	4.02	2.98
		• Hepatorenal Syndrome	1	1.90
		• Diarrhea	0.4	0.20
		• Total	65.55	35.82
Pantoparzole 40 mg	Appropriate indications and dose	• Erosive esophagitis associated with gastroesophageal reflux disease (GERD)	2.9	3.10
		• Zollinger-Ellison syndrome	2.5	3.80
		• Prevention of stress-related mucosal damage in patients with a history of ulcer, gastrointestinal bleeding or coagulopathy within the past year, taking glucocorticoides, NSAIDs, aspirin, anticoagulant and fibrinolytic, mechanical ventilation for more than 48 hours, staying in the ICU for more than a week, history of traumatic brain injury, obscure gastrointestinal bleeding, and unable to use oral form	64.4	61
		• Alternative to oral therapy in patients who are unable to continue taking oral form or no possibility of gavage	3.0	4.0
		• Upper gastrointestinal bleeding (non-varicose)	8.6	7.9
		• Prohibition or intolerance to injectable ranitidine	2.5	5.1
		• Total appropriate indications	83.9	84.9
		• Appropriate dose	41.1	78
	Inappropriate indications and dose	• Ability to take oral form	5.8	4.9
		• Possibility of gavage	3.02	3.21
		• Ability to take ranitidine or other H2 blockers	7.2	6.9
		• Total inappropriate indications	16	15
		• Inappropriate dose	58.9	22
Acetaminophen 1g	Appropriate indications and route of administration	• Management of mild to moderate pain	11	6
		• Management of moderate to severe pain with adjunctive opioid analgesics	38	34
		• Reduction of fever	51	60
		• Total appropriate indication	100	100
		• Appropriate route of administration (inability to take oral form (ex. NPO, nausea vomiting, aspiration risk) or rectal form of medication.)	34	83
	Inappropriate	• Inappropriate route of administration (ability to take oral or rectal form of medication)	66	17

Table-5: Comparison of medication expenditure in both 6 month phases.

Medications	Cost (USD)		Total Number of Unit Drug Used		Reduction of Unit Drug Used, %	P-value
	Phase 1	Phase 2	Phase 1	Phase 2		
Human Albumin 20%	104735	69754	3027	2016	29.7	0.001
Pantoprazole 40 mg	23282	15890	6652	4540	31.8	0.006
Acetaminophen 1g	27385	8255	10954	3302	69.9	0.001
Total	155402	93899	20633	9858	52.2	0.001

Phase 1= pre-protocol implementation, Phase 2= post-protocol implementation, 1 USD= 3902 Rial.

4- DISCUSSION

The major aims of this study were reducing the healthcare expenditures and improving the rational administration of medications. In this regard, there was evidence that implementation of designed practice protocols, can reduce medical expenditures and also increase appropriate and rational use of medications significantly. As well, in our results, other previous studies have noted that timely implementation of medication prescription protocols can provide health benefits to patients by appropriate medication use and cost savings to the health service provider (14-16). In a similar study, a heart and vascular institute recently developed a strategy to estimated cost savings of two costly medications they use and they could save $8.5 million over 2 years (19). Studies noted that in healthcare systems, pharmaceutical expenditure is one of the largest components of the entire hospital's operating costs (16). Implementation of prescription protocols can improve appropriate medication use and reduce costs to the health service providers (15). Likewise, our results showed that the implementation of designed strategy could significantly reduce medical expenditures for three costly medications in our hospital. According to a report from the Food and Drug Organization of the Health Ministry in 2008 in Iran, the most costly medication used in hospitals was Human Albumin (16). Studies done in the past few years showed that the use of human albumin in 50–70% of prescriptions was inappropriate (14, 15, 20-25) . These studies indicated the inappropriate indications for use of albumin, for example, the nutritional supplementation (48.39%), and hypoalbuminemia (19.35%) were the two most frequent reasons for inappropriate albumin use (14) or use of albumin for nutritional intervention and treatment of edema (15). The albumin indication after the cardiac surgery was the most inappropriate prescription among other indications in a similar study (20). Another inappropriate indication for albumin use was volume replacement in critically ill patients in a study from Italy (22). As in other studies, results of this study showed that the most frequent inappropriate indications for albumin use were hypoalbuminaemia (27.73 %), and use as volume expander after cardiac surgery (23.01%). Moreover, results from this study showed that based on the verified protocol, 65.55% of albumin administrations were inappropriate. After implementation of the verified protocol, this amount was reduced to 35.82%. The improper administration of proton pump inhibitors (PPIs) including pantoprazole has been shown in other studies as well, they reported inappropriate PPI use in 54% of patients treated with PPIs in a primary care situation (26). Another study showed that up to 55% of patients for whom PPIs were administered were over-prescribed (27). Other similar studies that examine the impact of inappropriate use of PPIs on

medication costs, ranked pantoprazole among the "Top10" costly medications (26, 27). Results obtained from other comparable studies showed that 67% (13), and 55% (21) of pantoprazole administrations were inappropriate. Besides, results from this study showed that based on the verified protocol, 58.9% of pantoprazole vial prescriptions were inappropriate. After implementation of the verified protocol, this amount was reduced to 22%. Regarding pantoprazole, an issue that should be considered was the prescription of pantoprazole in half the cases related to the prevention of stress-related mucosal ulcers, and we noticed that the pantoprazole dosing for this indication was inappropriate in our hospital. Results of this study showed that 66% of acetaminophen was prescribed as an inappropriate route of administration. This amount reduced to 17% after implementation of verified protocol. The results of a systematic review on six Randomized Controlled Trial (RCT) studies indicated that there was no strong evidence for superiority of IV acetaminophen administration over oral routes. In addition, for patients who can take an oral dosage form, no clear indication exists for preferential prescribing of IV acetaminophen (28). Another issue about the use of studied medications is the fact of cost and the impact of this high cost on healthcare expenditures. The cost of one night's hospitalization in referral university hospitals in Iran is 23.06 USD at the time of this study and this is while the cost of one human albumin vial in Iran was more than this amount. Also, when albumin was used as volume expander in various situations it has modest results when compared with more cost-effective therapeutic alternative choices like crystalloid solutions (saline and Ringer's lactate), and synthetic colloids (dextran, hydroxyethyl starch and gelatin derivatives) (21). About the cost of pantoprazole, results showed that pantoprazole expenditure over 6 months was 21,583 USD. However, expenditure on oral dosage forms of that over 6 months was 755 USD. But, the total cost of all other dosage forms of acetaminophen was less than that of Apotel. Apotel expenditure over 6 months was 24,000 USD. Conversely, expenditure on all other dosage forms such as the syrup, suppository, tablet, suspension, and other forms over 6 months was 1,250 USD. Because of the small healthcare budget in low and middle-income countries, in the case of low evidence of high efficacy of certain dosage form, low-cost forms could be used.

5- CONCLUSION

In this study, a strategy was developed that was successful in reducing the negative financial impact of increase in the inappropriate use of medications. This strategy involves collecting information, analyzing data, reviewing text books and guidelines, communicating with the treatment team, designing protocols, implementing and monitoring the intervention. The implementation of this strategy by a multidisciplinary team of pharmacists and physicians was highly successful in reducing use of three costly medications. The authors believe this strategy can be implemented for other medications associated with high expenditure and inappropriate administration. Ultimately, this strategy can be used by other healthcare systems to help manage pharmaceutical expenditures.

6- CONFLICT OF INTEREST: None.

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