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THE BENEFICIAL EFFECT OF INCORPORATING CLINICAL PHARMACIST TO INTENSIVE CARE TEAM: COST BENEFIT ANALYSIS.

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ABSTRACT:

Purpose: This study aims to evaluate the cost-benefit of incorporating a clinical pharmacist as a part of the Intensive Care Unit (ICU) team.

Introduction: The ICU is a crucial unit in any hospital because it offers a much needed care to patients with serious and life-threatening illnesses. However, the high standard of care provided in the ICU comes at a high cost particularly in terms of drug expenses because most ICU patients frequently need to take a wide variety of expensive and complex medications, the high financial burden of such requirements can significantly strain the healthcare budget and have an impact on how resources are distributed making it crucial to manage and optimize drug costs.

ICU pharmacists, who conduct in depth medication reviews, keep track of drug interactions and making evidence-based recommendations and help by suggesting affordable alternatives, encouraging the use of generic drugs, and spotting chances for therapeutic replacements can offer a great help with this issue.

Methodology: Data on medicine usage from the adult ICU at King Hussein Medical Center (KHMC) at the Jordanian Royal Medical Services (RMS) were gathered for a 6-month period as part of this single-center retrospective study. The study period was split into two three-month period: one from 7-9/2022, during which a clinical pharmacists was not integrated into the intensive care unit, and the other from 10-12/2022, when they were. The primary outcome assessed was the cost of the pharmaceuticals used over the two separate time periods.

Keywords: Critical care ;Intensive care unit; Pharmaceutical care; Clinical Pharmacy; Clinical pharmacist interventions; Economic evaluation.

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1. Introduction:

The ICU is a crucial unit in any hospital because it offers a much needed care to patients with serious and life threatening illnesses including serious infections, organ failure, cardiovascular events or major surgeries. It is staffed with highly qualified healthcare experts who can deliver critical care around the clock[1-3].

ICU patients are in need of careful monitoring and specialized care[4], therefor it's important to pay close attention to their medication schedules and treatment regimens. Since, it is a complex procedure that involves exact dosages, potential drug interactions, and ongoing observation to achieve the best therapeutic results with the lowest possible chance of adverse effects. Therefore, in order to provide each patient with individualized care that takes into account their particular needs and medical complexity, interdisciplinary teamwork between doctors, nurses, pharmacists, and other healthcare experts is crucial[5-8].

The cost of providing high-quality treatment in ICU has significant financial implications, which are mostly caused by the high costs of medication therapy. ICU patients sometimes need a wide variety of expensive medications to take care of their complex needs resulting from their serious and complicated medical illnesses. As a result, a substantial financial strain caused by these medication requirements is placed on the total healthcare budget leading to the compromise of health resources across various medical departments and services[11].

ICU clinical pharmacists are essential in resolving the complicated problems relating to medication management in the ICU. These trained pharmacists perform thorough and in-depth medication reviews by carefully assessing each patient particular regimen and their knowledge of pharmacology enables them to spot possible drug interactions thereby lowering the possibility of negative effects and improving treatment results[9, 10].

ICU pharmacists provide vital advice by implementing evidence based recommendations, ensuring that the prescribed medications are in line with the patient particular needs and medical circumstances. Additionally, they actively assist in lessening the financial load by identifying affordable alternatives by recommending the use of generic medications that maintain therapeutic efficacy. ICU pharmacists are also expert at spotting chances for medicinal substitutes allowing for less expensive but not less effective therapies while upholding the highest levels of patient care and overall clinical services quality, thereby greatly lessens the budgetary impact on hospital budgets [12-14].

2. Method:

King Hussein Medical Center (KHMC) is one of the main medical centers at the Jordanian Royal Medical Services (RMS) and it has an ICU with a 40 bed capacity were patients with a variety of medical conditions are admitted. Data on the quantities of some of the most commonly used medications in KHMC ICU were gathered for a 6-month period and were analyzed using Microsoft Excel Spreadsheet Software as part of this single-center retrospective study.

The study period was split into two three-month period: one from 7-9/2022, during which a clinical pharmacist was not integrated into the intensive care unit (Period A), and the other from 10-12/2022, when they were (Period B). The primary outcome assessed was the cost of the pharmaceuticals used over the two separate time periods.

3. Results:

We obtained the relative local purchasing price for each item in Jordanian Dinar (JD) and used Microsoft Excel Spreadsheet Software to calculate for each drug the cost benefit resulted from the difference in use during the study period and represented the resulted data in the form of relative percentages of cost reduction.(Table1: The quantities of used medications during period A and Period B and the resulted difference in consumption and there relative percentages .Table2: The cost in JD for used medications during period A and Period B and the resulted Cost benefit and there relative percentages).

The "Cost Benefit" column indicates the difference in costs between the two periods (Positive values represent cost savings, while negative values indicate an increase in costs).

Table1: The quantities of used medications during period A and Period B and the resulted difference in consumption and there relative percentages.

Medication	Units Used /Period A	Units Used /Period B	Quantity Difference	Quantity Reduction Percentage
Esomeprazole 40mg Injection	1059	409	650	61.38%
Labetalol Ampule	959	306	653	68.09%
Verapamil Ampule	23	7	16	69.57%
Hydralazine Ampule	100	28	72	72.00%
Citicoline 500mg injection	256	151	105	41.02%
Isoproterenol Ampule	290	70	220	75.86%
Norepinephrine Ampule	6924	6240	684	9.88%
Heparin Vial	1150	941	209	18.17%
Tinzaparin Vial	807	633	174	21.56%
Adrenaline Ampule	2111	1535	576	27.29%
Phenobarbital 200mg Ampule	103	44	59	57.28%
Benzylpenicillin 1,000,000 IU Vial	83	23	60	72.29%
Piperacillin, Tazobactam Vail	2530	2668	-138	-5.45%
Cefepime 1 gm Vial	185	87	98	52.97%
Cefoxitin 1gm Vial	23	15	8	34.78%
Ceftazidime 1gm Vial	394	209	185	46.95%
Ceftriaxone 1gm Vial	1265	1449	-184	-14.55%
Imipenem 500mg Vial	1804	1887	-83	-4.60%
Ertapenem 1gm Vial	45	5	40	88.89%
Amikin 500mg Vial	574	616	-42	-7.32%
Gentamycin 80mgVial	160	58	102	63.75%
Vancomycin 1gm Vial	279	593	-314	-112.54%
Colistin 2milion Amp	1612	1295	317	19.67%
Metronidazole IV Solution	1507	1132	375	24.88%
Fluconazole Vial	189	220	-31	-16.40%
Regular insulin	19	13	6	31.58%
Methylprednisolone 500mg Vial	28	83	-55	-196.43%
KCL 15% Ampule	7375	7155	220	2.98%
Terlipressin 1mg Vial	98	57	41	41.84%
B12 1000mcg Ampule	123	41	82	66.67%
MgSo4 50% Ampule	355	280	75	21.13%
B-complex Injection	98	57	41	41.84%
B1 100mg Ampule	54	10	44	81.48%
Thiopental 1gm Vial	129	81	48	37.21%
Atropine Ampule	795	510	285	35.85%
Atracurium Ampule	15200	13800	1400	9.21%
Rocuronium Vial	960	840	120	12.50%
Lidocaine IV Vial	244	193	51	20.90%
Naloxone Ampule	32	25	7	21.88%
Human Albumin 20%	1467	1368	99	6.75%

Table2:The cost in JD for used medications during period A and Period B and the resulted Cost benefit and there relative percentages

Medication	Local Price/Unit	Cost/Period A	Cost/Period B	Cost Benefit	Cost Reduction Percentage
Esomeprazole 40mg Injection	0.53	564.45	218.00	346.45	61.38%
Labetalol Ampule	2.52	2416.68	771.12	1645.56	68.09%
Verapamil Ampule	1.10	25.32	7.71	17.62	69.57%
Hydralazine Ampule	0.65	65.00	18.20	46.80	72.00%
Citicoline 500mg injection	0.47	119.81	70.67	49.14	41.02%
Isoproterenol Ampule	1.24	360.47	87.01	273.46	75.86%
Norepinephrine Ampule	0.42	2887.31	2602.08	285.23	9.88%
Heparin Vial	1.79	2060.80	1686.27	374.53	18.17%
Tinzaparin Vial	7.94	6405.16	5024.12	1381.04	21.56%
Adrenaline Ampule	0.29	614.30	446.69	167.62	27.29%
Phenobarbital 200mg Ampule	1.85	190.55	81.40	109.15	57.28%
Benzylpenicillin 1,000,000 IU Vial	0.32	26.56	7.36	19.20	72.29%
Piperacillin, Tazobactam Vail	1.60	4042.94	4263.46	-220.52	-5.45%
Cefepime 1 gm Vial	2.20	407.19	191.49	215.70	52.97%
Cefoxitin 1gm Vial	2.08	47.82	31.19	16.63	34.78%
Ceftazidime 1gm Vial	0.65	254.13	134.81	119.33	46.95%
Ceftriaxone 1gm Vial	0.25	314.99	360.80	-45.82	-14.55%
Imipenem 500mg Vial	2.25	4064.41	4251.41	-187.00	-4.60%
Ertapenem 1gm Vial	20.58	925.92	102.88	823.04	88.89%
Amikin 500mg Vial	0.37	212.38	227.92	-15.54	-7.32%
Gentamycin 80mgVial	0.30	48.48	17.57	30.91	63.75%
Vancomycin 1gm Vial	1.70	474.30	1008.10	-533.80	-112.54%
Colistin 2milion Amp	3.32	5353.45	4300.70	1052.76	19.67%
Metronidazole IV Solution	0.33	489.78	367.90	121.88	24.88%
Fluconazole Vial	1.15	217.92	253.66	-35.74	-16.40%
Regular insulin	1.44	27.32	18.69	8.63	31.58%
Methylprednisolone 500mg Vial	3.90	109.28	323.95	-214.67	-196.43%
KCL 15% Ampule	0.18	1312.75	1273.59	39.16	2.98%
Terlipressin 1mg Vial	22.94	2247.83	1307.41	940.42	41.84%
B12 1000mcg Ampule	0.26	31.49	10.50	20.99	66.67%
MgSo4 50% Ampule	0.85	302.46	238.56	63.90	21.13%
B-complex Injection	0.30	29.60	17.21	12.38	41.84%
B1 100mg Ampule	0.62	33.59	6.22	27.37	81.48%
Thiopental 1gm Vial	3.46	445.82	279.94	165.89	37.21%
Atropine Ampule	0.26	206.70	132.60	74.10	35.85%
Atracurium Ampule	0.49	7448.00	6762.00	686.00	9.21%
Rocuronium Vial	1.25	1200.00	1050.00	150.00	12.50%
Lidocaine IV Vial	0.24	58.07	45.93	12.14	20.90%
Naloxone Ampule	1.56	49.98	39.05	10.93	21.88%
Human Albumin 20%	18.26	26787.42	24979.68	1807.74	6.75%
		72880.41	63017.83	9862.58	13.53%

To further simplify the result, medications under investigation were classified into 4 groups (Group 1-Group 4), where Group 1: contained mostly medications affecting the cardiovascular system and anticoagulation medications, Group 2: contained antibiotics medications, Group 3: contained mostly medications effecting the central nervous system and Group 4: contained other medications effecting variety of systems including gastrointestinal and endocrine systems. (Table3: The total cost benefit/group in JD during study period and the resulted relative percentages.).

Table 3: The total cost benefit/group in JD during study period and the resulted relative percentages

Group	Medication	Total Cost Benefit/Group	Total Cost Reduction Percentage/Group
Group 1	Labetalol, Verapamil, Hydralazine, Atropine, Terlipressin, Isoproterenol, Norepinephrine, Heparin, Tinzaparin, Adrenaline	5206.36 JD	30.11%
Group 2	Benzylpenicillin, Piperacillin/ Tazobactam, Cefepime, Cefoxitin, Ceftazidime, Ceftriaxone, Imipenem, Ertapenem, Amikin, Gentamycin, Vancomycin, Colistin, Metronidazole, Fluconazole.	1361.01 JD	8.06%
Group 3	Phenobarbital, Thiopental, Citicoline, Atracurium, Rocuronium, Lidocaine, Naloxone.	1183.25 JD	12.44%
Group 4	Regular insulin, Methylprednisolone, KCL 15%, B12 1000mcg, MgSo4 50%, B-complex, B1 100mg, Human Albumin 20%, Esomeprazole.	2111.96 JD	7.23%

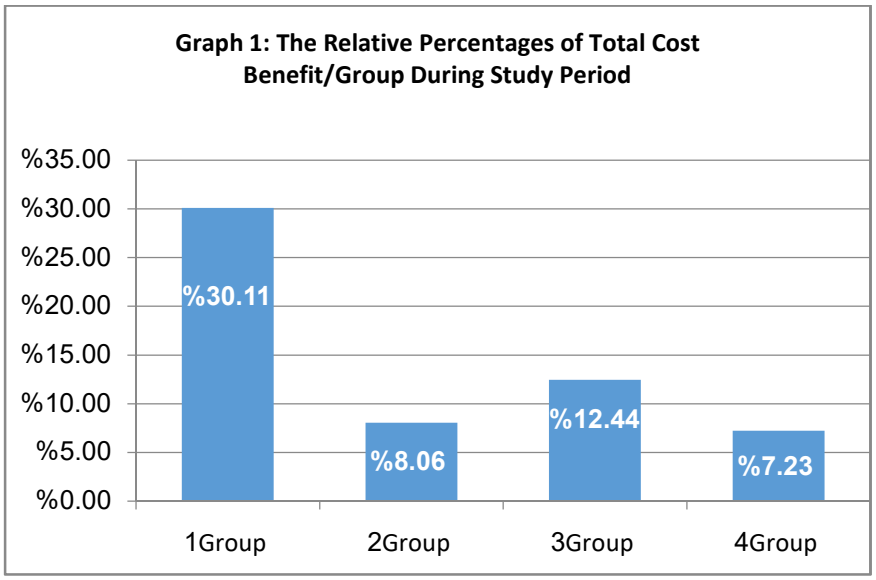
4. Discussion:

The results show that having a clinical pharmacist involved has significantly reduced the cost of drugs in the ICU. There was a significant decrease in drug costs during period B (The overall cost benefit was 13.53%), which implies that having a clinical pharmacist on staff in the ICU has improved cost management and pharmaceutical use.

Deeper inspection of certain drugs when period B is compared to Period A shows numerous interesting patterns. A large number of drugs showed a considerable decrease in amount usage. This suggests that the clinical pharmacist's involvement had probably resulted in more effective and rational prescribing.

Although a substantial reduction in quantity used between the two periods was seen for several medications, such as "B1 100mg Ampule" and "Methylprednisolone 500mg Vial", it's also important to address situations where the cost-benefit analysis showed a rise in medications cost during Period B for drugs like "Piperacillin, Tazobactam Vial" and "Vancomycin 1gm Vial". It's understandable that certain circumstances or patient-specific factors may have had an impact on the prescribing trends for those medications during Period B and it may be as a direct result of the clinical pharmacist recommendations itself therefor additional research is necessary to understand the underlying causes of the cost increase.

Of the 4 groups of medications group 1 showed a total of 30.11% reduction in the total cost during period B compared to period A which shows a significant influence of the clinical pharmacist recommendations regarding the management of cardiovascular and anticoagulation drugs. Group 2 showed a 12.44% reduction which further supports the positive effect the clinical pharmacist involvement had in the area of central nervous system medication management (Graph 1).



5. Conclusions:

Our study shows an overall costs reduction by 13.53% indicating that clinical pharmacist involvement in medication management had a positive effect on the quantities and the cost of medications used therefore helped in utilizing medications more effectively and appropriately proving that cost optimization was successful.

This study results supports the importance of clinical pharmacists as a valuable resource and an important part of the ICU healthcare team, especially in the context of cost control and maintaining the quality of health services[9, 11, 13, 14].

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