

Nutrition Support Pharmacy Services in Critically Ill Cancer Patients Admitted to Intensive Care Units: A Retrospective Analysis of Clinical Pharmacists' Interventions

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ABSTRACT

Objectives: This study aimed to analyze clinical pharmacists' interventions in managing nutrition support therapy in critically ill cancer patients admitted to intensive care units.

Methods: A retrospective analysis of 9949 electronically reported clinical pharmacist interventions of patients admitted to ICU from January 2020 to December 2022 was conducted. All patients' records with clinical pharmacists' interventions related to nutrition support therapy in ICU cancer patients were included and analyzed.

Results: The number of interventions for managing nutrition support therapy was 95 (0.95 %). Parenteral nutrition ($n = 83$, 87.4 %) was the most frequently used class of nutrition support therapies. The evaluation, adjustment, and monitoring of total parenteral nutrition ($n = 75$, 78.9 %) was the most frequent intervention of clinical pharmacists. The acceptance rate of clinical pharmacists' interventions in nutrition support therapy by physicians was 100 %.

Conclusion: Clinical pharmacists have a role in managing specialized nutrition support therapy in critically ill cancer patients. The prevailing clinical pharmacists' intervention was evaluating, adjusting, and monitoring total parenteral nutrition. More studies are needed to investigate the barriers that prevent the application of nutrition support pharmacy services in Jordan and to find the impact of these services on patient outcomes.

Keywords: Clinical pharmacy services, nutrition support pharmacy, cancer, critical care.

1. INTRODUCTION

According to the American College of Clinical Pharmacy (ACCP), clinical pharmacy is the area of pharmacy concerned with the science and practice of rational medicine use [1]. Clinical pharmacy practice is based on the philosophy of pharmaceutical care, which aims to enhance patient care and obtain optimal patient outcomes [1].

Clinical pharmacists are healthcare professionals who specialize in providing direct patient care. The clinical

pharmacy discipline has evolved to include many specialties [1]. The Board of Pharmacy Specialties (BPS) administers pharmacist certifications in various specialties, including nutrition support pharmacy, critical care pharmacy, emergency medicine pharmacy, geriatric pharmacy, oncology pharmacy, paediatric pharmacy, and pharmacotherapy [2]. Nutrition Support Pharmacy is a speciality that provides optimum care to patients receiving specialized nutrition support, including parenteral or enteral nutrition, by qualified pharmacists [2].

Nutrition therapy includes oral, enteral, and parenteral nutrition to maintain optimal health [3]. Nutrition Support Therapy provides nutrients enterally or parenterally to prevent or treat malnutrition. Enteral nutrition (EN), or "tube feeding," is a type of nutrition support therapy in

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which patients can receive their nutritional needs by administering liquid formulas via enteral access devices or feeding tubes that directly access the stomach or small intestine [3,4]. Parenteral Nutrition is another type of nutrition support therapy in which patients meet their nutritional needs by administering a sterile intravenous (IV) solution containing carbohydrates, lipids, protein, vitamins, minerals, fluid, and other nutrients. Parenteral nutrition is used when a patient's nutritional needs could not be met through the gastrointestinal GI tract alone. [3,4].

Nutrition support professionals (NSPs) can be pharmacists, dietitians, nurses, physicians, or other healthcare providers [4]. Nutrition support pharmacists compound the prescribed parenteral nutrition formulation. They also provide nutrition support pharmacy services to patients [16]. Nutrition support clinical pharmacists may work independently or as part of the healthcare team [17,18]. Clinical pharmacists are essential members of critical care health teams and contribute to the safety and management of medications for this vulnerable population [16-25]. They provide various services, including medication reconciliation, drug monitoring, and drug information services, which lead to minimizing drug-related errors and optimizing medication therapy in intensive care units (ICU) [16-20]. Clinical pharmacists also provide nutrition support pharmacy services. These activities improve health quality, reduce mortality, improve patient outcomes, and decrease healthcare-related costs [16-20].

According to recent guidelines and recommendations, timely nutritional therapy should be carefully considered for malnourished or at-risk malnutrition patients undergoing anticancer management [20,21]. When oral intake is inadequate, enteral or parenteral nutrition should be considered if enteral nutrition is not adequate or feasible. The timing of nutritional interventions is critical, as early intervention may improve cancer patients' perceived quality of life. Nutrition therapy targeting the

management of caloric deficit has improved patient outcomes [20-25].

The current healthcare system's focus on providing high-quality, affordable care imposes many challenges on health workers [5,6]. Preventing and managing malnutrition during hospitalization optimizes the quality of care, improves clinical outcomes, and reduces costs [6,7,8]. Although studies' findings are contrasting, available evidence showed that early nutrition support can reduce complications, duration of hospital stay, hospital readmission rates, mortality, morbidity, and costs. Optimized Nutrition support therapy is expected to save costs and enhance clinical outcomes in hospitalized patients [5-15].

A limited number of studies explored the role of clinical pharmacists in the Middle East [31-35]. Few studies investigated the role of clinical pharmacists in Jordan. However, none of these studies investigated the role of clinical pharmacists in specialized nutrition support therapy [36,37,38]. King Hussein Cancer Centre (KHCC) is a specialized cancer centre in Jordan. Clinical pharmacy services at KHCC cover all inpatient services and some outpatient clinics. Clinical pharmacists review all patients' medication orders, participate in clinical discussions with physicians and other healthcare professionals on a daily basis, and provide comprehensive therapeutic care plans [39].

Based on the above and due to the lack of information about the role of nutrition support pharmacy services in critically ill cancer patients in Jordan, the aim of this study was to analyze the interventions of clinical pharmacists in managing nutrition support therapy in ICU cancer patients at KHCC.

2. METHODS

The study protocol was approved by the Institutional Review Board (IRB) at King Hussein Cancer Centre on 25 Oct 2021 with approval number RC/2021/153.

A retrospective analysis of electronically reported

clinical pharmacist interventions in 9949 patients admitted to intensive care units at KHCC in Amman, Jordan, from January 2020 to December 2022 was conducted. All patient records with clinical pharmacist interventions for managing nutrition support pharmacy services in ICU cancer patients at King Hussein Cancer Centre were included.

Nutrition support pharmacy (NSP) services were classified into enteral nutrition (EN) and parenteral nutrition (PN). Reported clinical pharmacists' interventions for managing nutrition support pharmacy (NSP) services were classified into the following categories: Lab Evaluation, order clarification, recommendation/initiation, Recommendation/discontinuation, and total parenteral nutrition (TPN) evaluation/adjustment/monitoring. The time clinical pharmacists took to intervene was reported and recorded by clinical pharmacists in the pharmacy database. Times were collected and analyzed for all interventions. Patients' age groups were classified into two categories: the adult group for patients older than 18 and the paediatric group for patients 18 or under. Descriptive statistics were utilized to evaluate the results in frequencies and percentages.

Mann-Whitney U test was used to compare the means of the time clinical pharmacists took to intervene in the paediatric and adult ICU services groups and between the enteral and parenteral nutrition groups.

Analysis was performed using the Jamovi statistical package 2022 [29,30]. A p-value less than 0.05 was considered significant.

3. RESULTS

The number of interventions related to managing nutrition support therapy was 95 (0.95 %). The acceptance rate of clinical pharmacists' interventions in nutrition support therapy by physicians at KHCC was 100 %.

Most of the study population were males ($n = 61$, 64.2%). The average age of females was 40.9 years ($SD \pm 25.6$), and the average age of males was 36.6 years ($SD \pm 25.4$). The study population comprised adult patients ($n = 56$, 58.9 %) and paediatric patients ($n = 39$, 41.1%). The descriptives of age are described in Table 1.

Table 1: Participants age

	Age (years)
N	95
Missing	5
Median	44
Standard deviation	25.4
IQR	47.5
Minimum	2
Maximum	83
25th percentile	13.0
50th percentile	44.0
75th percentile	60.5

3.1. Distribution of participants based on admission date:

The majority of participants were admitted to ICU in the year 2022. The number of patients admitted to the ICU in 2022 was ($n = 43$, 45.3%). The number of patients admitted in 2021 was ($n = 28$, 29.5 %), and in 2020 was ($n = 24$, 25.3).

3.2. Analysis of nutrition support therapies in ICU cancer patients:

Parenteral nutrition ($n = 83$, 87.4 %) was found to be the most used class of nutrition support therapies in ICU cancer patients. The frequency of nutrition support pharmacy services according to age and gender is described in Table 2.

Table 2: Frequencies of nutrition support therapies

Nutrition support therapies	Age group	Gender	Counts	% of Total	Cumulative %
Enteral nutrition	Adult	F	10	10.5 %	10.5 %
		M	2	2.1 %	12.6 %
	Pediatric	F	0	0.0 %	12.6 %
		M	0	0.0 %	12.6 %
Parenteral nutrition	Adult	F	12	12.6 %	25.3 %
		M	32	33.7 %	58.9 %
	Pediatric	F	12	12.6 %	71.6 %
		M	27	28.4 %	100.0 %

3.3. Analysis of clinical pharmacists' interventions in nutrition support pharmacy services

The evaluation, adjustment, and monitoring of TPN ($n=75$, 78.9 %) was found to be the most frequent intervention of clinical pharmacists in the management of

nutrition support therapy in ICU cancer patients, followed by discontinuation of the nutrition support therapy ($n=14$, 14.7 %). Table 2 depicts the frequencies of drug interventions.

Table 2: Frequencies of Intervention

Intervention	Counts	% of Total	Cumulative %
Lab Evaluation	1	1.1 %	1.1 %
Order clarification	3	3.2 %	4.2 %
Recommendation/ Discontinuation	14	14.7 %	18.9 %
Recommendation/initiation	2	2.1 %	21.1 %
TPN evaluation/adjustment/monitoring	75	78.9 %	100.0 %

3.4. Analysis of time taken by clinical pharmacists to intervene:

The number of interventions related to managing nutrition support therapy was 95 (0.95 %). The sum of

times taken was 1824 minutes. The minimum time was 2, and the maximum time was 45 minutes. Tables 3 and 4 describe the distribution of intervention time taken based on age, gender, and type of intervention.

Table 3: Distribution of time taken by clinical pharmacists (according to gender and age group)

	Age group	Gender	Time Taken
N	Adult	F	22
		M	34
	Pediatric	F	12
		M	27
Missing	Adult	F	0
		M	0
	Pediatric	F	0
		M	0
Median	Adult	F	15.0
		M	20.0
	Pediatric	F	20.0
		M	20

	Age group	Gender	Time Taken
Standard deviation	Adult	F	4.93
		M	8.50
	Pediatric	F	7.72
		M	8.13
IQR	Adult	F	7.50
		M	0.00
	Pediatric	F	0.00
		M	0.00
Minimum	Adult	F	2
		M	2
	Pediatric	F	15
		M	15
Maximum	Adult	F	20
		M	45
	Pediatric	F	45
		M	45
25th percentile	Adult	F	11.3
		M	20.0
	Pediatric	F	20.0
		M	20.0
50th percentile	Adult	F	15.0
		M	20.0
	Pediatric	F	20.0
		M	20.0
75th percentile	Adult	F	18.8
		M	20.0
	Pediatric	F	20.0
		M	20.0

Table 4: Distribution of time taken by clinical pharmacists (according to type of intervention)

	Intervention	Time Taken
N	Lab Evaluation	1
	Order clarification	3
	Recommendation/ Discontinuation	14
	Recommendation/initiation	2
	TPN evaluation/adjustment/monitoring	75
Missing	Lab Evaluation	0
	Order clarification	0
	Recommendation/ Discontinuation	0
	Recommendation/initiation	0
	TPN evaluation/adjustment/monitoring	0
Median	Lab Evaluation	5
	Order clarification	10
	Recommendation/ Discontinuation	15.0
	Recommendation/initiation	15.0

	Intervention	Time Taken
	TPN evaluation/adjustment/monitoring	20
Standard deviation	Lab Evaluation	NaN
	Order clarification	0.00
	Recommendation/ Discontinuation	4.73
	Recommendation/initiation	0.00
	TPN evaluation/adjustment/monitoring	7.78
IQR	Lab Evaluation	0.00
	Order clarification	0.00
	Recommendation/ Discontinuation	0.00
	Recommendation/initiation	0.00
	TPN evaluation/adjustment/monitoring	0.00
Minimum	Lab Evaluation	5
	Order clarification	10
	Recommendation/ Discontinuation	2
	Recommendation/initiation	15
	TPN evaluation/adjustment/monitoring	2
Maximum	Lab Evaluation	5
	Order clarification	10
	Recommendation/ Discontinuation	15
	Recommendation/initiation	15
	TPN evaluation/adjustment/monitoring	45
25th percentile	Lab Evaluation	5.00
	Order clarification	10.0
	Recommendation/ Discontinuation	15.0
	Recommendation/initiation	15.0
	TPN evaluation/adjustment/monitoring	20.0
50th percentile	Lab Evaluation	5.00
	Order clarification	10.0
	Recommendation/ Discontinuation	15.0
	Recommendation/initiation	15.0
	TPN evaluation/adjustment/monitoring	20.0
75th percentile	Lab Evaluation	5.00
	Order clarification	10.0
	Recommendation/ Discontinuation	15.0
	Recommendation/initiation	15.0
	TPN evaluation/adjustment/monitoring	20.0

3.6. Time taken by clinical pharmacist to intervene: enteral nutrition compared to PN

Mann-Whitney U test was conducted to compare the time clinical pharmacists took to intervene in enteral

nutrition compared to PN. The test showed a difference between population means ($p < 0.001$, 95% Confidence Interval). The results are shown in table 5.

Table 5: Mann Whitney U Test

						95% Confidence Interval		
		Statistic	p	Mean difference	Lower	Upper		Effect Size
Time Taken	Mann-Whitney U	121	< .001	-5.00	-10.00	-5.00	Rank biserial correlation	0.757

Note. $H_a \mu_{\text{Enteral feeding}} \neq \mu_{\text{TPN}}$

3.7. Time took by clinical pharmacists to intervene: paediatric compared to adult

Mann Whitney U Test was conducted to compare the time clinical pharmacists took to intervene in a paediatric

group compared to the adult group. The test showed a difference between population means ($p < 0.001$, **95% Confidence Interval**). The results are shown in table 6.

Table 6: Mann Whitney U Test

						95% Confidence Interval		
		Statistic	p	Mean difference	Lower	Upper		Effect Size
Time Taken	Mann-Whitney U	706	0.001	-1.88e-5	-5.00	-5.60e-5	Rank biserial correlation	0.354

Note. $H_a \mu_{\text{Adult}} \neq \mu_{\text{Paediatric}}$

4. DISCUSSION:

Few studies have investigated the role of clinical pharmacists in intensive care units in general [20-28]. This study was conducted at KHCC, a specialized cancer centre in Jordan. KHCC is considered a role model for other hospitals in Jordan as it is the only centre providing specialized nutrition support pharmacy services.

Despite the low number of clinical pharmacists' interventions in nutrition support therapy (0.95%), it is considered significant as it is the first experience in Jordan. More studies are needed to investigate the barriers that prevent applying nutrition support pharmacy services in Jordan. Further studies are also required to determine the impact of applying these services on patient outcomes.

This study found that clinical pharmacists had provided direct patient care to patients receiving nutrition support therapy, contrasting the findings of a study investigating the pharmacist's role in parenteral nutrition therapy in Kuwait [32]. The Kuwaiti study found that pharmacists in six governmental hospitals and one private hospital in Kuwait mainly performed technical tasks such as compounding total parenteral nutrition with minimal role in providing direct patient care [32].

This is the first study to describe clinical pharmacists' interventions in managing nutrition support therapy in the ICU cancer setting up to the authors' knowledge. This is one of the strengths of the current study. Our research team found that the most frequent interventions of clinical pharmacists were related to parenteral nutrition, followed by enteral nutrition. These findings were consistent with a prospective Chinese study conducted over one year in an ICU at an academic hospital in China [32]. Our research team also found that the most frequent interventions of clinical pharmacists in the management of nutrition support therapy in ICU cancer patients were the evaluation, adjustment, and monitoring of TPN ($n = 75$, 78.9 %) followed by discontinuation of the nutrition support therapy ($n = 14$, 14.7 %). This differs from the findings of the aforementioned Chinese study, which found that parenteral prescription and delivery are the most frequent interventions [31]. This difference might be explained by the fact that the involvement of clinical pharmacists in the management of nutrition support therapy practice is relatively new, and this is the first experience in Jordan. Another study in the literature found that the top intervention of nutrition support service

pharmacists was general laboratory monitoring, which is consistent with the current study[33].

This study found that the number of clinical pharmacists' interventions related to nutrition support therapy was relatively low compared to the total number of clinical pharmacists' interventions in the ICU. This finding is consistent with a survey of American nutrition support clinicians, in which 23% stated that their institutions did not have dedicated pharmacists to review parenteral nutrition orders [35]. This highlights the need for more active participation of clinical pharmacists in managing nutrition support therapy.

This was the first study to investigate the mean time the clinical pharmacist took to intervene in the management of nutrition support therapy in the cancer ICU setting. To the best of our knowledge, no previous studies are in the literature, which is another strength of this study.

The interventions in this study took between 2 and 45 minutes, while the findings of a related study showed that most pharmacist interventions in a university hospital setting took between 15 and 30 minutes to complete [35]. The current study was conducted in the ICU at a specialized cancer centre, while the other study in the literature was conducted at a university hospital in different departments. That would explain the difference between the two studies' findings. More studies are needed to investigate the factors affecting the time needed to provide clinical pharmacy interventions across different populations and health services. It would benefit the strategic planning and management of clinical pharmacy services.

The findings of this study highlighted the importance of exploring the time clinical pharmacists take to make interventions in the management of nutrition support therapy in ICU settings. These findings pave the way for future studies in different settings to determine the

efficiency of clinical pharmacy services. More studies are needed to investigate the barriers that prevent applying nutrition support pharmacy services in Jordan. Further studies are also required to determine the impact of applying this service on patient outcomes.

The current study's limitation is the likely less-than-perfect documentation of intervention due to the retrospective design, which should be acknowledged. In addition, all interventions were included without running a quality appraisal for their content.

5. Conclusion:

This retrospective analysis described clinical pharmacist-delivered interventions in managing nutrition support therapy in the ICU cancer setting in Jordan. Clinical pharmacists have a role in managing specialized nutrition support therapy. The prevailing clinical pharmacist intervention was TPN's evaluation, adjustment, and monitoring. Nutrition support pharmacy services for critically ill cancer patients are uncommon in Jordan and could only be reported at KHCC. The number of clinical pharmacists' interventions related to nutrition support therapy was relatively low compared to the total number of clinical pharmacists' interventions in the ICU. However, this is considered significant as it is the first experience in Jordan. More studies are needed to investigate the barriers that prevent applying nutrition support pharmacy services in Jordan. Further studies are required to determine the impact of applying this service on patients, the cost of treatment, and the length of hospitalization.

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Conflict of interest

No potential conflict of interest relevant to this study was reported.

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خدمات صيدلة الدعم الغذائي في مرضى السرطان في وحدات العناية المركزة: تحليل تداخلات الصيدلة السريرية

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ملخص

الأهداف: تهدف هذه الدراسة إلى تحليل تدخلات الصيدلة السريرية في إدارة علاج دعم التغذية في مرضى السرطان المصابين بأمراض خطيرة الذين يتم إدخالهم إلى وحدات العناية المركزة.

الطريقة: تم إجراء تحليل بأثر رجعي ل 9949 تدخلا صيدليا سريريا تم الإبلاغ عنها إلكترونيا للمرضى الذين تم إدخالهم إلى وحدة العناية المركزة من يناير 2020 إلى ديسمبر 2022. تم تضمين وتحليل جميع سجلات المرضى مع تدخلات الصيدلة السريرية المتعلقة بعلاج دعم التغذية في مرضى السرطان في وحدة العناية المركزة.

النتائج: كان متوسط عمر المشاركين في الدراسة 38.1 سنة. وبلغ عدد التدخلات المتعلقة بإدارة العلاج الداعم للتغذية 95 تدخلا. كان متوسط الوقت الذي استغرقه الصيدلي السريري للتدخل 19.2 دقيقة. كانت التغذية الوريدية هي الفئة الأكثر استخداما من علاجات دعم التغذية. كان تقييم وتعديل ومراقبة التغذية الوريدية الكلية هو التدخل الأكثر شيوعا للصيدلة السريرية.

الخلاصة: يلعب الصيدلة السريريون دورا في إدارة العلاج المتخصص لدعم التغذية. كان تدخل الصيدلة السريرية السائد هو تقييم وتعديل ومراقبة التغذية الوريدية الكلية. هناك حاجة إلى مزيد من الدراسات للتحقيق في العوامل التي تؤثر على الوقت اللازم لتوفير تدخلات الصيدلة السريرية عبر مختلف السكان والخدمات الصحية.

الكلمات الدالة: خدمات الصيدلة الإكلينيكية، صيدلية دعم التغذية، السرطان، الرعاية الحرجة.

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