

# Role of Clinical Pharmacy Services in Vitamin Supplementation in Critically Ill Cancer Patients: A 3-Year Retrospective Study at a Comprehensive Cancer Centre

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## ABSTRACT

**Background:** Clinical pharmacists provide nutrition support pharmacy services, including evaluating micronutrient status and managing vitamin use. However, only a limited number of studies have explored the role of clinical pharmacists in managing vitamin supplementation.

**Objective:** To explore clinical pharmacists' interventions in managing vitamin supplementation in critically ill cancer patients admitted to intensive care units.

**Methods:** This retrospective analysis reviewed 9,949 electronically reported clinical pharmacist interventions for patients admitted to the ICU from January 2020 to December 2022. All patient records with clinical pharmacists' interventions related to vitamin supplementation in ICU cancer patients were extracted and analyzed.

**Results:** The total number of interventions related to vitamin management was 129 (1.30%). Vitamin D was the most commonly used vitamin supplement (n = 39, 30.2%). Initiation of vitamin supplementation (n = 55, 42.6%) was the most frequent intervention by clinical pharmacists. The acceptance rate by physicians was 100%.

**Conclusion:** Clinical pharmacists play a key role in managing nutrition support therapy and vitamin supplementation in critically ill cancer patients. This study represents the first experience in Jordan and serves as a role model. Further research is needed to investigate barriers to implementing nutrition support pharmacy services and vitamin supplementation in Jordan, as well as to explore the impact of these services on patient outcomes.

**Keywords:** Clinical pharmacy services, nutrition support pharmacy, vitamins, critical care.

## 1. INTRODUCTION

Clinical pharmacy aims to optimize the use of medicines [1]. It represents a field of professional practice and research that encompasses pharmaceutical care but is not limited to it [1]. The clinical pharmacy discipline has evolved into many specialties, including nutrition support pharmacy [2]. Clinical pharmacists are essential members of critical care health teams, contributing to the safety and management of medications for this vulnerable population [3–11]. Vitamins are nutrients that the body needs in small

amounts to function properly and maintain health. They are classified as either fat-soluble or water-soluble [13]. Clinical pharmacists provide nutrition support pharmacy services, including evaluating micronutrient status and managing vitamin supplementation [11,12]. These activities have been shown to improve patient outcomes and reduce healthcare-related costs [12,17–19]. Timely nutritional therapy should be considered for patients undergoing anticancer treatment who are at risk of malnutrition [14–16].

Oxidative stress and inflammation are physiological responses to injury during critical illness. Under normal conditions, the human antioxidant defense system counteracts inflammation and oxidative stress. However,

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this antioxidant capacity is often significantly compromised, and serum levels of micronutrients, including vitamins, are markedly depleted in critically ill patients [21]. Although the evidence remains inconclusive, treating micronutrient deficiencies is expected to enhance clinical outcomes in critically ill patients [20].

Vitamins and minerals are among the most commonly recommended and dispensed classes of complementary medicines by pharmacists [22]. A lack of scientific evidence and reliable information sources are common barriers to the practice of complementary medicine [22,23].

A limited number of studies have explored the role of clinical pharmacists in managing vitamin use, particularly in critical care settings [26–32].

Based on the above and due to the lack of information about the role of clinical pharmacists in vitamin supplementation in critically ill cancer patients in Jordan, this study aimed to analyze clinical pharmacists' interventions in managing vitamin use in ICU cancer patients at King Hussein Cancer Center (KHCC).

## 2. METHODS

Ethical approval was granted by the Institutional Review Board (IRB) at King Hussein Cancer Centre (KHCC) on 25 October 2021 (approval number RC/2021/153).

This retrospective analysis included electronically

reported clinical pharmacist interventions for 9,949 patients admitted to intensive care units at KHCC in Amman, Jordan, from January 2020 to December 2022. All patient records with clinical pharmacist interventions related to managing vitamin supplementation in ICU cancer patients were extracted and analyzed. The time taken by clinical pharmacists to intervene was routinely recorded in the pharmacy database. Intervention times were collected and analyzed for all cases.

Patients were categorized into two age groups: adults (older than 18 years) and pediatrics (18 years or younger). Descriptive statistics were used to present the results as frequencies and percentages.

The Mann–Whitney U test was applied to compare the time taken by clinical pharmacists to intervene between the pediatric and adult ICU patient groups.

All analyses were performed using the Jamovi statistical package (2022) [24,25]. A p-value of less than 0.05 was considered statistically significant.

## 3. RESULTS

### 3.1. Participants characteristics

The study population comprised pediatric patients (n = 29, 22.5%) and adult patients (n = 100, 77.5%). Most participants were male (n = 78, 60.5%). The majority of patients were admitted to the ICU in 2020 (44.2%), followed by 2021 (35.7%). Table 1 summarizes the participants' characteristics.

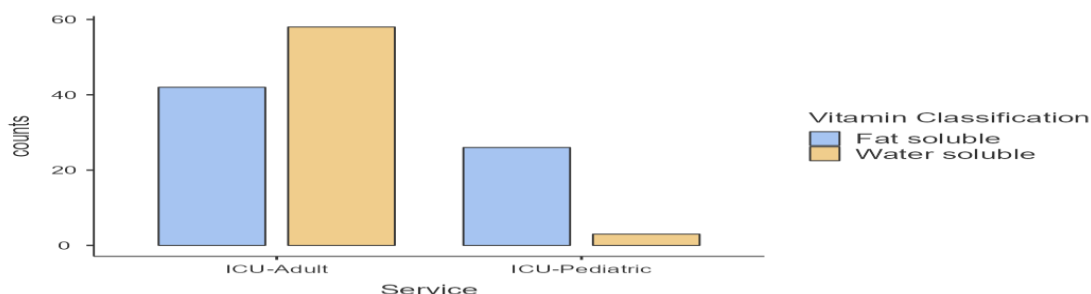
**Table 1: Characteristics of participants**

|             |           |        |    |         |       | Percentiles |         |        |  |
|-------------|-----------|--------|----|---------|-------|-------------|---------|--------|--|
| Age group   |           | Gender | N  | Median  | IQR   | 25th        | 50th    | 75th   |  |
| Age (years) | Adult     | F      | 40 | 59.50   | 15.25 | 47.75       | 59.50   | 63.0   |  |
|             |           | M      | 60 | 57.00   | 18.00 | 50.25       | 57.00   | 68.3   |  |
|             | Pediatric | F      | 11 | 11      | 10.00 | 6.00        | 11.00   | 16.0   |  |
|             |           | M      | 18 | 9.50    | 12.25 | 4.75        | 9.50    | 17.0   |  |
| Date        | Adult     | F      | 40 | 2021.00 | 1.00  | 2020.00     | 2021.00 | 2021.0 |  |
|             |           | M      | 60 | 2020.00 | 1.00  | 2020.00     | 2020.00 | 2021.0 |  |
|             | Pediatric | F      | 11 | 2021    | 1.00  | 2021.00     | 2021.00 | 2022.0 |  |
|             |           | M      | 18 | 2021.00 | 1.00  | 2021.00     | 2021.00 | 2022.0 |  |

### 3.2. Vitamin supplement use in critically ill cancer patients admitted to ICU.

Fat-soluble vitamins (n = 68, 52.7%) were the most commonly used vitamin supplements (Figure 1). Vitamin D was the most frequently used individual supplement (n = 39, 30.2%), followed by vitamin C (n = 29, 22.5%),

vitamin K (n = 28, 21.7%), and folic acid (n = 14, 10.9%). The forms of vitamin D supplementation included cholecalciferol (n = 29, 74.4%) and alfacalcidol (n = 10, 25.6%). Table 2 shows the frequencies of these supplements.



**Figure 1: Frequency of use of fat-soluble and water-soluble vitamins in critically ill cancer patients admitted to ICU at KHCC**

**Table 2: Frequencies of supplements**

| Supplement  | Gender | Age group | Counts | % of Total | Cumulative % |
|-------------|--------|-----------|--------|------------|--------------|
| Folic acid  | F      | Adult     | 3      | 2.3 %      | 2.3 %        |
|             |        | Pediatric | 0      | 0.0 %      | 2.3 %        |
|             | M      | Adult     | 11     | 8.5 %      | 10.9 %       |
|             |        | Pediatric | 0      | 0.0 %      | 10.9 %       |
| Thiamine    | F      | Adult     | 3      | 2.3 %      | 13.2 %       |
|             |        | Pediatric | 1      | 0.8 %      | 14.0 %       |
|             | M      | Adult     | 7      | 5.4 %      | 19.4 %       |
|             |        | Pediatric | 1      | 0.8 %      | 20.2 %       |
| Vitamin B12 | F      | Adult     | 1      | 0.8 %      | 20.9 %       |
|             |        | Pediatric | 0      | 0.0 %      | 20.9 %       |
|             | M      | Adult     | 4      | 3.1 %      | 24.0 %       |
|             |        | Pediatric | 1      | 0.8 %      | 24.8 %       |
| Vitamin C   | F      | Adult     | 13     | 10.1 %     | 34.9 %       |
|             |        | Pediatric | 0      | 0.0 %      | 34.9 %       |
|             | M      | Adult     | 16     | 12.4 %     | 47.3 %       |
|             |        | Pediatric | 0      | 0.0 %      | 47.3 %       |
| Vitamin D   | F      | Adult     | 15     | 11.6 %     | 58.9 %       |
|             |        | Pediatric | 3      | 2.3 %      | 61.2 %       |
|             | M      | Adult     | 17     | 13.2 %     | 74.4 %       |
|             |        | Pediatric | 4      | 3.1 %      | 77.5 %       |
| Vitamin E   | F      | Adult     | 0      | 0.0 %      | 77.5 %       |
|             |        | Pediatric | 0      | 0.0 %      | 77.5 %       |
|             | M      | Adult     | 0      | 0.0 %      | 77.5 %       |

| Supplement | Gender | Age group | Counts | % of Total | Cumulative % |
|------------|--------|-----------|--------|------------|--------------|
|            |        | Pediatric | 1      | 0.8 %      | 78.3 %       |
| Vitamin K  | F      | Adult     | 5      | 3.9 %      | 82.2 %       |
|            |        | Pediatric | 7      | 5.4 %      | 87.6 %       |
|            | M      | Adult     | 5      | 3.9 %      | 91.5 %       |
|            |        | Pediatric | 11     | 8.5 %      | 100.0 %      |

### 3.3. Role of clinical pharmacists in the management of vitamin supplementation

The initiation of vitamin supplementation (n = 55, 42.6%) was the most frequent clinical pharmacist intervention in managing vitamins for ICU cancer patients, followed by discontinuation of vitamin supplementation (n

= 32, 24.8%). Table 3 provides details on the frequency of interventions. The total number of interventions related to vitamin management was 129 (1.30%). The total time spent on these interventions was 1,845 minutes, with a minimum of 1 minute and a maximum of 40 minutes per intervention (Table 4).

**Table 3: Frequencies of interventions for the management of vitamin supplementation.**

| Intervention                                   | Counts | % of Total | Cumulative % |
|------------------------------------------------|--------|------------|--------------|
| Clarification of orders                        | 2      | 1.6 %      | 1.6 %        |
| Dose clarified/evaluated                       | 17     | 13.2 %     | 14.7 %       |
| Drug Information provided                      | 2      | 1.6 %      | 16.3 %       |
| Duration of RX Order Clarified                 | 5      | 3.9 %      | 20.2 %       |
| Lab Evaluation                                 | 1      | 0.8 %      | 20.9 %       |
| Medication reconciliation/admission            | 14     | 10.9 %     | 31.8 %       |
| Route of administration clarified.             | 1      | 0.8 %      | 32.6 %       |
| Initiation of vitamin supplementation          | 55     | 42.6 %     | 75.2 %       |
| Discontinuation of the vitamin supplementation | 32     | 24.8 %     | 100.0 %      |

**Table 4: Times taken by clinical pharmacists to intervene in vitamin supplementation in ICU cancer patients at KHCC**

|            |                                     |    |        |      | Percentiles |       |       |
|------------|-------------------------------------|----|--------|------|-------------|-------|-------|
|            | Intervention                        | N  | Median | IQR  | 25th        | 50th  | 75th  |
| Time Taken | Clarification of orders             | 2  | 11.50  | 8.50 | 7.25        | 11.50 | 15.75 |
|            | Dose clarified/evaluated.           | 17 | 15     | 5.00 | 10.00       | 15.00 | 15.00 |
|            | Drug Information provided           | 2  | 3.00   | 0.00 | 3.00        | 3.00  | 3.00  |
|            | Duration of RX Order Clarified      | 5  | 10     | 0.00 | 10.00       | 10.00 | 10.00 |
|            | Lab Evaluation                      | 1  | 25     | 0.00 | 25.00       | 25.00 | 25.00 |
|            | Medication reconciliation/admission | 14 | 15.00  | 0.00 | 15.00       | 15.00 | 15.00 |
|            | Route of administration clarified.  | 1  | 40     | 0.00 | 40.00       | 40.00 | 40.00 |
|            | Therapy recommendation / Initiation | 55 | 15     | 0.00 | 15.00       | 15.00 | 15.00 |
|            | Therapy recommendation/Discontinue  | 32 | 15.00  | 0.00 | 15.00       | 15.00 | 15.00 |

The Mann-Whitney U test was used to compare the time clinical pharmacists took to intervene between the pediatric and adult ICU groups. The test showed no significant

difference between the two groups' intervention times (Table 5).

**Table 5: Mann-Whitney U test**

|                                                                      |                       | <b>Statistic</b> | <b>p</b>     |
|----------------------------------------------------------------------|-----------------------|------------------|--------------|
| <b>Time Taken</b>                                                    | <b>Mann-Whitney U</b> | <b>1393</b>      | <b>0.630</b> |
| <b>Note. <math>H_0: \mu_{ICU-Adult} = \mu_{ICU-Pediatric}</math></b> |                       |                  |              |
|                                                                      |                       |                  |              |

#### 4. Discussion

Clinical pharmacists play a role in managing vitamin supplementation in critically ill cancer patients in Jordan. Vitamin D was the most commonly used vitamin. The most frequent intervention by clinical pharmacists was initiating vitamin supplementation. The number of clinical pharmacists' interventions related to vitamin supplementation was relatively low compared to the total number of clinical pharmacist interventions in the ICU, which is consistent with a prospective study conducted at an academic hospital in China [26].

Although the number of interventions in vitamin supplementation was relatively low compared to overall clinical pharmacist interventions in the ICU, it is considered significant as this represents the first experience of its kind in Jordan. The nutrition support pharmacy services at KHCC are regarded as a role model. Further research is needed to explore barriers to implementing nutrition support pharmacy services, including the assessment of vitamin deficiencies and provision of vitamin supplements. Additional studies are also required to investigate the impact of vitamin supplementation and nutrition support pharmacy services on patient outcomes, healthcare expenditures, and length of hospital stay.

Most available evidence has focused on the role of community pharmacists in recommending complementary and alternative medicines, including vitamins and minerals [22,23]. This is the first study to provide insights into clinical pharmacists' interventions in managing vitamin

supplementation in critically ill cancer patients admitted to intensive care units in the Middle East. Only a few studies have investigated the role of clinical pharmacists in intensive care units generally [26-29]. None of the previous studies in the literature have explored the role of clinical pharmacists in vitamin supplementation specifically in critically ill cancer patients, which is one of the strengths of the current study.

This study explored the use of vitamin supplements in critically ill cancer patients, including different supplement forms. To our knowledge, it is the first study to examine the mean time clinical pharmacists took to intervene in vitamin supplementation in intensive care units at a comprehensive cancer center, which represents another strength of the study.

Clinical pharmacists' interventions ranged from 1 to 40 minutes, contrasting with a related study where most pharmacist interventions in a university hospital setting took 15 to 30 minutes to complete [29]. The current study focused exclusively on the role of clinical pharmacists in vitamin supplementation for cancer patients admitted to intensive care units. In contrast, the other study was conducted across various university hospital departments, which may explain the differences in findings between the two studies.

Further research is needed across different hospital departments and patient populations to identify factors affecting micronutrient supplementation and nutrition support pharmacy services. This is critical to improving the efficiency of these services.

A limitation of the current study, which should be acknowledged, is the likely incomplete documentation of interventions due to its retrospective design.

### 5. Conclusion

Clinical pharmacists play an important role in managing vitamin supplementation in Jordan. The initiation of vitamin supplementation is the most common clinical pharmacist intervention among critically ill cancer patients admitted to intensive care units. Nutrition support pharmacy services for these patients, including vitamin supplementation, remain uncommon in Jordan and have thus far only been reported at King Hussein Cancer Center. Although the number of clinical pharmacist interventions related to vitamin supplementation was relatively low

compared to the total number of interventions in the ICU, this finding is significant as it represents the first documented experience of its kind in Jordan. Further studies are needed to identify the barriers hindering the implementation of nutrition support pharmacy services, including vitamin supplementation, for critically ill cancer patients. Additional research is also required to assess the impact of these services on patient outcomes.

### Funding

No specific funding was obtained for this work.

### Conflict of interest

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

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## دور خدمات الصيدلة السريرية في صرف مكملات الفيتامينات لمرضى السرطان المصابين بأمراض خطيرة: دراسة استرجاعية لمدة ثلاث سنوات في مركز شامل للسرطان

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### ملخص

**الخلفية:** يقدم الصيادلة الإكلينيكيون خدمات صيدلانية داعمة للتغذية، تشمل تقييم حالة المغذيات الدقيقة وإدارة استخدام الفيتامينات. من الجدير بالذكر أن عدد الدراسات حول دور الصيادلة الإكلينيكيين في إدارة مكملات الفيتامينات محدود. **الهدف:** دراسة تدخلات الصيادلة الإكلينيكيين في إدارة مكملات الفيتامينات لدى مرضى السرطان ذوي الحالات الحرجة الذين دخلوا وحدات العناية المركزة.

**المنهجية:** هذا تحليل بأثر رجعي لـ 9949 تدخلًا صيدلانيًا سريريًا مُبلَّغًا عنها إلكترونيًا لدى مرضى دخلوا وحدة العناية المركزة من يناير 2020 إلى ديسمبر 2022. تم استخراج جميع سجلات المرضى التي تتضمن تدخلات الصيادلة الإكلينيكيين المتعلقة بمكملات الفيتامينات لدى مرضى السرطان في وحدة العناية المركزة، وتم تحليلها. **النتائج:** بلغ إجمالي عدد التدخلات المتعلقة بإدارة الفيتامينات 129 تدخلًا (1.30%). وكان فيتامين د أكثر مكملات الفيتامينات استخدامًا (n = 39، 30.2%). كان البدء بتقديم مكملات الفيتامينات (n = 55، 42.6%) التدخل الأكثر شيوعًا للصيادلة السريريين. وبلغ معدل قبول الأطباء 100%.

**الخلاصة:** للصيادلة السريريين دور في إدارة العلاج الداعم للتغذية ومكملات الفيتامينات لمرضى السرطان ذوي الحالات الحرجة. تُعد هذه التجربة الأولى من نوعها في الأردن، وتُعتبر نموذجًا يُحتذى به. هناك حاجة إلى مزيد من الدراسات لدراسة عوائق تطبيق خدمات صيدلية الدعم الغذائي ومكملات الفيتامينات في الأردن، واستكشاف تأثير هذه الخدمات على نتائج المرضى.

**الكلمات الدالة:** خدمات الصيدلة السريرية، صيدلية الدعم الغذائي، الفيتامينات، الرعاية الحرجة.

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