ISSN (O): 2349-5332
CODEN: IRJPHY

DISTRIBUTION PATTERNS OF EPOETIN ALFA IN JORDANIAN ROYAL MEDICAL SERVICES: A FOUR-YEAR ANALYSIS OF TWO MAJOR MILITARY HOSPITALS

Haya Mohammed Najeeb Batiha;PH[1], Majedah Mustafa Mahmoud Jaradat;PH[1], Ahlam Jamil Abd Al Rahman Al Khatatbeh;MD[2], Gharam Khalid Mugbel Hrahsheh ; MD[2], Ruba Daher Mahmoud Quraan;PH[1].

[1]Pharmacist, Royal Medical Services, Jordan.
[2] Medical Doctor, Royal Medical Services, Jordan.

Submitted on: 04.01.2026; **Revised on:** 06.01.2026; **Accepted on:** 07.01.2026

ABSTRACT

Introduction: The top-tier integrated healthcare systems have high-quality and financially sustainable delivered care due to the effective allocation of resources across the system. At all levels of the healthcare system, cost and resource allocation efficiency are most important for high-quality and financially sustainable delivered healthcare. Specific to the intricacies of cost management within the integrated healthcare systems, Epoetin alfa, utilized for treating anemia in patients with chronic kidney disease and cancer, and the cost management before the administration of Epoetin alfa in any of its available formulations (2000 UI and 4000 UI) becomes necessary.

Objectives: The study focused on distribution patterns and redistribution of Epoetin alfa (2000 UI and 4000 UI) within the King Hussein Medical Hospital and Prince Rashid Ben Al-Hasan Military hospital hospitals, part of the Jordanian Royal Medical Services (JRMS), over the period 2020 to 2023. Average monthly redistribution figures from the Main JRMS warehouses are analyzed and utilized in this research to assess the distribution based on the consumption trends and ascertain resource allocation, use, and preferences based on variability by institution. Enhanced understanding of the distribution of medicine in military healthcare systems to help inform managers, pharmacists, and members of the supply chain professionals is the goal of this research.

Methodology: A retrospective quantitative layout will be utilized using legit JRMS warehouse distribution information for both dosage strengths. Verified information from 2020–2023 will be analyzed using descriptive statistics (etc., mean, median, standard deviation) and trend analysis to discover temporal changes in medication use. Comparative evaluation will investigate health facility-particular intake levels, formula preferences, and stability patterns. Annual growth rates and coefficients of variant will quantify utilization consistency and spotlight variability requiring centered control. Data visualization will illustrate distribution tendencies and inter-hospital variations.

Results: The analysis of 13,117 distributed doses revealed a strong network-wide preference for the 4000 IU formulation, which constituted 88.0% of total consumption. Prince Rashid Ben Al-Hasan Military Hospital (PRH) demonstrated a highly standardized utilization pattern, with the 4000 IU strength accounting for 94.3% of its usage and exhibiting a low Coefficient of Variation (CV) of 17.2%, indicating high predictability. In contrast, King Hussein Medical Hospital (KHMC) showed greater variability (CV 34.8% for 4000 IU) and a significant, anomaly-driven spike in 2000 IU usage in 2022 (rising to 785 doses from 0 in 2021). This surge in the lower-strength formulation coincided with a decline in 4000 IU availability, suggesting a reactive therapeutic substitution in response to supply chain disruptions.

Corresponding author: H. M. N. Batiha
e-mail: batihahaya@gmail.com,
Mobile No: 00962776216258

Indian Research Journal of Pharmacy and Science; 45(2025); 3451-3461
Journal Home Page: https://www.irjps.in

1. INTRODUCTION:

The effective management of pharmaceutical supply chains is a defining aspect of modern, integrated healthcare, especially in the context of high-priced, clinically indispensable therapeutics. [1]. In limited resources such as a national military medical service, the effectiveness of drug delivery has direct implications on not only the finances of the healthcare system but also the quality of patient care as well [2]. Jordanian Royal Medical Services (JRMS) provides a widespread network of clinics and hospitals, thus, providing healthcare services to the military personnel and dependent persons. This simplification of the process of distributing necessary pharmaceuticals within this network becomes a strategic necessity.

Epoetin alfa is a recombinant human erythropoietin, which is a vital drug utilized in the management of chronic kidney disease (CKD) related anemia, oncologic chemotherapy, and other pathologies [3]. It has a high acquisition price that makes its stock and distribution worth a huge sum to any hospital formulary [4]. Disparity in dosage strengths of epoetin alfa vis-a-vis 2000 IU and 4000 IU avails clinical flexibility and at the same time initiates a twist to the logistical and inventory management procedure.

The current study is focused on the distribution of epoetin alfa in two hospitals with most significant role in the JRMS system, i.e. King Hussein Medical Hospital (KHMC) and Prince Rashid Ben Al-Hasan Military Hospital (PRH). This study is going to offer an insight beyond mere reporting of consumption by analyzing four years of the distribution data (2020-2023) to trace background trends, institutional preference and even provide insight into how demand does vary on account of such preferences. The discussed period is especially timely since it includes the risks and shocks caused by the global COVID-19 outbreak that challenged the strength of healthcare supply chains across the globe [5].

The objectives of this research are;

1. To determine the number of aggregate distributions of epoetin alfa and to compare the total utilization of epoetin alfa in KHMC and PRH.

2. To ascertain the preference of formulations (2000IU vs 4000IU) in each hospital, and to examine the clinical and logistical consequences of this choice.

3. To estimate the time stability of epoetin alfa distribution through Coefficient of Variation (CV), to examine year-to-year rates of growth in order to determine meaningful trend and aberrations.

4. To provide evidenced-based solutions to the JRMS management, pharmacists, and supply-chain professionals, and, therefore, optimize the purchasing and distribution of epoetin alfa and similar high-priced drugs.

The outcome findings will contribute to a paucity of the body of literature in pharmaceutical supply-chain management in the military healthcare settings, offering a comprehensive case study of the Middle East region.

2. LITERATURE REVIEW:

2.1. Epoetin Alfa: Medical Usage and Cost Effectiveness: Epoetin alfa belongs to the group of erythropoiesis-stimulating agent (ESA). Its mechanism of action involves stimulation of bone marrow hematopoiesis and thus it alleviates anemia [3]. The key indications of its use are anemia related to chronic kidney disease (CKD) and anemia caused by chemotherapy [6]. The choice between different ESA formulations and dosage levels (i.e., 2000 IU, 4000 IU, etc) is also a complicated clinical issue, which depends on the patient body weight, desired hemoglobin concentrations, the route of administration (IV/SC/etc.), and the dose frequency. [7].

even though the economic effects of ESAs are high. Because of their high cost, they form a considerable expenditure in the hospital formularies [4]. Studies examining the cost-effectiveness of ESAs often deal with dosage optimization to determine the optimal results of target hemoglobin levels at minimal drug wastage and side effects. The rationale between using weaker (2000 IU) and stronger (4000 IU) formulations is generally pivotal on the issue of inventory simplification and clinical leeway. Stronger preparations can reduce the volume of units needed in management, which may decrease administration and

inventory expenses, but weaker preparations are still essential in the accurate dose titration, especially in small patients such as children or adults with specific ailments.

2.2. Supply Chain Management of Pharmaceutical in Healthcare: Practically, pharmaceutical supply-chain management (PSCM) becomes attributed with the ability to provide the right drug, in the right amount, at the right time, to the right patient, at the lowest possible cost (1). The main aspects of PSCM include procurement, inventory, distribution and information technology integration (10). In multi-facility system like the Jordanian Military Health System (JRMS) whereby procurement is centralized and distribution is decentralized, the need to capitalize on the economies of scale without compromising the nimbleness demanded by autonomous hospital units through the advancement of the coordination strategies is a must (2).

The amount of money that a hospital spends on inventory may constitute a significant percentage of the overall operating expenses (1). In high value products, including Epoetin alfa, the risk of stock out that may undermine patient care as well as excessive inventory that may cause a loss of money through expiry or wasted capital is especially high. PSCM in the present day focuses more on the demand forecasting with the help of the previous consumption history and predictive analytics which allow to reduce these risks (5).

2.3. Supply Chain Threats and Challenges in Military Healthcare: Having a different set of constraints and needs, military healthcare systems, such as the JRMS, are required to maintain a high standard of preparedness, and often they cater to a special group of patients (e.g. military personnel and families) that have a unique health profile (11). Their supply chains are normally centralized and hierarchical designed to be resilient and deploy fast, which are sometimes inconsistent with the flexibility they might require in their daily medical practices (11).

Military healthcare logistics studies have highlighted the importance of having highly resilient and versatile supply chains that are resistant to external shocks, including geopolitical instability or pandemics (10). The COVID-19 pandemic made the study period (2020-2023) an acute time in evaluating the strength of the JRMS distribution system. International manufacturing and shipping has been impacted during this period and this may have had a direct effect on the supply of erythropoiesis-stimulating agents (ESAs), forcing hospitals to change their prescription and supply strategies (3).

2.4. Jordan Logistics in the Healthcare Industry: The research focusing on the Jordanian medical industry focuses on the adoption of information technology to improve the supply-chain effectiveness (5). Even though most of the available literature is about the case of private hospitals, the concepts of effective inventory management and how dimensions of the supply-chain affect service quality are universal (1). The JRMS, as a large provider in the public, faces the difficulty of balancing the high count of patients to service without going against the strict budgetary demands by the government. The detailed analysis of the particular situation of pharmaceutical distribution in Jordan is crucial to interpreting the results of the study because military hospitals are centralized in the national healthcare system of the country (2).

The present study is informed by this background as it provides a quantitative study on a single, high-value medication in the JRMS, as it correlates distribution statistics to future clinical and logistical predictors.

2.5. The Dosage Strength and Role in Clinical and Logistical Decision: Epoetin alfa is provided in various dosage levels including 2,000 IU and 4,000 IU and this is an intentional move by the manufacturers to suit the needs of various patients as well as the protocols involved in Epoetin alfa usage. The 2000 IU strength is ritually chosen to titrate the initial dose especially in patients with mild anemia, those sensitive to the drug, smaller groups of patients such as pediatrics (9). It allows more precise regulation of the hemoglobin increment, and in such a way it reduces the risks of the rapid hemoglobin correction including high blood pressure and thrombotic complications (8).

On the other hand, the 4000 IU strength is used as the major formulation to give maintenance therapy particularly in adult patients with chronic kidney disease who are under dialysis. The use of stronger vial makes preparation and administration easier, which

may limit nursing time and minimize the risk of medication errors (4). Logistically, control of less of a stronger product is usually translated to high efficiency. It will reduce the amount of physical space needed to store inventory, it will make inventory counts less difficult, and in general it can assist in reducing the administrative expenses (1). The strong bias of 4000 IU formulation in JRMS data is the same that can be noted in the world tendency towards the efficiency of logistics in large scale environments.

2.6. The effects of the external shocks on the Chains of the Pharmaceutical Supply: The epoch of 2020-2023 was marked by a significant global shock following the COVID-19 pandemic that caused vulnerabilities in the international pharmaceutical supply chain which functioned through the use of foreign-made production and shipping services (3). Military healthcare systems are more insulated due to strategic stockpiling yet most of them were susceptible to such pressures.

The substitution processes in the JRMS data showed by the spike in the 2000IU use at the time of a decrease in the 4000IU use can be directly attributed to the supply-chain bullwhip effect (10). This is the effect that small changes in demand at the retail level (the hospital) may have on causing increasingly larger changes up the supply chain (central warehouse or manufacturer). With a sensitive health care requirement like the Epoetin alfa, the slightest delay in shipment by the manufacturer of the required product may lead to the central warehouse ordering the preferable 4000 IU dose rationed, resulting in the hospitals being forced to deplete their emergency inventory of the 2000 IU dose. The result of such reactive consumption is a volatile demand signal that is very difficult to predict and control (11).

Moreover, the pandemic period was characterized by a change in patient care, which may include disruption in dialysis schedules or the interruption of routine oncologic treatment, both of which may lead to the change in the patient mix and, therefore, the demand of ESAs (6). The following temporal analysis and more specifically the year-over-year growth rates gives a proxy of the system to measure the adaptive capacity of the system when it is exposed to this unprecedented external shock.

2.7. The need of Data Based Inventory Modelling: The traditional inventory models include the Economic order quantity (EDO) model that assumes constant and unchangeable demand. Yet, the Coefficients of Variation (CV) were much greater than 120 per cent at both the King Hussein Medical Centre (KHMC) and the Prince Rashid BenAl-Hasan Military Hospital (PRH), indicating that in this case, it is not feasible to assume this. An example is the use of the 2000 IU dose, which is intermittent demand, and which requires specialized forecasting techniques.

In this case of intermittent demand, methods like the one suggested by Croston or artificial intelligence methods that can identify and forecast the sudden bursts (anomalies) are a better alternative to average-based methods. Joint Resource Management System (JRM) and its centralized database is thus well placed to implement such superior analytics. As it has been indicated by classifying Epoetin alfa formulations into different classes of inventory (ex: the regularly used 4000/IU at PRH as a regular stock and 2000/IU variable stock as a contingency stock), the JRM can apply different inventory policies that maximize efficiency and reduce the risk of stock-out in the future (4).

3. METHODOLOGY:

3.1. Study Design and Data Source: This research utilized a quantitative analytic model that was retrospective. The data source was the official distribution records kept in the main medical warehouses of the JRMS and containing the average monthly amounts of Epoetin alfa (2000 IU and 4000 IU) redistribution to KHMC and PRH. The observation period is four full calendar years, that is 1 January 2020 to 31 December 2023. The unit of analysis was the average monthly combined number of doses discharged to each hospital every year of each formulation.

3.2. Data Analysis: Spss software was used to analyze the data. The statistical and comparative measures that were calculated were as follows:

A. Descriptive Statistics:

- Volume of Distribution: A cumulative of all doses being distributed to each hospital during the four years.
- Preference Pre-formulation: Percentage of total distribution volume of the 4000 IU and 2000 IU formulation of the respective hospital.
- Annual Mean and Standard Deviation: The environmental values of central tendency and dispersion of the annual distribution of each formulation in each hospital.

B. Trend Analysis (Year-over-Year Growth rate): It is a percentage change in the amount of distribution that has occurred in the previous year, which is used to determine the temporal trends and important changes in consumption.

C. Consistency and Comparable Analysis:

Coefficient of Variation (CV): (the standard deviation/ the mean) x 100. CV is a normalized measure of dispersion, so it can be directly compared with the relative stability (dispersion) in the distribution between the two hospitals and both formulations regardless of the absolute volume. A smaller CV will mean that it is more consistent and predictable.

Annual Formulation Ratio (4000 IU, 2000 IU): The ratio on the base of the dosage strength of 4000 IU doses versus 2000 IU doses distributed over a year, which will give the idea regarding the year–to-year clinical and inventory approach of the hospitals in terms of dosage strength.

4. RESULTS:

The analysis of the data provided a fully developed statistical portrait of Epoetin alfa distribution.

4.1. The overall Distribution and Formulation Preference: The total amount of Epoetin alfa distributed to KHMC within the four years (2020-2023) is 7199, the total distribution was about 21.6 percent higher than the distribution to PRH (5918) (table 1, figure 1).

Table 1: The overall Distribution of Epoetin alfa

Hospital	Total Distribution (Doses)	2000 IU (Doses)	4000 IU (Doses)	4000 IU Percentage of Total
KHMC	7,199	1,240	5,959	82.8%
PRH	5,918	339	5,579	94.3%
Total	13,117	1,579	11,538	88.0%

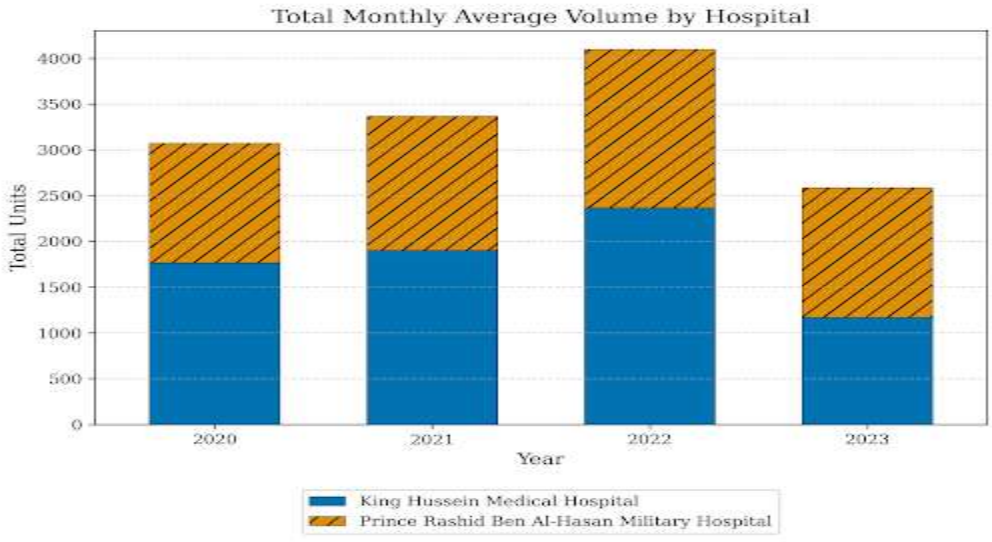

Figure 1: Total monthly average volume by hospital

The 4000 IU formulation is particularly favored in both facilities where it makes up 88.0 percent of all Epoetin alfa administered in two institutions. It is worth noting that PRH prefers 4000IU formulation (94.3%) over KHMC (82.8%). This difference implies that PRH may have a more standardized, high dose centric protocol or raised average dosing requirement of its patient population.

4.2. Distribution Consistency (Coefficient of Variation): To determine the relative stability of the volumes of annual distribution in each formulation in each hospital Coefficient of Variation (CV) was used (table 2).

Table 2: the relative stability of the volumes of annual distribution in each formulation in each hospital Coefficient of Variation (CV)

Hospital	Formulation	Annual Mean (Doses)	Standard Deviation (Doses)	Coefficient of Variation (CV)
KHMC	2000 IU	310.0	373.3	120.4%
KHMC	4000 IU	1,489.8	519.0	34.8%
PRH	2000 IU	84.8	134.8	159.1%
PRH	4000 IU	1,394.8	239.7	17.2%

4000 1U formulation is much more stable at PRH (CV equals 17.2 per cent) versus KHMC (CV equals 34.8 percent). This steep stability at PRH implies that there is a very predictable and stable usage trend which is beneficial in inventory management. On the other hand the 2000 IU formulation shows very high variability at both hospitals (CV > 120) thus it is very sporadic in usage and probably triggered by definite non routine clinical or supply chain events.

4.3. Temporal trends and anomalies: Anomalies often indicate a change in the expected behavior of the system under examination. Temporal trends and temporal anomalies often provide evidence of a variation in the expected behavior of the system being studied. The growth rates (year-on-year) highlight the dynamics of the Epoetin alfa distribution during the period of study (table 3, figure 2, and figure 3).

Table 3: Temporal trends and anomalies of Epoetin alfa distribution

Hospital	Formulation	2021 YoY Growth	2022 YoY Growth	2023 YoY Growth
KHMC	2000 IU	-100.0%	Inf	-45.1%
KHMC	4000 IU	9.4%	-17.0%	-53.3%
PRH	2000 IU	Inf	52.4%	793.8%
PRH	4000 IU	10.1%	18.1%	-33.5%

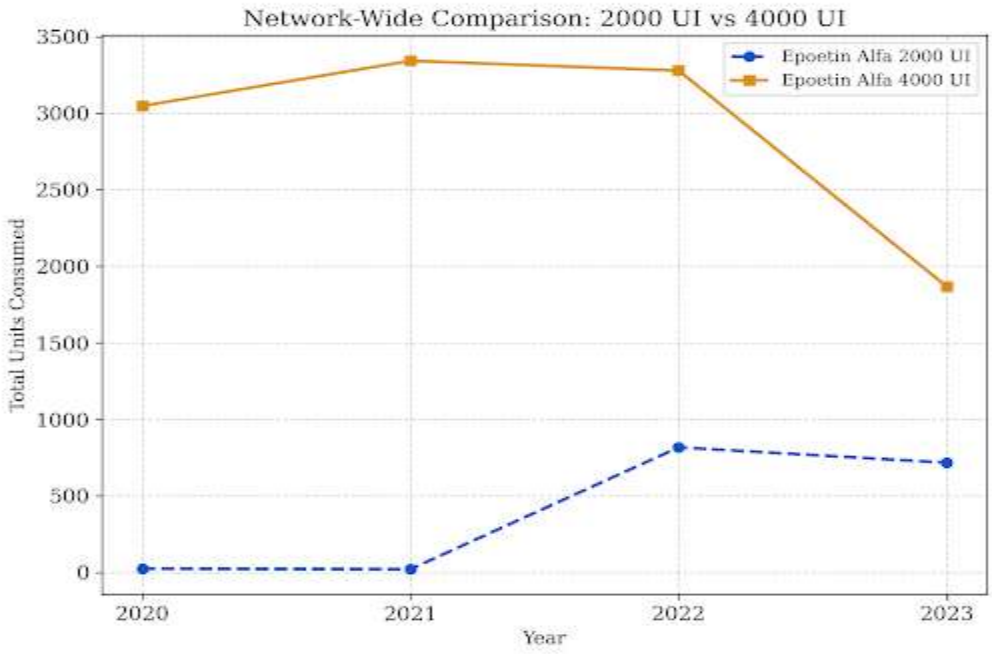

Figure 2: Network –wide comparison: 2000 UI vs 4000 UI

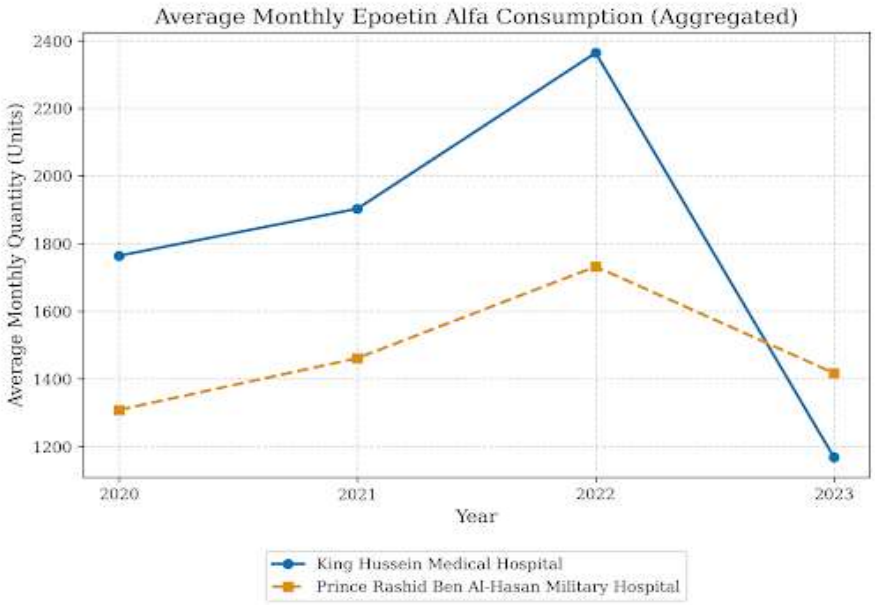

Figure 3: Average monthly Epoetin Alfa consumption

KHMC 2000 IU Spike (2022). The 2000 IU formulation distribution at KHMC dropped to 24 doses in 2020 and then skyrocketed to 785 doses in 2022, followed by a decrease down to 431 in 2023. The increase in the growth rate in 2021, of Inf (infinite), is a mathematical artefact due to a zero base in 2021. This sharp, short-lived spike in 2022 is a strong indication of the existence of a supply-side substitution event, as the 4000 IU formulation of interest was unavailable temporarily, and clinicians had to use the less powerful variant in order to meet the needs of patients.

PRH 2000 IU Surge (2023). Little use of the 2000 IU formulation was seen in PRH until 2023, when distribution increased by 793.8 per cent (32 doses in 2022 to 286 in 2023). This late-period spurt, which saw a reduction in 4000 IU distribution by 33.5 percent in the same year, suggests a similar but less pronounced replacement or a major shift in clinical practice to reduced dosage regimen.

4.4. Annual Formulation Ratio: The 4000 IU to 2000 IU dosage allocation per year depicts another example of changing preference (table 4).

Table 4: Annual Formulation Ratio

Year	KHMC (4000 IU : 2000 IU)	PRH (4000 IU : 2000 IU)
2023	1.71 : 1	3.95 : 1
2022	2.01 : 1	53.13 : 1
2021	Inf : 1	68.57 : 1
2020	72.50 : 1	Inf : 1

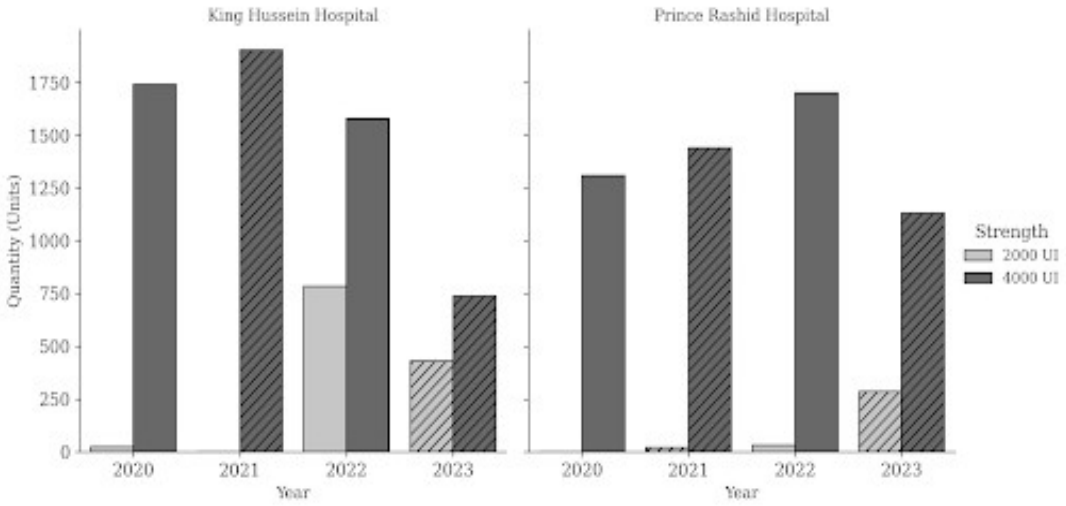

Figure 4: Annual Formulation Ratio

Extreme variability is confirmed by ratio analysis. The KHMC ratio decreased by 72.5:1 in 2020 to 1.71:1 in 2023, and in 2023 (the highest relative use of 2000 IU) it was the lowest ratio. The PRH ratio had been unusually high until 2023, when it declined due to the increase in 2000IU usage (3.95:1). The Inf values refer to the years where the 2000 formulation of IU was not disseminated at all (KHMC in 2021, PRH in 2020).

5. DISCUSSION:

The distribution patterns of Epoetin alfa in the JRMS network are analyzed to produce important information about the realities of pharmaceutical supply-chain management in a military medical establishment. The results highlight the primacy of the study two major hospitals differences on volume and consistency of consumption.

5.1. Differences in Institutional Utilization and Preference: This increased distribution overall volume at KHMC compared to PRH is likely to be due to the fact that it is a larger and more central referral hospital, with possibly a more extensive and more complex patient base, including more patients with end stage renal disease (ESRD) or cancer who may be on erythropoiesis-stimulating agent (ESA) therapy. The relative lack of formulation preference (82.8 3 at KHMC vs. 94.3 3 at PRH) is one of the significant results. The almost exclusive utilization of the 4000 IU formulation in PRH indicates a very standardized clinical guideline, which might have been instigated by the desire to simplify the inventory in as well as economical terms. This approach can reduce the dosing frequency of regimen needed to manage patients which, in turn, can potentially decrease administrative and inventory expenses and resonate with the best practices of high-volume and stable patient groups.

The fact that KHMC is more eager to use the 2000 IU formulation, although not always, also points to a more flexible or heterogeneous clinical setting. This is necessary to deal with patients who need strict dose adjustments, like the movement to dialysis and non-dialysis services or AKD patients with certain comorbid conditions.

5.2. Measuring Supply-Chain Risk and Response Practices: The 2000 IU distribution at both hospitals, especially the spike at KHMC in 2022 was greatly varied, and thus a good indication of stress in the supply-chain. In the perfect supply situation, consumption of the less desirable low strength formulation would be steady and low. The 2022 sharp upsurge in 2000 IU distribution at KHMC, which coincides with a large decline in 4000 IU distribution, could possibly indicate that the hospital simply had to utilize the existing 2000 IU storage as an alternative to the desired 4000 IU, perhaps, owing to a temporary stockout or an extreme shortage of the latter. This is often referred to as therapeutic substitution or inventory-driven prescribing, which is a typical demonstration of supply chain vulnerability to high costs, single-source drugs.

The PRH surge in 2000 IU use in 2023, although not so dramatic in absolute terms, indicates a similar, although later, adaptive response. The time difference between the two hospitals suggests that KHMC being the larger organization can suffer supply-chain pressures sooner or to a greater extent. Coefficients of variation (CV) of the 2000 IU formulation in the two hospitals prove that it does not follow consistent clinical demand but consistent reactive needs, which makes it an essential variable signifying supply-chain instability.

The CV is a potent non-unitary measure of measuring supply-chain risk. The 4000 IU formulation at PRH has a CV of 17.2 which is exceptionally low when compared to pharmaceutical products in general, signifying a high level of maturity in its operation and predictability in its usage of ESA. Conversely, a 2000 IU formulation of above 120 percent at the two hospitals indicate marked systemic risk and a major change in inventory approach of this product is required.

5.3. Inventory Management Implication: The analysis has some evident, quantitative implications to the inventory management of the Jordanian Royal Medical Services (JRMS). To begin with, it should have a differentiated inventory policy, it cannot have one-size-fits-all inventory policy. The intake of 4000 IU Epoetin alfa presented in Prince Rashid Ben Al-hasan Military Hospital (PRH) is highly balanced with a coefficient of variation (CV) of 17. 2% and promotes lean and just-in-time (JIT) inventory model and great confidence in demand forecasting. On the contrary, King Hussein Medical Hospital (KHMC) has higher variability (CV 34.8 percent, 4000IU) and needs a stronger safety stock and an adaptable forecasting model with possible cases of substitution. Second, the 2000 IU version forecasting must be considered differently; its infrequent use makes the usage of the conventional time-series forecasting useless. The 2000 IU product should be modelled as contingent inventory or alternation goods, the level of procurement should be related to the risk of stock outage of 4000 IU product and minimum requirement of clinical dose titration instead of the past average consumption. Third, the visibility of the supply-chain would be a major concern: the observed instances of substitution may be explained by the inability of the central warehouse and hospitals to observe each other in real-time. Installing a strong and well aligned

information system to provide the pharmacists and managers with real time stock levels throughout the network may result in proactive inter-hospital transfer so that the necessity of inventory-induced prescribing is reduced.

5.4. Military Healthcare Logistics Strategic Implications: Being a military healthcare system, the JRMS must not only be cost efficient, but operationally ready and strategically sound. The threats demonstrated through substitution events to the supply-chain represent a real risk to this mandate; any failure of the supply chain of a critical medication like Epoetin alfa would put the care of a relatively large segment of patients affiliated with the military in jeopardy. Choosing to have better inter-hospital coordination is, consequently, of significance especially in a military setting. JRMS needs to have a centralized command structure that will enable the fast and effective transfer of strategic medical assets. Evidence indicated that PRH, possessing a stable consumption, might be an effective strategic reserve of the 4000iU formulation, yet, KHMC which is more variable, needs a stronger internal safety stock. The adoption of a common and real-time inventory system is not only a logistical enhancement but a strategic requirement of staying ready in the whole chain.

JRMS supply chain is stressed tested by the analysis of the 2020-2023 period, which includes the COVID 19 pandemic. There was a reactive action in the adaptive use of the 2000 IU formulation, which proved to be, nevertheless, clinically effective. The subsequent policy should focus on the active approach, such as the diversification of suppliers, the filling of strategic stocks of important medicines, and the implementation of sophisticated predictive analytics that will enable the detection and elimination of external shocks in the future.

6. CONCLUSIONS:

This paper has managed to identify the patterns of Epoetin alfa (2000-IU and 4000-IU) distribution, comparing King Hussein Medical Hospital (KHMC) and Prince Rashid Bin Al-hasan Military Hospital (PRH) in the scope of 2020-2023 in the context of the Jordanian Royal Medical Services. The main findings can be summarized as follows: (i) Dominant Preference: high prevalence of 4000 IU in both hospitals, more so in PRH, which indicates that there is a clinical argument in favor of high-dose regimens in most patients; (ii) Stability Contrast: high prevailing use of 4000 IU at PRH that facilitates efficient inventory management, and higher deviations in 2000 IU of 4000 IU usage at KHMC in 2022 in particular, indicating a more complex or diverse operational environment; (iii) Supply Chain Vulnerability: The extreme variability and sporadic spikes in 2000 IU utilization at both hospitals, most notably at KHMC in 2022, is a clear indicator of supply chain vulnerability and the use of the lower-strength formulation as a reactive substitute for the preferred 4000 IU dose. This results can used to base the decision on optimization of the JRMS pharmaceutical supply chain to turn a reactive to a proactive inventory management model.

REFERENCES:

1. Al-Saa'da, R.J., Taleb, Y.K.A., Al Abdallat, M.E., Al-Mahasneh, R.A.A., Nimer, N.A. and Al-Weshah, G.A., 2013. Supply chain management and its effect on health care service quality: quantitative evidence from Jordanian private hospitals. *Journal of Management and Strategy*, *4*(2), p.42.
2. Management Sciences for Health (MSH) 2024, *Institutionalizing Pharmaceutical Procurement Frameworks in Jordan*, MTaPS Jordan Technical Brief, Management Sciences for Health, viewed 26 November 2025, https://www.mtapsprogram.org/wp-content/uploads/2024/04/MTaPS-Jordan-Technical-Brief-Pharmaceutical-Procurement-March-2024-2.pdf.
3. Schoener, B. and Borger, J., 2022. Erythropoietin stimulating agents. StatPearls.
4. Gauthier-Loiselle, M., Michalopoulos, S.N., Cloutier, M., Serra, E., Bungay, R., Szabo, E. and Guérin, A., 2021. Costs associated with the administration of erythropoiesis-stimulating agents for the treatment of anemia in patients with non-dialysis-dependent chronic kidney disease: a US

societal perspective. Journal of Managed Care & Specialty Pharmacy, 27(12), pp.1703-1713.

5. Abd Alraheem Aljazazi, N., 2021. The Impact of Information Technology on Supply Chain Management in health sector in Jordan. *مجلة كلية التربية (أسيوط)*, *37*(8), pp.26-50.
6. Crathorne, L., Huxley, N., Haasova, M., Snowsill, T., Jones-Hughes, T., Hoyle, M., Briscoe, S., Coelho, H., Long, L., Medina-Lara, A. and Mujica-Mota, R., 2016. The effectiveness and cost-effectiveness of erythropoiesis-stimulating agents (epoetin and darbepoetin) for treating cancer treatment-induced anaemia (including review of technology appraisal no. 142): a systematic review and economic model. *Health Technology Assessment*, *20*(13), pp.1-588.
7. Collins, A.J., Brenner, R.M., Ofman, J.J., Chi, E.M., Stuccio-White, N., Krishnan, M., Solid, C., Ofsthun, N.J. and Lazarus, J.M., 2005. Epoetin alfa use in patients with ESRD: an analysis of recent US prescribing patterns and hemoglobin outcomes. *American journal of kidney diseases*, *46*(3), pp.481-488.
8. Duh, M.S., Weiner, J.R., White, L.A., Lefebvre, P. and Greenberg, P.E., 2008. Management of anaemia: a critical and systematic review of the cost effectiveness of erythropoiesis-stimulating agents. *Pharmacoeconomics*, *26*(2), pp.99-120.
9. Thamer, M., Zhang, Y., Kaufman, J., Stefanik, K. and Cotter, D.J., 2006. Factors influencing route of administration for epoetin treatment among hemodialysis patients in the United States. *American journal of kidney diseases*, *48*(1), pp.77-87.
10. Mohammadian, M., Yaghoubi, M., Amin Jarrahi, M., Babaei, M., Bahadori, M., Teymourzadeh, E. (2022). 'Evaluating the Performance of Medical Equipment Supply Chain Management in Military Hospitals: A Case Study', *Journal of Military Medicine*, 23(1), pp. 75-89. doi: 10.30491/JMM.23.1.75
11. Nazer, L.H. and Tuffaha, H., 2017. Health care and pharmacy practice in Jordan. *The Canadian journal of hospital pharmacy*, *70*(2), p.150.
12. Crathorne, L., Huxley, N., Haasova, M., Snowsill, T., Jones-Hughes, T., Hoyle, M., Briscoe, S., Coelho, H., Long, L., Medina-Lara, A. and Mujica-Mota, R., 2016. The effectiveness and cost-effectiveness of erythropoiesis-stimulating agents (epoetin and darbepoetin) for treating cancer treatment-induced anaemia (including review of technology appraisal no. 142): a systematic review and economic model. *Health Technology Assessment*, *20*(13), pp.1-588.

CONFLICT OF INTEREST REPORTED: NIL; SOURCE OF FUNDING: NONE REPORTED