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ADDRESSING NUTRITIONAL NEEDS: LESSONS FROM A SUPPLY CHAIN PERSPECTIVE ON PEDIATRIC AND ADULT MULTIVITAMIN USE IN THE JORDANIAN ROYAL MEDICAL SERVICES HOSPITALS.

Deema Awwad Hassan Al Qawaqneh;PH[1], Rawan Amjad Farhan Khraisat;PH[1], Noor Rakan Ali Alabdallat;PH[1], Reem Mohammed AbdelRazzaq Al Hiari;PH[1], Duha Mansour Helal Al_Dhaisat;PH[1].

[1]Pharmacist, Royal Medical Services, Jordan.

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ABSTRACT

1. Introduction: Multivitamins serve as crucial supplements aimed at correcting nutritional deficiencies in individuals across both pediatric and adult demographics. In the Jordanian Royal Medical Services (JRMS), multivitamin tablets and syrups are systematically distributed from central medical warehouses to hospitals, with tablets predominantly given for adult patients and syrups meant for pediatric patients in need of treatment. Comprehending the dispensing variations of these formulations is essential for enhancing supply chain management and guaranteeing equitable access to needed medications. This research will analyze the dispensing habits of multivitamin tablets and syrups at three prominent JRMS hospitals: Prince Rashid Ben Al-Hasan Military Hospital, Prince Hashem Ben Al-Hussein Military Hospital, and Queen Alia Military Hospital, spanning a four-year timeframe from 2020 to 2023.

2. Objective: The main objective of this study is to examine the dispensing variations in multivitamin tablets and syrups within JRMS hospitals, with a focus on identifying habits of consumption and potential attitudes among healthcare providers. The study will additionally seek to evaluate the influence of stock shortages on dispensing practices and investigate the differences in utilization across various hospitals. The study seeks to better understand the factors that affect the dispensing of multivitamin formulations, thereby informing strategies to enhance supply chain efficiency and optimize the allocation of resources within the JRMS healthcare system.

3. Methodology: This investigation relies on a retrospective, quantitative methodology to examine dispensing data sourced from JRMS medical warehouses. The dataset will encompass the average monthly quantities of multivitamin tablets and syrups dispensed to the three hospitals on an annual basis from 2020 to 2023. Descriptive statistics will be employed to effectively summarize the data, while variations will be examined through percentage change calculations and visual representations, including bar charts. The research will analyze dispensing habits across hospitals and pinpoint potential intervals of stock shortages by examining shifts in dispensing quantities. The results will enhance our comprehension of multivitamin use in JRMS hospitals and guide future initiatives aimed at optimizing pharmaceutical supply chains and improving patient care.

Keywords: Multivitamin dispensing, pharmaceutical supply chain, Jordanian Royal Medical Services, pediatric multivitamin syrup, adult multivitamin tablets, medication utilization.

Corresponding Author: D. A. H. Al Qawaqneh
E-mail: dqawqneh@gmail.com,
Mobile No: 00962777001551

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1. INTRODUCTION:

Multivitamins are among the most commonly used dietary supplements worldwide and play an important role in addressing nutritional gaps [1]. In groups of people like younger patients, elder people, and those with diseases; where the foods people eat cannot meet the body's need, they are useful [1,2]. Multivitamins come in a lot of formulations with tablet and syrup being the most regularly prescribed. Doctors usually prescribe tablets for adult patients since they're easy to take, stable and easy to store. However, syrup is prescribed for pediatric patients since it's easy to swallow and tasty. The difference in the formulations is important because it shows that two different types of patients require multivitamins that their doctor prescribes.

To aid military personnel, their families and dependents the Jordanian Royal Medical Services (JRMS) has a central medical depot that distribute medications like multivitamins, which are as essential pharmaceuticals to the warehouses of its hospitals, Prince Rashid Ben Al-Hasan Military Hospital, Prince Hashem Ben Al-Hussein Military Hospital and Queen Alia Military Hospital are three of the largest hospitals of the JRMS which treat a large and varied population that includes adults as well as children and these hospitals hold great importance for the JRMS system and offering comprehensive healthcare to a large segment of the Jordanian population.

Understanding the dispensing patterns of multivitamin forms (tablets and syrups) is important for several reasons, first: it provides insights and perspectives into the distribution and utilization of those supplements within the JRMS healthcare system and therefore reflecting both patient needs and clinical preferences, second it highlights any potential disparities of differences in resource allocation or supply chain management which can influence the availability of those medications and others essential medications, third it also offers and presents an opportunity to identify trends and patterns which can be useful in informing future decision-making such as optimizing stock levels, addressing stock shortages and eventually improving patient care, however despite the importance of multivitamins in clinical practice there is limited research on their dispensing patterns particularly in military healthcare systems and most studies focus on the clinical efficacy of multivitamins or their part in addressing specific nutritional deficiencies with no or little attention being given to the logistical and operational characteristics of their distribution and that is why this study aims to fill this gap by examining and investigating the dispensing patterns of multivitamin tablets and syrups in JRMS hospitals over a four-year period (2020-2023).

This study aims to examine and evaluate the dispensing and distribution practices and habits of multivitamin tablets (for adults) and syrups (for pediatrics) within three of the JRMS hospitals during the study period which is from 2020 to 2023 and to identify trends in consumption and the existence of any potential preferences among each hospital healthcare providers for specific multivitamin forms and also to assess the impact and influence of stock shortages on dispensing patterns and resource allocation and finally to provide recommendations which can help in enhancing the supply chain and improving the availability of multivitamins in JRMS hospitals, this study is can be significant for numerous reasons: first it contribute and donates to the existing literature on medicine supply chain management principally in military healthcare systems, second it provides an actionable insights and perspectives for policymakers and administrators at the JRMS and therefore enabling them to make knowledgeable and informed decisions about inventory management and resource allocation, third it also highlights and demonstrate the importance of understanding hospital specific dispensing patterns which can vary based on the patient demographics, the clinical practices policies and the supply chain dynamics.

It focuses on the dispensing of multivitamin tablets and syrups from JRMS medical stores to three large military hospitals: Prince Rashid Ben Al-Hasan Military Hospital, Prince Hashem Ben Al-Hussein Military Hospital and Queen Alia Military Hospital and the study analysis is based on using the mean monthly quantities issued to each of those hospitals annually covering the period from 2020 to 2023 and the study does not assume any additional data and focuses exclusively on the dispensing patterns of multivitamin forms and by examining these patterns the study try to shed light on the use of multivitamins in JRMS hospitals, identify potential challenges in the supply chain and provide recommendations for improving the availability and accessibility of these essential supplements.

The remainder of this paper is composed as follows: (1) The methodology section which defines the data collection and their analysis process and includes the statistical techniques which have been used to identify trends and patterns, (2) The results section which presents the findings of the study and includes the resulting trends in dispensing patterns and resulted hospital-specific variations and discrepancies, (3) The discussion section which explores the implications of the findings and includes the potential factors which influenced the

dispensing patterns and what possible impact stock shortages had, (4) The conclusions section which summarizes the key findings and tries to provides recommendations for future research and practice.

2. METHOD:

2.1 Study Design and Data Source: The timespan of the retrospective investigation of this analysis was the period 2020-2023. Data of dispensing of multivitamin tablets and syrup from JRMS medical warehouses to three military hospitals were collected and analyzed and it included the annual average monthly quantities of multivitamin syrup (for the pediatric use) and for the tablet (for the adult use) supplied to each hospital. The data comes from JRMS inventory data showing what is dispensed to Prince Rashid Ben Al-Hasan Military Hospital, Prince Hashem Ben Al-Hussein Military Hospital and Queen Alia Military Hospital.

2.2 Data Analysis: The methodology of this study is designed to systematically analyze the dispensing patterns of multivitamin tablets and syrups in three large hospitals within the JRMS hospitals network over the study four-year period and in this study a retrospective quantitative approach was used and the study adopted data on average monthly quantities of forms of multivitamin dispensed from the JRMS medical warehouses to Prince Rashid Ben Al-Hasan Military Hospital, Prince Hashem Ben Al-Hussein Military Hospital and Queen Alia Military Hospital.

2.3 Study Design and Data Source: This study uses past dispensing data for multivitamin tablets and syrups in JRMS healthcare system where information regarding the average quantities of the two multivitamin forms dispensed from JRMS medical warehouses to the study military hospitals were obtained. The study is limited to three large military hospitals of JRMS network, Prince Rashid Ben Al-Hasan Military Hospital, Prince Hashem Ben Al-Hussein Military Hospital and Queen Alia Military Hospital which were selected because on their size, number of patients and their representations of patient demographics including both adults and children, also the study period 2020-2023 was selected based on a recent trend in dispensing pattern including the possible impacts of external factors such as the COVID-19 pandemic on pharmaceutical supply chains [3].

2.4 Data Analysis Framework: The dispensing data was analyzed in a stage wise manner in order to examine the presences of any trends, patterns or variations in the utilization of the different multivitamin forms and in the begging it involved organizing the data to a structured format which represents and shows the year, hospital and medication form (tablet/syrup) in order to make it easier to compare dispensing amounts by hospital and over time, next we started by studying the dispensing trends of multivitamin syrup and tablets over the years. The dispensing amounts for every year and each month were analyzed to see if any consistent increase or decrease exists over the years and analyzing the data for sharp drop in the dispensing quantities of multivitamins in order to identifying possible periods of the stock shortage. and in the third stage the resulted dispensing patterns were compared between the three hospitals which involved finding any year-wise percentage change in dispensing quantity for each hospital and also comparing the relative consumption of multivitamin forms and we also investigated what might have caused those difference in the consumption pattern such as size and patient mix and other possible factors, the fourth phase focused on the implications and effects of those identified patterns and we also looked at how stock shortages may affect dispensing patterns with possible reasons for the different patterns in different hospitals and what this means for the supply chain and patient care, statistical methods have been used to facilitate the analysis, bar charts were used to compare the dispensing in various hospitals and to assess trends in dispensing over time also descriptive statistics were used in which the dispensing was summarized across all four hospitals; however, this study has certain limitations. In the first place, the analysis is based on data only, which reflects the average monthly quantities of multivitamins dispensed to each hospital. Knowing more like, who are the patients, which doctor prescribed, what was the reason for shortage stocking can add more value. The COVID-19 pandemic impacted the usage and distribution of multivitamins and supplements in Jordan [3,4]. And the study does not specifically analyze how the pandemic has influenced the findings, which can be studied in the future.

3. RESULTS:

The study was based on the dispensing data of multivitamins tab and syrup from 3 hospitals of the Jordanian Royal Medical Services (JRMS) and the study period was limited to 2020-2022. The results are in two main types, first dispensing trends for multivitamin syrups (for pediatric use), and second dispensing trends for multivitamin tablets (for adult use). Further, hospital-wise evaluation and the resultant impact of stock shortages are elaborated.

3.1 Dispensing Trends for Multivitamin Syrups (Pediatric Use): There were remarkable differences in how the multivitamin syrups which are intended mainly for the children and how they were distributed to the study hospitals, Prince Rashid Ben

Al-Hasan Military Hospital had the highest quantities dispensed in 2020 in which an average of 231 units were issued per month however in the years that followed the number dropped to 191 in 2023 which may suggest there were lower visits for pediatric patients to the hospital or a change in clinical guidelines or a changes in the choices of the hospital healthcare providers [5], Prince Hashem Ben Al-Hussein Military Hospital was identified to have dispensed syrups more than any of the study other military hospital and had a steady increase with it at 175 units per month in 2020 and a higher rate in the following years to 253 in 2022 before experiencing a slight drop at 198 in 2023, overall the increase suggests that this hospital has a growing number of pediatric patients visiting who needs multivitamins syrup dispensing and this rise could also reflects a spike in admission of kids or a focus on treating nutritional deficiencies in kids [6]. In 2021 Queen Alia Military Hospital dispensed only 32 units of the syrup and in 2023 the numbers peaked to 91 units, though these were the lowest dispensing quantities across all hospitals they were steadily increasing and Queen Alia Military Hospital nearly tripled the dispensing quantities over the years and this rising demand for multivitamin syrups might suggest a greater awareness of pediatric nutritional deficiencies or improvement in facility's stock availability and supply [5] [Figure 1].

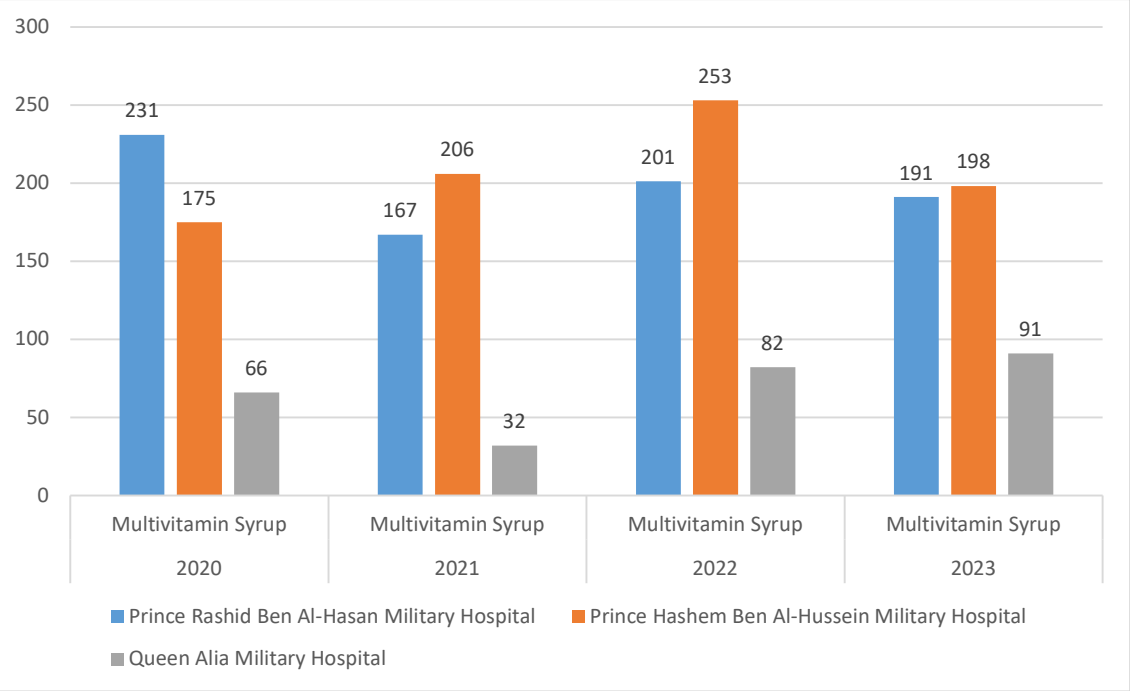

Figure 1: The consumption of multivitamin syrup in study hospitals over years

3.2 Dispensing Trends for Multivitamin Tablets (Adult Use): The supply of multivitamin tablets, which are primarily for adult patients, is much higher than that of syrups, owing to a higher number of adult patients in JRMS hospitals, Prince Rashid Ben Al-Hasan Military Hospital had the highest dispensing quantities overall of 58491 units in 2022, however the rapid decline to 28827 units in 2023 is suggestive of a stock shortage of the tablets or a change in the prescribing pattern [7], tablet dispensing also showed a sharp increase at Prince Hashem Ben Al-Hussein Military Hospital, which showed an increase from 18,132 in 2020 to 53,567 in 2022 after which a drop down to 22,257 in 2023 occurred which is also suggestive of a stock shortage of the tablets or a change in the prescribing pattern and therefore the continuous rise and fall trend can be a sign of system-wide stock issues for adult multivitamin tablets [6]. Queen Alia Military Hospital which is despite being the lowest in dispensing quantities among the study three hospitals showed some what a steady growth in tablet dispensing throughout the study period. From 12,617 units in 2020 dispensing peaked at 31,622 units in 2022 and dropped to 22,477 units in 2023. In overall this observed upward trend suggests that the study facility experienced a growing demand for the adult multivitamins which may be caused by an increase in adult patient visits or by a greater awareness of nutritional supplementation importance and role in health management [Figure 2].

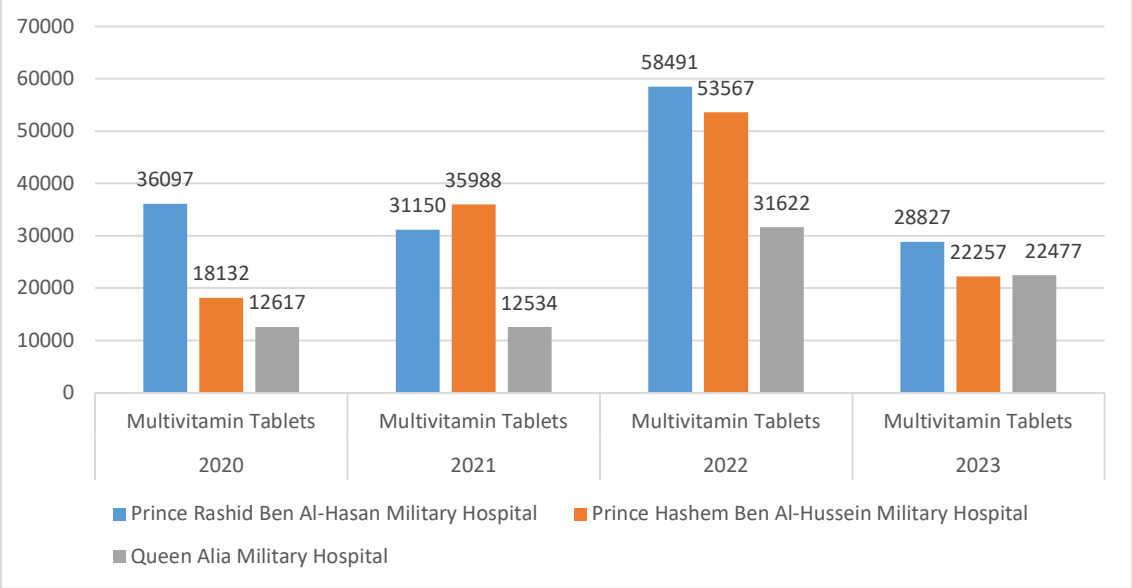

Figure 2: The consumption of multivitamin tablets in study hospitals over years

3.3 Comparative Analysis and Hospital-Specific Variations: The data comparison shows large differences and variations in how those two forms of multivitamins are being distributed to the three hospitals, Prince Rashid Ben Al-Hasan Military Hospital always topped the dispensing quantities for both forms of multivitamins which can be attributable to the hospital larger patient population as well as the large volume of patients. Prince Hashem Ben Al-Hussein Military Hospital had a steady increase in the dispensing of syrups which may show and reflect a potential focus on pediatric care. Queen Alia Military Hospital although it dispensed the least quantity compared to the others it overall showed a uniform upward trend in syrup and tablet dispensing which is indicative of an improvement in resource allocation and patient care [Figure 3].

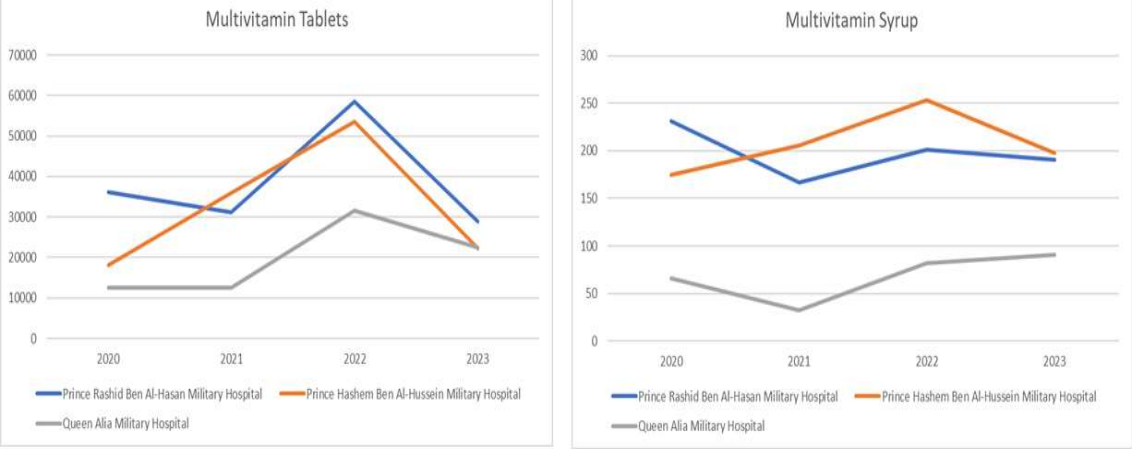

Figure 3: Comparative analysis of the consumption of multivitamins in study hospitals over years

The declining dispensing quantity over the years especially in 2023 where the dispensing of tablets in all hospitals decreasing, may indicate stock disruption which also comes clear with the consistent and steady dispensing of syrups during the same period which may imply the prioritization of pediatric dispensing due to limited stock all of which further highlight the challenges of managing pharmaceutical supply chains specially in a large healthcare system like the JRMS and it emphasize the need for strong inventory management policies and practices [7].

4. DISCUSSION:

4.1 Interpretation of Findings: This paper sheds light on the dispensing pattern of multivitamin forms in the hospitals of JRMS. The reason for dispensing a higher quantity of tablets as compared to syrups is that the population of adult patients being served are larger than the pediatric population. Yet, the steady upward trend in the dispensing of syrups at the Prince Hashem Ben Al-Hussein Military Hospital and Queen Alia Military Hospital. It may indicates a growing focus on pediatric care or trendy focus on nutritional supplementation for children. Nonetheless the huge fall off in 2023 dispensing of all tablets by all hospitals is concerning and seems to show some system wide stock shortages in the whole system and this decrease could greatly affect adults and those people with chronic illnesses or nutritional deficiencies who depend on additional supplements [5]. During the same time period, syrup dispensing has remained stable; perhaps since the pediatric population is often regarded as vulnerable, they may be prioritized.

4.2 Clinical Preferences and Prescribing Practices: The differences in hospital dispensing may also indicate a difference in the clinical preference of doctors. For instance the steady rise in dispensing syrups at Prince Hashem Ben Al-Hussein Military Hospital may suggest a preference for liquid formulations among the pediatricians at this hospital and the high dispensing of adult tablet preparations at Prince Rashid Ben Al-Hasan Military Hospital could be to treat a large population of adults or a greater focus on them. These variations and differences highlight the importance of recognizing hospital-specific dispensing patterns and the factors and characteristics that influence them. Further studies can carry on evaluating the causes for the differences in light of reasons such as patient demographics, clinical guidelines etc.

4.3 Supply Chain Management and Stock Shortages: Supply chain issues and stock shortages may have caused the amount of tablets provided to patients to unexpectedly go up and down leading to the sudden drop in the dispensing of a tablet in 2023 which indicates that a possible stock shortages triggered by either demand or supply or both. The covid-19 pandemic during the study period between (2020–2022) might have also contributed to this fluctuation in supply since many global supply-chains disrupted due to COVID pandemic and lead to the demand for essential medicines to skyrocket and to overcome these problems [3], JRMS may need to look into getting better at stock management by having a better capabilities in tracking the levels of the stock and demand prediction and place orders accordingly, additionally JRMS's supply chain could be better managed by efforts to diversify the supply chain and minimize reliance on a single sources for its medications which in turns could help in reducing the impact of any future disruptions [7].

4.4 Implications for Patient Care: The study's results can affect how patients are cared for in the JRMS healthcare organization since it is very important to always have multivitamin forms on hand to help with nutritional deficiencies and other health issues. It is evident from the consistent and steady dispensing of syrups that pediatric dispensing has been prioritized in times of stock outs. However the reduction in dispensing tablets in 2023 raises concerns regarding adult patients since nutritional deficiencies can cause many health issues in adults such as immune problems, tiredness, and chronic diseases and efforts should be augmented to make sure that adult patients must have access to multivitamin supplementation.

4.5 Recommendations for Future Research and Practice: This paper demonstrates that more studies should be done in future to examine the factors influencing dispensing including the effect of stock-out effect on dispensers. Future studies could be conducted to examine other data sources such as the characteristics of patients whose requests were fulfilled in pharmacies, pharmacist dispensing patterns, stock shortage reasons and many more. Also a qualitative studies using interviews with health care providers and the JRMS supply chain manager could also help to better understand the challenges and opportunities to increase availability of multivitamin forms in the JRMS hospitals. This emphasis the consequence and importance of improving pharmaceutical supply chains and the significance of implementing efficient and effective inventory management strategies in practice in health systems similar to JRMS that may include practices like using technology to track how much stock there is and making plans if things don't go as expected and in the end by tackling these challenges we can only hope to make sure there are always essential medicines present and boost our patient care system.

5. CONCLUSIONS:

This study looked at how three of the Jordanian Royal Medical Services (JRMS) hospitals were given out multivitamin tablets and syrups from 2020 to 2023. The results showed that tablets were given out more often because there were more adult patients. On the other hand, syrups grew steadily and almost constantly, which shows that the focus was on taking care of kids. And the sudden drop in tablet distribution in 2023 could also mean that there isn't enough stock. This shows how hard it can be to keep

track of a supply chain. On the other hand the steady flow of syrups may have meant that pediatric patients got more attention and priority when resources were tight. The different ways that hospitals give out medications show how clinical preferences, patient demographics, and supply chain dynamic forces all affect the way medications are given out. These results also show how important it is for you as a healthcare system to keep track of your stock and use your resources wisely so that you always have the medicines you need on hand. Researchers need to pay more attention to the things that change these patterns in the future. Data-driven methods can also help JRMS and other healthcare systems give better care and make supply chains work better. JRMS can better meet the nutritional needs of its many patients and improve the quality of care overall by fixing these problems.

Limitations of the Study: This study has several limitations, it relies solely on the collected aggregate dispensing data which does not include patient demographics, prescribing patterns or reasons for potential stock shortages which in turn if available may be used to provide more insight. Also focusing on three JRMS hospitals limits generalizability of its analysis to a wider area. Furthermore the period when the study was conducted (2020-2023) covered the COVID-19 pandemic which probably influenced the dispensing patterns and supply chains but this was not analyzed. Finally, the study does not examine the effectiveness of multivitamin supplementation and patient outcomes.

Conflict of Interest: The authors declare no conflicts of interest. This study was conducted as part of an independent research project and received no funding from external sources.

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