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FACTORS INFLUENCING THROMBOLYTIC AGENT SELECTION IN MILITARY HEALTHCARE: A RETROSPECTIVE ANALYSIS OF STREPTOKINASE VERSUS ALTEPLASE DISTRIBUTION IN THE JORDANIAN ROYAL MEDICAL SERVICES HOSPITALS

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ABSTRACT

1. Introduction: Thrombolytic agents are used to treat acute myocardial infarction and acute ischemic cerebrovascular attacks. These medicines are very important to restore blood flow to the affected tissues and prevent more damage. In the Jordanian Royal Medical Services (JRMS), Streptokinase and Alteplase are the main two thrombolytic drugs utilized, but their use may vary between hospitals as hospitals may modify clinical protocols based on resource availability, individual and institutional factors as well as prescribers' prescribing habits. Understanding all these dynamics is important for improving patient treatment, resource allocation and administrative policies.

2. Objective: The main objective of this study is to assess the dispensing of Streptokinase and Alteplase at King Hussein Medical Hospital and Prince Rashid Ben Al-Hasan Military Hospital. The study will try to evaluate trends in the use of these drugs, preference at each hospital, and assess factors affecting their use. The study will try to assess the effects of these patterns on patient management, resource utilization, and clinical practice within the JRMS and by accomplishing these objectives the study will try to present evidence-based information to aid in the future policy-making operations and improve the effectiveness of thrombolytic therapy within the JRMS.

3. Methodology: The study will employ both quantitative and qualitative methods in order to develop a comprehensive understanding of thrombolytic drug usage in JRMS and its impact on health care delivery. Our research will use a retrospective approach to conduct this study based on data obtained from the main medical warehouses of JRMS; the average monthly distribution quantities of Streptokinase (1,500,000 IU vial) and Alteplase (50mg vial) to King Hussein Medical Hospital and Prince Rashid Ben Al-Hasan Military Hospital between 2020 and 2023 will be the focus of this study. Data will be analyzed to determine yearly consumption patterns and possible periods of unavailability. In order to summarize the data, descriptive statistics will be used to visually interpret the data the study will also have a qualitative assessment of the factors influencing the prescribing patterns. The results of this study have the potential to serve as a building block for improved patient care and better resource allocation in Jordan, providing guidance for policymaking, clinical protocols, and procurement strategies, facilitating an enhanced quality and equity in healthcare delivery within JRMS.

KEYWORDS: Thrombolytic, Streptokinase, Alteplase, Jordanian Royal Medical Services, JRMS, medication dispensing patterns.

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INTRODUCTION:

Thrombolytic agents play a very fundamental and essential role in the treatment and management of acute cardiovascular and cerebrovascular incidents which include myocardial infarction, ischemic stroke, pulmonary embolism and other conditions [1]. These critical medications function through dissolving the blood clots and thus reinstating and restore blood flow to the impacted tissues and preventing additional damage or mortality [2]. The swift administration of these thrombolytics agents is highly essential for patients' lives given that their effectiveness is significantly influenced by time and the fact that earlier intervention is associated with improved patient outcomes. [3] In the setting of the Jordanian Royal Medical Services (JRMS) health network the primary thrombolytic agents used within its hospitals are Streptokinase in a 1,500,000 IU vial and Alteplase in a 50 mg vial and both of those medications demonstrate efficacy in achieving reperfusion and they exhibit notable differences regarding some of their characteristics like cost, pharmacokinetics, administration procedures and their potential side effects which make comprehending their utilization patterns crucial for enhancing patient care, efficiently managing healthcare resources, and guiding future procurement and the formulation of clinical guidelines.

Streptokinase as a medication is categorized as a first-generation thrombolytic agent which is produced from beta-hemolytic streptococci and it has gained widespread application due to its cost-effectiveness and long term established efficacy [4], however it is now known to be linked to an increased likelihood of allergic reactions and immunogenicity which has limited its repeated administration and use [5]. Alteplase on the other hand is a recombinant tissue plasminogen activator (tPA) and it represents a second-generation thrombolytic agent that is characterized by an enhanced fibrin specificity and a reduced chances of systemic bleeding complications but however while it offers notable benefits it is considerably more costly than Streptokinase, which is a factor that highly impacts its availability and use especially in health systems and settings with limited resources or financial constraints [6].

The Jordanian Royal Medical Services functions as one of the most prominent and respected healthcare providers in Jordan and it manages an extensive large network of hospitals and medical facilities distributed throughout Jordan and dedicated to serving both military personnel and civilians [7]. Within the JRMS network thrombolytic medications are distributed from central medical warehouses located in Amman the capital of Jordan to its network individual hospitals in accordance with each hospital demand and the availability of medications within the JRMS system and in this study we analyzed two of the main hospitals within the JRMS: King Hussein Medical Hospital and Prince Rashid Ben Al-Hasan Military Hospital, which are some of the largest and most distinguished institutions within the JRMS network, yet despite the fact that these hospitals function under a unified administrative structure, discrepancies in the utilization of thrombolytic medications may arise from differences in patient demographics, clinical protocols, prescriber preferences, and the allocation of resources.

This study seeks to analyze the dispensing habits of Streptokinase and Alteplase from JRMS medical warehouses to King Hussein Medical Hospital and Prince Rashid Ben Al-Hasan Military Hospital throughout a four-year timeframe spanning specifically from 2020 to 2023 with the primary objective to discern and identify any variations in the use of these medications across the two hospitals and to investigate the underlying factors may have contributed to these discrepancies. We also looked at and compared the average monthly amounts made to each hospital during the study period. This will help us find out what doctors like to prescribe, if there are any shortages and how well thrombolytic drugs distribution works in the JRMS network as a whole. The study also tries to look at the big picture and see how these trends affect patient care, the management of healthcare resources, and the making of policies.

This research is important because it can help the JRMS network make choices that are based on facts. It might be able to better use resources, follow clinical guidelines, and teach prescribers by looking at how thrombolytic drugs are used in different ways. The findings could also add to the ongoing conversation about thrombolytic therapy in low- and middle-income countries (LMICs), where there isn't always enough money or resources to pay for treatment [8]. This study also tries to show how thrombolytic drugs are used in the JRMS as a whole. This will help the ongoing work that is already being done to make healthcare in Jordan better and more fair for everyone. The results might also encourage others to do more research on thrombolytic therapy in other similar healthcare settings. This could help patients get better and make better use of the limited resources that are available in healthcare.

STUDY METHODOLOGY:

The study looked very closely at how the Jordanian Royal Medical Services gave out thrombolytic drugs, which was very strict. The King Hussein Medical Hospital and the Prince Rashid Ben Al-Hasan Military Hospital were the two main hospitals

that were looked at. The research employed data sourced from JRMS medical warehouses which gave the study information about how much Streptokinase (1,500,000 IU vial) and Alteplase (50 mg vial) these hospitals got on average each month from 2020 to 2023. We then made tables that showed how much each hospital had on average each month and year. This made it easy to spot patterns and trends.

The analysis was planned with care to examine several valuable aspects of thrombolytic treatment utilization, the study initially analyzed the annual consumption trends to differentiate variations in the average monthly quantities that were dispensed throughout the four-year duration, this process required monitoring the consumption of Streptokinase and Alteplase across each hospital to assess the presence of consistent trends, whether increases, decreases or fluctuations in dispensing patterns. Then the study further examined hospital-specific preferences by investigating the utilization rates of Streptokinase in comparison to Alteplase at King Hussein Medical Hospital and Prince Rashid Ben Al-Hasan Military Hospital and the objective of this comparison was to discern any significant variations in prescribing practices between the two institutions then the study further examined potential shortages by identifying intervals characterized by decreased dispensing, which may suggest stock deficiencies or alterations in clinical protocols.

We used descriptive statistics to describe the data, which helped us figure out how many of each type of medicine and hospital were given out on average each month. We also looked for unusual patterns and behaviors in the data set by using graphs and charts. The study's goal was to use quantitative and qualitative analysis to give a full and clear picture of how thrombolytic drugs are used and shared in the JRMS. We also examined the trends in a qualitative way and also took into account other things that might have affected doctors prescribing practices like the cost, clinical guidelines, and rules that were specific to each hospital.

STUDY RESULTS:

This study looked at how thrombolytic drugs were given out and found that King Hussein Medical Hospital and Prince Rashid Ben Al-Hasan Military Hospital used Streptokinase and Alteplase in very different ways over the four years of the study (table 1). The data that reflect the average monthly quantities dispensed to each hospital propose significant insights into prescribing patterns, hospital-specific preferences and the potential challenges associated with stock availability. The findings are presented comprehensively, emphasizing annual consumption trends, medication preferences that are specific to each hospital and the potential consequences for medical practice and utilization of resources, the data reveals notable tendencies in the usage of Streptokinase and Alteplase across the two hospitals throughout the study duration where the observed trends underscore both shared characteristics and distinctions in the utilization of these medications and indicating possible variations in clinical protocols, patient requirements and the availability of resources.

Table 1: The use of Strptokinase and Alteplase over time

Medication	**Streptokinase 1500000 IU Vial**				**Alteplase 50mg vial**			
Year	2020	2021	2022	2023	2020	2021	2022	2023
King Hussein Medical Hospital	10	7	7	6	10	10	10	8
Prince Rashid Ben Al-Hasan Military Hospital	17	17	18	21	0	0	0	0

At King Hussein Medical Hospital, the utilization of Streptokinase showed a constant decrease throughout the four-year duration (figure 1). In the year 2020 the hospital was supplied with an average of 10 vials monthly however this figure demonstrated a consistent decline until ultimately arriving at 6 vials per month by the year 2023, This observed downward trend indicates a potential conversion away from the use of Streptokinase and this shift may be influenced by modifications in clinical guidelines, the emergence of alternative therapeutic options or hesitations regarding the side

effects associated with this medication, on the other hand there was a significant rise in the utilization of Streptokinase at Prince Rashid Ben Al-Hasan Military Hospital during the corresponding timeframe in which it began with 17 vials per month in 2020 and then the hospital's utilization increased to 21 vials per month by 2023 and the observed upward trend suggests a significant dependence on Streptokinase which is likely due to its cost-effectiveness, proven efficacy or restricted availability of alternative thrombolytic agents [9].

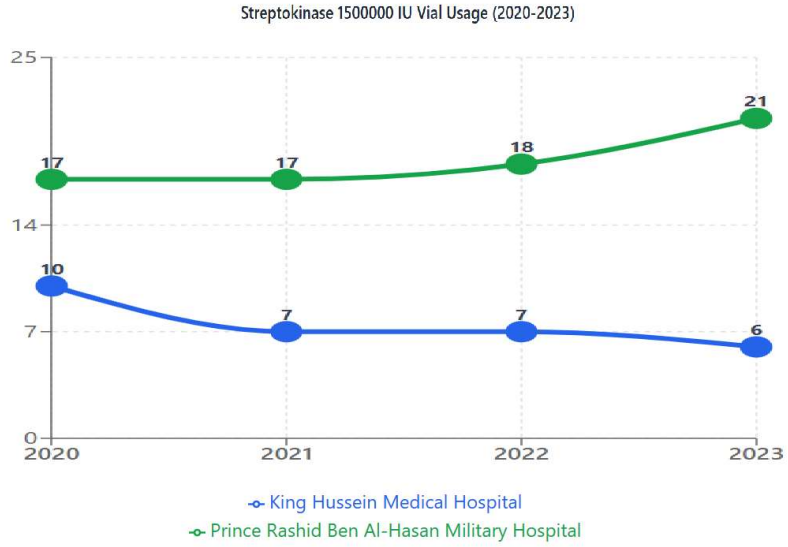

Figure 1: The use of Streptokinase overtime

The consumption of Alteplase showed a distinct pattern and also revealed the existence of significant discrepancies between the two hospitals, first at King Hussein Medical Hospital the pattern showed a rather consistent trend with an average issuing of 10 vials per month across the years from 2020 to 2022 and a modest reduction in the issuance to 8 vials per month in 2023 and this observed decrease may indicate an alterations in clinical practice, potential stock shortages or a transition towards alternative treatment procedures. Second It is important to highlight that Prince Rashid Ben Al-Hasan Military Hospital did not employ Alteplase at any point during the study period and this notable lack of Alteplase utilization is striking and prompts critical inquiries regarding the determinants affecting prescribing behaviors within this institution, some of the potential factors may encompass financial implications, restricted access to the medication, or a tendency for Streptokinase informed by clinical experience or established institutional guidelines.

The resulting data indicated the presences of distinct variations in the preferences for thrombolytic medications which were observed between the two hospitals and these observed preferences are likely indicative of a complicated interplay of clinical, economic and logistical considerations that shape prescribing practices within each hospital. At King Hussein Medical Hospital both Streptokinase and Alteplase were employed and used for managing medical conditions however, the decreasing utilization pattern seen with Streptokinase alongside with the stable to declining trend seen in the use of Alteplase indicates a possible evolution in treatment protocols and the hospital's readiness and willingness to utilize both types medications suggests a potentially adaptable strategy regarding thrombolytic therapy which may be influenced by the availability of diverse resources or the compliance with the latest clinical guidelines and on the other hand the Prince Rashid Ben Al-Hasan Military Hospital utilized Streptokinase exclusively with no documented use of Alteplase throughout the study period, this observed preference may stem from the hospital's emphasis on cost-effective treatment options, restricted availability of Alteplase, or a pronounced institutional tendency towards Streptokinase which is rooted in historical application and perceived effectiveness.

The information also helps us think about and understand the problems that could come up when we store and use drugs. King Hussein Medical Hospital is using less Streptokinase, and Prince Rashid Ben Al-Hasan Military Hospital isn't using

any Alteplase at all. It indicates that both the hospitals might not have enough amounts of medications, or they might have changed how they buy it. When King Hussein Medical Hospital stopped using Alteplase in 2023. This could mean that the hospital is working with other drugs or that there isn't enough of this one for a while. Prince Rashid Ben Al-Hasan Military Hospital only uses Streptokinase, so this could also be the case for them. They might not be able to get Alteplase easily, or they might use a strategic initiative to better manage their stock. We saw patterns that show how important it is to have good ways to buy and keep track of stock so that patients can always get the medicines they need (figure 2).

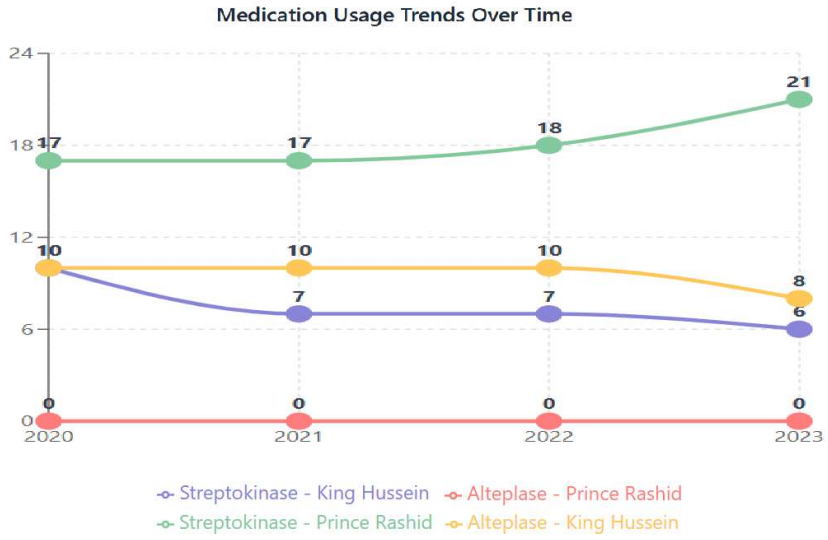

Figure 2: Medication usage trends over time

The analysis of the data shows a number of important results that show how the two JRMS hospitals use thrombolytic drugs in different ways. There is less Streptokinase used at King Hussein Medical Hospital possibly because the doctors or treatment guidelines have changed. Healthcare providers might not want to use it because they know it has side effects, or it could be because new treatments are available or coming out. On the other hand, Prince Rashid Ben Al-Hasan Military Hospital used Streptokinase more and more. The hospital doctors might really prefer this medicine because it works and is cheap. King Hussein Medical Hospital showed a steady use of Alteplase between 2020 and 2022. There was a small drop in 2023, though. This could mean that there was an issue with stock availability or the way things are done in the clinic, or the treatment guidelines have changed. Another interesting thing is that Prince Rashid Ben Al-Hasan Military Hospital didn't use Alteplase. This could mean that there are issues that make it hard to get the hospital modern thrombolytic treatments. Some of these issues might be not having enough money, not being able to supply the hospital easily, or the hospital already having preferences of Streptokinase. The study's joint observations give us important information about the factors and determinants that are affecting the use of thrombolytic drugs in the JRMS. They also show the importance of policy formulation in this domain.

The results of this study may hold significant relevance to the JRMS which may use it to make decisions about how to run its clinics and spend its money. It's clear that the two hospitals used drugs in different ways. This shows how important it is to have standard clinical guidelines so that all patients in the JRMS health network get the same level of care. Additionally, the potential challenges associated with stock availability underscore the necessity of implementing effective procurement and inventory control procedures that are designed to avert shortages and guarantee the access to essential medications and by identifying these trends and patterns, the study establishes a solid foundation for subsequent research and the formulation of effective policies. Future research may investigate the clinical outcomes which are linked to the identified prescribing patterns and examine the determining factors affecting prescriber choices and evaluate the consequences of stock shortages on how patients are treated and the resulted clinical outcomes and therefor these initiatives are expected to significantly advance the objective of enhancing

thrombolytic therapy within the JRMS and elevate the standards of healthcare delivery in Jordan.

DISCUSSION AND COMMENTS:

The results of this study demonstrated notable disparities in the usage and utilization patterns of thrombolytic agents between King Hussein Medical Hospital and Prince Rashid Ben Al-Hasan Military Hospital during the study four-year period from 2020 to 2023 and the observed differences are likely caused by a mixture of clinical, economic, and logistical factors which carry significant implications for patient care, resource management and policy formulation within the Jordanian Royal Medical Services. It's interesting that the two hospitals use Streptokinase in different ways. King Hussein Medical Hospital doctors may be using Streptokinase less because they want to treat patients in a different way now. This trend might mean that the hospital has started using new methods or protocols to treat patients that might work better with different thrombolytic agents or non-thrombolytic methods, like percutaneous coronary intervention (PCI). Healthcare providers may have also used less Streptokinase because they were trying to avoid its side effects, such as allergic reactions and the possibility that it would make the immune system weaker [6]. More patients are getting Streptokinase at Prince Rashid Ben Al-Hasan Military Hospital. This shows that hospital doctors clearly prefer this treatment. The hospital probably chose this option because it is cheap, works, and is in line with the rules for how to treat patients. And the increasing use of Streptokinase within this hospital may also suggest restricted availability of alternative thrombolytic agents, such as Alteplase. It could be because they don't have enough money or can't get them.

The usage of Alteplase underscores the differences observed between the two hospitals, at King Hussein Medical Hospital the utilization of Alteplase exhibited stability from 2020 to 2022; however a modest decrease was observed in 2023 and this observed reduction may be associated to modifications in clinical practice which may include the implementation of advanced therapies or a transition towards non-thrombolytic treatment options and this situation may also indicate the existence of transient stock shortages or deliberate strategic choices to prioritize alternative medications, also the complete absence of Alteplase utilization at Prince Rashid Ben Al-Hasan Military Hospital represents a noteworthy observation that necessitates further exploration and the observed pattern indicates possible obstacles to the implementation of advanced thrombolytic therapies including elevated costs, restricted accessibility or institutional reluctance to modify established protocols and the limited utilization of Alteplase may also suggest a preference for Streptokinase which is potentially influenced by clinical experience or an emphasis on cost containment especially in settings with restricted resources.

The disparities and variations noted in the utilization of thrombolytic medications across the two hospitals feature the significant impact of factors such as, individual institutional protocols, resource accessibility and economic factors on the prescribing behaviors and the results of this study also underscore the necessity for standardized clinical guidelines within the JRMS to promote and ensure a consistent and equitable patient care since the differences in treatment protocols may result in unequal patient outcomes especially in critical situations like myocardial infarction and ischemic stroke, and its only through the alignment of clinical practices among different hospitals the JRMS has the potential to enhance the quality of care while optimizing the utilization of scarce healthcare resources in the same time, also another significant factor to consider is the potential influence of stock shortages on the utilization of medications. The observed reduction in the utilization of Streptokinase at King Hussein Medical Hospital joined with the lack of Alteplase administration at Prince Rashid Ben Al-Hasan Military Hospital may indicate the presence of underlying issues related to stock availability and the procurement processes and therefore efficient inventory management and procurement techniques are crucial to prevent shortages and guarantee reliable access to essential medications and effectively tackling these challenges necessitates a collaborative approach among hospital administrators, procurement personnel, and clinical staff to match cost considerations with the imperative of delivering high-quality patient care.

The results of this study carry significant implications and lessons to be learned for healthcare systems in low- to middle-income countries where financial constraints and limited resources frequently impact treatment choices [8] and where there is a predisposition towards cost-effective medications which are exemplified by Streptokinase is frequently observed in such contexts. However, it is essential to consider this against the potential advantages offered by more contemporary therapies such as Alteplase and future research is needed to investigate the clinical outcomes linked to the identified prescribing patterns in addition to the factors that may affect the prescriber preferences and patient access to thrombolytic drugs. By addressing these issues healthcare systems have the potential chance to enhance the quality and equity of

care for patients experiencing acute cardiovascular and cerebrovascular illnesses especially in low- to middle-income countries.

CONCLUSIONS AND FINAL THOUGHTS:

This study highlights the critical need to comprehend and address the factors that affect the utilization of thrombolytic medications within the JRMS, the discrepancies in medication utilization which were observed between King Hussein Medical Hospital and Prince Rashid Ben Al-Hasan Military Hospital underscore the necessity for the establishment of standardized clinical guidelines, efficient resource management and the necessity of focused interventions aimed at enhancing patient care outcomes. However future research aiming to investigate the clinical outcomes linked to the identified prescribing patterns in addition to the determinants that shape prescriber preferences and patient access to thrombolytic medications. Building up these findings, the JRMS has the potential to improve patient care quality while also optimizing the utilization of scarce healthcare resources at the same time. Additionally this study significantly enhances and improves the existing literature on thrombolytic therapy within low- and middle-income countries and offer critical insights and perceptions which can inform and improve healthcare delivery systems in Jordan and the results may also guide upcoming policy decisions, clinical guidelines, and procurement strategies and thereby improving the quality and equity of care for patients experiencing acute cardiovascular and cerebrovascular conditions. By tackling the challenges outlined in this study, the JRMS can further its commitment to delivering outstanding care that is patient-focused to all individuals within its network.

STUDY LIMITATIONS: There are a number of limitations to this study that need to be recognized, the data set merely included general dispensing information and left out important information about patient outcomes, prescriber characteristics, and stock levels and this contributed to it being hard to come up with full conclusions about the factors that led to the patterns that were found, also the study only looked at a four-year period (2020–2023) which may not be enough for establishing long term trends or changes in clinical practice that could help us better understand how thrombolytic medications are used and the results are especially important for the Jordanian Royal Medical Services and they may not be useful for other healthcare systems or areas because differences in resources, protocols and patient demographics could change how medications are used in different places and situations. The identified limitations underscore the necessity for additional research aimed at bridging these gaps and enhancing our comprehension of thrombolytic therapy practices. The identified limitations underscore the necessity for additional research aimed at bridging these gaps and enhancing our comprehension of thrombolytic therapy practices.

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