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QUANTITATIVE ASSESSMENT OF LEVOTHYROXINE CONSUMPTION IN THE JORDANIAN ROYAL MEDICAL SERVICES HOSPITALS FACILITIES: A RETROSPECTIVE ANALYSIS.

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ABSTRACT

Introduction: Levothyroxine is the typical treatment for hypo-thyroidism, which is a condition where the thyroid gland can't produce enough levels of the thyroid hormones . The most frequently prescribed forms of Levothyroxine are the 50 mcg and 100 mcg tablets, which are dispensed and used in variable doses based on clinical needs. In the Jordanian Royal Medical Services (JRMS), Levothyroxine is highly used, however much about how it's being consumed across different hospitals remain underexplored making the understanding of how it's being prescribed, distributed, and consumed essential tool to provide insights into the current treatment practices and the current operational characteristics. This study will track how these two doses were distributed to four major JRMS hospitals over a four-year period, from 2020 through 2023.

Objective: The primary aim of this study is to comprehend and compare how Levothyroxine 50 mcg and 100 mcg tablets are being used across the four JRMS hospitals: King Hussein Medical Hospital, Prince Rashid Ben Al-Hasan Military Hospital, Prince Hashem Ben Al-Hussein Military Hospital, and Prince Ali Bin Al-Hussein Military Hospital during the period 2020 to 2023. The study will aim to identify if there are recognizable patterns, whether certain strength is preferred and if usage spikes in certain years. We also will attempt to identify factors that might be driving those patterns including hospitals and patients characteristics. The results of this study may help optimizing the prescribing and distribution of Levothyroxine, leading to more efficient and effective system and better resource utilization at the JRMS while maintain patients outcomes.

Methodology: This quantitative, retrospective study will analyze historical data on the average monthly distributed quantities of Levothyroxine 50 mcg and 100 mcg tablets to the study hospitals from 2020 to 2023. Data will be gathered from the JRMS electronic system and statistical analysis will be conducted in order to recognize any trends over the four-year period of the study and then compare it between the hospitals. The analysis will also account for the impact of variables such as hospital nature, patient population, and any variations in clinical procedures. The findings will be used to suggest recommendations for improving Levothyroxine prescribing and distribution procedures.

KEYWORDS: Levothyroxine, hypothyroidism, pharmaceutical consumption, military hospitals, Jordan, retrospective analysis

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1. INTRODUCTION:

Hypothyroidism represents one of the most common endocrine disorders that internationally affecting around 3-5% of the world general population [1] and this condition significantly influences patient quality of life and healthcare systems worldwide, this disease manifests through several symptoms that include weakness, weight gain, cold intolerance, depression and cognitive impairment [2]. Left untreated, hypothyroidism can progress to severe complications such as myxedema coma, cardiovascular disease and neuropsychiatric disorders.

Levothyroxine sodium is a synthetic structure of thyroxine (T4) which has arisen as the gold standard treatment for hypothyroidism [3]. The medication works by replacing deficient endogenous thyroid hormone and thereby bring back normal physiological function and lessening associated symptoms. Clinical studies consistently demonstrate levothyroxine's ability to normalize thyroid-stimulating hormone (TSH) levels and improve patient-reported outcomes when appropriately dosed and monitored [4], its pharmaceutical strengths includes multiple levothyroxine formulations with the 50 mcg and 100 mcg tablets being the most commonly prescribed ones in clinical practice [5]. The selection between these different formulations depends on patient age, patient body weight, hypothyroidism severity, cardiac status and concurrent medications and initial dosing typically starts with lower strengths particularly in elderly patients or those with cardiovascular comorbidities followed by titration based on clinical response [6].

The Jordanian Royal Medical Services (JRMS) represents a comprehensive healthcare network that is serving military personnel, their families and civilian populations across Jordan and within the JRMS network levothyroxine consumption represents a significant component of pharmaceutical spending due to its chronic nature that necessitate a lifelong therapy in most patients [7]. However, consumption patterns may vary considerably between different hospitals reflecting differences in patient demographics, clinical practices, physician preferences and institutional characteristics.

Recognizing medication consumption patterns serves multiple critical principles within the healthcare management. Clinically, such analysis provides perceptions into disease prevalence, treatment practices and therapeutic outcomes within specific populations [8]. Administratively consumption data informs pharmaceutical procurement decisions, inventory management strategies and resource allocation planning, also a comparative analysis between facilities can identify best practices and guide the standardization efforts. However despite its clinical importance and its widespread utilization within the JRMS network a comprehensive analysis of its consumption patterns across different hospital facilities still limited and therefore this knowledge gap represents a significant limitation in understanding current treatment practices and optimizing pharmaceutical management within the JRMS system.

2. LITERATURE REVIEW:

The medical management of hypothyroidism has grown significantly with levothyroxine arising as the preferred therapeutic intervention following wide research and clinical experience [9]. Contemporary clinical guidelines from major endocrinological societies consistently recommend levothyroxine as first-line therapy for hypothyroidism based on robust evidence that demonstrating efficacy in normalizing thyroid function tests and improving clinical symptoms [10].

Dosing considerations for levothyroxine involve multiple patient-specific factors which influence the patients therapeutic outcomes and safety profiles. Age represents a critical determinant with the elderly patients typically requiring lower initial doses due to their increased sensitivity and higher cardiac complication risk [11]. Body weight calculations also inform dosing algorithms with typical replacement doses ranging from 1.2 - 1.8 mcg per kilogram in younger adults and cardiac status also significantly influences the dosing strategies and require gradual titration in patients with coronary artery disease or arrhythmias [12].

Pharmacokinetic characteristics contribute to levothyroxine's clinical utility while presenting specific management considerations, the medication

exhibits a long half-life of approximately seven days which allow for once-daily dosing but also make it requiring 6-8 weeks between dose adjustments to accurately assess therapeutic response [13]. Absorption characteristics also present important clinical considerations especially with food, coffee and certain medications which significantly reduce its bioavailability [14,15].

Global epidemiological research provides a valuable context for understanding levothyroxine utilization patterns, hypothyroidism prevalence rates vary largely based on the geographic location, the iodine intake, the demographic characteristics and the diagnostic criteria [16]. Developed countries typically report prevalence rates ranging from 2-8% in their general populations with higher rates in women and elderly individuals. Military populations also present unique epidemiological considerations relevant to understanding levothyroxine utilization within the JRMS context, military personnel may experience different risk profiles for thyroid dysfunction owing to occupational exposures, stress factors, deployment conditions and healthcare screening protocols [17] and healthcare delivery models within military medical systems also usually differ from civilian settings in terms of patient demographics, treatment protocols and pharmaceutical management practices.

3. METHODOLOGY:

3.1 Study Design: This study used a quantitative retrospective and observational design to investigate levothyroxine consumption habits within four major JRMS hospital facilities over a four years period from 2020 to 2023, this retrospective approach enabled a comprehensive analysis of the historical consumption data.

3.2 Study Setting: The study was conducted within the JRMS network which represent one of Jordan's largest healthcare systems. Four major hospitals were selected based on size, patient volume, and comprehensive pharmaceutical services: King Hussein Medical Hospital which is a flagship tertiary care facility with comprehensive specialty services, Prince Rashid Ben Al-Hasan Military Hospital a major secondary/tertiary care facility, Prince Hashem Ben Al-Hussein Military Hospital a regional medical center with specialized clinics and Prince Ali Bin Al-Hussein Military Hospital a comprehensive medical facility providing primary through tertiary care.

3.3 Data Sources and Collection: Data were obtained from the JRMS electronic pharmacy information system which maintains comprehensive pharmaceutical dispensing history across all network facilities, the system maintains detailed information including drug names, strengths, quantities, dispensing dates and facility locations following standardized data entry protocols and quality assurance procedures. Data extraction used standardized queries to capture all levothyroxine dispensing records for 50 mcg and 100 mcg tablet formulations during the study period. Quality control procedures included verification of hospital identifiers, confirmation of medication coding accuracy, and validation of quantity calculations.

3.4 Study Variables: Primary variables included annual consumption quantities of levothyroxine 50 mcg and 100 mcg tablets for each hospital during each study year, secondary variables included calculated ratios of 50 mcg to 100 mcg tablet consumption which provides insights into prescribing patterns and strength preferences. Additional contextual variables considered hospital characteristics such as size, patient volume, specialty services and geographic location.

3.5 Statistical Analysis: Descriptive statistical analysis was used to characterize the consumption patterns for each hospital and each medication strength, measures included frequencies, percentages, and ranges also trend analysis was used to identify consumption changes over the study period. Comparative analysis between hospitals used appropriate statistical tests with ratio analysis examining relationships between formulation consumption.

4. RESULTS:

4.1 Overall Consumption Patterns: Analysis uncovered a substantial variation in the consumption quantities and utilization patterns between facilities. King Hussein Medical Hospital constantly demonstrated the highest consumption volumes for both strengths throughout the study period. For 50 mcg tablets its annual consumption ranged from 59,827 tablets in 2022 to 71,108 tablets in 2020 representing

a 16% decrease from peak consumption, the 100 mcg tablets showed greater variability that ranged from 43,713 tablets in 2020 to 61,390 tablets in 2021 indicating a 40% increase. Prince Rashid Ben Al-Hasan Military Hospital exhibited the second-highest consumption levels among the four hospitals with 50 mcg tablets ranging from 15,105 tablets in 2021 to 22,820 tablets in 2022 showing a notable 51% increase between 2021 and 2022 which was then followed by a 20% decrease in 2023, the 100 mcg tablets demonstrated less variation which ranged from 27,407 tablets in 2023 to 33,966 tablets in 2022. Prince Hashem Ben Al-Hussein Military Hospital showed an intermediate consumption patterns with 50 mcg tablets ranging from 13,657 tablets in 2020 to 20,380 tablets in 2022 demonstrating a 49% increase from 2020 to 2022, the 100 mcg tablets showed more stability which ranged from 28,493 tablets in 2020 to 32,579 tablets in 2022. Prince Ali Bin Al-Hussein Military Hospital consistently showed the lowest consumption levels among the four hospitals with 50 mcg tablets ranging from 7,938 tablets in 2021 to 10,946 tablets in 2022 and despite the smaller absolute quantities this hospital showed proportionally significant variations with a 38% increase from 2021 to 2022 (table 1).

Table 1: The frequency of distribution of Levothyroxine tablets per year and hospitals

Year	Name	King Hussein Medical Hospital	Prince Rashid Ben Al-Hasan Military Hospital	Prince Hashem Ben Al-Hussein Military Hospital	Prince Ali Bin Al-Hussein Military Hospital
2020	Levothyroxine 50mcg Tablets	71,108	18,232	13,657	8,690
	Levothyroxine 100mcg Tablets	43,713	31,359	28,493	8,705
2021	Levothyroxine 50mcg Tablets	63,829	15,105	14,191	7,938
	Levothyroxine 100mcg Tablets	61,390	28,517	31,281	8,234
2022	Levothyroxine 50mcg Tablets	59,827	22,820	20,380	10,946
	Levothyroxine 100mcg Tablets	54,898	33,966	32,579	9,358
2023	Levothyroxine 50mcg Tablets	66,596	18,216	18,508	8,481
	Levothyroxine 100mcg Tablets	60,580	27,407	30,081	7,729

4.2 Strength-Specific Consumption Analysis: The 50 mcg tablet consumption analysis showed very distinct patterns across the different hospitals and within years. King Hussein Medical Hospital showed a general declining tendency from 2020 to 2022 followed by increases in 2023 that didn't reach initial 2020 levels which suggests potential changes in prescribing practices or patient population characteristics. Prince Rashid Ben Al-Hasan Military Hospital showed the most dramatic 50 mcg consumption variation in which there was a significant spike in 2022 followed by substantial decreases in 2023 and this pattern may be due to temporary factors such as supply chain problems or changes in patient population or the clinical practice (figure 1).

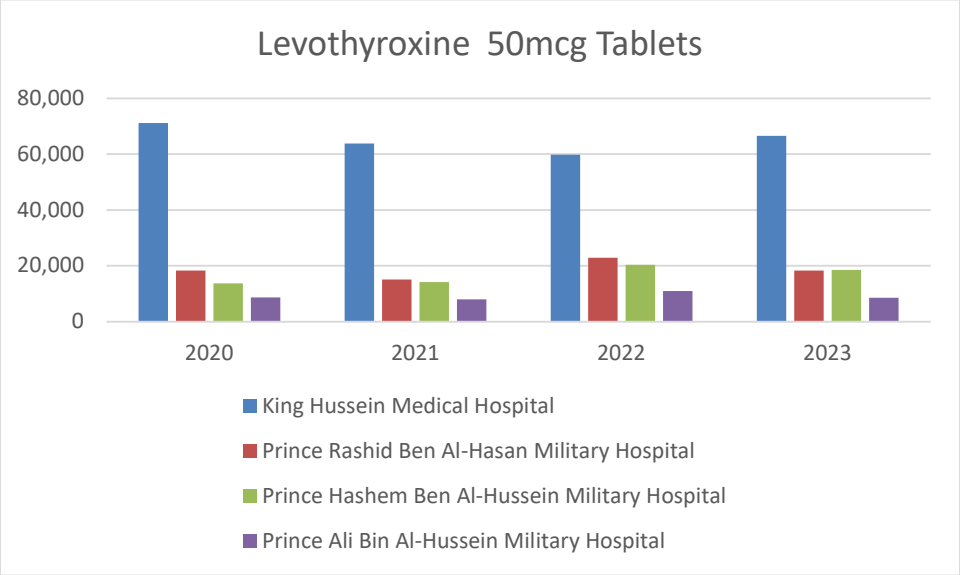

Figure 1: The frequency of distribution of Levothyroxine 50 mcg tablets by years and hospitals

The 100 mcg tablet consumption showed different patterns in comparison to the 50 mcg formulations. King Hussein Medical Hospital demonstrated an increased consumption from 2020 to 2021 followed by 2022 decrease and 2023 increase again which may be reflective of a complex interaction between patient needs, clinical practices and supply considerations (figure 2).

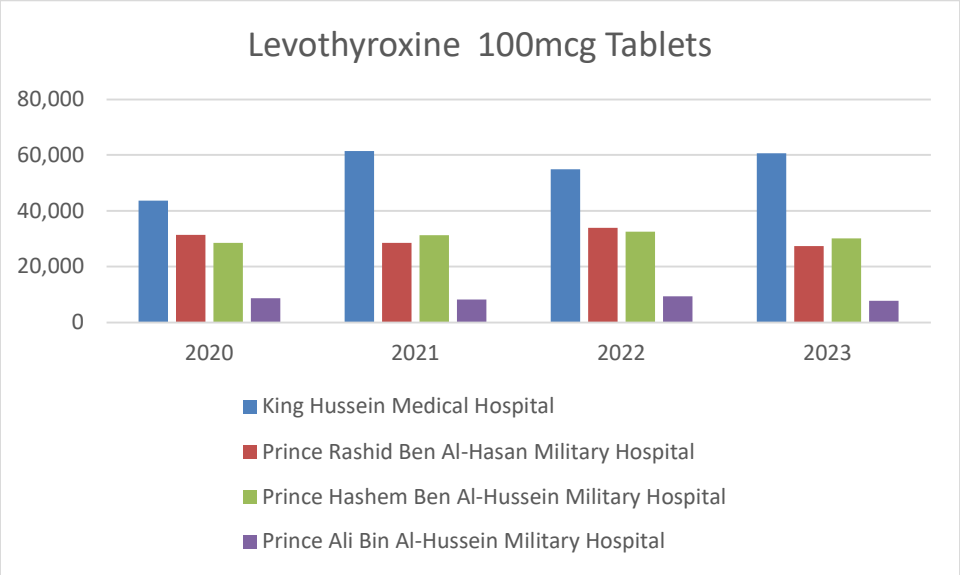

Figure 2: The frequency of distribution of Levothyroxine 100 mcg tablets by years and hospitals

4.3 Ratio Analysis: The analysis of 50 mcg to 100 mcg consumption ratios showed a significant difference between each of the hospitals and provided a valuable insights into the prescribing preferences and characteristics of the patient population, King Hussein Medical Hospital consistently maintained and showed ratios above 1.0 throughout the study period which ranged from 1.04 in 2021 to 1.63 in 2020 indicating that there is a consistent preference for 50 mcg over 100 mcg tablets, Prince Rashid Ben Al-Hasan Military Hospital also demonstrated consistently low ratios throughout the study period ranging from 0.53 in 2021

to 0.67 in 2022 and these low ratios below 1.0 indicate clear preference for 100 mcg tablets and suggesting patient populations that requiring higher doses or clinical practices that favors higher strength formulations, Prince Hashem Ben Al-Hussein Military Hospital consistently showed the lowest ratios among all facilities in the study ranging from 0.45 in 2021 to 0.63 in 2022 and indicating a strong preference for 100 mcg tablets and suggesting patient populations with more severe hypothyroidism or clinical practices favoring higher initial doses, Prince Ali Bin Al-Hussein Military Hospital showed ratios close to 1.0 throughout most of the study period ranging from 0.96 in 2021 to 1.17 in 2022 suggesting relatively equal utilization of both strengths and possibly reflecting diverse patient populations or clinical practices utilizing both formulations based on individual needs (figure 3).

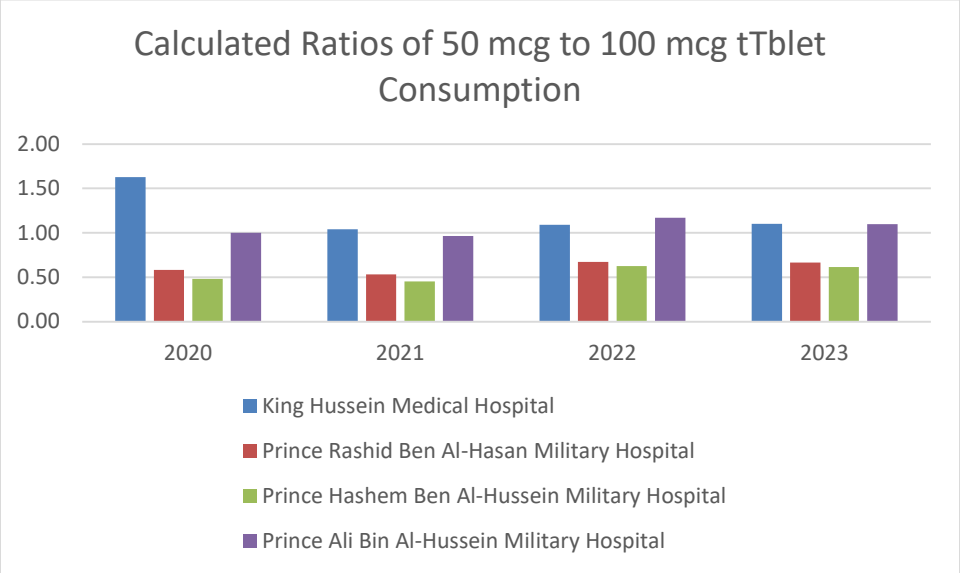

Figure 3: Calculated ratio of 50 mcg to 100 mcg tablet consumption

4.4 Temporal Trends Analysis: Longitudinal analysis exposed distinct temporal trends for each hospital and medication strength. King Hussein Medical Hospital showed declining trends for 50 mcg tablets from 2020 to 2022 with partial recovery in 2023, the 100 mcg tablets revealed more complex patterns with increases from 2020 to 2021 then decreases in 2022 and subsequent increases in 2023, Also Prince Rashid Ben Al-Hasan Military Hospital displayed a significant 50 mcg consumption variability with a notable 2022 spike while the 100 mcg consumption remained relatively stable which is suggestive of factors that specifically affecting lower-strength formulation demand. Prince Hashem Ben Al-Hussein Military Hospital demonstrated generally increasing trends for both formulations from 2020 to 2022 with slight 2023 decreases therefore suggesting a growing demand for levothyroxine therapy at this facility.

5. DISCUSSION:

5.1 Principal Findings: Our analysis showed that there were big differences in how levothyroxine was used across the study hospitals which gave us useful information about the clinical practices, patient groups and the operational aspects of the JRMS healthcare system. The variations in absolute consumption levels are most likely due to variances in the size of the hospital, the number of patients, and the complexity of the cases. King Hussein Medical Hospital has the highest consumption level because it is a tertiary care center. The strength preference patterns revealed by ratio analysis offered a compelling perspective on variations in clinical practice and the evident distinction between hospitals favoring 50 mcg versus 100 mcg tablets indicates systematic differences in prescribing practices, patient demographics, or clinical protocols that necessitate further investigation and potential standardization initiatives.

5.2 Clinical Practice Implications: Those observed strength preference patterns have important implications for comprehending the differences in clinical practice within the JRMS network, for example hospitals that prefer 50 mcg tablets may use more cautious dosage methods. This could be because they treat patients who are older, have a higher risk of heart disease or follow clinical guidelines that call for slow dose titration [18] and facilities that prefer 100 mcg may cater to patients with more severe hypothyroidism, younger individuals with a reduced cardiovascular risk or adopt clinical practices that advocate for greater starting dosages to expedite the attainment of therapeutic targets also these disparities in prescribing practices may show that doctors are adapting to the demands of their patients in their area but could indicate opportunities for protocol standardization and best practice sharing.

5.3 Operational and Management Considerations: From the point of view of pharmaceutical management consumption patterns offer useful information for improving inventory management, procurement planning and resource allocation across the JRMS network. Because hospitals tend to be distinguished from one another inventory planning decisions should be based on the needs of each facility rather than a one-size-fits-all strategy. For pharmacy operations, ratio analysis is very useful because it provides an actionable insight and information. Hospitals with consistently low or high ratios may find that adjusting their inventory allocation to better reflect specific prescribing trends and patient demands helps them avoid stockouts of preferred formulations while keeping excess inventory to a minimum.

5.4 Quality Improvement Opportunities: Variations in consumption patterns and strength preferences present opportunities for quality improvement programs focused on standardizing best practices while also maintaining an appropriate flexibility level for local patient needs. Comparative analysis of clinical outcomes associated with different prescribing patterns could help identify optimal tactics for different patient populations and developing standardized clinical protocols for levothyroxine prescribing could help reduce unnecessary variations while maintaining clinical effectiveness and such protocols should consider patient-specific factors including age, cardiovascular status and hypothyroidism severity while providing guidance for initial dose selection and titration strategies [19].

5.5 Economic Considerations: The economic consequences of the observed consumption patterns across the study hospitals warrant consideration in pharmaceutical budget management and the cost optimization contexts, despite that both formulations generally have similar per-tablet costs the overall consumption volumes significantly impact total pharmaceutical expenditures for levothyroxine therapy and potential dose optimization through appropriate strength selection may offer cost savings opportunities while maintaining clinical effectiveness. Patients requiring doses that are multiples of 100 mcg may be more cost-effectively managed with 100 mcg tablets rather than multiple 50 mcg tablets, though clinical considerations must remain paramount.

Limitations: Several limitations should be considered when interpreting findings. The retrospective design limits our ability to identify causal relationships between observed patterns and potential explanatory factors, while analysis reveals significant consumption pattern variations a definitive conclusions about underlying causes require additional investigation incorporating patient-level data and clinical context also the aggregate consumption data nature prevents analysis of individual patient outcomes, treatment effectiveness or prescribing decision appropriateness and the four-year study period while its sufficient for identifying trends and patterns but it may not capture longer-term cycles or full impact of major healthcare system changes.

6. CONCLUSION:

This extensive examination of levothyroxine usage across four major JRMS hospitals for the period of 2020 to 2023 revealed notable disparities in the utilization patterns of this medication and offered critical insights into clinical practices, patient demographics, and operational features within the military healthcare system. This study findings indicate that a distinct variations among the study hospitals in term of absolute consumption rates, strength preferences, and temporal trends, which have substantial ramifications for pharmaceutical management, standardization of clinical practices, and

quality enhancement initiatives. The observed consumption patterns illustrate intricate connections among patient demographics, clinical practices, institutional characteristics, and operational aspects affecting medicine utilization within the JRMS network, King Hussein Medical Hospital has the greatest levels of consumption all the study years which is in line with its main duty as a tertiary care facility. However the different strength preferences analysis show that there are disparities in the way prescriptions are written that need to be looked into and maybe improved. Ratio analysis shows strength preference patterns that are useful for both clinical practice and managing drugs. The fact that several hospitals prefer different tablet strengths shows that there are chances to share best practices, standardize protocols and to optimize inventory while yet being flexible enough to meet the needs of individual patients and the judgment of clinicians. From the point of view of quality improvement the differences that were found are chances to standardize best practices while still keeping clinical effectiveness and therefore creating evidence-based prescribing procedures that take into account individual patient characteristics and offer systematic guidance could enhance clinical results while minimizing unwarranted differences in practice patterns. Future study that builds on these findings could also provide us with more information on what affects how levothyroxine is used and how that affects the clinical outcomes. Future studies that include patient-level data, comparative effectiveness research, and economic analysis could help us understand even more and help us make evidence-based changes to how levothyroxine is prescribed and managed in military healthcare settings.

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