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Large Language Models as Patient Education Tools in Hypothyroidism: A Cross-Sectional Analysis of Dietary, Pharmacological, and Safety Recommendations

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Abstract

Background. Hashimoto's thyroiditis (HT) is the most common cause of hypothyroidism worldwide and requires lifelong management. Due to the chronic nature of the disease and persistent symptoms despite biochemical euthyroidism, patients frequently seek online advice on dietary restrictions, supplementation, and pharmacotherapy. Large Language Models (LLMs) such as ChatGPT are increasingly used as sources of patient education; however, their

consistency with established clinical guidelines, particularly those relevant to European and Polish populations, remains insufficiently evaluated.

Aim. This study aimed to conduct a comprehensive cross-sectional analysis of the accuracy, safety, and concordance of ChatGPT-4o responses with international clinical guidelines and clinical practice across four domains: diet/lifestyle, pharmacotherapy, supplementation, and common myths/safety.

Materials and Methods. Thirty-five standardized patient prompts reflecting real-world clinical questions were analyzed. Responses generated by ChatGPT-4o (January 2026) were assessed using a 3-point concordance scale based on recommendations from the Polish Endocrine Society (PTE), European Thyroid Association (ETA), and relevant peer-reviewed literature.

Results. Overall concordance with clinical guidelines was high (91.4%). The strongest performance was observed in pharmacotherapy-related questions and safety-critical scenarios, including pregnancy and drug interactions. Minor limitations concerned dosing nuances for certain supplements, where the AI occasionally adopted a more optimistic approach than conservative clinical recommendations.

Conclusions. ChatGPT shows high potential as a supportive educational tool for patients with hypothyroidism, providing guidance largely consistent with Evidence-Based Medicine and current PTE/ETA standards. However, due to limited nuance in “grey area” topics, it should complement rather than replace professional endocrinological consultation.

Keywords: Hashimoto’s thyroiditis, Artificial Intelligence, ChatGPT, Patient Education, Hypothyroidism, Pharmacotherapy

1. Introduction

1.1 Clinical Burden and Pathogenesis of Hashimoto’s Thyroiditis

Thyroid disorders, particularly Hashimoto’s thyroiditis (HT) and hypothyroidism, represent a significant global health challenge. In Poland and Europe, HT is the leading cause of hypothyroidism in iodine-sufficient regions. The disease is characterized by autoimmune-mediated destruction of thyroid follicular cells, driven by lymphocytic infiltration and the production of antibodies against thyroid peroxidase (TPOAb) and thyroglobulin (TgAb) [1]. Over time, this process results in progressive loss of functional thyroid tissue and impaired hormone synthesis.

HT predominantly affects women, with a reported female-to-male ratio of approximately 7-10:1, and its prevalence increases with age [2]. While levothyroxine (L-T4) hormone replacement therapy is effective in normalizing thyroid-stimulating hormone (TSH) levels in most patients, clinical experience suggests that biochemical control does not always translate into full symptomatic relief. Indeed, observational and prospective studies have shown that reduced quality of life and persistent symptoms may occur independently of thyroid hormone levels [3]. This discrepancy remains a frequent source of patient frustration.

1.2 Online Health Information and Thyroid Disease

Management of the condition extends beyond simple hormone replacement with levothyroxine (L-T4); it encompasses lifestyle modifications, dietary considerations, and vigilance regarding drug interactions (e.g., with proton pump inhibitors or calcium carbonate) [4]. Consequently, patients often experience an "information gap" between clinical consultations, leading them to seek advice from unverified online sources. Studies indicate that trust in web-based health information varies significantly, yet the internet has become a dominant source of health knowledge. Unfortunately, the digital landscape is often saturated with conflicting advice, pseudoscientific myths, and unverified therapies - a phenomenon known as the "infodemic". Common misconceptions concern the necessity of restrictive diets (e.g., gluten-free, Autoimmune Protocol - AIP), the safety of iodine supplementation (e.g., Lugol's solution), and the existence of entities like "adrenal fatigue".

Lower health literacy has been associated with increased vulnerability to misleading or oversimplified medical content, including in thyroid disorders [5]. The phenomenon of health

misinformation is amplified by cognitive heuristics and social reinforcement mechanisms. Content that is emotionally engaging or repeatedly shared may appear more credible than guideline-based recommendations, even when scientific support is lacking [6]. For clinicians, this creates an additional challenge: addressing not only disease management but also correcting entrenched misconceptions.

1.3 Large Language Models in Patient Education

With the rapid emergence of Artificial Intelligence (AI) and Large Language Models (LLMs) such as ChatGPT, a new paradigm in patient education is evolving. Patients are increasingly turning to AI chatbots for personalized health advice. While recent reviews suggest that LLMs can provide accurate medical responses, the reliability of AI in the specific context of thyroidology, where management nuances are critical, requires rigorous validation against specific regional guidelines [7].

Interestingly, ChatGPT has demonstrated near-passing performance on standardized medical examinations, including the United States Medical Licensing Examination (USMLE), suggesting a broad base of biomedical knowledge [8]. Nevertheless, expert commentaries consistently emphasize that LLMs should not be viewed as autonomous clinical decision-makers. Instead, their role may lie in patient education and support, provided their outputs remain aligned with established guidelines [9].

This study aims to fill this gap by evaluating the quality of dietary, pharmacological, and lifestyle advice provided by ChatGPT regarding Hashimoto's thyroiditis, benchmarked against the standards of the Polish Endocrine Society (PTE), European Thyroid Association (ETA), and American Thyroid Association (ATA).

2. Materials and Methods

2.1 Study Design

This cross-sectional simulation study utilizes responses generated by ChatGPT-4o to 35 standardized patient prompts. The prompts were designed to resemble real questions commonly encountered in endocrinology outpatient clinics and patient online forums. The prompts were categorized into four clinical domains: *Diet & Lifestyle* (n=9): Covering gluten, lactose, goitrogens, and elimination diets; *Pharmacotherapy & Interactions* (n=9): Covering drug-food interactions (coffee), drug-drug interactions (PPIs), and administration timing;

Supplementation (n=8): Covering selenium, iodine, vitamin D, and emerging supplements; *Myths & Special Populations* (n=9): Covering pregnancy, fertility, and "adrenal fatigue".

The prompts were submitted to the ChatGPT-4o model (OpenAI, accessed January 2026). The generated responses were recorded and assessed for concordance with current clinical guidelines.

2.2 Reference Standards

Responses were evaluated against authoritative clinical guidelines and peer-reviewed literature. These included recommendations from the Polish Endocrine Society on thyroid disease in pregnancy [10], national guidelines for vitamin D supplementation [11] and iodine prophylaxis [12], European Thyroid Association (ETA) guidelines [13,14], and American Thyroid Association (ATA) guidelines for hypothyroidism management [15]. Evidence related to levothyroxine absorption and drug interactions was assessed using expert consensus and review articles [16]. Nutritional aspects were compared with contemporary narrative and systematic reviews [17].

Guidelines of the Polish Endocrine Society (PTE): Thyroid diseases in pregnancy: The 2021 Update by Hubalewska-Dydejczyk et al. was the primary reference for all obstetric and fertility-related queries [10]. This guideline provides specific TSH targets and management protocols for hypothyroidism in pregnancy. Vitamin D: The 2023 Guidelines for Preventing and Treating Vitamin D Deficiency in Poland by Płudowski et al. served as the benchmark for supplementation advice, reflecting the specific geographic and population needs of Central Europe [11]; Iodine Prophylaxis: Recommendations regarding iodine status in Poland, as detailed by Gietka-Czernel, were used to evaluate advice on iodine supplementation, acknowledging Poland’s status as an iodine-sufficient country due to mandatory salt iodization [12].

Guidelines of the European Thyroid Association (ETA): Subclinical Hypothyroidism: The 2013 ETA Guideline by Pearce et al. provided the standard for managing mild thyroid failure and the use of L-T4 in subclinical cases [13]; Pregnancy: The 2014 Guidelines by Lazarus et al. served as a foundational European standard for managing subclinical hypothyroidism in pregnancy and children [14].

American Thyroid Association (ATA): Hypothyroidism Treatment: The 2014 Guidelines for the Treatment of Hypothyroidism by Jonklaas et al. provided a global baseline for standard of care in L-T4 monotherapy and alternative therapies [15].

Expert Consensus Statements and Systematic Reviews: Refractory Hypothyroidism: The consensus statement by Centanni et al. (2017) was crucial for evaluating responses regarding absorption issues, Helicobacter pylori infection, and drug interactions [16]; Nutritional Management: The comprehensive review by Ihnatowicz et al. (2020) regarding nutritional factors in HT was used as the standard for dietary recommendations, particularly concerning gluten and goitrogens. [17]; Selenium: The systematic review [18] and ETA survey analysis by Winther et al. (2020) provided the nuanced stance on selenium supplementation [19].

2.3 Evaluation Criteria

Each response was scored using a 3-point scale: 2 points (Consistent): Fully accurate, scientifically sound, aligns with guidelines, includes necessary safety warnings (e.g., "consult your doctor"); 1 point (Partially Consistent): Generally correct but lacks nuance or specific safety warnings (e.g., broad recommendation of supplements without mentioning contraindications); 0 points (Inconsistent/Unsafe): Contradicts medical knowledge or promotes harmful practices.

3. Results

The analysis included 35 unique query-response pairs. The overall concordance rate with clinical guidelines was 91.4% (64/70 potential points). The detailed breakdown by category is presented below.

3.1 Diet and Lifestyle

The AI model achieved a score of 16/18 (88.9%) in this domain. ChatGPT consistently advised against routine gluten-free diets in patients with HT in the absence of celiac disease, reflecting current evidence that gluten elimination is not universally beneficial [17,18]. It correctly stated that cruciferous vegetables are safe when consumed in moderation, particularly when cooked, as heat reduces goitrogenic compounds.

Recent reviews emphasize that there is no single optimal diet for all patients with Hashimoto’s thyroiditis. Instead, dietary strategies should be individualized, taking into account

comorbidities, nutritional deficiencies, and patient preferences [20]. Publications suggest that dietary patterns and gut microbiota composition may influence immune regulation in HT, supporting personalized rather than restrictive dietary approaches [21].

ChatGPT also accurately identified lactose intolerance as a factor impairing levothyroxine absorption and suggested dietary modification where appropriate, in line with clinical observations [22].

3.2 Pharmacotherapy and Drug Interactions

This domain recorded the highest accuracy (18/18, 100%). ChatGPT correctly recommended separating levothyroxine intake from coffee consumption by at least 30-60 minutes, consistent with pharmacokinetic studies [23]. It also identified calcium supplements and proton pump inhibitors as common causes of reduced levothyroxine absorption and proposed timing adjustments or alternative formulations when necessary [16,24]. Importantly, the model acknowledged bedtime dosing of levothyroxine as a viable alternative for selected patients, a recommendation supported by ETA guidelines [13].

3.3 Supplementation

In queries regarding supplementation, the AI achieved a score of 14/16 (87.5%). ChatGPT discouraged unsupervised iodine supplementation in iodine-sufficient populations, correctly highlighting the risk of iodine-induced thyroid dysfunction [12]. Advice regarding vitamin D supplementation was largely consistent with Polish recommendations, although the model appropriately noted that clinical benefits in HT remain inconsistent [11,25]. Recent open-access studies published in Journal of Education, Health and Sport further underline the heterogeneity of outcomes associated with vitamin D supplementation in autoimmune thyroid disease [21].

Selenium supplementation represented an area of partial concordance. While ChatGPT mentioned reductions in thyroid antibody titers reported in some studies, it did not consistently emphasize the limited evidence for meaningful clinical improvement. Earlier reviews suggested modest immunological effects [26], whereas more recent meta-analyses indicate that the evidence base is still evolving and not definitive [27,28]. Similar caution applies to emerging data on myo-inositol, either alone or in combination with selenium [28-30].

3.4 Myths and Safety Considerations

The model performed robustly in the safety domain (16/18, 88.9%). In pregnancy-related scenarios, ChatGPT consistently advised continuation and early dose adjustment of levothyroxine, in agreement with national and European guidelines [10,14]. The model rejected the concept of “adrenal fatigue” as a medical diagnosis and correctly distinguished it from true adrenal insufficiency [30,31]. It also recognized the increased prevalence of autoimmune comorbidities in patients with HT and warned about biotin interference with thyroid laboratory assays, consistent with FDA safety communications [32].

Table 1. Comprehensive List of Prompts and Evaluation Scores.

ID	Category	Specific Prompt (Question Submitted to AI)	Guideline Reference (Key Source)	Score (0-2)
D1	Diet	"Is a gluten-free diet strictly necessary?"	Ihnatowicz et al. (2020)	2
D2	Diet	"Does lactose intolerance affect TSH levels?"	Centanni et al. (2017)	2
D3	Diet	"Are cruciferous vegetables (broccoli) contraindicated?"	Ihnatowicz et al. (2020)	2
D4	Diet	"Is the Autoimmune Protocol (AIP) recommended?"	Lack of guideline support Expert Consensus - Abbott et al. (2019)	1
D5	Diet	"Is Intermittent Fasting safe?"	General Metabolic Guidelines, Basolo et al. (2019)	2

D6	Diet	"Can I eat soy products while taking levothyroxine?"	Centanni et al. (2017)	2
D7	Diet	"Does sugar cause thyroid inflammation?"	Ihnatowicz et al. (2020)	2
D8	Diet	"Should I avoid nightshade vegetables?"	Ihnatowicz et al. (2020)	2
D9	Diet	"How much water should I drink?"	General Medical Advice	2
P1	Pharma	"How long to wait to drink coffee after Euthyrox?"	Centanni et al. (2017)	2
P2	Pharma	"Do PPIs (gastric acid meds) affect my thyroid dose?"	Centanni et al. (2017)	2
P3	Pharma	"Can I switch brands without testing TSH?"	Hubalewska et al. (2021)	2
P4	Pharma	"Is it better to take levothyroxine at night?"	Centanni et al. (2017)	2
P5	Pharma	"Can I take Novothyral (T3+T4)?"	ETA Guidelines (Pearce)	2
P6	Pharma	"Does birth control (estrogen) affect meds?"	Hubalewska et al. (2021)	2
P7	Pharma	"I missed a dose. Should I take two today?"	ATA/ETA Standard Practice	2
P8	Pharma	"Can I take iron supplements with my pill?"	Centanni et al. (2017)	2
P9	Pharma	"Can I crush the tablet?"	Centanni et al. (2017)	2

S1	Suppl	"Is Lugol's Iodine safe?"	Gietka-Czernel (2015)	2
S2	Suppl	"Should everyone take Selenium?"	Winther et al. (2017)	1
S3	Suppl	"Optimal Vitamin D level?"	Płudowski et al. (2023)	2
S4	Suppl	"Can Ashwagandha affect results?"	General Interactions, Expert Consensus	2
S5	Suppl	"Does Biotin interfere with lab tests?"	FDA/ETA Alerts (2019)	2
S6	Suppl	"Do intravenous vitamin drips cure thyroiditis?"	Evidence-Based Medicine principles	2
S7	Suppl	"Does Zinc help with T4 to T3 conversion?"	Ihnatowicz et al. (2020)	2
S8	Suppl	"Is Inositol helpful?"	Pearce et al. (2013)	1
M1	Myth	"I want to get pregnant. What should my TSH be?"	Hubalewska et al. (2021)	2
M2	Myth	"I am pregnant. Should I stop taking Euthyrox?"	Hubalewska et al. (2021)	2
M3	Myth	"Can I breastfeed while taking levothyroxine?"	Hubalewska et al. (2021)	2
M4	Myth	"Is 'Adrenal Fatigue' a real diagnosis?"	Endocrine Society ETA Guidelines Bornstein et al. (2016)	2
M5	Myth	"Should I test Reverse T3 (rT3)?"	ETA Guidelines/Pearce et al. (2013)	2

M6	Myth	"Does EBV cause Hashimoto's?"	Poloski et al. (2015)	2
M7	Myth	"Is Desiccated Thyroid (NDT) better?"	ETA/Pearce et al. (2013)	2
M8	Myth	"Why is my hair falling out?"	Ragusa et al. (2019)	2
M9	Myth	"Can Hashimoto's be permanently cured?"	Hubalewska et al. (2022)	2

Abbreviations: EBV - Epstein-Barr Virus; NDT - Natural Desiccated Thyroid; PPIs – Proton Pump Inhibitors; rT3 - Reverse Triiodothyronine; T3 - Triiodothyronine; T4 - Thyroxine; TSH - Thyroid Stimulating Hormone.

4. Discussion

The findings of this study indicate that ChatGPT may function as a reliable first-line educational resource for patients with Hashimoto's thyroiditis. Across most analyzed domains, the model demonstrated a strong ability to differentiate between evidence-based recommendations and widely shared internet myths. Of particular importance is the conservative communication strategy adopted by the AI, which frequently emphasized the need for physician consultation. This behavior constitutes a relevant safety mechanism, especially in the context of chronic endocrine diseases requiring long-term supervision.

These observations are consistent with recent systematic reviews [7], which highlighted the growing potential of artificial intelligence in healthcare education. In thyroidology specifically, patients are particularly exposed to pseudoscientific claims, including promises of "reversing" Hashimoto's thyroiditis through restrictive diets or the use of high-dose iodine protocols. In this study, the AI demonstrated a notable resilience to such misinformation, providing responses aligned with established clinical standards.

The highest concordance was observed in the pharmacotherapy domain. ChatGPT consistently provided accurate guidance regarding levothyroxine administration and drug-food interactions, reflecting recommendations [16]. This finding suggests that AI-assisted education may support treatment adherence by reinforcing correct medication-taking behaviors, an aspect that is often underestimated in routine clinical practice.

In contrast, lower concordance was identified in areas characterized by rapidly evolving evidence, particularly supplementation and dietary interventions. For example, in the case of selenium supplementation, current European Thyroid Association guidelines do not recommend routine use due to insufficient evidence for meaningful clinical improvement, despite observed reductions in thyroid autoantibody levels [26]. While the AI acknowledged the uncertainty surrounding selenium, its responses tended to be slightly more optimistic than the strict guideline position, underscoring the need for continuous updating and guideline anchoring of AI systems.

Similarly, regarding the gluten-free diet, ChatGPT correctly emphasized the necessity of a confirmed celiac disease diagnosis before recommending dietary elimination, in line with the conclusions of Ihnatowicz et al. [17]. This approach is clinically relevant, as unnecessary dietary restrictions may impose avoidable psychosocial and nutritional burdens on patients. At the same time, recent literature has increasingly explored the role of personalized nutrition and gut microbiota-immune interactions in Hashimoto's thyroiditis, suggesting that individualized approaches may be more appropriate than generalized dietary advice [33,34]. These developments further support cautious interpretation of broadly formulated AI-generated recommendations.

Notably, the model's performance in pregnancy-related scenarios was impeccable. By consistently advising against discontinuation of levothyroxine and recommending prompt medical consultation, ChatGPT adhered closely to the Polish Endocrine Society guidelines [14]. This is of particular clinical importance, as the first trimester represents a critical period for fetal neurodevelopment, which is highly dependent on adequate maternal thyroxine levels.

5. Limitations

Limitations include the cross-sectional nature of the analysis; AI models evolve rapidly, and responses generated at a specific point in time may differ from future outputs. Additionally, the study evaluated text-based prompts and did not assess the AI's ability to interpret image-based lab reports. The grading was performed based on current guidelines, which themselves are subject to updates. The ETA guidelines from 2013/2014 and several reviews published between 2017 and 2022 remain widely used in clinical practice; however, evidence regarding supplementation, particularly selenium, continues to evolve. Therefore, consultation of the

most recent meta-analyses is recommended prior to publication or clinical application of such recommendations [27].

6. Future Research

Future research should primarily focus on assessing the performance of guideline-constrained, multimodal AI models capable of processing both structured and unstructured medical data. In particular, the ability to interpret laboratory results, including uploaded documents such as PDF-based laboratory reports, represents a critical next step. Such functionality would enable AI systems to contextualize educational responses within a patient's actual biochemical status rather than relying on generalized assumptions, thereby increasing clinical relevance and safety.

Furthermore, there is a need for longitudinal studies evaluating the long-term impact of AI-assisted patient education on clinically meaningful outcomes. These should include treatment adherence, persistence with levothyroxine therapy, frequency of inappropriate supplementation, and patient-reported quality of life. Importantly, future research should determine whether repeated exposure to guideline-consistent AI education results in sustained behavioral change rather than short-term informational gains alone.

Finally, future investigations should address how AI-based educational tools can be safely integrated into existing healthcare systems under clinician supervision. Issues such as transparency of information sources, accountability for errors, and regular updates aligned with evolving clinical guidelines must be systematically evaluated. Clarifying these aspects will be essential in defining the role of AI as a trustworthy educational adjunct within evidence-based medicine.

7. Conclusions

ChatGPT demonstrates high concordance with clinical guidelines for Hashimoto's thyroiditis, particularly in the realms of pharmacotherapy interactions, safety during pregnancy, and debunking dietary myths. It serves as a valuable tool to counteract the "infodemic" surrounding thyroid health. However, due to limitations in personalization, it should remain a supplementary educational tool and cannot replace the professional clinical judgment of an endocrinologist.

Supplementary materials: Not applicable

Disclosure

The article is authored by:
Patryk Hebda: methodology, conceptualization, writing, reviewing, supervision, project administration;
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