Hypothyroidism

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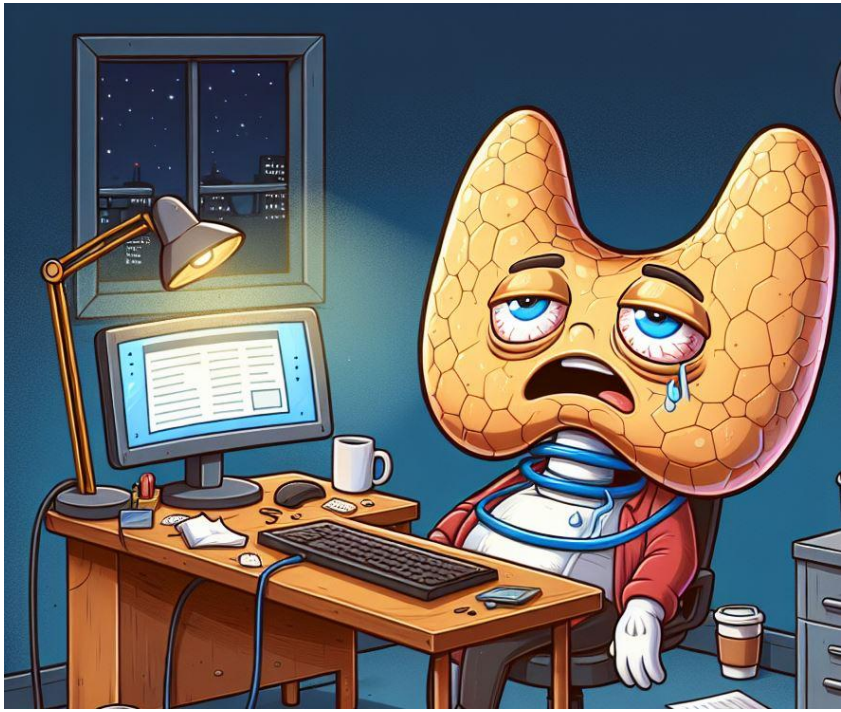


DALHOUSIE UNIVERSITY

Image created by Microsoft Copilot, 2024

Disclosures

I. None relevant to today's topic (or thyroid disease)

Relationships With Financial Sponsors

SPEAKERS BUREAU/ HONORARIA:	**Diabetes/Obesity:** CPD Network Association, Eli Lilly, Novo Nordisk, Dexcom, Abbott (FreeStyle Libre)
GRANTS/RESEARCH SUPPORT/PATENTS:	None
CONSULTING FEES:	**Diabetes:** Abbott (FreeStyle Libre)
OTHER:	Assistant Professor in Medicine (Dalhousie)

I will be using AI-generated images (not content)
Off-label recommendations will be clearly indicated

CPD = Continuing Professional Development

Objectives

*Patient Oriented

I. Explain the most common **causes** of hypothyroidism in adults and an *approach to screening/**workup**

II. Understand some **nuances** and possible **pitfalls** in thyroid function interpretation and investigation

III. Outline an approach to treating hypothyroidism, including medication **indications** and options

IV. Describe common challenges with thyroid hormone replacement (and **alternative** therapies)

Image created by Microsoft Copilot, 2024

“Why is my thyroid low?”

Case 1a: HT 43F

- History: G2P2, celiac disease
- Meds: nil (*biotin supplement)
- 2019: 6 months postpartum
- Fatigue, weight gain, hair loss
- Exam: N

- TSH: 2.5 (Mar*)→6.8↑ (May)→11↑ (Aug)
- fT4/fT3: N (Mar*)→N (May)→↓ (Aug)

"Why is my thyroid low?"

Generated image by Meta AI, 2025
TSH = thyroid-stimulating hormone; fT4 = free thyroxine; fT3 = free triiodothyronine; N = normal

“I think there is something wrong with my thyroid”

Case 2: DQ 38M

- History: nil
- Medications: nil
- 2 weeks: anterior neck pain, swelling following upper respiratory tract infection
- 1 week: palpitations, tremor, diaphoresis, anxiety
- Exam: tremor, tachycardia, ?L-sided nodule
- TSH undetectable↓, fT4 32.2↑, CRP 110↑
- Neck pain and swelling: naproxen, prednisone
- Repeat (8 weeks): TSH 9.9↑, fT4 N, CRP 0.4, TPO < 3

Generated image by Meta AI, 2024

TSH = thyroid-stimulating hormone; fT4 = free thyroxine; CRP = C reactive protein; TPO = thyroid peroxidase antibody

“Are my medications making me feel off?”

Case 3: PA 75F

- History: hypertension, IBS, GERD, type 2 diabetes, dyslipidemia, osteopenia
- Medications: metformin, candesartan, rosuvastatin, pantoprazole, alendronate
- 3 months: fatigue, anorexia, presyncope, headache, minor MVC ("missing things when I drive")
- Exam: 82/63, pulse 55, "dry", brittle hair, dry skin
- TSH N, Na 123↓, K N, hemoglobin 128↓

"Are my meds OK?"

Generated image by Meta AI, 2025

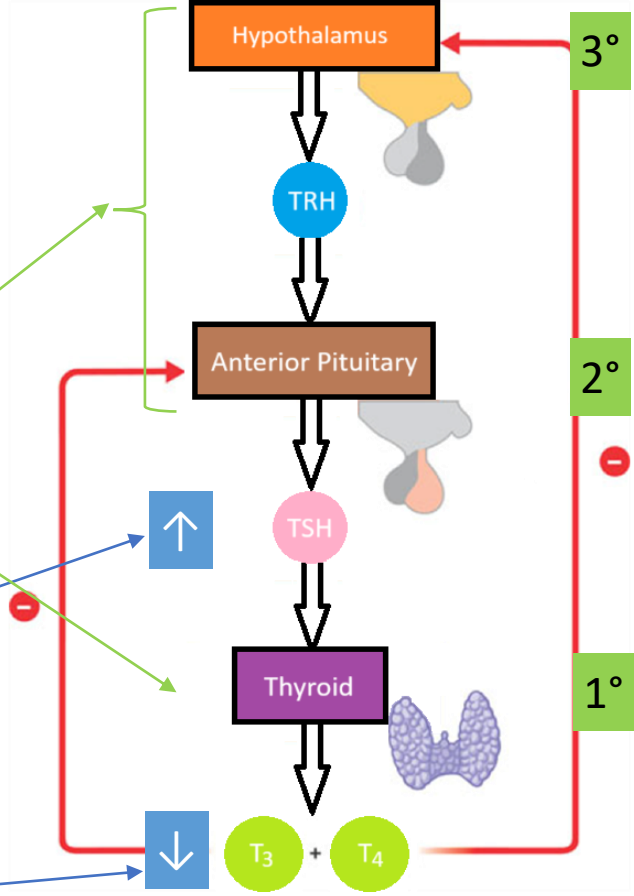
GERD = gastroesophageal reflux disease; IBS = irritable bowel syndrome; MVC = motor vehicle collision; TSH = thyroid-stimulating hormone; Na = sodium; K = potassium; N = normal

I. Hypothyroidism:

- Primary: peripheral gland
  - i.e. thyroid issue
- Secondary: central/brain
  - i.e. pituitary/hypothalamic

- Subclinical: TSH ↑, fT4/fT3 N
- Overt: TSH ↑, fT4/fT3 ↓

- Transient: "flux" or temporary state
  - e.g. thyroiditis, post-therapy



[1]ATA 2014; [5]AAFP 2021; [A]Ross et al. 2025
TRH = thyroid-releasing hormone; TSH = thyroid-stimulating hormone;
fT4 = free thyroxine; fT3 = free triiodothyronine; N = normal

I. Hypothyroidism: Differential

V – Vascular	(Radiation)
I – Infiltrative	(Hemochromatosis, Sarcoidosis)
– Infectious	(Subacute thyroiditis)
T – Trauma	(Surgery)
A – Autoimmune	(Hashimoto's)
M – Metabolic	(Severe iodine, Thyroid resistance)
I – Iatrogenic	(Drugs, Radioactive iodine)
N – Neoplastic	(Pituitary mass)
C – Congenital	(Agenesis, dysgenesis, Synthesis)

[1]ATA 2014; [5]AAFP 2021; [A]Ross et al. 2025

I. Hypothyroidism: DDx

Noteworthy causes:

A. Autoimmune
   - Hashimoto's

B. Iatrogenic: drugs

C. Thyroiditis (?transient)

D. Central
   - Most important distinction to make

Most common?

Reversible?

Go away?

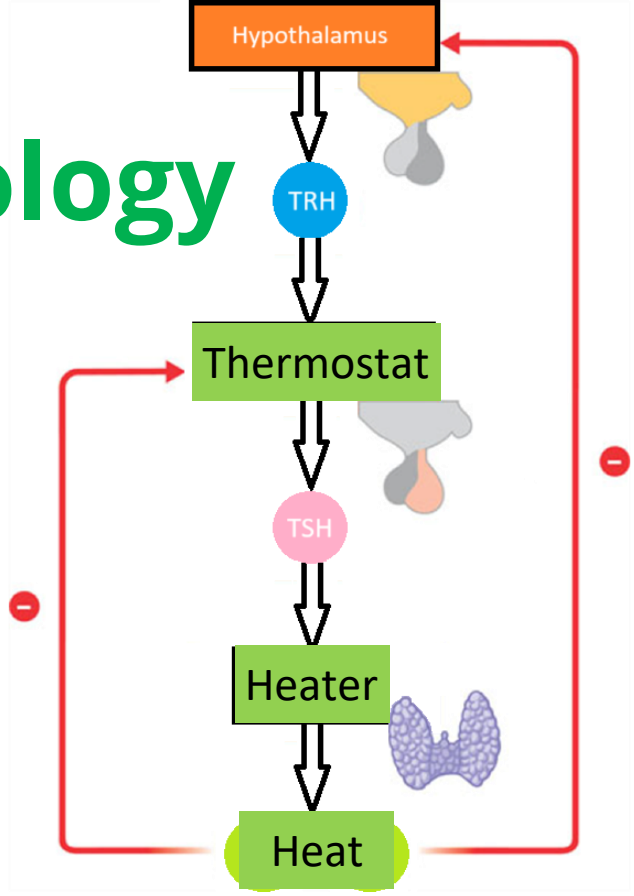
Other deficiency?

HYPOTHYROIDISM: MAJOR CAUSES
PRIMARY (THYROID)
Chronic autoimmune thyroiditis: **Hashimoto's**
Iatrogenic: Thyroidectomy, Radioiodine therapy, External irradiation
Iodine (severe only): Deficiency **or** Excess
Drugs: **Thionamides**, **Lithium**, **Amiodarone**, Immunotherapy (**checkpoint inhibitors**), Tyrosine kinase inhibitors, Interferon alfa, Interleukin 2
Infiltrative diseases: Fibrous thyroiditis, Hemochromatosis, Sarcoidosis
Transient hypothyroidism: Subtotal thyroidectomy, Post-radioactive iodine therapy (e.g. Graves' disease/toxic nodule), Post-thyroid suppression withdrawal (euthyroid patients), **Thyroiditis** (Painless [silent, lymphocytic], subacute granulomatous [de Quervain's], postpartum
Congenital: Thyroid agenesis/dysgenesis, Defects in hormone synthesis
SECONDARY (CENTRAL)
Pituitary: TSH deficiency
Hypothalamic: TRH deficiency
THYROID HORMONE RESISTANCE
*Adapted from [1]ATA, [5]AAFP, [A]UpToDate

[1]American Thyroid Association 2014; [5]American Academy Family Physicians 2021; [A]Ross et al. 2025
TRH = thyrotropin-releasing hormone; TSH = thyroid-stimulating hormone

I. Hypothyroidism: Etiology

1. Underproduction of thyroid hormones (T4 and T3)
   - Peripheral (1°):
     - Autoimmune
     - Iatrogenic
     - Medications
     - Infiltrative/congenital
   - Central: underproduction or TSH (or TRH)
2. [Rare: resistance, consumptive]

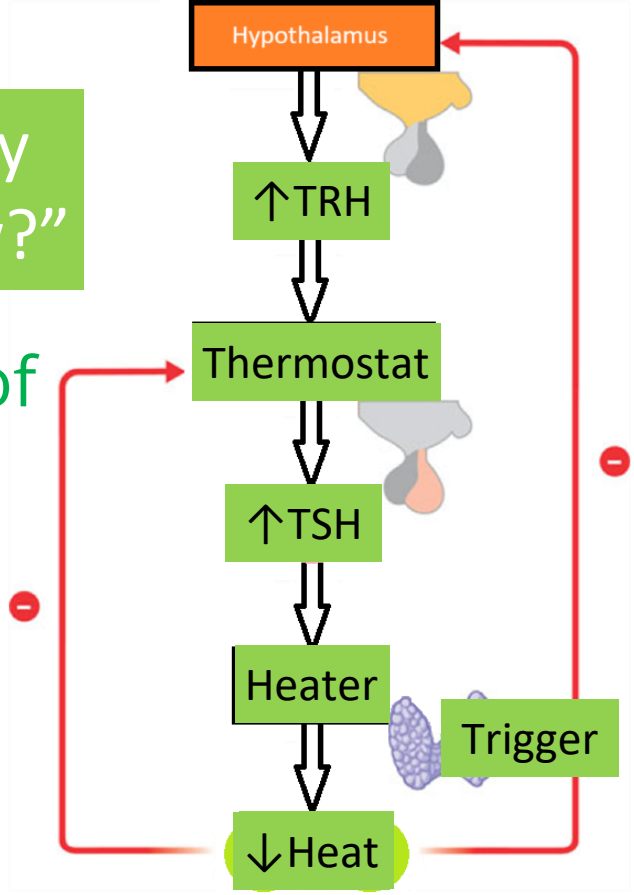


"Why is my thyroid low?"

[1]ATA 2014; [5]AAFP 2021; [A]Ross et al. 2025
TRH = thyrotropin-releasing hormone; TSH = thyroid-stimulating hormone; T4 = thyroxine; T3 = triiodothyronine

A. Hashimoto's

"Why is my thyroid low?"



- Autoantibody triggers destruction of thyroid tissue
  - Most common primary cause
- Autoimmune: TPO usually positive
  - This makes the diagnosis
  - TPO: marker of potential autoimmune dysfunction (hyper or hypothyroidism)
    - Should NOT be repeated
- Course: subclinical hypothyroidism period progressing to overt hypothyroidism (variable)

[1]ATA 2014; [5]AAFP 2021; [A]Ross et al. 2025

TRH = thyrotropin-releasing hormone; TSH = thyroid-stimulating hormone; T4 = thyroxine; T3 = triiodothyronine

TPO = thyroid peroxidase

B. Drugs

Noteworthy:

- Lithium
- Amiodarone
- Checkpoint inhibitors
- Calcium
- Iron
- Steroids
- PPIs

DRUGS AND THYROID FUNCTION	
HYPOTHYROIDISM	
Inhibition of hormone Synthesis or Release	**Thiomanides**, **Lithium**, Perchlorate, Aminoglutethimide, Kelp, **Iodine** (Amiodarone, Contrast, Iodide [SSKI], Expectorants, Betadine douches, Topical antiseptics), Thalidomide
Decrease T4 Absorption	**Calcium**, **Iron**, Cholestyramine, Colestipol, Colesevelam, Chromium, Aluminum hydroxide, Sucralfate, Raloxifene, PPIs, Sevelamer, Lanthanum carbonate
Immune dysregulation	Interferon alfa, Interleukin-2, Immunotherapy (**checkpoint inhibitors**)
TSH Suppression	Dopamine, Bexarotene (increased T4 clearance)
Destruction	Immunotherapy (**checkpoint inhibitors**), Tyrosine kinases inhibitors
Type 3 Deiodination	Tyrosine kinases inhibitors
ABNORMAL THYROID FUNCTION TESTS	
Low TBG	Androgens, Danazol, **Glucocorticoids**, Niacin, L-asparaginase
Decreased T4 Binding	Salicylates, Salsalate, Furosemide, Heparin, Non-steroidal anti-inflammatory Drugs
Increase T4 Clearance	Phenytoin, Carbamazepine, Rifampin, Phenobarbital, Ritonavir
TSH Suppression	Dopamine, **Glucocorticoids**, Octreotide
Impaired T4 to T3 Conversion	**Amiodarone**, Propylthiouracil, Contrast/liopanoic acid, **Glucocorticoids**, Propranolol, Nadolol
*Adapted from [1]ATA, [5]AAFP, [A]UpToDate	

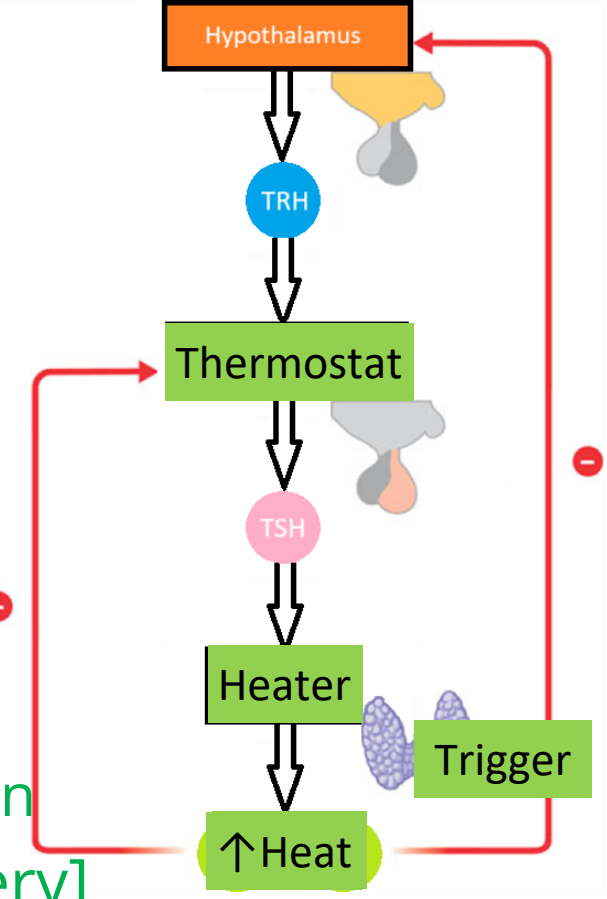
[1]American Thyroid Association 2014; [5]American Academy Family Physicians 2021; [A]Ross et al. 2025

TSH = thyroid-stimulating hormone; T4 = thyroxine; T3 = triiodothyronine; TBG: thyroxine binding globulin

PPIs = proton pump inhibitors; SSKI = saturated solution of potassium iodide

C. Thyroiditis

"What's wrong?"



- Thyroid "irritated" (stored T4 > T3 released), then absence of new hormone synthesis ("stunned")
  - Many triggers: viral, postpartum, neck palpation, radiation, medications, iodine supplements (*lion's mane, ashwanganda*)
  - Follows upper respiratory or GI infection
- Phasic: thyrotoxic, hypothyroid, [recovery]
  - This makes the diagnosis
- TPO antibody can positive (Hashimoto's), CRP elevated
- Uptake and scan: no uptake (decreased from normal)
  - Rarely needed

[1]ATA 2014; [5]AAFP 2021; [A]Ross et al. 2025; [C]Burman et al. 2025

TRH = thyrotropin-releasing hormone; TSH = thyroid-stimulating hormone; T4 = thyroxine; T3 = triiodothyronine

GI = gastrointestinal; TPO = thyroid peroxidase; CRP = C reactive protein

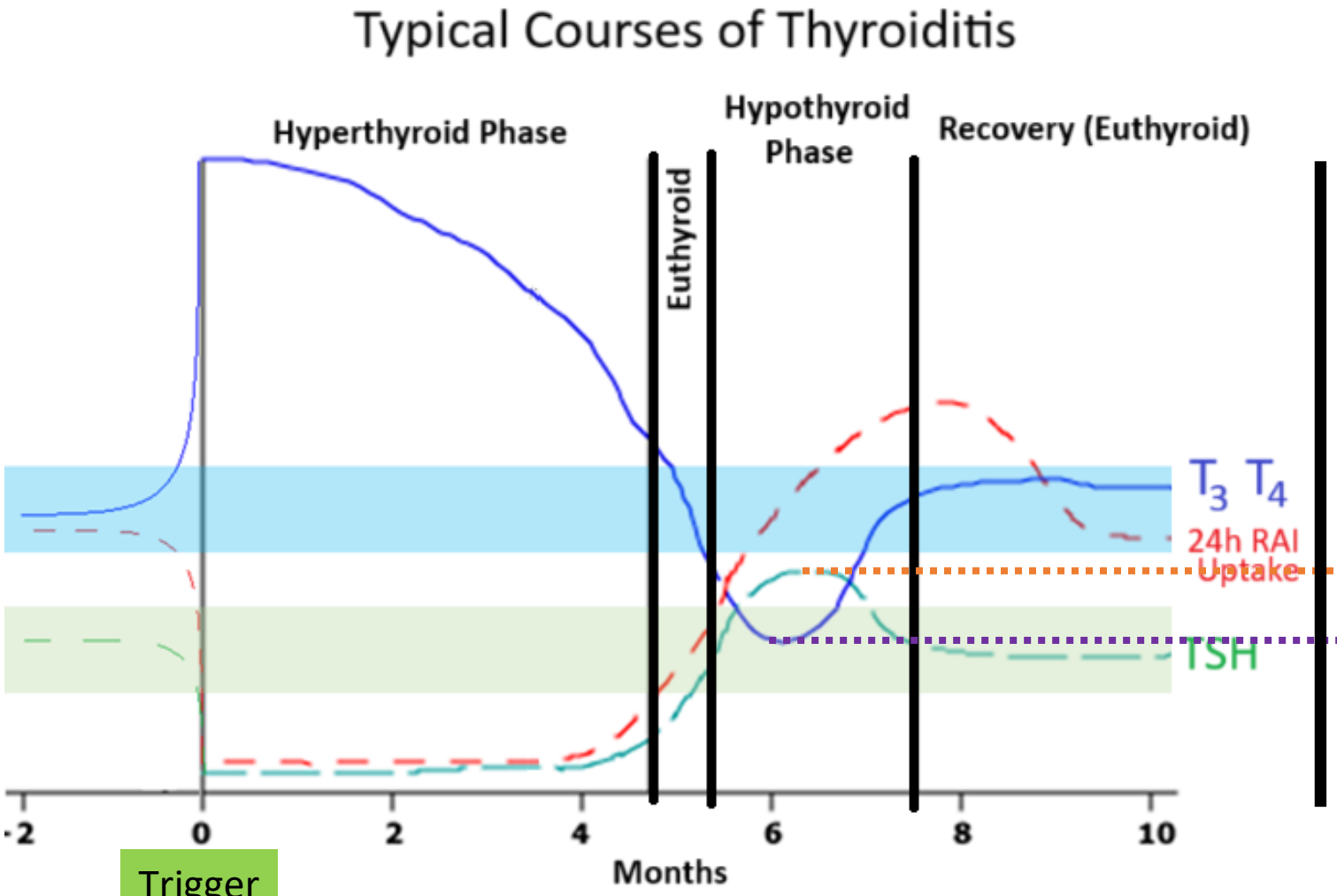
C. Thyroiditis

UpToDate®

THYROIDITIS: MAJOR CAUSES
PAINFUL (TENDER)
Subacute: Granulomatous, Suppurative (de Quervain's), Nonsuppurative
Infectious: Acute or Chronic
Iatrogenic: Radiation, Palpation/Trauma
PAINLESS
Painless: Silent, Lymphocytic (Spontaneous, Subacute)
Drugs: Lithium, Amiodarone (type 2), Immunotherapy (checkpoint inhibitors), Tyrosine kinase inhibitors, Interferon alpha, Interleukin 2
Chronic lymphocytic: **Hashimoto's**, Postpartum
Fibrous: Reidel's, IG4-related, invasive
*Adapted from [C]UpToDate

Adapted from [C]Ross et al. 2025; [C]Burman et al. 2025
IG4 = immunoglobulin G4

C. Thyroiditis



(*or Permanent Hypothyroidism) - e.g. Hashimoto's

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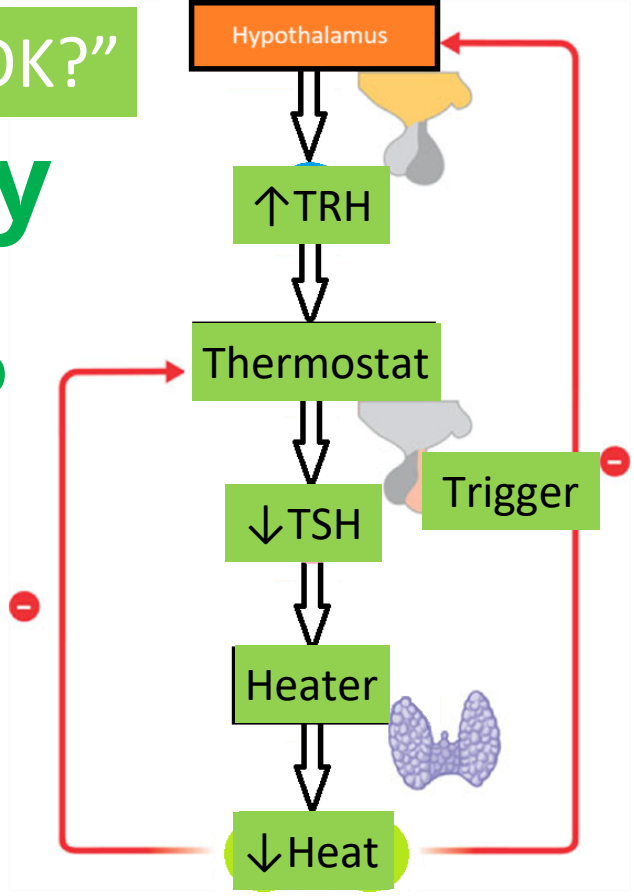
[1]ATA 2014; [5]AAFP 2021; [C]Burman et al. 2025; Adapted from [D]Ross et al. 2025
TSH = thyroid-stimulating hormone; T4 = thyroxine; T3 = triiodothyronine

"Are my meds OK?"

D. Secondary: Pituitary



- Pituitary injury results in inability to make enough TSH
  - TSH ↓ (or inappropriately N) and ↓ fT4/fT3
    - This makes the diagnosis
- Screen for other deficiencies
  - (Go): GH — IGF-1
  - (Look For) LH/FSH — Estradiol/testosterone
  - (The) TSH — TSH AND fT4
  - (Adenoma) ACTH — 8AM cortisol
  - (Please) Prolactin — 8AM, fasting prolactin

TRH = thyrotropin-releasing hormone; TSH = thyroid-stimulating hormone; fT4 = free thyroxine; fT3 = free triiodothyronine; LH = luteinizing hormone; FSH = follicle-stimulating hormone; N = normal GH = growth hormone; IGF-1 = insulin-like growth factor-1; ACTH = adrenocorticotropic hormone

D. Pituitary Deficiencies

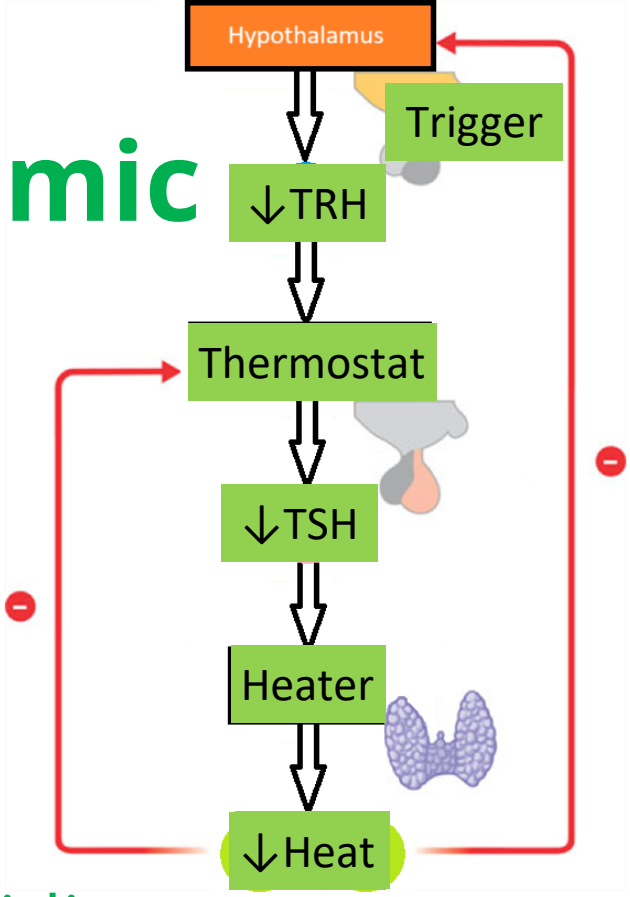
- (Go): GH – IGF-1
  - Adults: nonspecific symptoms
- (Look For): LH/FSH – E_2/testosterone
  - ♂: fatigue, reduced libido, gynecomastia
  - ♀: hot flashes, vaginal dryness, amenorrhea
- (The): TSH (see below)
- (Adenoma): ACTH – 8 AM cortisol
  - Fatigue, weight loss, anorexia, nausea/vomiting, abdominal pain, diarrhea, hyponatremia
- (Please): excess prolactin – 8 AM, fasting
  - Galactorrhea, oligomenorrhea

Image created by Microsoft Copilot, 2025

GH = growth hormone; IGF-1 = insulin-like growth factor-1; TSH = thyroid-stimulating hormone
LH = luteinizing hormone; FSH = follicle-stimulating hormone; E_2 = estradiol; ACTH = adrenocorticotropic hormone

D. Tertiary: Hypothalamic

- Hypothalamic injury results in inability to make enough TRH (and/or) TSH
- Need to screen for other deficiencies (as above)



- Both causes of central hypothyroidism should prompt further investigation and referral to endocrinology
  - Sellar MRI

[1]ATA 2014; [5]AAFP 2021; [A]Ross et al. 2025; [3]ETA 2018
TRH = thyrotropin-releasing hormone; TSH = thyroid-stimulating hormone; T4 = thyroxine; T3 = triiodothyronine
MRI = magnetic resonance imaging

I. Hypothyroidism: Approach

1. Symptoms? Signs?
   - Fatigue, weakness, weight gain, constipation, dry skin, carpal tunnel, myalgia/arthralgia, paresthesia, depression, brain fog, cold intolerance, menstrual irregularities
   - Exam: goitre, bradycardia, diastolic hypertension, delayed reflexes
   - Central cause: brain injury/mass, new headache, peripheral vision loss, other pituitary deficiencies
2. Offending agents?
   - Biotin, iodine (kelp, dulse), medications (lithium, amiodarone, checkpoint inhibitors, cytokines, tyrosine kinase inhibitors)
3. Repeat testing in 6-8 weeks (after minimizing interference from #2.)
   - Thyroid function studies: TSH (fT4 – if central cause suspected)
   - TPO antibody

[1]ATA 2014; [5]AAFP 2021; [D]Ross et al. 2025
TSH = thyroid-stimulating hormone; fT4 = free thyroxine; TPO = thyroid peroxidase

“Can you please check my thyroid levels?”

I. Hypothyroidism: Screening

"Can you check my thyroid?"

- Symptoms/signs present: screen
- If not, do not screen[5] vs. (*consider[1])
  - History of autoimmune disease or thyroid injury
    - Celiac, type 1 diabetes, neck surgery/radiation
  - Pregnancy? (first trimester – controversial)
  - Medications known to cause hypothyroidism
  - Pituitary/hypothalamic disorder
  - Change in labwork:
    - Substantial dyslipidemia, hyponatremia, macrocytic anemia, ↕CK
  - Exam: new thyroid nodule, pericardial/pleural effusion
- Hospitalized/ill: do NOT screen (out-patient recovery)

[1]ATA 2014; [4]ATA 2017; [5]AAFP 2021; [D]Ross et al. 2025
CK = creatine kinase

I. Hypothyroidism: Approach

- TSH ↑: repeat 6-8 weeks with fT4
  - fT4 ↓: primary hypothyroidism likely
  - fT4 N: subclinical hypothyroidism
  - fT4 ↑: see inset
- TSH N: primary hypothyroidism unlikely
  - *Convincing symptoms (hypothyroidism, pituitary deficiency) or possible central disease: repeat TSH and fT4 ("exception")
  - fT4 ↓: nonthyroidal illness or central hypothyroidism
  - fT4 N: hypothyroidism ruled out
  - fT4 ↑: see inset
- TSH ↓: repeat 6-8 weeks with fT4
  - fT4 ↓: nonthyroidal illness or central hypothyroidism
  - fT4 N: biotin (or other assay interference)
  - fT4 ↑: hyperthyroidism

TSH ↑/N, fT4 ↑:
- Assay interference
- Amiodarone?
- Thyroid hormone resistance? (rare)
- TSHoma (rare)

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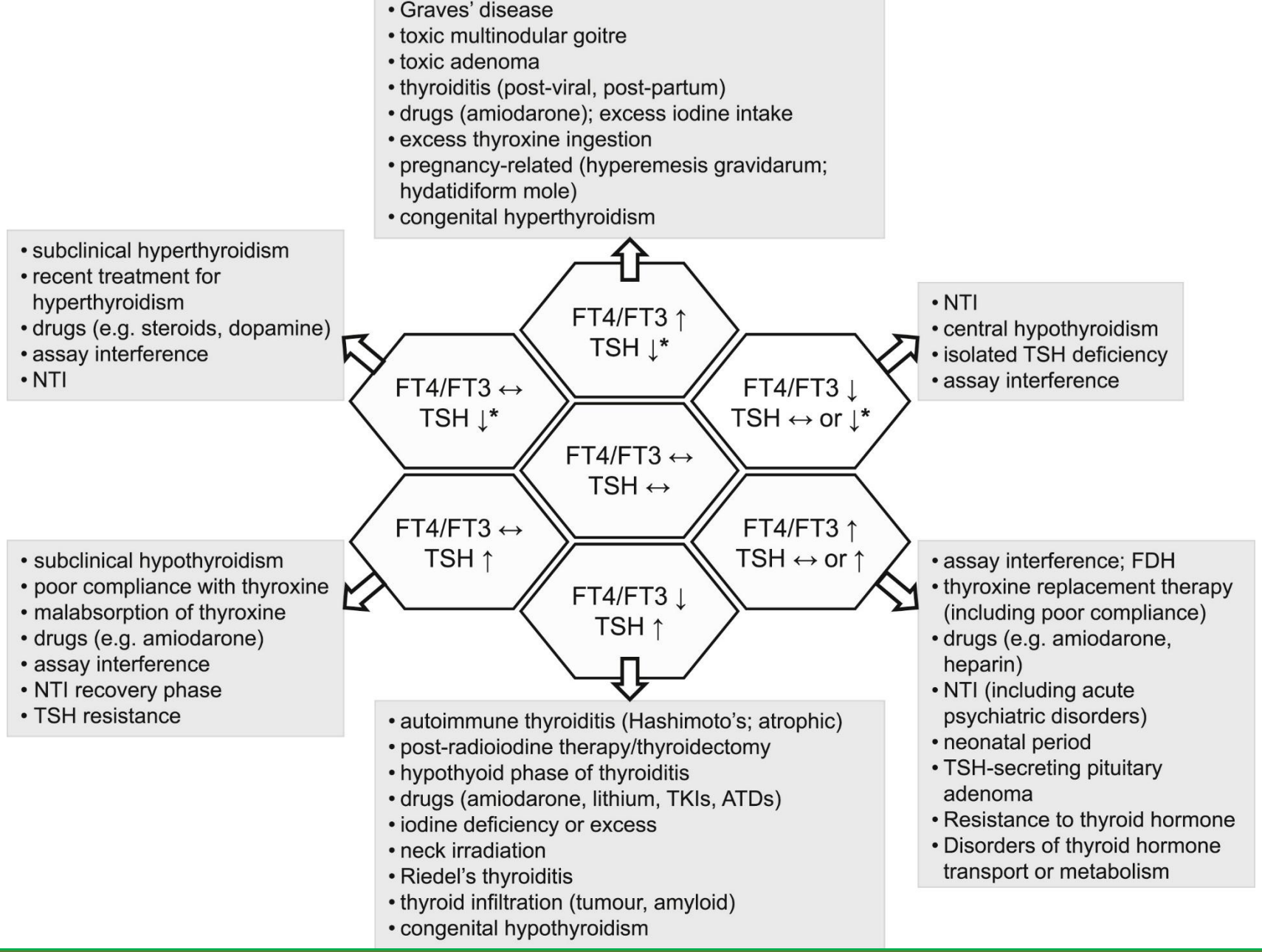
Adapted from [D]Ross et al. 2025
TSH = thyroid-stimulating hormone; fT4 = free thyroxine; fT3 = free triiodothyronine; N = normal



[6]Koulouri et al. 2013

TSH = thyroid-stimulating hormone; fT4 = free thyroxine; fT3 = free triiodothyronine; NTI = nonthyroidal illness
TKIs = tyrosine kinase inhibitors; ATDs = antithyroid drugs; FDH = familial dysalbuminaemic hyperthyroxinaemia

I. Hypothyroidism: Approach

Symptoms?
- Other possible cause?

TSH
CBC, ferritin, bhCG, CRP

Repeat labs
- 6-8 weeks
- No biotin x 7 days
- Offending agent?

fT4 (fT3)
TPO

Abnormal exam?
- Goitre
- Nodule

Thyroid ultrasound

Persistent, overt hypothyroidism

OR

*Subclinical hypothyroidism (low dose)

Levothyroxine

Primary hypothyroidism does NOT require endocrinology

[1]ATA 2014; [5]AAFP 2021; [F]Ross et al. 2025
CBC = complete blood count; CRP = C reactive protein; bhCG = Beta-human chorionic gonadotropin
fT4 = free thyroxine; fT3 = free triiodothyronine; TPO = thyroid peroxidase

I. Hypothyroidism: Mimics

Differential Diagnoses for Normal Thyroid Function with Persistent Symptoms	
Anemia (e.g. vitamin B_{12} or iron deficiency) Autoimmune (rare) Adrenal insufficiency Atrophic gastritis with pernicious anemia Diabetes mellitus type 1 Rheumatoid arthritis	Chronic kidney disease Liver disease Menopause Mental health (e.g. depression, anxiety, somatoform disorders) Obstructive sleep apnea Viral infections (e.g. Lyme disease, HIV, mononucleosis)

[1]ATA 2014; adapted from [5]AAFP 2021; [F]Ross et al. 2025
TSH = thyroid-stimulating hormone; HIV = human immunodeficiency virux

II. Nuances of Investigations

A. Biotin
B. Subclinical hypothyroidism
C. Steady-state
D. Pregnancy
E. T4 vs. T3; free vs. total
F. Thyroid antibodies
G. In-patients (myxedema coma)
H. Ultrasound

T4 = free thyroxine; T3 = triiodothyronine

“Does it matter if I take biotin? Can’t hurt, right?”

A. Biotin


Benefits of using
Biotin capsules
Improve skin health
Makes your hair thicker and longer
Brittle nails
Prevent hair fall
Treat Dandruff


BIOTIN
XOVAK
~pharma~
100% Plant-Based Vegetarian
Made from
Organic
10000 mcg Per Veg. Capsule
100% Vegan
Organic Herbs
Natural Vitamins
100% Vegetarian
100% Plant Based Formula
Superior Absorption*
High Quality
No Side Effect
Gluten, GMOs, Wheat, Dairy, Soy, Yeast, Sodium, Preservatives and Color, Heavy Metal, Synthetic Vitamins & Chemicals
BIOTIN
10000 mcg
VEGAN
HAIR, SKIN & NAILS


Best Multivitamin
For Hair Skin And Nails
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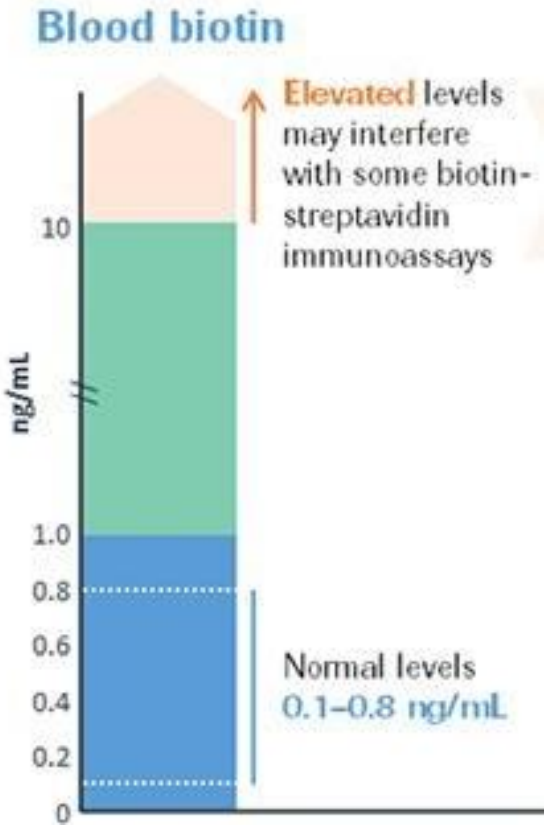
A. Biotin

"Does it matter if I take biotin?"



- Vitamin B7 (water-soluble)
  - Many names: vitamin H, coenzyme R, factor S, factor W, vitamin Ba, protective factor X
- Biotin-streptavidin is one of nature's strongest non-covalent interactions
  - In vitro diagnostic tests take advantage of by immobilizing biotinylated capture antibodies
- Up to 85% of common immunochemistry analyzers used biotin-streptavidin immunoassays
  - Immunoassay manufacturers and FDA have issued safety warnings about biotin interference
  - Reported levels of 1.0-1200ng/mL

[7]Pazirandehm & Burns 2021; [8]Rodrigo et al 2022; [9]Haddad, Giacherio, & Barkan 2019

A. Biotin

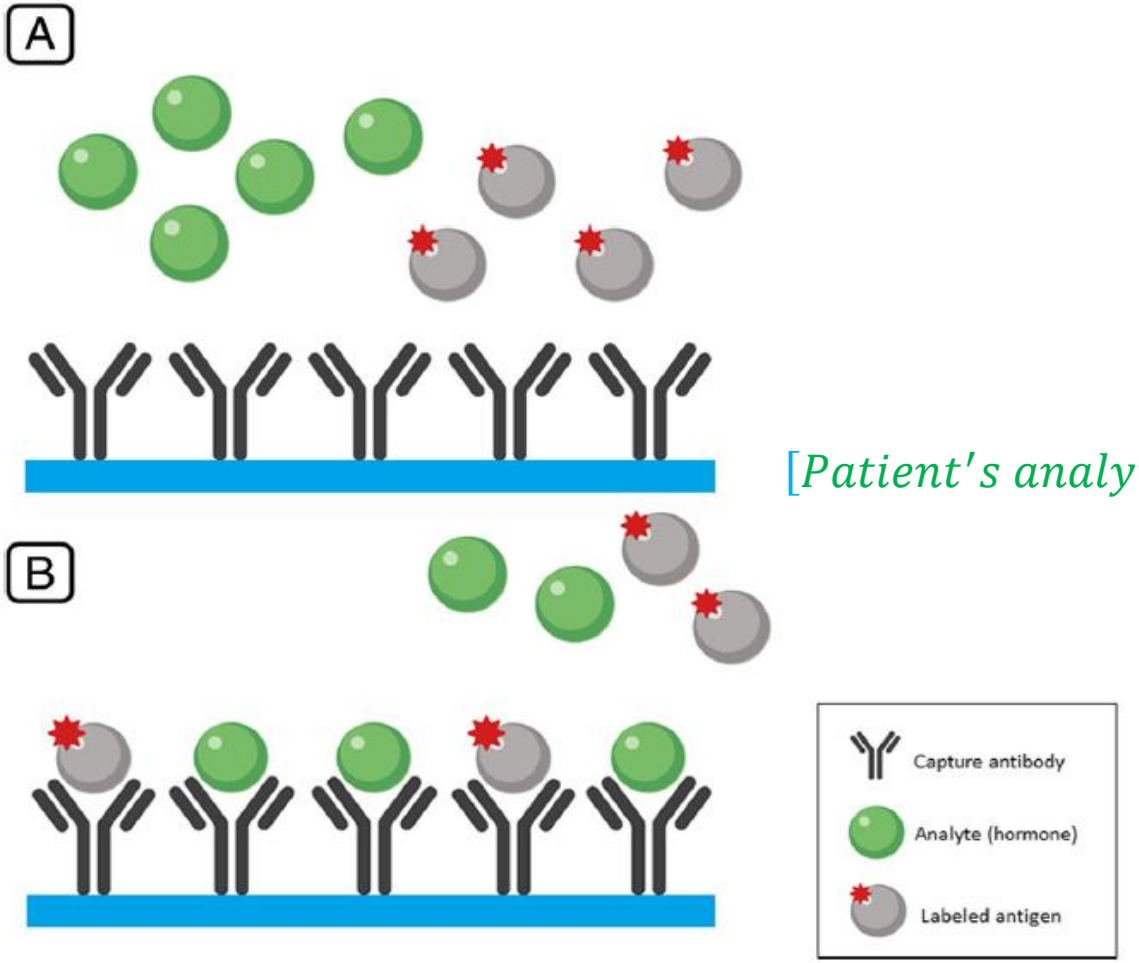
Immunoassay refresher: 2 types of analyte detection

A. Competitive assay
   - Patient's analyte and known quantity of labelled analyte compete for specific antibodies
   - After wash off, signal of bound labelled analyte measured: $[Patient's\ analyte] \propto {}^{1}/_{signal}$

B. Non-competitive assay (sandwich)
   - Patient's analyte binds to fixed capture antibody, then labelled antibody binds to the fixed antibody complex
   - After wash off, signal of labelled antibody complexes measured: $[Patient's\ analyte] \propto signal$

[7]Pazirandehm & Burns 2021; [8]Rodrigo et al 2022; [9]Haddad, Giacherio, & Barkan 2019; [10]Bowen et al 2019

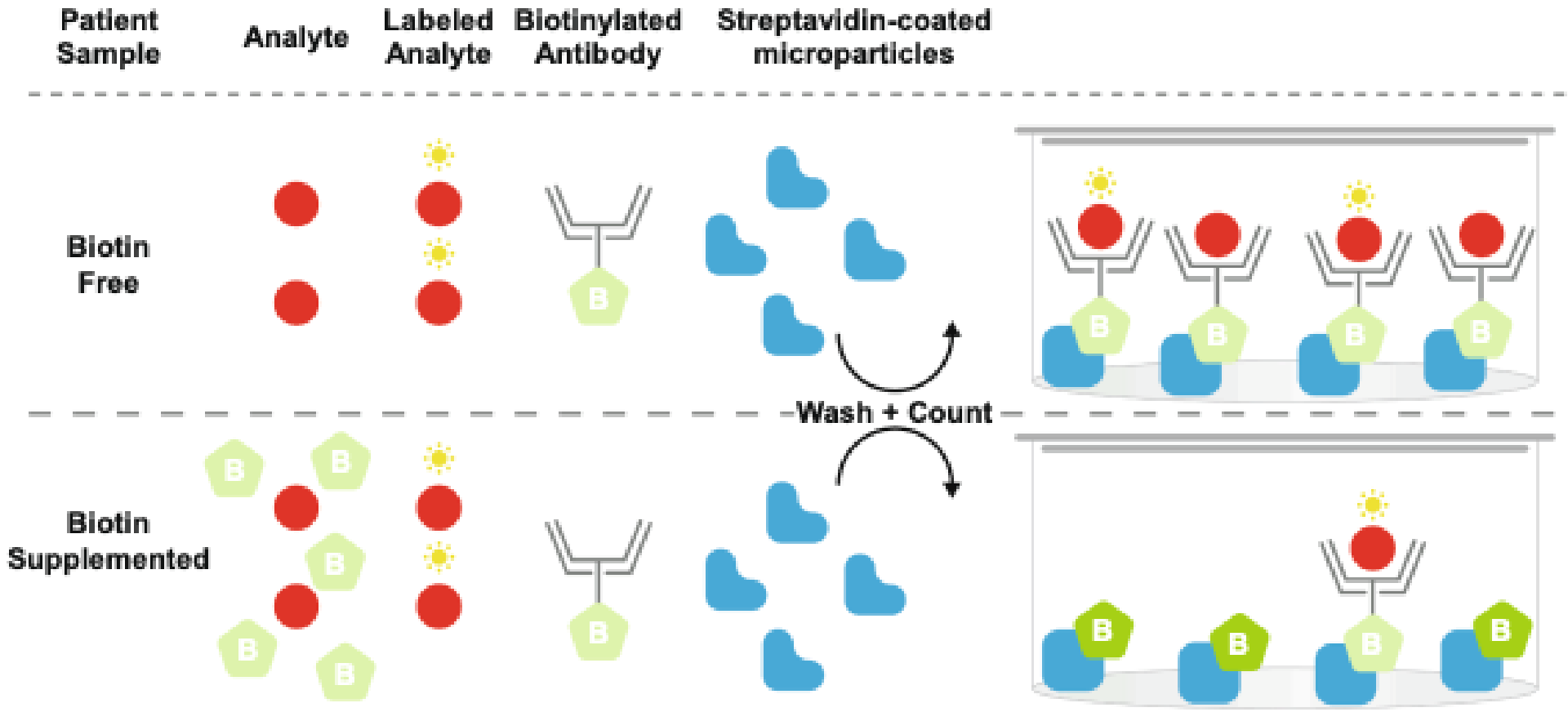
Competitive Assay



$$[Patient's\ analyte] \propto {}^{1}/_{signal}$$

[7]Pazirandehm & Burns 2021; [8]Rodrigo et al 2022; [9]Haddad, Giacherio, & Barkan 2019; [10]Bowen et al 2019

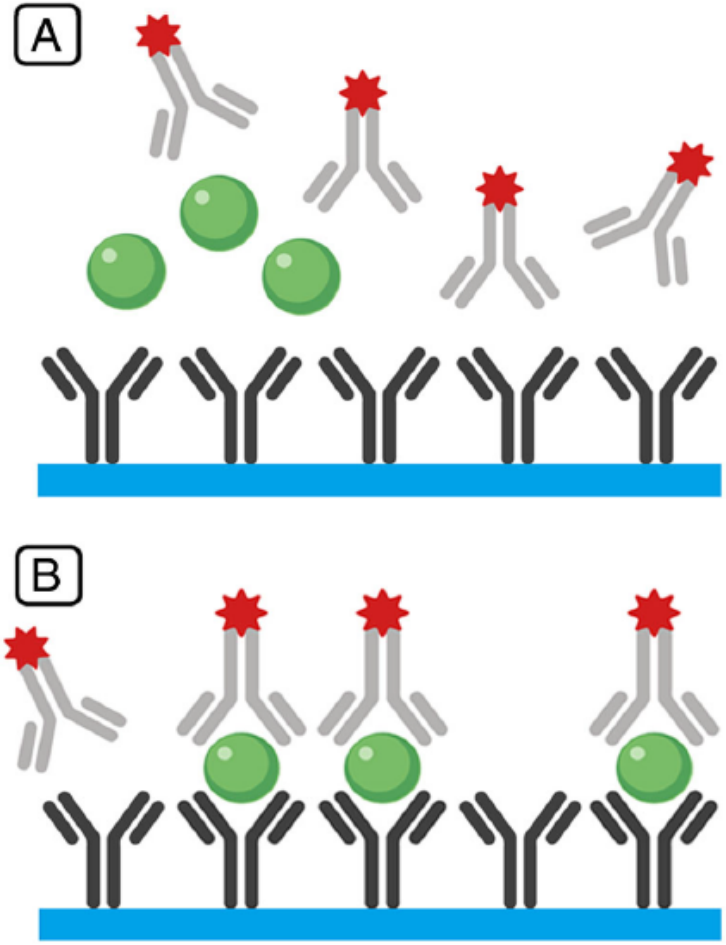
A. Competitive assay $[Patient's\ analyte] \propto {}^{1}/_{signal}$



Biotin falsely decreases measured signal (falsely high result)

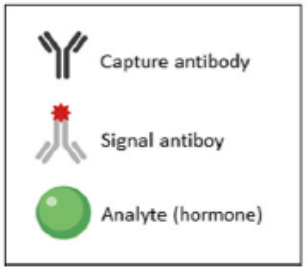
[7]Pazirandehm & Burns 2021; [8]Rodrigo et al 2022; [9]Haddad, Giacherio, & Barkan 2019; [10]Bowen et al 2019

Non-competitive Assay



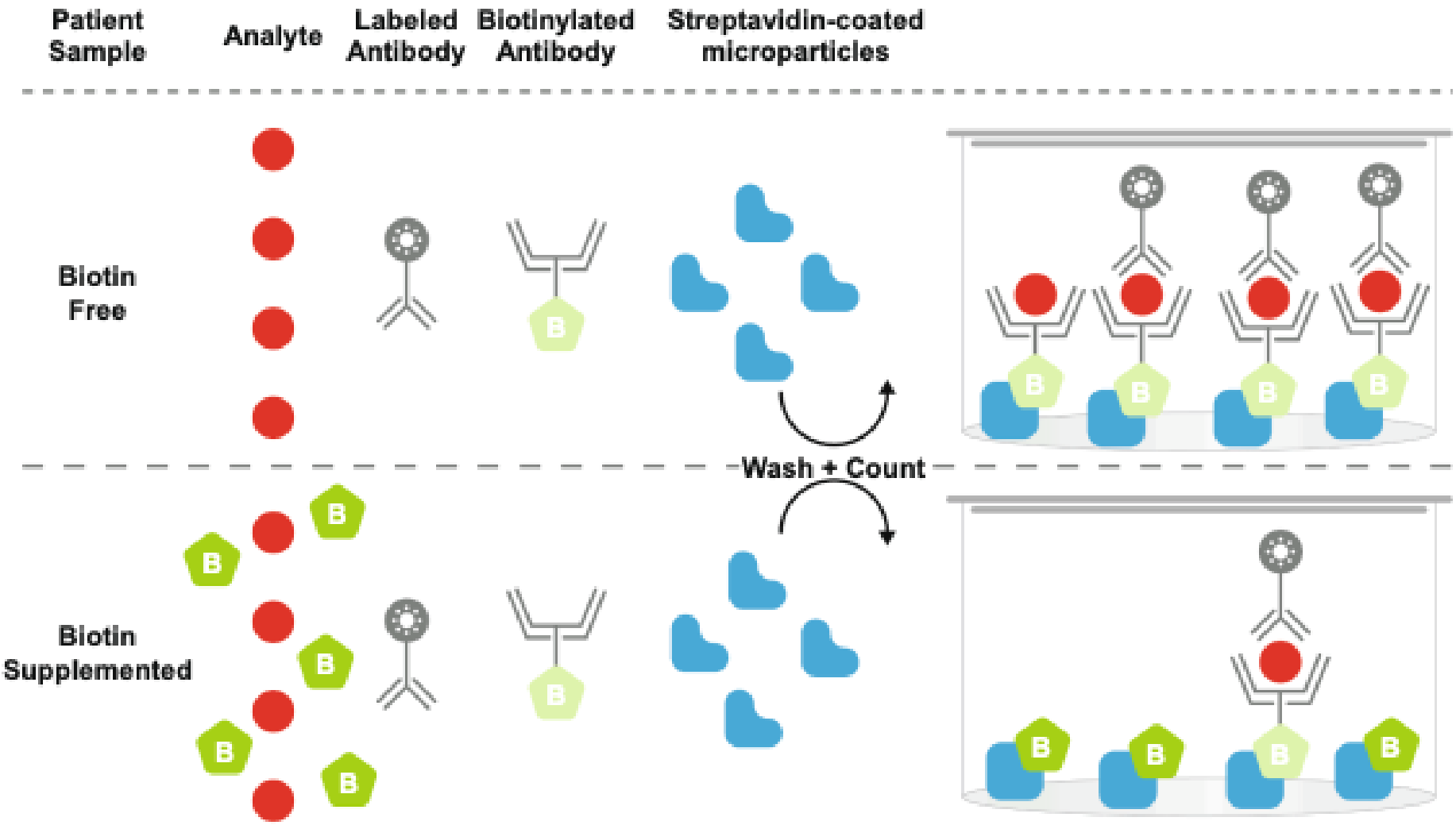
Sandwich

$$[Patient's\ analyte] \propto signal$$



[7]Pazirandehm & Burns 2021; [8]Rodrigo et al 2022; [9]Haddad, Giacherio, & Barkan 2019; [10]Bowen et al 2019

B. Non-competitive assay $[Patient's\ analyte] \propto signal$



Biotin falsely decreases measured signal (falsely low result)

[7]Pazirandehm & Burns 2021; [8]Rodrigo et al 2022; [9]Haddad, Giacherio, & Barkan 2019; [10]Bowen et al 2019

A. Biotin

Assays at The Moncton Hospital lab should not be susceptible to biotin interference

Multivitamin

30-60
mcg/day

No recommended daily intake (RDI) exists, as deficiencies are rare

Hair & nail supplement

5,000-10,000
mcg/day

More than 125 times the suggested intake

Experimental therapeutic regimen

>10,000
mcg/day

Doctor-directed for specific patient populations

1 **ASK** your patients to report everything they are taking, including prescription and OTC medicines, vitamins and supplements, prior to a blood draw.

2 **UNDERSTAND** that many patients are not aware that they are taking high dose biotin because it is packaged as a supplement for hair, skin and nail beauty.

3 **INFORM** your patients about how to prepare for blood work. If they take high dose biotin, they will need to **wait** before a blood draw.

When in doubt, have patients hold biotin for 7 days

“Can my thyroid levels change as I get older?”

B. Subclinical Hypothyroidism

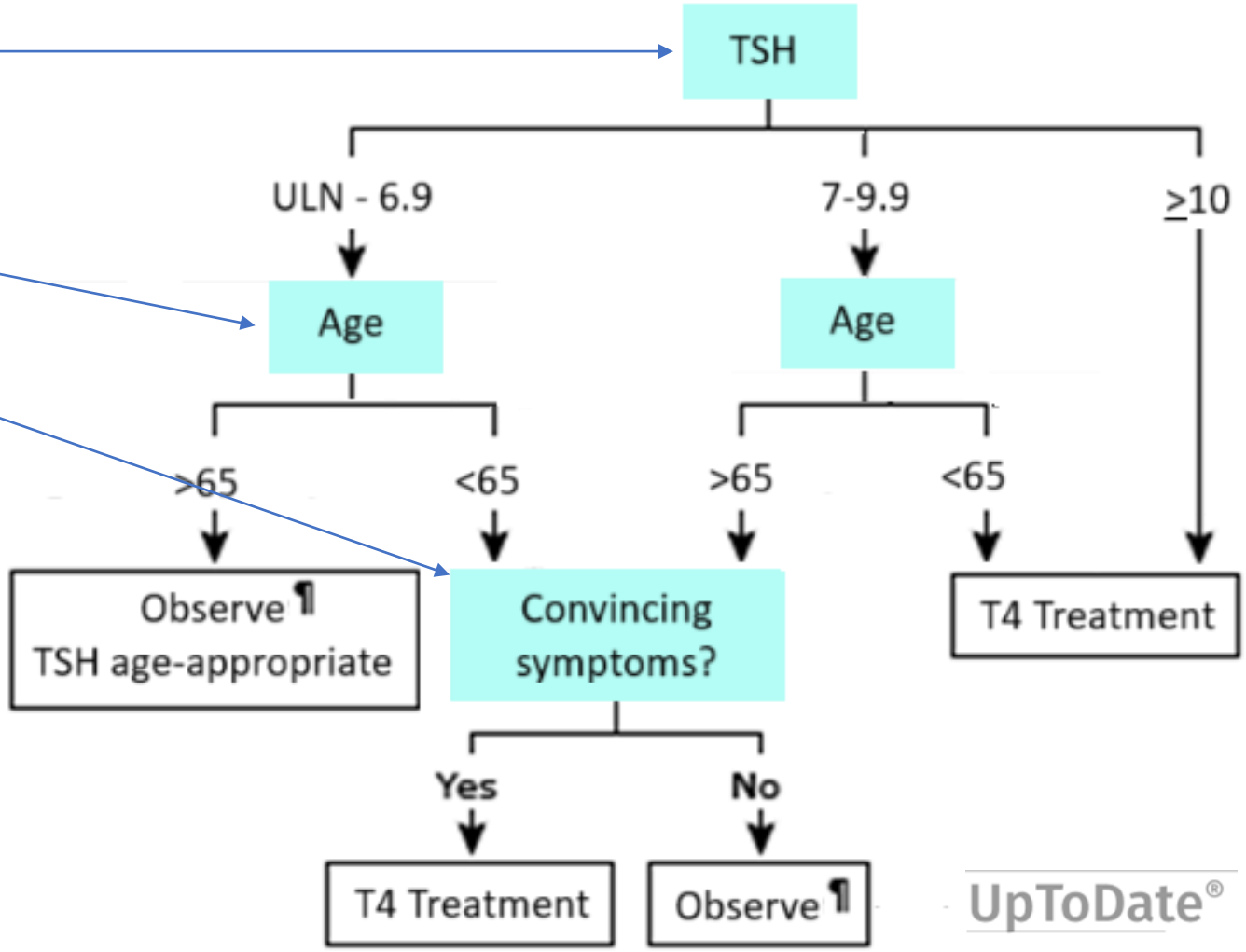
- Persistently ↑ TSH, normal fT4
  - Inverse logarithmic relationship
  - TSH more sensitive: better screening test
- Can be caused by any etiology discussed above
  - Recovery from non-thyroidal illness
- Age matters:
  - Younger patients more likely to progress
  - Older patients (>65y) need higher TSH levels
    - "Normal" is based off younger population
    - Treating mild subclinical hypothyroidism causes harm

"Can thyroid change with age?"

[1]ATA 2014; [5]AAFP 2021; [E]Ross et al. 2025
TSH = thyroid stimulating hormone; fT4 = free thyroxine

B. Subclinical Hypothyroidism

1. TSH level?
2. Age?
3. Symptoms?
   - Worsening fatigue
   - Constipation
   - Cold intolerance
   - Growing goitre



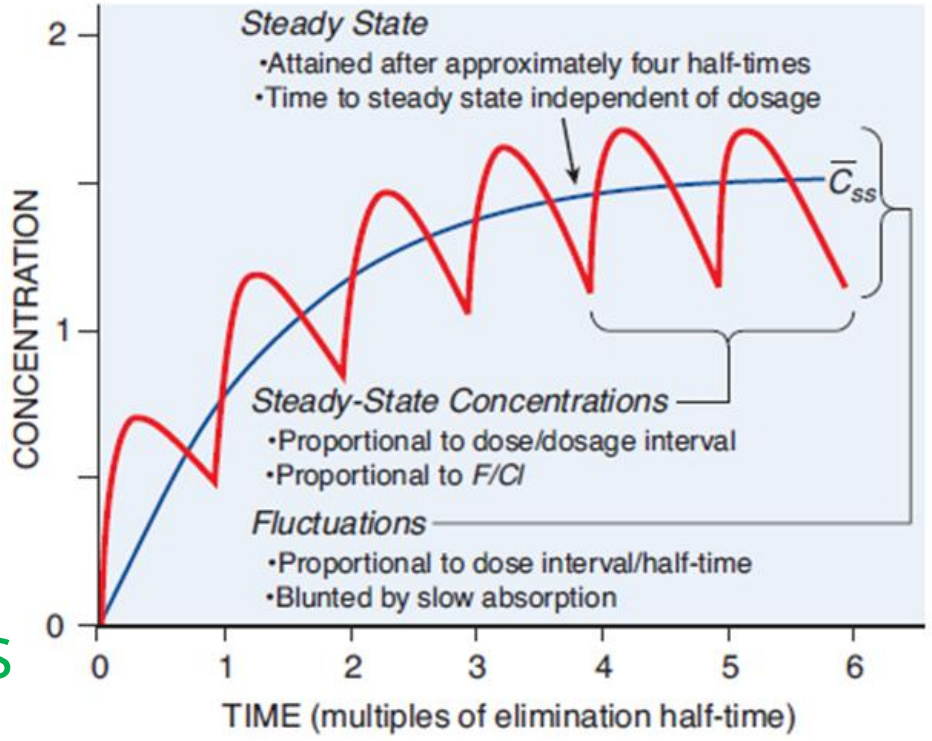
[1]ATA 2014; [5]AAFP 2021; Adapted from [E]Ross et al. 2025; ¶ = repeat in 6months
TSH = thyroid stimulating hormone; T4 = (levo)thyroxine; ULN = upper limit normal

“Can we recheck my thyroid next week?”

C. Steady State

- Changes in thyroid function tests take time
- Repeating TSH <6 weeks not recommended
- Exception: write "exception" on req
  - Pregnancy: every 4 weeks

"Can we recheck next week?"



[1]ATA 2014; [4]ATA 2017; [5]AAFP 2021; [F]Ross et al. 2025
TSH = thyroid stimulating hormone

D. Pregnancy

- TSH range of normal is assay-specific
  - Based off young, non-pregnant adults
- If reference range not provided, use the ATA trimester standard:
  - 1st trimester: 0.1-2.5
  - 2nd trimester: 0.2-3.0
  - 3rd trimester: 0.3-3.0

[4]American Thyroid Association 2017; [1]ATA 2014; [5]AAFP 2021; [F]Ross et al. 2025
TSH = thyroid stimulating hormone

“What is my total T4?”

E. Free T4 vs. Free T3

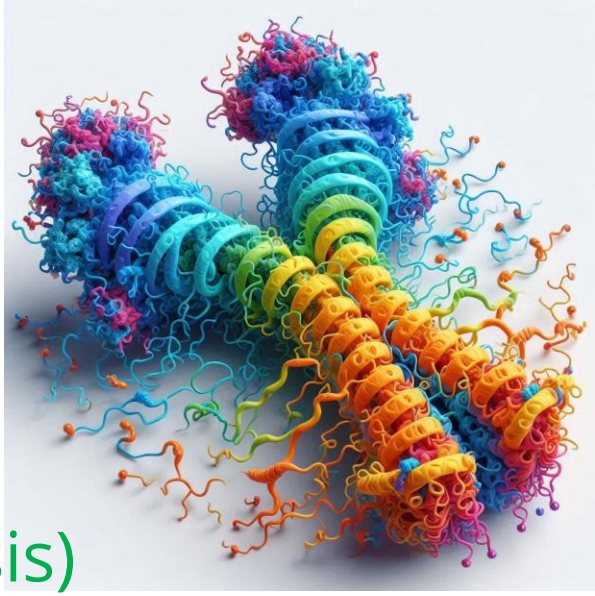
"What is my total T4?"

- Lab will automatically run these if TSH abnormal (reflexive)
  - T3 affected by non-thyroidal illness
- If central cause suspected
  - Need to write "exception" for fT4
- Total T4 or total T3: do NOT order
  - Limited role in thyroid assessment (?pregnancy)

[1]ATA 2014; [5]AAFP 2021; [C]Ross et al 2025
TSH = thyroid stimulating hormone; fT4 = free thyroxine; T4 = thyroxine; T3 = triiodothyronine

“Can we recheck my TPO?”

F. Thyroid Antibodies



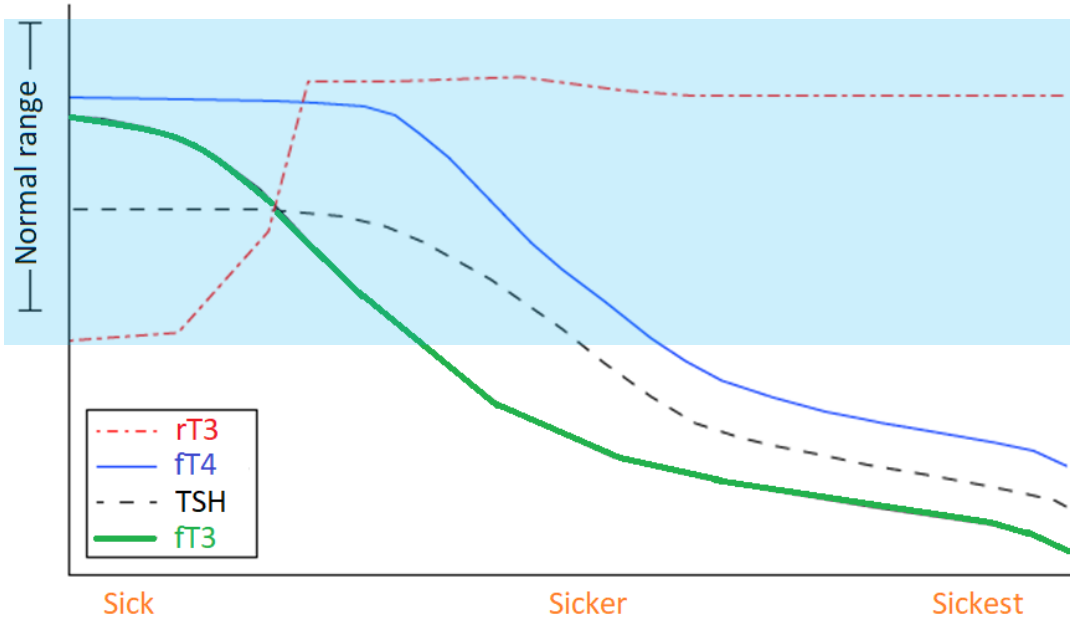
- Thyroid peroxidase (TPO):
  - Marker of potential autoimmune thyroid dysfunction (NOT diagnosis)
  - (i.e. once per patient lifetime)
    - Elevated in hyperthyroidism:
      - Graves' disease (not specific)
    - Elevated in patients with N thyroid:
      - Annual TSH screening reasonable
    - Elevated in hypothyroidism:
      - Hashimoto's disease/thyroiditis

"Can we recheck my TPO?"

Image created by Microsoft Copilot, 2025
[4]ATA 2014; [5]AAFP 2021; [C]Ross et al. 2025
TSH = thyroid stimulating hormone; N = normal

G. In-patients

- Sick euthyroid syndrome
  - Incidentally noted abnormal thyroid function should be repeated in 6-8 weeks as an outpatient



- Checkpoint inhibitors: hyperthyroidism or hypothyroidism
  - Oncology: protocol for monitoring

UpToDate®

[4]ATA 2014; adapted from [C]Ross et al. 2025

G. In-patients

Iodine (e.g. CT contrast):

- Wolff-Chaikoff: protective
  - Excess iodine exposure reduces thyroid synthesis
- Jod-Basedow: abnormal
  - Abnormal thyroid cells "escape" and use excess iodine to increase thyroid synthesis (hyperthyroidism)

[Recent iodine exposure makes thyroid uptake/scan less reliable and radioactive iodine therapy less effective.]

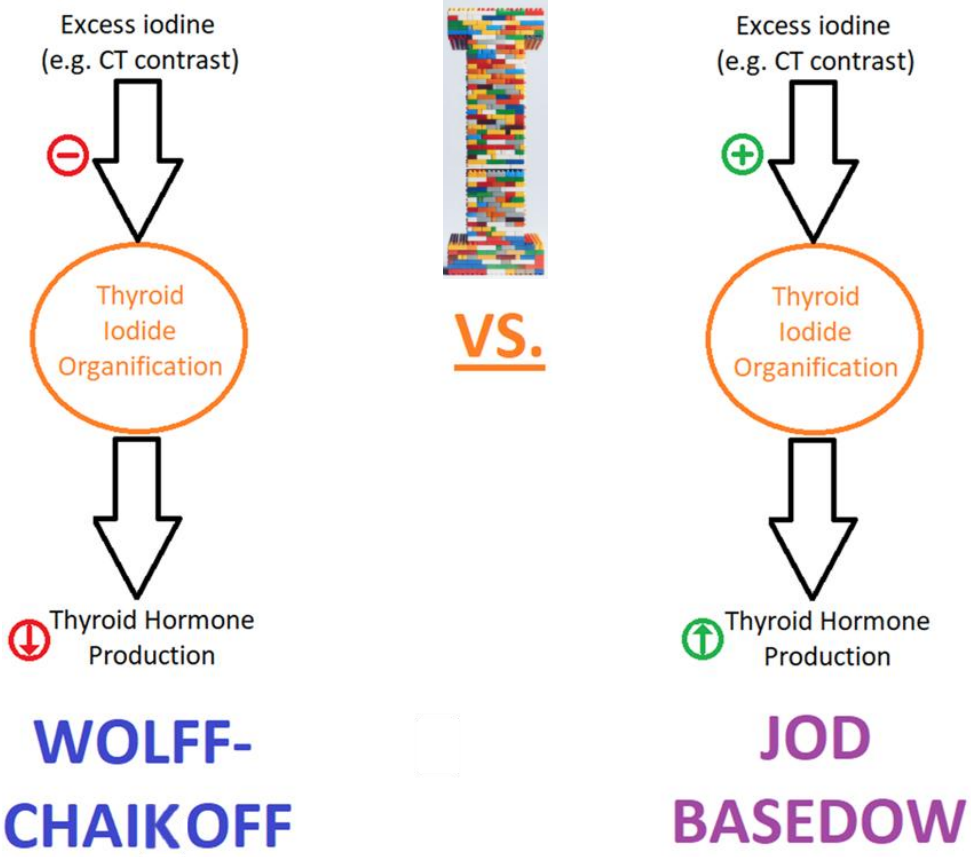
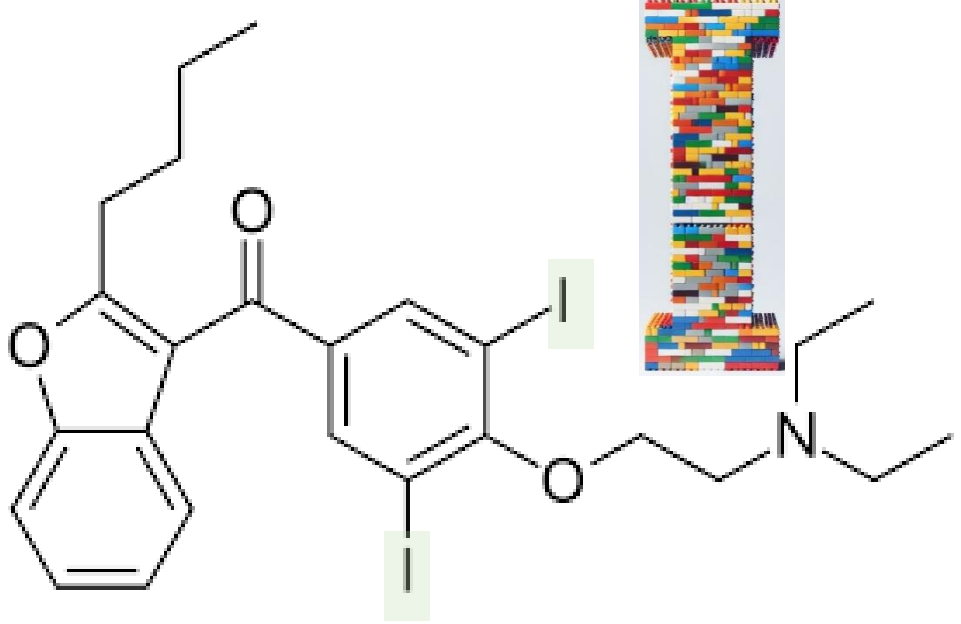


Image created by Microsoft Copilot, 2025

G. In-patients



Iodine (amiodarone): long half-life (baseline testing recommended)

- Hypothyroidism
- Hyperthyroidism: amiodarone-induced thyrotoxicosis
  - Type 1: pre-existing goitre or latent Graves' disease
  - Type 2: destructive thyroiditis

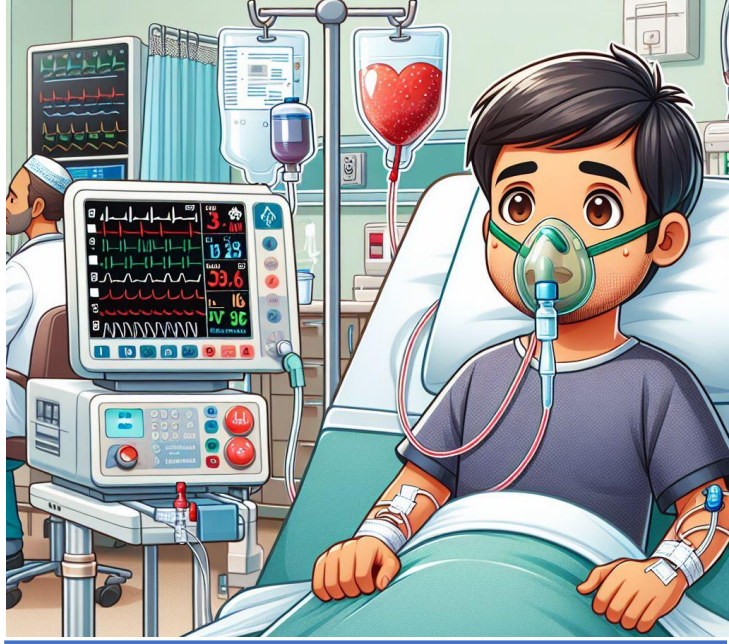
"Do I have to stop amiodarone?"

Image created by Microsoft Copilot, 2025
[4]ATA 2014; [C]Ross et al. 2025

G. Myxedema Coma

Severe hypothyroidism slowing multiple organs (emergency)

- Variable TSH, low fT4/fT3 (usually undetectable)
- Hydrocortisone IV, then
- Levothyroxine 200 mcg + liothyronine 10mcg IV
- Supportive measures
  - Ventilation, IVF, vasopressors, rewarming, IV dextrose, empiric antibiotics, cardiac monitor



↓Level of consciousness
↓Temperature
↓Blood pressure
↓Heart Rate
↓Respiratory Rate
↓natremia
↓glycemia

Image created by Microsoft Copilot, 2025

[4]ATA 2014; [5]AAFP 2021; [H]Ross et al. 2025

TSH = thyroid-stimulating hormone; fT4 = free thyroxine; fT3 = free triiodothyronine

“Can I have a thyroid ultrasound?”

H. Ultrasound

- Order only if abnormal exam
- Helpful for investigating:
  - Goitre
  - Nodules
- NOT helpful for hypothyroidism/hyperthyroidism
  - Need special training to accurately collect and interpret results within this context

"Can I have a thyroid ultrasound?"

Image created by Microsoft Copilot, 2024

[4]ATA 2014; [5]AAFP 2021

Choosing Wisely – Canada

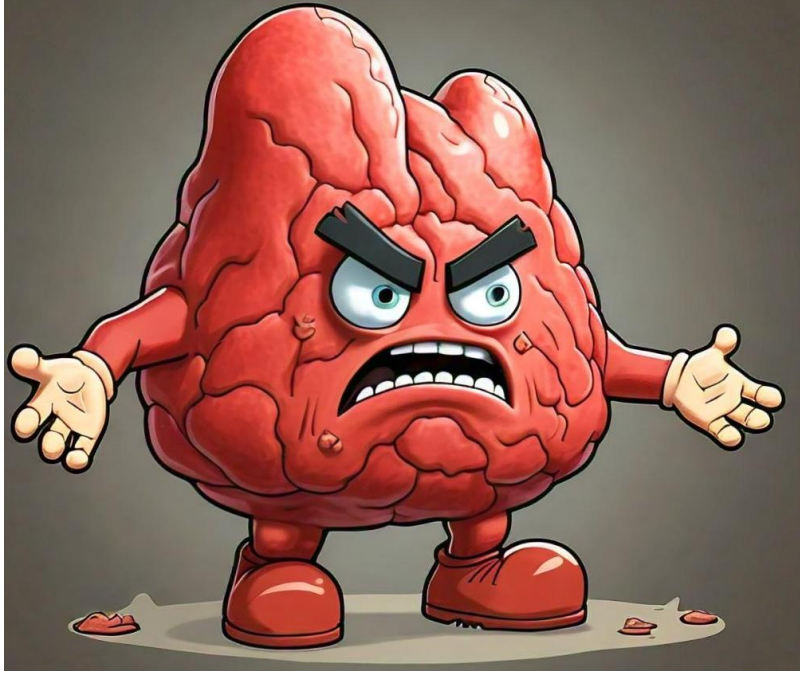
- Don't order thyroid function tests as screening for asymptomatic, low risk patients.
- Don't routinely order a thyroid ultrasound in patients with abnormal thyroid function tests unless there is a palpable abnormality of the thyroid gland.
- Don't use Free T4 or T3 to screen for hypothyroidism or to monitor and adjust levothyroxine dose in patients with known primary hypothyroidism, unless the patient has suspected or known pituitary or hypothalamic disease.
- Don't routinely test for Anti-Thyroid Peroxidase Antibodies (anti-TPO).

[11]https://choosingwiselycanada.org/; [5]AAFP 2021

TSH = thyroid-stimulating hormone; T4 = thyroxine; T3 = triiodothyronine

A. Hashimoto's Tx

- May require thyroid hormone replacement



B. Drugs

- If possible, try another option

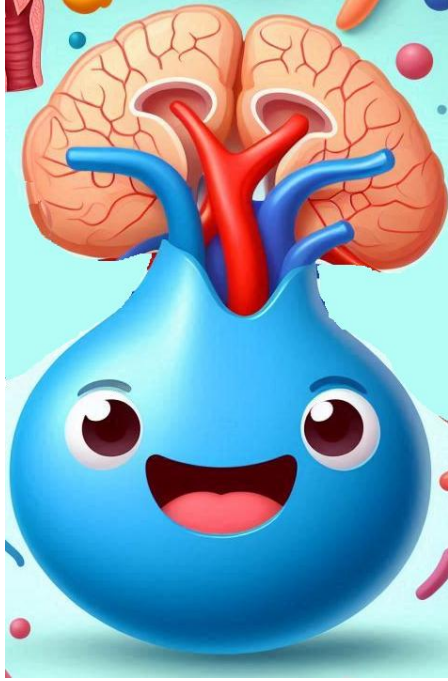
C. Thyroiditis Tx

- May require thyroid hormone replacement

Generated image by Meta AI, 2024

[4]ATA 2014; [5]AAFP 2021; [C]Burman et al. 2025

D. Central: Tx



- If co-existing adrenal insufficiency, this takes precedence (do NOT start levothyroxine)
  - Need to start hydrocortisone first to avoid decompensation
- Monitoring dose: do NOT order TSH (“useless”)
  - Patient cannot make enough TSH
- Adjust levothyroxine dose to target mid-normal fT4 (write “exception”)

Generated image by Microsoft Copilot, 2025

[2]ETA 2018; [4]ATA 2014; [5]AAFP 2021;

TSH = thyroid stimulating hormone; fT4 = free levothyroxine

III. Hypothyroidism: Tx Goals

1. Improve signs/symptoms
2. Normalize TSH
   - >65: upper $^1/_3$ normal range
   - Persistent symptoms: lower ½ range
   - Pregnancy: lower ½ range (*controversial)
3. Reduce goitre (if present)
   - ~50% see decrease (lags behind TSH)
4. Avoid iatrogenic hyperthyroidism
   - Osteopenia/porosis, atrial fibrillation

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016
TSH = thyroid-stimulating hormone

III. Hypothyroidism: Tx Options

- T4: levothyroxine (body converts to T3)
  - [Brands: Synthroid, Eltroxin]
  - PROs: good evidence, cheap, long half-life, clinical experience, availability
  - CONs: (pro-hormone?)
- T3: liothyronine (3-4x more potent than T4)
  - [Brand: Cytomel]
  - PROs: (active hormone)
  - CONs: inconsistent, poor evidence, short half-life, non-physiologic
- "Natural": e.g. desiccated thyroid
  - 1 grain (60mg): ~38 mcg T4 + ~9 mcg T3
  - I do NOT recommend (guidelines, most Endos agree)

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016
fT4 = thyroxine; fT3 = triiodothyronine

III. Hypothyroidism: Tx Start

- Evidence-based: levothyroxine ~1.6 mcg/kg/day
  - T4 is the unanimous standard of care
  - T3 is not recommended
    - Contraindicated in pregnancy, cardiac, >65
  - Special diets not recommended (e.g. iodine)
  - >65: start low, go slow (target upper $^1/_3$ normal)

- Some patients may require alternating dose (off-label)
  - E.g. 75mcg (odd days) with 88 mcg (even days)

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016
T4 = (levo)thyroxine; T3 = liothyronine

III. Hypothyroidism: Tx Adjust

- TSH high: increase based off absolute level
  - TSH >ULN-10: ↑12-25mcg/day
  - TSH 10-20: ↑25-50 mcg/day
  - TSH >20: use fT4 to guide
- TSH normal: repeat x 1 to check steady state
  - Recheck based off symptoms, pregnancy, estrogen status, medications, weight changes
- TSH low: reduce by 12-25mcg/day

- Stable: annual TSH (*q 2years if <75mcg)

[4]ATA 2014; [5]AAFP 2021; adapted from [F]Ross et al 2016
TSH = sthyroid stimulating hormone; fT4 = free thyroxine; ULN = upper limit normal

“Why can’t I seem to get my thyroid levels right?”

IV. Challenges

"Why can't I get my levels right?"

- Adherence
- Interfering agents
- Malabsorption
- Allergy/intolerance
- Pregnancy
- Estrogen/Menopause
- Weight changes
- Persistent symptoms
- "Natural"
- Thyroid cancer

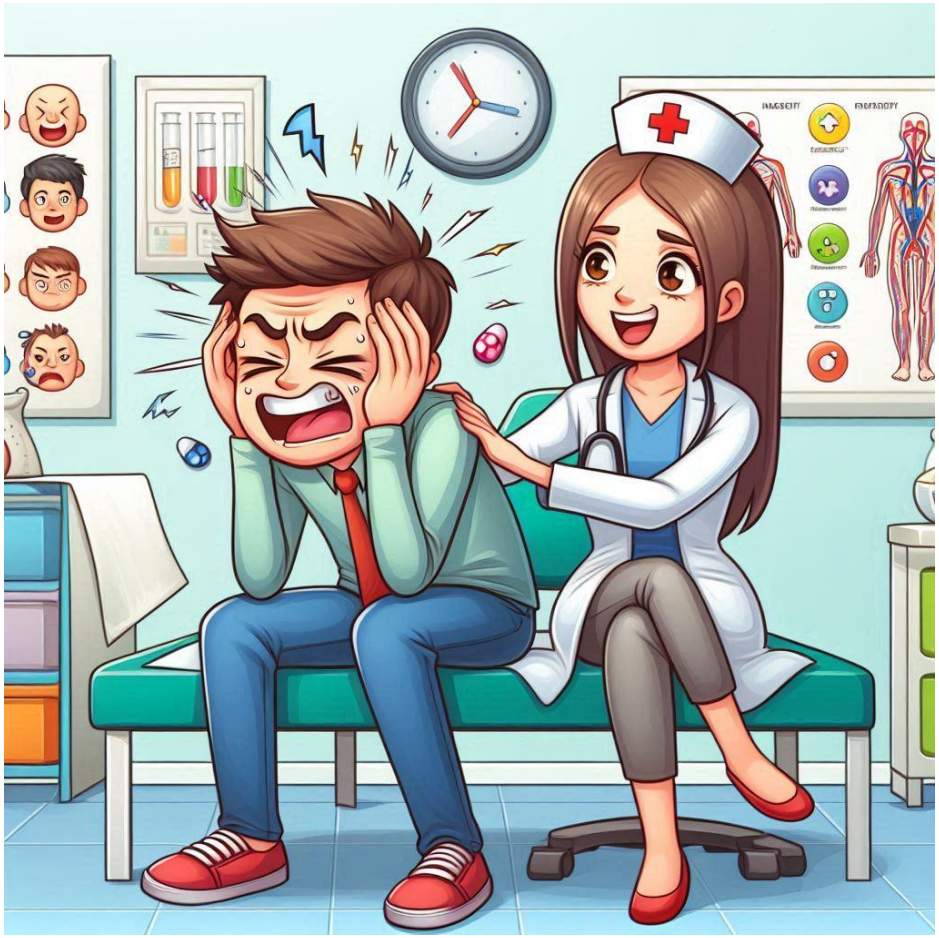


Image generated by Microsoft Copilot, 2025

[4]ATA 2014; [5]AAFP 2021; [6]Koulouri et al. 2013

IV. Adherence

- Proper administration: write on prescription
  - Wait at least 30 minutes before eating/drinking anything besides water (60 minutes better)
  - Do not take within 2 hours of eating/drinking anything besides water (4 hours for vitamins)

- Daily reminder
  - Bedside table/habits

- Once weekly dosing: daily dose x 7 (off-label)

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016

IV. Interfering Agents

DRUGS AND THYROID FUNCTION	
HYPOTHYROIDISM	
Inhibition of Hormone Synthesis or Release	**Thiomanides**, **Lithium**, Perchlorate, Aminoglutethimide, Kelp, **Iodine** (Amiodarone, Contrast, Iodide [SSKI], Expectorants, Betadine douches, Topical antiseptics), Thalidomide
Decrease T4 Absorption	**Calcium**, **Iron**, Cholestyramine, Colestipol, Colesevelam, Chromium, Aluminum hydroxide, Sucralfate, Raloxifene, Proton pump inhibitors, Sevelamer, Sertraline, Lanthanum carbonate
Immune Dysregulation	Interferon alfa, Interleukin-2, Immunotherapy (**checkpoint inhibitors**)
TSH Suppression	Dopamine, Bexarotene (increased T4 clearance)
Destruction	Immunotherapy (**checkpoint inhibitors**), Tyrosine kinases inhibitors
Type 3 Deiodination	Tyrosine kinases inhibitors
ABNORMAL THYROID FUNCTION TESTS	
Low TBG	Androgens, Danazol, **Glucocorticoids**, Niacin, L-asparaginase
Decreased T4 Binding	Salicylates, Salsalate, Furosemide, Heparin, Non-steroidal anti-inflammatory drugs
Increase T4 Clearance	Phenytoin, Carbamazepine, Rifampin, Phenobarbital, Ritonavir, Imatinib
TSH Suppression	Dopamine, **Glucocorticoids**, Octreotide
Impaired T4 to T3 Conversion	**Amiodarone**, Propylthiouracil, Contrast/Iiopanoic acid, **Glucocorticoids**, Propranolol, Nadolol

*Pearl: review medication changes

[4]ATA 2014; [5]AAFP 2021; [6]Koulouri et al. 2013; adapted from [F]Ross et al 2016
TSH = thyroid-stimulating hormone; T4 = thyroxine; T3 = triiodothyronine; TBG: thyroxine binding globulin
PPIs = proton pump inhibitors; SSKI = saturated solution of potassium iodide

IV. Malabsorption

- Levothyroxine cannot be absorbed reliably
- Other deficiencies may be present
  - Iron, anemia, vitamin D, vitamin B12
- Celiac disease is the most common culprit
  - Post-bariatric surgery, pancreatitis, gastritis

*Pearl: celiac/hypothyroidism travel together

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016

“I think I’m allergic to my thyroid pills”

IV. Allergy/Intolerance

- Levothyroxine 50mcg (white) has no colour
  - Can usually achieve required dose with these tablets alone

- Compounding pharmacies
  - More options for allergies or intolerances

Synthroid

What the important non-medicinal ingredients are:

Acacia, confectioner's sugar, lactose, magnesium stearate, povidone, talc and colour additives.

Eltroxin

Non-medicinal Ingredients
acacia powder, corn starch, lactose, magnesium stearate and colouring agents (see colouring agents below)

Cytomel

calcium sulfate, gelatin, starch (corn), stearic acid, sugar and talc.

"I'm allergic to thyroid pills?"

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016

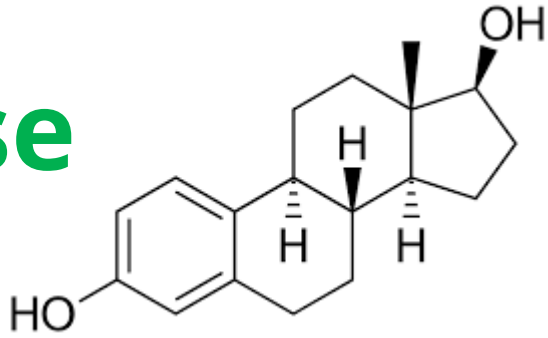
IV. Pregnancy

- Pregnant women need ~20% more
  - Separate from prenatal vitamin (?biotin)
- Check thyroid function every 4 weeks
  - Can reduce frequency once stable levels
- Return to pre-pregnancy dose after
  - May require more if breastfeeding

*Pearl: take 2 pills on Sundays when pregnant

[4]ATA 2017; [4]ATA 2014; [5]AAFP 2021

IV. Estrogen/Menopause



- Estrogen impacts the body's levels of thyroxine-binding globulin
  - Changes amount available to body

- Starting oral contraceptive may require dose increase
- Postmenopausal women may require dose decrease

*Pearl: ♀ passing 50 requires dose re-assess

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016

IV. Weight Changes

- Levothyroxine is a weight-based medication
  - <65: ~1.6 mcg/kg/day: good starting point
- Change in weight for any reason may require dose adjustment

*Pearl: change in weight needs dose re-assess

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016

“I only want ‘natural’ thyroid treatment”

IV. "Natural"

"I want 'natural' treatment?"

- T4: levothyroxine (body converts to T3)
  - Standard of care

Synthroid

Eltroxin

- T3: liothyronine (3-4x more potent than T4)
  - Humans make T4:T3 ~14:1

Cytomel

- "Natural": e.g. desiccated thyroid (animal)
  - Seasonal variation: porcine 4-6:1, bovine 8-10:1
  - Production variation: dose varies batch-to-batch
  - Evidence: inadequate, not better than standard of care, quality of life not improved
    - Often leads to ↑ fT3 high, while ↓TSH and ↓ fT4

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016; [3]ETA 2021

TSH = thyroid-stimulating hormone; fT4 = free thyroxine; fT3 = free triiodothyronine

“Why do I still feel unwell?”

IV. Persistent Symptoms

- TSH upper ½ normal: increase dose (placebo)
- TSH normal:
  - Rule out other nonthyroidal causes (see above)
  - Lifestyle factors
    - Well-balanced diet, adequate amounts of fruits, vegetables, and high-value protein; healthy snacking
    - Regular exercise, combination of aerobic and resistance work
    - Stress management with relaxation, meditation, yoga, counselling
  - Comorbidities: other chronic illness, depression
  - Consider T3 supplementation

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016; [3]ETA 2021
TSH = thyroid-stimulating hormone; T3 = liothyronine

IV. Persistent Symptoms

- Nonspecific hypothyroidism symptoms
  - If TSH normal, not likely thyroid-related
  - Hashimoto's: ?autoimmune symptoms
    - Fatigue, weight gain, "fog", depression, ↓quality of life
- Can trial small dose T3 for patients with persistent symptoms (NOT desiccated thyroid):
  - NOT appropriate >65, pregnancy, thyroid cancer
  - Monitoring (?): bone density, ECG
- Some symptoms do not return to normal (likely other contributors)
  - If no improvement, stop T3

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016; [3]ETA 2021
T3 = liothyronine; ECG = electrocardiogram

IV. Persistent Symptoms

- Converting T4 to T4 + T3 combination:
  - T3 ~ 4 x T4 (mcg)
    - T4 75-100: T4 50-75mcg + T3 2.5mcg BID
    - T4 112-137: T4 88-112mcg + T3 5mcg qAM + 2.5mcg qPM
    - T4 150-175: T4 112-137mcg + T3 5mcg BID
    - T4 200-250: T4 150-200mcg + T3 7.5mcg qAM + 5mcg qPM

Equivalent doses of LT4, LT4 + LT3 and DTE given to study subjects

Capsules	1	2	3	4	5	6	7	8	9
LT4 (mcg)	88	100	112	125	137	150	175	200	250
LT4 + LT3 (mcg)	63/7.5	75/7.5	82/7.5	88/10	100/10	112/10	125/12	150/15	175/20

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016; [3]ETA 2021
T4 = levothyroxine; T3 = liothyronine

IV. Persistent Symptoms

- Converting desiccated thyroid to T4
  - 1 grain (60mg): ~75-100 mcg T4
- Converting desiccated thyroid to T4 + T3
  - 1 grain (60mg): ~38 mcg T4 + ~9 mcg T3

Equivalent doses of LT4, LT4 + LT3 and DTE given to study subjects

Capsules	1	2	3	4	5	6	7	8	9
LT4 (mcg)	88	100	112	125	137	150	175	200	250
LT4 + LT3 (mcg)	63/7.5	75/7.5	82/7.5	88/10	100/10	112/10	125/12	150/15	175/20
DTE (mg)	60	67.5	75	82.5	90	105	120	135	165

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016; [3]ETA 2021
T4 = levothyroxine; T3 = liothyronine

“I had thyroid cancer…”

IV. Thyroid cancer

"I had thyroid cancer…"

- Papillary/follicular thyroid cancer usually TSH responsive
  - To reduce the risk of recurrence, higher doses of levothyroxine for TSH suppression
    - High risk (target A): TSH 0.01-0.1 ("abnormal")
    - Intermediate risk (target B): TSH 0.1-0.5 ("abnormal")
    - Low risk (target C): TSH LLN-2.0 (lower ½ normal)

- If subclinical hyperthyroidism (low TSH, normal fT4),
  - Do NOT adjust medication unless you know the target
- If overt hyperthyroidism (low TSH, high fT4),
  - Reduce dose slowly and ASK about appropriate target

[4]ATA 2014; [5]AAFP 2021; [F]Ross et al 2016;
TSH = thyroid stimulation hormone; fT4 = free thyroxine; LLN = lower limit normal

Case 1a: HT 43F

- History: G2P2, celiac disease
- Meds: nil (*biotin supplement)
- Exam: N
- 2019: 6 months postpartum
  - Fatigue, weight gain, hair loss
  - TSH: 2.5 (Mar*)→6.8↑ (May)→11↑ (Aug)
  - fT4/fT3: N (Mar*)→N (May)→↓ (Aug)

"Why is my thyroid low?"

- Primary (overt) hypothyroidism:
  - Levothyroxine 88mcg (TSH/fT4 normalized x 2)

Generated image by Meta AI, 2025

TSH = thyroid-stimulating hormone; fT4 = free thyroxine; fT3 = free triiodothyronine; N = normal

Case 1b: HT 43F

- History: G2P2, celiac disease, primary hypothyroidism
- Levothyroxine 88mcg
  - TPO: positive
  - TSH low N, fT4 N 2020-2025

- Hashimoto's with residual symptoms:
  - Nonspecific
    - Fatigue, "low mood", above pre-pregnancy weight, dry skin

"Why do I feel unwell?"

Generated image by Meta AI, 2025
TSH = thyroid-stimulating hormone; fT4 = free thyroxine; N = normal

Case 1b: HT 43F

- History: G2P2, celiac disease, primary hypothyroidism from Hashimoto's with residual symptoms on Levothyroxine 88mcg

- Trial levothyroxine 75mcg + liothyronine 2.5mcg BID
  - TSH, fT4, fT3 N
- Symptoms not improved

Generated image by Meta AI, 2025

TSH = thyroid-stimulating hormone; fT4 = free thyroxine; fT3 = free triiodothyronine N = normal

Case 1b: HT 43F

- History: G2P2, celiac disease, primary hypothyroidism from Hashimoto's with residual symptoms on Levothyroxine 75mcg + liothyronine 2.5mcg BID

- Levothyroxine 75mcg + ↑liothyronine 5mcg qAM + 2.5mcg qPM
  - TSH 0.2 ↓, fT4 and fT3 N
- Stopped liothyronine (resumed T4 88mcg)

Generated image by Meta AI, 2025

TSH = thyroid-stimulating hormone; fT4 = free thyroxine; fT3 = free triiodothyronine; N = normal

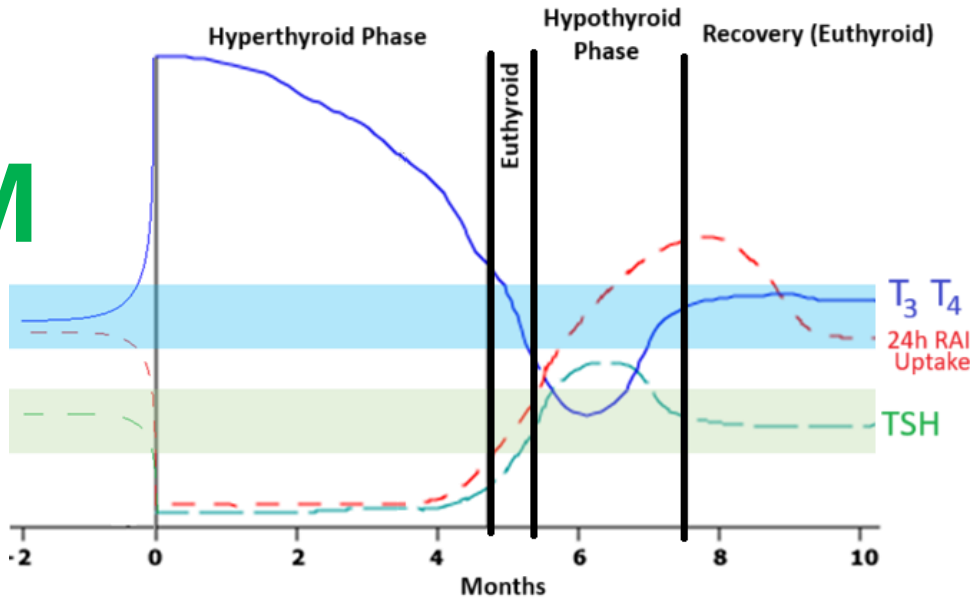
Case 2: DQ 38M

- History: nil
- Medications: nil
- 2 weeks: anterior neck pain, swelling following upper respiratory tract infection
- 1 week: palpitations, tremor, diaphoresis, anxiety
- Exam: tremor, tachycardia, ?L-sided nodule
- TSH undetectable↓, fT4 32.2↑, CRP 110↑
- Neck pain and swelling: naproxen, prednisone
- Repeat (8 weeks): TSH 9.9 ↑, fT4 N, CRP 0.4, TPO < 3

Generated image by Meta AI, 2024

TSH = thyroid-stimulating hormone; fT4 = free thyroxine; CRP = C reactive protein; TPO = thyroid peroxidase antibody

Case 2: DQ 38M



- Abnormal exam: order thyroid ultrasound
- Most likely: subacute thyroiditis (de Quervain's)
  - Could resolve spontaneously
- Repeat labs in 2 months'
  - TSH 6.8 (ULN 4.5)
  - fT4 N

TSH = thyroid-stimulating hormone; fT4 = free thyroxine; ULN = upper limit normal N = normal

Case 2: DQ 38M

- Begins to experience fatigue
- Repeat labs (8 weeks):
  - TSH 7.8↑, fT4 N

- Subclinical hypothyroidism:
  1. TSH persistently >6.9
  2. Age <65
  3. Symptoms present

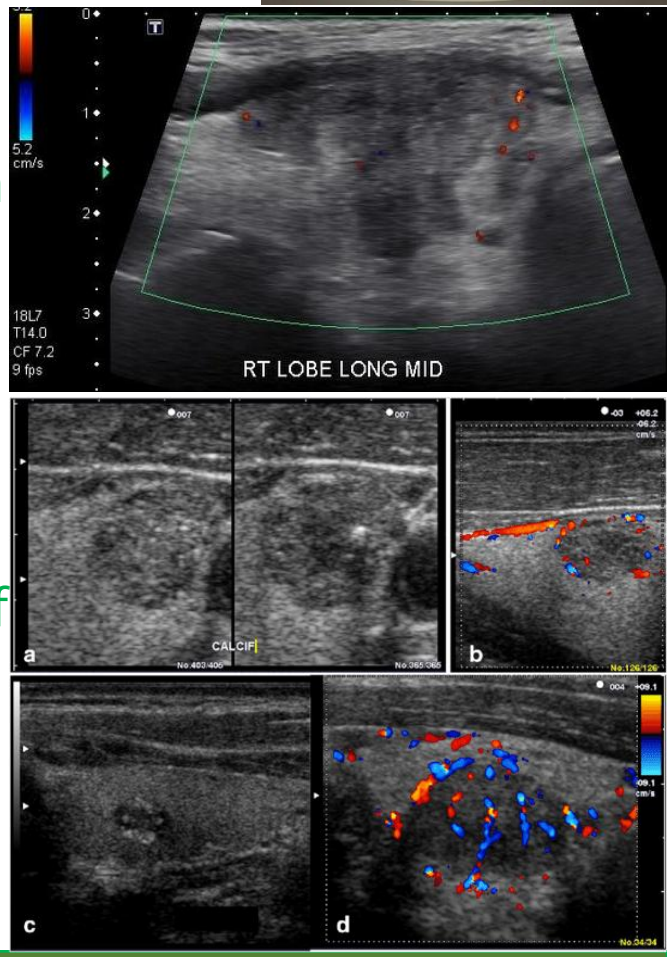
- Treatment recommended: T4 started (25mcg)

Generated image by Meta AI, 2024

TSH = thyroid-stimulating hormone; fT4 = free thyroxine; N = normal; T4 = (levo)thyroxine

Case 2: DQ 38M

- Thyroid ultrasound:
  - There is a large 1.8 x 2.0 x 3.4 centimetre rounded well circumscribed lesion within the left lobe of the thyroid gland. This is solid and hypoechoic relative to back-ground parenchyma. Lesion is wider than tall with no calcifications.
  - [Diffuse heterogeneity of the background thyroid parenchyma with large lobular masses within both lobes of the thyroid gland. Given the provided history of fevers in the degree of heterogeneity/ size of bilateral nodules, findings are favoured on the basis of subacute De Quervain Thyroiditis.]



ACR TI-RADS

COMPOSITION (Choose 1)	
Cystic or almost completely cystic	0 points
Spongiform	0 points
Mixed cystic and solid	1 point
Solid or almost completely solid	2 points

ECHOGENICITY (Choose 1)	
Anechoic	0 points
Hyperechoic or isoechoic	1 point
Hypoechoic	2 points
Very hypoechoic	3 points

SHAPE (Choose 1)	
Wider-than-tall	0 points
Taller-than-wide	3 points

MARGIN (Choose 1)	
Smooth	0 points
Ill-defined	0 points
Lobulated or irregular	2 points
Extra-thyroidal extension	3 points

ECHOGENIC FOCI (Choose All That Apply)	
None or large comet-tail artifacts	0 points
Macrocalcifications	1 point
Peripheral (rim) calcifications	2 points
Punctate echogenic foci	3 points

Add Points From All Categories to Determine TI-RADS Level

0 Points	2 Points	3 Points	4 to 6 Points	7 Points or More
TR1 Benign No FNA	**TR2** Not Suspicious No FNA	**TR3** Mildly Suspicious FNA if ≥ 2.5 cm Follow if ≥ 1.5 cm	**TR4** Moderately Suspicious FNA if ≥ 1.5 cm Follow if ≥ 1 cm	**TR5** Highly Suspicious FNA if ≥ 1 cm Follow if ≥ 0.5 cm*

COMPOSITION	ECHOGENICITY	SHAPE	MARGIN	ECHOGENIC FOCI
Spongiform: Composed predominantly (>50%) of small cystic spaces. Do not add further points for other categories. *Mixed cystic and solid:* Assign points for predominant solid component. Assign 2 points if composition cannot be determined because of calcification.	*Anechoic:* Applies to cystic or almost completely cystic nodules. *Hyperechoic/isoechoic/hypoechoic:* Compared to adjacent parenchyma. *Very hypoechoic:* More hypoechoic than strap muscles. Assign 1 point if echogenicity cannot be determined.	*Taller-than-wide:* Should be assessed on a transverse image with measurements parallel to sound beam for height and perpendicular to sound beam for width. This can usually be assessed by visual inspection.	*Lobulated:* Protrusions into adjacent tissue. *Irregular:* Jagged, spiculated, or sharp angles. *Extrathyroidal extension:* Obvious invasion = malignancy. Assign 0 points if margin cannot be determined.	*Large comet-tail artifacts:* V-shaped, >1 mm, in cystic components. *Macrocalcifications:* Cause acoustic shadowing. *Peripheral:* Complete or incomplete along margin. *Punctate echogenic foci:* May have small comet-tail artifacts.

**Refer to discussion of papillary microcarcinomas for 5-9 mm TR5 nodules.*

TIRADS = Thyroid Imaging Reporting and Data System; FNA = fine needle aspiration

Case: DQ 38M

- Thyroid ultrasound:
  - There is a large 1.8 x 2.0 x 3.4 centimetre rounded well circumscribed lesion within the left lobe of the thyroid gland. This is solid and hypoechoic relative to back-ground parenchyma. Lesion is wider than tall with no calcifications.
  - Diffuse heterogeneity of the background thyroid parenchyma with large lobular masses within both lobes of the thyroid gland. Given the provided history of fevers in the degree of heterogeneity/size of bilateral nodules, findings are favoured on the basis of subacute De Quervain Thyroiditis.
- TIRADS 4: FNA if >1.5cm

Composition (Choose 1)*	☐ Cystic or almost completely cystic 0 points
	☐ Spongiform 0 points
	☐ Mixed cystic and solid 1 point
	☑ Solid or almost completely solid 2 points
Echogenicity (Choose 1)*	☐ Anechoic 0 points
	☐ Hyperechoic or isoechoic 1 point
	☑ Hypoechoic 2 points
	☐ Very hypoechoic 3 points
Shape (Choose 1)*	☑ Wider-than-tall 0 points
	☐ Taller-than-wide 3 points
Margin (Choose 1)*	☑ Smooth 0 points
	☐ Ill-defined 0 points
	☐ Lobulated or irregular 2 points
	☐ Extra-thyroidal extension 3 points
Echogenic Foci (Choose All That Apply)*	☑ None or large comet-tail artifacts 0 points
	☐ Macrocalcifications 1 point
	☐ Peripheral (rim) calcifications 2 points
	☐ Punctate echogenic foci 3 points
Total Points	4
TI-RADS Level	TR4
Recommendations	Moderately Suspicious: FNA if ≥ 1.5 cm; Follow if ≥ 1 cm at 1, 2, 3, and 5 y

TIRADS = Thyroid Imaging Reporting and Data System; FNA = fine needle aspiration

Case 3: PA 75F

- History: hypertension, IBS, GERD, type 2 diabetes, dyslipidemia, osteopenia
- Medications: metformin, candesartan, rosuvastatin, pantoprazole, alendronate
- 3 months: fatigue, anorexia, presyncope, headache, minor MVC ("missing things when I drive")
- Exam: 82/63, pulse 55, "dry", brittle hair, dry skin
- TSH N, Na 123↓, K N, hemoglobin 128↓

"Are my meds OK?"

Generated image by Meta AI, 2025

GERD = gastroesophageal reflux disease; IBS = irritable bowel syndrome; MVC = motor vehicle collision; TSH = thyroid-stimulating hormone; Na = sodium; K = potassium; N = normal

Case 3: PA 75F

- 3 months: fatigue, anorexia, presyncope, headache, minor MVC (field deficit)
- Suspect central/pituitary disorder
- G – IGF-1 130 (low N)
  L/F – LH 0.4 FSH 1.2
  T – TSH N, fT4 2.5↓, fT3 0.6↓
  A – 8 AM cortisol 28↓
  ACTH 5.5 (inappropriately normal),
  P – prolactin 2000↑ (prolactin-secreting mass)

Generated image by Meta AI, 2025

IGF-1 = insulin-like growth factor 1; LH = luteinizing hormone; FSH = follicle-stimulating hormone; MVC = motor vehicle collision; TSH = thyroid-stimulating hormone; fT4 = free thyroxine; fT3 = free triiodothyronine; ACTH = adrenocorticotropic hormone

Case 3: PA 75F

- 3 months: fatigue, anorexia, presyncope, headache, minor MVC (field deficit)
- Panhypopituitarism
- Sellar MRI:
  - 2.1cm, homogenously enhancing pituitary mass suspicious for macroadenoma with stalk deviation and tenting of optic chiasm; consultation with neurosurgery (and/or endocrinology) recommended
- Central hypothyroidism from prolactinoma

Generated image by Meta AI, 2025

MVC = motor vehicle collision; MRI = magnetic resonance imaging

When to Call Endocrinology

- Central hypothyroidism
- Pregnancy (overt hypothyroidism)
- Myxedema coma
- Amiodarone
- Rare causes

- When something does not make sense…

"I want to see a specialist"

Endo Referral Checklist

- ❑ Clear clinical question
- ❑ Symptoms of hypothyroidism
- ❑ Supplements containing biotin, iodine
- ❑ Updated medication list, including drug allergies, medications tried for this issue
- ❑ List of previous thyroid function studies (along with corresponding levothyroxine doses)
- ❑ Thyroid ultrasound (only if abnormal exam)

Take Away Points

- Keep the differential for hypothyroidism simple
  - Basic workup reveals “important” causes
- Be mindful of nuances of thyroid testing
  - Try to eliminate interferences before repeating
- Most treatment is straightforward
- Some cases need special consideration
  - Do not hesitate to ask local Endo for advice

Questions?
Thoughts?

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ATA = American Thyroid Association; ETA = European Thyroid Association AAFP = American Academy of Family Physicians

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