Casual Friday Series

Mechanics of Optimal Thyroid Function IV

A BIOGENETIX CLINICAL PRESENTATION

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Biogenetix

53 yo female
No rx
DM2
Hypothyroidism

	Test	Current Result and Flag		Previous Result and Date		Units	Reference Interval
▲	**Glucose** [01]	**310**	**High**	**315**	04/19/2025	mg/dL	70-99
	BUN [01]	15		18	04/19/2025	mg/dL	6-24
	Creatinine [01]	0.72		0.68	04/19/2025	mg/dL	0.57-1.00

Insulin

	Test	Current Result and Flag		Previous Result and Date		Units	Reference Interval
▼	**Insulin** [01]	**1.5**	**Low**	**1.6**	04/19/2025	uIU/mL	2.6-24.9

	Test	Current Result and Flag		Previous Result and Date		Units	Reference Interval
▲	**TSH** [01]	**4.920**	**High**	**5.590**	04/19/2025	uIU/mL	0.450-4.500
	Thyroxine (T4) [01]	5.3		6.5	03/20/2025	ug/dL	4.5-12.0
	T3 Uptake [03]	30				%	24-39
	Free Thyroxine Index	1.6					1.2-4.9

Hgb A1c with eAG Estimation

	Test	Current Result and Flag		Previous Result and Date		Units	Reference Interval
▲	**Hemoglobin A1c** [01]	**11.1**	**High**	**10.1**	04/19/2025	%	4.8-5.6
	Please Note: [01]	Prediabetes: 5.7 - 6.4 Diabetes: >6.4 Glycemic control for adults with diabetes: <7.0					
	Estim. Avg Glu (eAG)	272				mg/dL	

GlycoMark(R)(1,5 AG)

	Test	Current Result and Flag		Previous Result and Date	Units	Reference Interval
▼	**GlycoMark(R)(1,5 AG)** [04]	**<1.0**	**Low**		ug/mL	

GlycoMark(TM) is intended for use with managing glycemic control in diabetic patients. A low result corresponds to high glucose peaks.
1, 5-AG blood levels can be affected by clinical conditions or medications. Please refer to the directory of services or labcorp website test menu for detailed list of limitations.
Reference Range:
Adults Females: 6.8 - 29.3
Glycemic control goal for diabetic patients: >10

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WBC [01]	5.3	5.1	04/19/2025	x10E3/uL	3.4-10.8
RBC [01]	4.23	4.34	04/19/2025	x10E6/uL	3.77-5.28
Hemoglobin [01]	13.3	13.6	04/19/2025	g/dL	11.1-15.9
Hematocrit [01]	40.7	42.5	04/19/2025	%	34.0-46.6
MCV [01]	96	**98**	04/19/2025	fL	79-97
MCH [01]	31.4	31.3	04/19/2025	pg	26.6-33.0
MCHC [01]	32.7	32.0	04/19/2025	g/dL	31.5-35.7
RDW [01]	11.8	11.8	04/19/2025	%	11.7-15.4
Platelets [01]	301	274	04/19/2025	x10E3/uL	150-450
Neutrophils [01]	45	48	04/19/2025	%	Not Estab.
Lymphs [01]	44	41	04/19/2025	%	Not Estab.
Monocytes [01]	8	9	04/19/2025	%	Not Estab.
Eos [01]	2	1	04/19/2025	%	Not Estab.
Basos [01]	1	1	04/19/2025	%	Not Estab.
Neutrophils (Absolute) [01]	2.5	2.4	04/19/2025	x10E3/uL	1.4-7.0
Lymphs (Absolute) [01]	2.3	2.1	04/19/2025	x10E3/uL	0.7-3.1
Monocytes(Absolute) [01]	0.4	0.5	04/19/2025	x10E3/uL	0.1-0.9
Eos (Absolute) [01]	0.1	0.1	04/19/2025	x10E3/uL	0.0-0.4
Baso (Absolute) [01]	0.0	0.0	04/19/2025	x10E3/uL	0.0-0.2
Immature Granulocytes [01]	0	0	04/19/2025	%	Not Estab.
Immature Grans (Abs) [01]	0.0	0.0	04/19/2025	x10E3/uL	0.0-0.1

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Uric Acid

Test	Current Result and Flag		Previous Result and Date		Units	Reference Interval
▼ **Uric Acid** [01]	**2.6**	**Low**	**2.2**	04/19/2025	mg/dL	3.0-7.2
	Therapeutic target for gout patients: <6.0					

Phosphorus

Test	Current Result and Flag		Previous Result and Date		Units	Reference Interval
Phosphorus [01]	3.9				mg/dL	3.0-4.3

LDH

Test	Current Result and Flag		Previous Result and Date		Units	Reference Interval
LDH [01]	131				IU/L	119-226

GGT

Test	Current Result and Flag		Previous Result and Date		Units	Reference Interval
GGT [01]	10				IU/L	0-60

Triiodothyronine (T3)

Test	Current Result and Flag		Previous Result and Date		Units	Reference Interval
▼ **Triiodothyronine (T3)** [01]	**58**	**Low**	**70**	04/19/2025	ng/dL	71-180

Thyroid Antibodies

Test	Current Result and Flag		Previous Result and Date		Units	Reference Interval
Thyroid Peroxidase (TPO) Ab [03]	<9				IU/mL	0-34
Thyroglobulin Antibody [03]	<1.0				IU/mL	0.0-0.9
	Thyroglobulin Antibody measured by Beckman Coulter Methodology It should be noted that the presence of thyroglobulin antibodies may not be pathogenic nor diagnostic, especially at very low levels. The assay manufacturer has found that four percent of individuals without evidence of thyroid disease or autoimmunity will have positive TgAb levels up to 4 IU/mL.					

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	eGFR	100		104	04/19/2025	mL/min/1.73	>59
	BUN/Creatinine Ratio	21		**26**	04/19/2025		9-23
	Sodium [01]	137		137	04/19/2025	mmol/L	134-144
	Potassium [01]	4.2		4.5	04/19/2025	mmol/L	3.5-5.2
	Chloride [01]	101		100	04/19/2025	mmol/L	96-106
	Carbon Dioxide, Total [01]	22		23	04/19/2025	mmol/L	20-29
	Calcium [01]	9.1		9.3	04/19/2025	mg/dL	8.7-10.2
	Protein, Total [01]	6.2		6.7	04/19/2025	g/dL	6.0-8.5
	Albumin [01]	4.2		4.4	04/19/2025	g/dL	3.8-4.9
	Globulin, Total	2.0		2.3	04/19/2025	g/dL	1.5-4.5
	Bilirubin, Total [01]	0.4		0.4	04/19/2025	mg/dL	0.0-1.2
	Alkaline Phosphatase [01]	65		75	04/19/2025	IU/L	44-121
▼	**AST (SGOT)** [01]	**13**	**Low**	15	04/19/2025	IU/L	15-59
				Please note reference interval change			
	ALT (SGPT) [01]	15		17	04/19/2025	IU/L	0-35
				Please note reference interval change			

	Test	Current Result and Flag		Previous Result and Date	Units	Reference Interval
▲	**Fructosamine** [03]	**442**	**High**		umol/L	0-285
	Published reference interval for apparently healthy subjects between age 20 and 60 is 205 - 285 umol/L and in a poorly controlled diabetic population is 228 - 563 umol/L with a mean of 396 umol/L.					

C-Reactive Protein, Cardiac

Test	Current Result and Flag	Previous Result and Date		Units	Reference Interval
C-Reactive Protein, Cardiac [01]	2.33	**4.31**	04/19/2025	mg/L	0.00-3.00
Relative Risk for Future Cardiovascular Event					
Low					<1.00
Average					1.00 - 3.00
High					>3.00

Homocyst(e)ine

Test	Current Result and Flag	Previous Result and Date		Units	Reference Interval
Homocyst(e)ine [01]	<5.4	5.9	04/19/2025	umol/L	0.0-14.5

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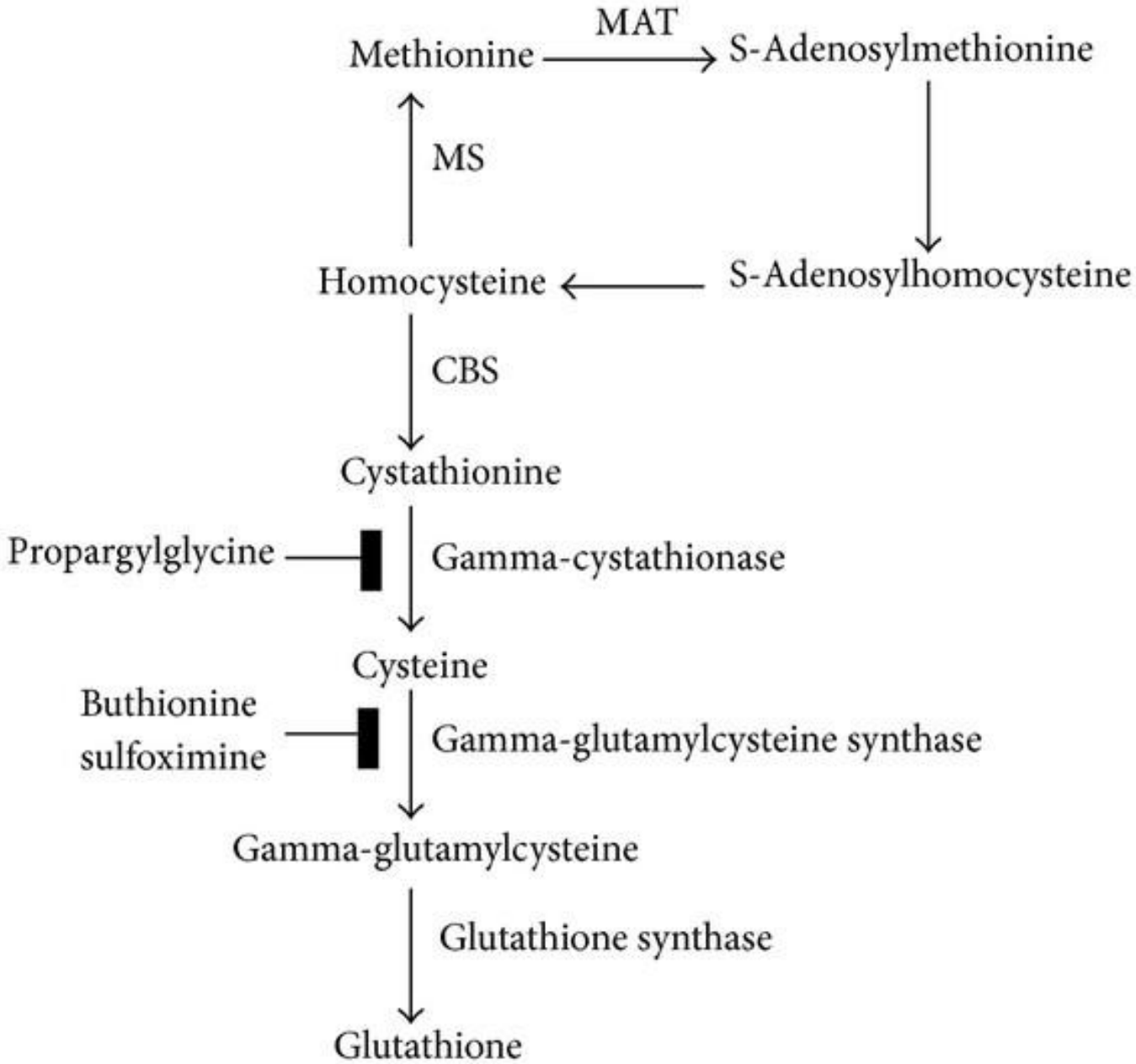
Transsulferation Pathway



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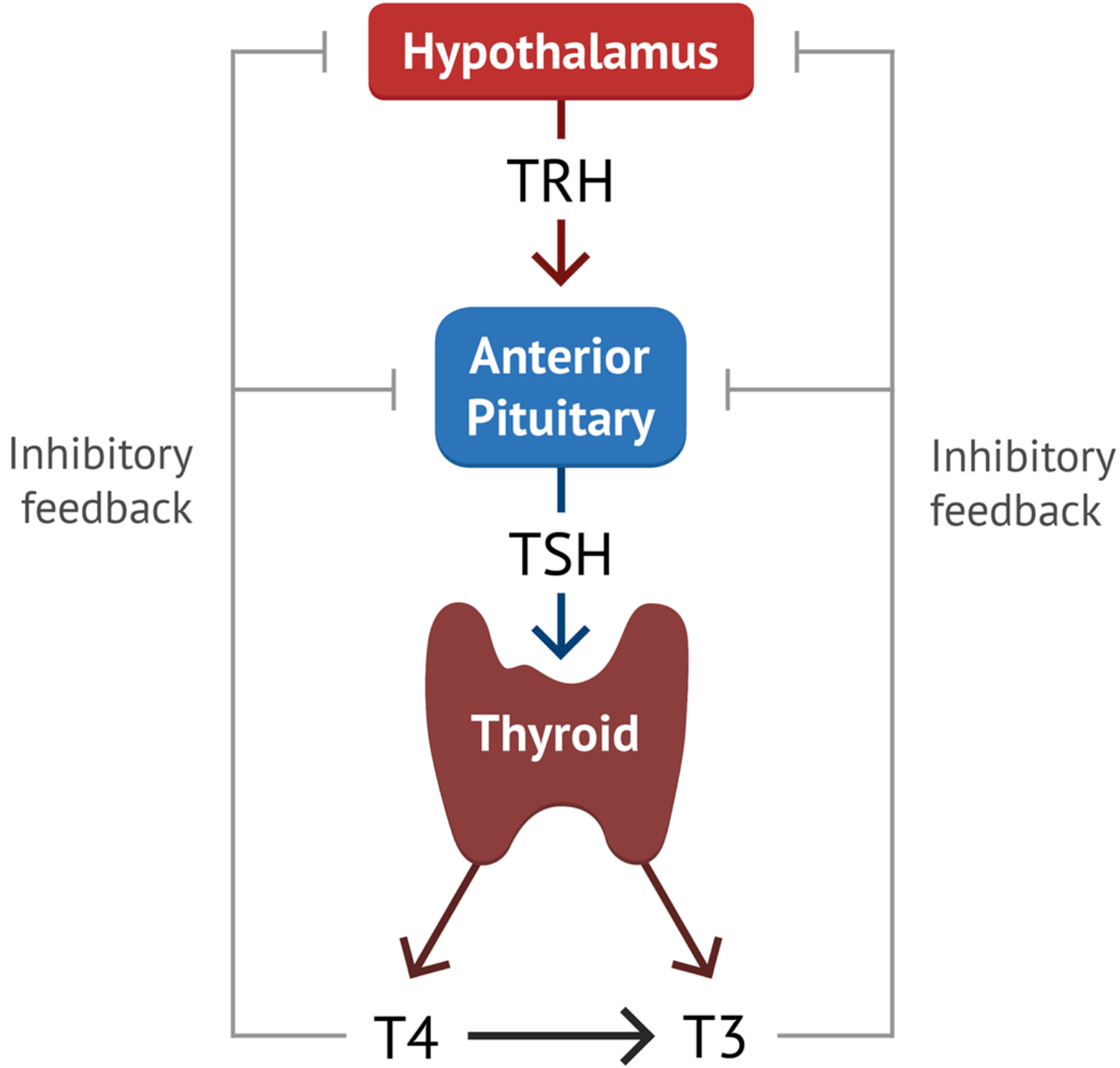
Hypothalamus
TRH
Anterior Pituitary
TSH
Thyroid
T4
T3
Inhibitory feedback
Inhibitory feedback

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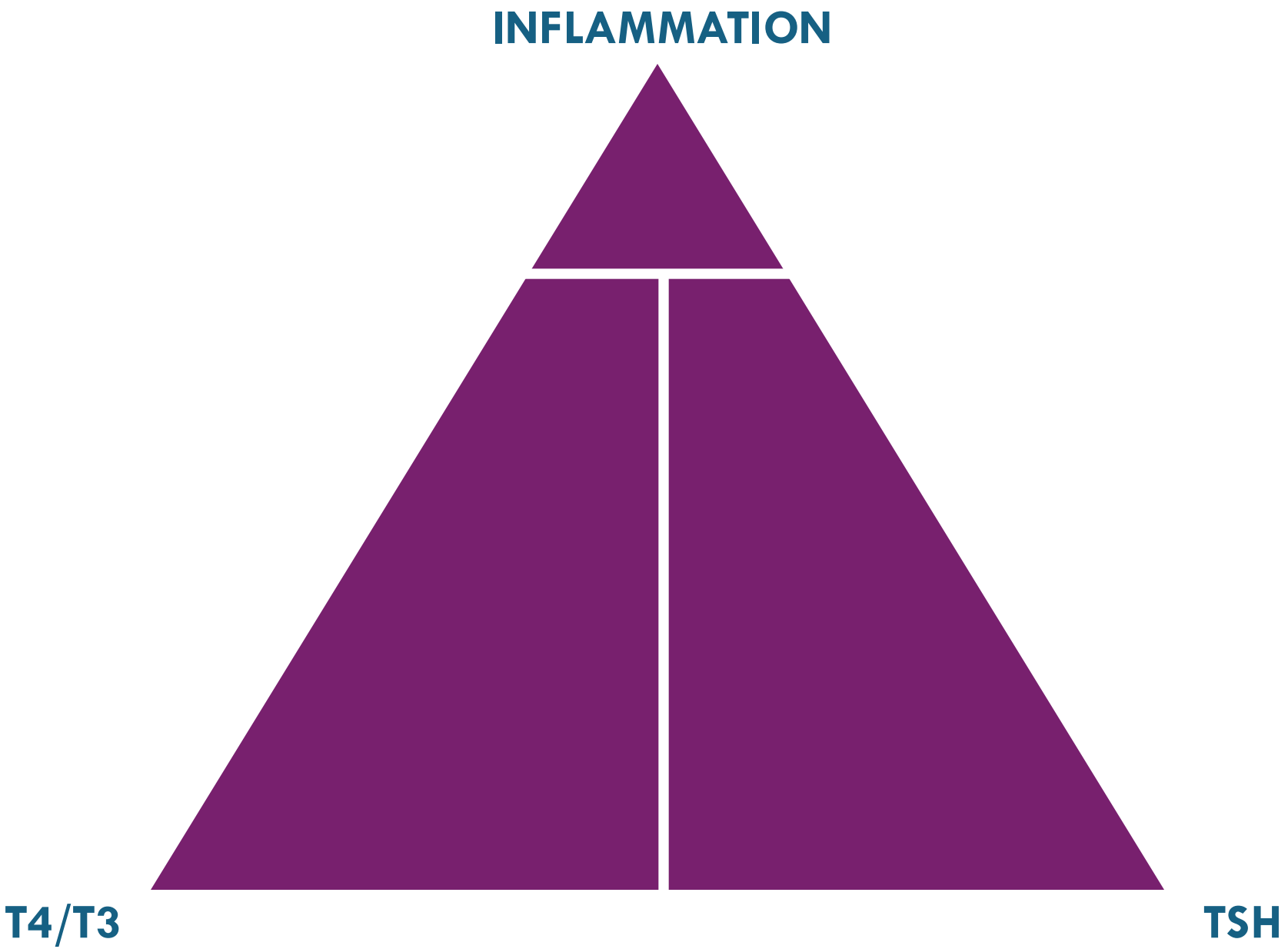
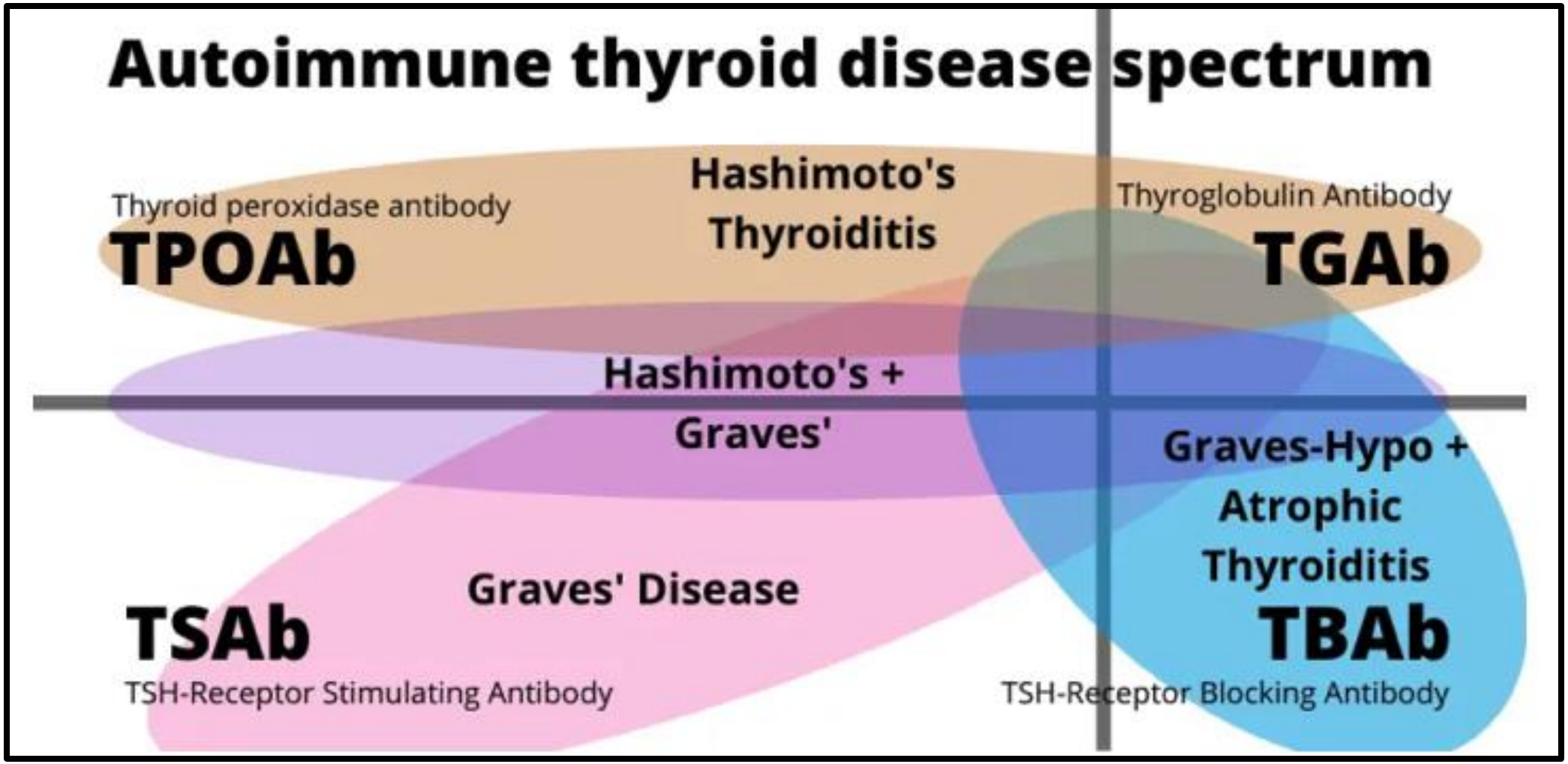
Euthyroid





https://thyroidpatients.ca/2020/04/05/remissions-and-fluctuations-trab/

Nutrients. 2020 Jun 12;12(6):1769. doi: 10.3390/nu12061769

Thyroid-Gut-Axis: How Does the Microbiota Influence Thyroid Function?

Jovana Knezevic [1], Christina Starchl [1,*], Adelina Tmava Berisha [2], Karin Amrein [1]

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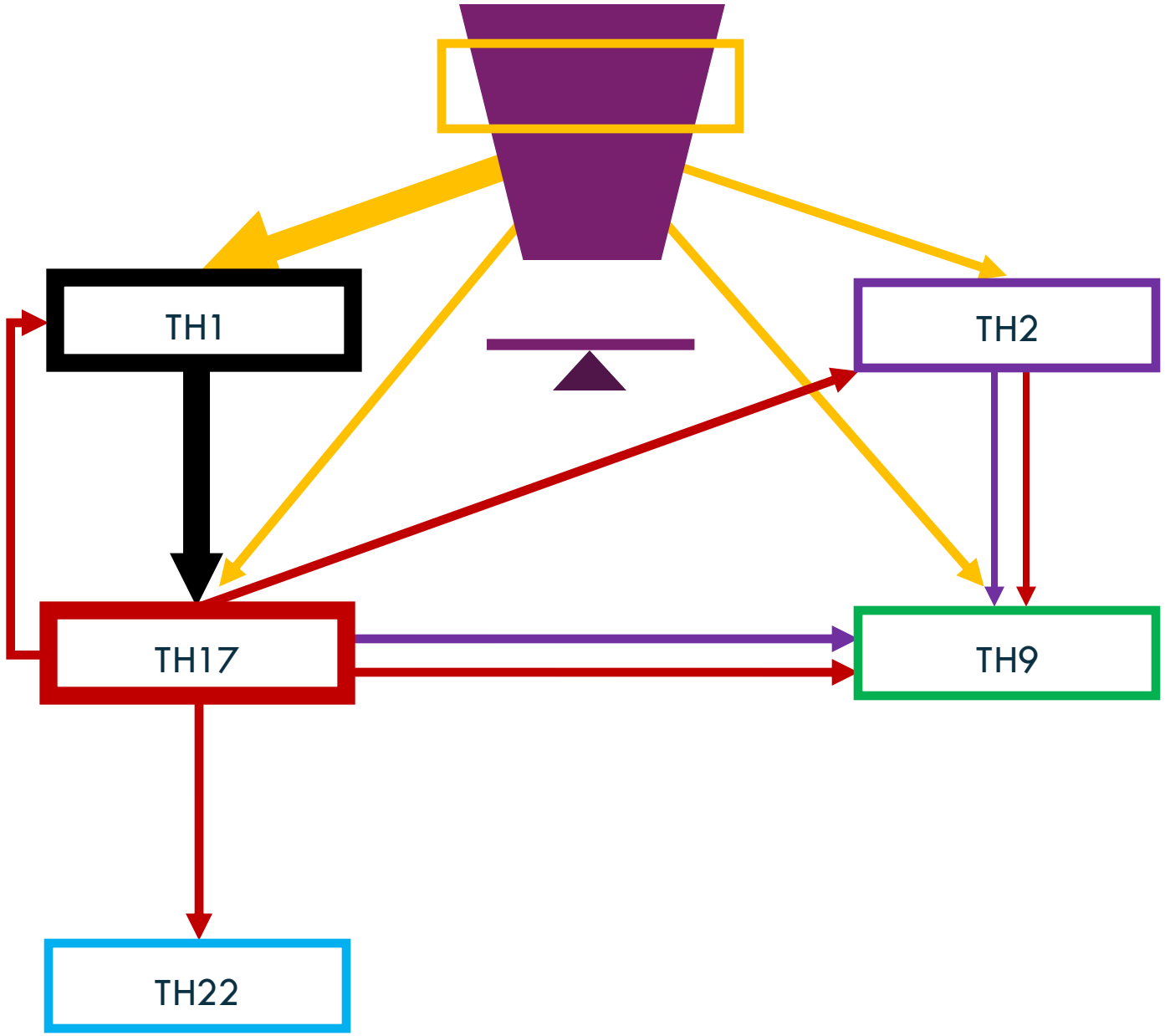
PMCID: PMC7353203 PMID: 32545596

Intestinal bacteria play a role in vitamin synthesis (vitamin K, folic acid, vitamin B2, B3, B5, B6, B7, and B12 [6,7], digestion of dietary fibers, regulation of the immune response, and mental disorders [8]. In regard to nutrition, the composition of the microbiota can be positively influenced by dietary fibers and other probiotic factors. For example, a rodent study showed that a change from a low-fat and high-fiber diet to a "Western diet" (high sugar, high fat, low fiber) made a difference in their microbiota composition after just one day [5]. David et al. illustrated changes in the microbiota in 10 participants after only five days of eating either a plant-based or animal-based diet [9]. Dietary fibers are of great importance to the intestine as their fermentation and the resulting short chain fatty acids (SCFAs) serve as an energy source for the enterocytes [5,10]. In addition, SCFAs (especially butyrate) impact the immune regulation and have anti-inflammatory effects [10,11].



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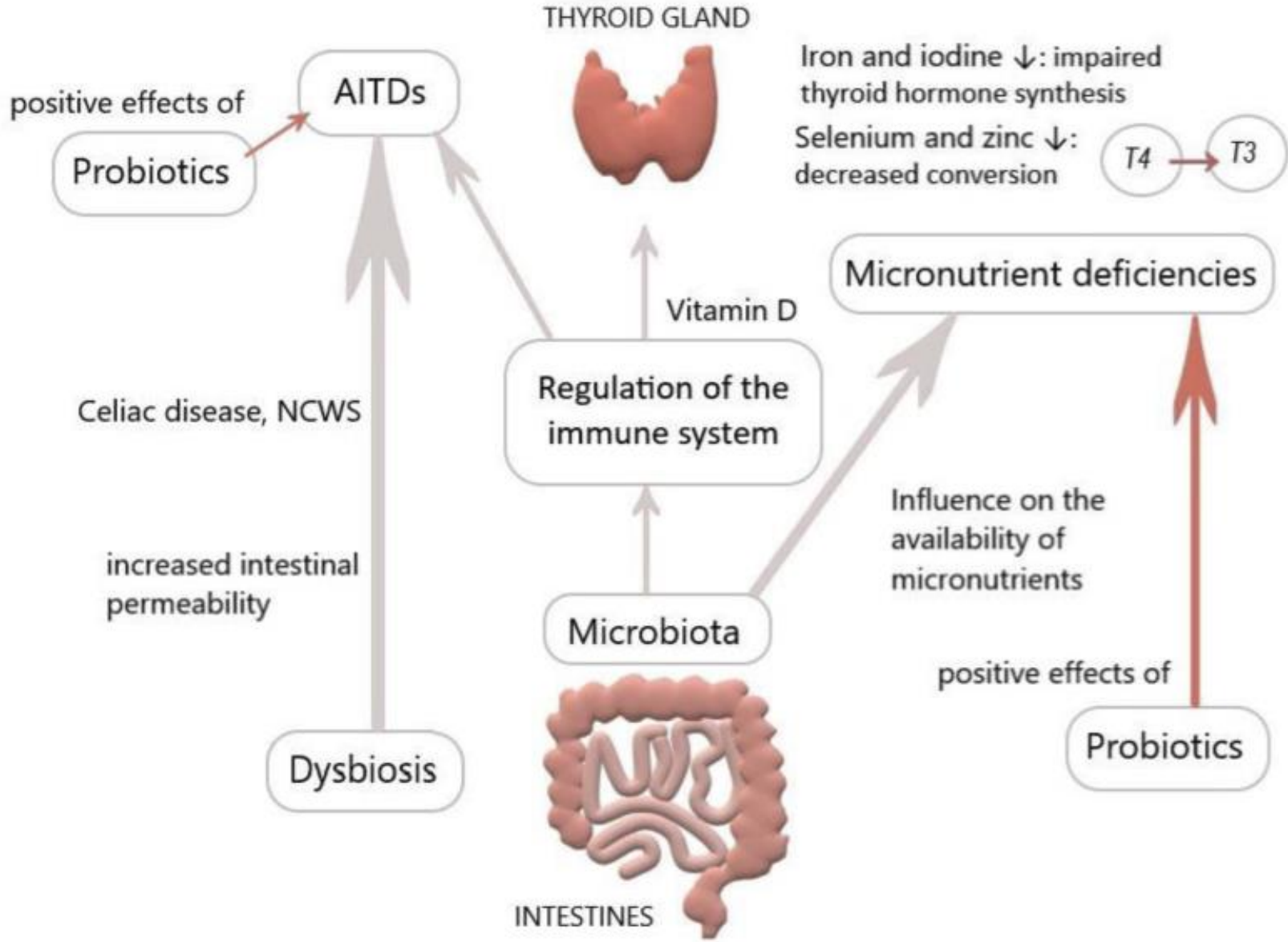

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Iodine

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The amount of iodine in soil determines the iodine content of food, resulting in regional differences. Seafood and seaweed, especially from saltwater, are a rich iodine source. Thus, regions near to the ocean and cultures with high seafood consumption, like the Japanese, [58] are more likely to be iodine sufficient. However, iodine fortification of salt and milk products attempts to ensure better overall global access to iodine sources [59].

Iodine deficiency can lead to goiter, probably thyroid nodules, and even thyroid cancer. On the other hand, papillary thyroid cancer seems to be more common in areas with high iodine intake, suggesting complex relations between iodine levels and adverse outcomes [63,64]. Iodine—at least when applicated during medical procedures in high doses—on the opposite, has been proven to influence the gut microbiota. Administering iodine containing contrast agents can have noxious effects on the microbiota by binding to the amino acids tyrosine and histidine on the bacterial membrane, as well as by oxidation of cytoplasmic and membrane components [4].

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Iron

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Dietary non-heme iron (Fe^{3+}) absorption is improved by acidic pH and mainly occurs in the proximal duodenum by divalent metal ion transporter 1 (DMT1), after being reduced by duodenal cytochrome b to Fe^{2+} [4,67]. On the contrary, heme iron Fe^{2+}, an important source for both the human and the intestinal microbiota, is directly absorbed by heme/folate transporter 1 (HCP1) in the host and by siderophores like enterobactin in bacteria. Particularly pathogenic strains grow well in heme-rich conditions, due to their efficient heme capturing ability [68]. Many enteric gram-negative bacteria, including *Salmonella*, *Shigella*, and pathogenic *E. coli* require iron for their virulence and colonization [69,70]. Beneficial commensal gut bacteria from genera *Lactobacillus* and *Bifidobacterium* on the other hand require less or no iron [71]. In mice, Constante et al. demonstrated that a heme-rich diet decreases microbial diversity and increases the abundance of *Proteobacteria,* namely *Clostridiales and Lactobacilales.* A heme-rich intestinal environment may favor bacteria-coding genes linked to heme uptake [72].

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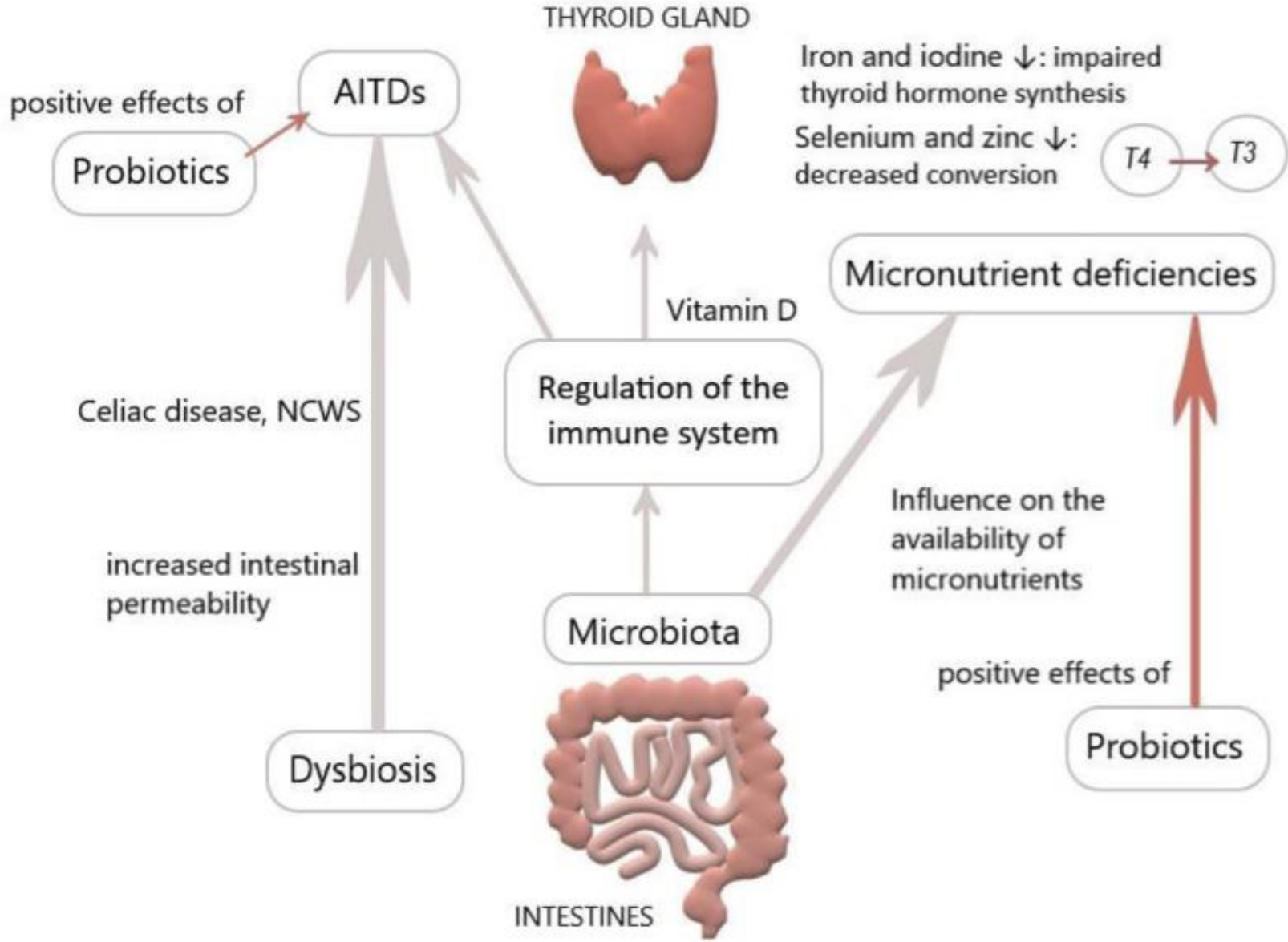

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Vit D

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Thyroid-Gut-Axis: How Does the Microbiota Influence Thyroid Function?

The steroid hormone vitamin D is pivotal for calcium and phosphate homeostasis and is either ingested as vitamin D2 from diet or synthesized as vitamin D3 from the skin. Several studies showed that tissues that contain local 1-α-hydroxylase can produce 1α-25$(OH)_2$D, inducing both autocrine and paracrine effects [76,102,103]. Vitamin D has complex effects on the immune system and is likely to affect the thyroid through its immunomodulatory effects. 1α-25$(OH)_2$D is believed to protect from autoimmunity by exerting immunoregulatory and tolerogenic effects, such as impairing autoantigen presentation in dendritic-cell subsets [76,104]. Human studies concluded that hypothyroid patients often present with lower levels of vitamin D or vitamin D deficiency than healthy controls. Inverse correlations between 25(OH)D concentrations and TPOAb, TgAb titers, and TSH in hypothyroidism seem to exist as well as a positive relationship of 25(OH)D with T3 levels [76,105,106,107]. Not all studies did observe lower levels of 25(OH)D in patients with hypothyroidism [108]. Low concentrations of vitamin D in hypothyroidism could also represent a consequence of disease, rather than part of its cause [76]. However, taking into account the existing studies, as well as the low cost and minimal side effects of vitamin D, monitoring and supplementation in patients with HT may be recommended [41].

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Selenium

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Selenium is an essential trace mineral, involved in the immune system and in several thyroid functions. Glutathione peroxidase, deiodinase isoenzymes, and thioredoxin reductase—which protect the thyroid gland from free radicals—are just a few of the > 20 human selenoproteins. The thyroid gland contains the highest amount of selenium in the body and under conditions of deficiency, it is able to retain selenium. Although very low amounts of selenium are required for deiodinase activity, selenium deficiency can decrease synthesis of thyroid hormones and seems to have an impact on thyroid function [41,76,96,97]. The selenium content of plant based food depends on soil composition, primarily as a result of the weathering of selenium-containing rocks or volcanic activity. The availability of selenium to plants is also influenced by soil moisture. Areas including Europe, New Zealand, Sibiria, north-east, and south-central China have very low amounts of selenium in their soil. In contrast, the USA and Canada are seleniferous. In animal products, especially the inner organs contain high concentrations of selenium and the geographic variation of selenium contents in animal food is reduced by feeding supplements in commercial animal agriculture [98].

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Selenium

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There are two main dietary forms of selenium. Selenomethionine (especially present in plant products) is taken up by intestinal methionine transporters and the absorption of selenocysteine (especially present in animal products) is poorly understood, but may be facilitated via dibasic and neutral amino acids. For selenium supplementation, inorganic selenium forms are used [99]. Selenium affects the composition and colonization of the microbiota in the intestine. Kasaikina found that selenium increases the diversity of microbiota in mice and suggested that selenium causes unique effects across microbial taxa. Gut microbiota is able to sequester selenium and limit availability for the host [100].

In thyroid disorders, selenium deficiency is a common finding, including decreased hormone and enzyme activity and reduced peripheral T3 synthesis. In patients with autoimmune thyroid diseases, selenium supplementation may reduce levels of antithyroid antibodies, improve thyroid structure, improve thyroid metabolism, and improve clinical symptoms [97,101].

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Zinc

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Zinc is an essential micronutrient for thyroid function and homeostasis and is required for enzyme 1,5′-deoidinase, which catalyzes the conversion of T4 to T3 and reduces metabolic rate. Superoxide dismutase enzyme contains zinc, which is considered antioxidative. Additionally, zinc is a component of thyroid hormone binding transcription factor, which is important for gene expression [86,87,88,89]. Zinc deficiency affects the thyroid gland on multiple levels: zinc deficiency impairs TRH synthesis, but also TSH, T3, and T4. Beyond that, it influences T3 binding to nuclear receptors and binding of this receptor to DNA. Possible mechanisms for zinc deficiency include impaired gastrointestinal absorption [90,91,92,93,94]. In animal studies with rats, zinc deficiency reduced free levels of T3 and T4 by around 30% [95]. In humans with zinc deficiency, TSH, T3, and T4 decrease as well and hypothyroid patients often present with reduced levels of zinc and copper. Arora et al. found a significant and positive correlation of zinc and T3, but not with TSH or T4 in their case-control study of trace elements in hypothyroidism patients [86,96]. The relationship between zinc and thyroid disorders seems to be reciprocal, considering that hypothyroidism leads to zinc deficiency and insufficient supplementation with zinc causes hypothyroidism [4,86].

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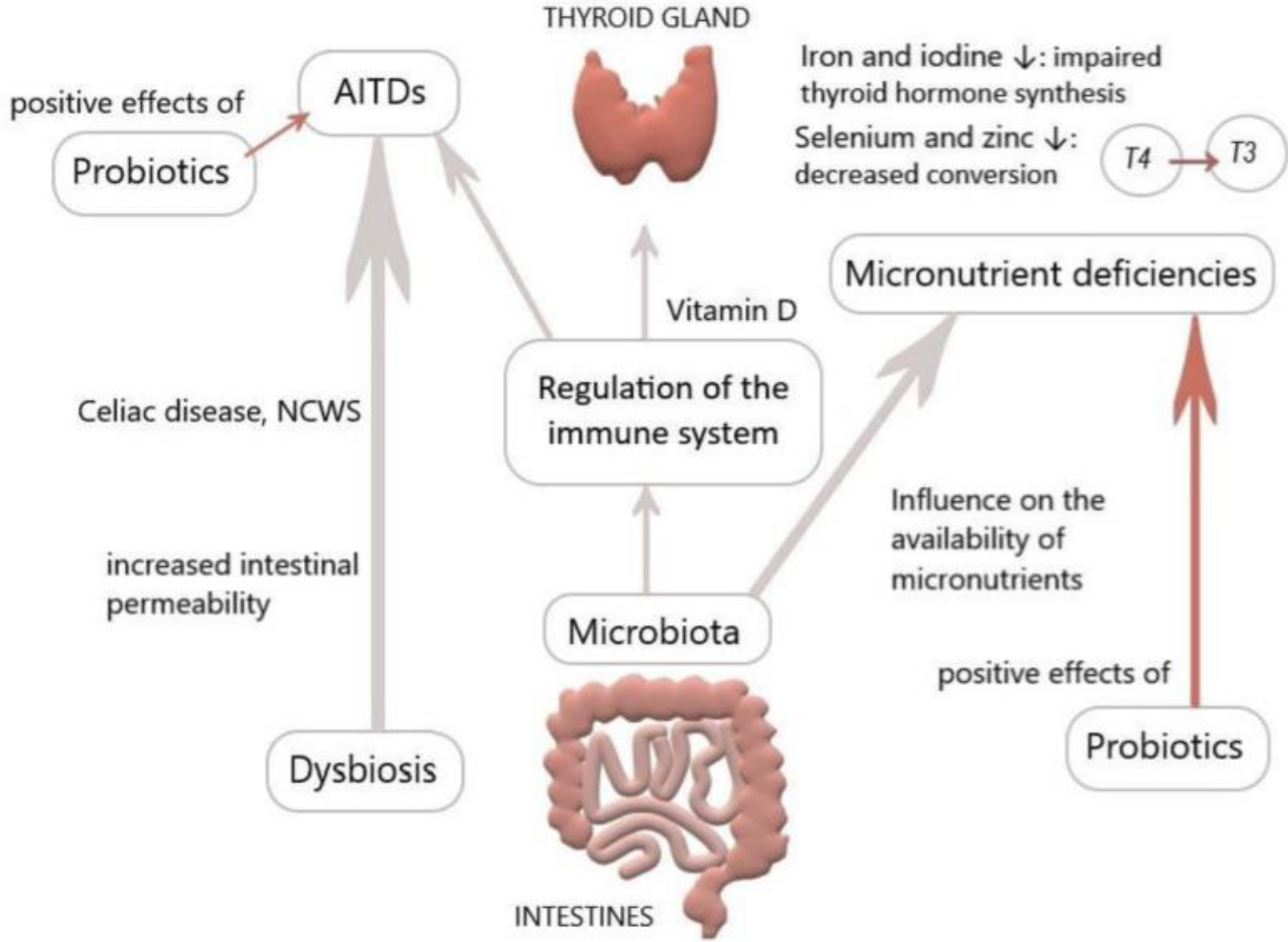

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Submit your case to the CC team

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