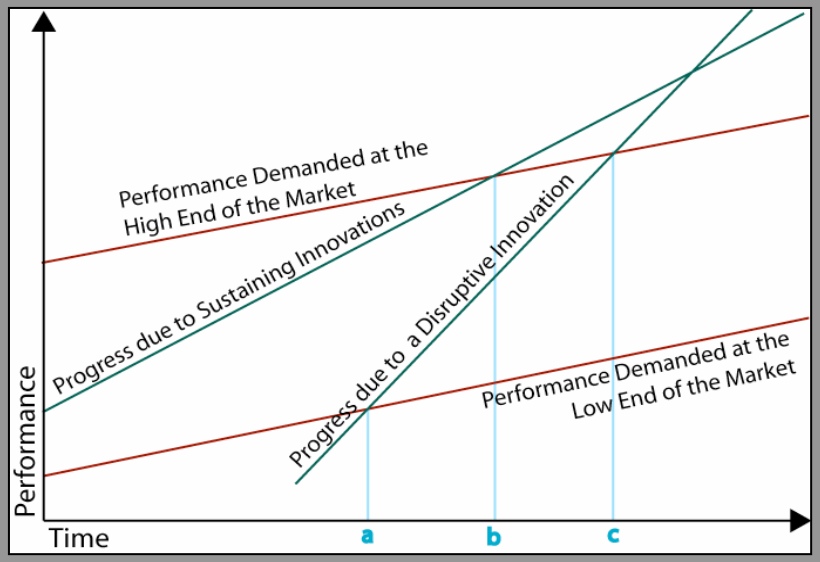
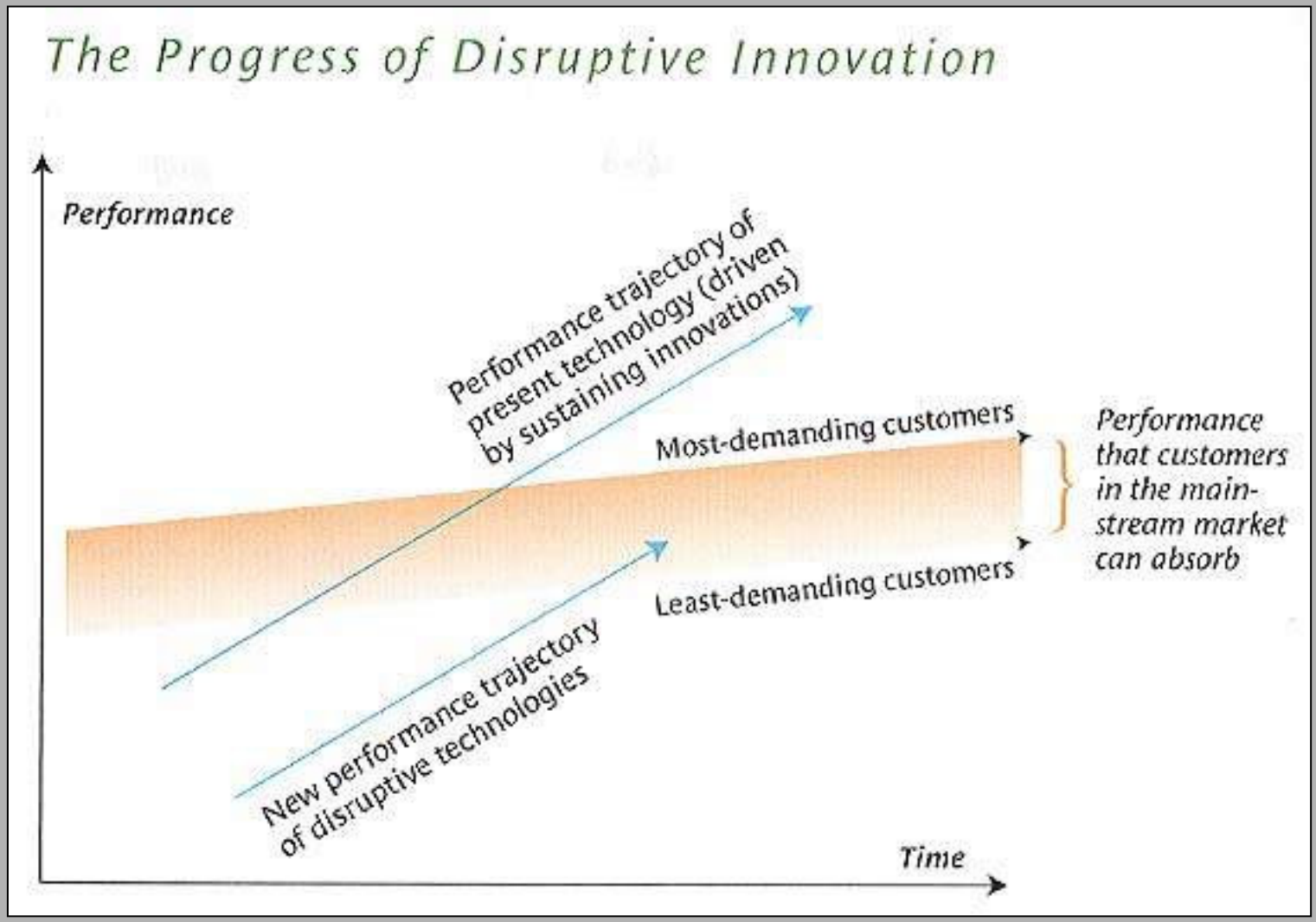
Adaptive Innovations in Medicine: Vitamin D, Iodine, and Selenium



Donald W. Miller, Jr., M.D.
Professor of Surgery, Division of Cardiothoracic Surgery
University of Washington School of Medicine

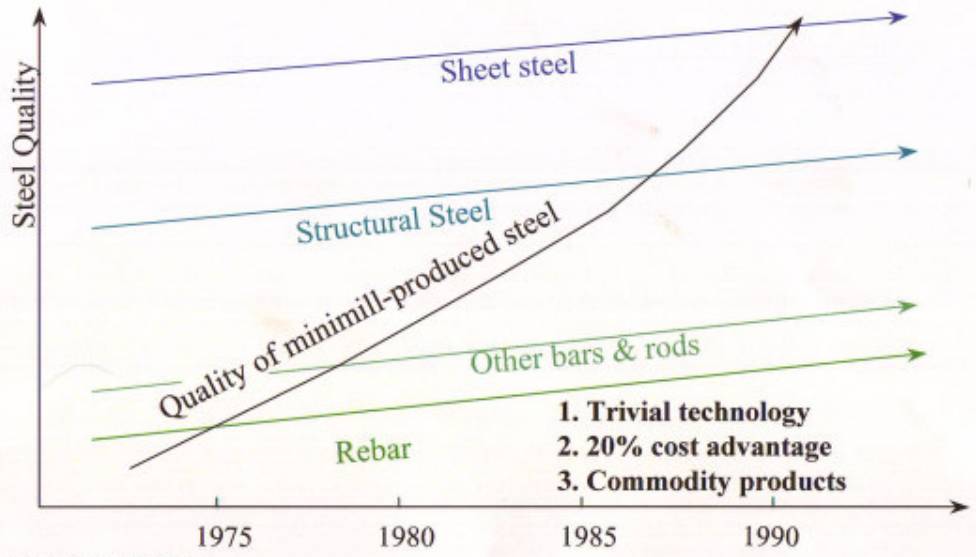
65th Annual Meeting
Association of American Physicians and Surgeons
Phoenix, Arizona September 12, 2008



Christensen CM, Bohmer R, Kenagy J. Will Disruptive Innovations Cure Health Care? *Harvard Business Review* 2000;78(Sept-Oct):106-112.

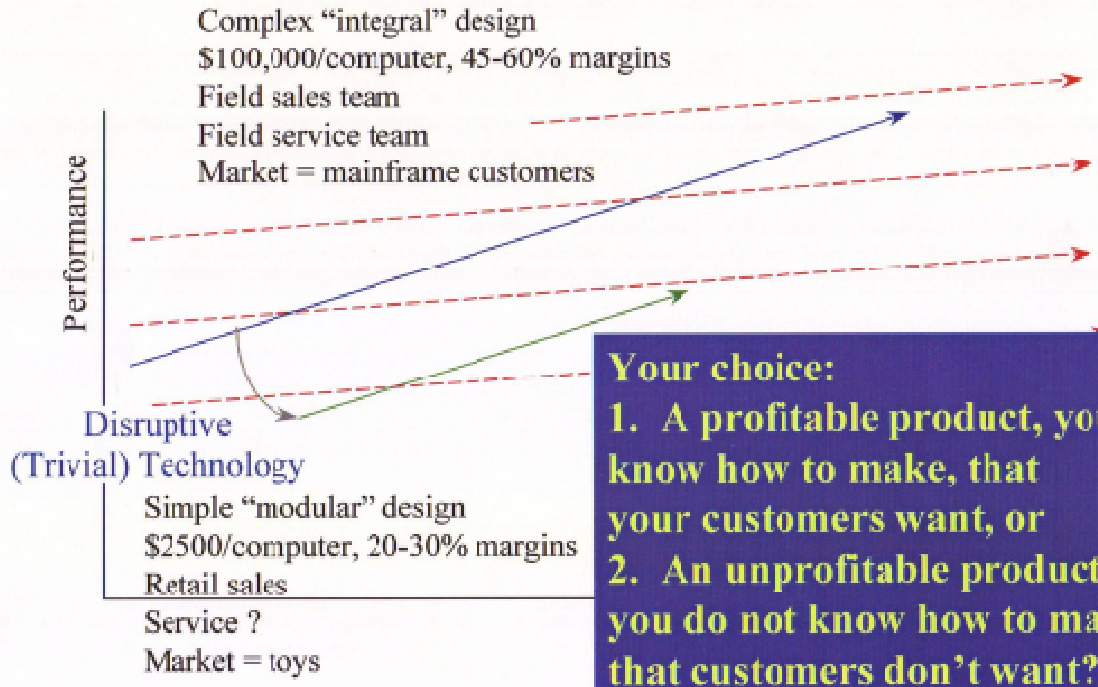
The Anatomy of a Disruption

Steel Mini-mills



What Happened to Digital?

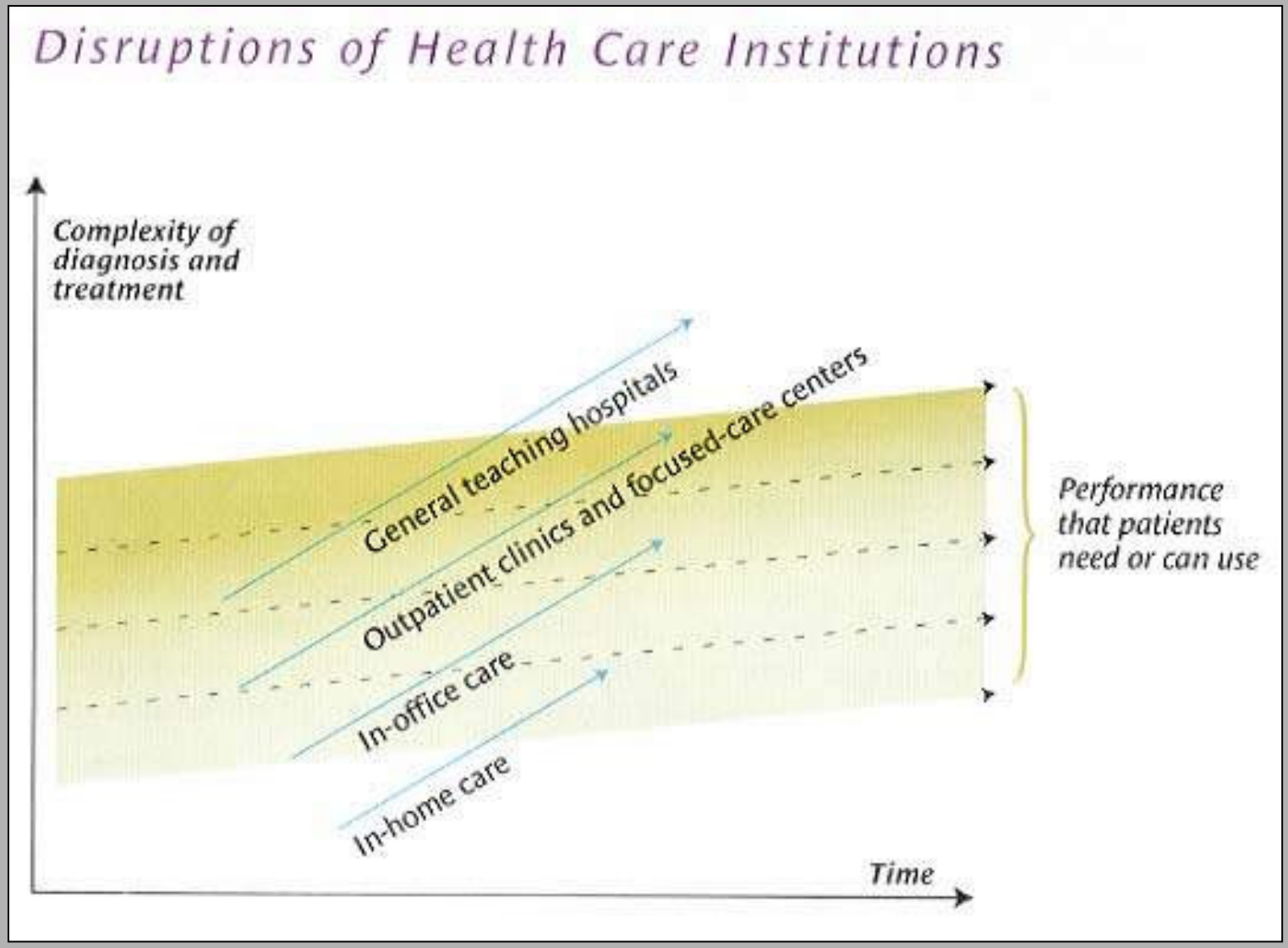
"It wasn't a lack of technical expertise."



Your choice:

1. A profitable product, you know how to make, that your customers want, or

2. An unprofitable product, you do not know how to make, that customers don't want?



Christensen CM, Bohmer R, Kenagy J. Will Disruptive Innovations Cure Health Care? *Harvard Business Review* 2000;78(Sept-Oct):106-112.

Vitamin D

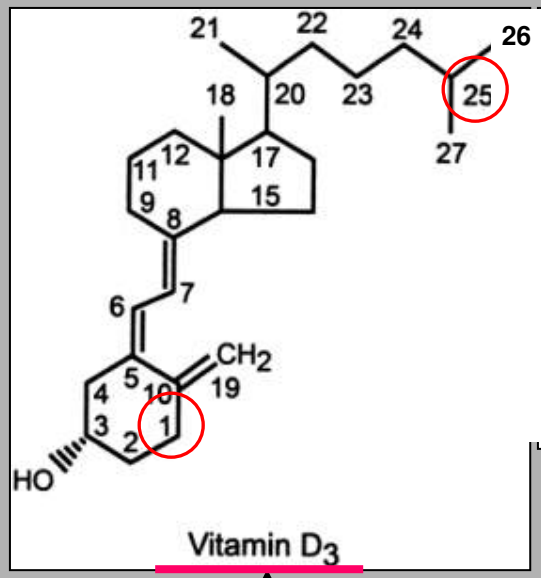
Recommended Dietary Allowance (RDA) for Vitamin D:

400 IU/day

To prevent rickets in children and osteomalacia in adults

Vitamin D Deficiency

Vitamin D → 25(OH)D → 1,25(OH)D



Vitamin D_3

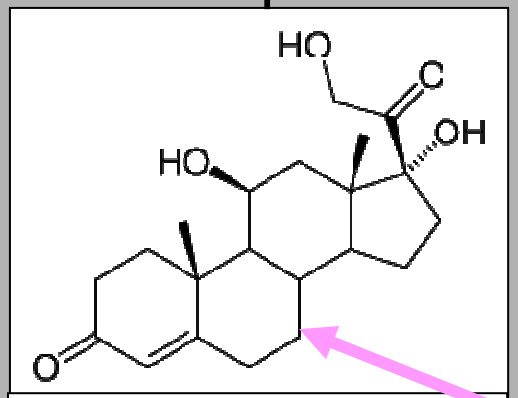
Liver microsomes (mitochondria)

Kidney mitochondria

+ cells throughout the body

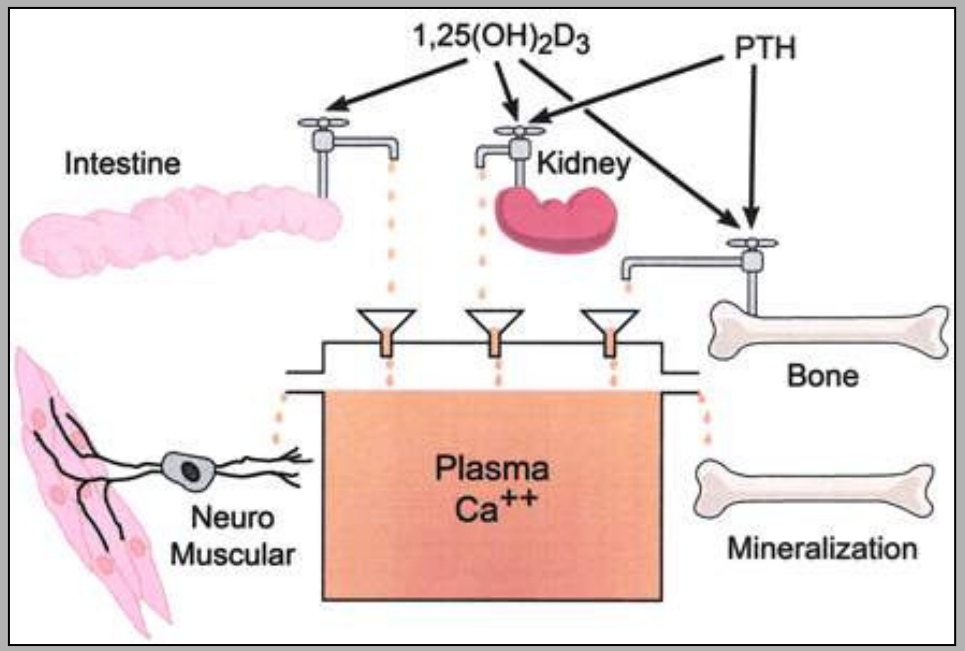
25-hydroxyvitamin D_3

1α, 25-dihydroxyvitamin D_3



7-dehydrocholesterol

UVB photons



Nuclear Receptors

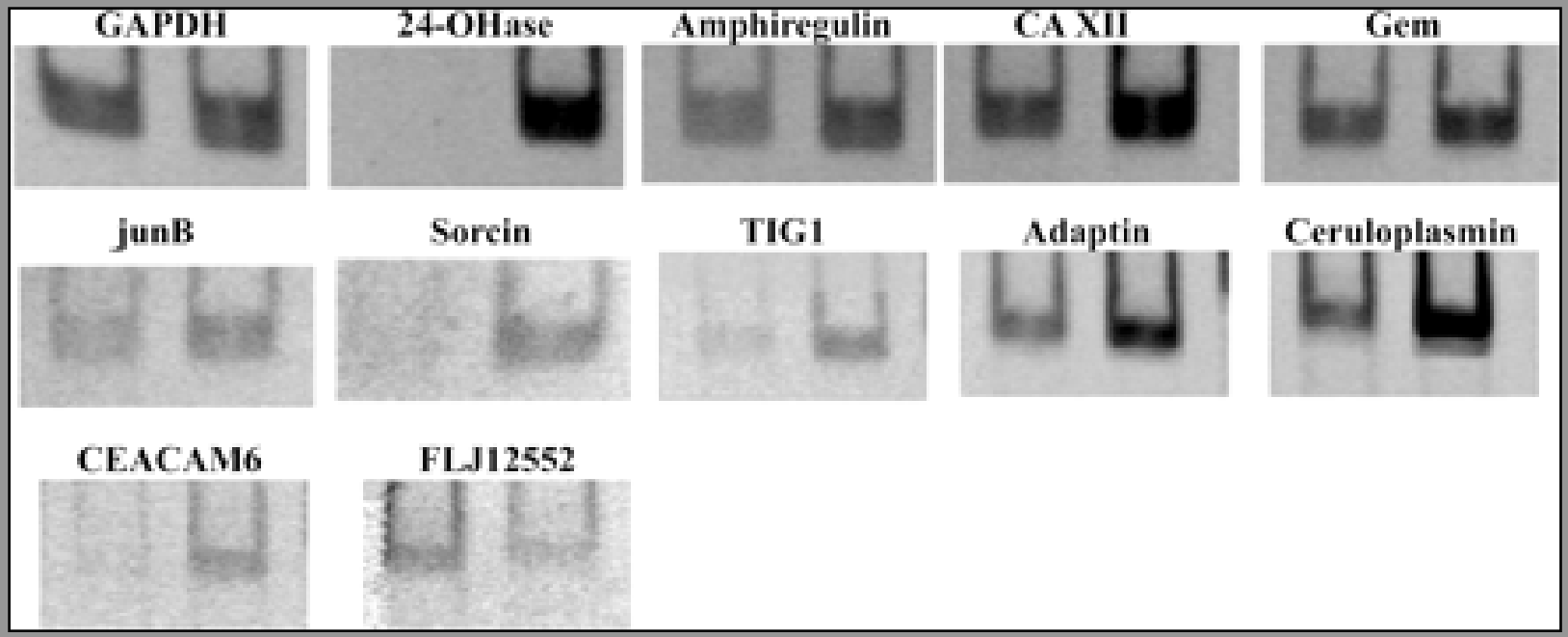
	Receptor	Subtype	Denomination	Ligand
Class I	TR	α, β	Thyroid hormone receptor	Thyroid hormone (T_3)
	RAR	α, β, γ	Retinoic acid receptor	Retinoic acid
	VDR		Vitamin D receptor	1-25$(OH)_2$ vitamin D_3
	PPAR	α, β, γ	Peroxisome proliferator activated receptor	Benzotriene B4; Wy 14.643 Eicosanoids; thiazolidinediones (TZD_S); 15-deoxy-12,41-prostaglandin J_2; polyunsaturated fatty acids
	PXR		Pregnane X receptor	Pregnanes; C21 steroids
	CAR/MB67	α, β	Constitutive androstane receptor	Androstanes; 1,4-bis[2-(3,5-dichloropyridyloxy)]benzene
	LXR	α, β	Liver X receptor	Oxysterols
	FXR		Farnesoid X receptor	Bile acids
	RevErb	α, β	Reverse ErbA	Unknown
	RZR/ROR	α, β, γ	Retinoid Z receptor/retinoic acid-related orphan receptor	Unknown
	UR		Ubiquitous receptor	Unknown
Class II	RXR	α, β, γ	Retinoid X receptor	9-*Cis*-retinoic acid
	COUP-TF	α, β, γ	Chicken ovalbumin upstream promoter transcription factor	Unknown
	HNF-4	α, β, γ	Hepatocyte nuclear factor 4	Fatty acyl-CoA thioesters
	TLX		Tailles-related receptor	Unknown
	PNR		Photoreceptor-specific nuclear receptor	Unknown
	TR2	α, β	Testis receptor	Unknown
Class III	GR		Glucocorticoid receptor	Glucocorticoids
	AR		Androgen receptor	Androgens
	PR		Progesterone receptor	Progestins
	ER	α, β	Estrogen receptor	Estradiol
	ERR	α, β, γ	Estrogen-related receptor	Unknown
Class IV	NGFI-B	α, β, γ	NGF-induced clone B	Unknown
Class V	SF-1/FTZ-F1	α, β	Steroidogenic factor 1 Fushi Tarazu factor 1	Oxysterols
Class VI	GCNF		Germ cell nuclear factor	Unknown
Class 0	SHP		Small heterodimeric partner	Unknown
	DAX-1		Dosage-sensitive sex reversal	Unknown

System and Tissue Distribution of Nuclear Vitamin D Receptors (VDR)

System	Tissue
Immune	Thymus, bone marrow, macrophages, B cells, T cells
Gastrointestinal	Esophagus, stomach, small intestine, colon, rectum
Cardiovascular	Endothelial cells, smooth muscle cells, myocytes
Respiratory	Lung alveolar cells
Hepatic	Liver parenchyma cells
Renal	Proximal and distal tubules, collecting duct
Endocrine	Parathyroid, thyroid, pancreatic beta cells
Exocrine	Parotid gland, sebaceous gland
CNS	Brain neurons, astrocytes, microglia
Epidermis/appendage	Skin, breast, hair follicles
Musculoskeletal	Osteoblasts, osteocytes, chondrocytes, striated muscle
Connective Tissue	Fibroblasts, stroma
Reproductive	Testis, ovary, placenta, uterus, endometrium, yolk sac

Nutrigenomics

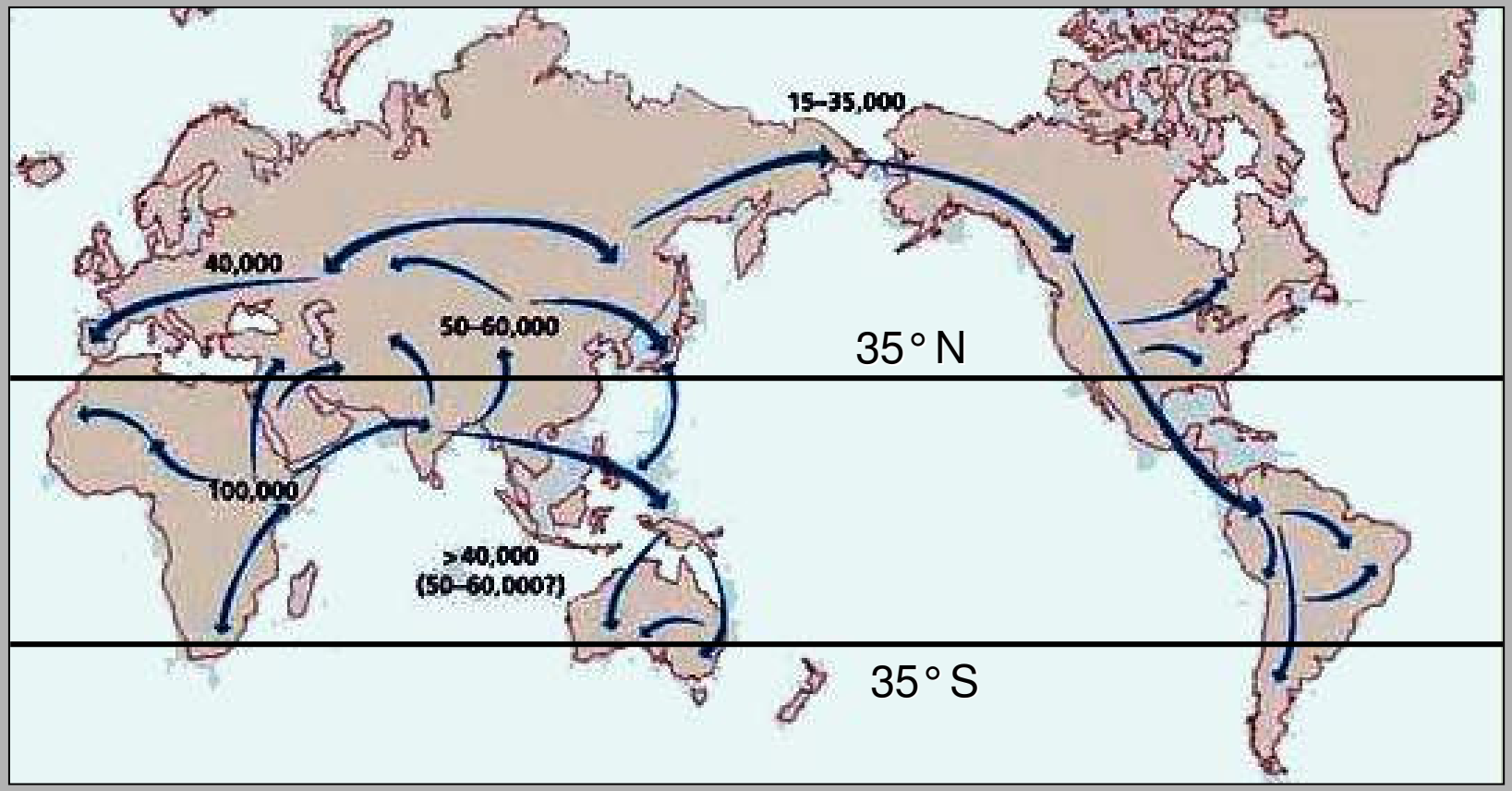
Vitamin D



Confirmatory PCR for 1,25-dihydroxyvitamin D-regulated genes found by Affymetrix GeneChip transcriptional profiling

Wood RJ, Tchack L, Angelo G, etal. DNA Microarray Analysis of Vitamin D-induced Gene Expression in a Human Colon Carcinoma Cell Line. *Physiological Genomics* 2004;17:122-129.

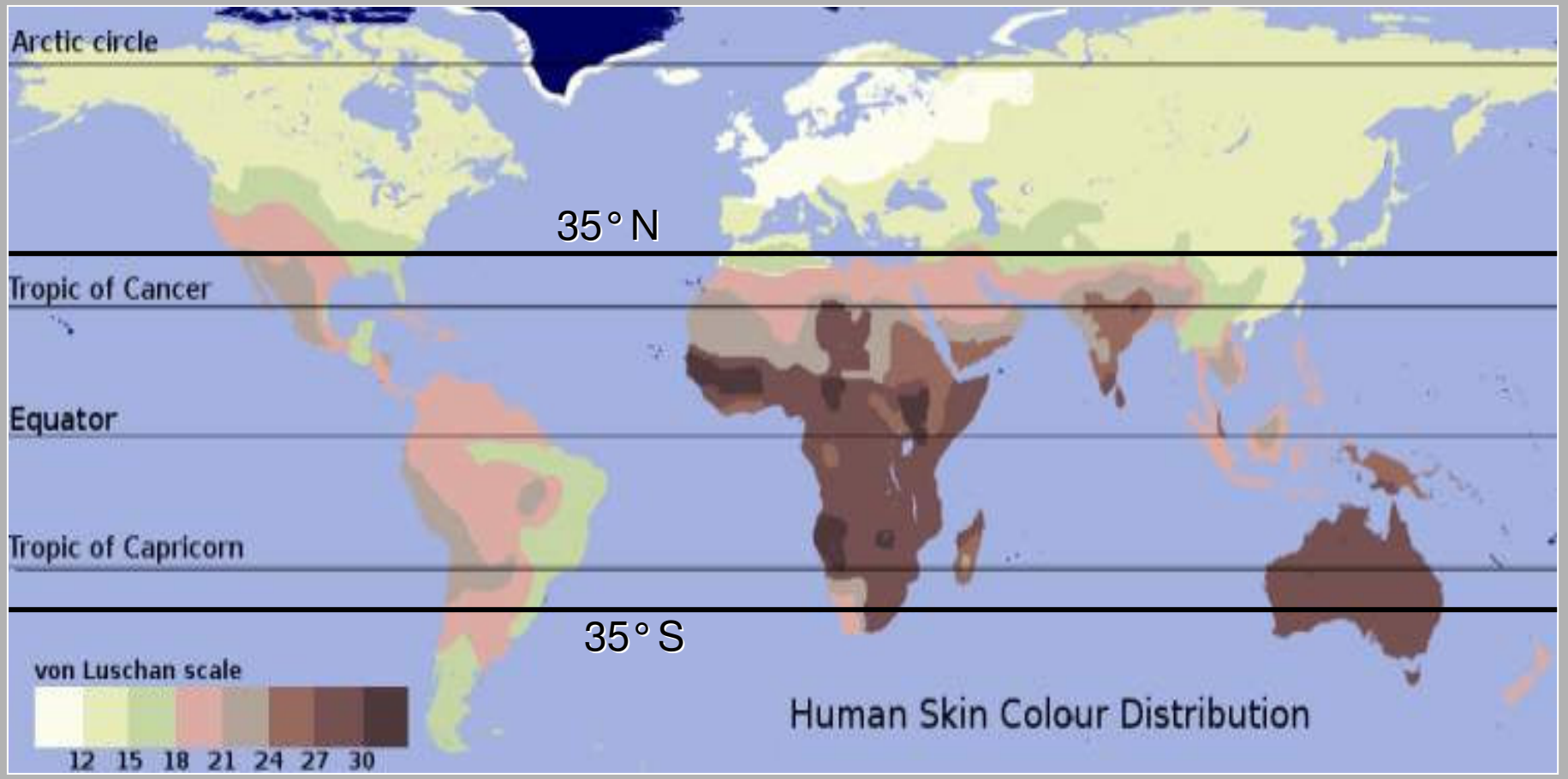
Human Migration Out of Africa



Lamson RI, etal. SLC24A5, a putative cation exchanger, affects pigmentation in zebrafish and humans. *Science* 2005;310:1782-1786.

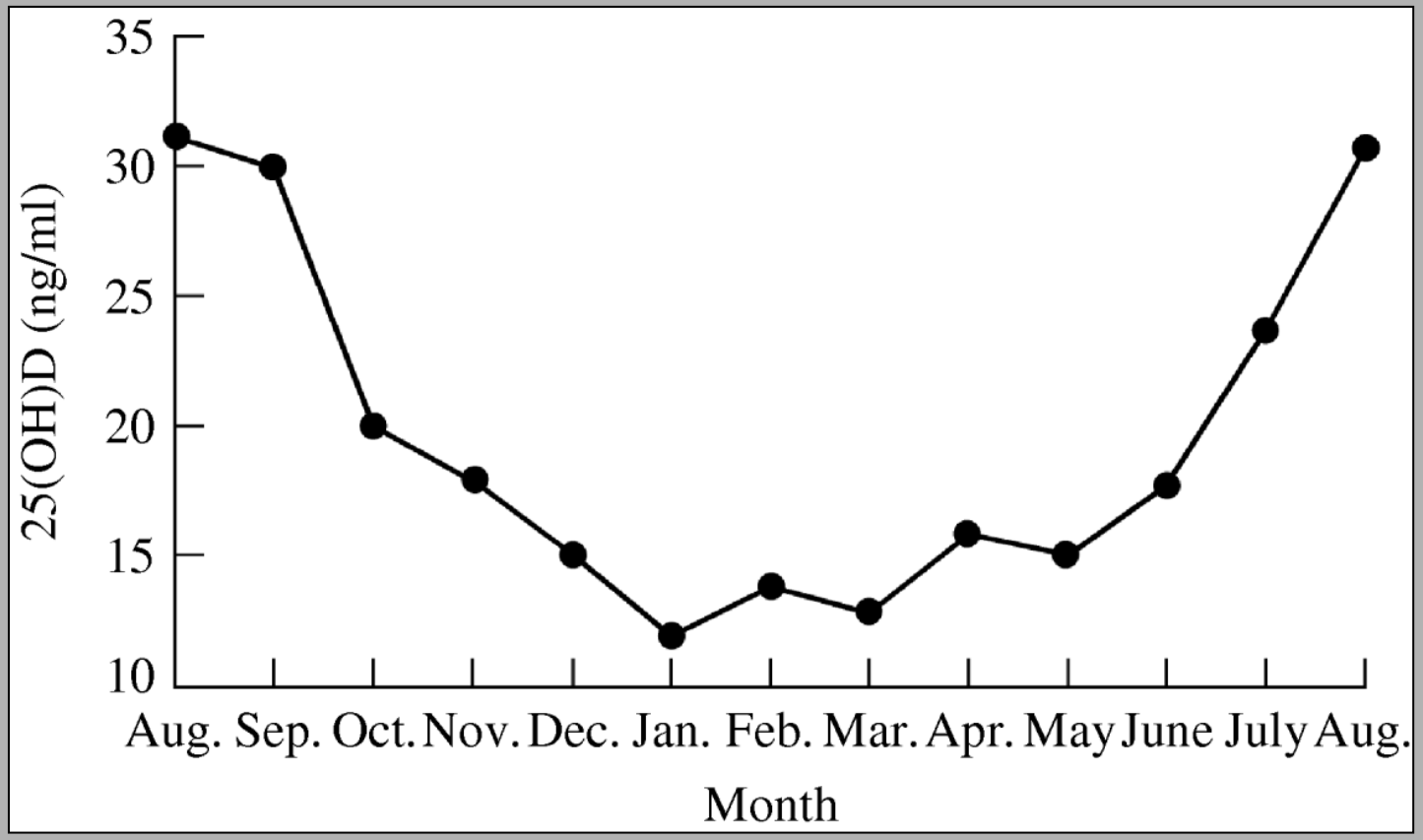

CANNOT
MAKE
VITAMIN D
IN
WINTER
ABOVE
35 N

Indigenous Human Skin Color by Latitude

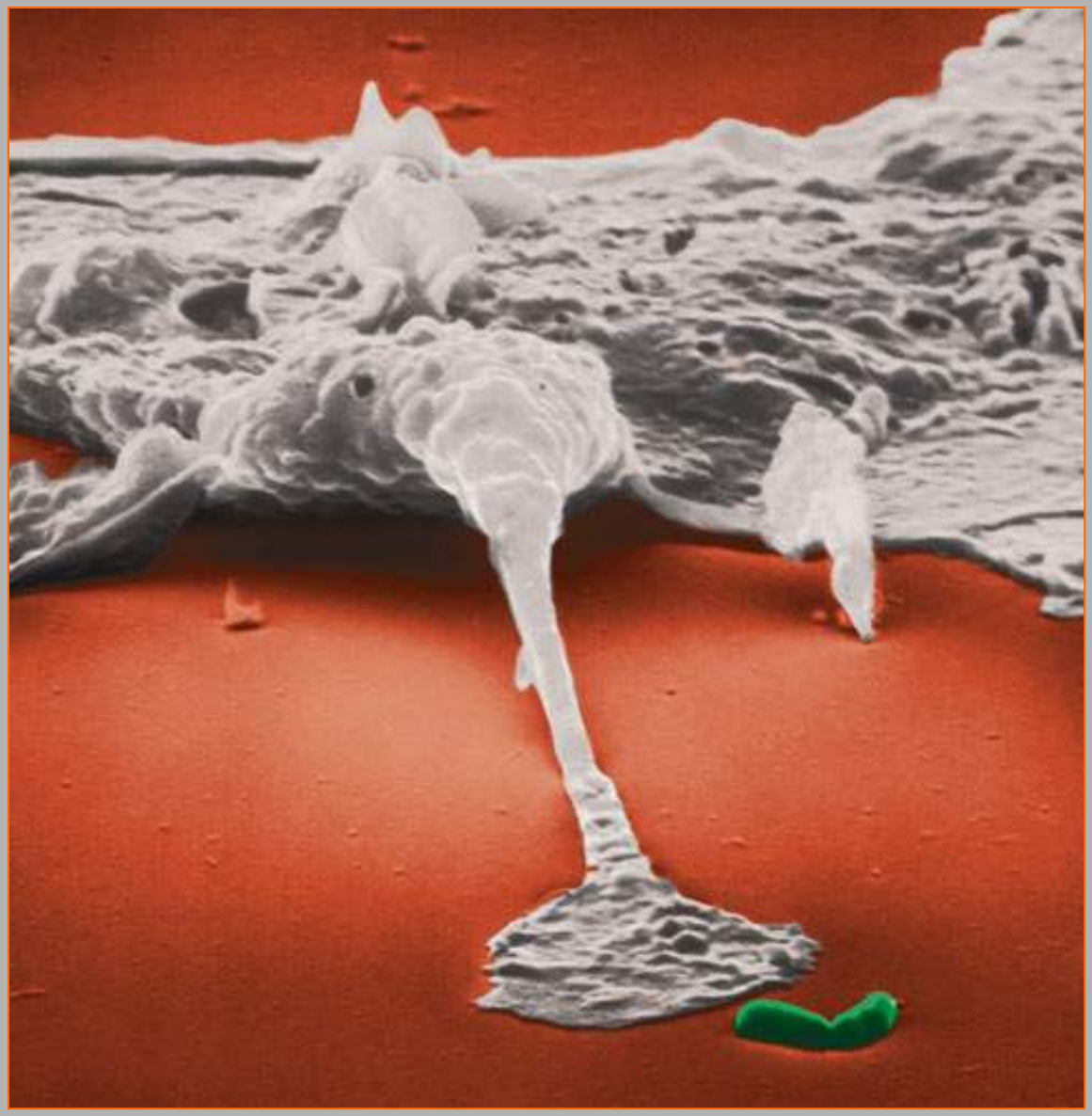


Jablonski NG, Chaplin G. The evolution of human skin coloration. *J Hum Evol* 2000;39:57-106

Seasonal Variation in 25-hydroxyvitamin D Levels in People at Latitude 48° N

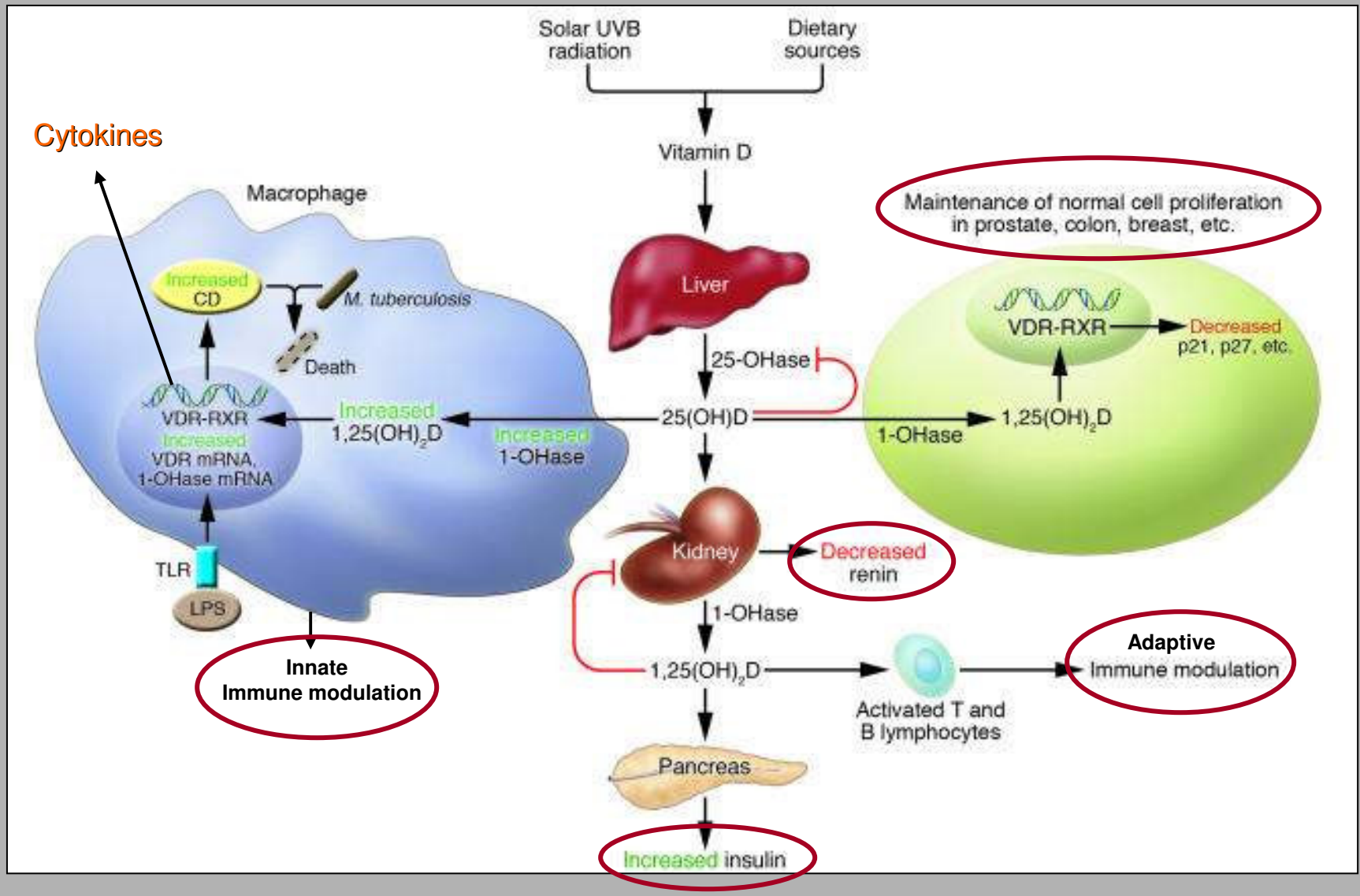


Cannell JJ, etal. Epidemic influenza and vitamin D. *Epidemiol Infect* 2006;134:1129-1140.



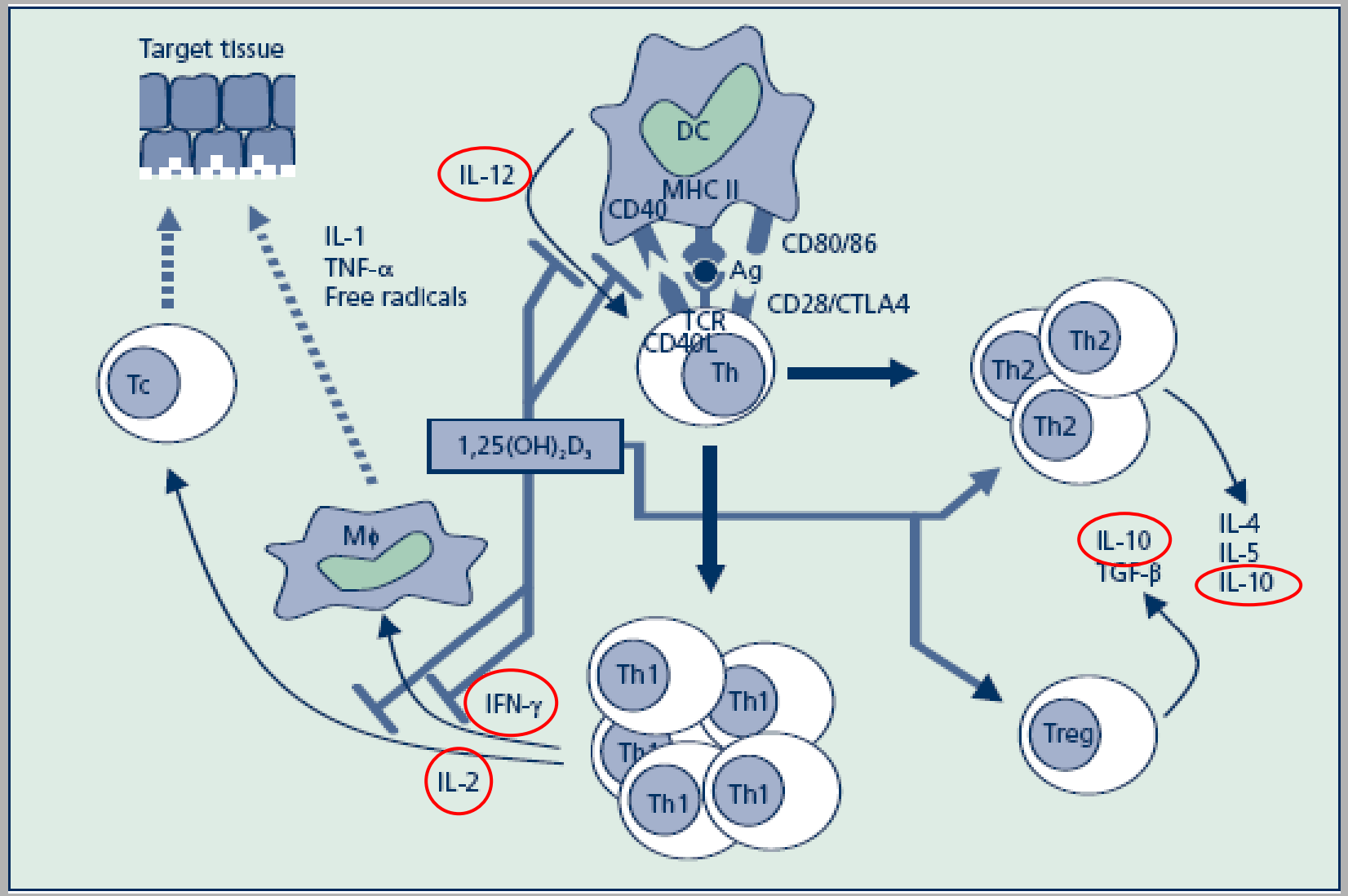
Cannell JJ, etal. Epidemic influenza and vitamin D. *Epidemiol Infect* 2006;134:1129-1140

Noncalcemic Functions of 1,25-dihydroxyvitamin D

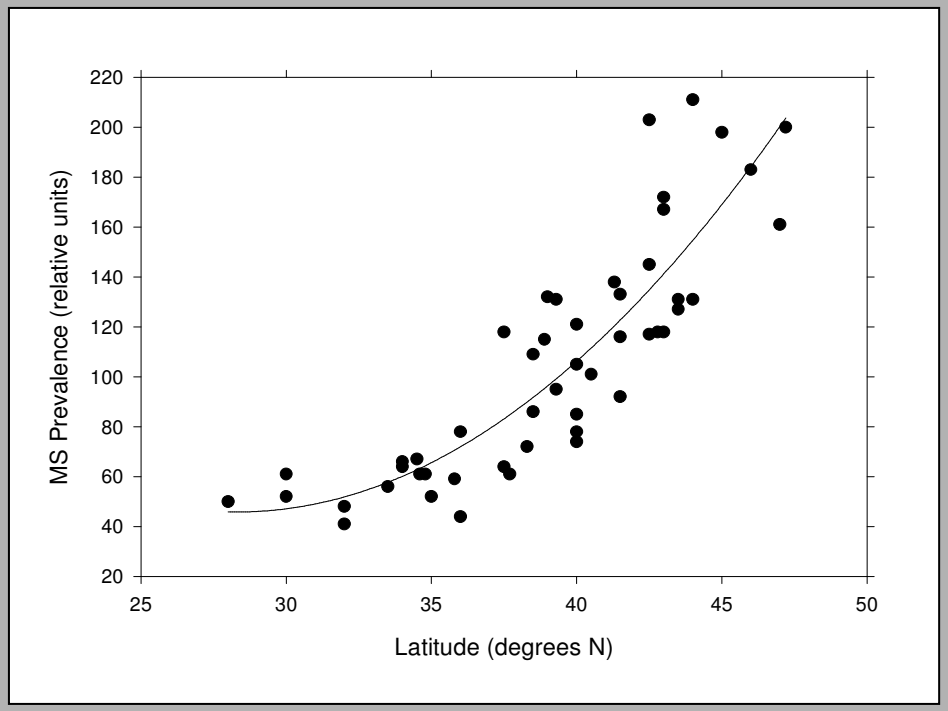


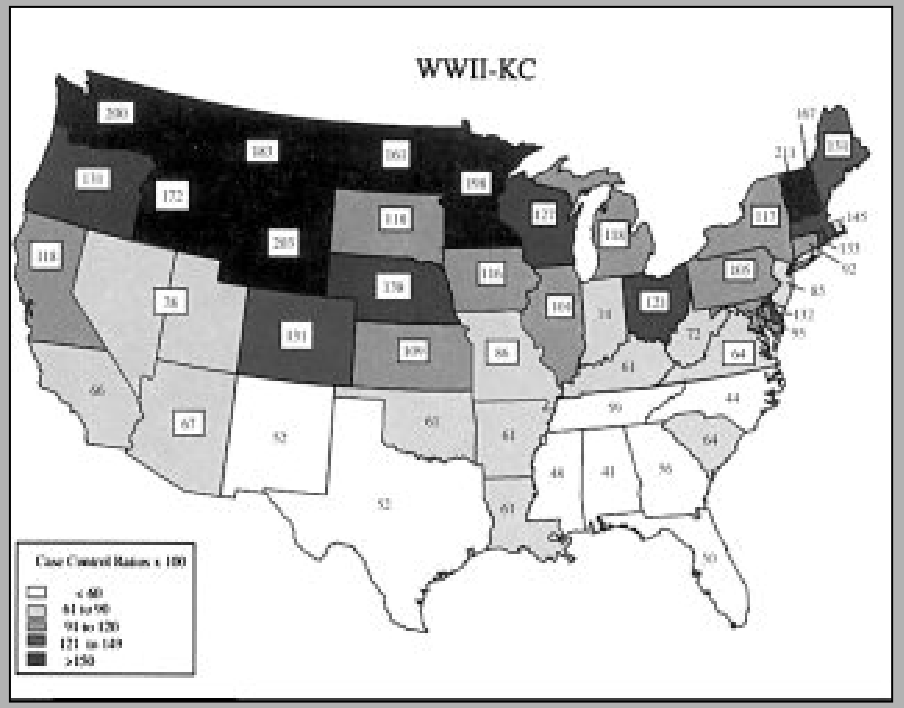
Tuberculosis Treated with Sunshine

Immunomodulatory Effects of 1,25-dihydroxyvitamin D



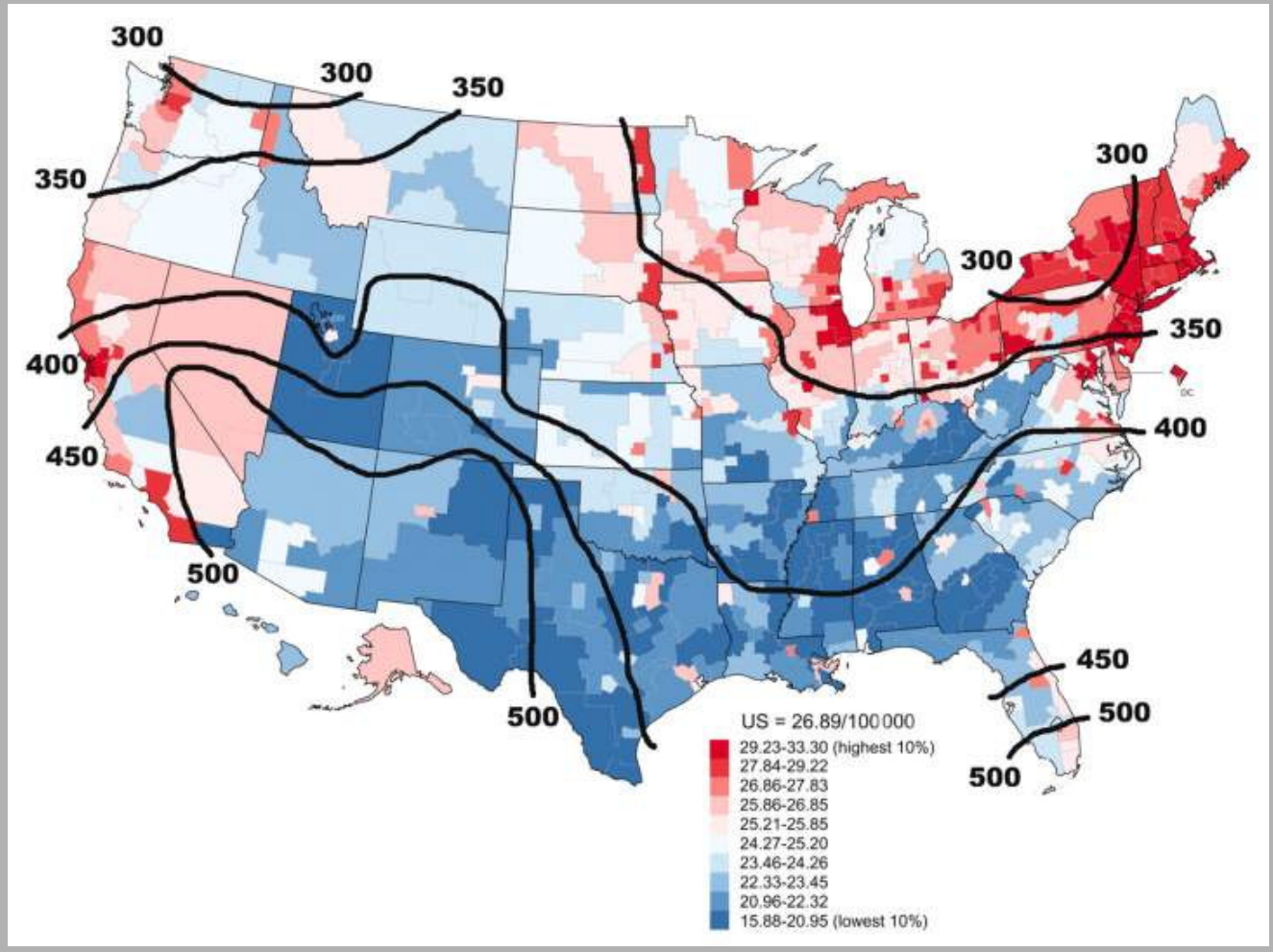
Multiple Sclerosis in World War II Veterans by Latitude and State of Residence





Wallin MT, etal. Multiple sclerosis in US veterans… *Ann Neurol* 2004;55:65-71

Breast Cancer Mortality Rates and Contours of Annual Mean Daily Solar Irradiance

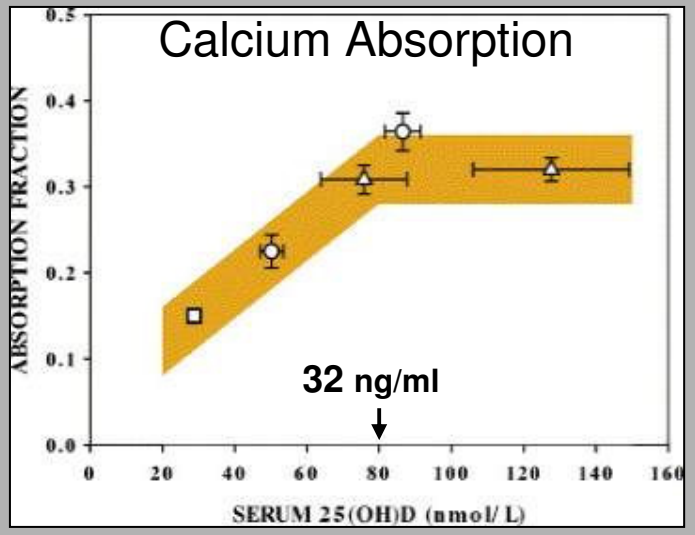


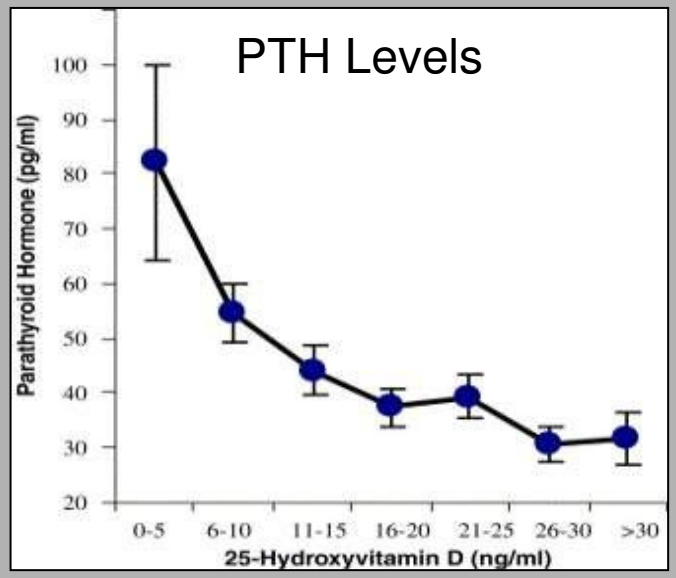
Lappe JM, etal. Vitamin D and calcium supplementation reduces cancer risk: Results of a randomized trial. *Am J Clin Nutr* 2007;85:1586-1591.

25-hydroxyvitamin D3 Blood Levels

Severely deficient	< 8 ng/ml
Deficient	8-19 ng/ml
Insufficient	20-29 ng/ml
Sufficient	30-49 ng/ml
Optimal	50-99 ng/ml
Excessive	100-150 ng/ml
Toxic	>150 ng/ml

(1 ng/ml = 2.5 nmol/L, 1 nmol/L = O.4 ng/ml)





Preop Vitamin D3 levels in 73 Veterans Undergoing Heart Surgery at the Seattle VA Hospital

No. of Patients	History of Cancer	25-hydroxyvitamin D_3 Level (ng/ml)
7 (9.6 %)	1 (colon)	< 8 (severely deficient)
41 (56.2%)	6*	8-19.9 (deficient)
9 (12.3%)	0	20-29.9 (insufficient)
13 (17.8%)	0	30-49.9 (sufficient)
3 (4.1%)	0	50-100 (optimal)

* Prostrate cancer – 3; Colon cancer – 1; Tonsillar cancer – 1; Melanoma -- 1

Surgery performed December 2006 – July 2007

Sources of Vitamin D

Cholecalciferol (D_3) and Ergocalciferol (D_2)

Dietary

Natural

Salmon (wild, 3.5 oz)	800 IU D_3
Salmon (farmed, 3.5 oz)	150 IU D_2 or D_3
Cod liver oil (1 tsp)	400-1100 IU D_3
Tuna (canned, 3.6 oz)	230 IU D_3
Egg yolk	20 IU D_2 or D_3

Fortified Foods

Milk (8 oz)	100 IU D_3
Orange juice (8 oz)	100 IU D_3
Infant formula (8 oz)	100 IU D_3
Butter (3.5 oz)	50 IU D_3
Breakfast cereals/serving	100 IU D_3

Supplements

Prescription

Ergocalciferol (D_2)	50,000 IU/capsule

Over the Counter

Multivitamins	400 IU D_2 or D_3
Cholecalciferol (D_3)	400, 800, 1000, 2000, 5000 and 50,000 IU/tablet

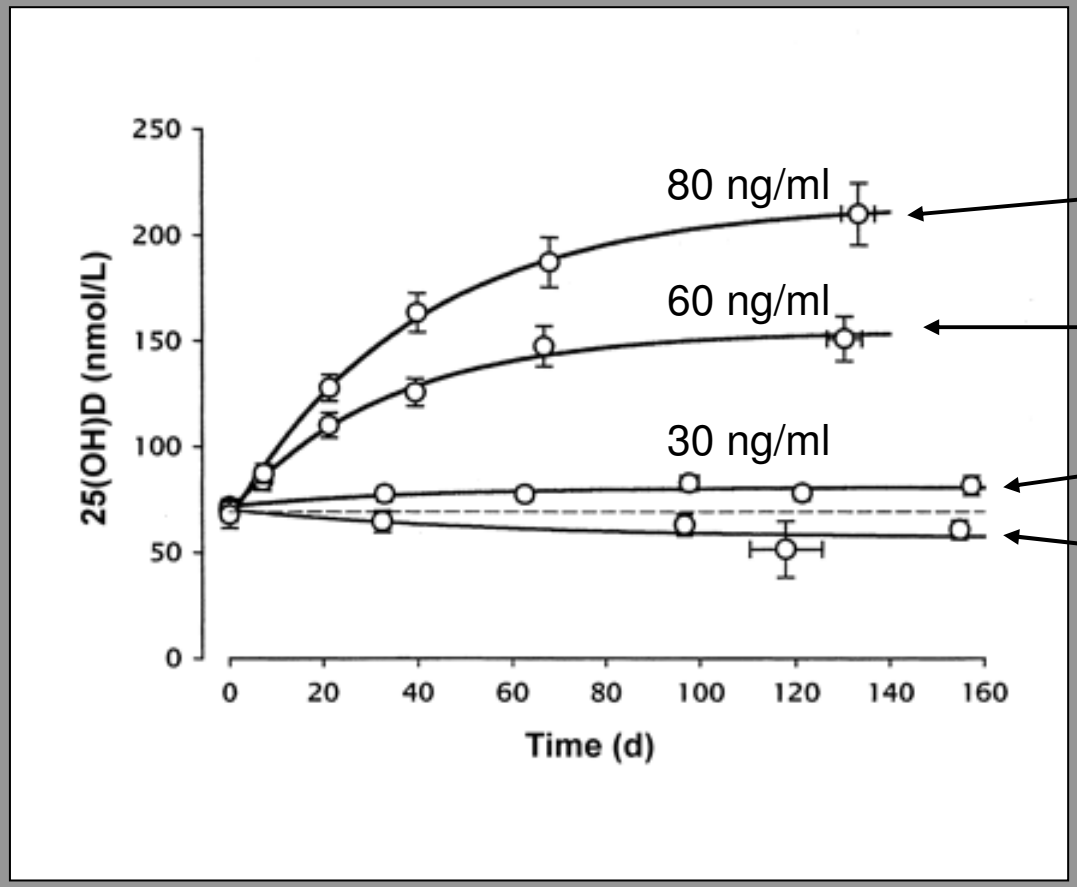
Skin synthesizes 20,000 IU D_3 in 20 minutes when exposed to sunlight

5,000 IU D_3

50,000 IU D_3

OTC at vitalady.com, lifespannutrition.com

Serum 25-hydroxyvitamin D3 Levels on 0, 1000, 5000, and 10,000 IU of Vitamin D_3 a Day



Heany RP, etal. Human serum 25-hydroxycholecalciferol response to extended oral dosing with cholecalciferol. *Am J Clin Nutr* 2003;77:204-210.

Benefits of Vitamin D

- Skeletal-muscular
  - Strong muscles and bones
- Infections
  - Prevent influenza, treat tuberculosis
- Cancer
  - Prevent breast, colon, and prostate cancer
  - ? Suppress metastasizes
- Autoimmune Diseases
  - Prevent multiple sclerosis and type 1 diabetes
- Cardiovascular Disease
  - Slow progression of atherosclerosis
  - Treat hypertension and congestive heart failure
- Neuropsychiatric Disorders
  - Prevent schizophrenia and relieve depression

Iodine

Iodine in Surgery

Thyroid-related Iodine Deficiency Pyramid

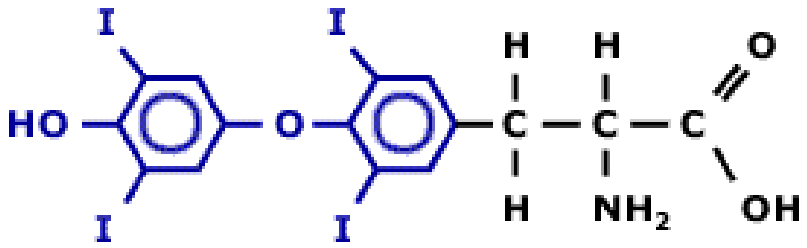
Worsening Iodine Deficiency

1-10%
Cretinism

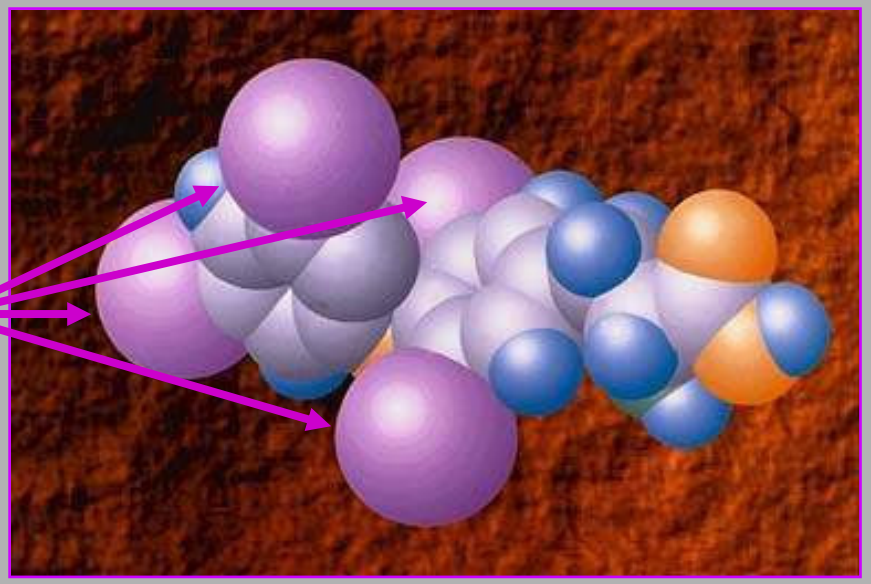
Mental Retardation
5-30 %

Loss of Energy due to Hypothyroidism
30-70 %

Iodine in Thyroid Hormones



3', 5', 3, 5-tetraiodothyronine
thyroxine, T4



Iodine atoms

The Mainstream Medical View of Iodine

1) The thyroid gland is the only organ that needs iodine, in microgram amounts, for biosynthesis of thyroid hormones.

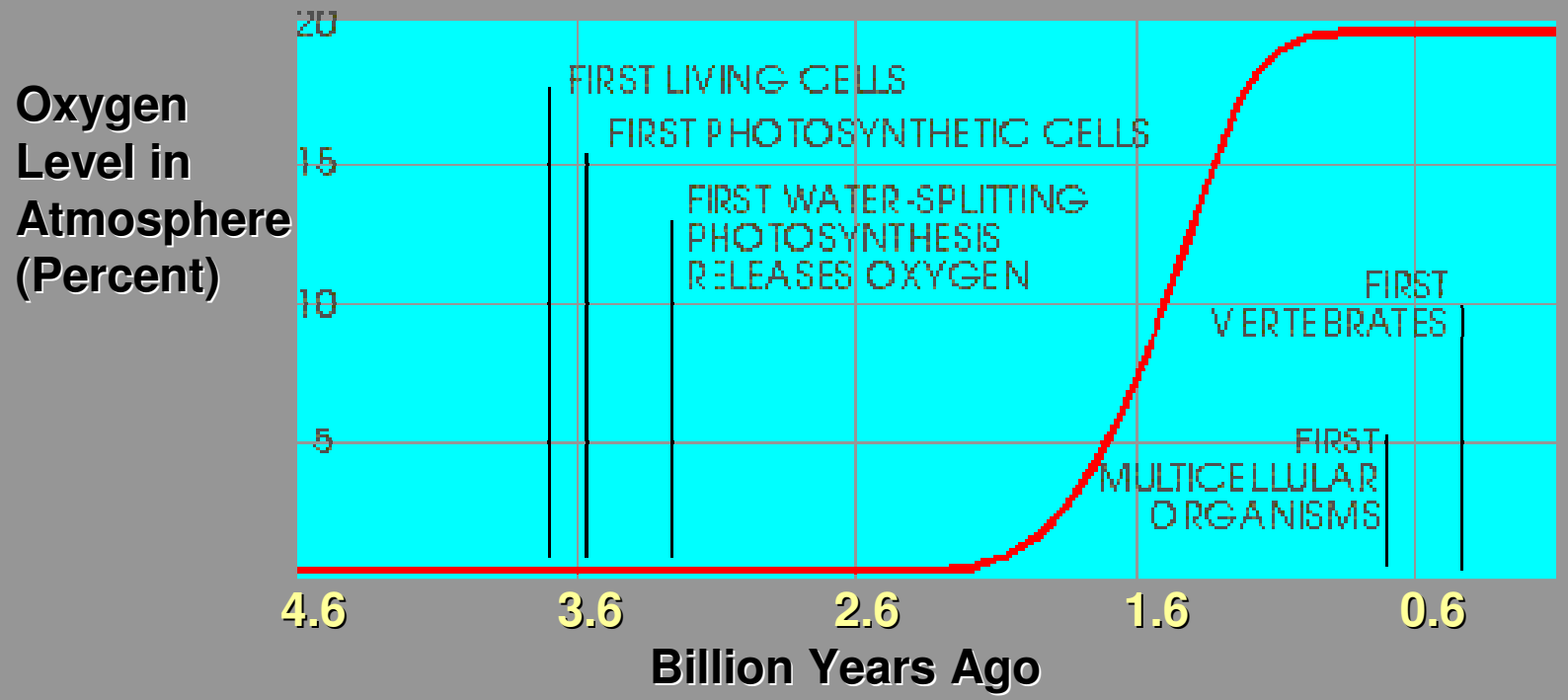
RDA for Iodine: 100-150 µg/day

2) A daily intake of more than 1-2 mg/day of iodine is excessive and potentially harmful.

Extrathyroidal Benefits of Iodine

- Formation of the Earth's Atmosphere
  - Role in photosynthesis
- Antioxidant
  - Prevent lipid peroxidation
- Fibrocystic disease of the breast
- Cancer
  - Trigger apoptosis
- Immune system
  - Suppress autoimmunity
  - Coat external proteins rendering them non-allergic
- Mucosal Defense
  - Provide antisepsis in mouth, stomach, and vagina
- Civil Defense
  - Against radioactive fallout

The Earth's 3rd Atmosphere, from 2.2 Ga



Photosynthesis first done by Cyanobacteria:

$$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$

Cyanobacteria are also the first life forms to tolerate and use..... Iodine

Kingdoms of Life

Eukaryotic cells

1. Plants
2. Animals
3. Fungi
4. Protista

Prokaryotic cells

5. Monera

Cyanobacteria

Other Bacteria

Archaea

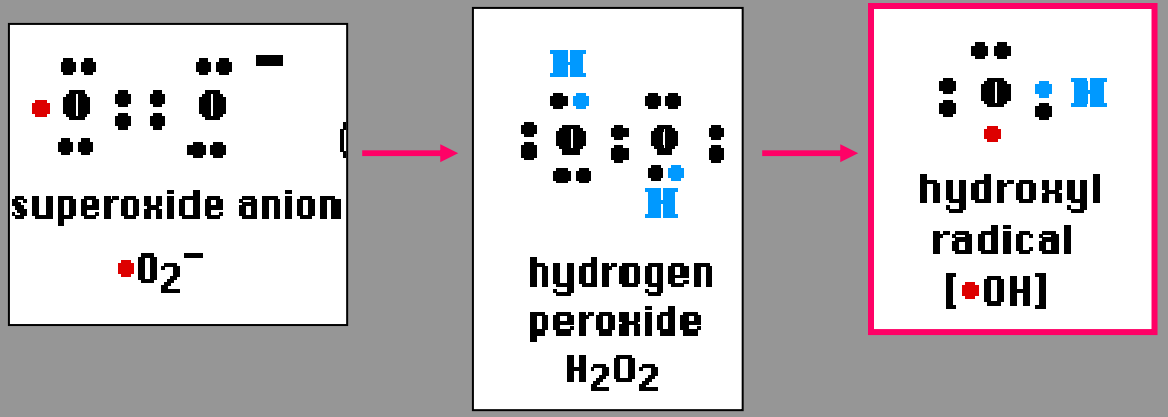
Algae

Seaweed: Kelp, etc.

Blue Green Algae

Iodine as an Antioxidant

Reactive Oxygen Species



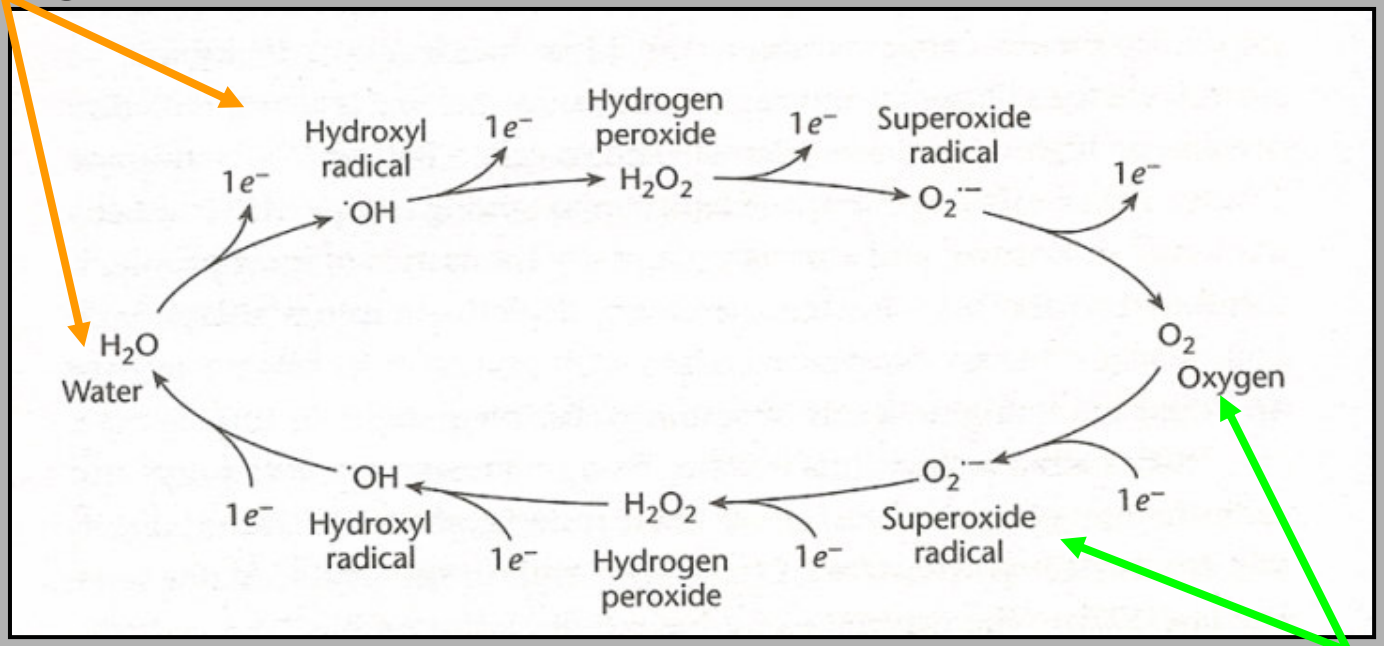
$$I^- + H_2O_2 \longrightarrow HIO + OH^- \longrightarrow$$

$$HIO + I^- + H^+ \longrightarrow I_2 + H_2O$$

Kupper FC, et al. Iodine uptake in Laminariales involves extracellular, haloperoxidase-mediated oxidation of iodide. *Planta* 1998;207:163-171.

Reactive Oxygen Species

Ionizing Radiation



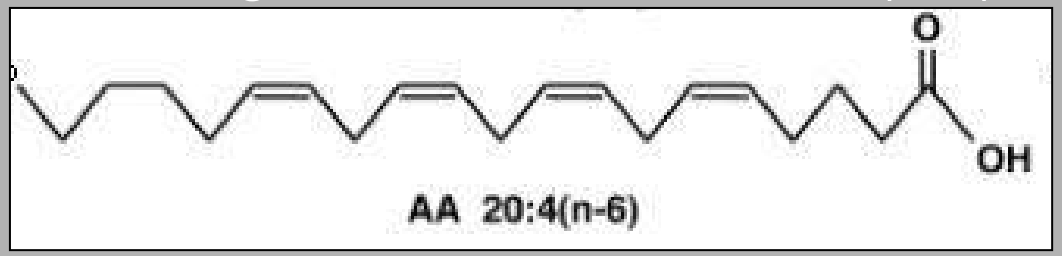
Photosynthesis:
Chlorophyll
Sunlight
CO_2

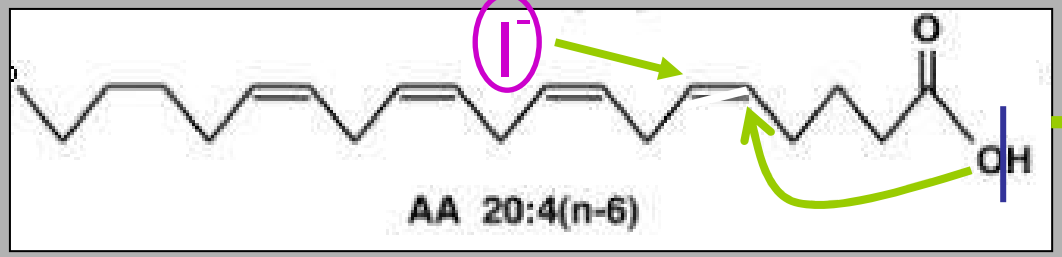
Lane, N. *Oxygen: The Molecule that Changed the World* London: Oxford University Press, 2004.

Iodine as an Antioxidant

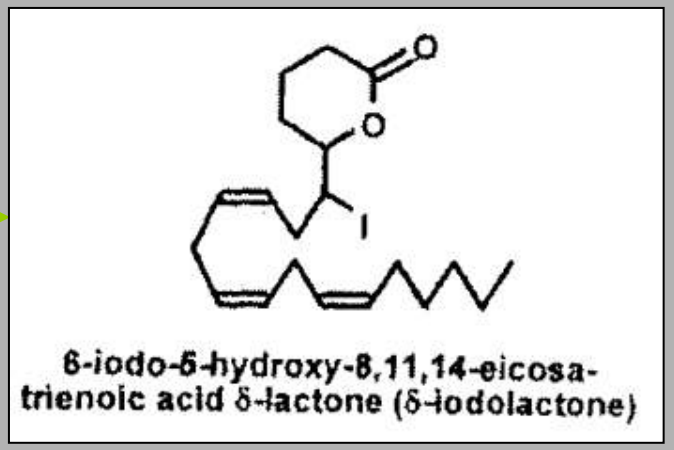
Prevent Lipid Peroxidation

Omega 6 Arachidonic Acid (AA)





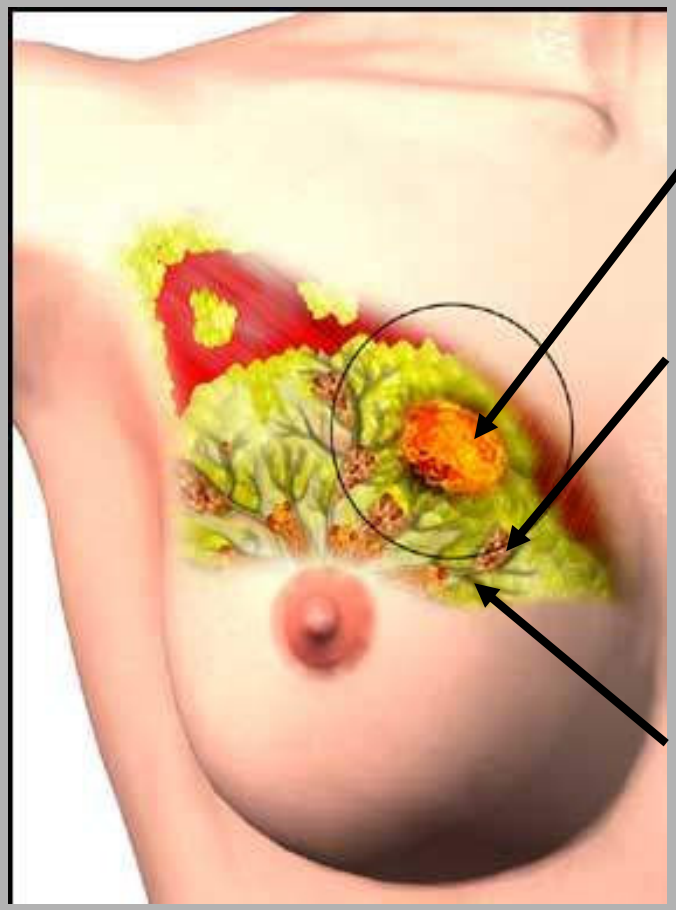
Iodolactone



Omega 3 Docosahexaenoic Acid (DHA)

Fibrocystic Breast Disease

Elemental Iodine, I_2, more effective than Iodide, I^-



Ghent WR, Eskin BA, Low DA, Hill LP. Iodine replacement in fibrocystic disease of the breast. *Can J Surg* 1993;36:453-460.

Diatomic Iodine (I_2)Treatment for Fibrocystic Disease

Special Report of Efficacy and Safety Results

(Submitted to FDA 21 March 1995)

Table F. Analysis of Total Breast Examination Score

Comparison Groups	Mean Changes from Baseline	p-values*
Iodine vs. Placebo	-23.9 vs. -2.6	<0.001
Iodine (C) vs. Placebo (C)	-29.1 vs. -2.6	<0.001
Iodine (C) vs. Iodine (I)	-29.1 vs. -18.7	0.01
Iodine (I) vs. Placebo (C)	-18.7 vs. -2.6	<0.001
Placebo (C) vs. Placebo (I)	-2.6 vs. -2.7	0.99

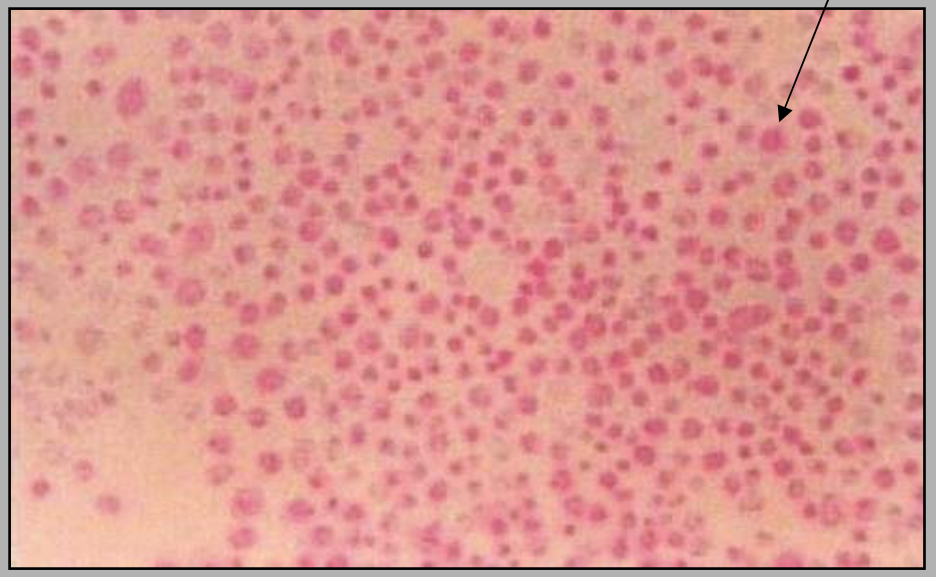
* F test

C: Compliant Patients

I: Patients with Treatment Interruptions

The Virginia Mason Randomized Controlled Trial

Iodine-Induced Apoptosis in Lung Cancer



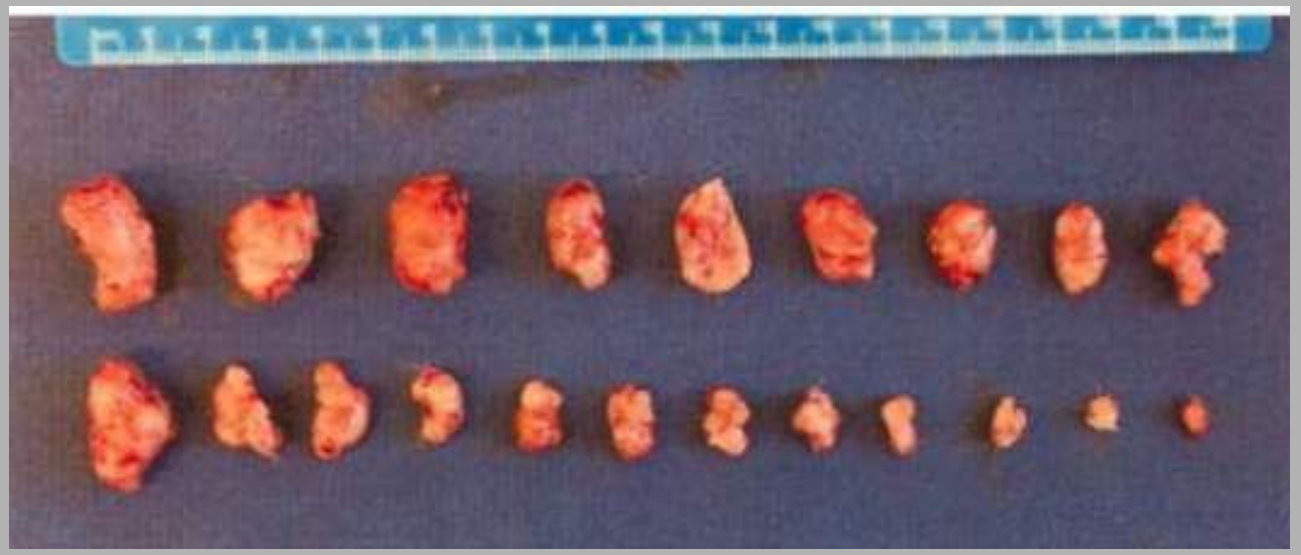
Iodine Sensitive Lung Cancer Cells

Parent (unmodified) Lung Cancer Cells

Zhang L. et al. Nonradioactive iodide effectively induces apoptosis in genetically modified lung cancer cells. *Cancer Res* 2003;63:5065-5072

Effect of Iodine on Tumor Growth in Mice

Genetically Modified Tumor Xenograft Controls

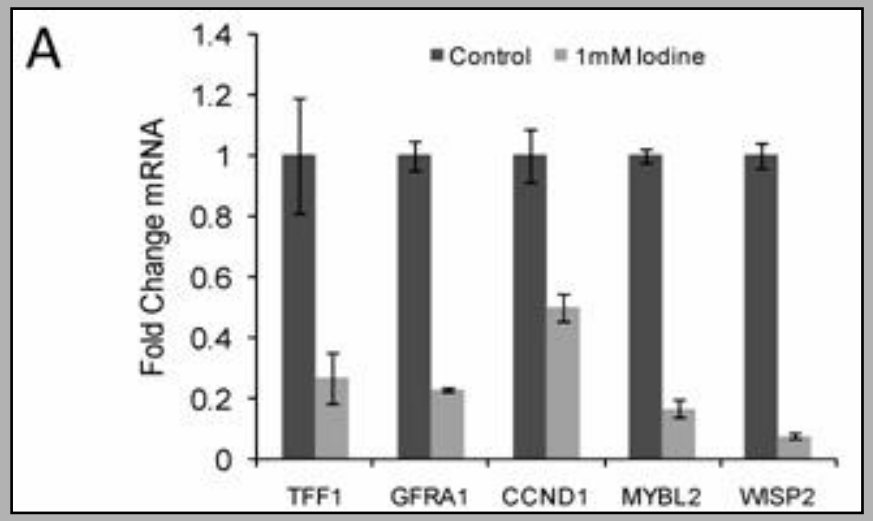


Genetically Modified Tumor Xenograft with Iodine

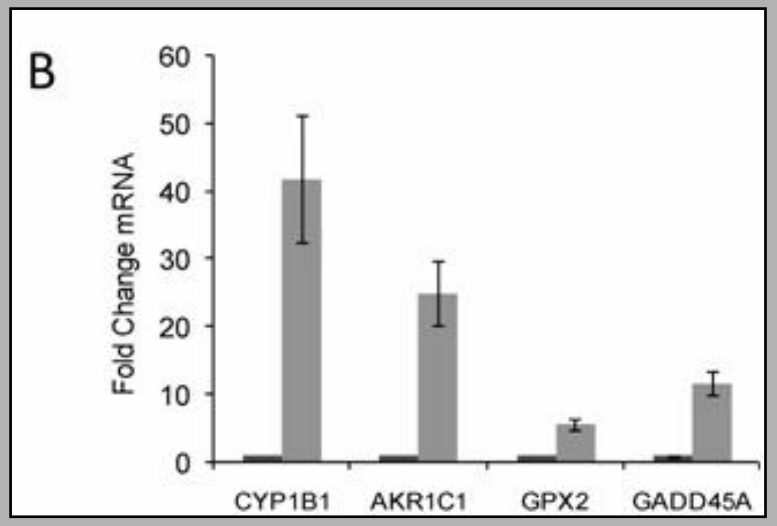
Zhang L. et al. Nonradioactive Iodide Effectively Induces Apoptosis in Genetically Modified Lung Cancer Cells. *Cancer Res* 2003;63:5065-5072

Nutrigenomics

Iodine



Down-regulated genes



Up-regulated genes

Stoddard FR, Brooks AD, Eskin BA, Johannes GJ. Iodine Alters Gene Expression in the MCF7 Breast Cancer Cell Line: Evidence for an Anti-Estrogen Effect of Iodine. *International Journal of Medical Sciences* 2008;5:189-196.

Evidence that Iodine Prevents Breast Cancer

Animal Studies

- Reduced incidence in rats given carcinogens

Human Studies

- Kills cancer cells grown *in vitro*
- Absorbed by cancer-prone ductal epithelium

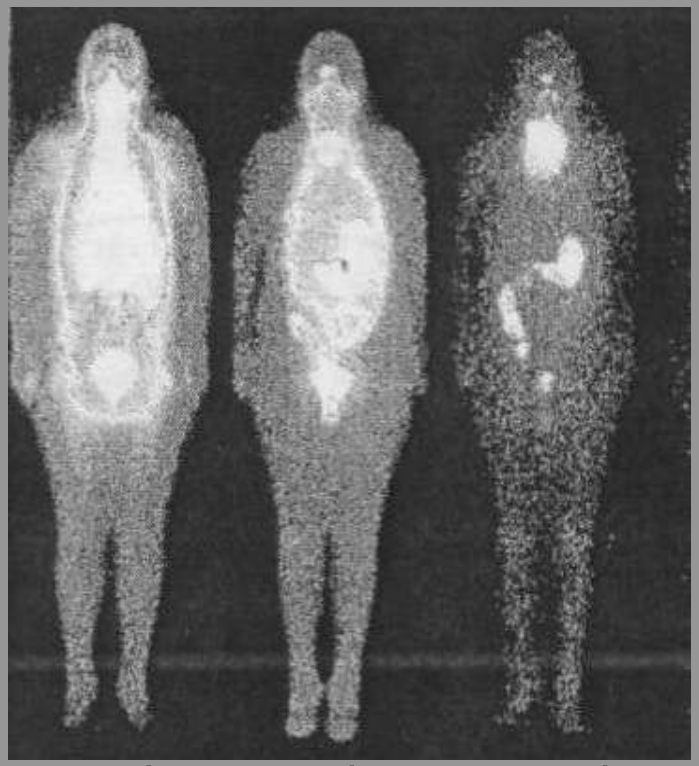
Epidemiological Studies

- Increased incidence with goiter
- Lower incidence in people who eat seaweed and fish

Miller DW. Extrathyroidal Benefits of Iodine. *J Am Phys Surg* 2006;11(4-Winter):106-110.

Organs with Iodine Concentrating Ability
Via the Sodium/Iodine Symporter Pump

^{125}I total-body scintiscans



30 min 6 hr 20 hr

Stomach Mucosa

Mammary Glands

Salivary Glands

Other: Cervix and Ovaries

Thymus

Epidermis

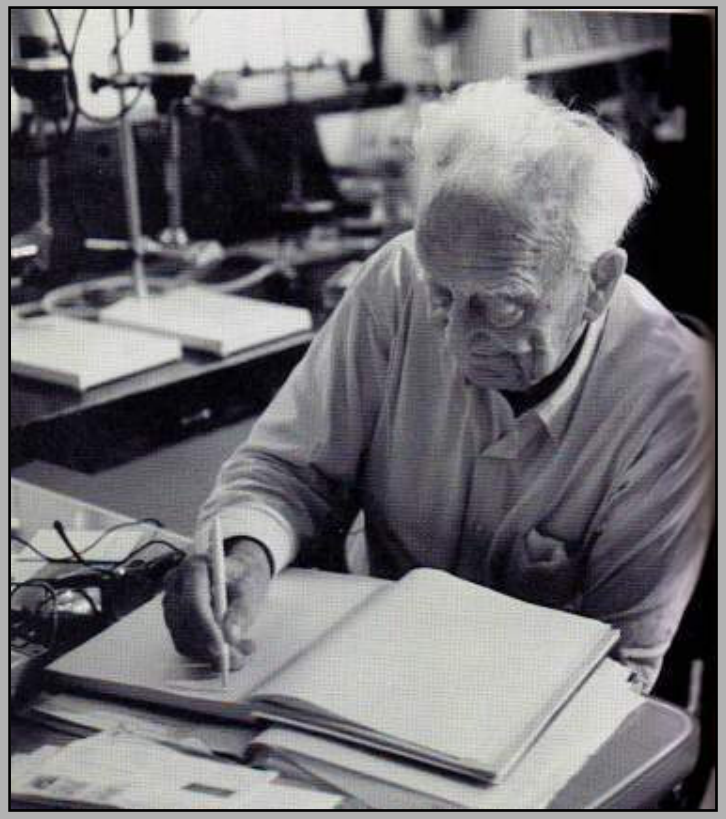
Choroid Plexus

Articular, Arterial, and Skeletal Systems

Venturi S, et al. Role of Iodine in Evolution and Carcinogenesis of Thyroid, Breast and Stomach. *Adv Clin Path* 2000;4:11-17.

Albert Szent-Györygi (1893-1986)

In 1937, when awarded the Noble Prize for discovering vitamin C



In 1983, at the Marine Biological Laboratory, Woods Hole, MA

Iodine in Dermatology

Table I. Reported uses for potassium iodide

Infectious
- Cutaneous cryptococcosis[31]
- Entomophthoramycosis (caused by *Basidiobolus* and *Conidiobolus* fungi)[27,28]
- Human pythiosis (caused by *Pythium insidiosum* fungus)[29]
- Lymphocutaneous *Nocardia brasiliensis*[30]
- Sporotrichosis (fixed cutaneous and lymphocutaneous)[5,23-26]

Neutrophilic dermatoses
- Pyoderma gangrenosum[18]
- Sweet's syndrome[1,15,17]

Panniculitis
- Erythema nodosum[1,14,15]
- Nodular vasculitis[1,14,15]
- Subacute nodular migratory panniculitis[16]

Miscellaneous
- Behçet's syndrome[1,15]
- Erythema multiforme[1,15]
- Wegener's granulomatosis[19]

Sterling JB, Heymann WR. Potassium iodide In dermatology: A 19th century drug for the 21st century—uses, pharmacology, adverse effects, and contraindications. *J Am Acad Dermatol* 2000;43:691-697.

Sporotrichosis

Pyoderma Gangrenosum

Nodular Vasculitis

Iodine Poisoning

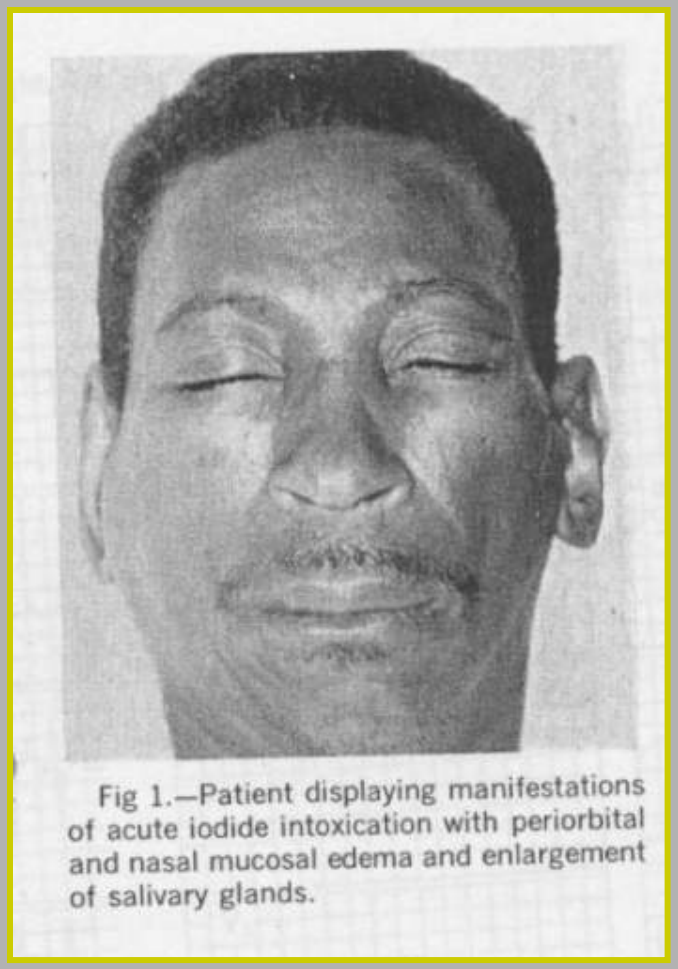


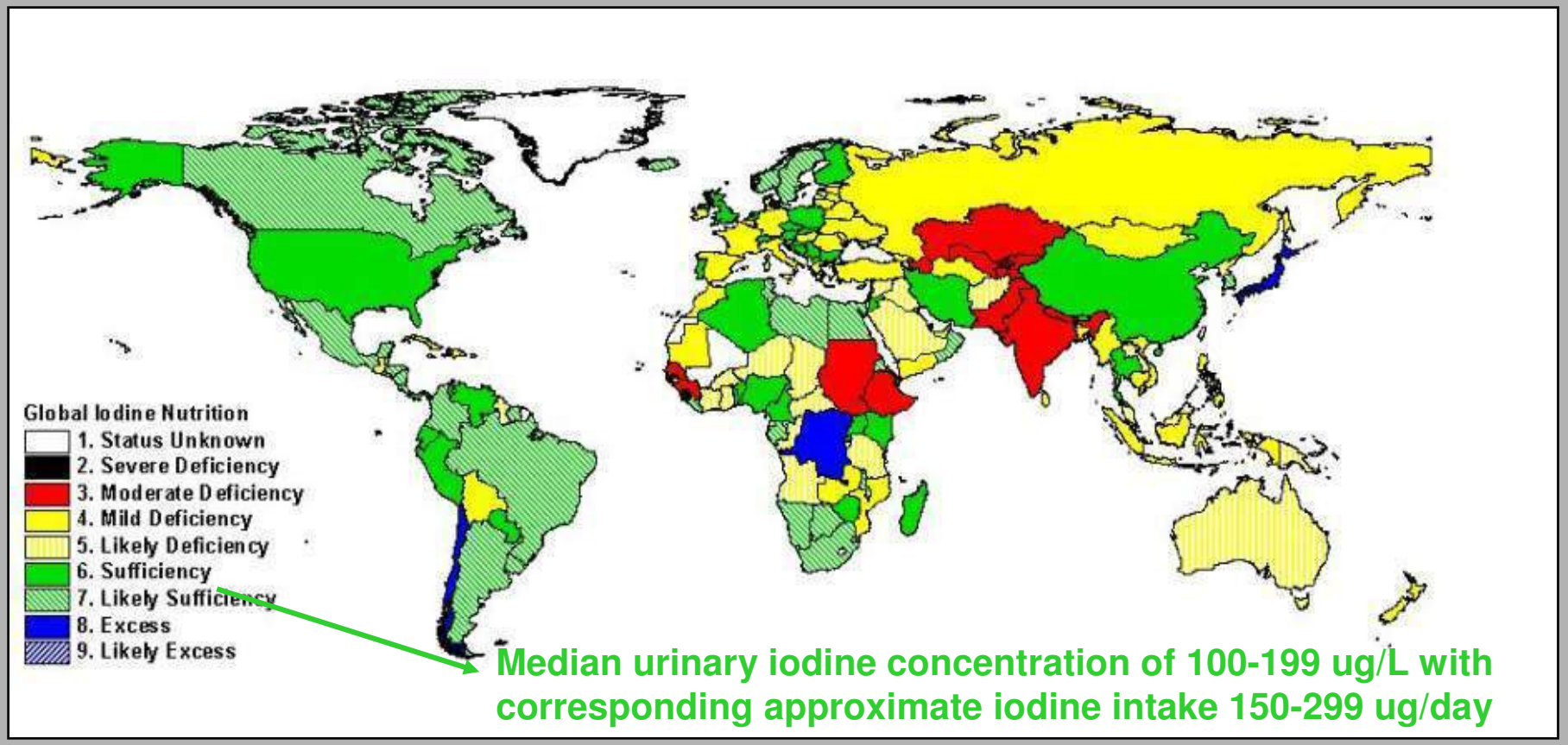
Fig 1.—Patient displaying manifestations of acute iodide intoxication with periorbital and nasal mucosal edema and enlargement of salivary glands.

Ingested 15 gm of Iodine – 100,000 x the RDA of 0.00015 gm (150 µg)

Serum Iodide level was 2,950 ug/dL (normal is 3.5 µg/dL with daily intake of 150 ug Iodine)

Salivary Iodide Level 60,000 ug/dL (normal 105 µg/dL)

Worldwide Iodine Nutrition



International Council for the Control of Iodine Deficiency Disorders. Current IDD Status Database, 2003.

Iodine Intake in Japan

Table II

Annual change of intake of food by food groups in Japan

(Except for the calories, all values below are expressed as gms / per capita / day)

Yrs.	1950	1952	1954	1956	1958	1960	1962	1963
Calories	2,098	2,109	2,074	2,092	2,118	2,096	2,080	2,083
Proteins								
Total	68	70	69	69.1	70.1	69.7	70.4	70.6
Animal	17	23	22	22.6	23.8	24.7	27.3	27.7
Vegetable	51	47	47	46.5	46.4	45.0	43.2	42.9
Fat	18	20	21	21.8	23.7	24.7	28.3	29.2
Carbohydrate	418	412	403	405	406	399	386	382
Sugars	7.2	14.5	15.6	15.6	12.3	12.3	13.4	14.0
Fats & Oils	2.6	3.9	4.6	5.1	5.7	6.1	7.6	8.1
Beans	53.7	68.4	68.2	72.7	71.0	71.2	70.8	69.4
Milk	6.8	10.2	12.5	19.4	22.0	29.5	35.9	38.8
Milk products		0.4	0.6	2.1	2.6	3.4	5.9	6.3
*Sea weeds (dry weight)	3.0	4.1	4.8	5.0	5.0	4.7	4.5	4.6

Iodine Intake 1950-1963:
13.8 mg/per capita/day
(average 4.5 gm seaweed a day. Measured Iodine content 0.3mg/gm)

Seaweed consumption in 2001:
14.6 gm (dry weight)

Iodine Intake 2001: 43.8 mg
If Iodine content the same (was not measured)

Nutrition in Japan, 1964. Nutrition Section, Bureau of Public Health, Ministry of Health and Welfare, Tokyo, Japan, March 1965.

Iodine Intake in the United States

Urinary iodine levels (µg/L) in the United States, age 6-74

	NHANES I, 1971-74[1]	NHANES III, 1988-91[1]	NHANES 2000
Median	320	145	161
SE	0.6	0.3	0.7

[1]Hollowell, JE et al. Iodine nutrition in the United States. Trends and public health implications: Iodine excretion data from National Health and Nutrition Examination Surveys I and III (1971-74 and 1988-94). J Clin Endocrinol Metab 83:3401-3408. 1998.

Current Average Daily Intake of Iodine:
240 µg (0.24 mg)

Iodine Intake in 1970s:
480 µg (0.48 mg)

Health Comparisons: United States and Japan

	United States	Japan
Incidence of Breast Cancer	Highest in World	Lowest
Life Expectancy	77.85 years (48th/226 countries)	81.25 years (No. 6)
Infant Mortality Rate (deaths under age 1 per 1,000 live births)	7.0	3.5 (Lowest in World)

On Truth

Leo Tolstoy: *I know that most men, including those at ease with problems of the greatest complexity,…*

George Orwell: *At any given moment there is an orthodoxy,…*

Albert Guérard: *When you seek a new path to truth, you must expect to find it blocked by expert opinion.*

"Medical Science" on Iodine: Then and Now

Now

- A thyroid-centered *consensus* recommending 150 μg/day iodine allowance and not to exceed 300 μg/day
- Without evidence, endocrinologists decree that >1 mg is potentially harmful
- Allopathic physicians ignore studies that show iodine in milligram doses cures fibrocystic disease of the breast

Then

1779: The Coventry Remedy used to treat goiter revealed to be burnt sea sponge

1811: Iodine discovered (Bernard Courtois)

1816: Sea sponge found to contain high quantities of iodine (Andrew Fyfe)

1819: Tincture of Iodine alone shown to shrink goiter (Jean Coindet)

The Truth on Iodine

Dose-Related Benefits

In microgram (µg) amounts:	For thyroid hormones
In milligram (mg) amounts:	Prevent (and treat) fibrocystic disease of the breast Prevent cancer Balance immune system Achieve optimal health
In gram (g) amounts:	Treat various dermatologic, pulmonary, cardiovascular, and fungal diseases

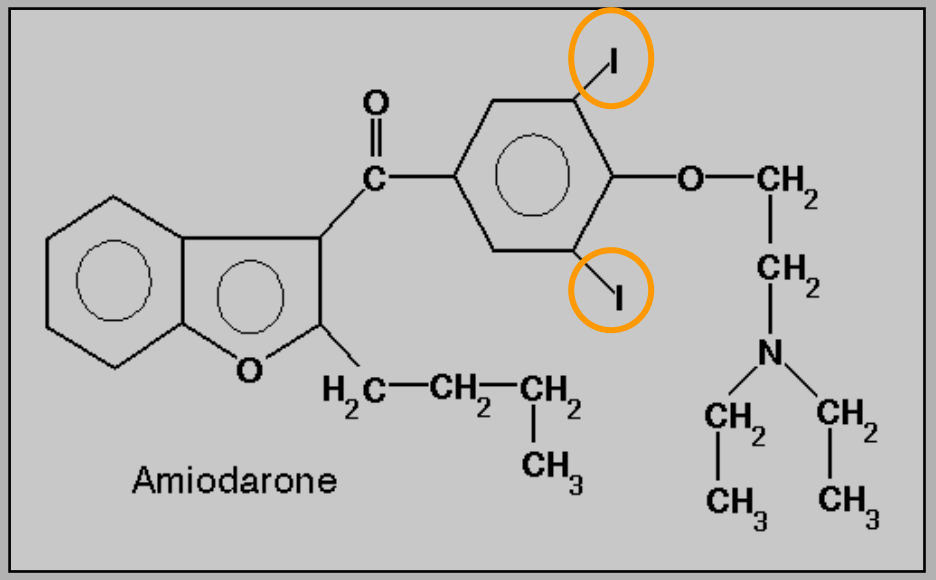
Different Kinds of Iodine

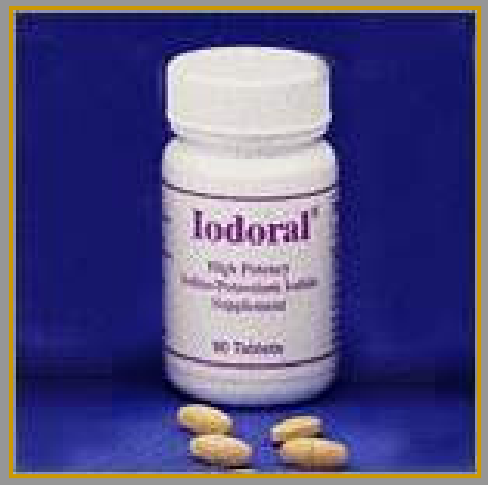
- Inorganic, Nonradioactive (^{127}I)
  - KI, SSKI, Lugol's Solution, Iodoral,
  - Tincture of Iodine, Povidone-Iodine
- Organic
  - Endogenous
    - Thyroid hormones
  - Synthetic
    - Amiodarone
    - Radiocontrast media
      - Iopanoic acid, Meglumine Iotroxate, Propyliodone, etc.
- (Inorganic) Radioactive Isotopes

(Inorganic) Oral Iodine Supplements

- KI (Potassium Iodide)
  - A 130 mg tablet contains 100 mg of iodide
- SSKI (Saturated Solution of Potassium Iodide)
  - 38 mg/drop iodide (760 mg/ml)
    - 19 mg/drop in Tahoma Clinic's SSKI Tri-Quench
- Lugol's Solution -- 5% iodine (I_2) and 10% KI
  - 6.5 mg/drop blend of iodine and iodide (130 mg/ml)
- Iodoral -- 5% iodine and 10% KI
  - One tablet = 12.5 mg blend of iodine and iodide

Organic Iodine: Amiodarone





The Iodine Project

Hypothesis: Whole body sufficiency of iodine requires mg (12.5 mg), not µg (150 µg) daily amounts

Principle Investigators

Guy Abraham MD, 1997: Optimox Corp., Torrance, CA

Jorge Flechas MD, 2000 (1,000 pts.): Flechas Family Practice, Hendersonville, NC

David Brownstein MD, 2003 (3,000 pts.): Center for Holistic Medicine, West Bloomfield, MI

Iodine Loading Test

Take 50 mg iodine, urine collected for 24 hours

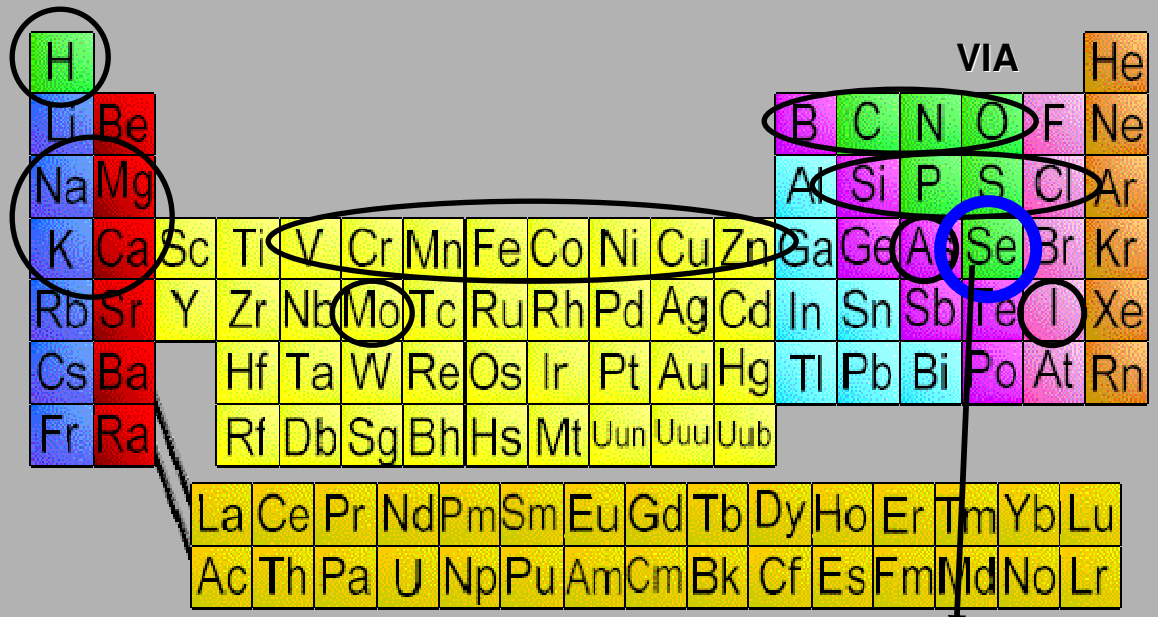
Less than 90 % excretion indicates iodine insufficiency

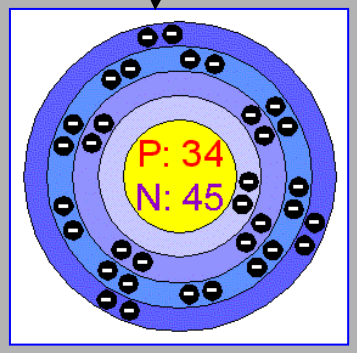
Benefits Patients Report Taking Iodine in Milligram Doses

(100+ times the RDA)

- Feel Healthier
  - ✓ Sense of Well-Being
  - ✓ Lifting of Brain Fog
  - ✓ Increased Energy – Achieve More in Less Time
- Feel Warmer in Cold Environments
- Need Less Sleep
- Regular Bowel Movements
- Improved Skin Complexion

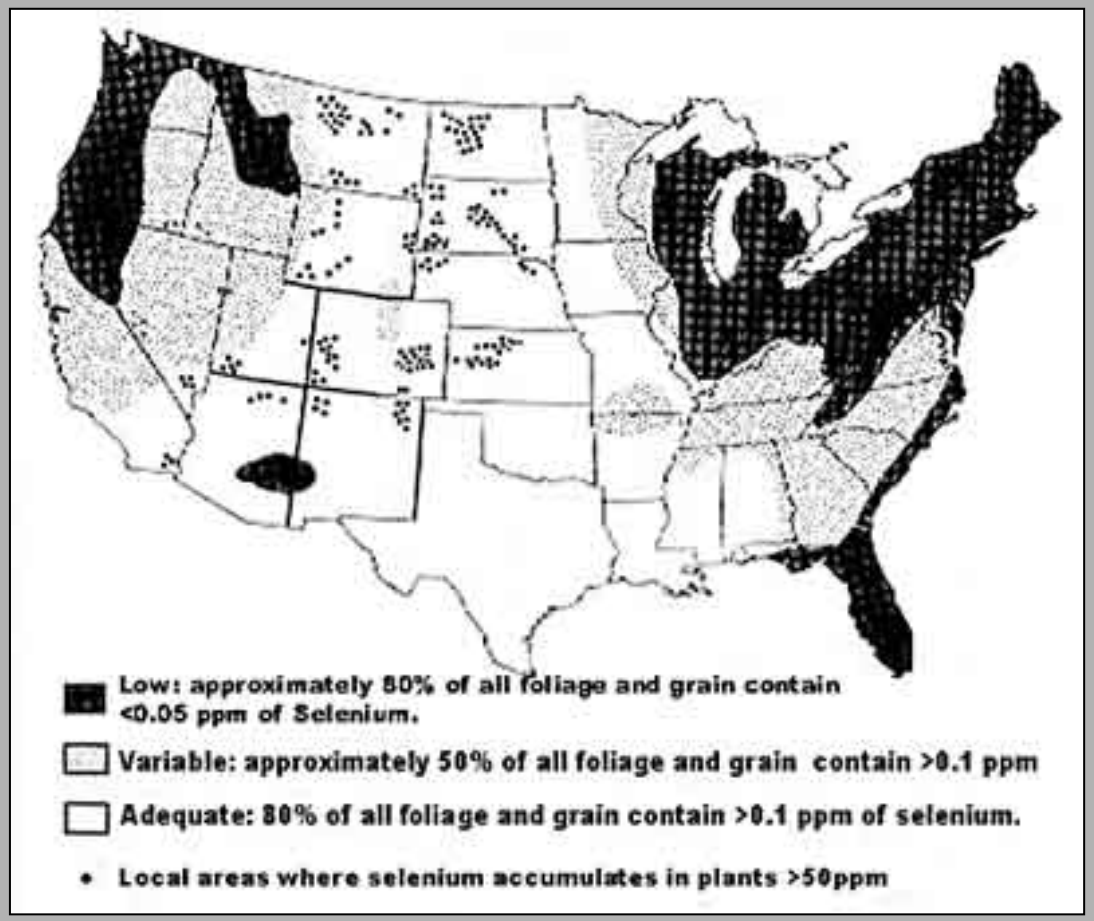
Selenium

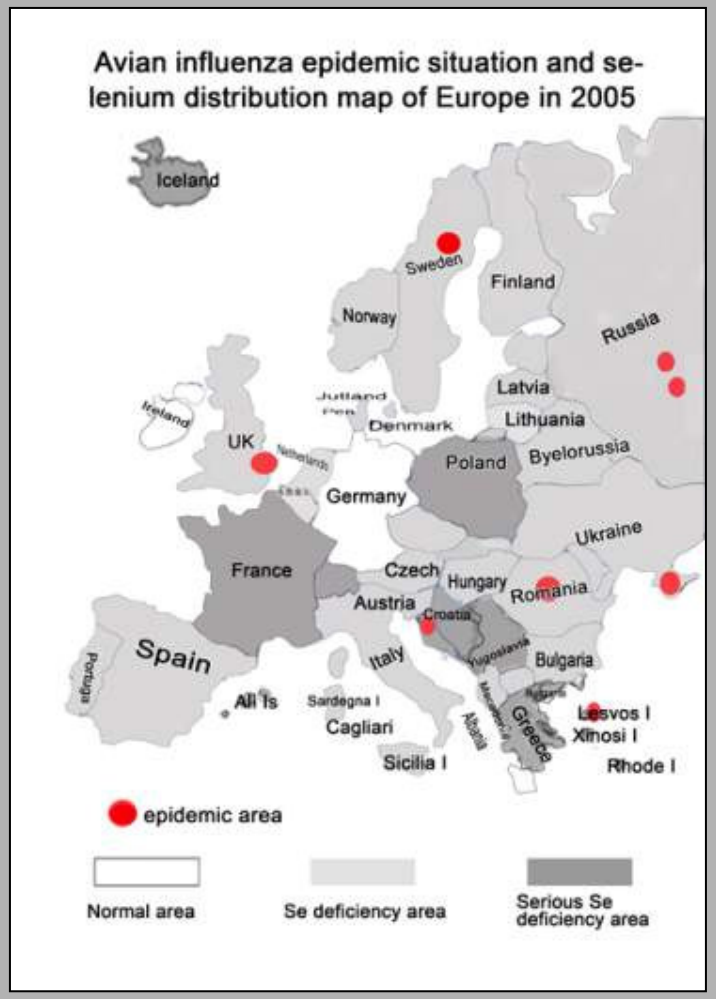




	Atomic Weight
Selenium	78.96
Molybdenum	95.9
Iodine	129.9

Selenium in Soil: U.S. and Europe

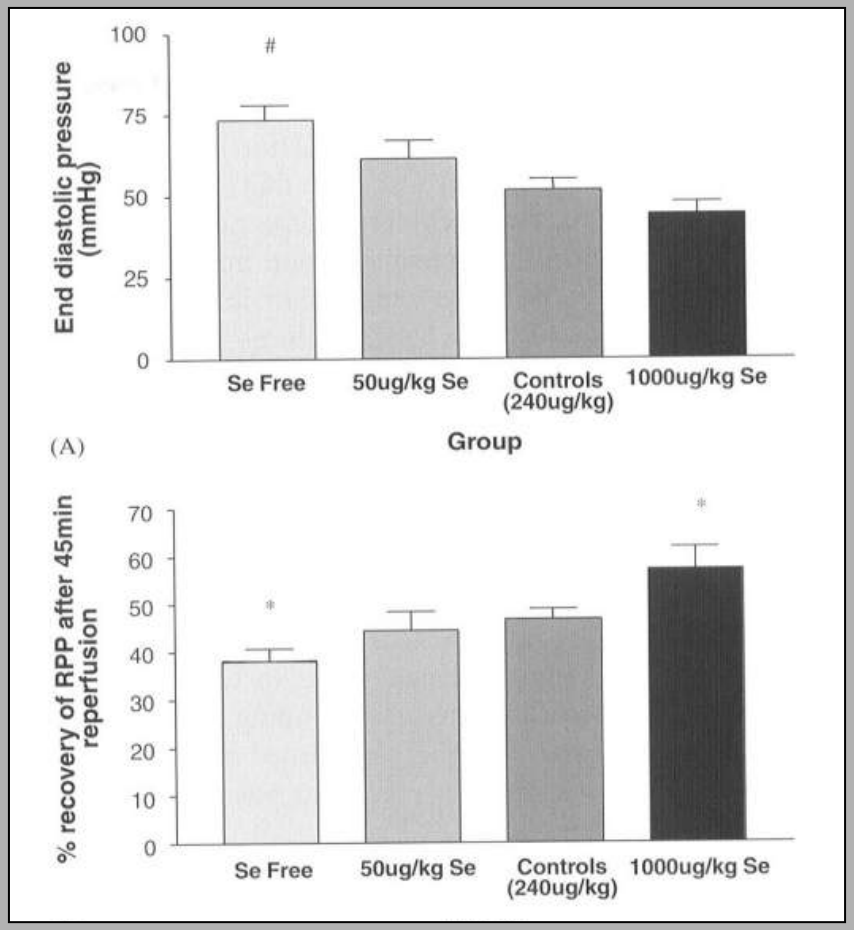




Selenium-containing Proteins

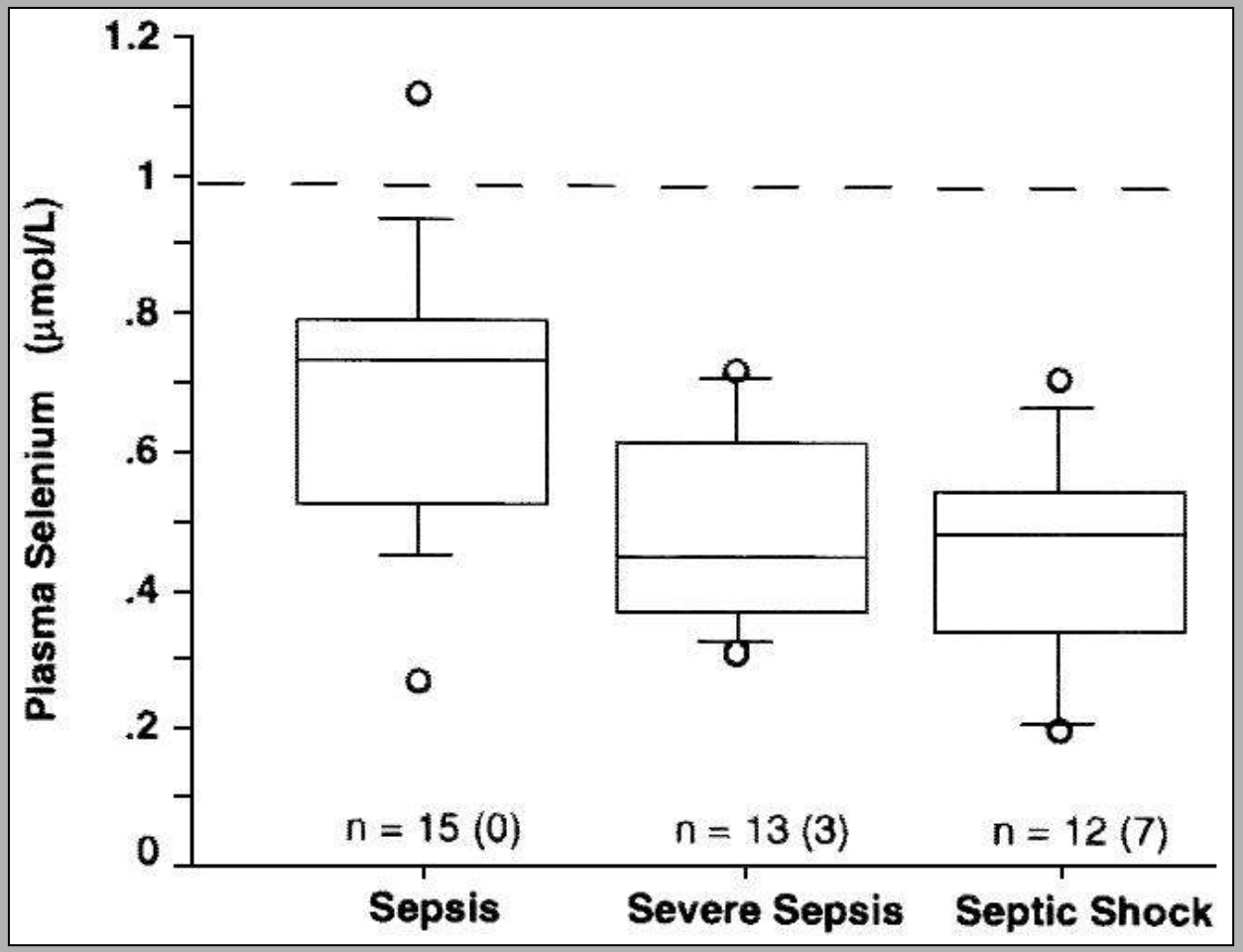
- Glutathione peroxidase
- Iodothyronine deiodinase
- Thioredoxin reductase
- Selenoprotein P
- Selenoprotein W
- Prostrate epithelial selenoprotein

Selenium and Cardiac Function post Ischemia-Reperfusion



Vernardos K, etal. Effects of dietary selenium on glutathione peroxidase and thioredoxin reductase activity and recovery from cardiac ischemia-reperfusion. *J Trace Elements Med Biol* 2004;18(1):81-89.

Selenium and Sepsis



Forceville X, etal. Selenium, systemic immune response syndrome, sepsis, and outcome in critically ill patients. *Crit Care Med* 1998;26(9):1536-1544.

Harborview Antioxidant Supplementation Protocol

- Vitamin C
  - 1000 mg IV tid x 2 days, then 1000 mg po/ng/ft x 5 days
- Vitamin E
  - 1500 IU po/ng/ft bid x 7 days
- Selenium
  - 400 μg IV qd x 2 days, then 400 μg po/ng/ft x 5 days

Nathans AB, Neff MJ, Jurkovich GJ, Klotz P, Farver K, Ruzinski JT, Radella F, Garcia I, Maier RV. Randomized, Prospective Trial of Antioxidant Supplementation in Critically Ill Surgical Patients. Ann Surg 2002;236(6):814-822.

Selenium and Cancer

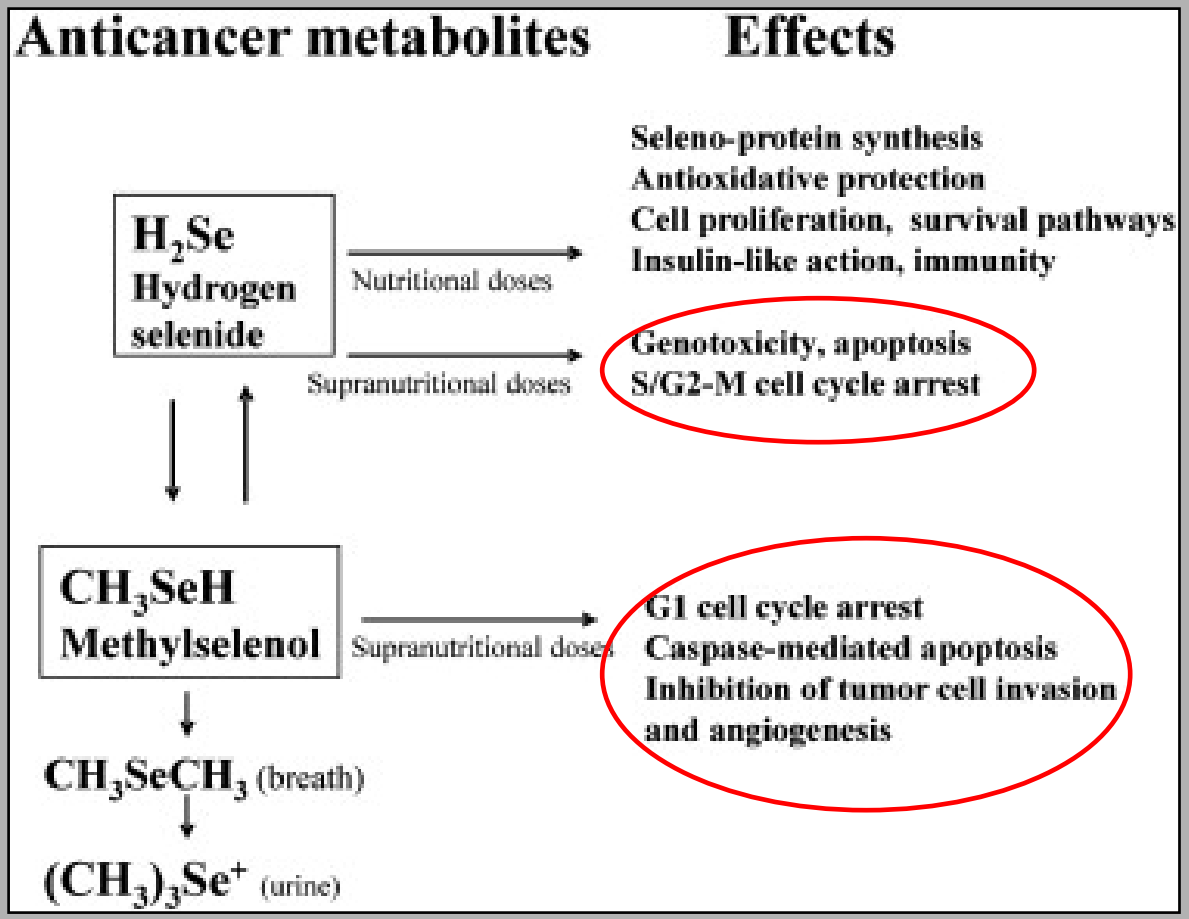
Table 2
Selenium supplementation[1] and cancer: trial results (16)

Events	Selenium	Placebo	Relative Risk
Total cancer incidence	77	119	0.63 (95% CI=0.47–0.85) p=0.001
Total cancer mortality	29	57	0.50 (95% CI=0.31–0.80) p=0.002
Prostate cancer	13	35	0.37 (95% CI=0.18–0.7[illegible]) p=0.002
Colorectal cancer	8	19	0.42 (95% CI=0.18–0.95) p=0.03
Lung cancer	17	31	0.54 (95% CI=0.30–0.98) p=0.04

[1]Selenium-enriched yeast daily supplement containing 200 μg selenium

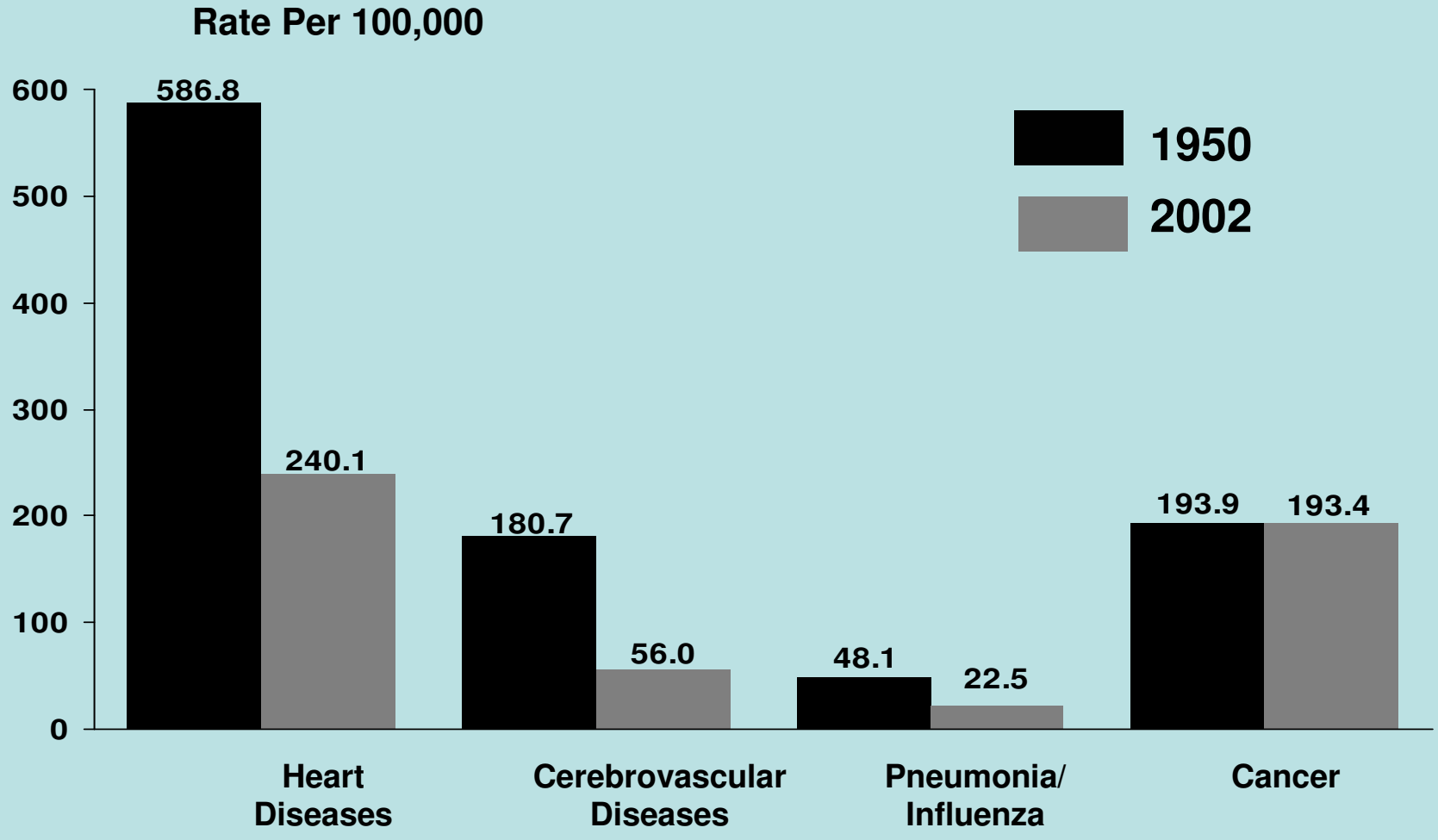
Clark LC, etal. Effects of selenium supplementation for cancer prevention in patients with carcinoma of the skin: a randomized controlled trial. *JAMA* 1996;276:1957-1963.

Selenium and Cancer



Zeng H, Combs GF Jr. Selenium as an anticancer nutrient: roles in cell proliferation and tumor cell invasion. *J Nutr Biochem* 2007; [Epub ahead of print June 27}

Change in the US Death Rates* by Cause, 1950 & 2002



* Age-adjusted to 2000 US standard population.
Sources: 1950 Mortality Data - CDC/NCHS, NVSS, Mortality Revised.
2002 Mortality Data: US Mortality Public Use Data Tape, 2002, NCHS, Centers for Disease Control and Prevention, 2004

A Disruptive Innovation in Health Care

Take:

Vitamin D 5000 IU/day — 10x its RDA (400 IU)

Iodine 12.5 mg/day — 100x its RDA (150 µg)

Selenium 200 µg/day — 4x its RDA (55 µg)

"The Moon Goddess' Role in Human Health"

"Extrathyroidal Benefits of Iodine"

"Iodine for Health"

"Vitamin D in a New Light"

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