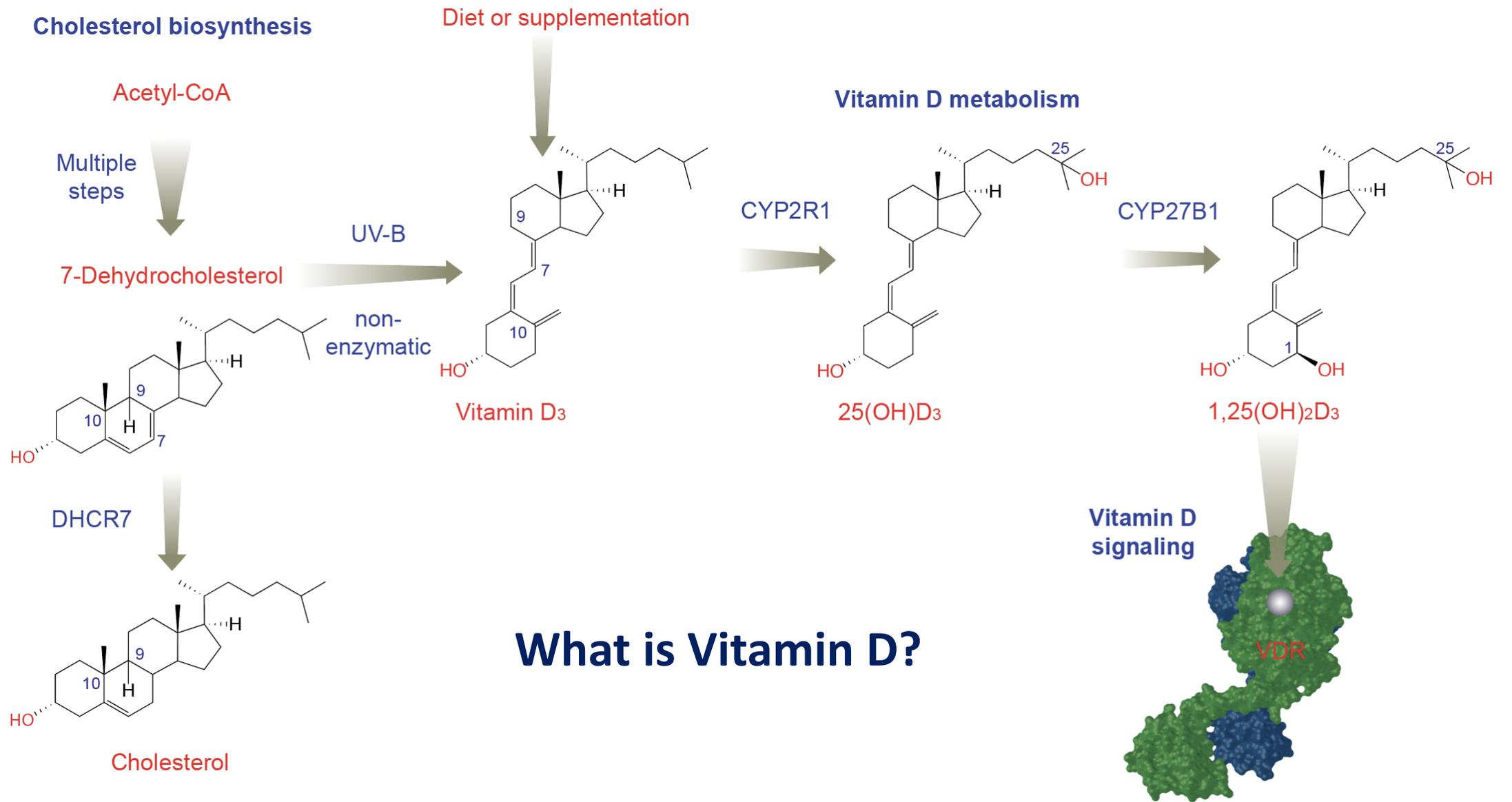


Epigenetic Insights into Vitamin D's Role in Healthy Aging

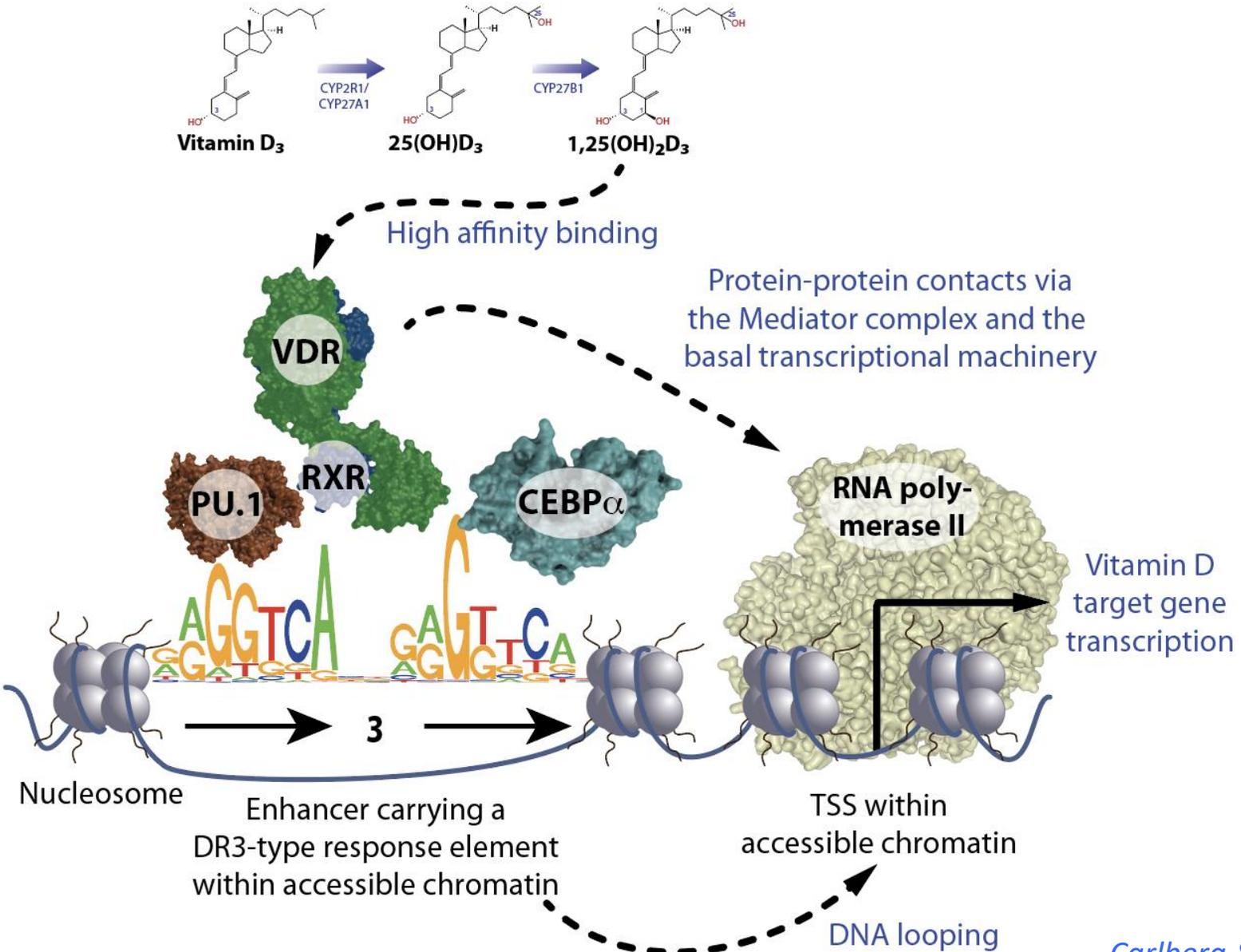
Carsten Carlberg, 17.03.2025, Brussels



NUTRIGENOMICS
ERA CHAIR | WELCOME2

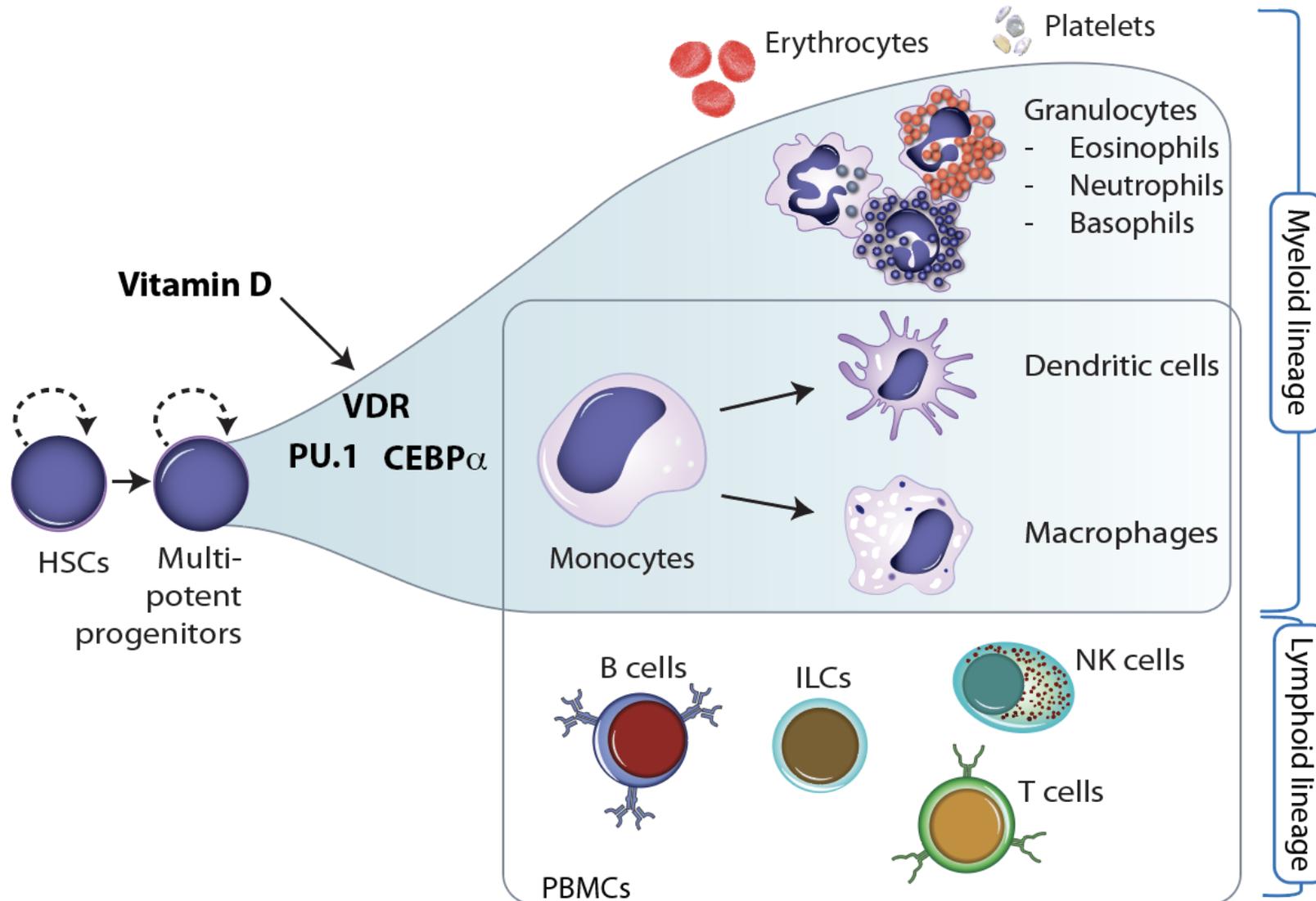


How Does Vitamin D work?



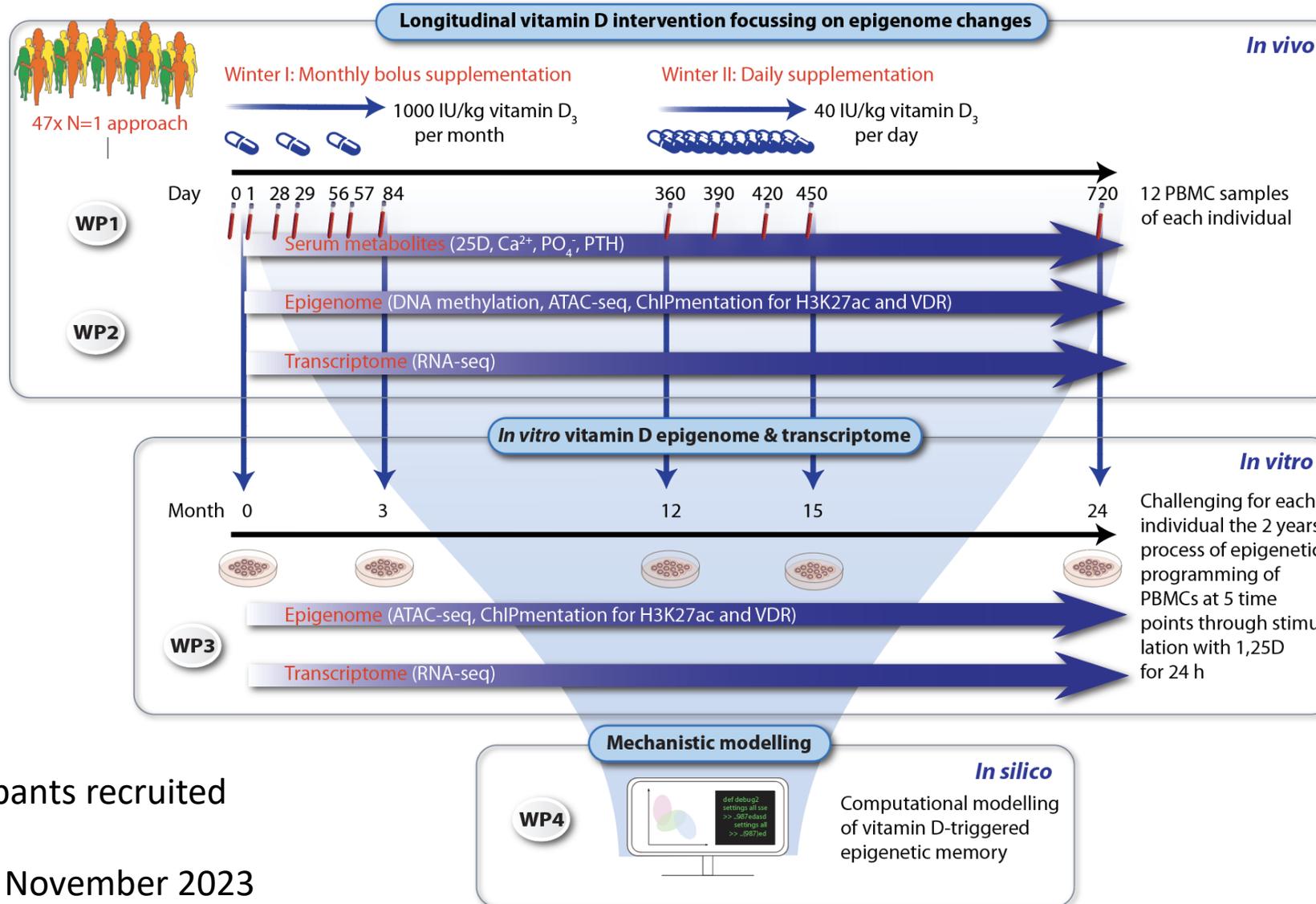
Vitamin D acts as a molecular switch regulating more than 1,000 genes.

Epigenetic Programming of Immune Cells by Vitamin D



During hematopoiesis vitamin D and its receptor VDR trigger the differentiation of myeloid cells like monocytes.

How Do We Investigate the *In Vivo* Function of Vitamin D?



In vivo

In vitro

In silico

47 participants recruited

Started in November 2023

Individual's Vitamin D Response Index: Personalized Supplementation



Response index

High

Mid

Low

Personalized vitamin D3 supplementation, in order to obtain maximal clinical benefit of vitamin D

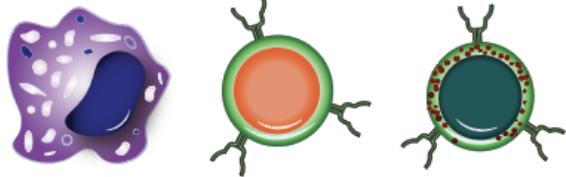
Bone

- Controlling bone homeostasis
- Calcium homeostasis



Immune system

- Stimulation of innate immunity
- Controlling of adaptive immunity



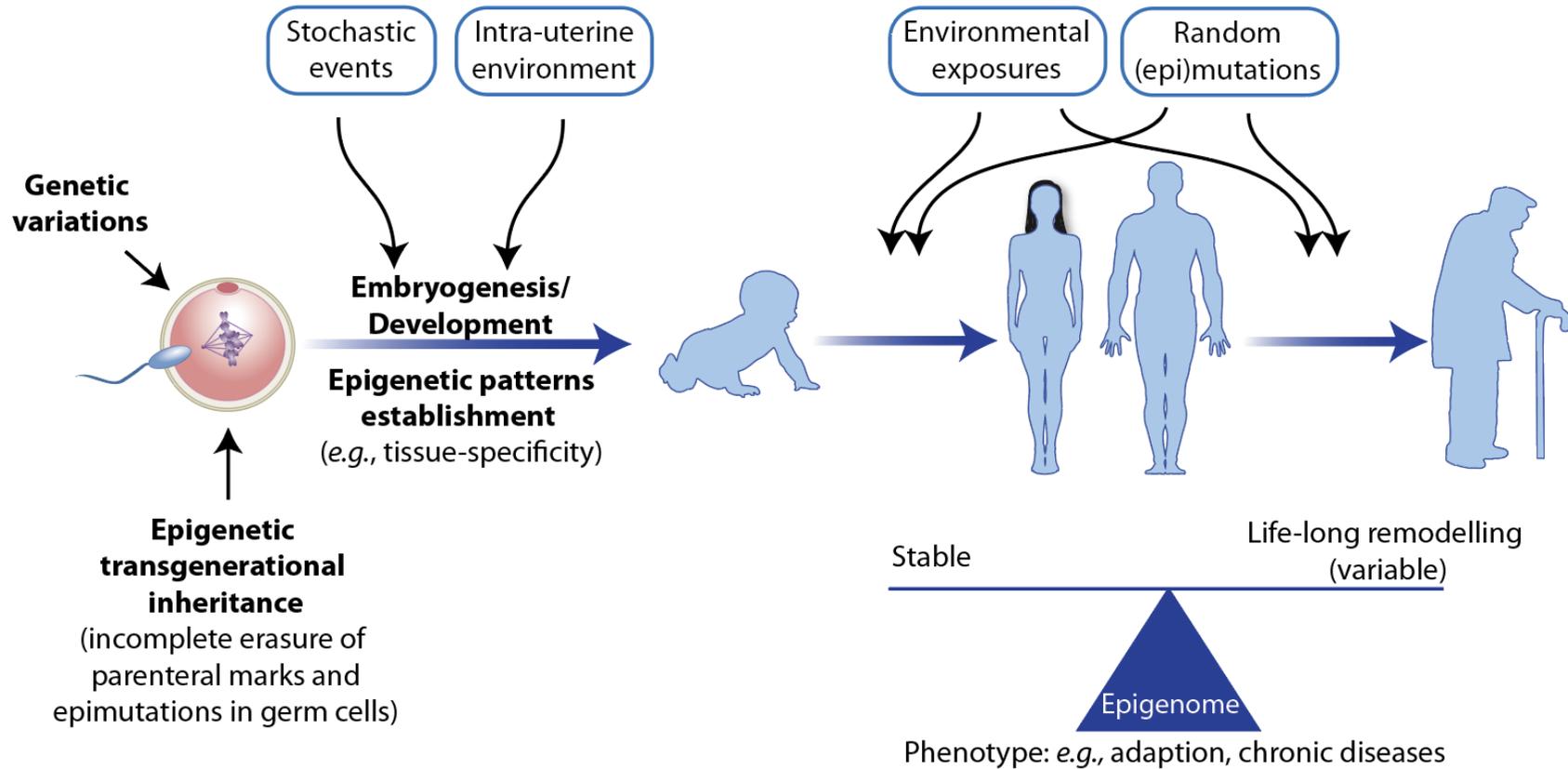
Muscle

- Strength
- Development



Vitamin D response index	Daily vitamin D3 supplementation	Immune system balance restored	Clinical effect
High	Standard (1000 IU)	+	Present
Mid	Standard (1000 IU)	+/-	Partial
Mid	Mid (2000 IU)	+	Present
Low	Standard (1000 IU)	-	Absent
Low	High (4000 IU)	+	Present

The Molecular Story of Life: Genome, Epigenome and Environment



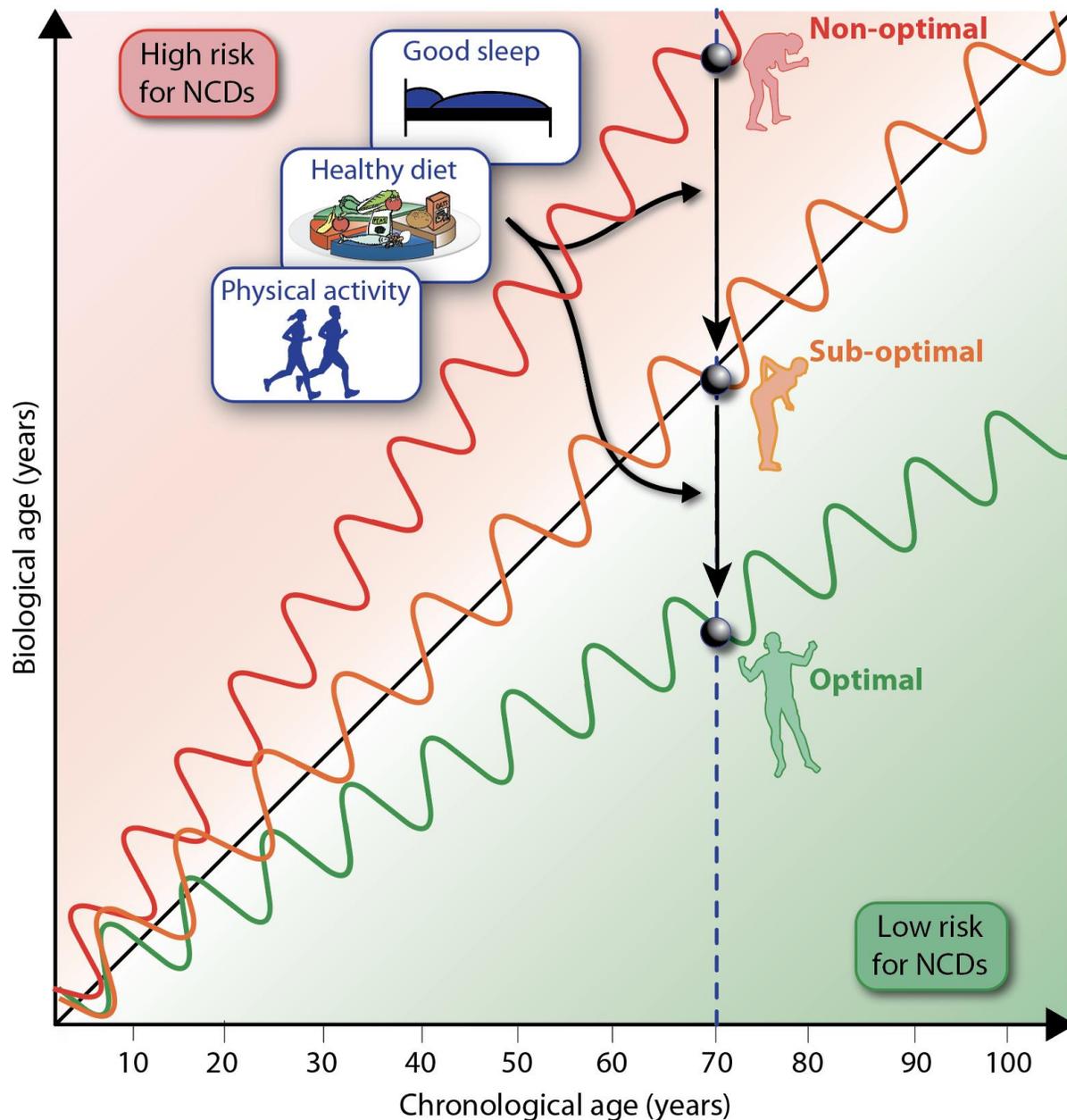
Phenotype = Genome + Epigenome + Environment

20%

80%

- Genetics and epigenetics influence life from conception to old age.
- While genetic predispositions play a role, most disease risks are shaped by environmental factors, which are largely driven by lifestyle choices.
- This means that, to a significant extent, we have the power to maintain our health and reduce the risk of common diseases through conscious lifestyle decisions.

Interindividual Variation in Biological Aging



This figure illustrates the difference between chronological and biological age, highlighting how lifestyle factors such as diet, physical activity, and quality can influence the rate of biological aging.

Molecular Understanding of Healthy Aging

EIT Food Healthy Ageing Think & Do Tank

EIT Food Healthy Ageing Think & Do Tank brings together strategic and delivery partners from across Europe to foster effective collaboration, knowledge sharing, and impactful initiatives that accelerate food system transformation to promote healthy ageing.



2024



Co-funded by the
European Union



President: Dr. Annemarie Oosting

Nutrition Development Director, Specialized Nutrition - Cargill Food Solutions

Vice Presidents:

Working Group 1: Dietary Strategies for Preventing Age-Related NCDs

Prof. Carsten Carlberg, ERA Chair for Nutrigenomics - Polish Academy of Sciences, Poland

Working Group 2: Targeted Approaches for Healthy Ageing

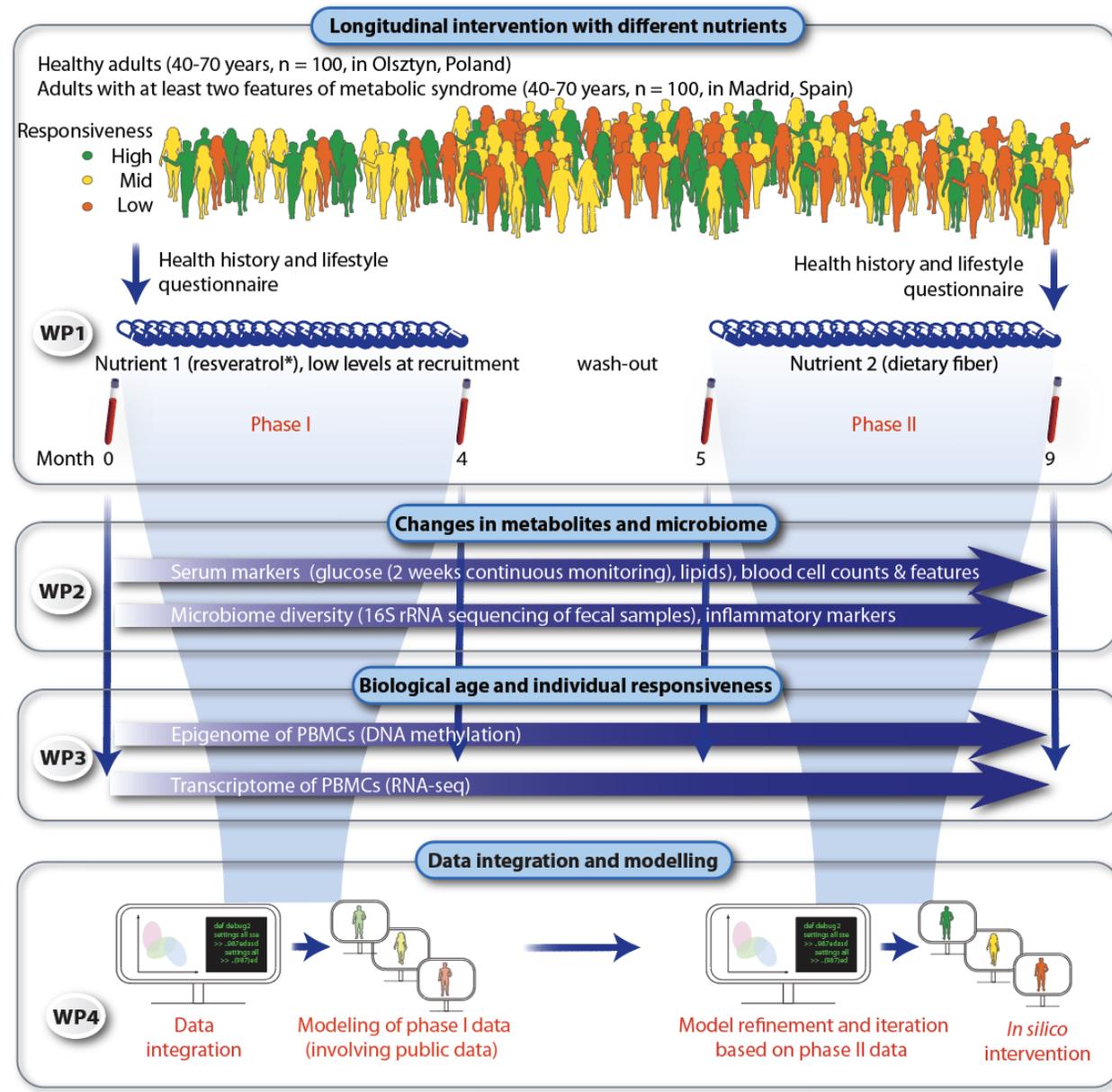
Irini Shoeman Giziakis, Open Innovation Manager – Danone Group

Working Group 3: Enhancing Wellbeing through Microbiome Health

Prof. Luca Coccolin, Department of Agricultural, Forest and Food Sciences, – University of Turin

NCDs = non-communicable diseases

Intervention Study Planned by the Healthy Aging Think & Do Tank



*alternatively to resveratrol also spermidine, DHA and EPA are considered

Which Nutrients Should Be Used in Longitudinal Healthy Aging Interventions?



Molecule	Efficacy	Effectiveness	Cost in Use	Yearly Cost (Est EUR)	Industry Interest	Molecular Understanding	Aggregated Score	Limiting Factors
Vitamin D	++	++	++	50	++	+	9	Requires sun exposure or high-dose supplementation for deficiencies.
Plant Sterols	++	+	++	60	++	+	8	Absorption variability, needs consistent intake, mainly effective for cholesterol.
Curcumin	++	±	+	120	++	+	7	Poor bioavailability, requires specialized formulations for absorption.
Omega-3 Fatty Acids	++	++	-	180	++	+	6	Effectiveness varies with dietary Omega-6/Omega-3 ratio and source.
Probiotics	++	±	--	250	++	+	5	Strain-specific effects, individual variability in microbiome response.
Quercetin	+	+	+	100	+	-	3	Variable absorption, unclear long-term benefits in human trials.
Epigallocatechin Gallate (EGCG)	+	±	+	90	+	-	3	High doses required, potential liver toxicity in excess.
Polyphenols	+	+	+	120	+	-	3	Effects depend on diet composition and individual metabolism.
Resveratrol	+	±	-	150	+	-	1	Limited bioavailability, high doses required for significant effect.
Spermidine	+	±	--	200	+	-	1	Dietary intake often insufficient, supplementation research ongoing.

This figure was created by the help of artificial intelligence (AI).



Thank you

Carsten Carlberg c.carlberg@pan.olsztyn.pl



Linking research with teaching

