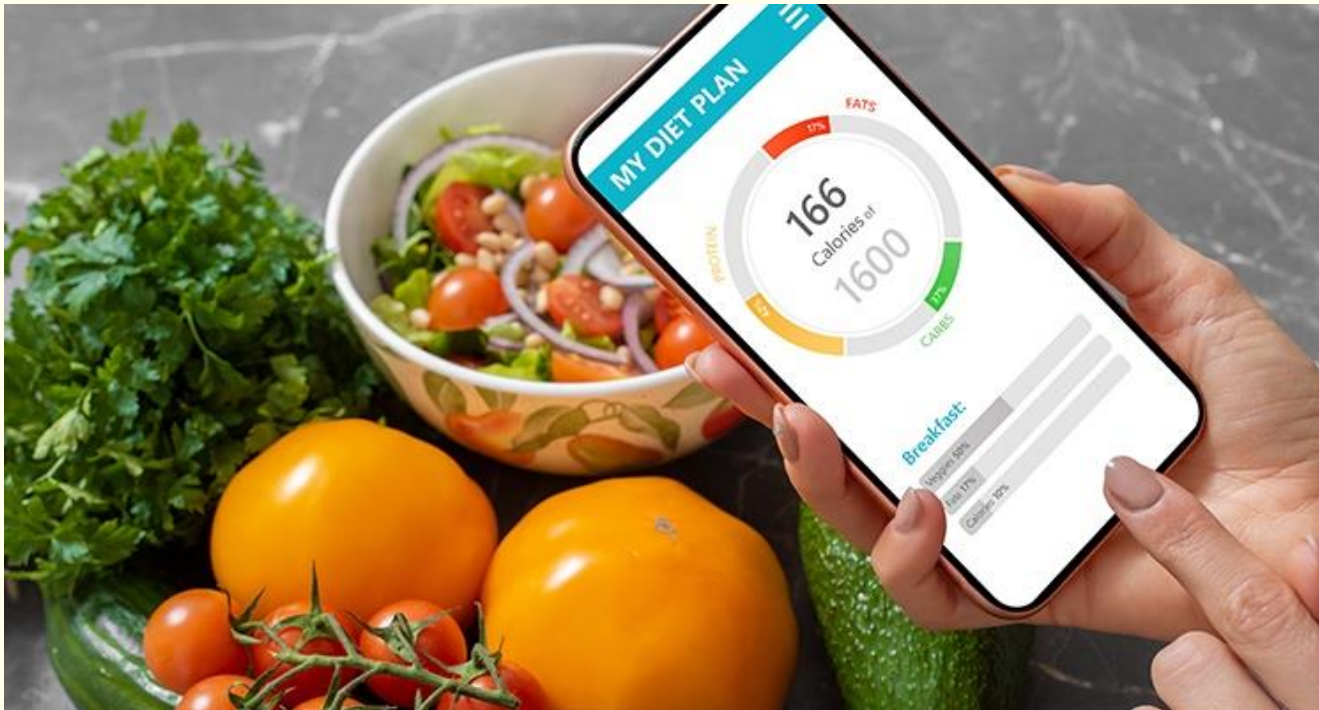


Personalized Nutrition



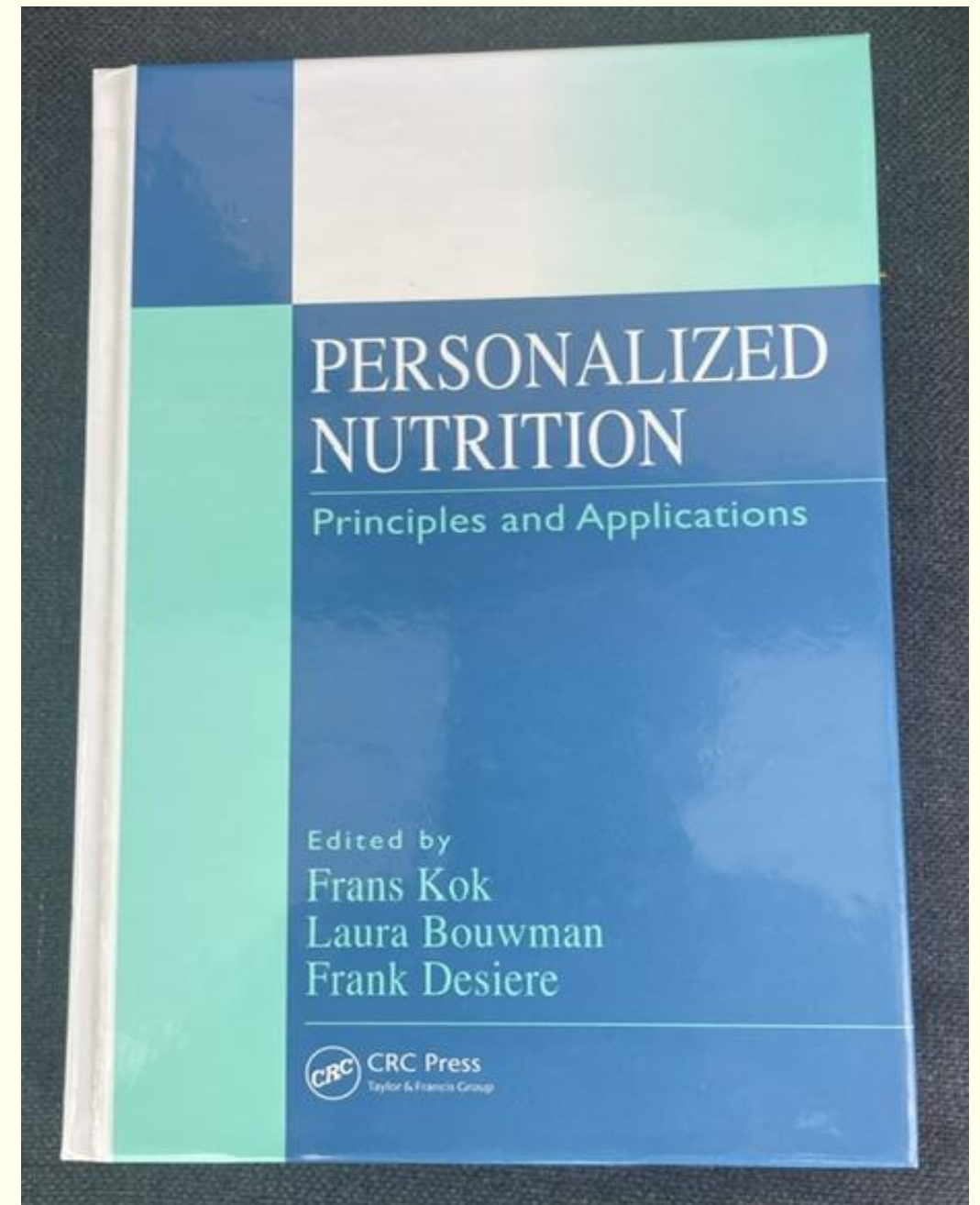
- ☐ Why people respond different to food?
- ☐ What is the evidence on Personalized Nutrition?
- ☐ Which direction is the field moving in?
- ☐ What is the Current Consensus?

Personalized Nutrition

Interest in Personalized Medicine and Personalized Nutrition after completion of the Human Genome Project in 2003.

Aim Personalized Nutrition:

Make healthy eating more **precise**, **effective** and **sustainable** by tailoring dietary advice to personal characteristics.



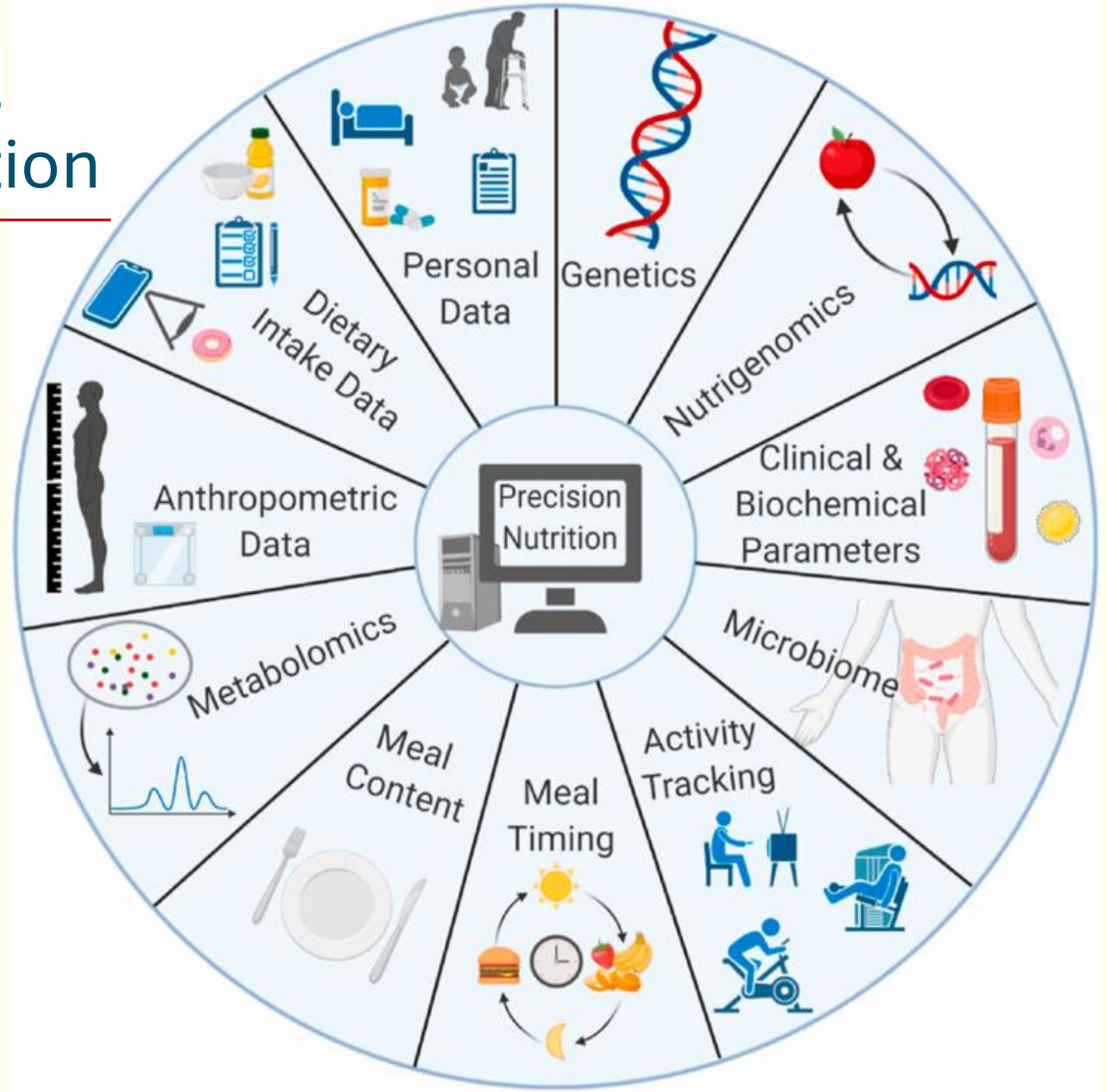
Textbook published in 2008

Tools and Methods in Personalized Nutrition

Analytical tools:

Digital technologies

Machine-learning / AI
accelerated the field.





Self-experiment in 2010

- Fully controlled cross-over dietary challenge of two months
- 1st month: Unhealthy diet/low physical activity
2nd month: Usual, healthy pattern.
- Not a supersize-me diet, but habitual diet in The Netherlands.
- At regular intervals blood/urine samples, tests and scans, including MRI



unhealthy month



healthy month



Most Body Parameters worsened

month

worse blood lipids

high blood pressure

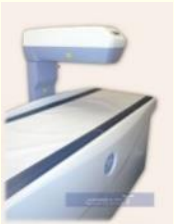
higher heart rate

increased belly fat

increased insulin

high liver enzymes

lower fitness



The Promise of Personalized Nutrition

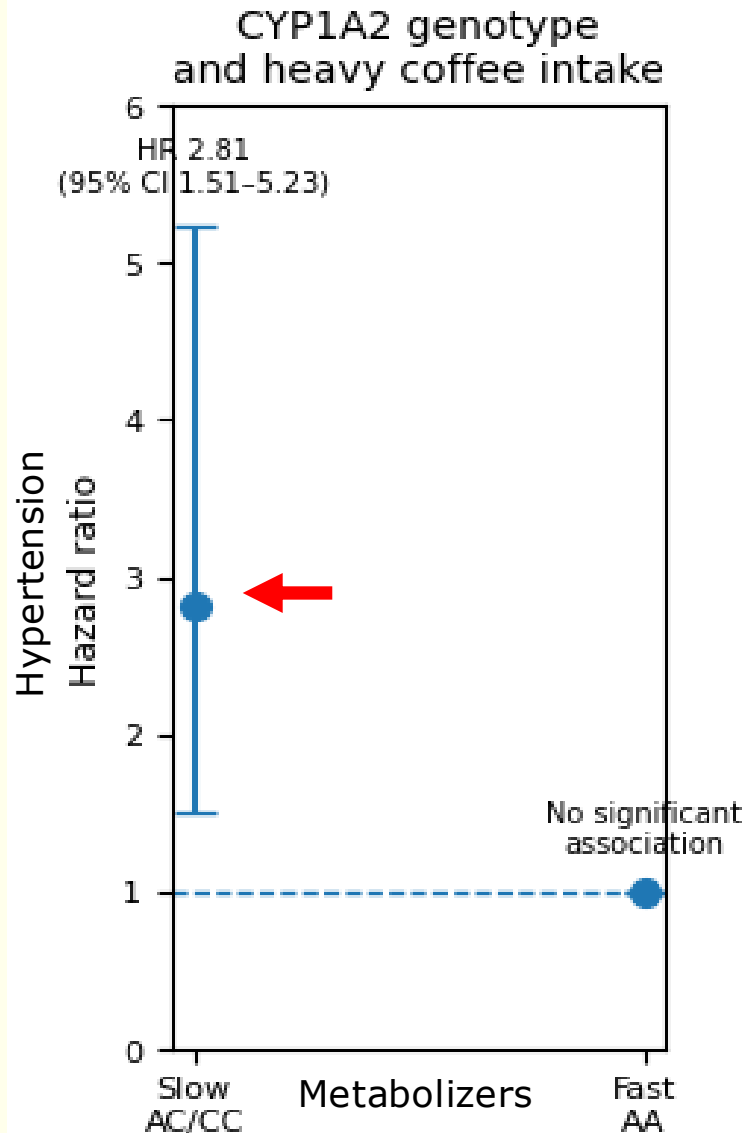
“From one-size-fits-all to nutrition tailored to the individual”



Why people respond differently to the same food/diet?

- ☐ **Genetics** (e.g., lactose intolerance; lipid metabolism)
- ☐ **Gut microbiome** (e.g., short-chain fatty acids from dietary fiber)
- ☐ **Metabolic health** (e.g., body weight and insulin sensitivity)
- ☐ **Glycemic responses** (e.g., large/modest glucose peak eating white rice)
- ☐ **Lifestyle factors** (e.g., physical activity, sleep quality, stress, alcohol etc)
- ☐ **Age and gender** (e.g., protein requirements important with aging)
- ☐ **Health conditions and medications** (e.g., diabetes, gastrointestinal disorders, celiac disease)

Impact of variation in the gene *CYP1A2* on the breakdown of caffeine

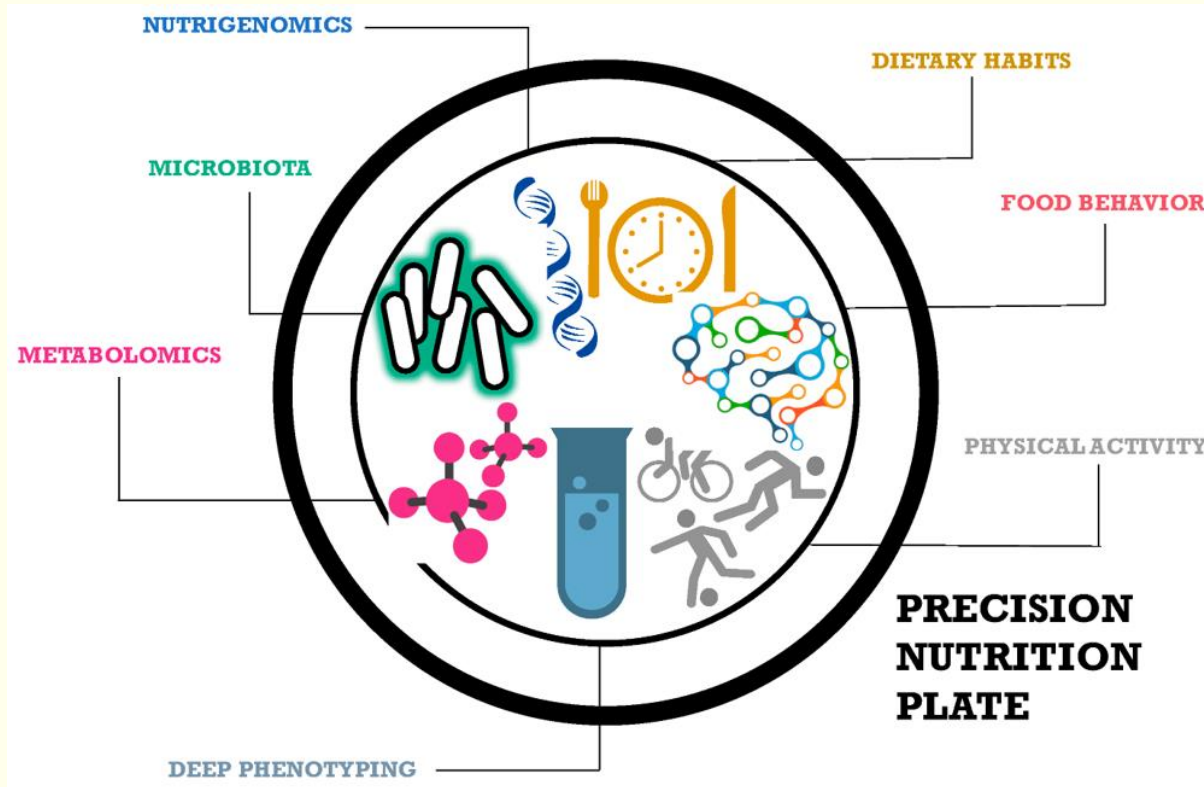


Mahdavi S et al, JAMA 2023

In general:

- Impact of genetics on variation in dietary response is modest.
- Most nutrition-related traits involve hundreds or thousands of genes, each with a small effect.
- Genetic testing alone cannot identify the “perfect diet”

Scientific evidence for Personalized Nutrition



Stage 1 — 2015:

People respond substantially different to the same food.



Stage 2 — 2020:

Predict differences using personal characteristics



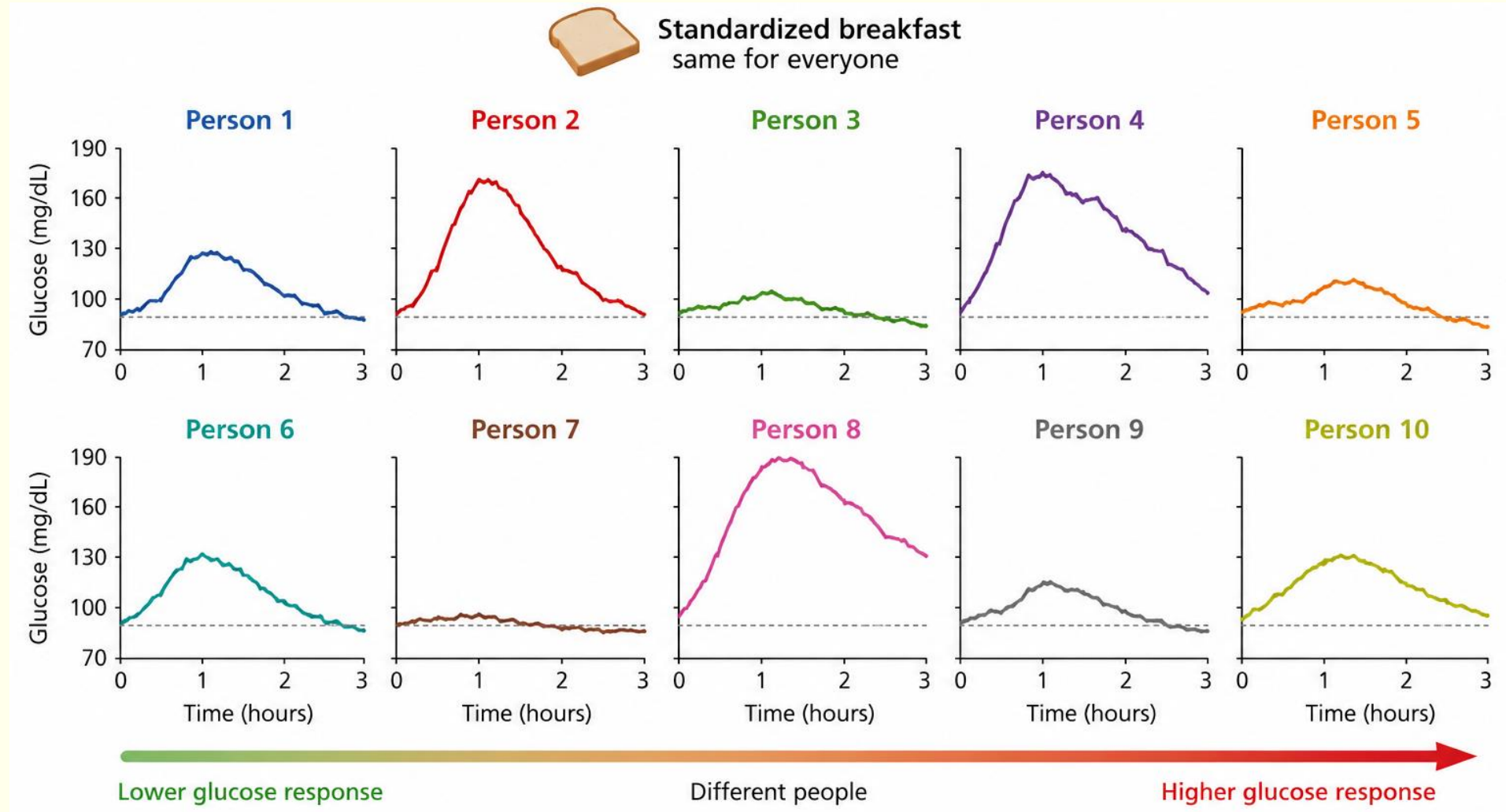
Stage 3 — 2025:

Use predictions to produce better health outcomes

Stage 1 Substantially different response to the same food.

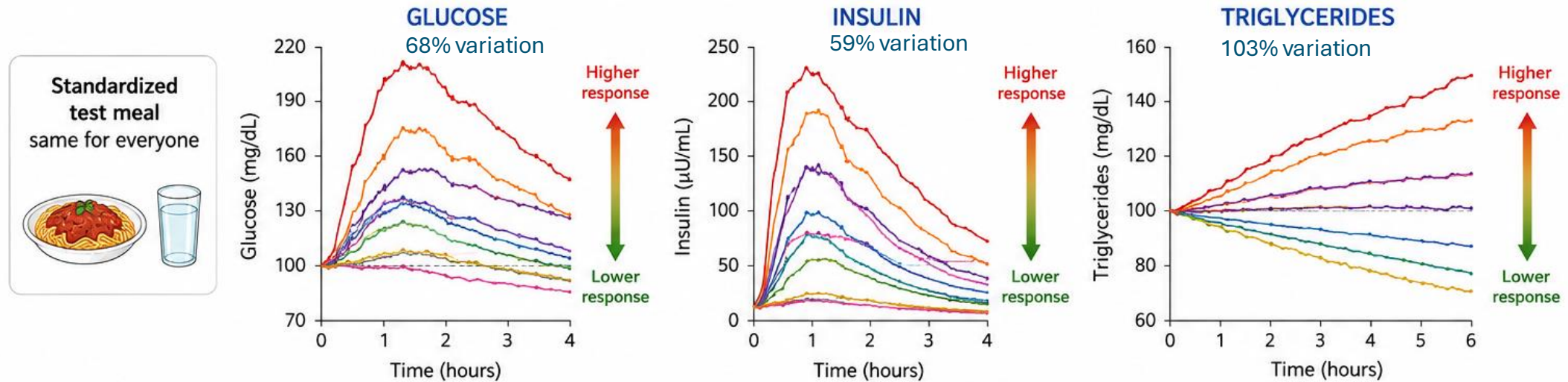
Monitoring **800 people**, recording **46,898 meals** and continuous glucose responses

Foods cannot
always be labeled
as universally
“good” or “bad.”



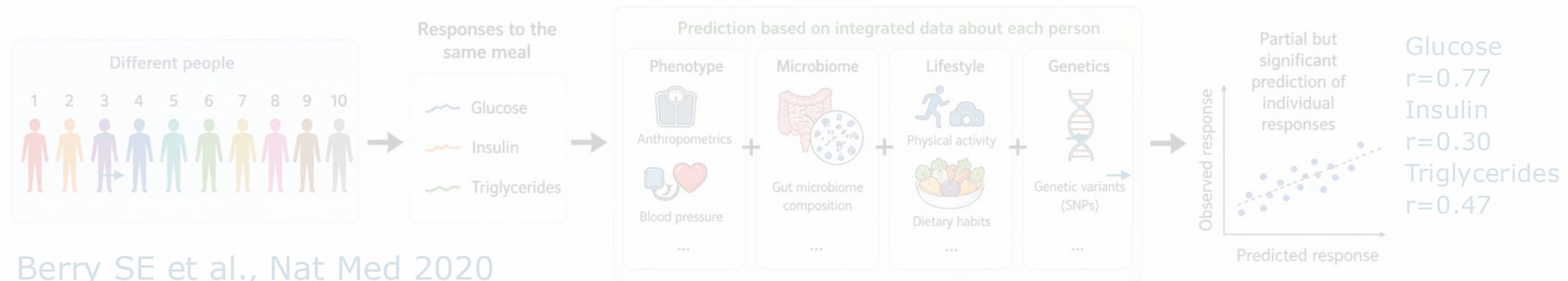
Stage 2 Prediction of responses using data on personal characteristics

A. Large inter-individual variability in metabolic responses to the same meal (n=1,000 from UK)



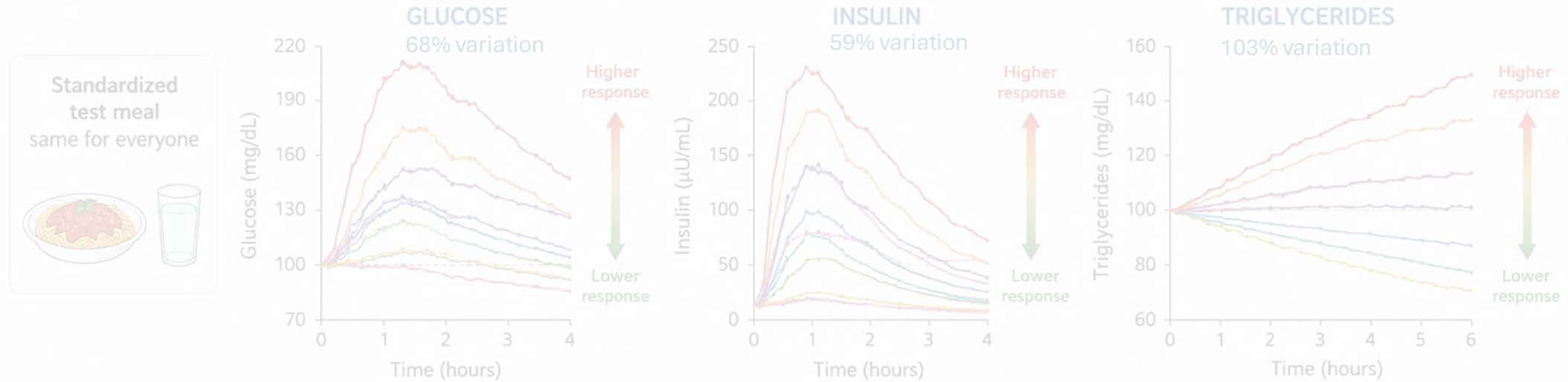
Personalized nutrition is the interaction between **food x person x microbiome x lifestyle x metabolism**

B. Inter-individual responses can be partially predicted by multiple factors



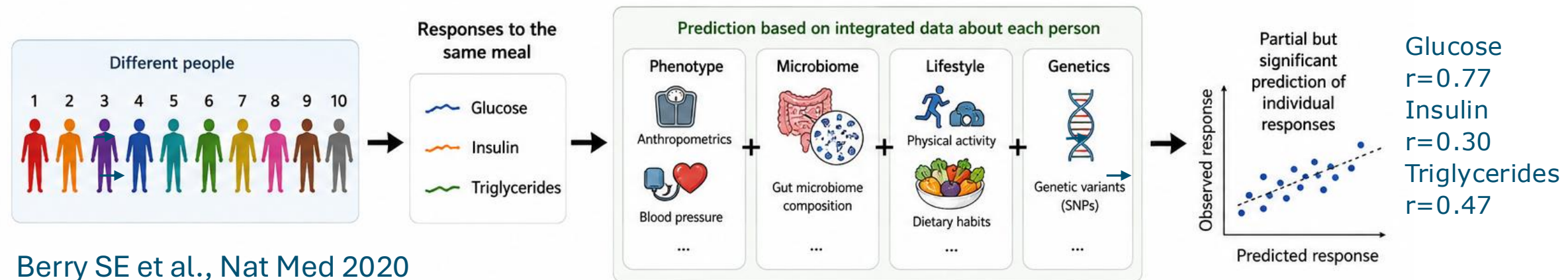
Stage 2 Prediction of responses using data on personal characteristics

A. Large inter-individual variability in metabolic responses to the same meal



Personalized nutrition is the interaction between **food x person x microbiome x lifestyle x metabolism**

B. Inter-individual responses can be partially predicted by multiple factors



Stage 3 Use Predictions for better health outcomes

Randomized controlled trial
of 18 weeks (n=347)

1 Study design



Personalized diet

Food choices each day
predicted to improve
blood sugar response



Conventional advice

Standard dietary guidance
based on current
recommendations

2 Personalized prediction



Microbiome



Blood markers



Anthropometrics



Dietary habits



Physical activity



Sociodemographics



Machine learning
model

Personalized nutrition improves
some – but not all – health
outcomes



Significant improvements



Triglycerides

↓ **-0.13 mmol/L**

P = 0.016



Body weight

↓ **-2.46 kg**

P < 0.001



Waist circumference

↓ **-2.35 cm**

P = 0.008



HbA1c

↓ **-0.05 percentage points**

P < 0.05



No significant difference



LDL cholesterol



Blood pressure



Fasting glucose



Insulin



C-peptide



Apolipoprotein A1



Apolipoprotein B

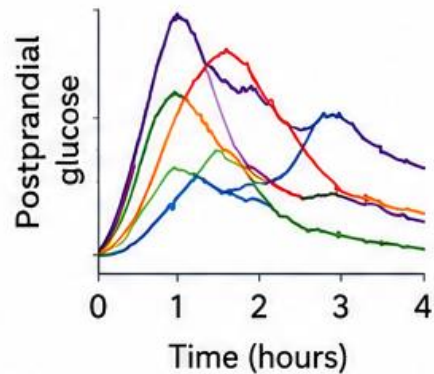


Postprandial triglycerides

From Data to Better Health

Individual variation

People respond differently to the same diet



Measure the person



You

Age, sex, BMI, metabolic health



Microbiome

Gut microbes



Diet & lifestyle

What you eat, activity, sleep, etc.



Genetics

Genetic & epigenetic markers



Environment

Exposome & other factors

Integrate the data Predict the response

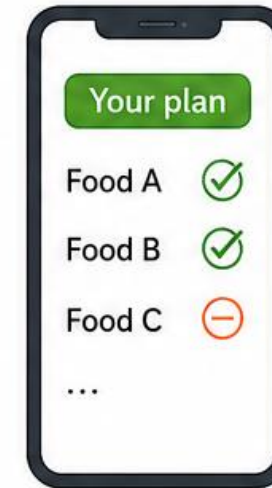
Integrate data with analytics and AI



Predict your responses to foods and diets

Personalize the diet

Personalized advice that is actionable and supportive



Improve health

Better health for individuals and populations



Improve cardiometabolic health



Prevent & manage disease



Reduce health inequalities



Support sustainable food systems

Where the field stands now?



Proof of concept that
precision can improve
health outcomes
(RCT evidence)



Rapid advances in
multi-omics, wearables
and data integration



Early real-world
applications
emerging



The goal: scalable,
equitable and effective
precision nutrition

Key challenges ahead



Standardization of
methods and data



Causal understanding



Translating predictions
into effective,
affordable interventions



Ethical, legal and
social considerations

What is the current Consensus?

General Dietary Advice still works for most people:

1. Eat plenty of vegetables/fruit, whole grains, legumes/nuts, and
2. Limit calories, saturated and trans fats, added sugars, salt and alcohol.

Personal Dietary Advice adds value by considering individual characteristics (metabolic health, preferences, health conditions, lifestyle and sometimes genes or gut bacteria).

The future is multi-factorial integrating biology, behavior and environment rather than relying on a single (genetic) test or biomarker.

