## Nutrigenomics and the Future of Nutrition

## Setting the Stage: Introduction & Overview

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### Disclosures

- Member, NAREEE Advisory Board & Chair, REE Scientific Advisory Council
- Member, Planning Committee for Vitamin D Standardization Program
- Visiting Scientist, NIH Office of Dietary Supplements, 2016-2017
- NIH funding (Vitamin D Metabolism in Pregnancy)

## **Objectives**

- Overview Population-based Dietary Guidance
  - Food-based Dietary Guidelines
  - Dietary Requirements
    - Nutritional Kinetics and Dynamics Relative to Population-based Dietary Requirements
- Nutrigenomics and Transition to Individually-based Dietary Guidance
  - Personalized Nutrition
- Complexities for Transition Ahead

# Decision-Making Steps: Health Outcome

1. Hazard (Health Outcome)
Identification
(Literature Review)

2. Hazard Characterization (Dose-Response Assessment → Ref. Value)

## Synthesizing the Evidence

- Food-based Dietary Guidance
  - European Food Safety Authority (EFSA)
  - US Dietary Guidelines: Nutrition Evidence analysis Library NEL) modeled on AND Evidence Analysis Library

- Nutrient Requirements
  - Dietary Reference Intakes (DRI)
  - EURRECA, SCAN & EFSA

# EFSA Scientific Opinion Establishing Food-Based Dietary Guidelines

- Integrate scientific knowledge about nutrients, foods & health in order to identify <u>dietary patterns</u> that facilitate achievement of desirable food and nutrient intakes
- Focus: diet-disease relationships of particular relevance to the specific <u>population</u>
- Use step-wise approach to identify
  - diet-health relationships (review evidence)
  - country specific diet-related health problems
  - nutrients of public health importance
  - foods relevant for food-based dietary guidelines
  - food consumption patterns

# U.S. Dietary Guidelines NEL- Analytic Framework & SR Questions for Dietary Patterns & Cancer

#### Target Population

Children and adults (2y+), healthy and at risk for chronic disease

{Literature will be examined by age group, sex, race/ethnicity, and geographic location as appropriate. Age/lifestage groups of interest include children, adolescents, adults, including pregnant, lactating, and peri-postmenopausal women, and older adults}

#### Intervention/Exposure

Adherence to a dietary pattern (e.g., a priori patterns (indices/scores), data driven patterns (factor or cluster analysis), reduced rank regression, or patterns derived from other methods (DASH, vegetarian))

#### Comparator

Different levels of adherence to a dietary pattern; Adherence to a different dietary pattern

#### **Endpoint Health Outcomes**

- Incidence of breast cancer
- Incidence of colorectal cancer
- Incidence of prostate cancer
- Incidence of lung cancer

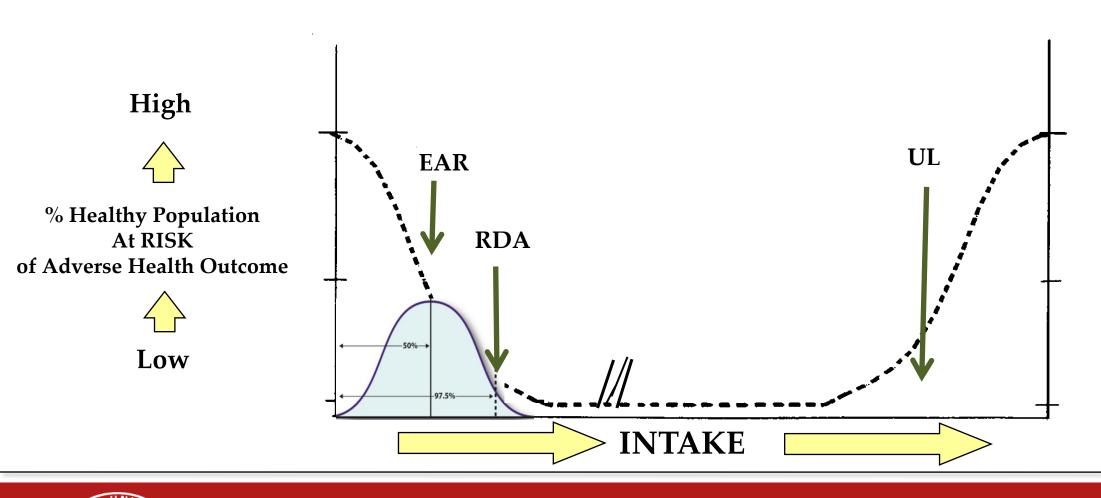
#### **Key Definitions:**

•Dietary patterns: The quantities, proportions, variety, or combination of different foods, drinks, and nutrients (when available) in diets, and the frequency with which they are habitually consumed.

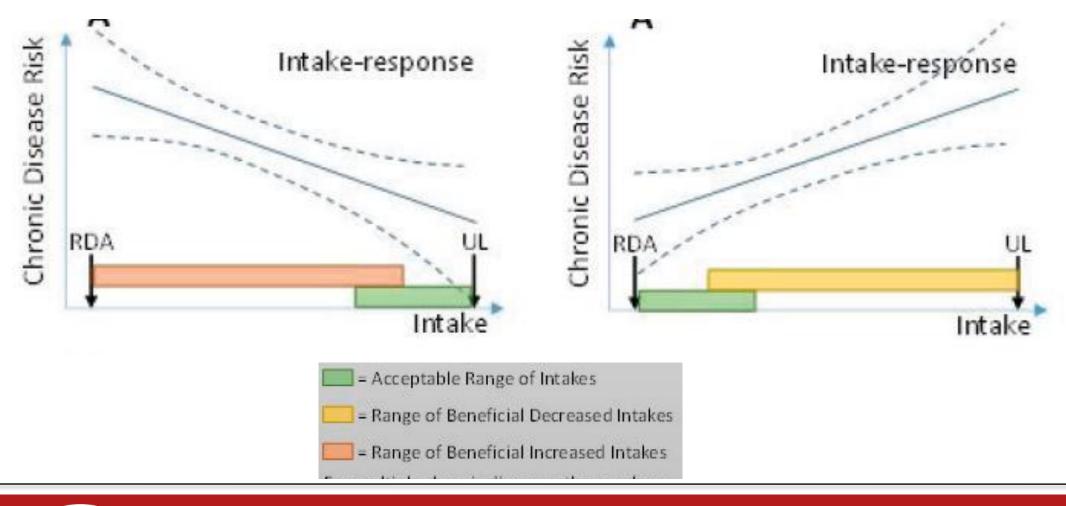
#### Potential Confounders

- Total energy intake
- •BMI
- •Sex
- Age
- Smoking
- Alcohol intake
- Physical activity
- •SES
- Race/ethnicity
- ·Family history
- Genetics
- •ERT
- Cx screening

# DRI: Distribution of Requirement Frequency & Risk of Adverse Outcome in Generally Healthy Population



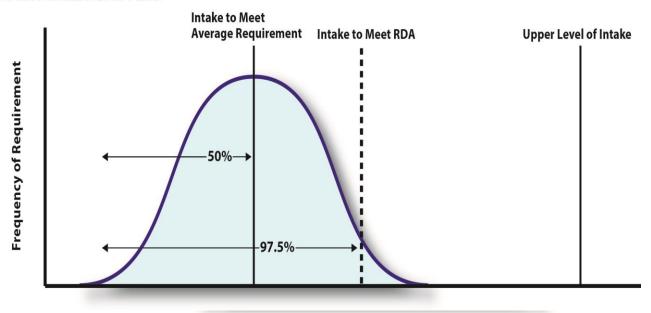
### **Proposed Chronic Disease DRI: Range of Effect**

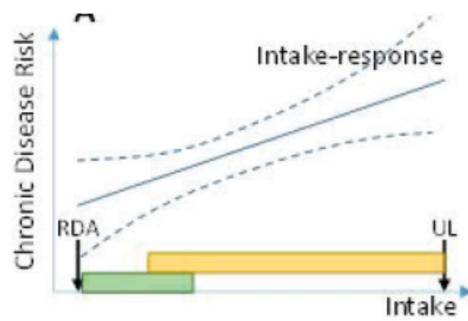


### Population Approach Reflects Individual Uncertainty



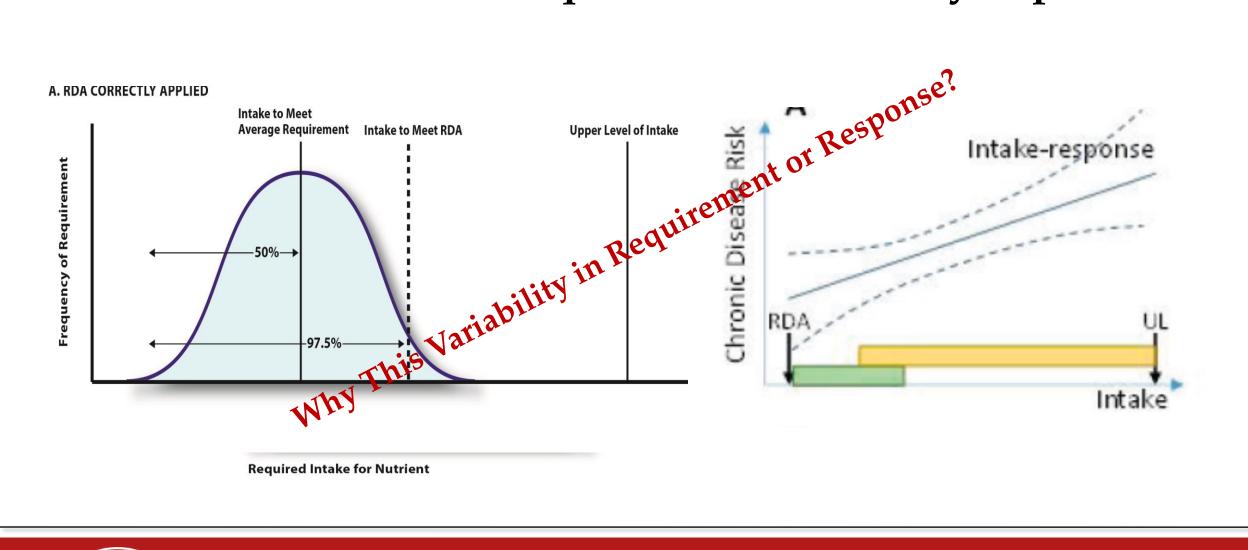
#### A. RDA CORRECTLY APPLIED





**Required Intake for Nutrient** 

### DRI: Distribution of Requirement in Healthy Population



### Nutritional Kinetics, Dynamics & Requirements

Nutrient Intake **Kinetics** 

Nutrient

**Concentration** @

**Site of Action** 

**Dynamics** 

Nutrient Action

Absorption

Digestion

Bioavailability

Distribution

Volume

**Compartments** 

**Body composition** 

Metabolism

Excretion

**Individual Variation** 

Genetics

**Epigenetics** 

**Nutrient – Gene Interactions** 

Age

Sex

**Physiological State** 

(Growing, Pregnant

Lactating, Stress, Disease, etc.)

**Nutrient-Diet Interactions** 

**Nutrient-Environment Interactions** 

**Drug-nutrient interactions** 

**Actions of nutrient** 

D-R at site of action

& effect

Maximal efficacy

Temporal response

Adverse or beneficial effect

D-R at site of action

**Deficiency** 

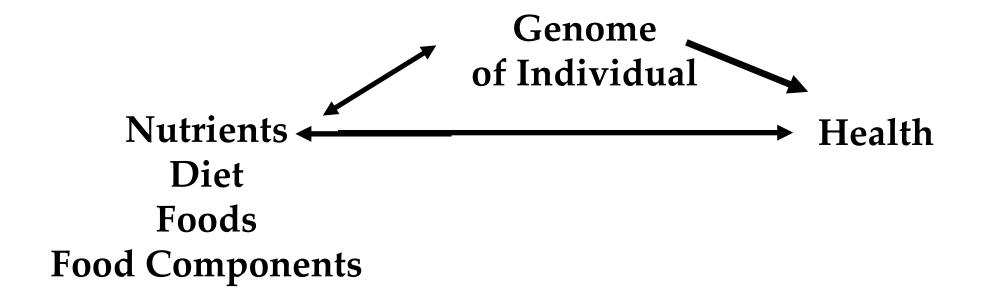
**Toxicity** 

Range

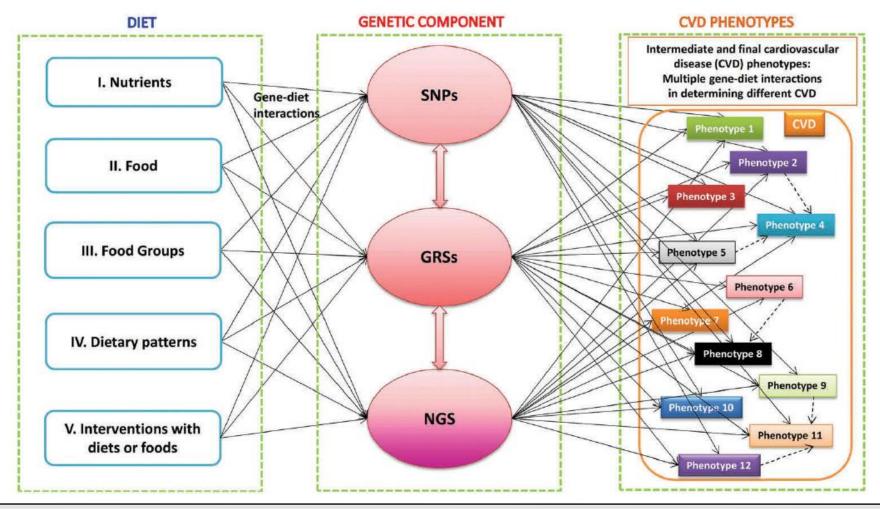
Temporal response

**Inflammatory response** 

## **Nutrigenomics** — Personalized Nutrition



# Complexities of Nutrigenomics & Chronic Disease Endpoints: CVD



## Consumer & Food Behaviors

- Health not only driving force
- TASTE often primary force
- Behavior change neither easy nor understood fully
- Barraged by conflicting information

# Integrating Population-based & Personalized Dietary Guidance?

- 43 nutrients
  - Variable amounts in foods
  - Necessary dietary pattern must provide even less abundant
- Other bioactive food components
- Nutrigenomics incomplete

## Nutrigenomics & Future of Nutrition: Complexities & Opportunities

- Interrelationship of diet, genomics & health (disease prevention): Session 1
- Application of nutrigenomics to diet tailored to individual: Session 2
- Policy & ethical implications: Session 3
  - Nature & strength of evidence
  - Consumer perspective & behavior
- Opportunities: Session 4