

# Incorporating Precision Nutrition into Food-based and Nutrient-based Guidelines

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# Disclosures

- **Member, NASEM Committee to Review DRI for Sodium and Potassium and for Calcium and Vitamin D**
- **Joint Institute for Food Safety and Applied Nutrition (JIFSAN) Advisory Committee**
- **Visiting Professor, Division of Nutritional Sciences, Cornell University**



# Objectives

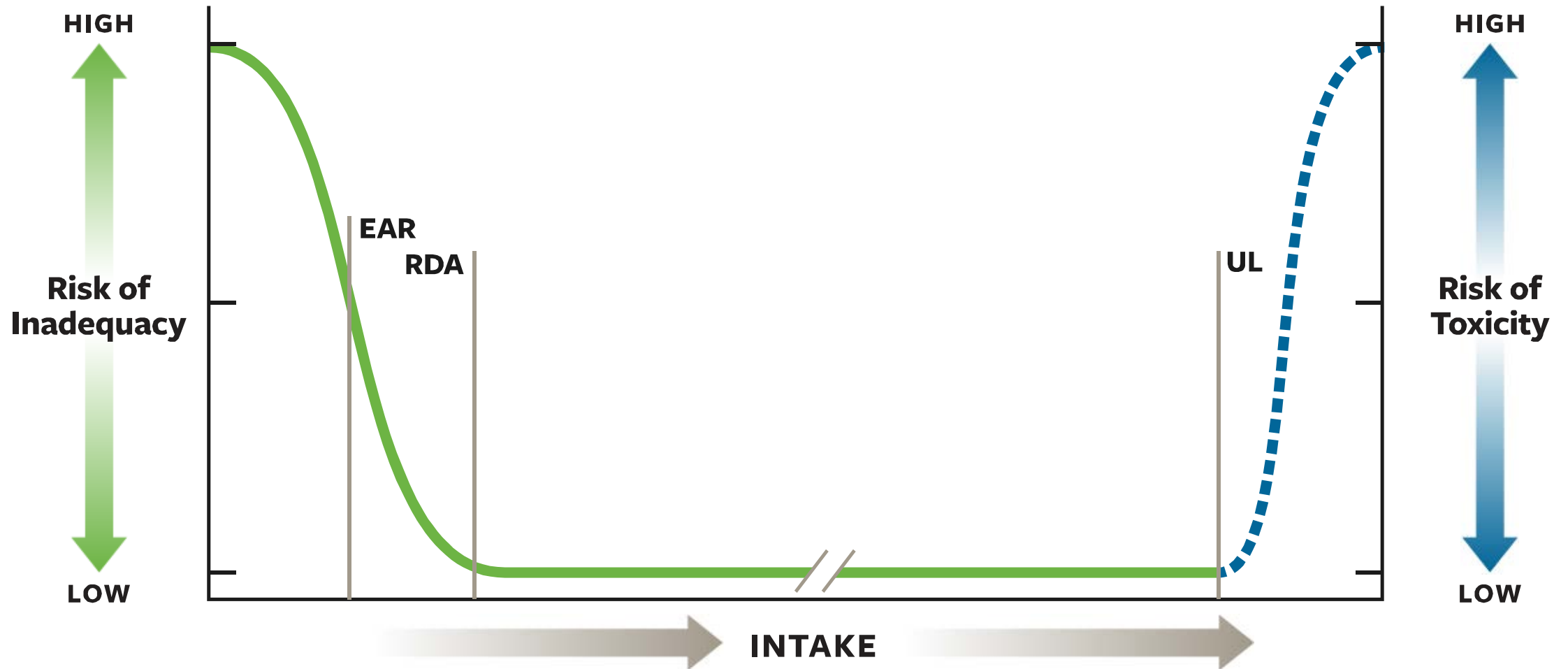
- Explore opportunities & challenges for incorporating precision nutrition into public health approaches: DRIs & Dietary Guidelines
  - Adequacy (DRI)
  - Chronic Disease
    - Nutrients & Chronic Disease Risk Reduction (DRI)
    - Dietary Patterns & Dietary Guidelines
  - Sub-group populations
- Consider opportunities & challenges for incorporating precision nutrition into individualized guidelines
- Reflect on blended models: public health & individualized guidelines



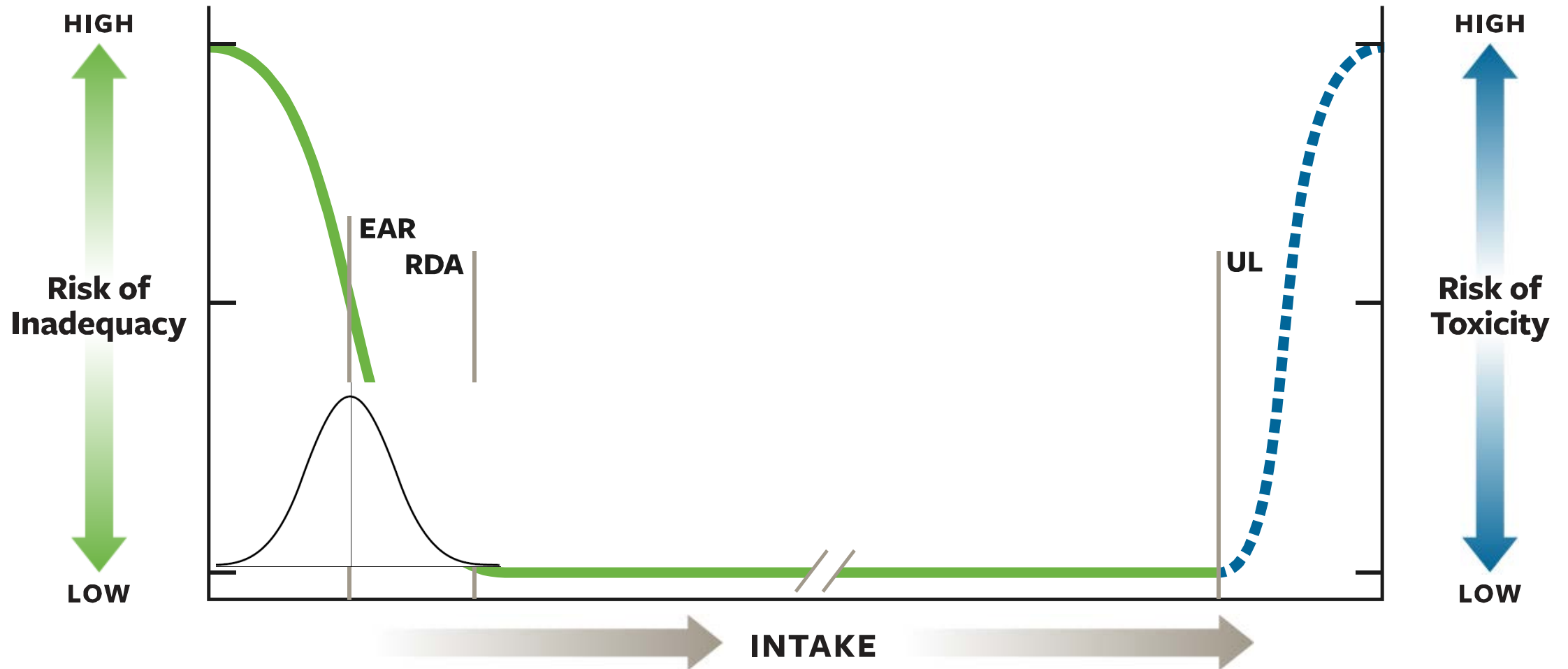
# Public Health Food and Nutrient Based Guidelines and Individualized Precision Nutrition Based Recommendations

| Public Health Guidelines                                                                                                                          | Individualized Recommendations                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inform population-based policies & regulatory actions (federal nutrition programs, nutrition labeling, status assessment)                         | Tailor nutrient & diet intake, dietary pattern & status assessment for unique individual                                                                                                 |
| Implement through national outreach/education, policies, regulations, fortification, population monitoring & assessment                           | Implement by individual interaction with supported technology (tech model), supported technology & health professional (hybrid model) or through individual action (self-directed model) |
| Must account for wide variation across <i>generally healthy</i> population in individual needs, risks, preferences, behaviors, environments, etc. | Address individual's unique needs, risks, preferences, behaviors, environments, health beliefs, etc.                                                                                     |
| Require moderate to high strength evidence because of risk to population                                                                          | Require moderate strength evidence in tech & hybrid model, but might be lower in self-directed model                                                                                     |
| Excludes those with diseases requiring MNT or altering needs due to malabsorption, dialysis, disability or altered mobility                       | Might include individuals with diseases requiring MNT or altered needs. Uncertain how Individualized recommendations blended with MNT                                                    |

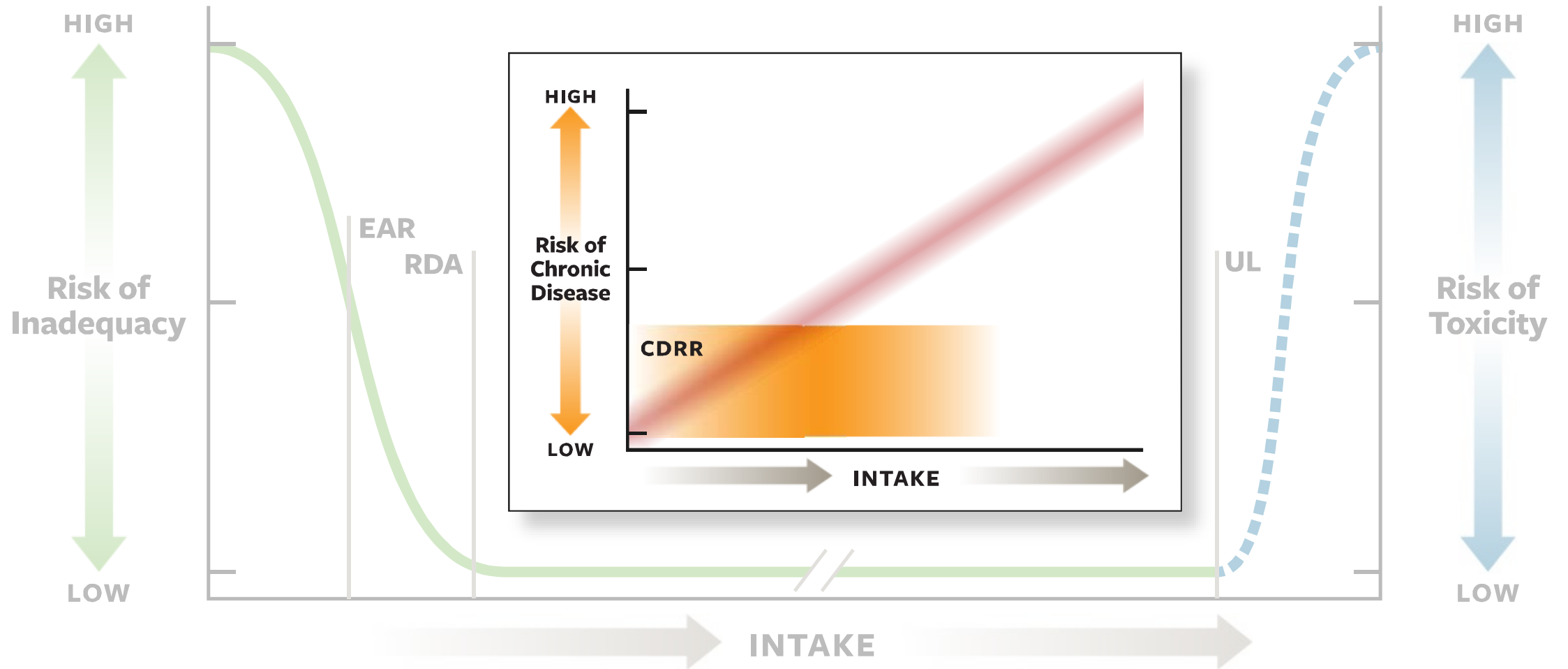
# Expanded Dietary Reference Intakes with CDRR and Chronic Disease Outcomes



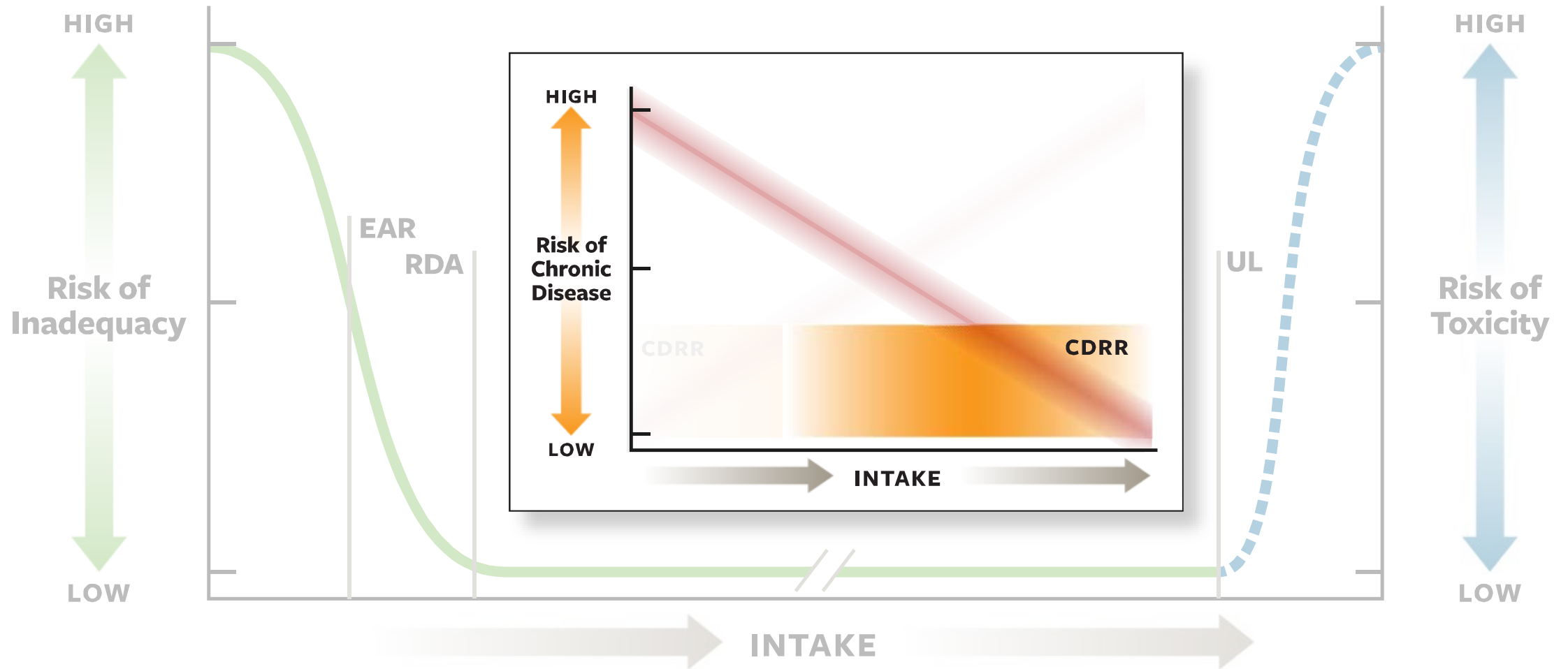
# Expanded Dietary Reference Intakes with CDRR and Chronic Disease Outcomes



# Expanded Dietary Reference Intakes with Chronic Disease Risk Reduction (CDRR) and Chronic Disease Outcomes

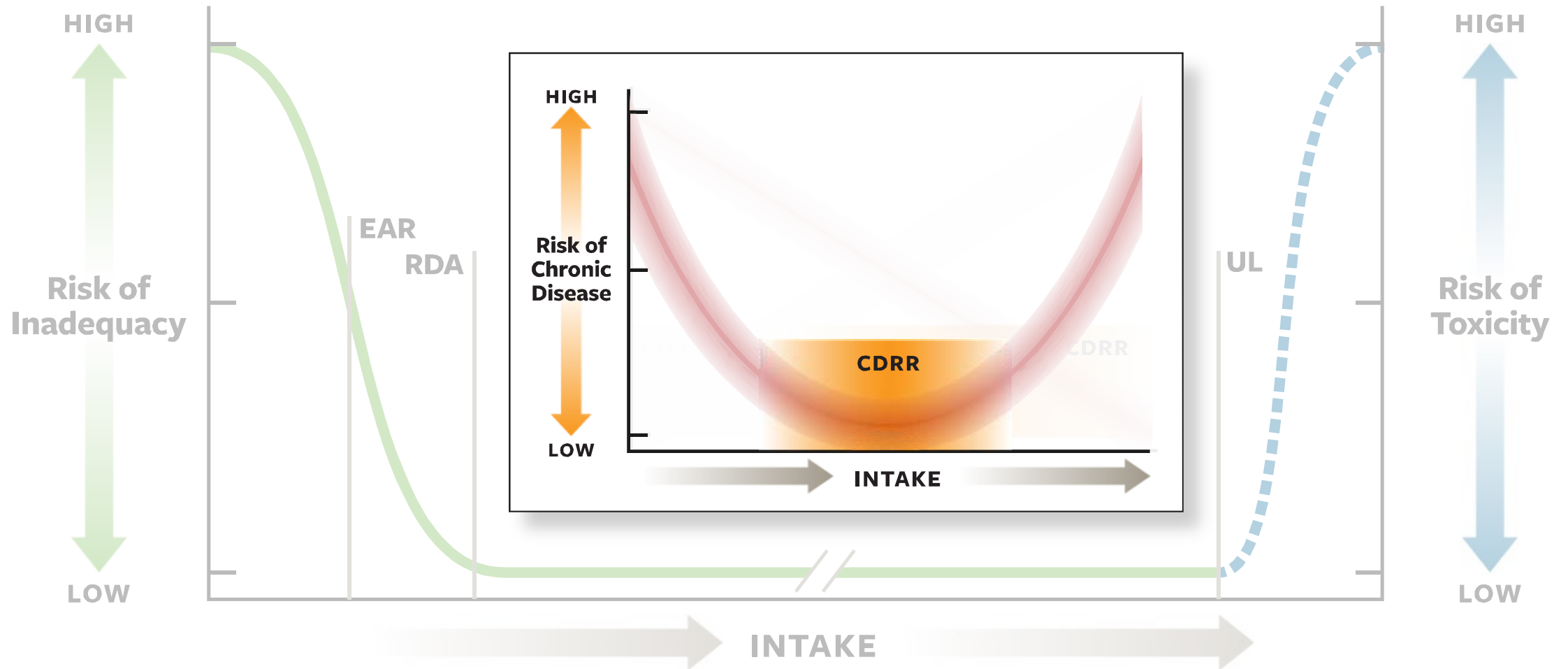


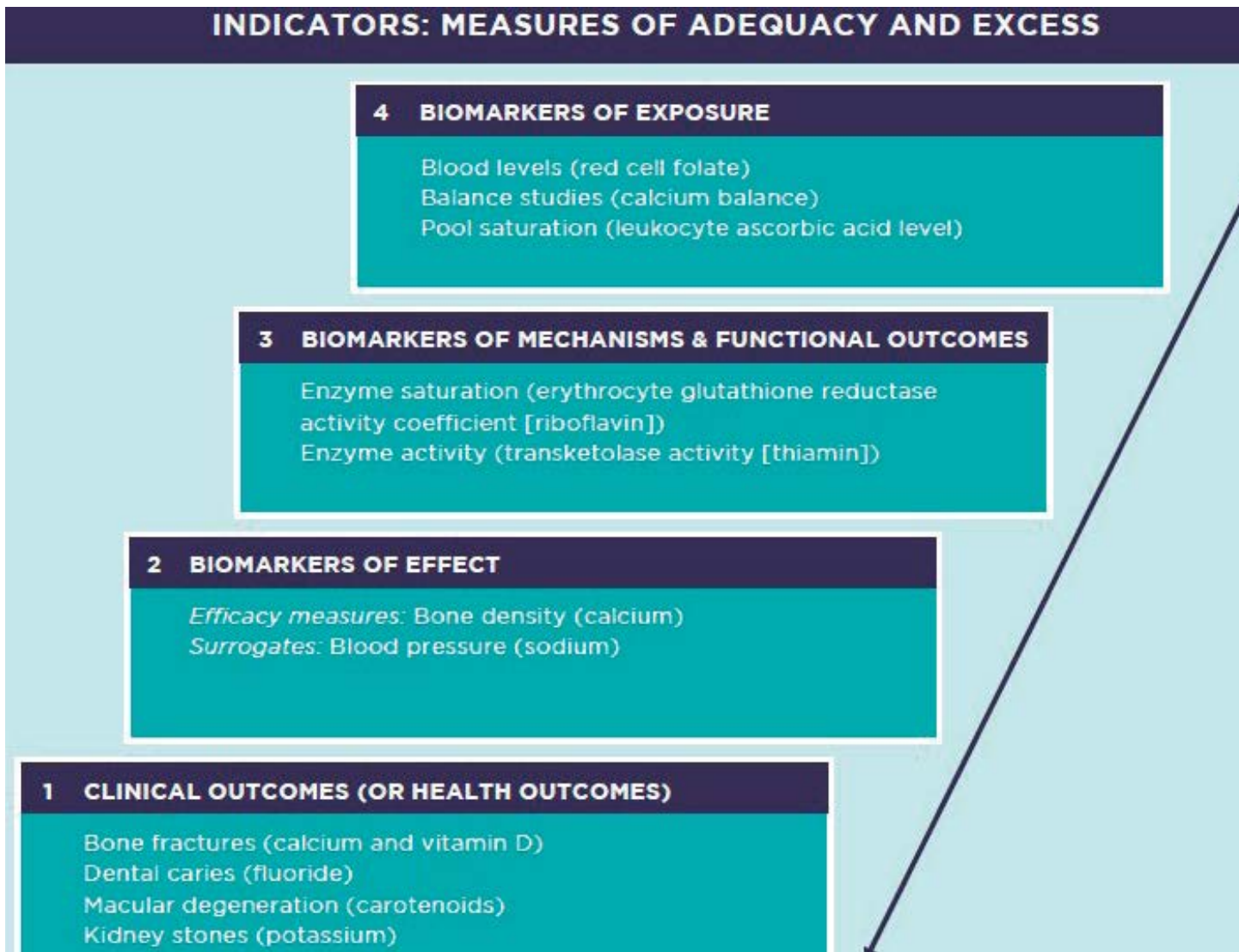
# Expanded Dietary Reference Intakes with Chronic Disease Risk Reduction (CDRR) and Chronic Disease Outcomes





# Expanded Dietary Reference Intakes with Chronic Disease Risk Reduction (CDRR) and Chronic Disease Outcomes





# Evidence for Selection of Adequacy/Toxicity Outcomes

- Indicator of status (biomarkers), on the causal pathway for disease of deficiency
- Direct evidence of disease of deficiency or adverse effect
- High certainty of causal & intake-response relationships for adequacy (RCT, metabolic/balance, depletion/repletion studies)



*Guiding Principles for Developing Dietary Reference Intakes Based on Chronic Disease Outcomes.* 2017, National Academies Press

Yetley et al. Am J Clin Nutr 2017; 105(Suppl):249S.

# Adequate Intakes (AI):

## When No Adequacy Outcome Identified

- **Currently 12 nutrients with AI based on**
  - DRI model (1997 to 2011) for Total Fat, w3 & w6 FA, Biotin, Choline, Vit K, Pantothenic Acid, Chromium, Fluoride, Manganese,
  - Expanded DRI model (2019) for Sodium & Potassium
- **OPPORTUNITY for Precision Nutrition to identify biomarkers & their variance**
  - Effect
  - Mechanistic or functional outcomes
  - Exposure

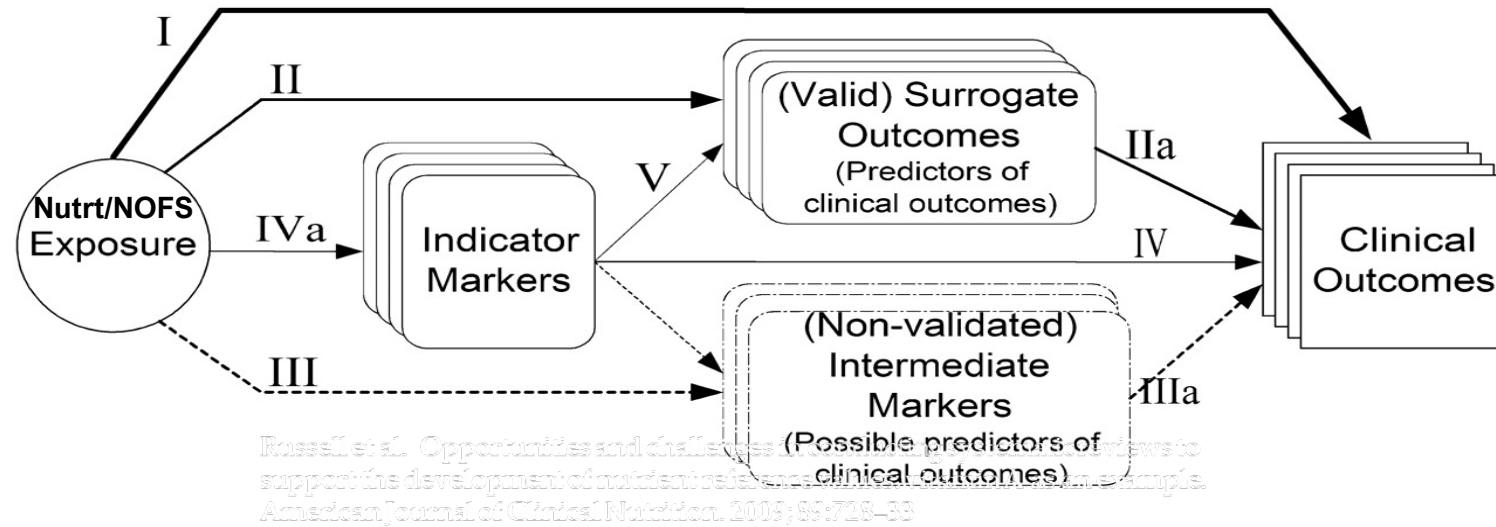


# Distinctions Between DRI for Adequacy and Chronic Disease

| DRI for Adequacy                                                                                        | DRI for Chronic Disease                                                                                                                           |
|---------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Needed because of deficiency (essential) or toxicity of a <u>nutrient</u> :                             | Not warranted unless sufficient evidence exists for <b>nutrient or naturally-occurring food substance (NOFS)</b> because risk of chronic disease: |
| <ul style="list-style-type: none"> <li>Affects everyone if intake is inadequate or excessive</li> </ul> | <ul style="list-style-type: none"> <li>Varies by individual, age and lifestage</li> <li>Is relative and can be small</li> </ul>                   |
| <ul style="list-style-type: none"> <li>Is caused by single nutrient</li> </ul>                          | <ul style="list-style-type: none"> <li>Related often to many factors (individual and environmental)</li> </ul>                                    |
| <ul style="list-style-type: none"> <li>Is prevented by nutritional interventions</li> </ul>             | <ul style="list-style-type: none"> <li>Is only partly ameliorated by nutritional intervention</li> </ul>                                          |

**OPPORTUNITY for Precision Nutrition:  
identify surrogate outcomes for chronic  
disease**

# Challenge for Precision Nutrition: Qualifying a Surrogate Outcome for Chronic Disease



For reproducible, analytically-validated surrogate outcomes, evidentiary process requires that the surrogate outcome:

- Is on causal pathway (observational and small intervention studies)
- Is concordant with changes in health outcome with specific nutritional intervention (rigorous clinical trials)
  - Explains a clinically significant proportion of response to nutritional intervention
- Predicts accurately (prognostic value) effect of nutritional intervention on clinical outcome (rigorous clinical trials)

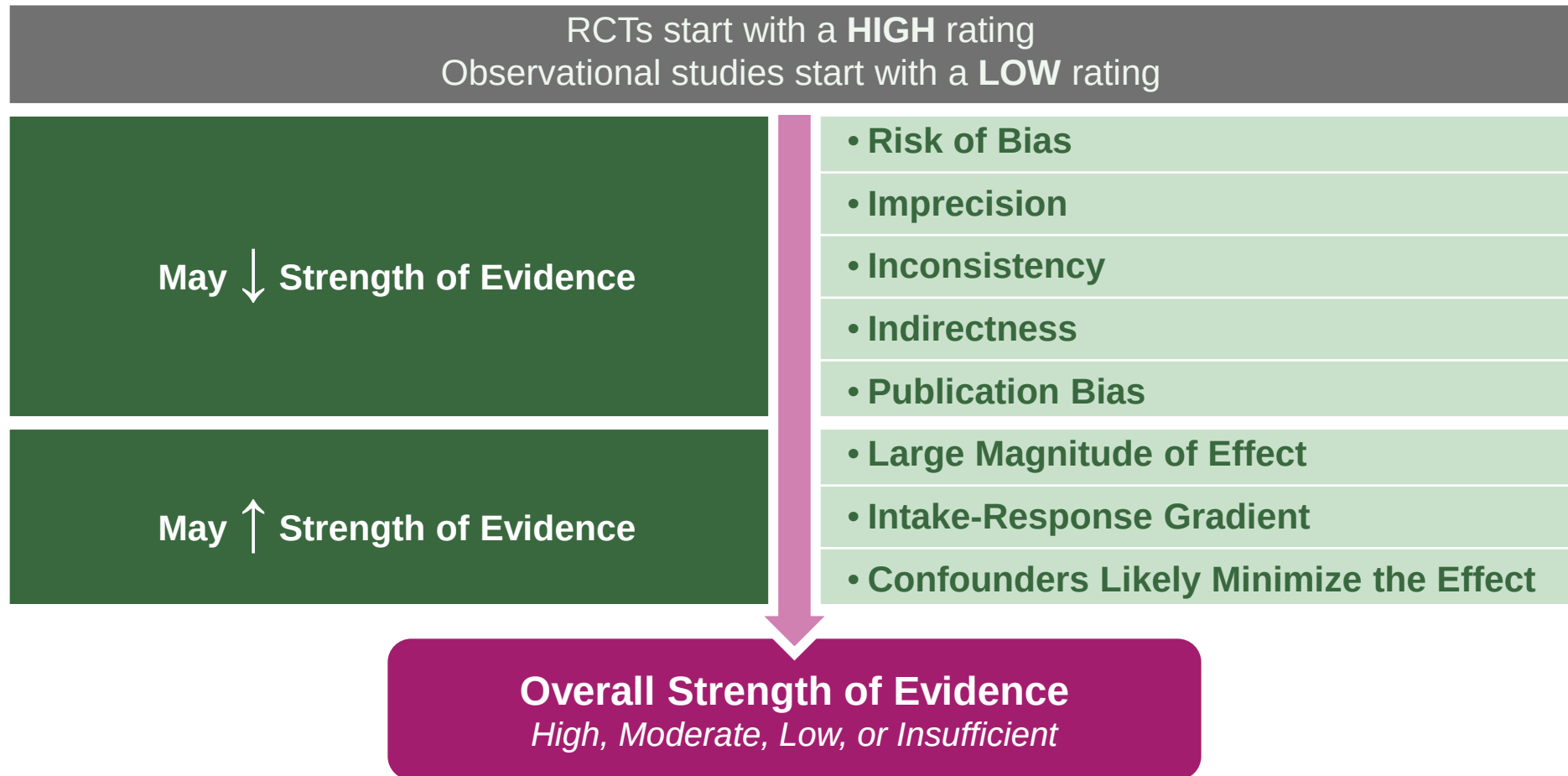
- **At least moderate** strength of evidence (GRADE) for **causal association** of nutrient or NOFS with chronic disease outcomes
  - Assess strength of evidence for single chronic disease outcome (IDEAL) or single **qualified** surrogate outcome individually (no aggregate of outcomes)
  - Nature of evidence may vary from that for adequacy
    - More evidence may be from observational studies than RCTs
    - Lower certainty of causal relation
      - Inherently higher risk of bias
        - Selection, confounding, etc.)
        - Methodologic (*intake assessment, exposure-disease continuum across lifespan, outcome assessment*)
          - More use of **qualified** surrogate outcomes
        - Publication

## Evidence for Selection of Chronic Disease Outcome



*Guiding Principles for Developing Dietary Reference Intakes Based on Chronic Disease Outcomes.* 2017, National Academies Press

# Evaluating Strength of Evidence to Support DRIs Using GRADE\*





# Opportunity for Precision Nutrition: Determine Sub-Groups in Population with Specific Needs

- Distinctly different distribution of requirement & responses
  - Vitamin D EAR: African Americans?
  - Dietary Patterns & Chronic Disease Risk (Dietary Guidelines)
- Responders versus Non-Responders
  - Sodium & CDRR
    - interior West African ancestry
    - Others
      - 2019 DRI Committee noted need to identify sodium sensitive individuals through determination of “rare and common genetic variants” and improved “methods.... discovery and validation of biomarkers in the blood or urine and use of proteomics and metabolomics to increase accuracy and facilitate implementation in *clinical* and public health settings”
  - Dietary Patterns & Chronic Disease Risk (Dietary Guidelines)





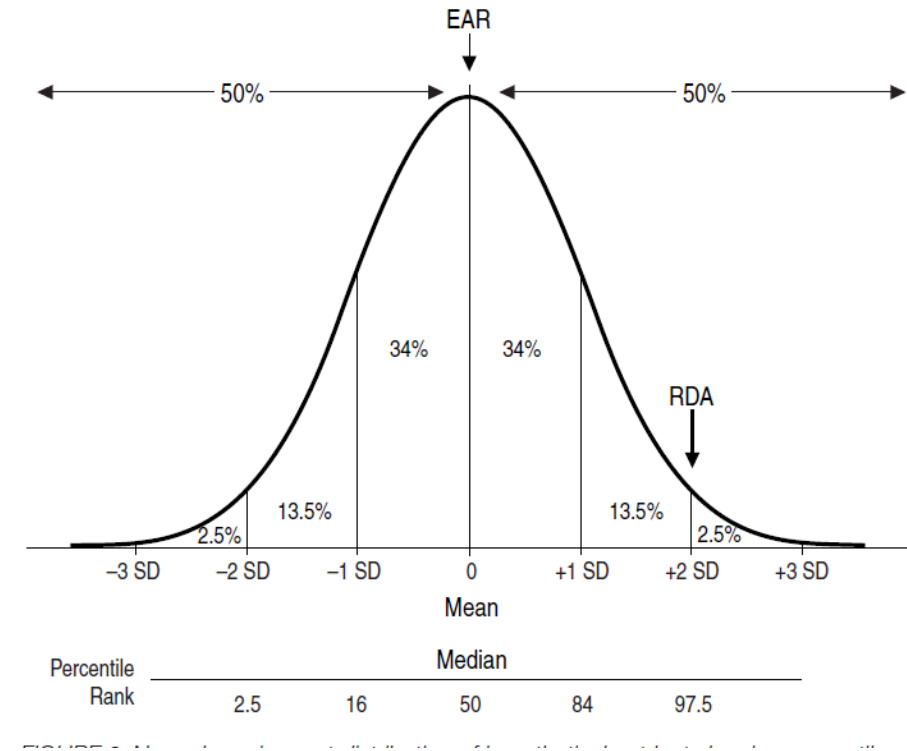
- **DRI process:**

- ☐ Defining a “healthy population” when prevalence of chronic disease is high

*Dietary Reference Intakes for Sodium and Potassium*. 2019, National Academies Press

# Individual Recommendations Based on Precision Nutrition

- Can individual algorithms be linked to public health guidelines?
  - DRIs
    - Adequacy
    - Chronic Disease
  - Dietary Guidelines
    - Tailor Dietary Patterns?
    - MyPlate
- What strength evidence will be required?



# Individual Guidelines Based on Precision Nutrition

Efficacy vs Effectiveness  
(T2) (T3)

- May relate to self-selection bias of participants in Precision Nutrition in current studies
- Consider Theories of Behavior Change beyond Socio-Ecological Model
  - *Health Belief Model*- perception of threat of health risk, benefits of avoiding risk & factors influencing decision to act (barriers, cues to action & self-efficacy)
  - *Theory of Planned Behavior* – relation of perceived control and individual's beliefs, attitudes, intentions, and behavior
  - *Transtheoretical Model* (Stages of Change) – individual's motivation & readiness to change
  - *The Precaution Adoption Process Model*- 7 stages from lack of awareness to action



# Reflections

- How can we develop blended models: public health & individual guidelines?
- What is communication strategy?
- How to ensure those at most risk have equitable access?
  - Uninsured (≈26 million American adults 2021), food insecure (est. 42 Americans 2021), homeless (0.5 million Americans 2021), least health-literate
  - SNAP (38 million) & WIC (6.2 million) participants
- How to ensure sufficient practitioners with appropriate scope & depth of training to implement individual guidelines & in what setting?



# Summary & Conclusions

- Develop blended models based on public health population approach and Precision Nutrition individualized approach
  - Need both public health food & nutrient based guidelines & individualized Precision Nutrition recommendations
- Opportunities for Precision Nutrition to inform public health guidelines
  - DRI
  - Dietary Guidelines
- Challenges for Precision Nutrition Implementation
  - Efficacy vs. Effectiveness
  - Equity & reduction of health & nutrition disparities

