سلطنة عمان
وزارة الثروة الزراعية والسمكية وموارد المياه

مركز سلامة وجودة الغذاء
FOOD SAFETY & QUALITY CENTER

أسبوع سلامة الغذاء
Food Safety week

رؤية عمان 2040

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نحو نظم غذائية مرنة ومتكيفة

Towards Resilient & Dynamic Food Systems

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Beyond Calories:
Beyond Calories: Unlocking the Potential of AI in Nutrition

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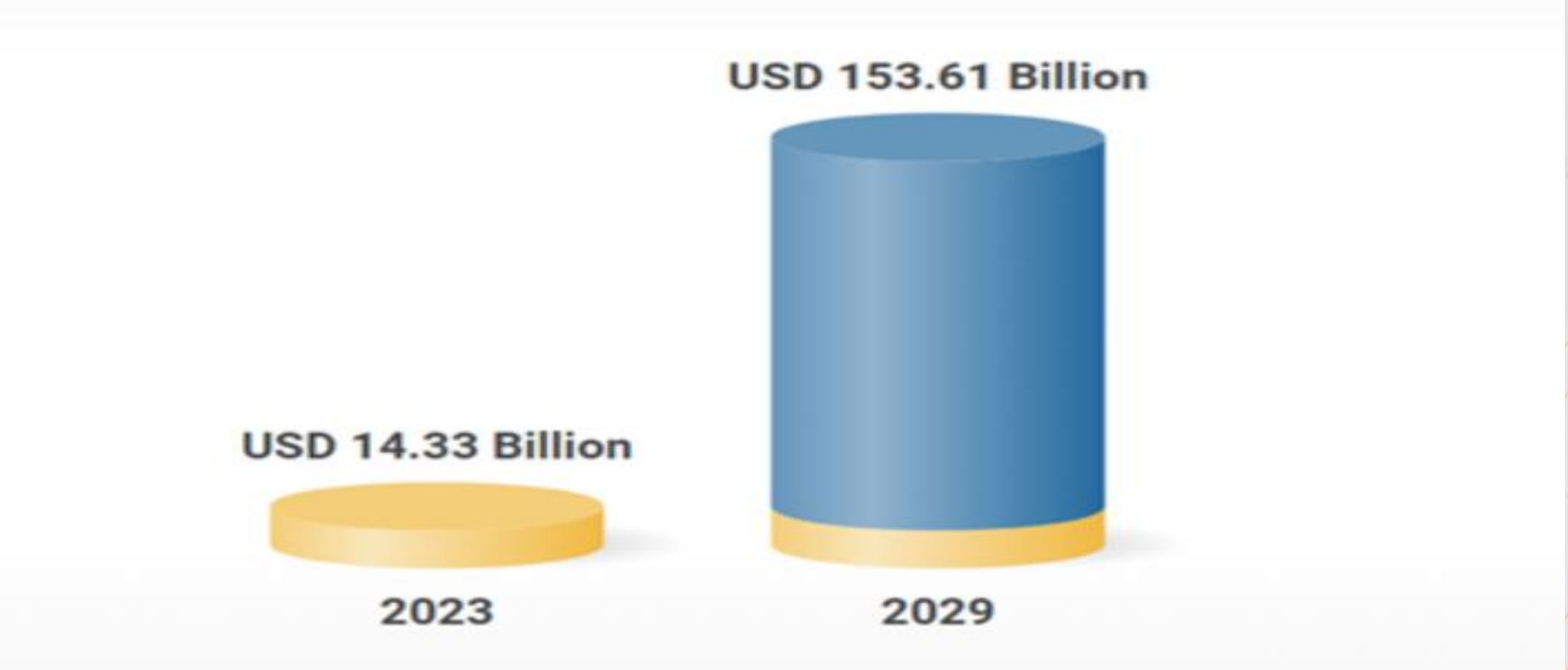
Artificial Intelligence (AI) in Healthcare Research Report 2024



(Research & Market, 2024)

AI in Personalized Nutrition: Market Growth Highlights

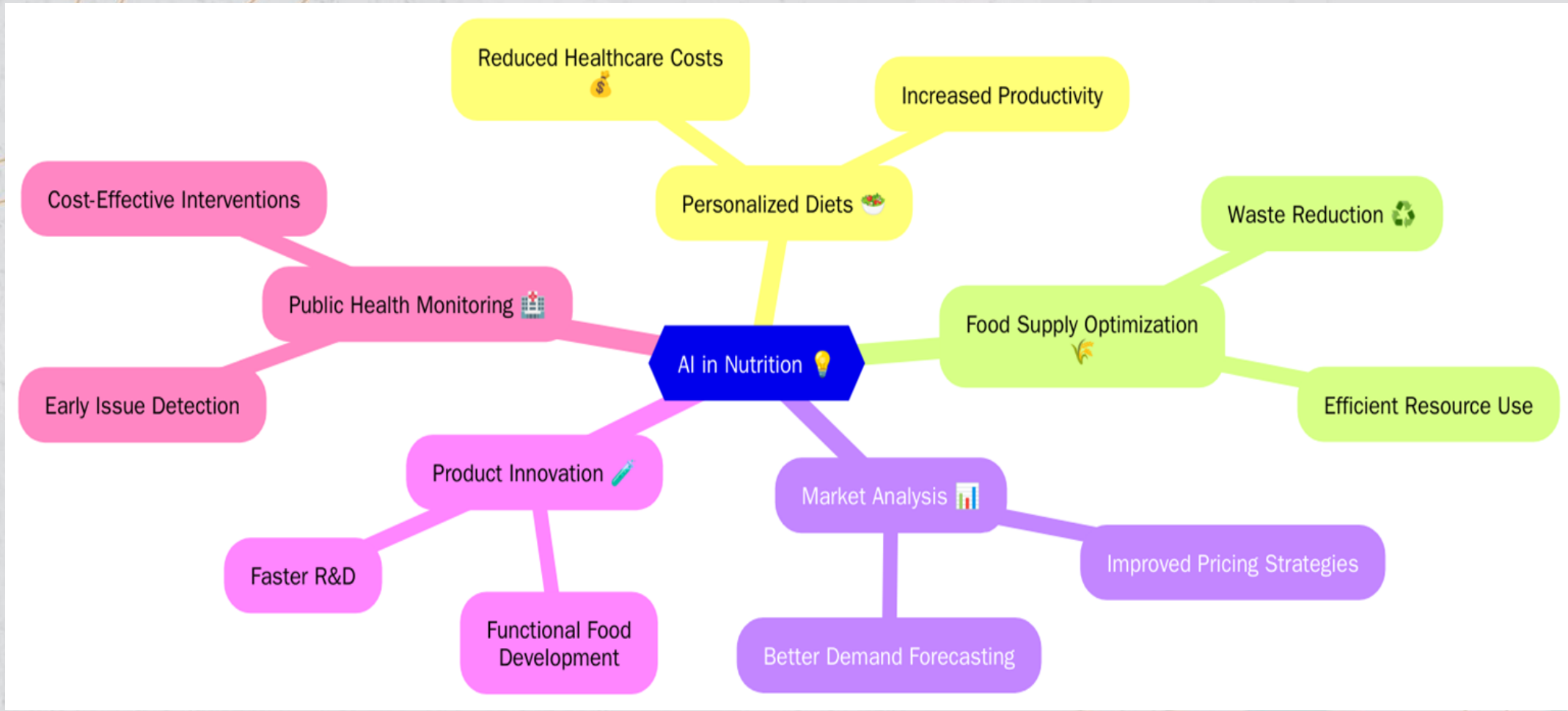
2022:
$1.6B

2023:
$2.96B

2024:
$3.66B

2028:
$8.51B
(Projected)

Economic Potential of AI in Nutrition

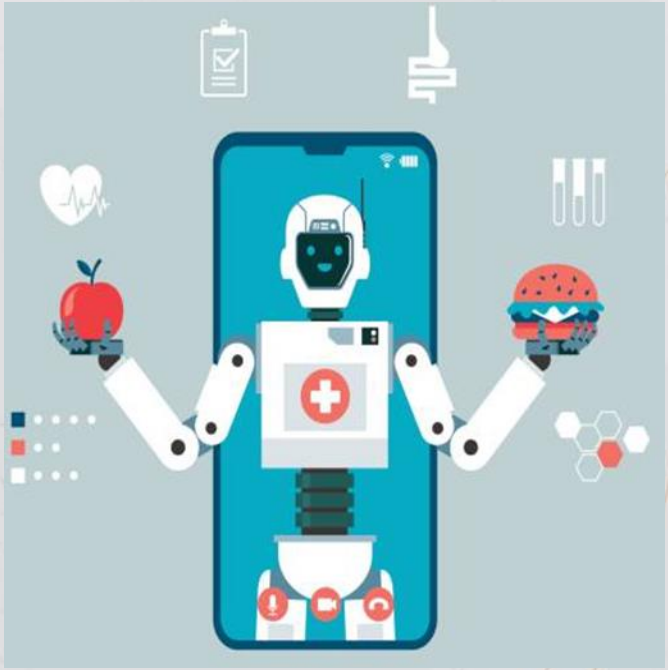


Background

Artificial intelligence (AI) encompasses technologies that mimic human intelligence and solve complex problems, using diverse strategies relevant to evidence synthesis.

Nutrition is a multifaceted science that examines how diet influences health and disease (Theodore Armand, et al., 2020)

The World Health Organization (WHO) identifies dietary factors as major contributors to global morbidity and mortality (WHO, 2021)



Machine learning

Equations

IoT

Desktop software

Device

Toolkit

Database

Nutris-Phone INTAKE
Diyetkolik DINO EurOFIR
Wellnavi FoodAI RiksmatenFlex
NutCrackerFFQ e-DA
FoodEx GloboDiet DASH
Nutricam Food4Me Well-D DietCam iFood
ALOHA Food2K e-DIA
NutriNet DeshiFoodBD FoodSeg eButton
myfood CAFD eBalance
OPEN NutPlan
Pinterest Foodbook

APP

Webserver

Food recognition and dietary record

Nutrient/recipe recommendations

Health monitoring

Intelligence

AI nutritionists

Applications

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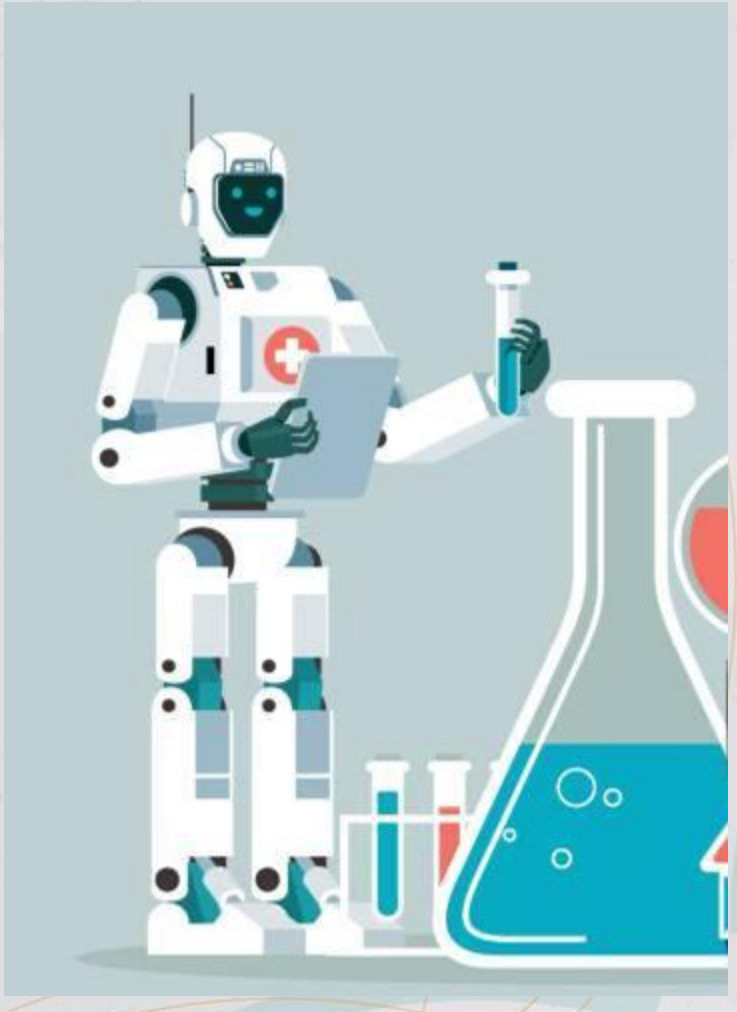
Background

AI in nutrition helps identify health risks and analyze databases, with strong growth expected in the next decade.

In clinical nutrition (CN), AI is transforming healthcare by linking food and health, enabling **dietary assessment** and personalized nutrition strategies..

It also supports disease management (e.g., CVD, diabetes, obesity), with strong growth expected.



Why Nutrition Guidance Is a Complex Data Challenge?

- Diverse and complex composition of foods and nutrients
- Wide variability in individual responses to dietary intake
- Multiple chronic diseases are influenced by nutrition
- Delayed onset of diet-related diseases due to long latency periods
- Lifelong, cumulative effects of dietary exposures

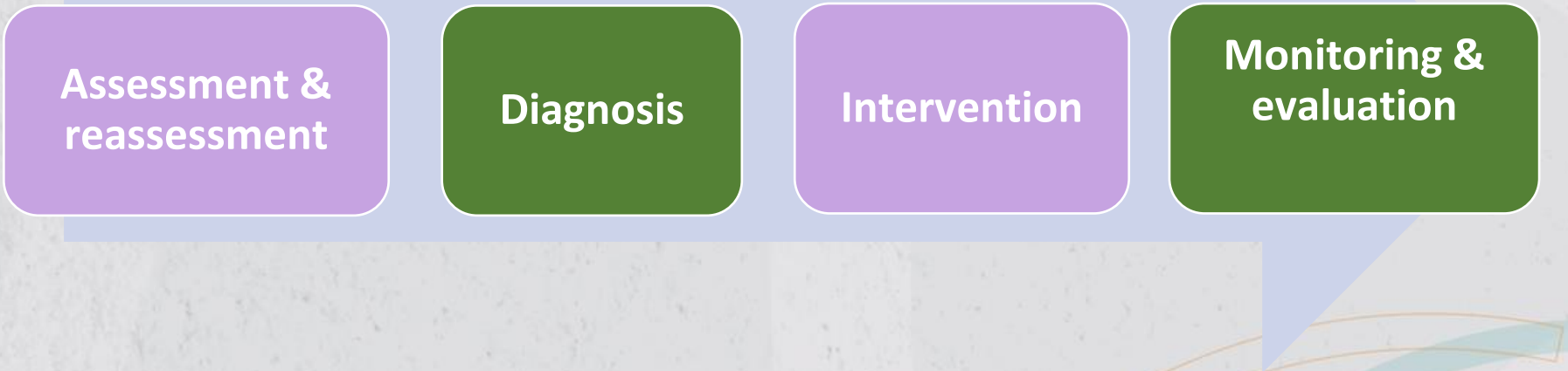
Potential Benefits of AI for Nutrition

- Improves care efficiency and effectiveness
- Supports nutrition research
- Elevates the role of qualified nutrition professionals

Nutrition Care Process (NCP): an overview

- A structured approach to provide **individualized nutrition care**.

- **Four steps:**



Role of AI in NCP

- Collects and processes complex health and dietary data
- Predicts optimal diets using machine learning
- Enables personalized meal plans and alerts

AI & NCP: AI-Driven Dietary Assessments

- *AI algorithms can analyze enormous amounts of dietary data to offer accurate insights into eating habits., including:*
  - **Nutritional status**
  - **Nutritional Deficiencies**
  - **Dietary intake,**
  - **Nutrients,**
  - **Portion sizes,**

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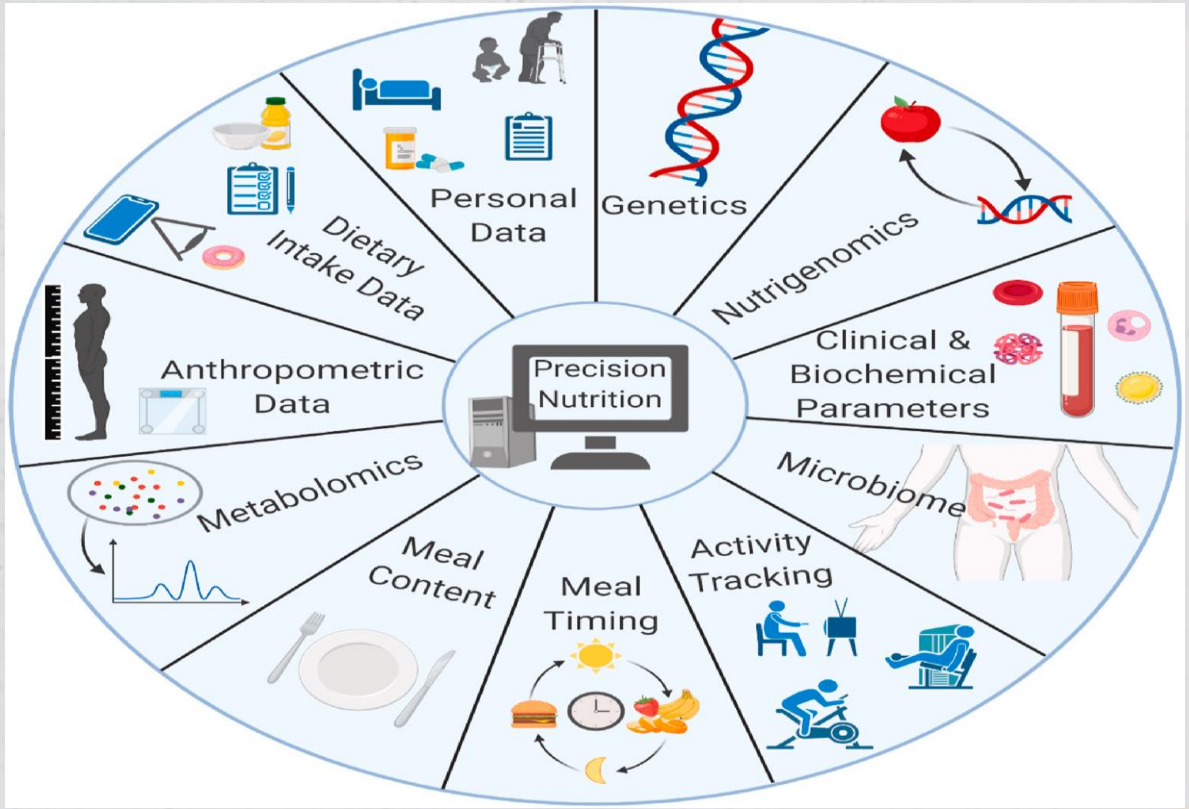
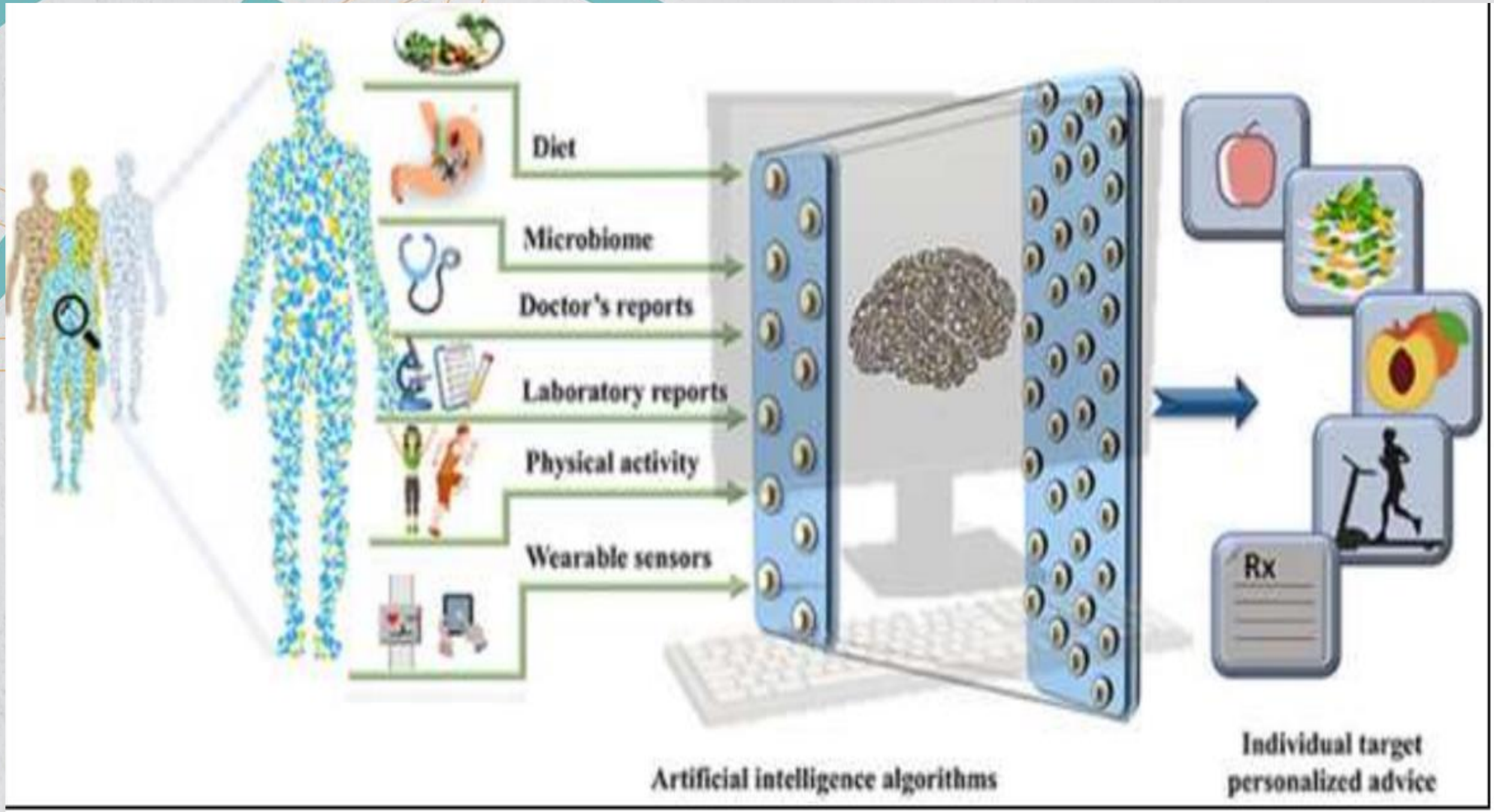
Feature data can be integrated into machine learning models to generate personalized nutrition advice.




Diet
Microbiome
Doctor's reports
Laboratory reports
Physical activity
Wearable sensors
Rx
Artificial intelligence algorithms
Individual target
personalized advice

AI for Nutrition Guidance

WEIGHT MANAGEMENT

MEAL PLANNING AND DIETARY RECOMMENDATIONS

PREDICTIVE ANALYSIS FOR HEALTH OUTCOMES

FOOD SENSITIVITY MANAGEMENT

NUTRIENT INTAKE TRACKING

Meal Planning and Recipe Recommendations

- AI-driven meal planning platforms
- Customized Meal Plans
- Taste Preferences Consideration
- Dietary Restriction
- Nutrient-Specific Recipes

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Predictive Nutrition and Health Outcomes

- Health Outcome Prediction
- Data-Driven Health Insights
- Early Disease Prevention
- Nutritional Deficiency Prevention

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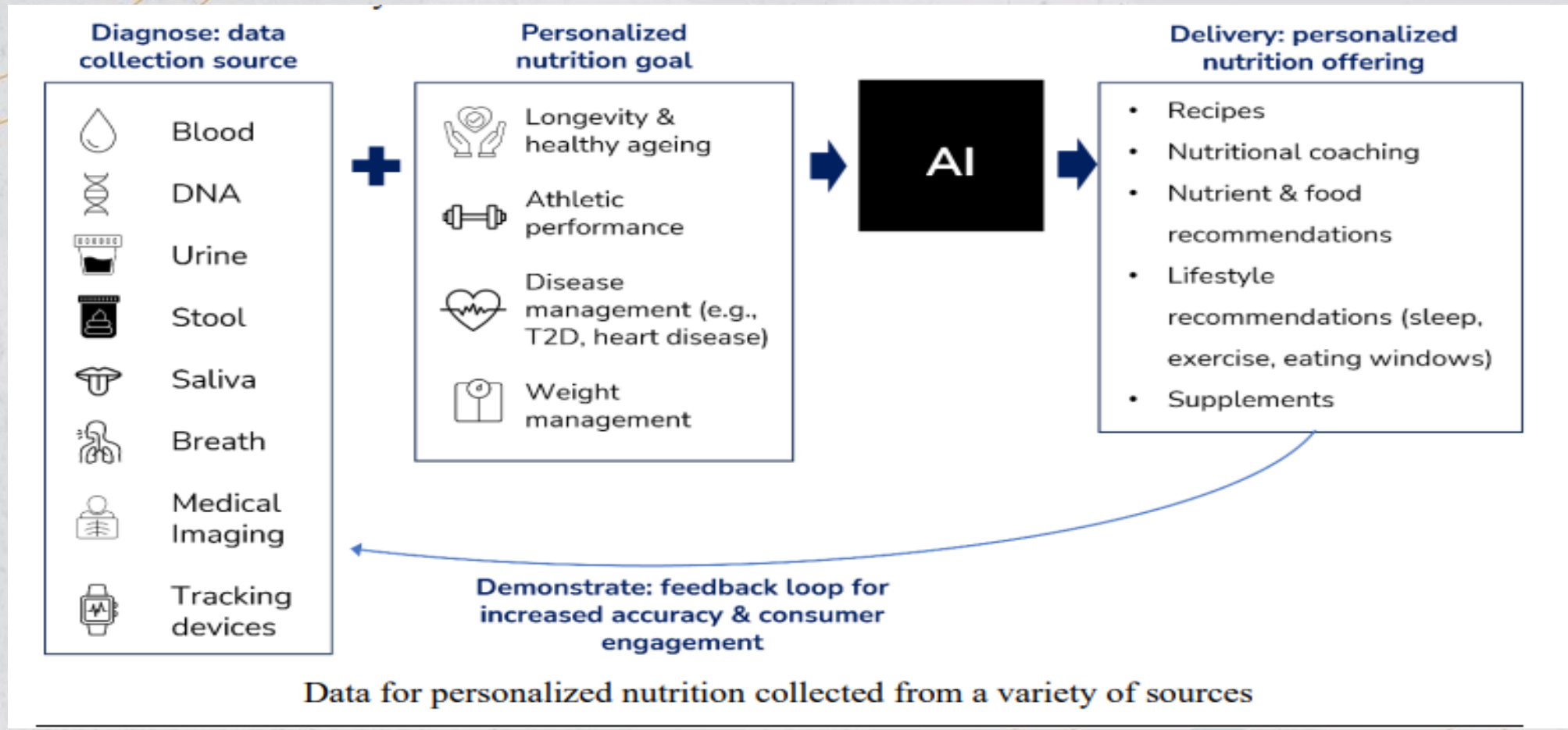
Benefits of AI in Personalized Diet Planning

1. **Precision and Customization:**
   - AI creates personalized diet plans based on **metabolism,** activity, and genetics.
   - Considers health needs (e.g**., low sodium for hypertension**) and taste preferences.
   - More effective than generic dietary guidelines.

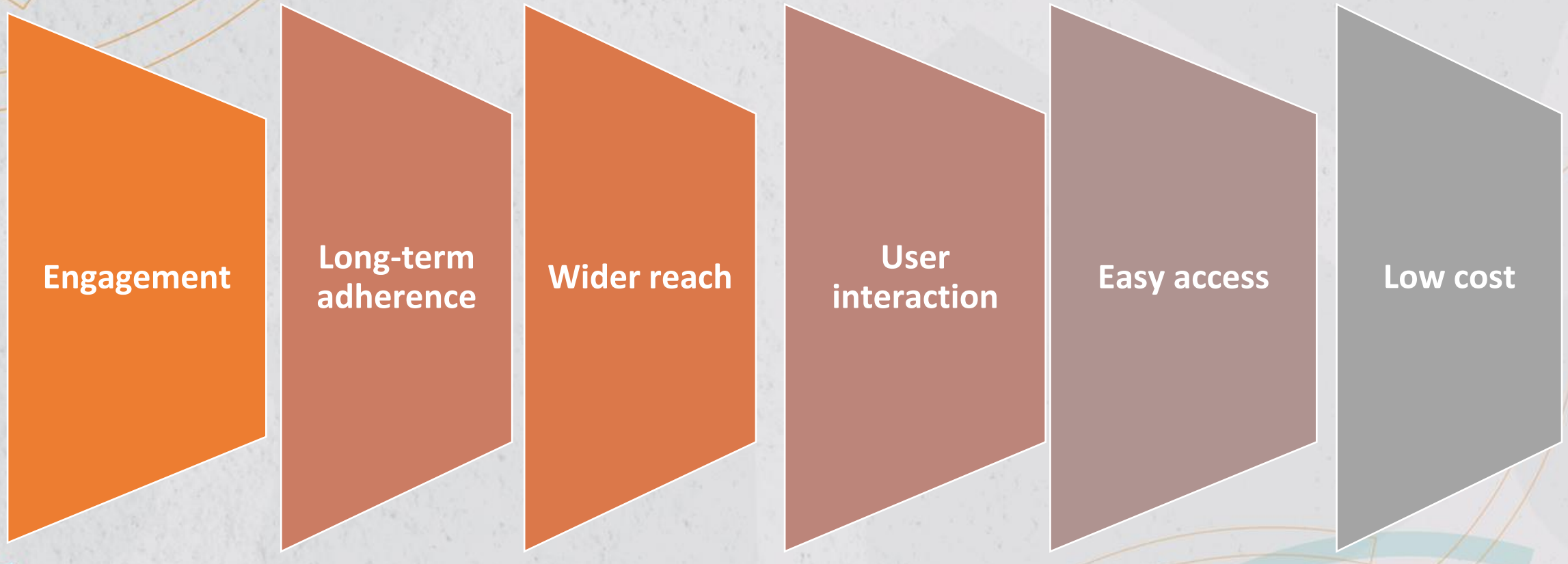
Data sources of personalized nutrition



Data for personalized nutrition collected from a variety of sources

Benefits of AI in Personalized Diet Planning:

2. Accessibility and End-User:



Benefits of AI in Personalized Diet Planning:

3. Real-Time Monitoring and Feedback

- Wearable and app-based tracking
- Real-time analysis of vitals and activity
- Instant dietary feedback
- Dynamic diet adjustments
- Enhanced adherence and nutritional outcomes

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Key AI Technologies

Natural Language Processing: Interprets food logs, health data

Machine Learning: Predicts health responses

Deep Learning: Identifies dietary patterns

Decision Support Systems: Recommends food choices

Applications of AI in Nutrition

AI Technique	Description
NLP (Natural Language Processing)	AI chatbots provide **personalized dietary recommendations** and guide users on **portion sizes**, activity goals, and **dietary changes**
Machine Learning (ML)	Analyzes data to generate personalized nutrition recommendations, monitor **food intake**, and identify **dietary patterns**
Deep Learning (DL)	Uses artificial neural networks to identify features within data, aiding in **nutrient prediction** and creating **individualized diets**.
Apps like ChatGPT	Evaluated for generating **dietary recommendations**. Found to align with guidelines but had inaccuracies in energy and allergen detection
Comparison with Food4Me	A study comparing ChatGPT to Food4Me found errors in linking nutrients to specific foods
ChatGPT in Clinical Settings	AI-generated diets were found to closely match **weight-loss plans** used in clinical settings
Wearable & Mobile	Monitors nutrition, **food intake**, and behavior through **wearable**

Application of AI in clinical nutrition

AI Technique	Description
Deep learning (DL)	Deep learning (DL) allows for rapid muscle mass evaluations through CT imaging, (currently implemented in research settings and some clinical centers) predicts early enteral nutrition needs for ICU patients, (still requires more large-scale validation studies before widespread clinical adoption), and verifies nasogastric tube (NGT) placement with chest X-rays (being actively used in many hospitals)
Machine learning (ML)	Assess the risk of refeeding syndrome, (currently experimental/research phase) while wearable devices monitor hydration (partially implemented), and detect infections in patients on home parenteral support (primarily experimental)
AI-integrated smart toilets	Monitor bowel movements, detect blood in the stool, and measure stool or stoma output, providing valuable data for managing hydration and fluid balance. (Primarily experimental/prototype phase)
Machine learning (ML)	Predict the likelihood and severity of adverse drug reactions based on factors like circulatory system diseases and parenteral nutrition in critically ill neonates. (Partially implemented in specialized centers)
Machine learning (ML)	Identifying malnutrition in cancer patients shows moderate agreement with established tools like the Patient-Generated Subjective Global Assessment. (Currently in transitional phase between experimental and implemented)
Advanced AI-assisted radiological imaging	Integrating malnutrition screening can enhance the detection of sarcopenia and accurate risk identification. (Partially implemented in clinical settings)

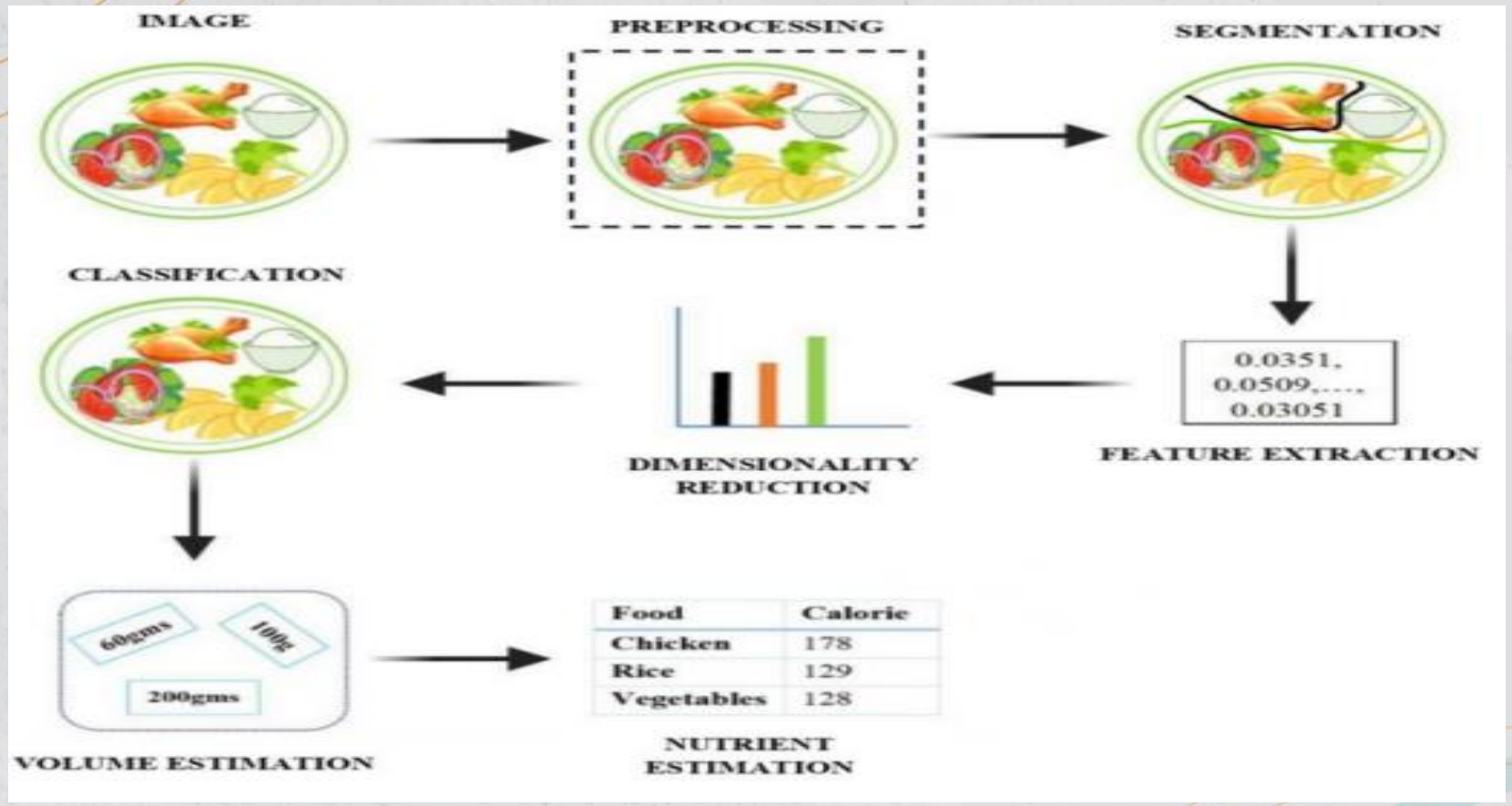
(Kassim, et., 2025)

Application of AI in clinical nutrition

AI Technique	Description
Extreme gradient boosting	Predict refeeding hypophosphatemia in ICU patients resuming enteral or parenteral nutrition after prolonged fasting. (Primarily experimental/research phase)
Deep learning (DL) and machine learning (ML)	Predict feeding intolerance in septic ICU patients based on nutrient type, feeding method, and health conditions. (Primarily experimental phase)
MUST-Plus model	Uses electronic health record (EHR) data and machine learning to accurately predict malnutrition risk by analyzing clinical assessments, physiological data, and lab results. (Partially implemented in selected healthcare systems)
eTRIP app	Supports weight loss with self-monitoring, AI-assisted behavioural nudging system. (Experimental phase)
XGBoost	Predict a patient's 1-year HbA1c change and help nutritionists make informed decisions about appropriate nutritional interventions. (Research/validation phase)
Explainable AI (XAI) and fuzzy logic-based reasoning	Used in clinical decision support systems (CDSS) to assess nutrition-related issues in geriatric patients, such as malnutrition, oropharyngeal dysphagia, dehydration, and eating disorders in those with dementia. (Limited clinical implementation)
A prototype CDSS	Assesses malnutrition and related issues in geriatric patients with high accuracy compared to expert evaluations. (Experimental/prototype phase)
Supervised learning Unsupervised learning Deep learning Cognitive learning Metamodeling-based sensitivity analysis	AI offers scalable solutions to tackle malnutrition using modeling strategies for classification, pattern recognition, predictions, language processing, and identifying actionable patterns in clinical parameters. (Full integration varies by institution)
Convolutional neural network (CNN)	Identifies children at risk of malnutrition and provides personalized intervention recommendations. (Experimental phase)

(Kassim, et., 2025)

Example 1: AI assisted diet identification for calorie calculation



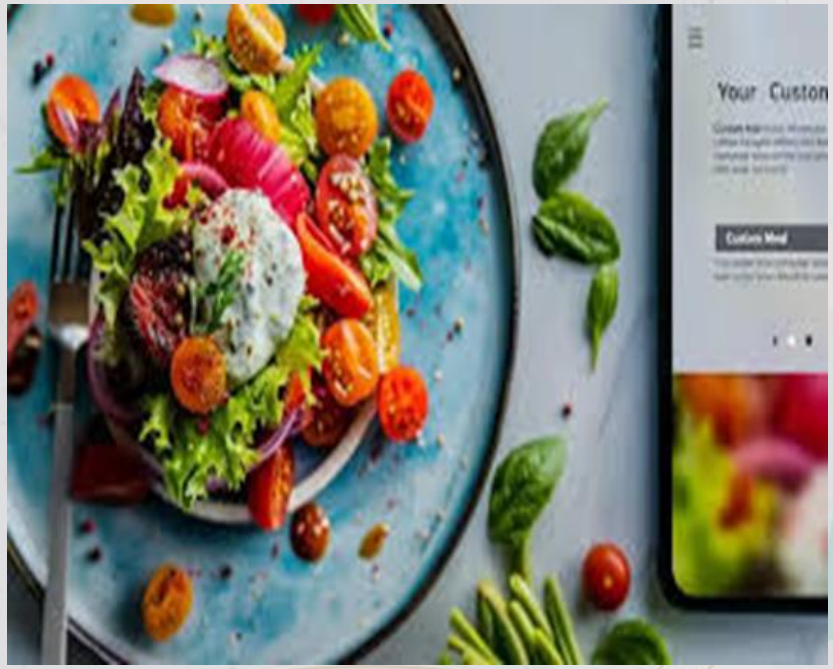
Example 2: AI benefits in nutrition

AI improves **malnutrition screening** with the MUST-Plus model, using Electronic Health Records (EHR) data and machine learning to predict risk from clinical and lab data.


HERE'S YOUR ORDER!

Impacts and Considerations of AI in Nutrition Care

- Enhances patient outcomes with personalized, evidence-based diets
- Assists healthcare professionals in providing tailored nutrition advice
- Demands careful oversight for safe and ethical use
- Enables patient self-monitoring through AI tools like wearables
- Supports personalized management of diet-related health issues



Challenges of AI in Nutrition

Data privacy & consent

Algorithm bias & lack of diversity in datasets

Limited access to AI tools in low-resource settings

Clinical validation required

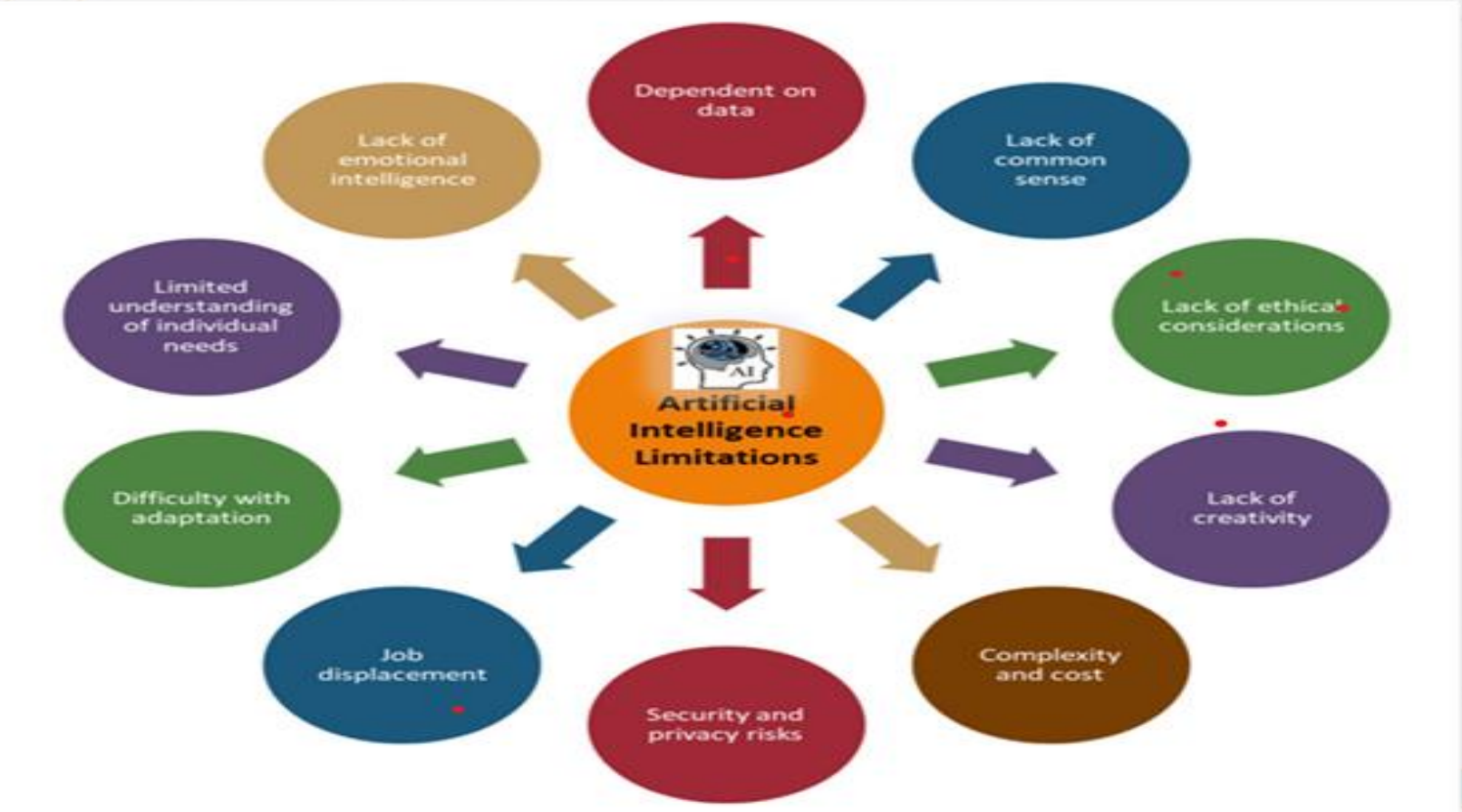
AI Use in Healthcare: Key Considerations

Understand, interpret, and explain AI outputs clearly.

Use AI only when benefits outweigh potential risks.

Apply AI responsibly and ethically (WHO, 2021)

AI Limitations



Future Directions

Advancements in AI for Nutrition

Ethical Framework and Regulatory Standards

Integration with wearable health devices

Use of lipidomics, microbiome, genetic data

Development of global standards for AI in nutrition

Human-AI collaboration for clinical decision-making

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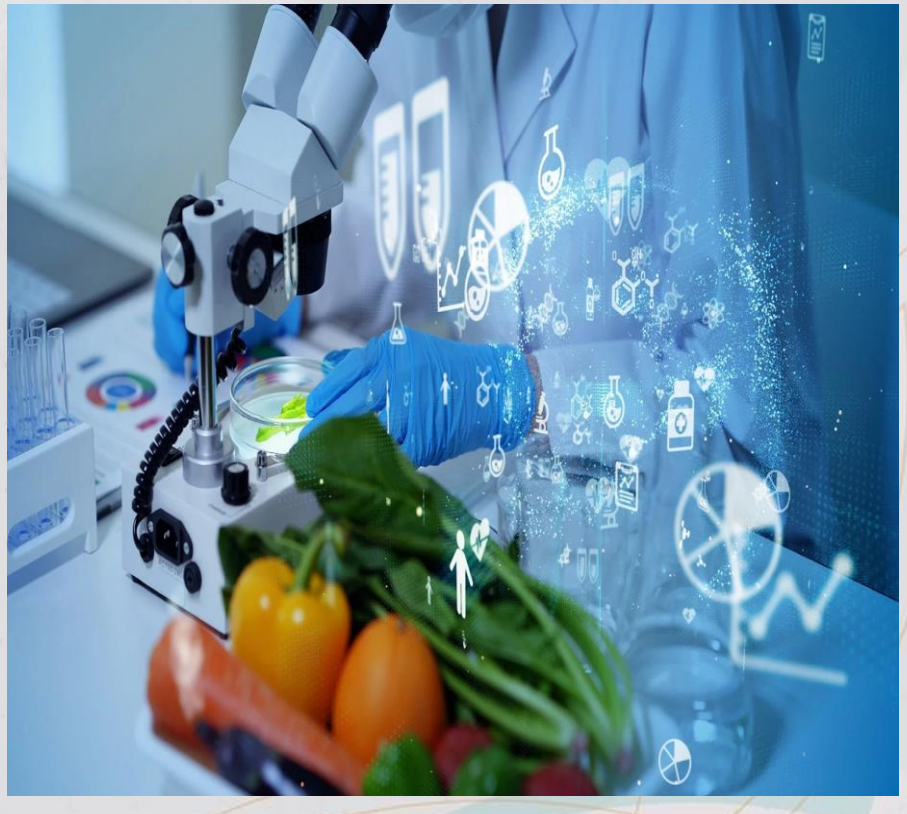
Conclusion

- AI may enhance individualization of dietary advice
- Promising for the management of non-communicable diseases
- Nutrition and ethics must remain priorities
- Collaboration across disciplines is key



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Thank you

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