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AI-Powered Probiotic Assessment: Potentials and Challenges

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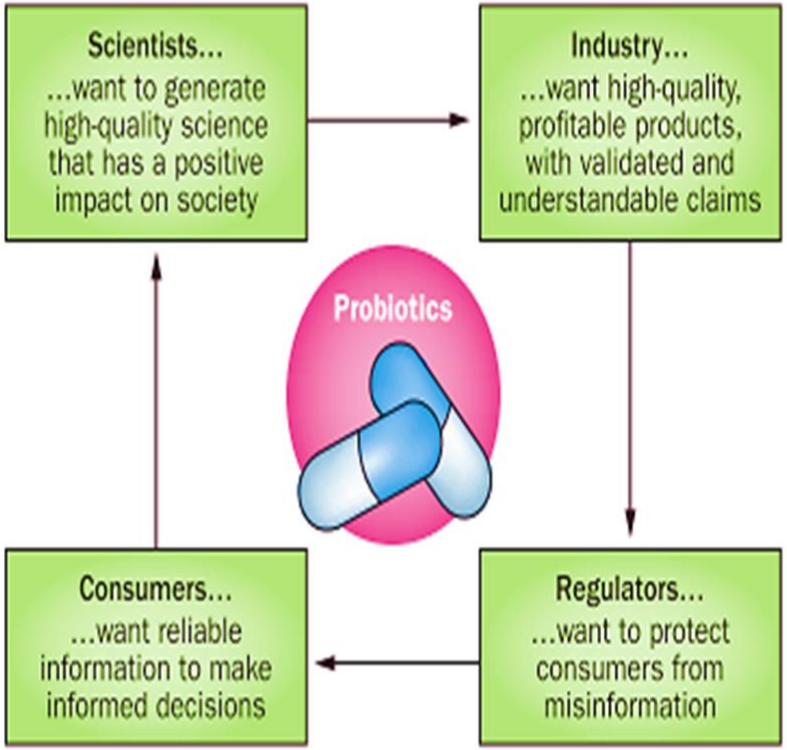
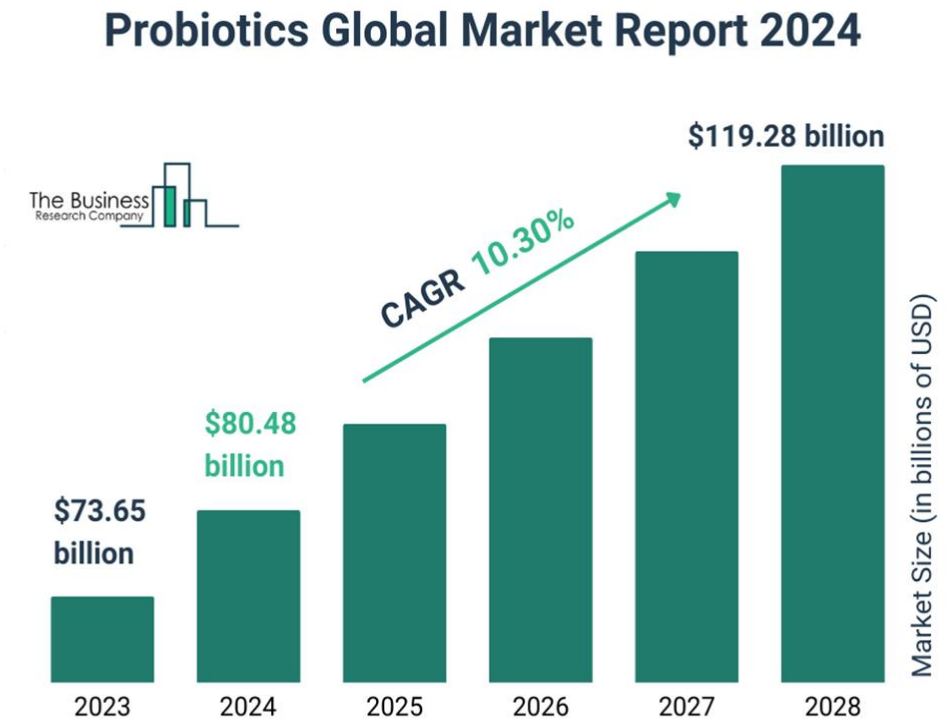
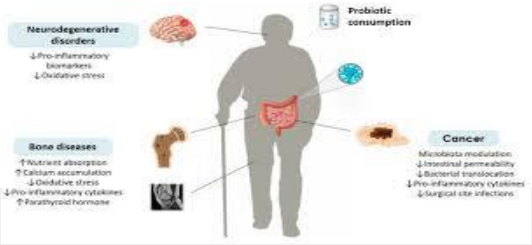
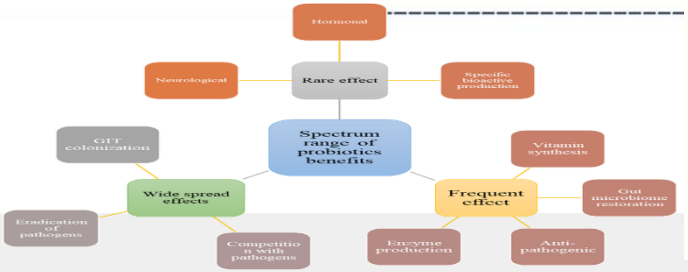
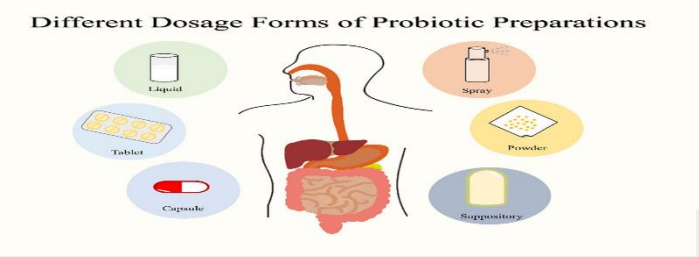
Scope of Probiotics: Multidimensional spectra of probiotics



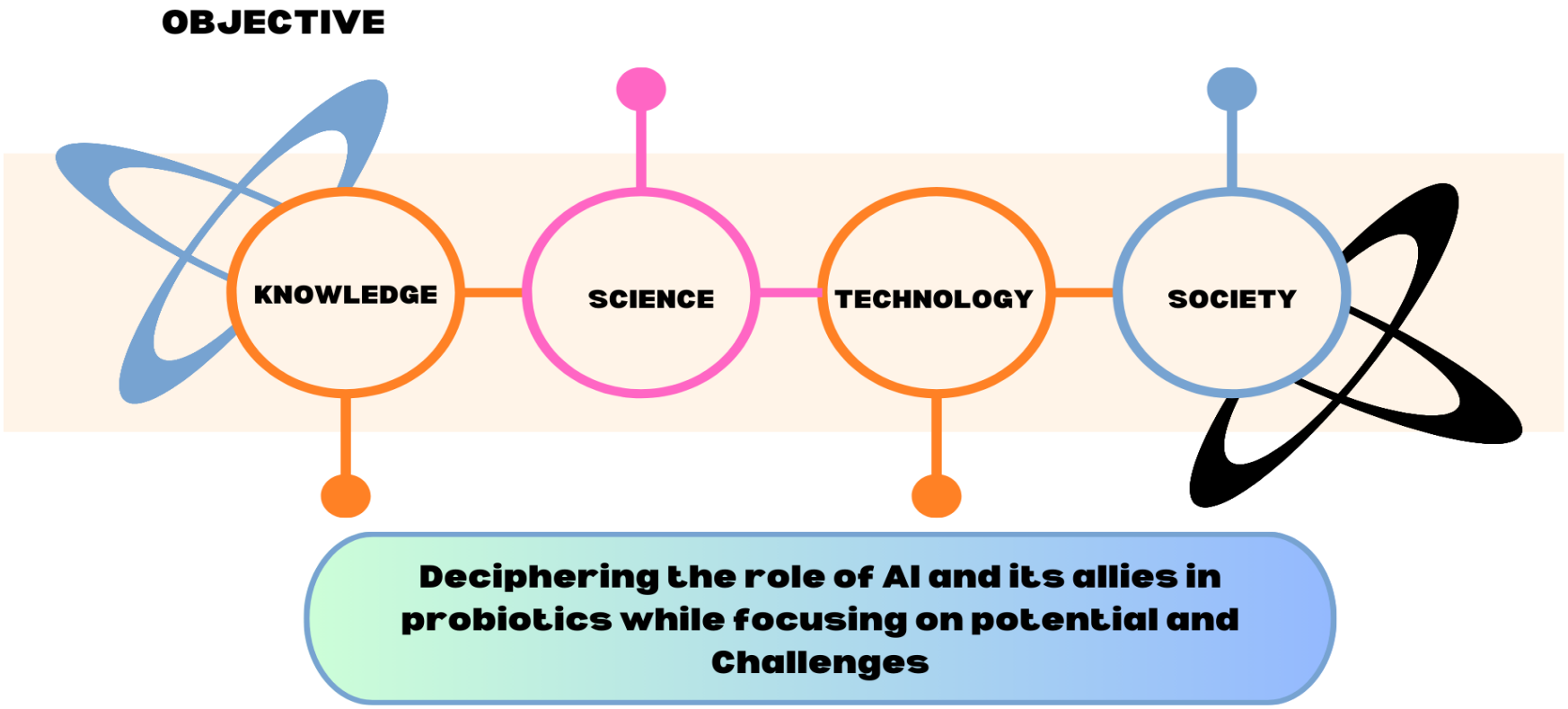








Aim of presentation



Probiotics Definition: WHO, FAO, and ISAPP

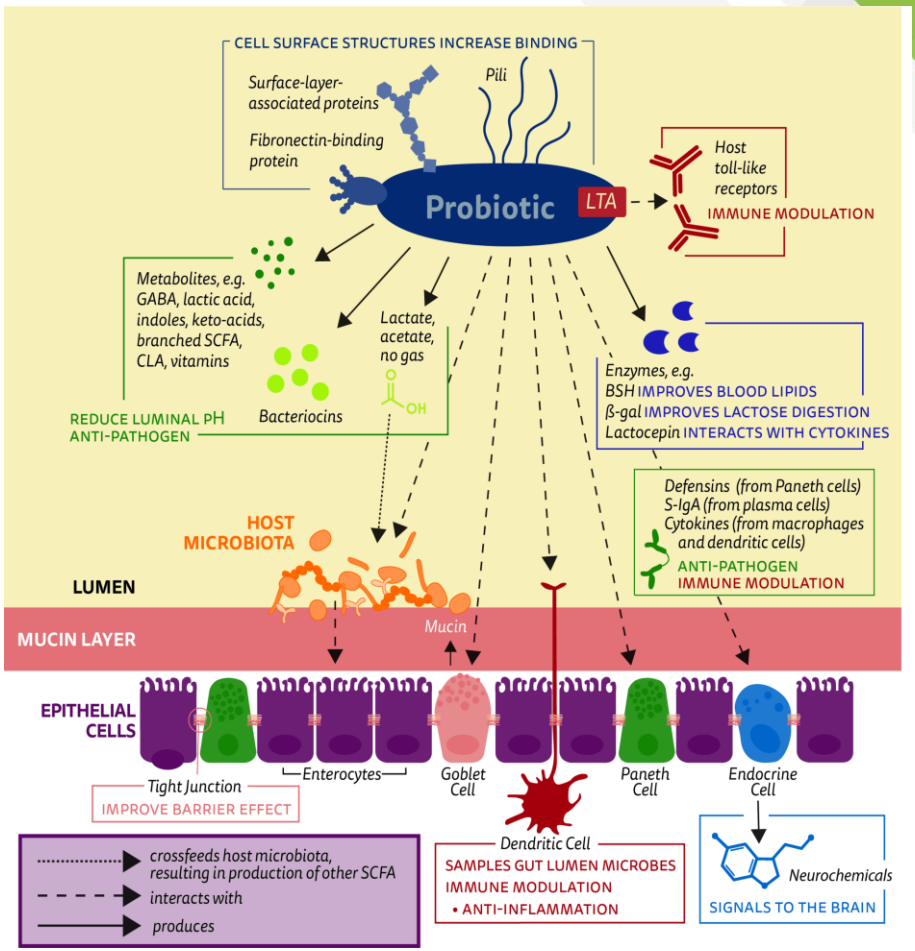
WHO/FAO in 2002:

The World Health Organization (WHO) defines probiotics as ”live microorganisms that can provide health benefits when taken in adequate amounts”.

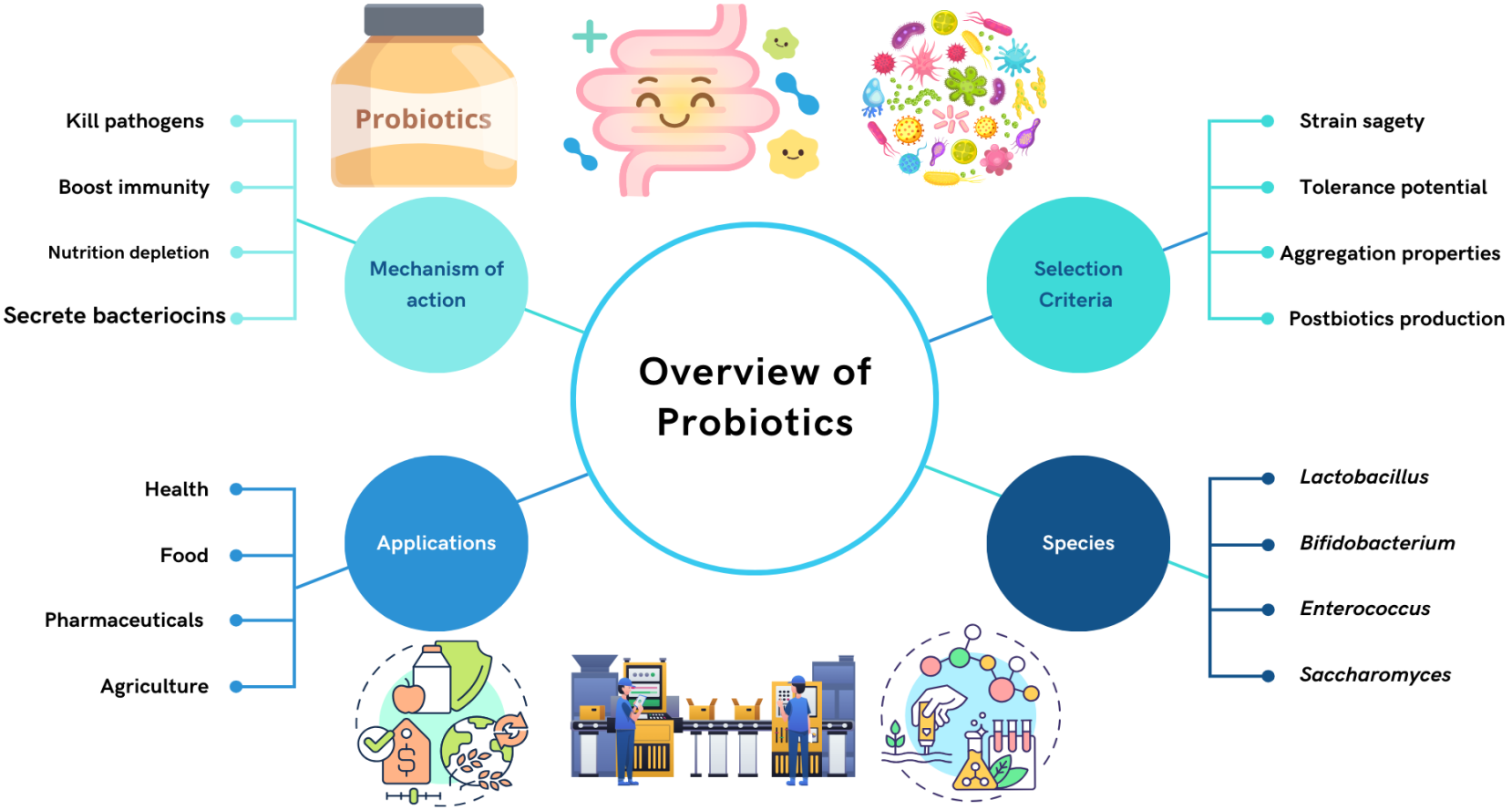
ISAPP in 2013:

The International Scientific Association for Probiotics and Prebiotics (ISAPP)

“live microorganisms that, when administered in adequate amounts, confer a health benefit on the host”.



Probiotics in a glance



Current scenario of probiotics

Advancement in probiotics

- Conventional probiotics
- Next-generation probiotics
- Engineered probiotics
- CRISPR-biotics
- Personalized probiotics

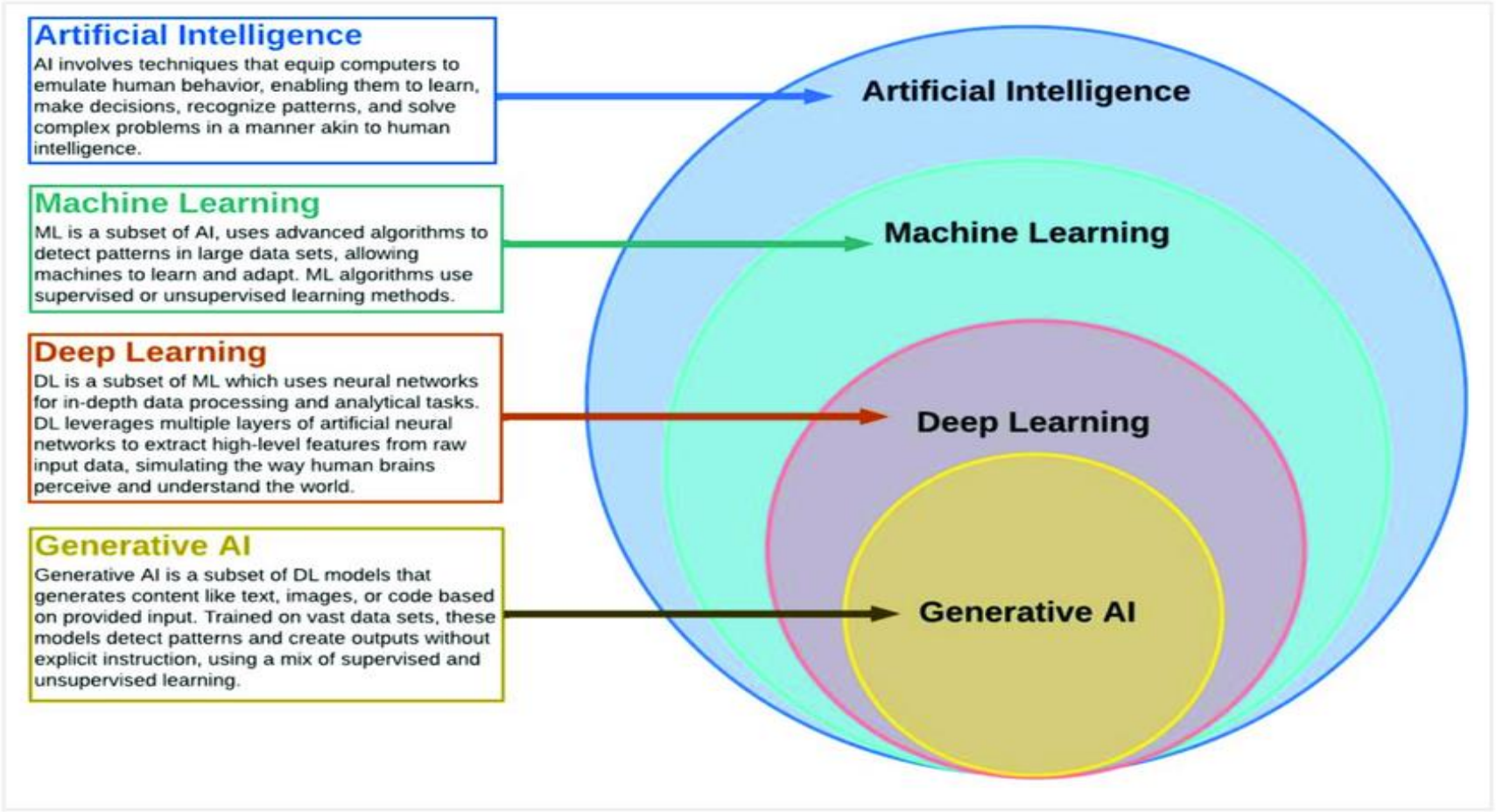
Challenges in probiotics

- Screening
- Large data analysis
- Complexity of the system
- Accuracy of data
- Quality control properties

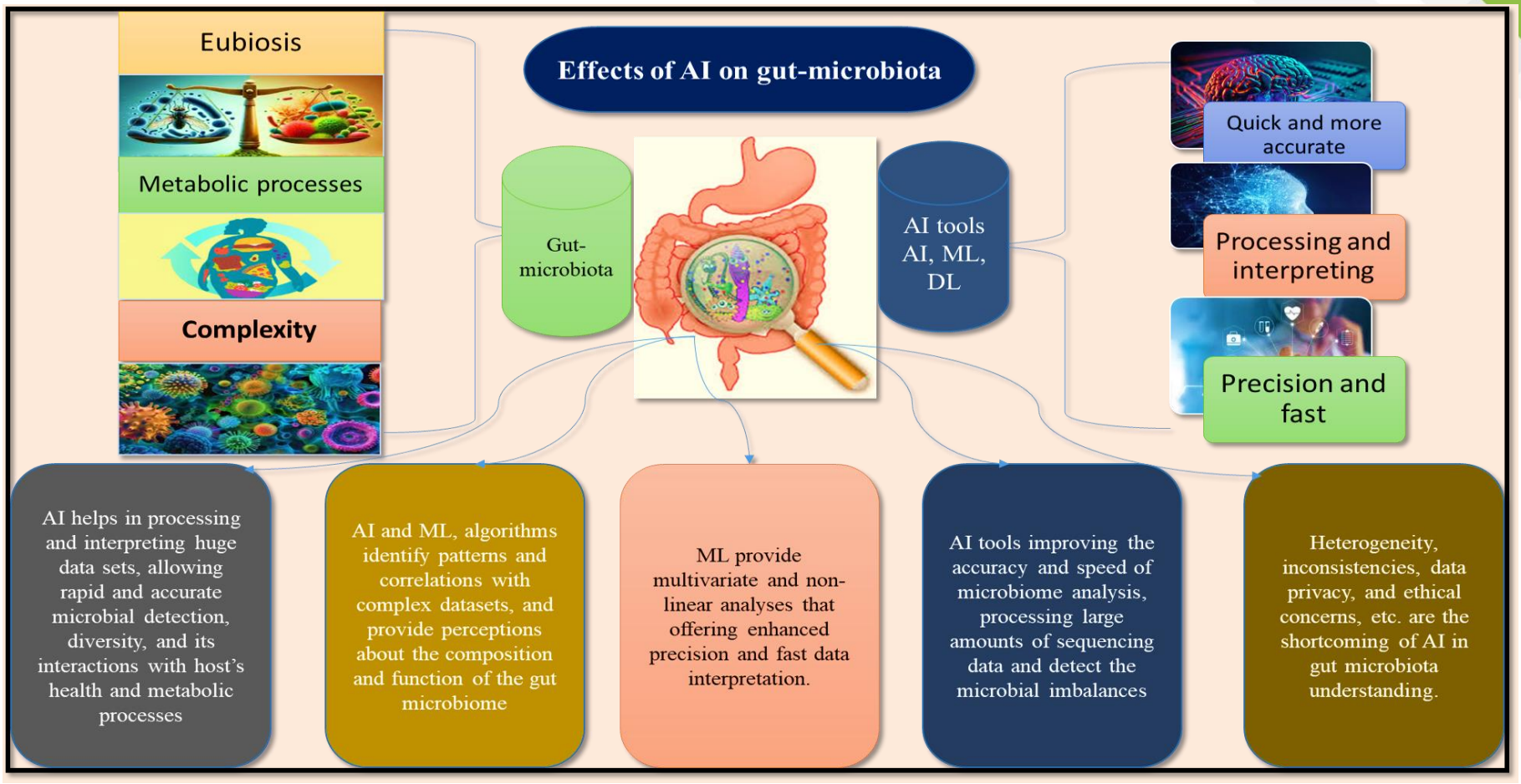
Shortcomings

Time-consuming → Results compromised → No-automation → Low sensitivity → Less specificity → Not accurate

Artificial Intelligence and its allies



Artificial intelligence (AI) and gut microbiota

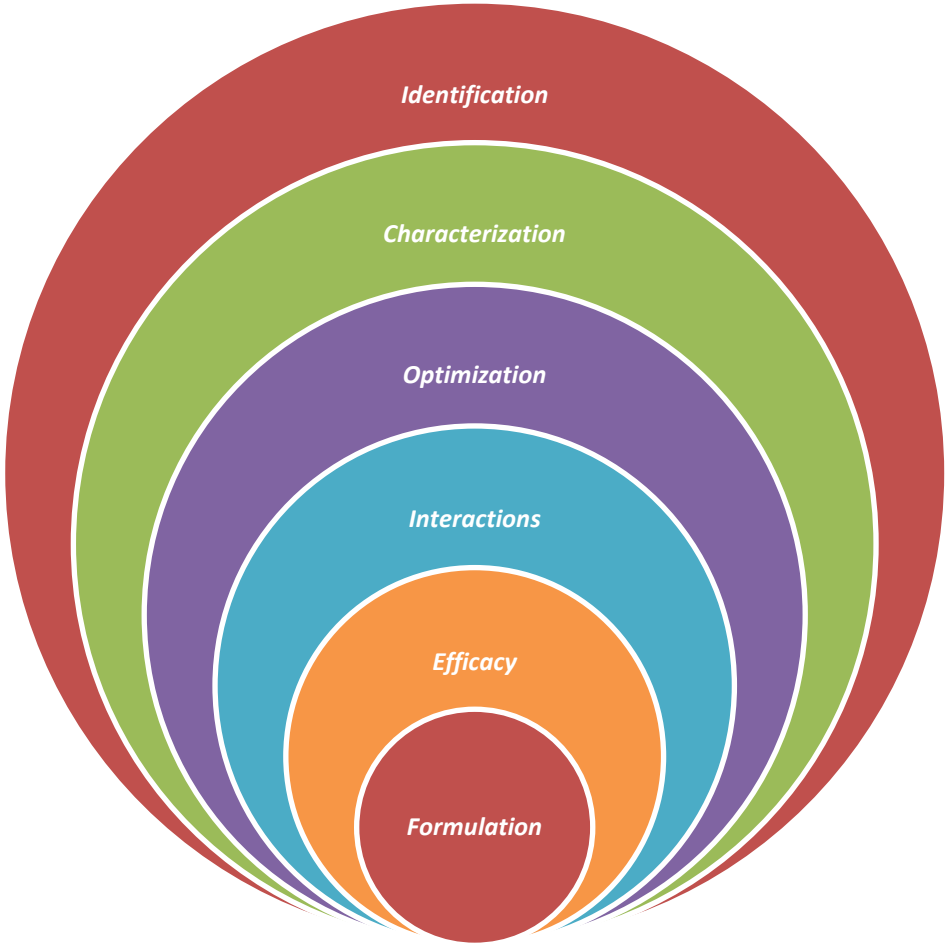


Artificial intelligence (AI) in probiotics

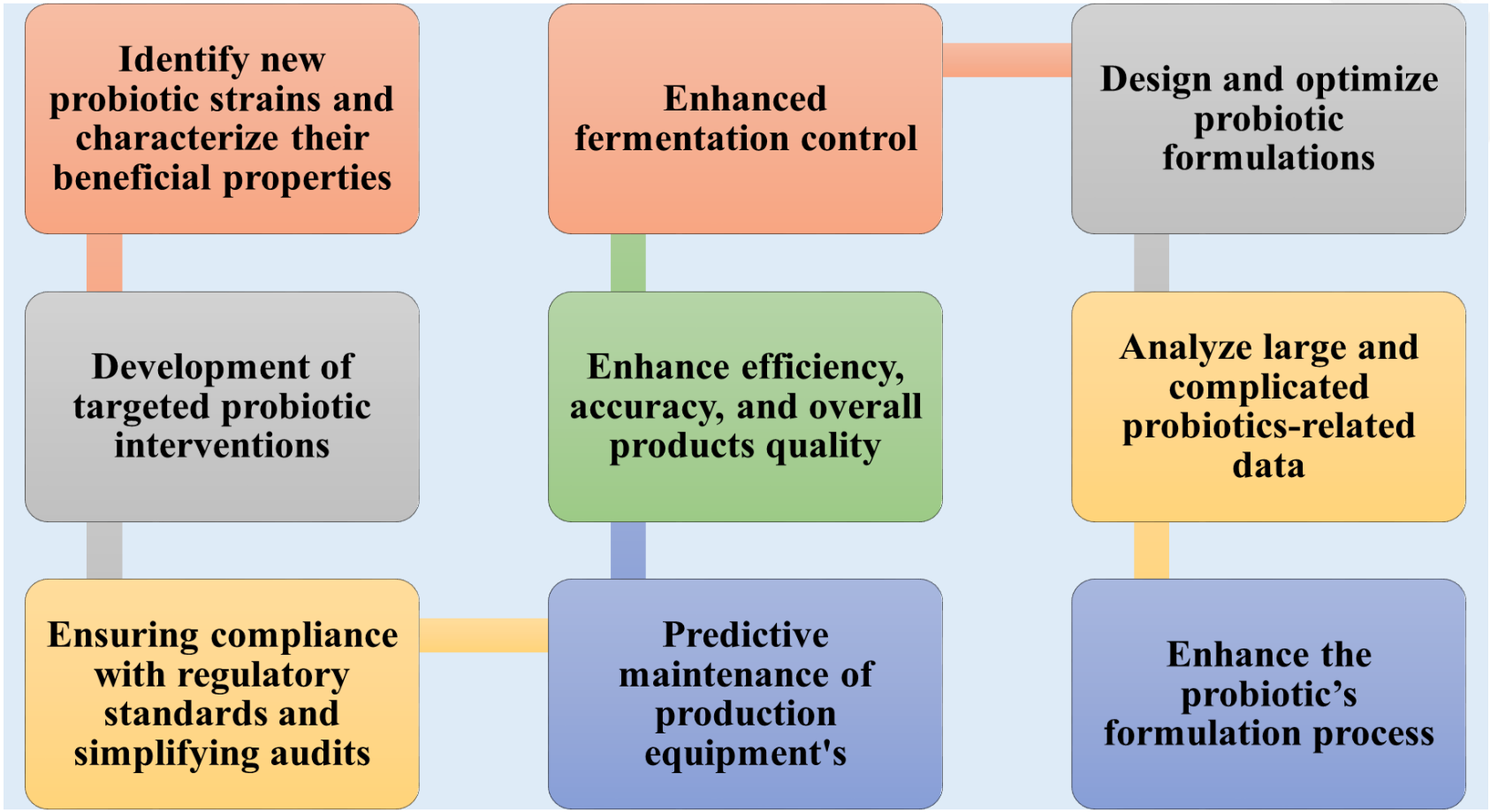
Artificial intelligence (AI) is being used in the field of probiotics to

- **analyze** complex microbiome data,
- **predict** the most effective probiotic strains for specific individuals,
- **design** personalized probiotic combinations, and
- **accelerate** the discovery of new probiotic candidates by identifying potential beneficial bacteria based on their genetic characteristics, essentially paving the way for "precision probiotics" tailored to individual needs.

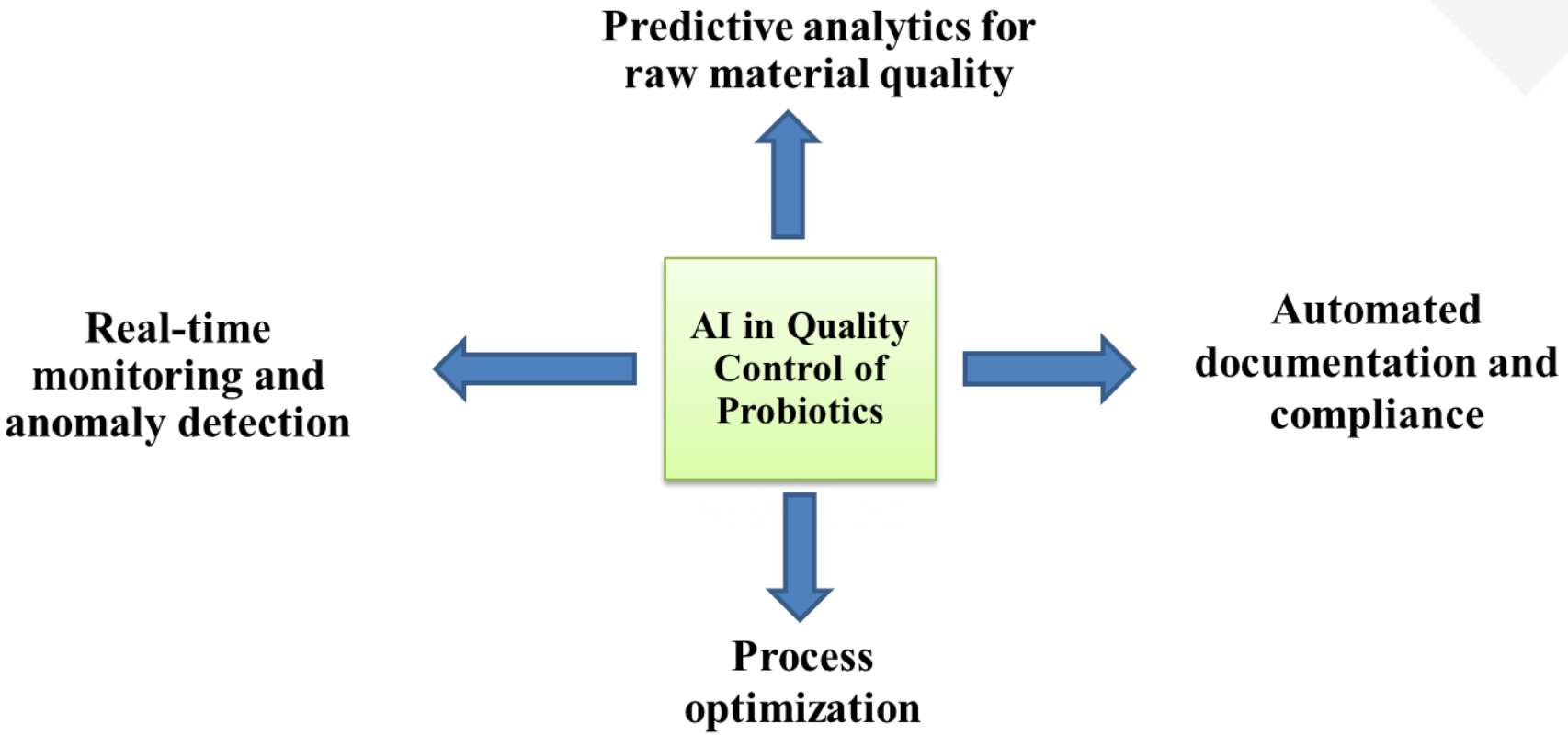
Spectrum of artificial intelligence in probiotics



Advantages of AI in probiotic



AI in Quality Control of Probiotics



Current shortcomings of AI in probiotics: Challenges

Multiple-step validation

The fastness and greater performance of AI tools required validation at different points, making it difficult to achieve.

AI-model development

The development of comprehensive AI models and their applications may consume time and money.

Results interpretations

Interpreting the results of comprehensive AI models is not an easy task, and any faults can lead to negative results.

Regulations

The dynamic nature and regular development of AI technologies raise a regulatory issue for proper validation.

Microbes similarities

The similar morphological and behavioral properties of microorganisms make it difficult to effectively use AI tools.

Genetic stability

The microbial genetic instability and acquisitions of characters from the environment make a hurdle to proper validation.

Challenges in AI-Powered Probiotic Assessment

Data Variability and Quality

•AI models require vast amounts of high-quality, standardized data, which is often difficult to obtain due to variations in microbiome composition across populations.

Lack of Standardized Protocols

•The absence of universally accepted methodologies for microbiome analysis and probiotic efficacy assessment hinders AI model development.

Ethical and Privacy Concerns

•Personalized probiotic recommendations necessitate sensitive health data, raising concerns about data security and privacy.

Complexity of Microbiome Interactions

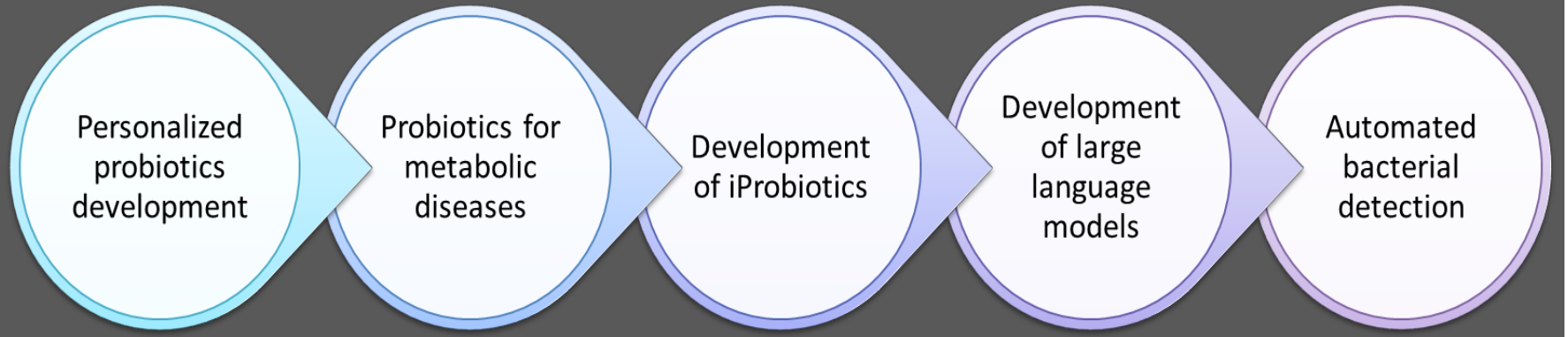
•The gut microbiome is highly dynamic, influenced by diet, lifestyle, and environment, making it challenging for AI to provide consistently accurate predictions.

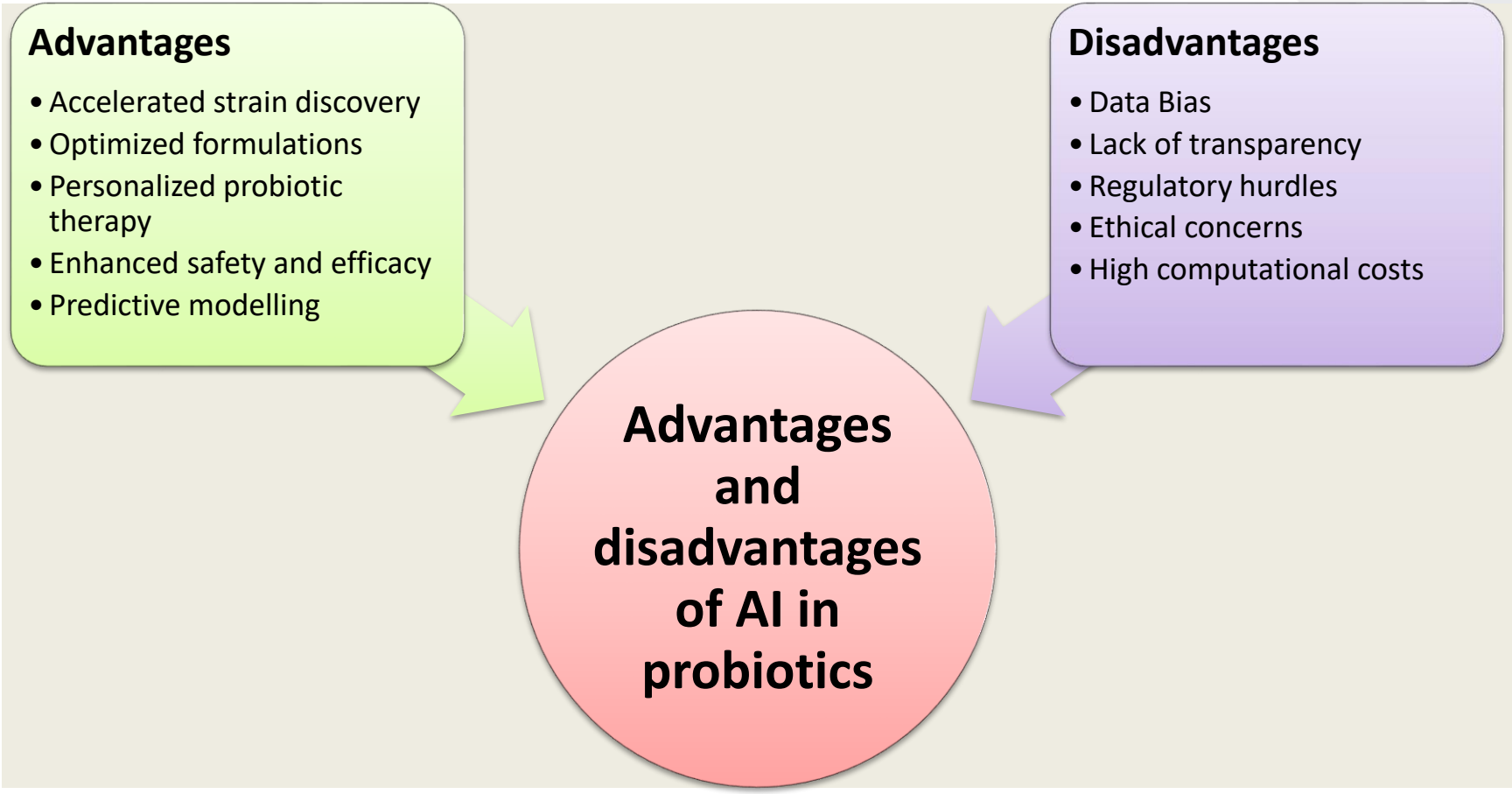
Regulatory and Clinical Validation

•AI-generated insights must undergo rigorous validation through clinical trials and regulatory approval before being integrated into mainstream healthcare.

Solutions for using AI in probiotics

Future perspective of using AI in the field of probiotics




Advantages
• Accelerated strain discovery
• Optimized formulations
• Personalized probiotic therapy
• Enhanced safety and efficacy
• Predictive modelling
Disadvantages
• Data Bias
• Lack of transparency
• Regulatory hurdles
• Ethical concerns
• High computational costs
Advantages and disadvantages of AI in probiotics

Summary

- Probiotics are live microorganisms that have beneficial properties when administered in adequate amounts.
- The field of growing rapidly while possessing challenges of screening, data interpretation, and complexity.
- The integration of AI tools greatly affects the microbial domains particularly the gut microbiota.
- AI also influence the probiotics by different aspects.
- Screening of microbes, complex data analysis, fastness, and less time-consuming are the advantages of using AI in probiotics.
- Data privacy, ethical concern, and lose regulations may limit the use of AI in probiotics.
- Collaboration, data sharing, and technologies integration can overcome the existing shortcoming

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