Data elements & Digital Health

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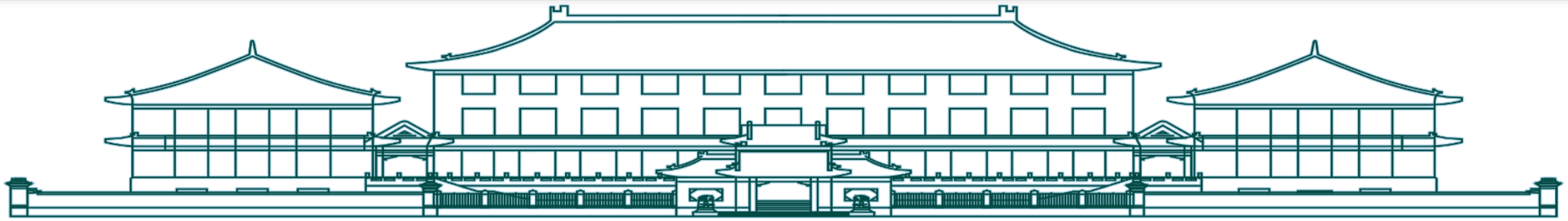
February 27, 2024



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Data has become a new factor of production

- On December 2, 2022, the State Council of China issued the *20 Measures for Data*, aiming to establish a foundational data system to maximize the role of data as a factor of production. These measures cover data property rights, data circulation and transactions, revenue distribution, security governance, and more.
- The document states that, as **a new factor of production**, data is the foundation of digital, intelligent, and network-based development. It is also quickly integrating into production, distribution, circulation, consumption, social service management, and other activities, **transforming ways of production, living, and social governance**.

Agricultural economy

Factors of production: land & labor

Industrial economy

Factors of production: technology & capital

Digital economy

Factor of production: data

[1] State Council. Opinions on Establishing a Foundational Data System to Maximize the Role of Data Elements. 2022.

"Data ×" Three-year Action Plan (2024–2026)

▪ Data × Technological innovation

- Promote **orderly and sharing** of scientific data and facilitate interconnectivity between data from different disciplines.
- Use scientific data to support technological innovation, with a focus on areas like biological breeding, new material creation, and **drug R&D**, and accelerate technological innovation and industry upgrade by integrating digital and intelligent technologies.
- Use scientific data to support the **development of foundation models**, build a foundation for scientific and knowledge resources, develop high-quality corpuses and basic science datasets, and support the development and training of AI foundation models.

▪ Data x Health

- Explore the **sharing of electronic medical record (EMR) data**, and promote unified standards and mutual recognition of examination and test data and results among different medical institutions.
- Systematically unlock the value of health data, improve personal health profiles, integrate physical examination, medical treatment, and disease control data, and innovate in **data-driven** public service models such as occupational disease monitoring and public health event warning.
- Strengthen medical data convergence and innovation, and expand new data application models and services such as **smart healthcare and smart health management**.

[1] National Data Administration of China et al. "Data ×" Three-year Action Plan (2024–2026). 2024.

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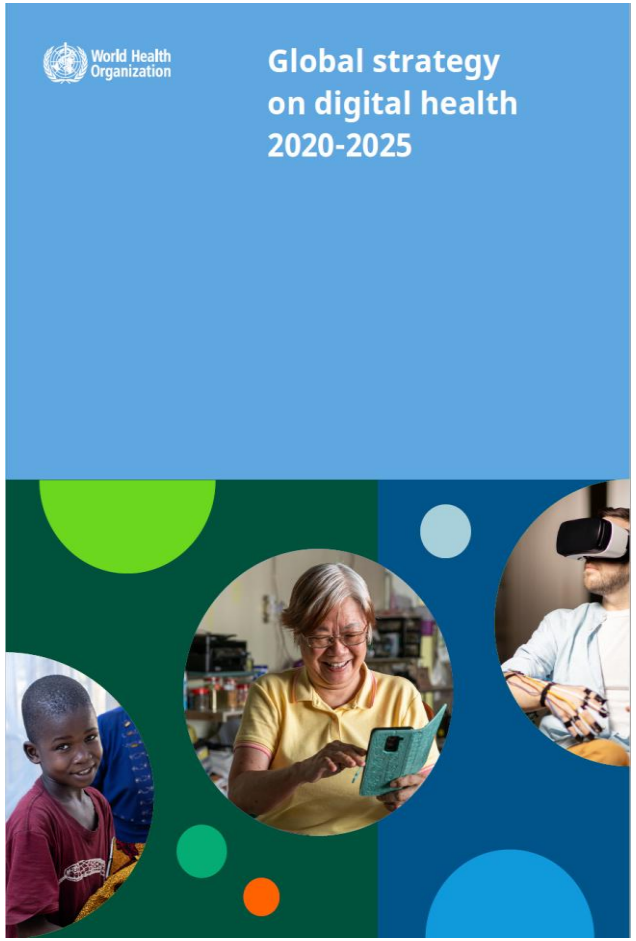
Digital health concepts



- **In May 2005, the 58th World Health Assembly proposed the concept of eHealth for the first time.**
  - Using information and communications technology (ICT) to support health and health-related areas
- **In May 2018, the 71st World Health Assembly adopted Resolution WHA71.7 on digital health.**
  - More inclusive and flexible;
  - Encouraging countries to develop digital technologies, promote life-cycle health through digital health, and build a health-centered digital health ecosystem
- **In April 2019, the World Health Organization (WHO) released the world's first guideline on digital health interventions.**
  - New recommendations on 10 ways to improve people's health and basic services through digital technology
- **In October 2019, WHO released the *Global Strategy on Digital Health (2020–2024)* (draft).**
- **In August 2021, WHO released the *Global Strategy on Digital Health (2020–2025).***
  - Pointing out the important role of the **digital health strategy** in health industry development around the world, and proposing the vision, strategic goals, and action framework for promoting digital health globally and nationally in order to facilitate **global digital health cooperation** and knowledge transfer.

Digital health definitions

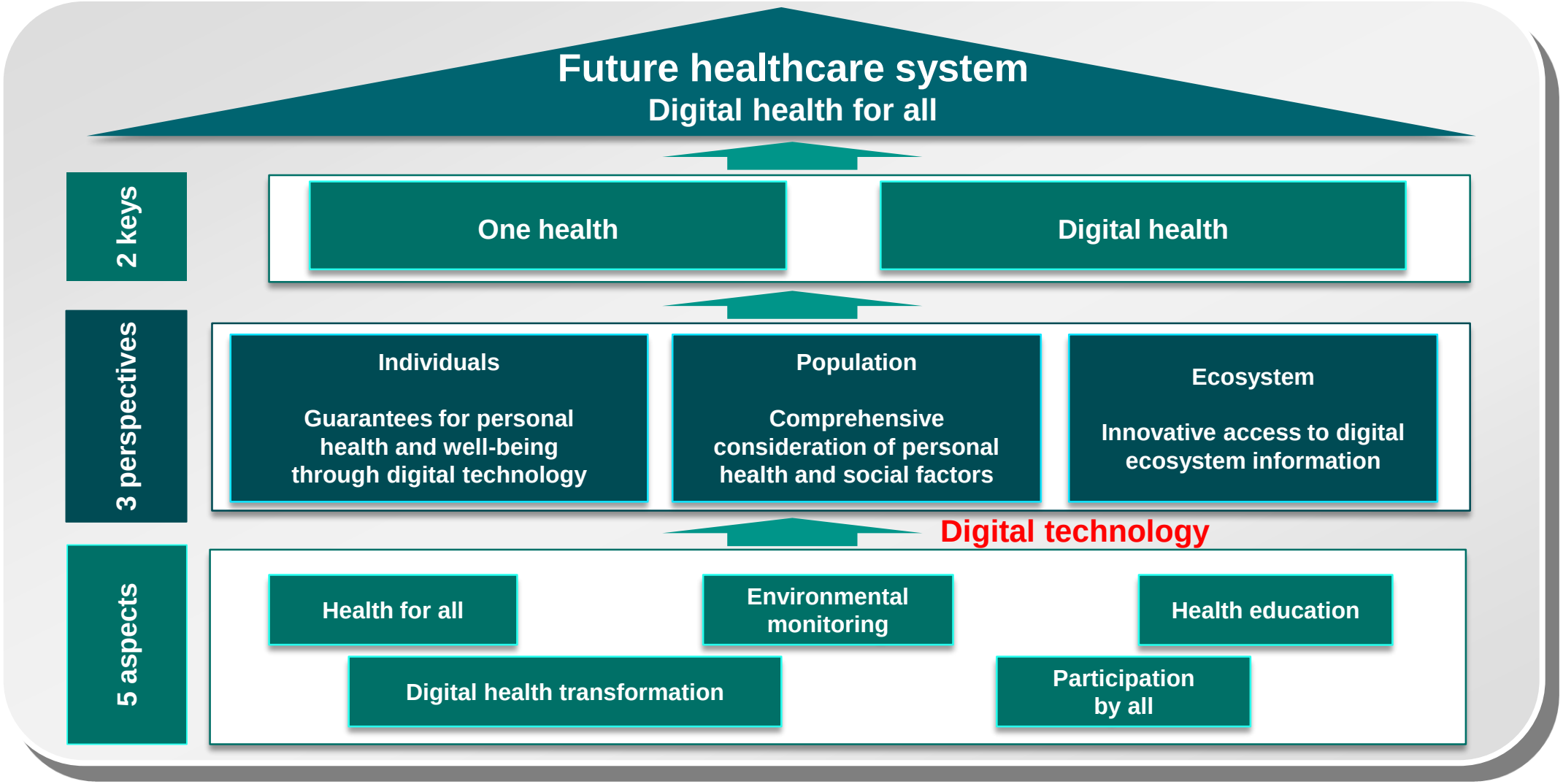
- According to WHO's *Global Strategy on Digital Health (2020–2025),* digital health is understood as "the field of knowledge and practice associated with the development and use of digital technologies to improve health". This definition encompasses digital consumers, as well as a wide range of smart and connected devices. It also encompasses health services supported by digital technologies like the IoT, AI, big data analytics, and robotics.

- The EU's definition of digital health is the use of advanced ICT to meet the needs of citizens, patients, medical personnel, and health policy makers.

- The US Food and Drug Administration (FDA) defines digital health as mobile health, health information technology, wearable devices, telehealth, telemedicine, and personalized medicine.

[1] E-Health in Europe: Current situation and challenges ahead. Health Policy and Technology. 2016.
[2] Digital Health Center of Excellence, https://www.fda.gov/medical-devices/digital-health-center-excellence/. [2022-3-20]

Digital health ecosystem building



One Digital Health: A Unified Framework for Future Health Ecosystems. J Med Internet Res. 2021

Solid foundation for data-driven health

WHO's 4 actions to improve the quality and availability of health data

National coordination

Establish national data coordination mechanisms to facilitate data comparison and reuse.

Strengthened monitoring

Strengthen monitoring of the public health environment and resources that are needed to effectively respond to public health threats.

Data sharing

Share relevant data to inform public health and socio-economic decision makers.

Data-driven culture

Promote a data-driven culture that enables citizens to access, use, and manage health data.

[1] WHO. Data and digital health in the WHO European Region in 2023. A year in review. 2024

Challenges to applying digital health technology

Technology

- Inadequate intelligence of digital health devices
- Shortages of high-quality digital health data resources
- Difficulties in realizing interconnectivity between different devices

Infrastructure

- Lack of sound infrastructure in poverty-stricken areas
- Limited power supply and low network speeds in poverty-stricken areas

People

- Varied medical staff acceptance of new technology
- Lack of training on the use of digital health technology

Laws

- Inadequate laws and policies related to privacy and data security

[1] Barriers and facilitators to utilizing digital health technologies by healthcare professionals. *npj Digit. Med.* 2023
[2] The global effect of digital health technologies on health workers' competencies and health workplace: an umbrella review of systematic reviews and lexical-based and sentence-based meta-analysis. Lancet Digit Health. 2023

Healthcare decision-making abilities

Health data

- EMRs
- Clinical guides
- Clinical trials
- International frontiers
- Doctor-patient communication
- Social media

Health knowledge

- EMR data
- Machine learning
- Medical knowledge graphs
- Expert consensus
- Knowledge inference

Decision support

- Computer-aided diagnosis
- AI-assisted treatment
- Health management
- Disease risk predictions
- Virtual assistants
- Intelligent medical imaging
- Intelligent drug mining

Precise, personalized decision-making support for clinicians

Personalized decision-making support

Service targets


Resident doctors


Outpatient doctors


Nurses


Interns


Pharmacists

Application level

Diagnosis Agent	Test recommendation	Surgery recommendation	Medical record checks	Rational medicine use
Disease classification	drug recommendation	High-risk warning	Knowledge reminders	Clinical trials

Technical level

Machine learning	Knowledge graphs	Rule extraction	Rule library management	Inference engines
Natural language processing	Big data	Rule scope definition	Computer vision	

Data level

Clinical knowledge sources and structured knowledge

Clinical guides	Authoritative monographs	Nursing knowledge
Pharmaceutical knowledge	Case literature	Technical specifications

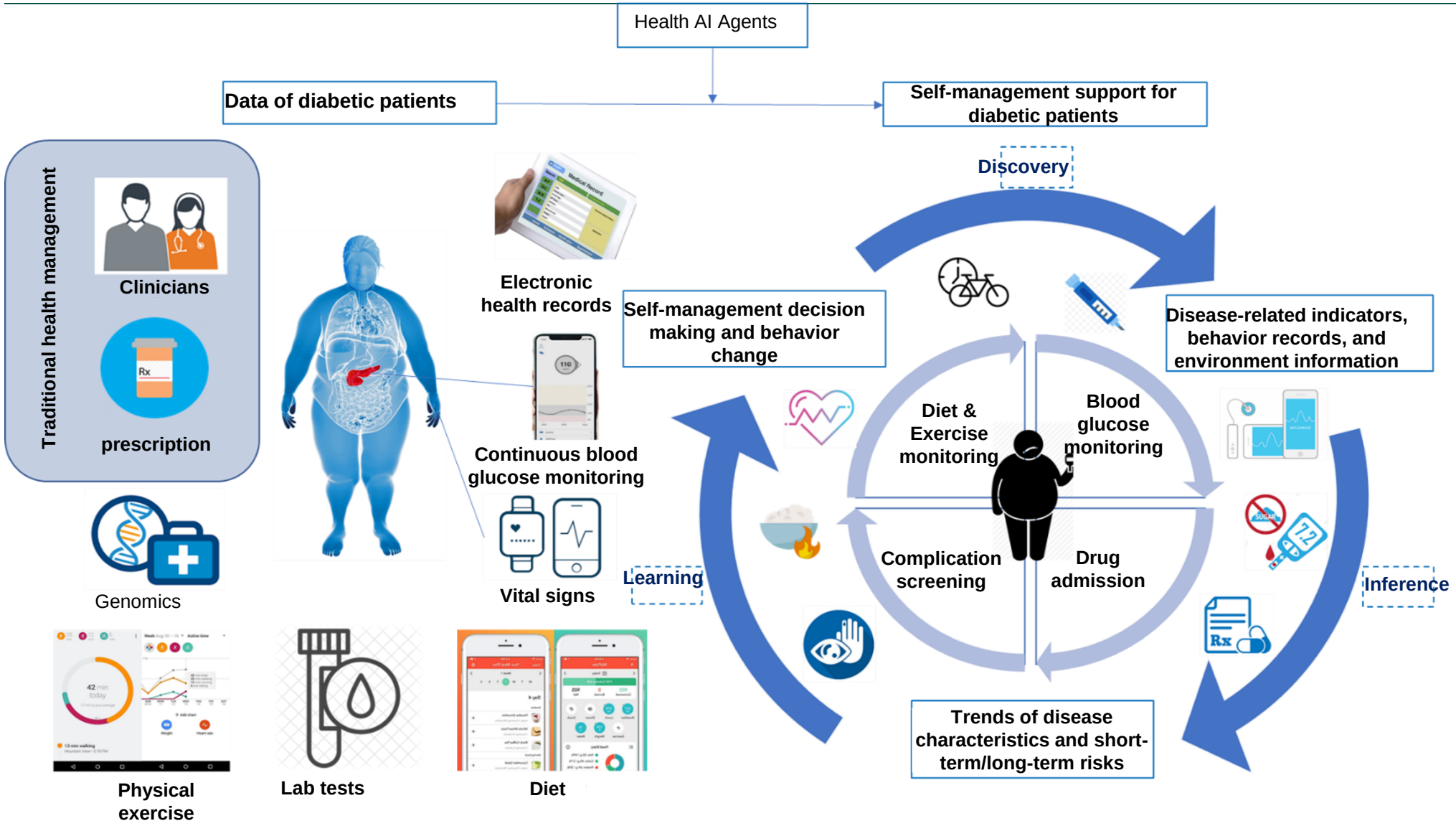
Patient information

Medical check results	Chief complaints	Age...
Medical history and family health history	Medical signs	

Key technologies

- **Knowledge-based recommendations**
- **Causal learning**
- **Explainable machine learning**
- **Effectiveness evaluation**
- **...**

Chronic disease management



[1] Xu Zidu et al. Progress of AI Application in Self-Management of Diabetes [J]. *Journal of Medical Informatics*, 2020, 41(01): 14-9.

Building a digital health service system for smart elderly care communities

Digital health service system architecture

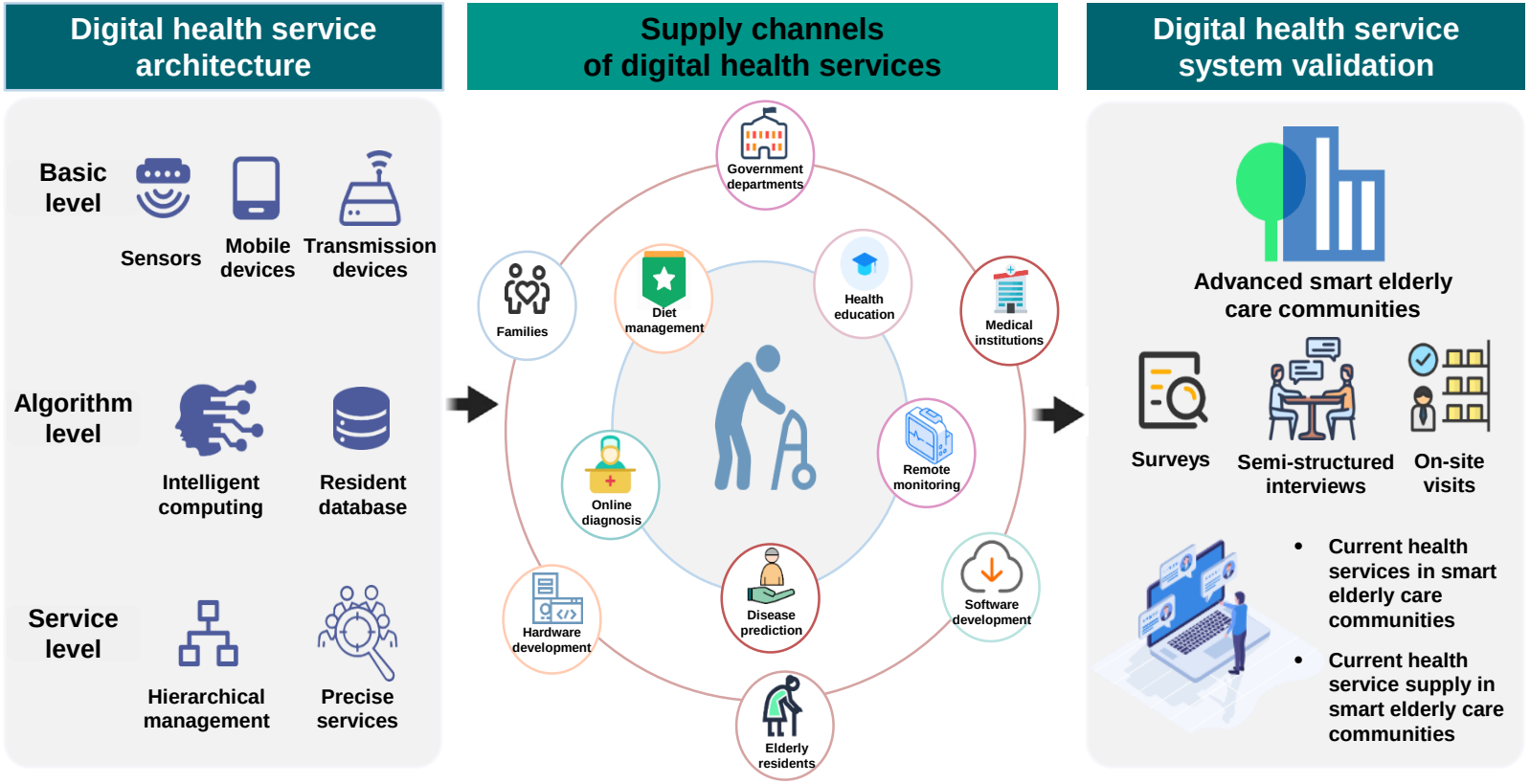
Build a digital health service system architecture for smart elderly care communities at the basic, algorithm, and service levels.

Supply channels of the digital health service system

Define seven types of entities that provide digital health services for smart elderly care communities and their functions, and use common digital health services as examples.

Digital health service system validation

Conduct surveys in advanced smart elderly care communities in China to demonstrate the feasibility of this system in the real world.

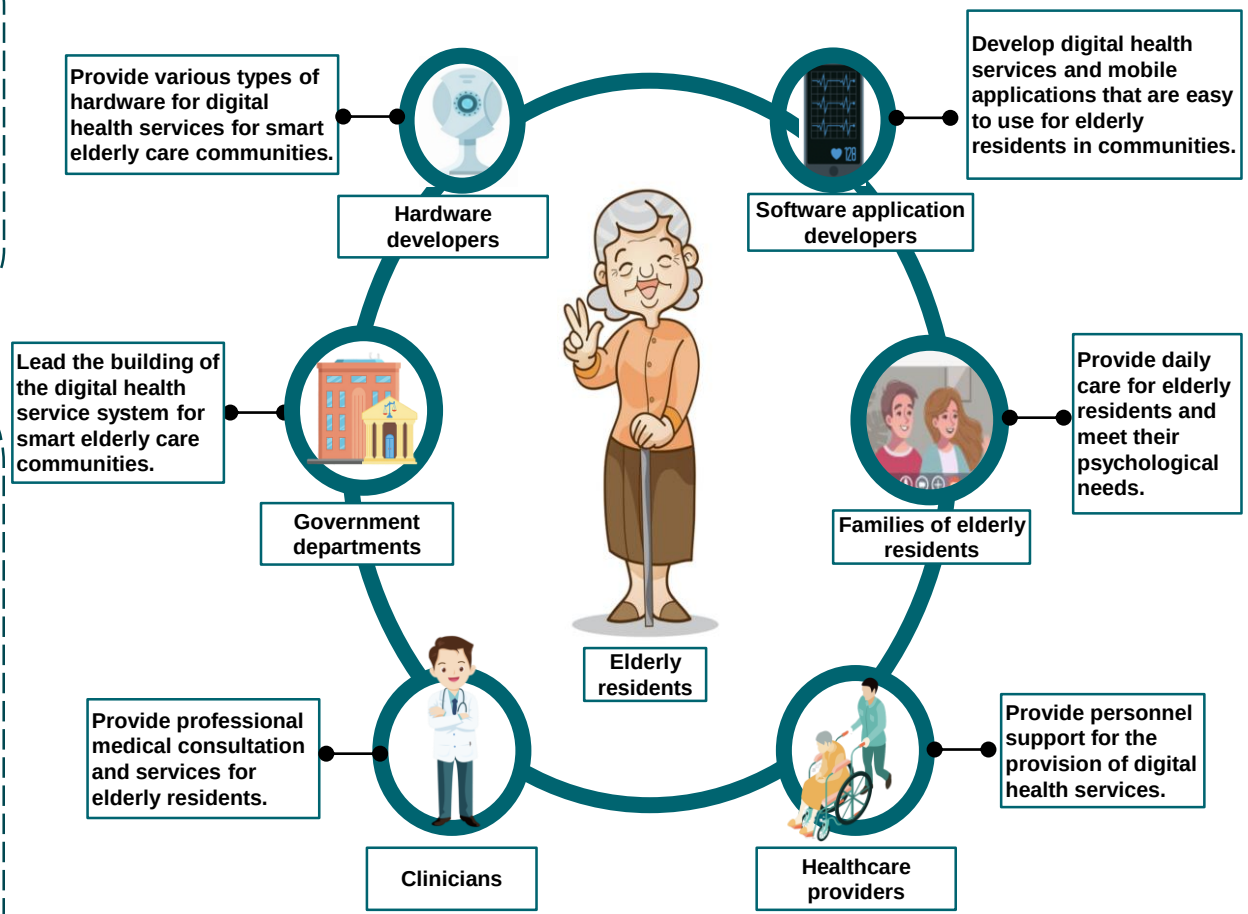


Theoretical basis of digital health service supply

Welfare pluralism theory	Digital governance theory
Clinicians, Healthcare providers, Government departments, Software application developers, Hardware developers, Families, and elderly residents.	**Integration of multiple entities in digital health services for smart elderly care communities**, and streamlines the digital health service supply chain in those communities.

Digital health service entities of smart elderly care communities and their responsibilities

- **Clinicians:** Provide professional medical consultation and services, and carry out regular tracking and follow-up.
- **Healthcare providers:** Provide personnel support for the provision of digital health services.
- **Government departments:** Government departments take the lead and provide policy support and resource coordination.
- **Software application developers:** Develop digital health services and mobile applications that are easy to use for elderly residents in communities.
- **Hardware developers:** Provide various types of hardware for digital health services for smart elderly care communities.
- **Families of elderly residents:** Provide daily care for elderly residents and meet their psychological needs.
- **Elderly community residents:** Request and receive digital health services in smart elderly care communities.



Smart dinning hall for elderly care communities

- **Build a standardized meal supply/communication environment**
- **Develop dietary profiles for the elderly**
- **Develop dietary knowledge graphs for the elderly**
- **Provide meal suggestions in real time**

Intelligent IoT	Dietary graphs	Personalized recommendation algorithms	Nutritionists
Foodstuff procurement	**Nutritional food supply**	**Health reports**	**Expert instructions**
Front-end feedback	Combination of dine-in and meal delivery	Overview of current diet status	Nutritionist participation throughout the process
Automatic order placement	Personalized dish recommendation	Nutritional analysis	Aggregation of multiple types of authoritative data
Waste reduction	Nutritional balance	Diet suggestions	Expert review of dietary graphs

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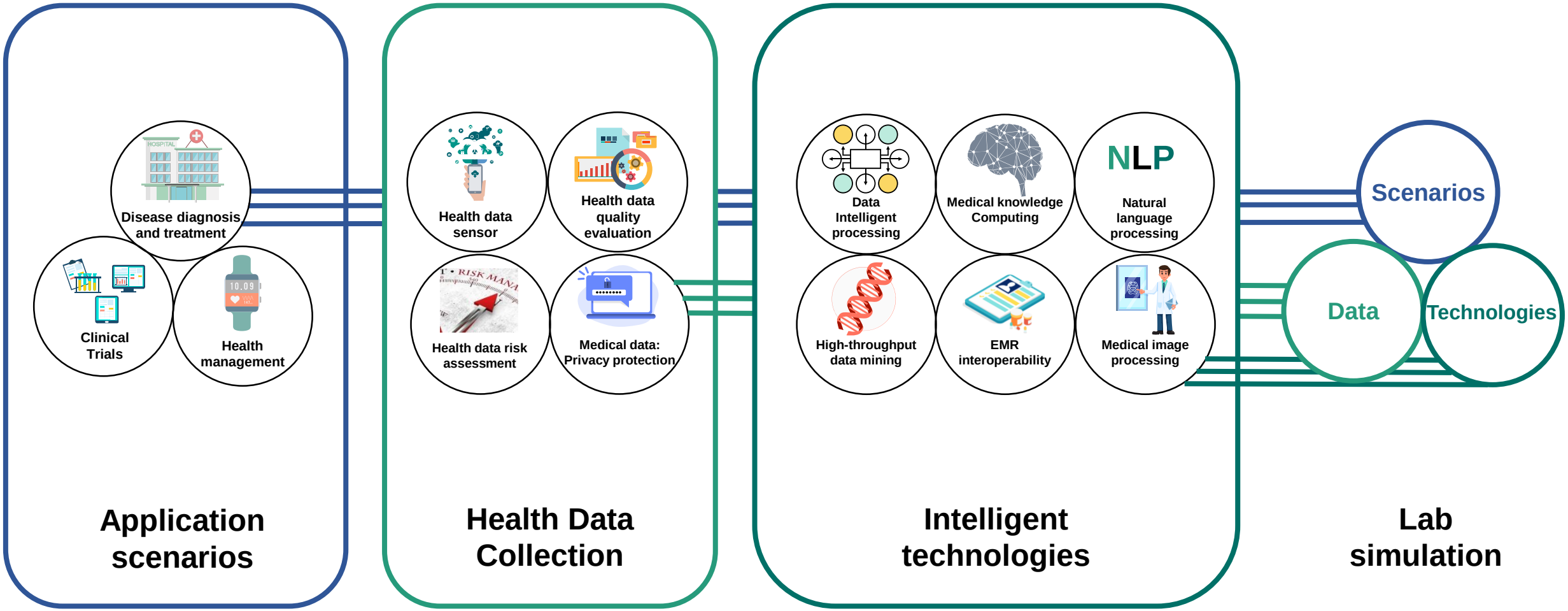
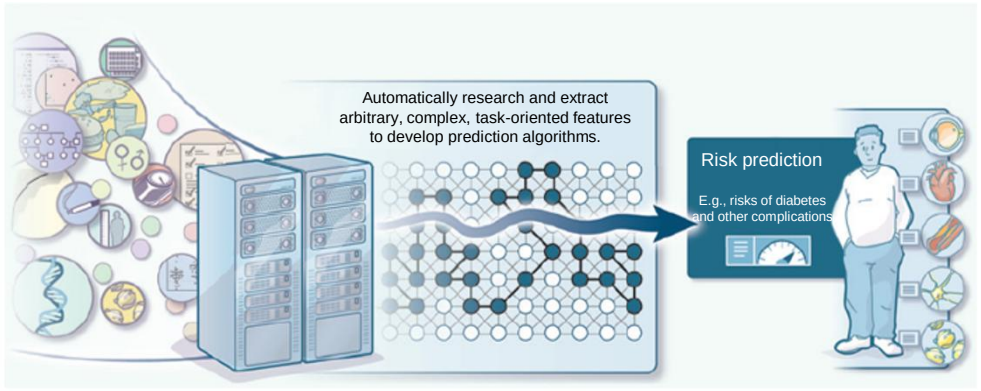
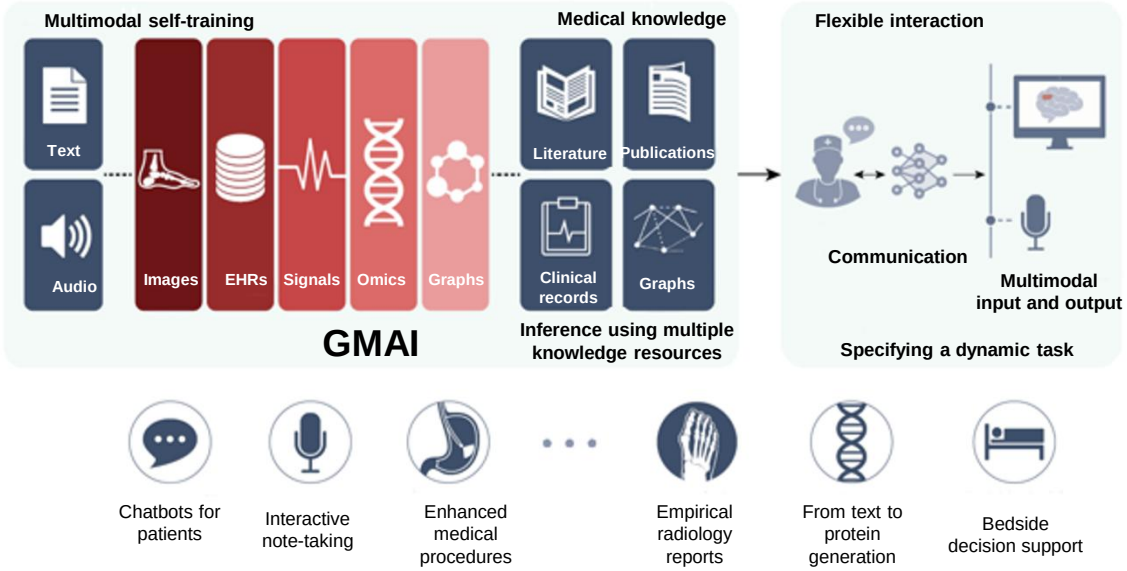
Close combination of scenarios, data, and technologies



Generative AI has great potential





AI: Perception → Cognition

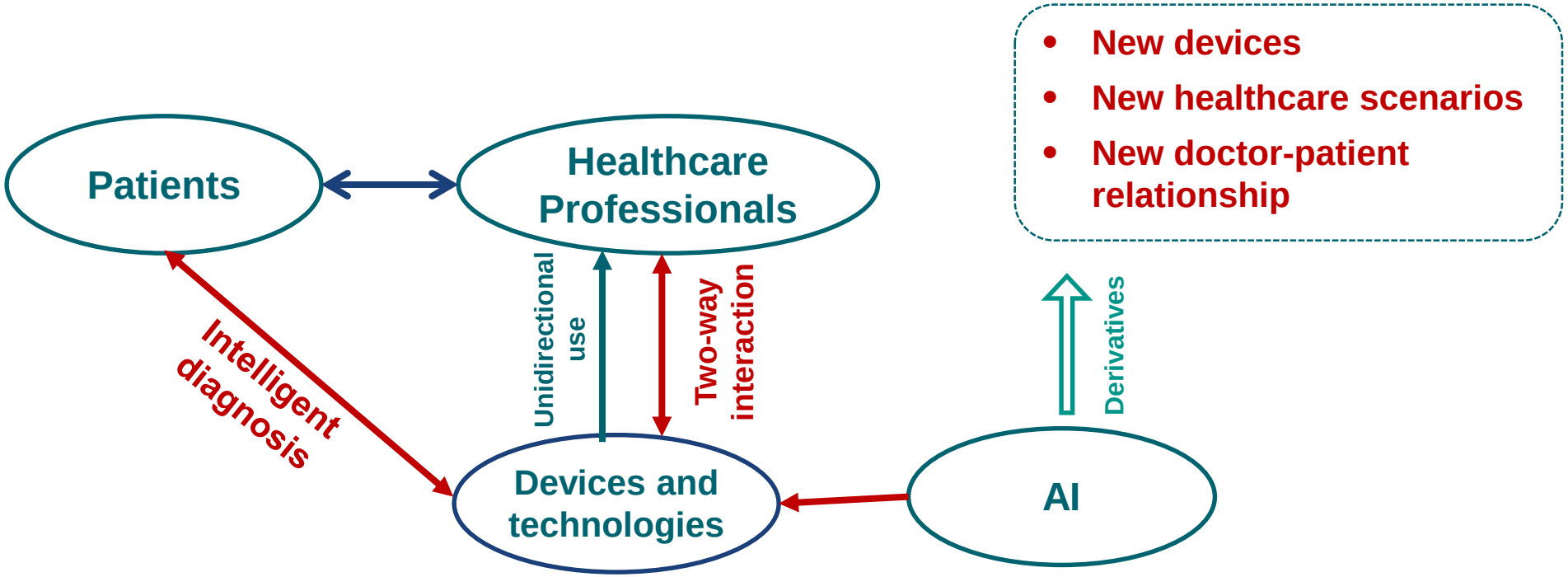
Enhanced multimodal medical data integration capability

Innovative application of medical AI models

[1] Where Medical Statistics Meets Artificial Intelligence. N Engl J Med. 2023
[2] Foundation models for generalist medical artificial intelligence. Nature. 2023

Reshaping healthcare relationships

- Medical care **involves** patients, equipment, technologies, hospitals, and regulators.
- AI has brought profound changes to various relationships in the **healthcare process**.
- There is a need to re-establish credible, reliable, high-quality, and efficient medical systems. **Synergy between policies, scientific research, technologies, applications, and industries is required.**



Smart healthcare management embedded in communities and homes

Trustworthy Healthcare AI

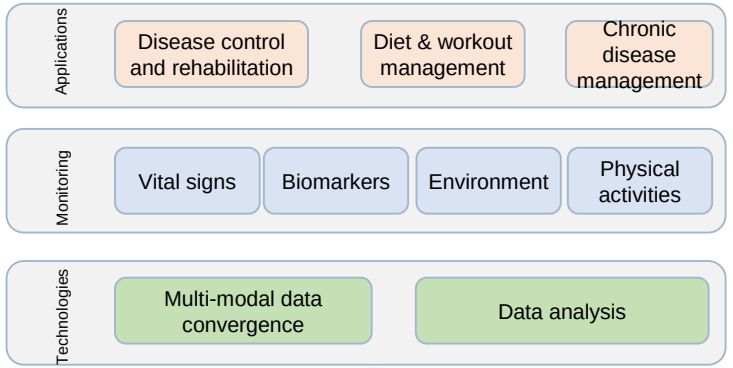
- **Explainable models**
- **Enabling people to understand** the choices made by AI agents in the decision-making process

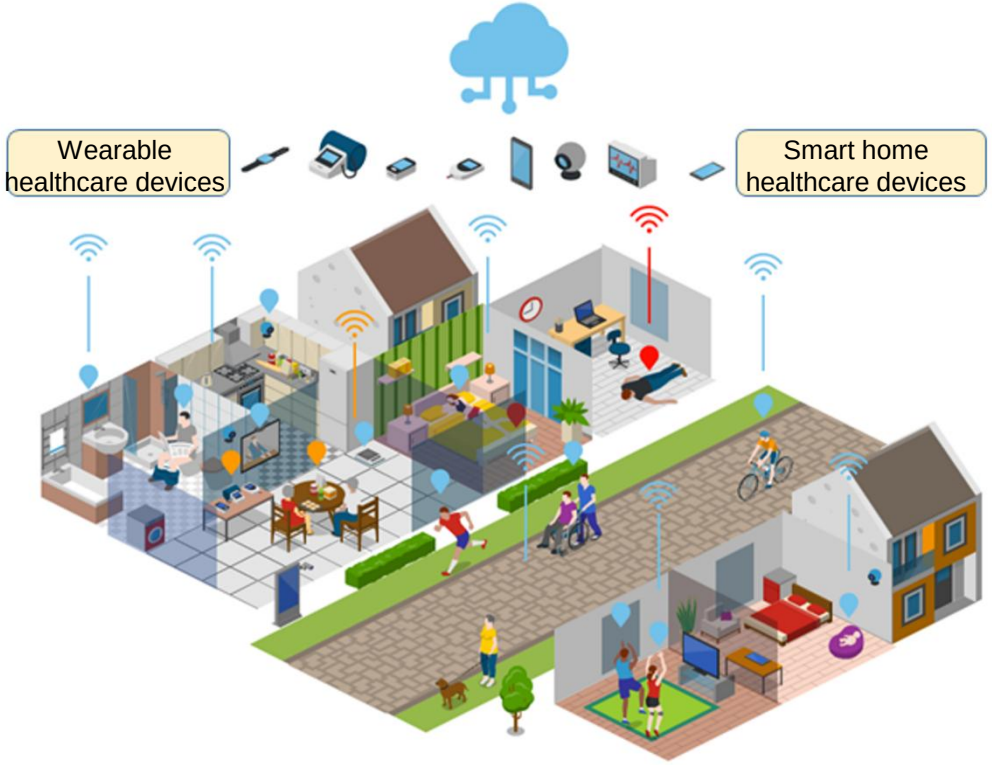
Embedded smart health management

- Development of **scenario-based intelligent system** tailed for each participants in the scenario.
- Improving clinical decision making with **breaking the technology barriers.**

Effectiveness evaluation of smart health products

- **Digital therapy** R&D for specific population
- Clinical diagnosis and treatment decision making in hospital





Thank you!