글로벌 ICT 표준 컨퍼런스 2023

Global ICT Standards Conference 2023

Inter-operable Home Healthcare IoT Device Platform for Accessible Healthcare

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주관 국립전파연구원 National Radio Research Agency
TTA IITP KEA kista ETRI

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01 Why Home Healthcare ?

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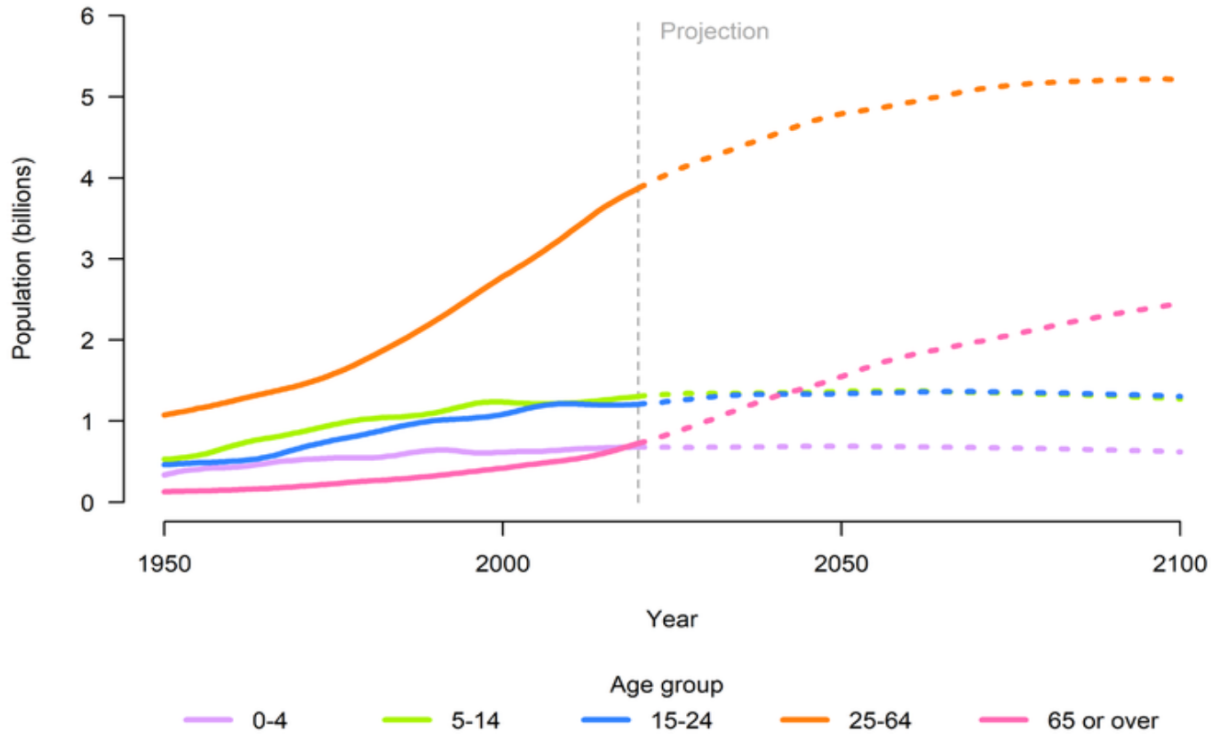
01. Background – Aging

The need for healthcare at home is increasing due to rapid growth of aging population

The elderly population is growing rapidly

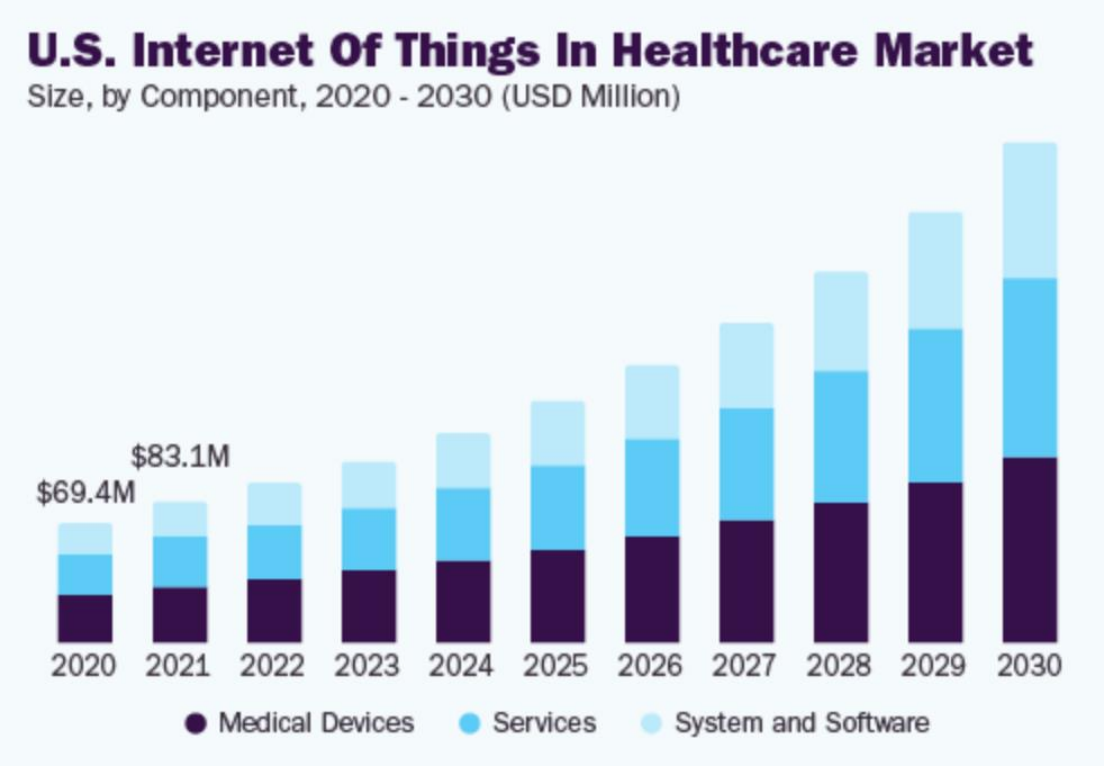


The global geriatric population is growing at a rapid pace. According to World Population Prospects 2019 (United Nations, 2019), there were 703 million people aged 65 years and above globally in 2019. In 2050, the number of elderly people is anticipated to reach 1.5 billion.

02. Background – Market Growth

The global IoT in healthcare market size was valued at USD 252.1 billion in 2022 and it is expected to expand at a compound annual growth rate (CAGR) of 16.8% from 2023 to 2030.

Report Overview



The increasing adoption of remote patient monitoring for improved out-of-hospital care boosts the market. Along with this, rising investments in implementing digital technologies in healthcare institutions, and the emergence of connected care are the key factors boosting industry growth.

Increasing applications of smart devices and wearables in healthcare, such as glucometer, tablets, smartphones, smartwatches and headphones, heartrate cuff, bands and others, is expanding the scope of internet of things, especially in healthcare as they give special attention to access the patients remotely. Moreover, the tracker system in these devices enables to access patients in emergency by sending emergency alerts to seek medical help.

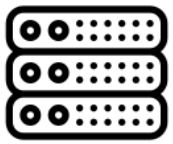
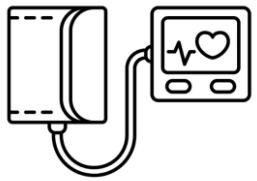
Source: Internet of Things in Healthcare Market Size Report, 2030

03. Limitations in Home Healthcare Products

Limitations in interoperability, integrated services, and data management

➔ Poor User Experience

Fragmented Services

Local Device Storage	Healthcare Provider's Systems	Cloud Storage	Mobile Apps
			
Home health care Device 1 Blood pressure monitors	Home health care Device 2 Glucose Meters	Home health care Device 3 (Pulse Oximeters)	Home health care Device 4 (Weight Scales)
			

04. Potential Solutions

Integration of Healthcare / Non-Healthcare IoT Services through Single Platform

➔ Seamless Healthcare Experience at Home

Integrated Services

Non-Healthcare IoT Devices

Smart air cleaner

Smart Lighting

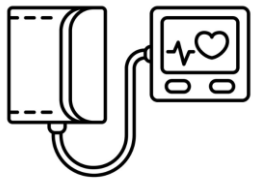
smart curtain

Integrated Service + Data Management

Healthcare IoT Devices

Thermal Massage bed

Alkaline Water Ionizer



Blood pressure monitors

Glucose Meters

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01. CES Innovation Award 2023

CES 2023 INNOVATION AWARD PRODUCT

Aloe Care

By Aloe Care Health

Honoree

Digital Health

Smart Hub 2 is a personal emergency response system that facilitates voice-activated communication with emergency response and caregivers. Aloe Care exclusively offers the following combination of proprietary features:

First application of WiFi-sensing fall detection for personal emergency response, this works in every room regardless of spatial displacement, e.g., even through walls
Voice-activated emergency requests, 24/7
Processes bespoke audio wakewords without internet connection
Anomalies with air quality (CO2 & VOCs), atmospheric pressure, temperature, and humidity prompt user alerts
Data communicated via LTE and WiFi
Connects to a caregiver companion app displaying user wellbeing, facilitating two-way communication between app and hub

CES 2023 INNOVATION AWARD PRODUCT

Dawn House

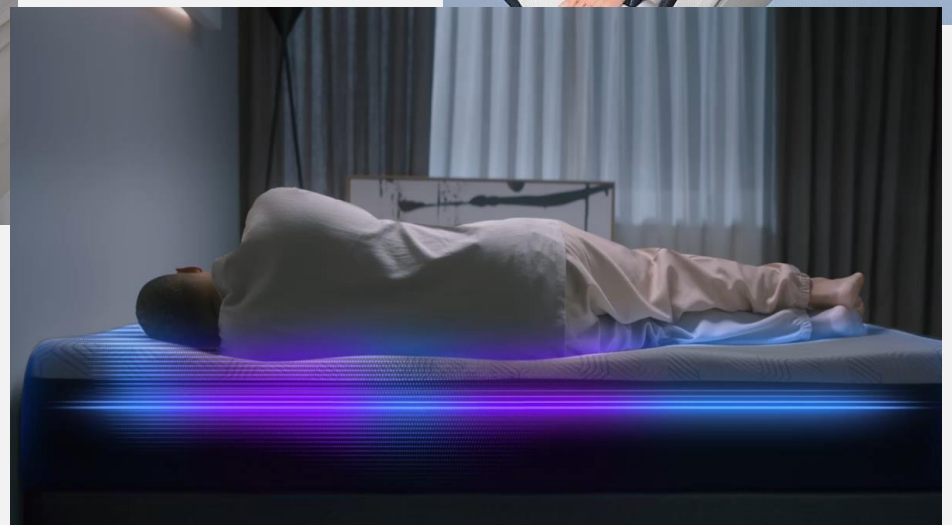
By Ergomotion, Inc.

Honoree

Digital Health

The Dawn House bed is an integrated sleep system that offers aging adults, and people with changing needs, the opportunity to stay safely at home through the unique pairing of multiple bed features: underbed motion lighting, adjustable height, optional support rail, rise to wake feature, anti-snore setting, Zero-G positioning, and passive sensors that measures micro-vibrations of your sleep levels, heart rate, heart rate variability, respiration and more. The sleep system includes the Dawn House app which works with the sensors in the base to provide daily, weekly, monthly, and yearly reports on health metrics that can be shared.

02. Recent Advances in Home Healthcare in South Korea



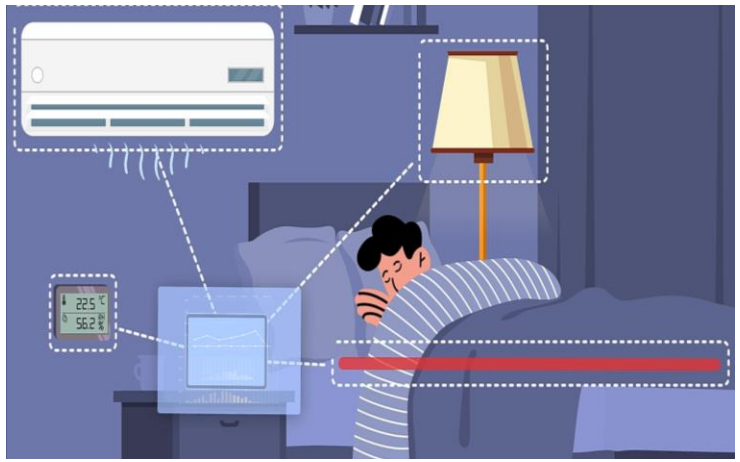
Source : Coway, Body Friend, Ceragem

03. Potential Use of Non-Healthcare IoT Devices in Healthcare Applications

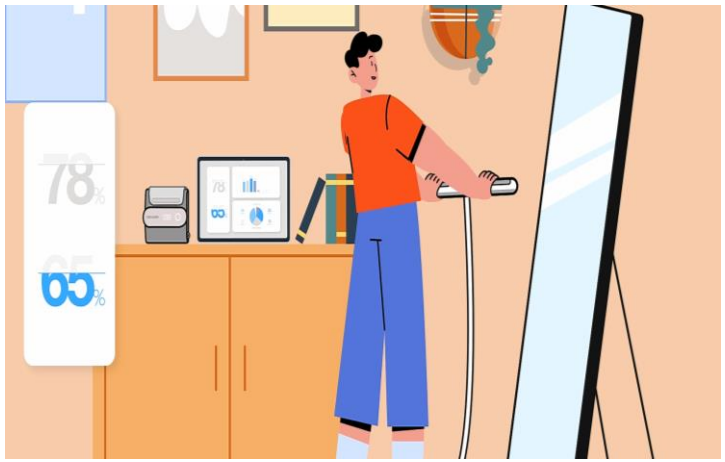
Non-healthcare IoT devices offer distinct advantages when integrated with healthcare applications, enhancing efficacy, safety, and overall seamlessness.

Non-Healthcare IoT Devices integrated with Healthcare Applications

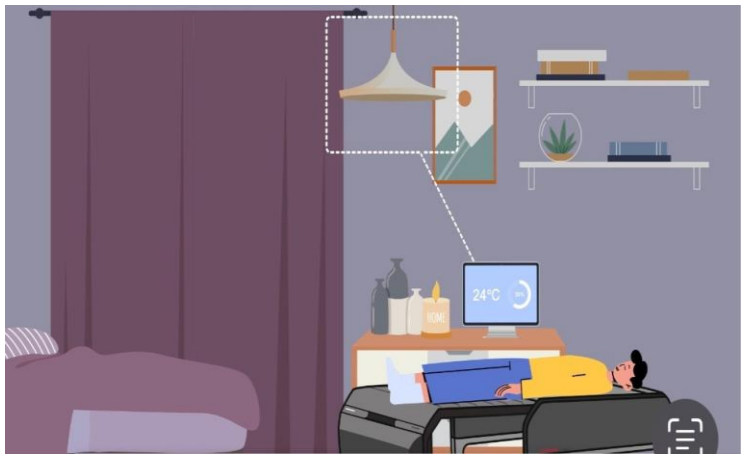
Light and Air Conditioning for Sleep Disorder



Weight and Shape Management for Obesity



Sleep and Posture Management for Spine Health



04. Integrated Healthcare IoT Platform Concept

Integration of IoT Technology makes home healthcare system more effective, efficient, and convenient

CLINICAL ONE

- Increase of Interoperability of home healthcare IoT devices
- Integrated data sharing using IoT platform
- Integrated control of home healthcare IoT devices and services
- Integrated healthcare data analysis and report
- Unified data representation and visualization
- Enforcing data privacy and security

05. Integrated Healthcare IoT Device Examples

Multiple Healthcare/Non-Healthcare IoT Devices

Healthcare devices include medical devices for monitoring / diagnosis / treatment

Integrated Controller & Services

Integrated control of all functions with one tablet
Integrated services using multiple healthcare/non-healthcare IoT Devices

CeraCore Engine™

Resting Device

Blood Circulation Device

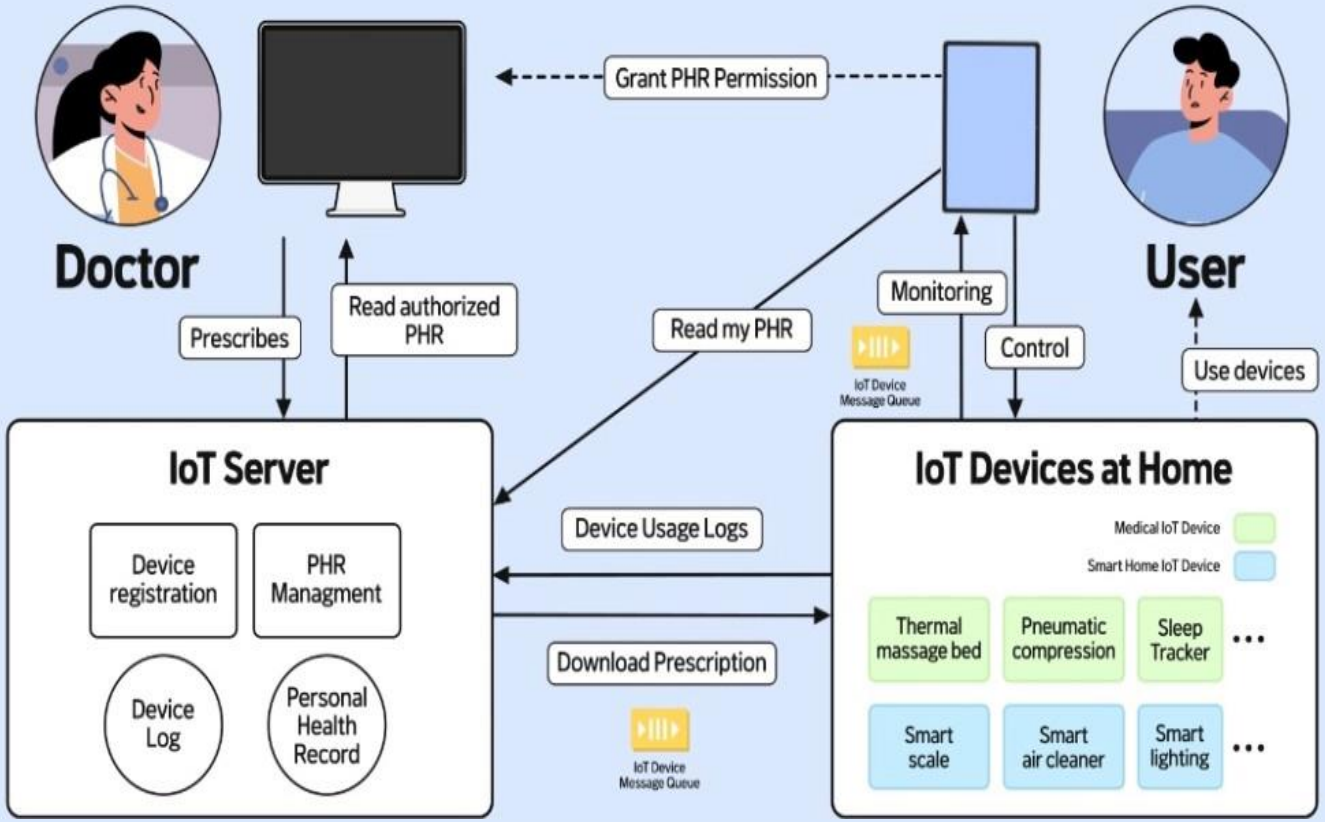
Home Application

Sleep monitoring

Electrocardiogram Monitoring

Blood Flow Monitoring

06. System Architecture Examples

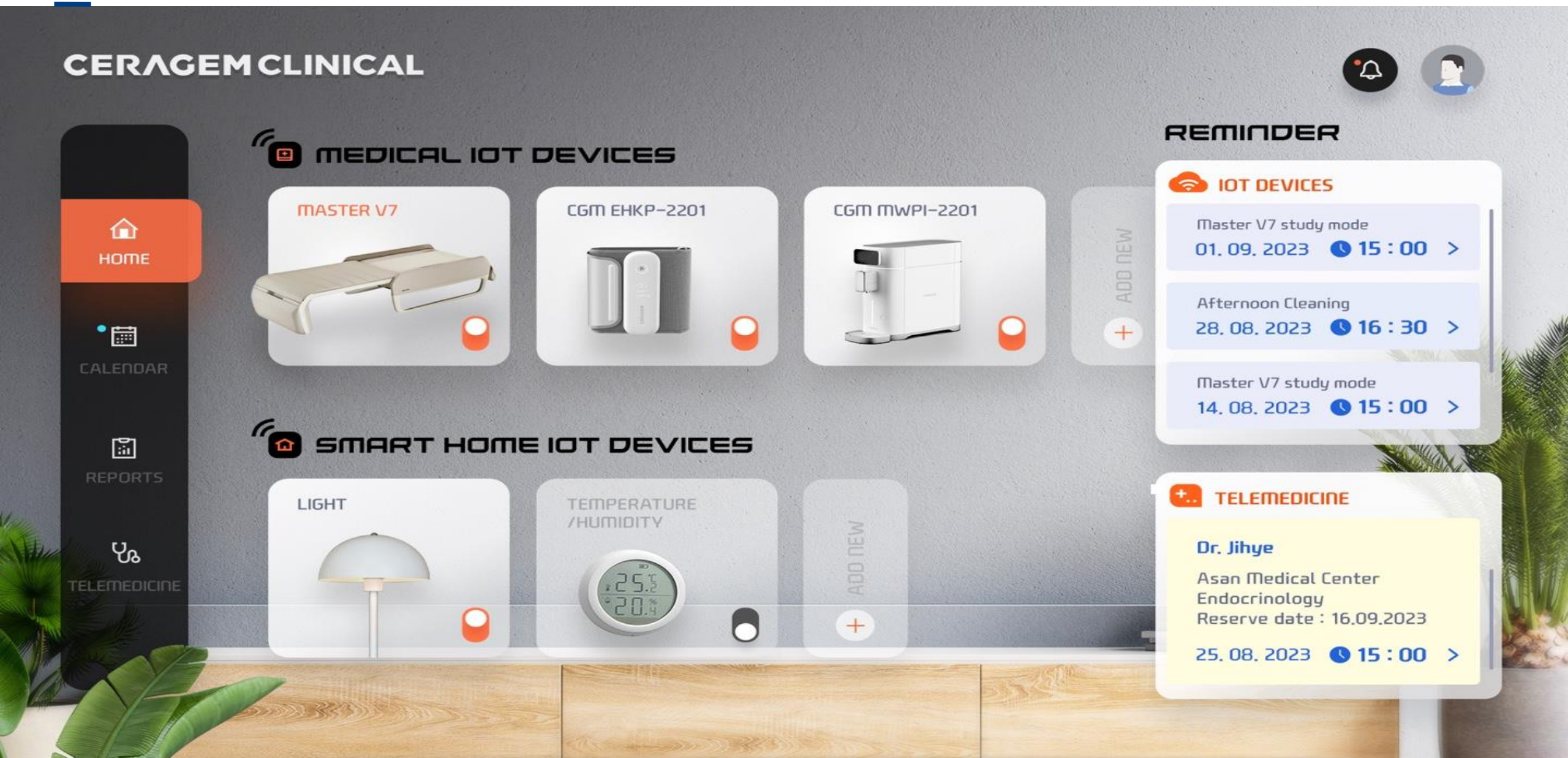


1. When you use medical and smart home IoT devices, data is sent to the IoT server for your Personal Health Record (PHR) as per your agreement.

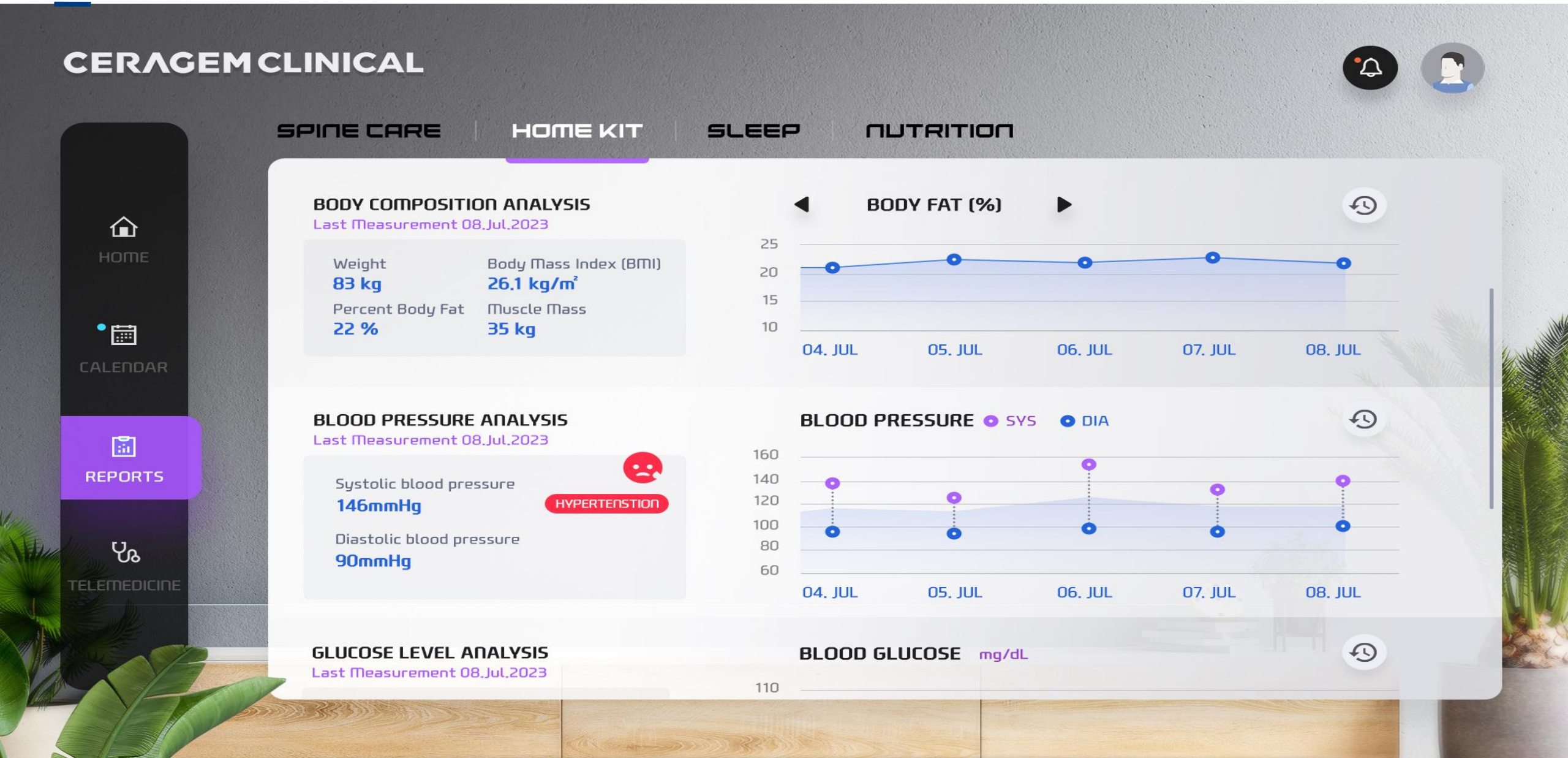
2. Doctors can review your data with your consent and provide appropriate prescriptions, which are stored on the IoT server.

3. You can download and selectively apply the prescription to your medical and smart home IoT devices as needed.

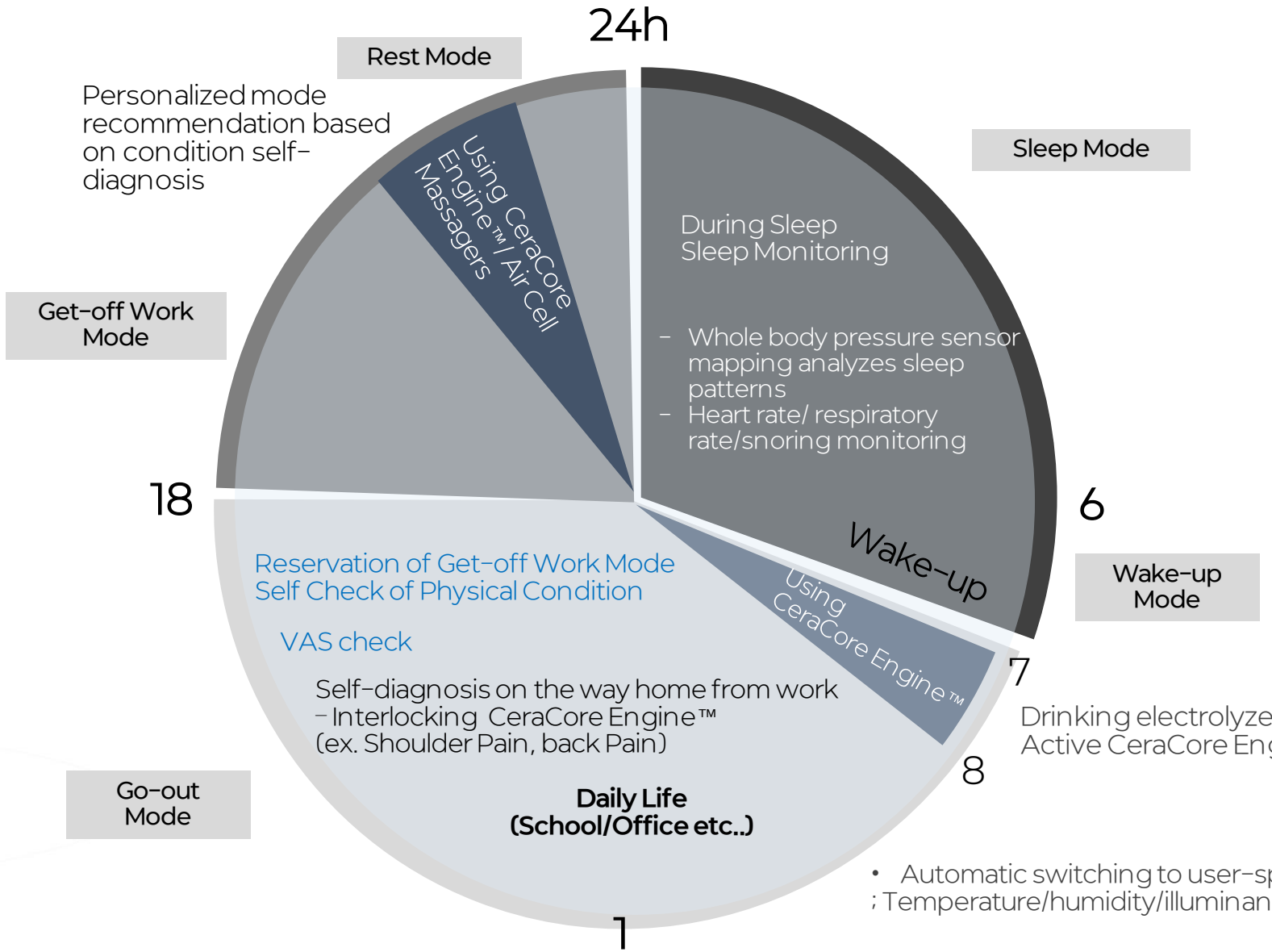
07. User Interface Examples



08. Data Management Dashboard Examples



09. User Scenario Examples



Example of Sleep Monitoring	
Routine Settings	- Recommendation of customized CeraCore Engine™ mode according to personal condition - Set bedtime/wake up time, alarm - Temperature/humidity/illuminance settings for good sleep/ curtain opening and closing - Customize temperature/humidity/illuminance when waking up, curtain opening, alarm
Sleep Monitoring	- Sleep monitoring during sleep : Whole body pressure sensor mapping analyzes sleep quality Heart rate/ respiratory rate/snoring monitoring
Evaluation of Sleep Quality	- In case of insomnia, the doctor refers to the medical treatment : Find the cause of insomnia through sleep monitoring data during sleep - Providing solutions to improve the sleep routine

- Automatic switching to user-specific settings for each mode
; Temperature/humidity/illuminance settings for good sleep/ curtain opening and closing

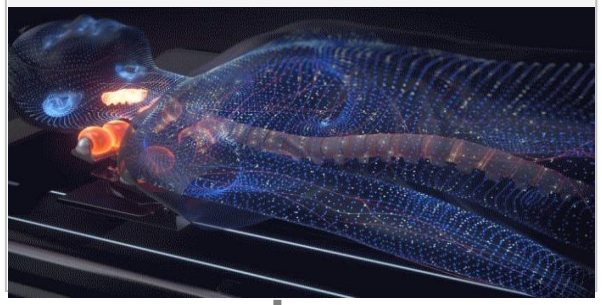
10. Use Case Examples

Telemedicine Usage Scenario of Home Healthcare Platform

Example of Spine scan data monitoring

1. Diagnosing structural abnormalities of the spine

2. Checking treatment progress with spine scans



3. maintaining stable management through a medical device

4. Utilization in the medical field

Example of Sleep at home monitoring

1. Hospital visits for lifespan disorders

2. Sleep hygiene education

3. Sleep at-home monitoring

4. Utilization in the medical field

10. Use Case Examples

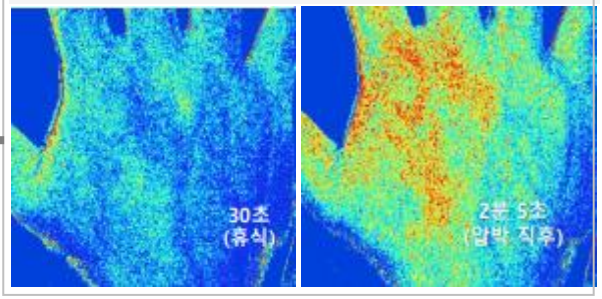
Telemedicine Usage Scenario of Home Healthcare Platform

Example of lymphedema monitoring

1. Patients with lymphedema and venous circulation

2. Home care after discharge

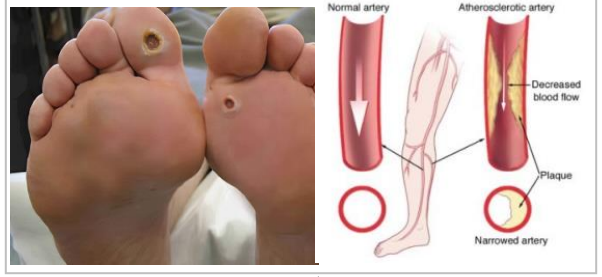
3. Laser Doppler measurement data monitoring



4. Utilization in the medical field

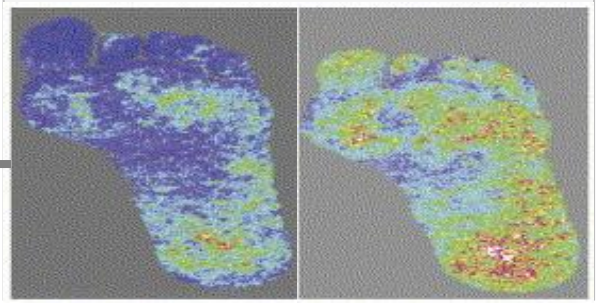
Examples of diabetic foot ulcer monitoring

1. Patients with diabetic foot ulcer



2. Home care after discharge

3. Laser Doppler measurement data monitoring



4. Utilization in the medical field

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Related Standards and Gap Analysis (1/4)

Organization	Standards & Projects	Gap Analysis
ISO/TC 215-IEC/SC62 JWG7 (Health Informatics)	62A/1516/NP: Medical devices: Guidance on the application of ISO 14791 – Part 2: Machine learning and artificial intelligence	• 62A/1516/NP covers how to use machine learning and artificial intelligence in medical devices. • In contrast, this PWI-TR will cover guidance on IoT application to home healthcare.
ISO/TC 215-IEC/SC62 JWG7 (Health Informatics)	62A/1491/NP: Health software and health IT systems safety, effectiveness and security	• 62A/1491/NP deals with the safety, effectiveness, and security of health software and health IT systems. • This PWI-TR may refer to 62A/1491/NP for safety, effectiveness, and security of home healthcare IoT system.
ISO/TC215 (Health Informatics)	ISO/CD TS 6268: Cybersecurity framework for telehealth environments	• ISO/CD TS 6268 deals with Cybersecurity framework for telehealth environment. • This PWI-TR may refer to ISO/CD TS6268 regarding personalized healthcare service based on Personal Health Records collected from home healthcare IoT devices.

Related Standards and Gap Analysis (2/4)

Organization	Standards & Projects	Gap Analysis
ISO/TC215 (Health Informatics)	ISO/CD TS 6201: Health Informatics – Personalized Digital Health – Framework	• ISO/CD TS 6202 provides a framework to incorporate Personalized Digital Health. • This PWI-TR may refer to ISO/CD as a framework for home healthcare IoT.
ISO/TC215 (Health Informatics)	ISO/AWI 17523: Requirements for electronics prescriptions	• ISO/AWI 17523 concerns the requirements for electronic prescriptions. • This PWI-TR may refer to ISO/AWI 17523 to build standards for electronic prescriptions for healthcare IoT devices.
ISO/IEC JTC1/SC25 (Interconnection of Information technology equipment)	JTC1-SC25/3178: Information Technology – Home Electronics System(HES) gateway – Application services	• JTC1-SC25/3178 concerns Application services using HES gateway for smart home and it does not cover home healthcare IoT

Related Standards and Gap Analysis (3/4)

Organization	Standards & Projects	Gap Analysis
ISO/IEC JTC 1/SC41 (Internet of Things and Digital Twin)	JTC 1/SC 41-PWI: IoT for stress management, good health, and well-being	• JTC 1/SC 41-PWI addresses IoT for stress management, good health, and well-being. • In contrast, this PWI-TR will cover applications of IoT for home healthcare including both diagnosis and therapeutics.
ISO TC215 IEC TC62/SC62A (Common aspects of medical equipment, software, and systems)	IEC82304-1: Health software – Part 1: General requirements for product safety	• IEC82304-1 covers the safety and security of health software products whose purpose is to manage, maintain, or improve an individual's health. • This PWI-TR may refer to IEC82304-1 for safety aspect of home health IoT products.
	IEC82304-2: Health and wellness app – Quality and reliability	• IEC82304-2 addresses questions and supporting evidence that can be used to clarify the quality and reliability of a health app. • This PWI-TR may refer to this standard in consideration of achieving quality and reliability IoT applications for home healthcare

Related Standards and Gap Analysis (4/4)

Organization	Standards & Projects	Gap Analysis
ISO/IEEE 11073 (Personal Health Devices)	IEEE 11073: Personal Health Devices	• ISO/IEEE 11073 provides agent-manager model for communication and data exchange of personal healthcare devices(agents) and their manager(a smart phone, a personal computer, a health appliances, etc.) • This PWI-TR may refer to ISO/IEEE 11073 for the communications and data exchange between home healthcare IoT devices.
OCF (Open Connection Foundation)	OCF 2.2.6 OCF Device Specification	• OCF 2.2.6 specifies an OCF IoT framework and data model and resource types of healthcare devices. • This PWI-TR gives guidance on IoT application to home healthcare in JTC 1/SC 41 viewpoint and OCF2.2.6 specifications can be a reference.

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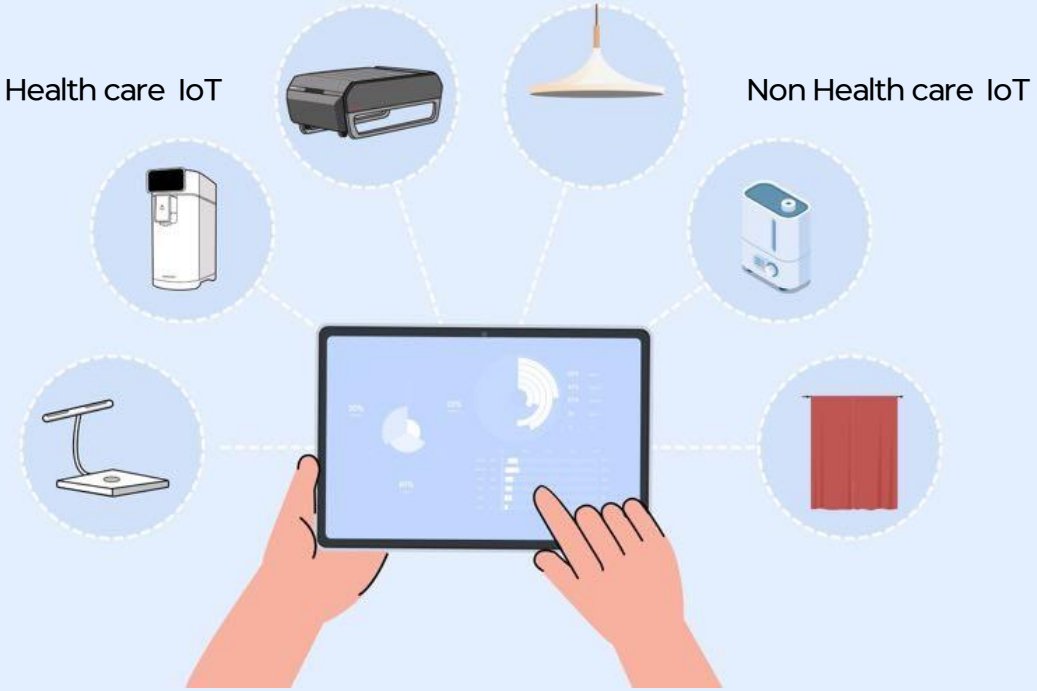
01. Potential Standardization Activities

Development of Technical Report

Title : Guidance on IoT application to home healthcare



Objective of TR

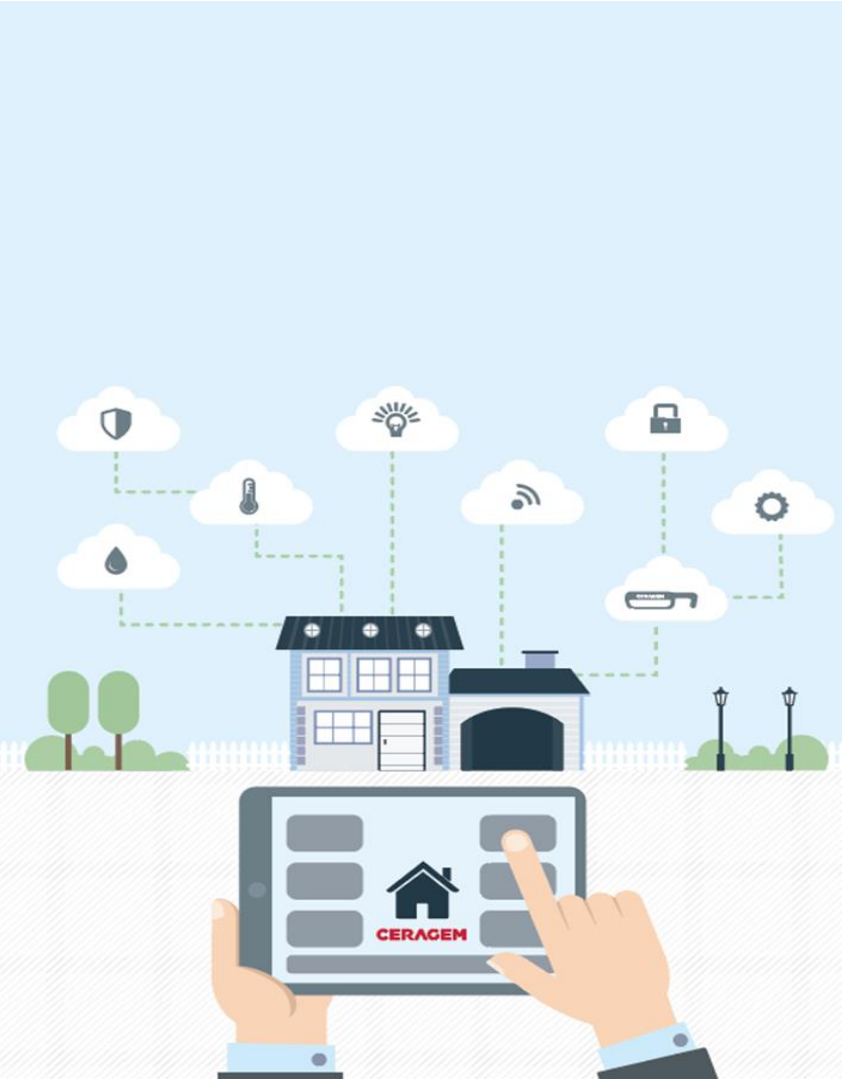
- Provides some guidance on IoT applications to home healthcare
- Handles functional issues for applying IoT technologies to home healthcare
- Laws, regulations, policies are out of scope

Scope

This document gives guidance on applying IoT technologies to home healthcare system considering home healthcare characteristics.

01. Potential Standardization Activities

Clause	Title
1	Scope
2	Normative references
3	Terms and definitions
4	Symbols and abbreviated terms
5	Characteristics of home healthcare IoT
6	IoT application system architecture for Home Healthcare
7	IoT devices for home healthcare
8	Information flow
9	Data management
10	Data representation and visualization
11	Privacy and security
	Annex A (informative) – Application examples
	Bibliography



02. Potential Commercialization Activities

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Thank you!

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