

# Expansion of **robotic technology to care** beyond **therapeutic rehabilitation**:

## Development of care robots and service models in Korea

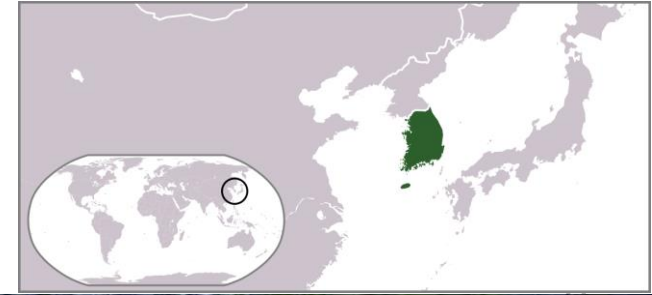
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National Rehabilitation Center, Seoul, Korea

**Acknowledgement** This study was funded by the Translational Research Program for Care Robots (grant number: HK19C0002) from the Ministry of Health and Welfare of South Korea.

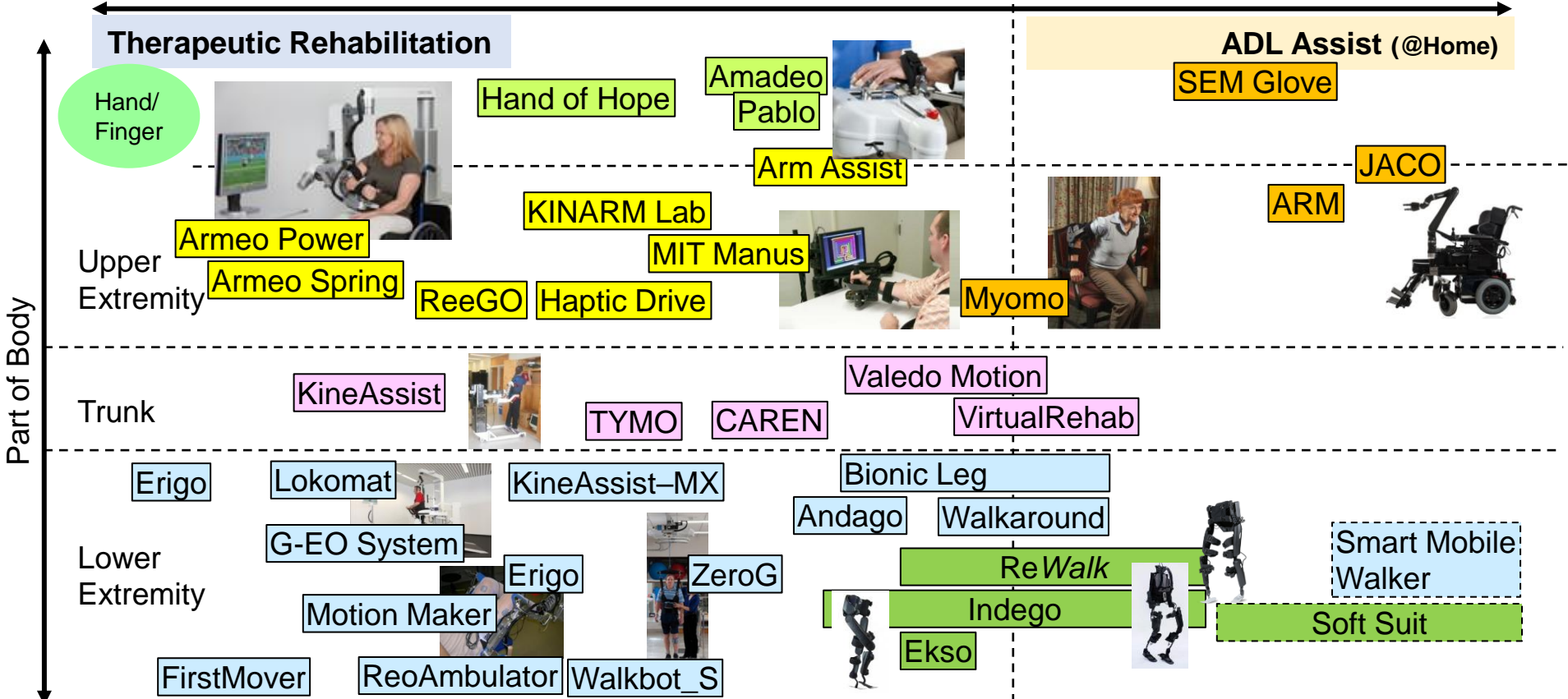
# National Rehabilitation Center, Korea = Rehabilitation Hospital + Research Institute

- **Location: Seoul, Korea**
- **Rehabilitation Hospital**
  - One of the biggest rehab hospitals in Korea.
  - Around 300 beds.
  - Major Patients: Spinal Cord Injury and Stroke. Sub-acute.
- **Translational Research Program for Rehab Robots**
  - 2013~. Making bridge from technological R&D to clinical applications
  - Experience on the enhancing tech, supporting device testing, and KFDA (MFDS) clearance/approval as a medical device
- **Pilot Provision Program for Rehab Robots**
  - 2012~. MoTIE and MoHW.
  - Pilot Provision of Rehabilitation Robots to Rehabilitation Hospitals
- **Translational Research Program for Care Robots**
  - 2019~. MoTIE and MoHW
  - Care Robot Device + Service Model



# Care Robot: A robot device that mainly performs tasks that require a caregiver.

- Therapeutic rehabilitation robots (hospital),
- Assistive robots (home),
- Care robots (hospital, facility, home)
  - Nursing care + Social care



Modified form (Song, 2016, Biomedical Engineering Letters)

# Robot? Robotic Device?

- 2.8 robotic device
  - **actuated mechanism** fulfilling the characteristics of **an industrial robot (2.9)** or a **service robot (2.10)**, but lacking either **the number of programmable axes (4.3)** or **the degree of autonomy (2.2)**
  - **EXAMPLE:** Power assist device; teleoperated device; two-axis industrial manipulator (2.1)
- 2.2 autonomy
  - ability to perform intended tasks based on current state and sensing, without human intervention

# Continuum of Care

- In healthcare, the **continuum of care** is now being used to describe how healthcare providers follow a patient from **preventive care, through medical incidents, rehabilitation, and maintenance.**

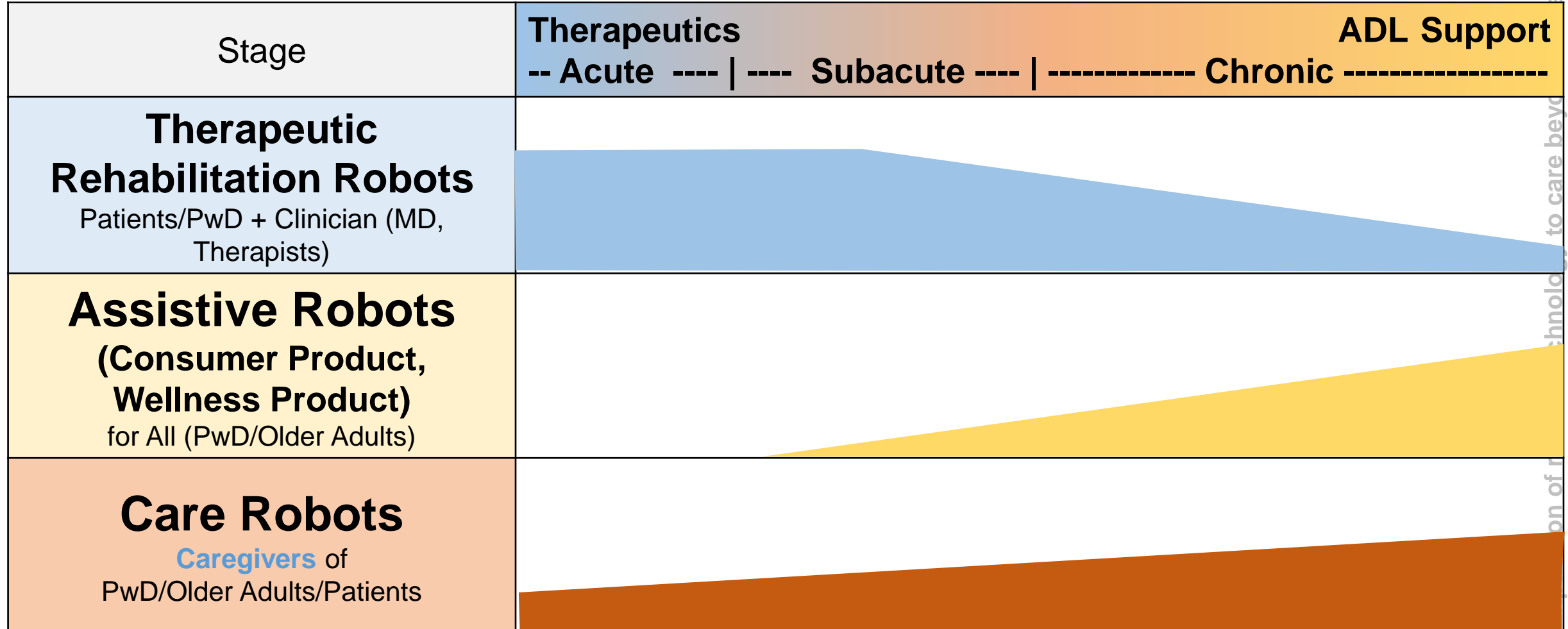
beyond therapeutic  
; and service models in Korea

## Continuum of Care



# Therapeutic Rehabilitation vs ADL supports

- **recovery** through treatment for **Impairment**?
- promoting **participation** through support for **activities of daily living**?
- a technology that **support caregivers** in hospitals, facilities, and at home?

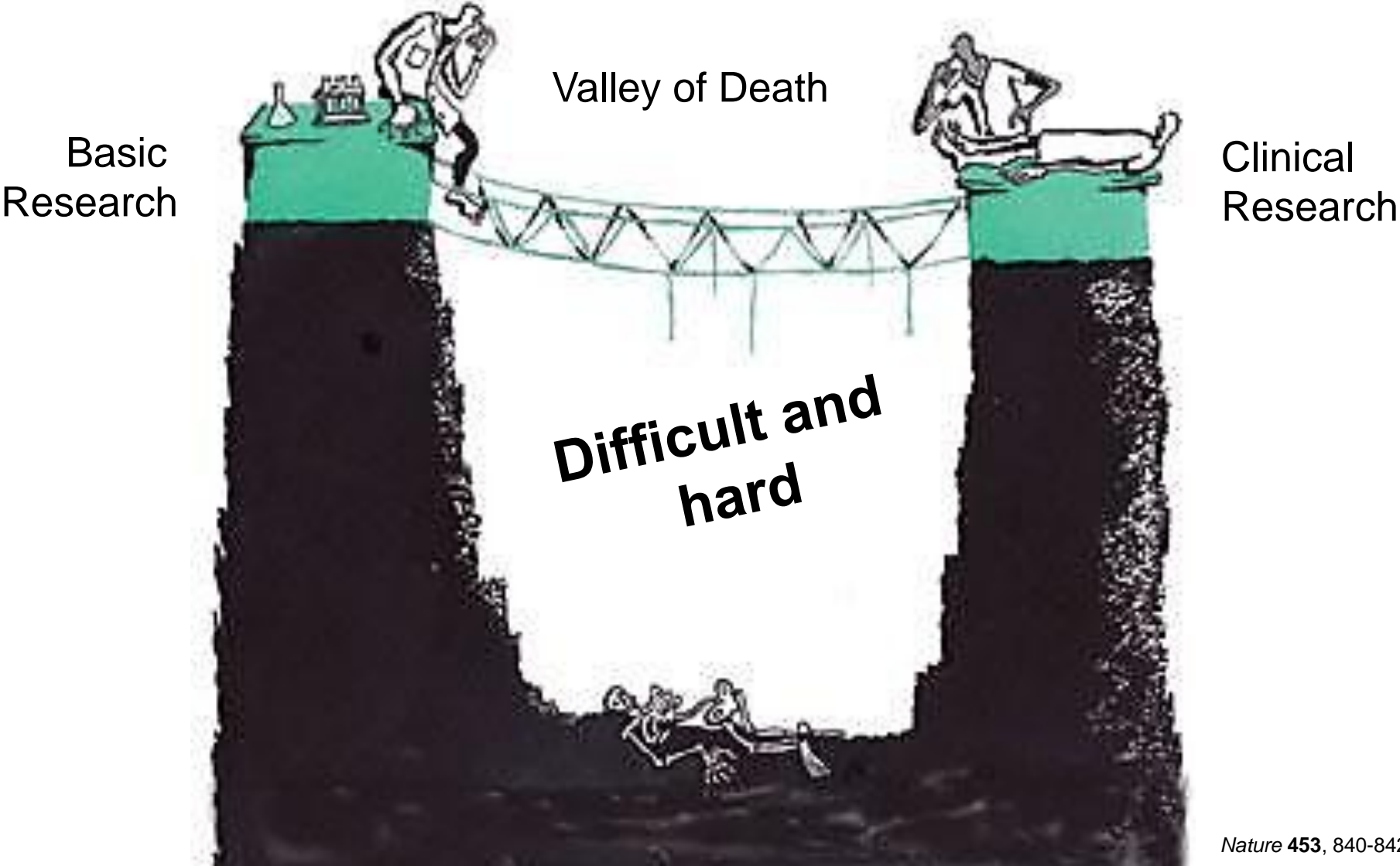


Therapeutic Rehabilitation: Development of care robots and service models in Korea  
 to care beyond  
 technology  
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# Translational Research for (Therapeutic) Rehabilitation Robots



# Translational research: Crossing the valley of death

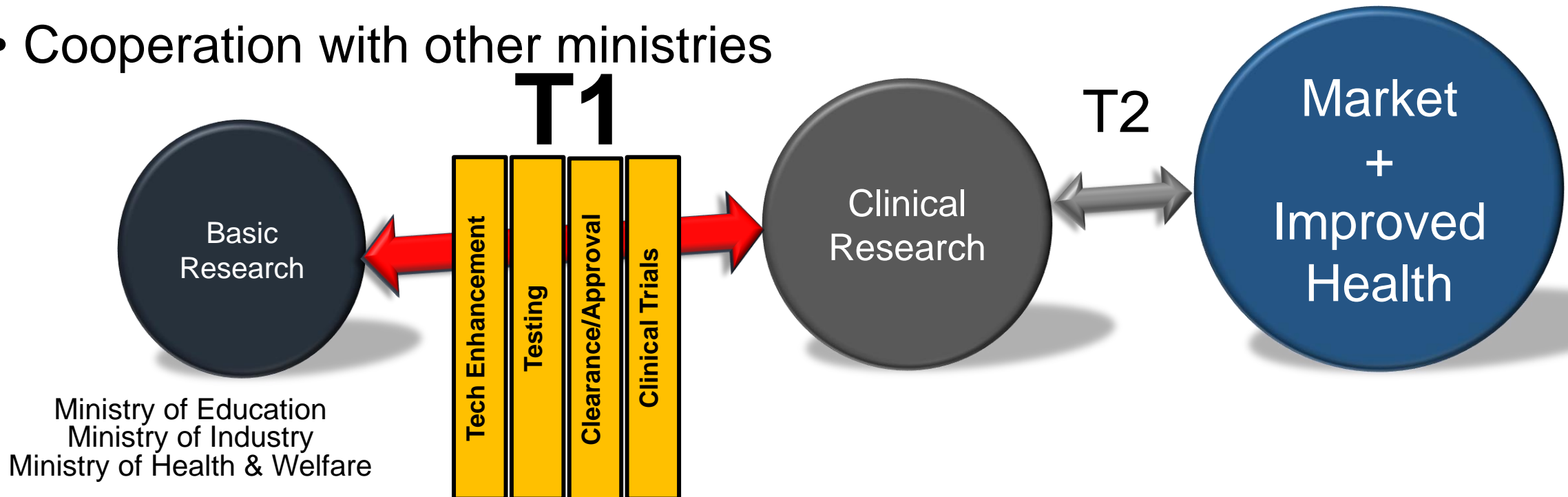


*Nature* 453, 840-842 (2008)



# Translational Research for Rehabilitation Robots

- 1) Technology Enhancement, 2) Testing, 3) Clearance/Approval (Certification), 4) Clinical Trials
- Specialized in rehabilitation robots, starting in 2013
- Accelerate clinical entry of rehabilitation robots
- Cooperation with other ministries





# Exo-glove poly

척수손상 환자의 손 기능 보조 로봇

# Major achievements of TRP for Rehab Robots in 2021



**ANGEL-LEGS M20**  
Certified as a medical device  
from an assistive device



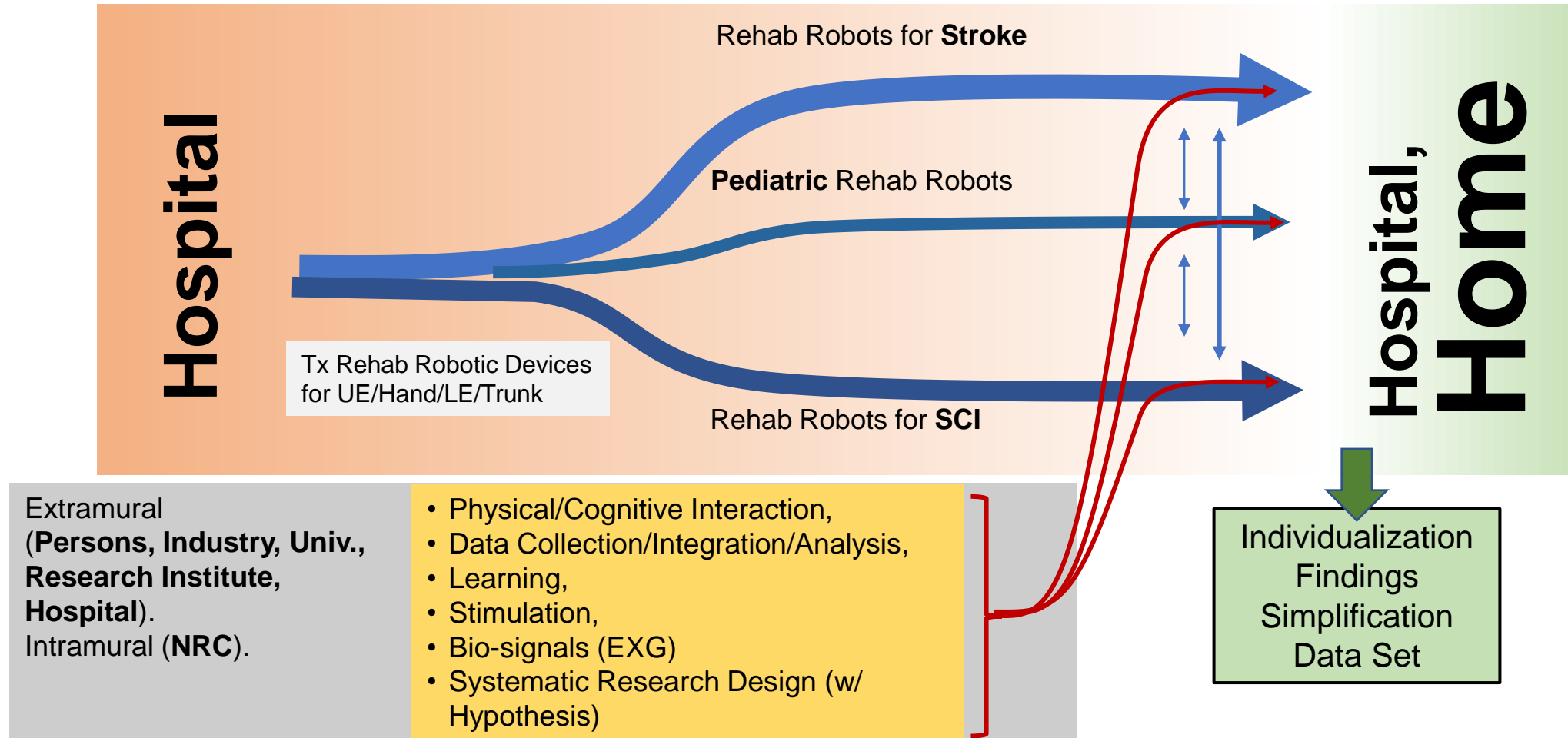
**Rebles planar**  
Medical device class 3  
approval



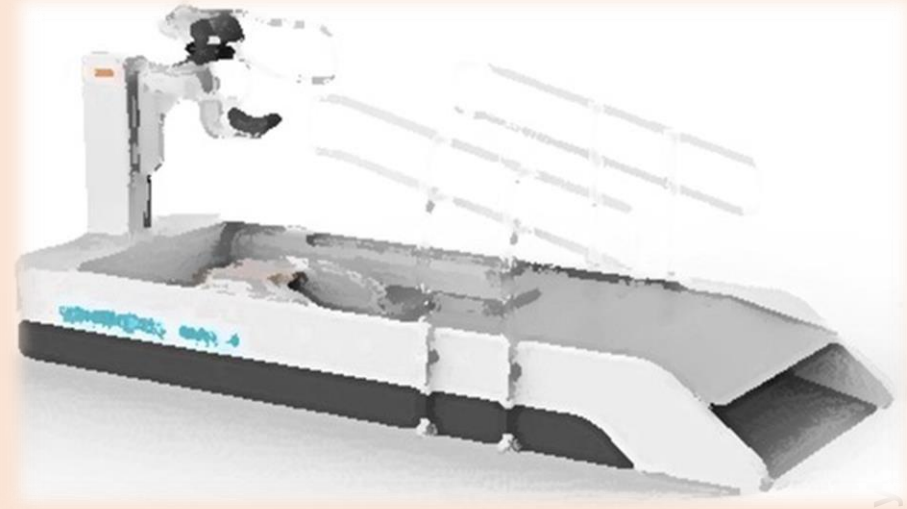
**R-BoT 1.0**  
Medical device class 2  
certification

# Next Direction: TRP for Rehab Robots

- 1) Tech enhancement → 2) Testing → 3) Approval / Clearance →
- 4) Clinical Trials / Usability Test → Pilot Supply → Market



# Pilot Provision for Rehab Robots



# Pilot Provision Program for Rehab Robots

## In order to make references in real hospitals

### 2012

(2012.4.1.~2016.3.30.)

Gait Rehabilitation Robot  
(Walkbot\_S)



- Number of institutions deployed: 4
- Sales record after this program  
→ Gait Rehabilitation Robot 21 EA

### 2013

(2013.5.1.~2017.4.30.)

Feeding Assistive Robot  
(CareMeal)



Transfer Robot  
(Robin-T)

Upper-Limb Rehabilitation Robot  
(Neuro-X)



- Number of institutions deployed: 4
- Sales record after this program  
→ Transfer robot 2 EA,  
Upper-limb rehabilitation Robot 8 EA

### 2014

(2014.5.1.~2018.4.30.)

Trunk Stability Rehabilitation Robot  
(3DBT-33)



Hand Rehabilitation Robot  
(RAPAEL Smart Glove)



- Number of institutions deployed: 4
- Sales record after this program  
→ Hand robot 250 EA  
→ Trunk stability robot 4 EA

### 2015

(2015.5.1.~2019.4.30.)

End-effector Type Gait Rehabilitation Robot  
(MORNING WALK)



Robotic Electronic Magnifier  
(E-bot PRO)



- Number of institutions deployed: 6
- Sales record after this program  
→ End-effector type gait robot 3 EA  
→ Robot electronic magnifier 431 EA

### 2016

(2016.8.2.~2020.7.31.)

Wearable Walking Assistance Robot  
(ANGELEGS)



Care bidet Robot  
(CURA1020)



- Number of institutions deployed: 4
- Sales record after this program  
→ Wearable walking robot 1 EA  
→ Care bidet 92 EA

# Pilot Provision Program for Rehab Robots

## In order to make references in real hospitals

### 2017

(2017.5.1.~2021.3.31.)

Exoskeleton Type Walk-Assist Robot (EXOWALK)



Upper-Limb Rehabilitation Robot (3DBT-61)



- Number of institutions deployed: 3

### 2018

(2018.5.1.~2021.12.31.)

Exoskeleton Type Gait Rehabilitation Robot (SUBAR)



2018 Rehabilitation Robot Excellent Utilization Organization: Hallym University Hangan Sacred Heart Hospital  
**Pioneering a new field of application of rehabilitation robot treatment for burn patients**

- Number of institutions deployed: 3

### 2019

(2019.5.1.~2022.12.31.)

End-effector Type Gait Rehabilitation Robot (Morning Walk)



The continuum of gait rehabilitation

Exoskeleton Type Gait Rehabilitation Robot (EXOWALK PRO)



- Number of institutions deploying: 3

### 2020

(2020.1.1.~2023.12.31.)



- Number of institutions deploying: 6

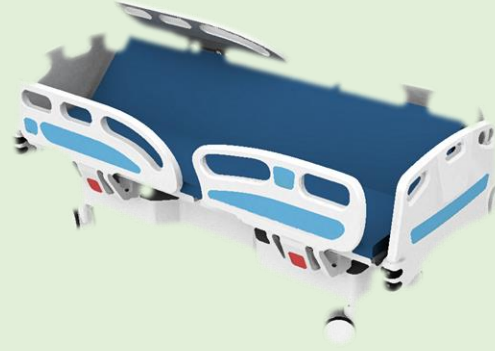
### 2021-22

(2020.1.1.~2023.12.31.)

- Clinical demonstration of lower-limb wearable robot (Angelegs M20)
- Target: 90 of cerebral palsy (children and adolescents)



- Number of institutions deploying: 5

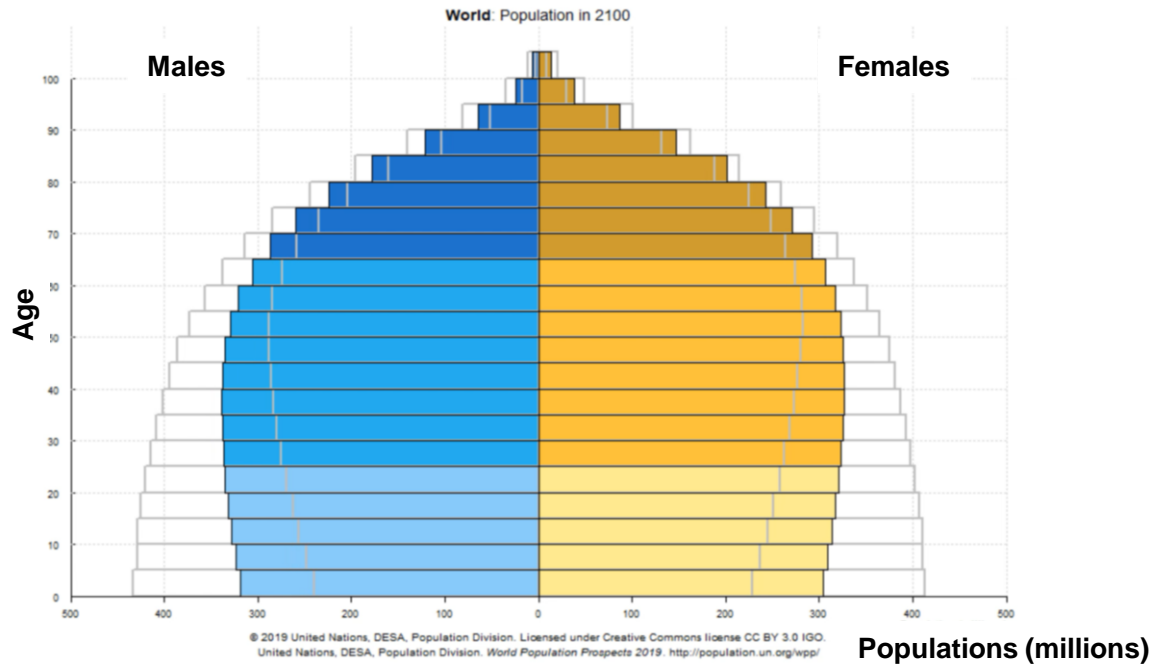


# Translational Research for Care Robots

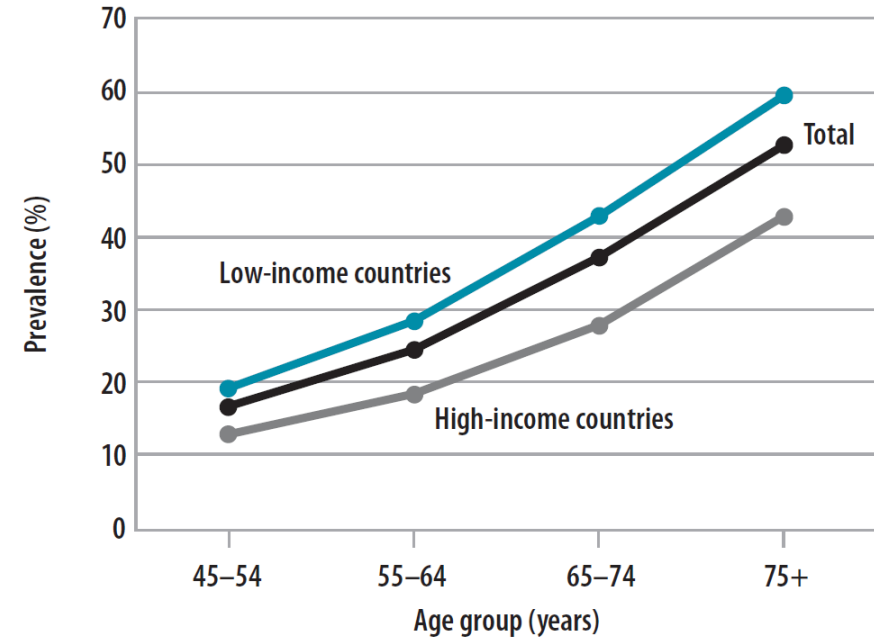


# World Population Ageing: Increase in the Older Adults + Age-Specific Disability Prevalence

- The number of people with disabilities increases with the aging population
- More than 50% of people over the age of 75 have a disability.



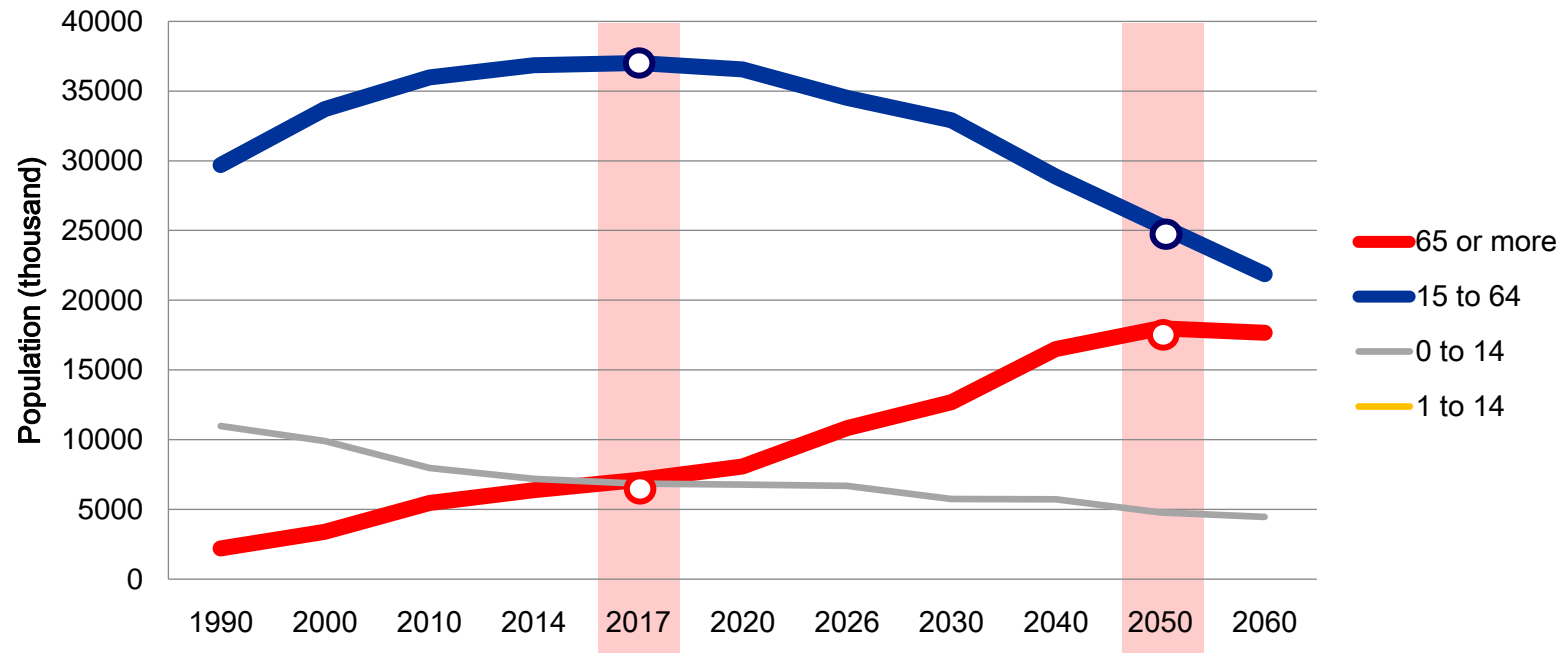
Source: 2019 United Nations



Source: WHO, 59 countries

# Korea faces rapidly aging population

- Being expected to surge in **demand for Care Robots**
  - People with significant disabilities and senior citizens.
  - Productive (15 to 64): Elderly (65 or more)  
= **5.2:1** (2017, Korea) → **1.4:1** (2050, Korea)



# Target Users = Care Receivers + Caregivers

## Mid-aged with Cerebral Palsy

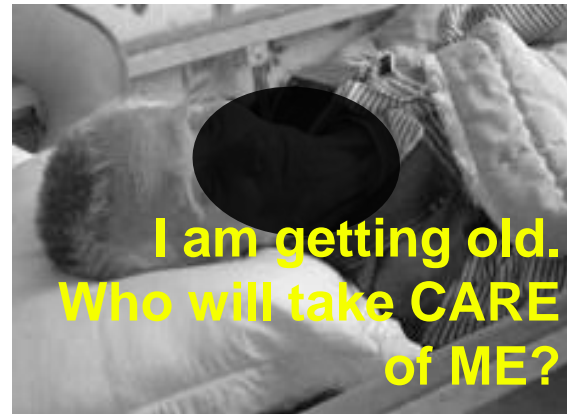
(People with Significant Disabilities)



- People with Significant Disabilities
- Need help 24 hours a day
- Want to show my independence from my parents
- Want to reduce discomfort or anxiety when I am self-reliant

## 73 year old Male

(Old Adults with Severely Limited Mobility)



- Do not want to be burden on my wife and children
- My wife, who takes care of me, grows older and becomes weak
- Worried about who can take care of my old wife

## Caregiver in her mid-50<sup>th</sup>

(Caregiver for old adults and PwD)



- Waist and wrist discomfort with chronic pain
- Want to take care of a mild person who could cause little physical and mental burdens
- Hard to adapt to new people every time

# How many people can reduce the burden of care?

- Care Receivers =  
**540,000 (1% of Korean)**

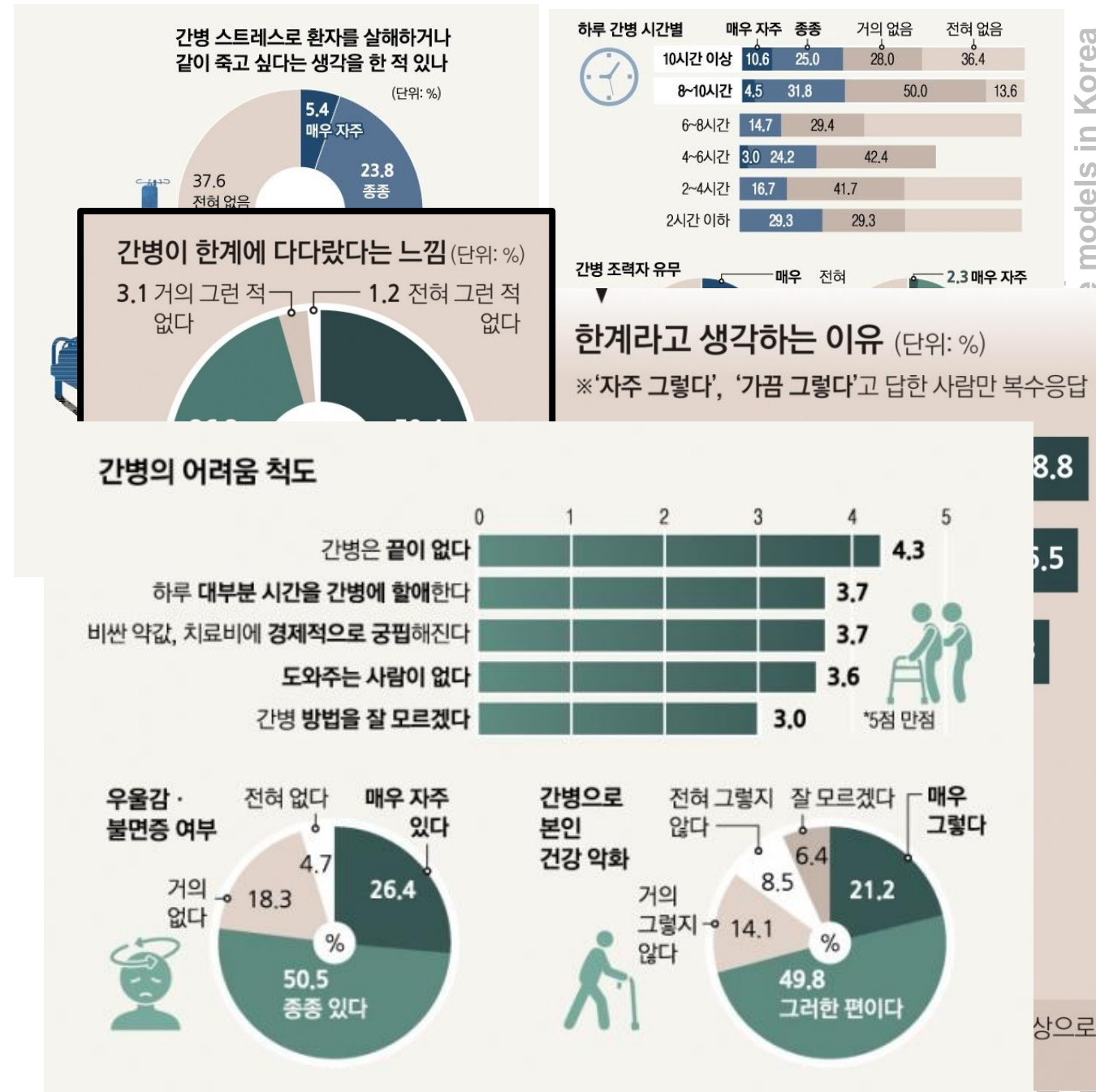
- People with Significant Disabilities.
- Old Adult with Severely Limited Mobility.

- Formal Caregivers =  
**360,000 (0.6% of Korean)**

- Formal + Informal caregivers =  
**3,600,000 (6% of Korean)**  
Including informal caregiver, i.e., family member, and paid workers

# Difficulty of Caregiving

- Care is endless.
- Most of the day is **devoted to care.**
- They become **economically poor** due to expensive drugs and treatment costs.
- There is **no one to help.**
- I don't know **how to care.**



# [Long-Term Care] Aging in Place: Growing Older at Home

- Personal care: Bathing, washing hair, getting dressed → Help for a short time
- Household chores: house cleaning, grocery shopping, laundry
- Meals: Meal → Meal delivery program
- Money management: Bill payment. handling insurance forms.
- Health care: Taking medications (indicate when to take, box of pills).  
Remember your doctor's orders

# AGING IN PLACE

## TIPS ON MAKING HOME SAFE AND ACCESSIBLE

Many older adults want to “age in place” —stay in their own homes as they get older—but may have concerns about safety, getting around, or other daily activities.



A few changes could make your home easier and safer to live in and help you continue to live independently.

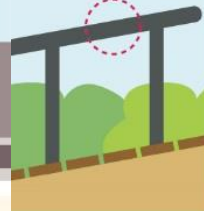


**Don't use area rugs** and check that all carpets are fixed firmly to the floor.



<https://www.nia.nih.gov/health/aging-place-growing-older-home#planning>

**Install a ramp** with handrails to the front door.



**Reduce fall hazards:** place no-slip strips or non-skid mats on tile and wood floors or surfaces that may get wet.



**Place light switches** at the top and bottom of stairs and remember to turn on night lights.



**Install grab bars** near toilets and in the tub or shower.

**Replace handles** on doors or faucets with ones that are comfortable for you to use.



For more information about aging in place, visit [www.nia.nih.gov/aging-in-place](http://www.nia.nih.gov/aging-in-place).



# Top Aging in Place Technologies to Help You Stay Home

- 1. Video Doorbell:** This smart technology from [Ring](#), and other providers, hooks into existing doorbells that enable a homeowner to see who comes to the door via the phone.
- 2. Voice and Remote Thermostat:** This tool ([Google Nest](#), [Amazon Smart Thermostat](#), and others) helps monitor thermostat functions including furnace and air conditioning by voice or by cell phone.
- 3. Virtual Assistant:** Amazon's Echo or Google Home allows homeowners to control their home with their voice – locking doors, turning lights on and off, adjusting the thermostat or viewing camera feeds
- 4. Stove Fire Prevention Devices:** These devices automatically shut off a stove if it is left unattended for a specific time. Devices like this are especially helpful for older adults living with dementia.
- 5. Home Monitoring Systems:** Monitoring systems could help family caregivers make sure their loved ones are safe and secure. To allow for independence, some systems do not require human intervention and have the ability to monitor even body temperature and sleep.
- 6. Social Media Platforms:** Over the past two years, technologies like Zoom and Facebook have become important ways to help older adults stay connected with loved ones and friends.
- 7. Watches with GPS Capabilities:** These smart watches from Apple, Garmin, FitBit and many others, can often track heart rate, blood pressure and body temperature. They can also track an aging loved one's location and will alert 911 if there is a fall.
- 8. Online Grocery Delivery:** This service helps limit worries about falling when out and about, as the groceries are brought right to the customer's door. Delivery also comes in handy if inclement weather or sickness keeps an aging adult home.
- 9. Telehealth:** When health questions arise, it's easy to schedule a medical appointment via computer or smart phone. Telehealth has several advantages, including cost savings, convenience, and the ability to provide care to older adults with mobility limitations, or those without easy access to a local doctor or clinic.



# Systematic Thinking (2017~2018): Setup strategies & Priorities for Care Robots Projects

- Shadowing in the real world
- Survey
- Care Robots Working Group with Various Stakeholders
- Focus Group Interview
- In-depth Interview
- Advisory Meeting
- Overseas Visits (Japan, Sweden, U.K., Finland, Denmark)



• MoHW - MoTIE Smart Care Robot Council

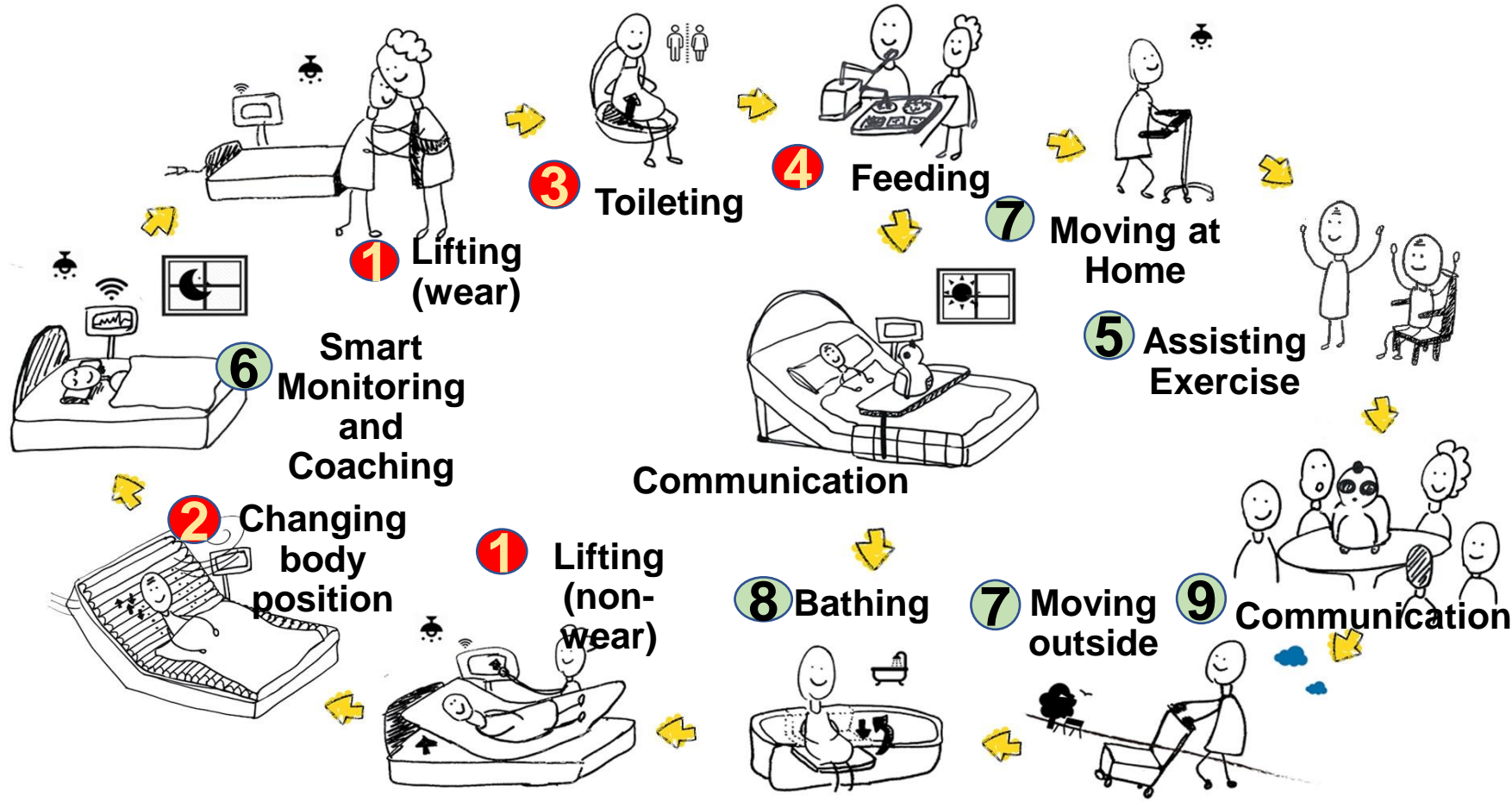
• Care Robot Network Forum (n=49) with Various Stakeholders

Care Robots Symposium

Expansion of robotic technology to care beyond therapeutic rehabilitation: Development of care robots and service models in Korea

# 9 Categories of Care Robots

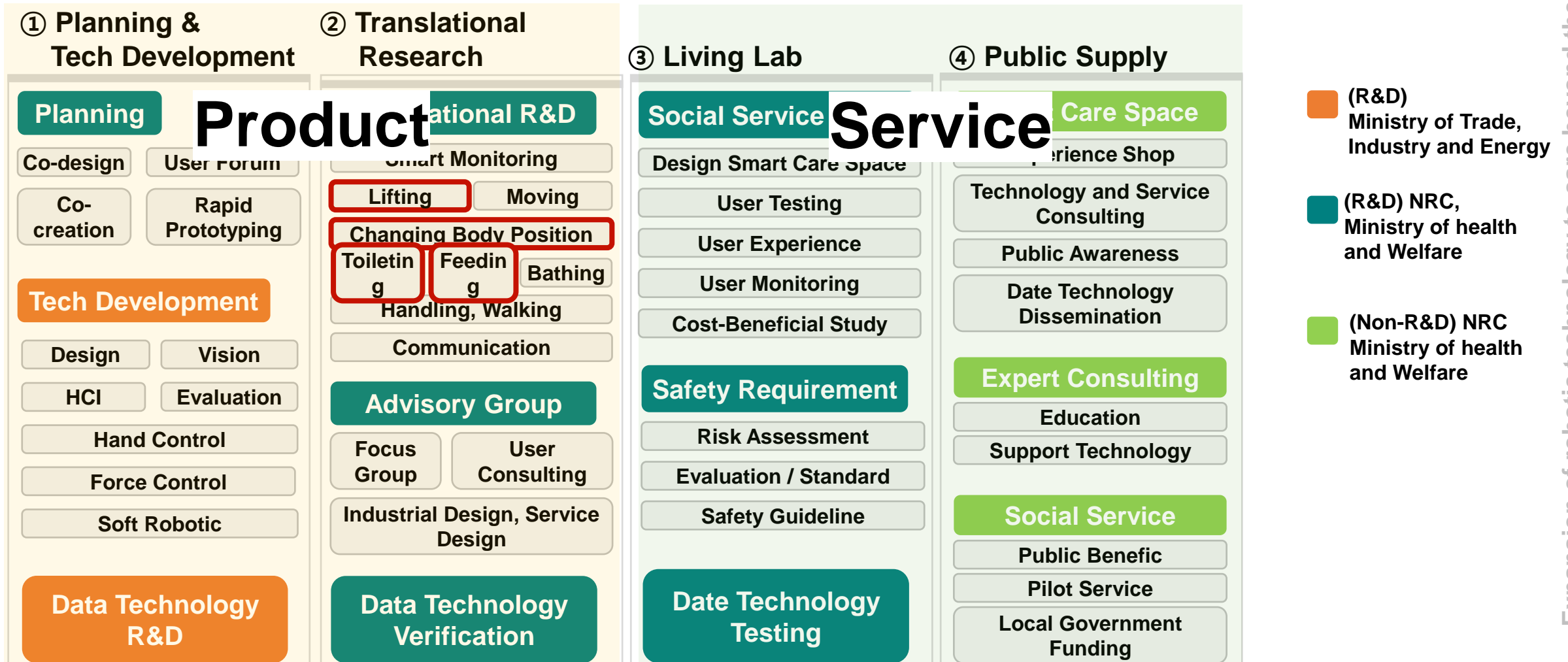
- High Priority: 1) Lifting, 2) Changing body position, 3) Toileting, 4) Feeding



# Smart Care Robot Ecology

## Balance: Product and Service

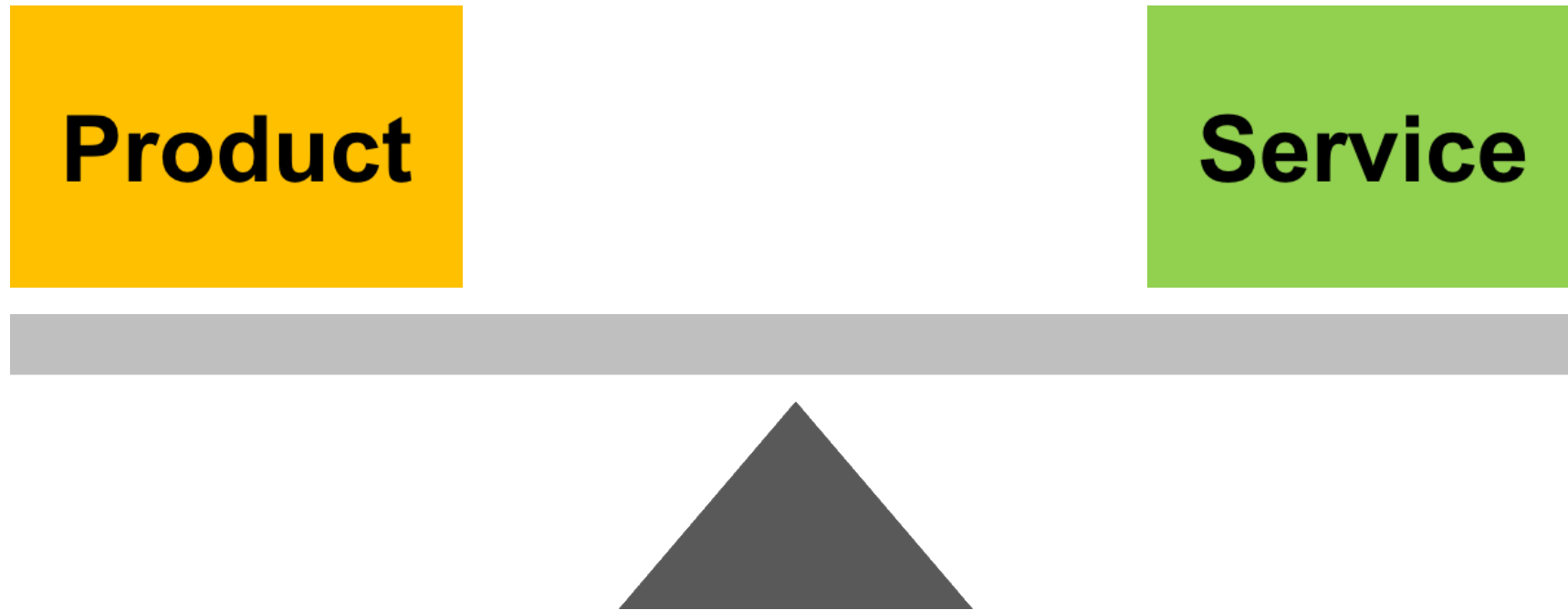
- Necessary to develop products and services simultaneously for rapid market entry.



# Smart Care Robot Ecology

## Balance: Product and Service

- Securing and reinvesting profits for manufacturing and service companies.
- Promotion of early pilot distribution (provision) through simultaneous development of products and services.



# Care Robot under Development

High Tech

Ministry of Industry  
Common product technology for care robots

Transfer support  
(Lift type, smart sling)



Bedsore/posture change support  
(AI-based)



Excreted support  
(feces treatment)



Meal support  
(Fully automatic, food sorting)



Creating a data-based sustainable development and demonstration environment

Low Tech

Ministry of Health & Welfare  
Translational research for care robots

Transfer support  
(2 pillars + mobile robot)



Bedsore/posture change support  
(sensor based)



Excreted support  
(Urine only, monitoring)



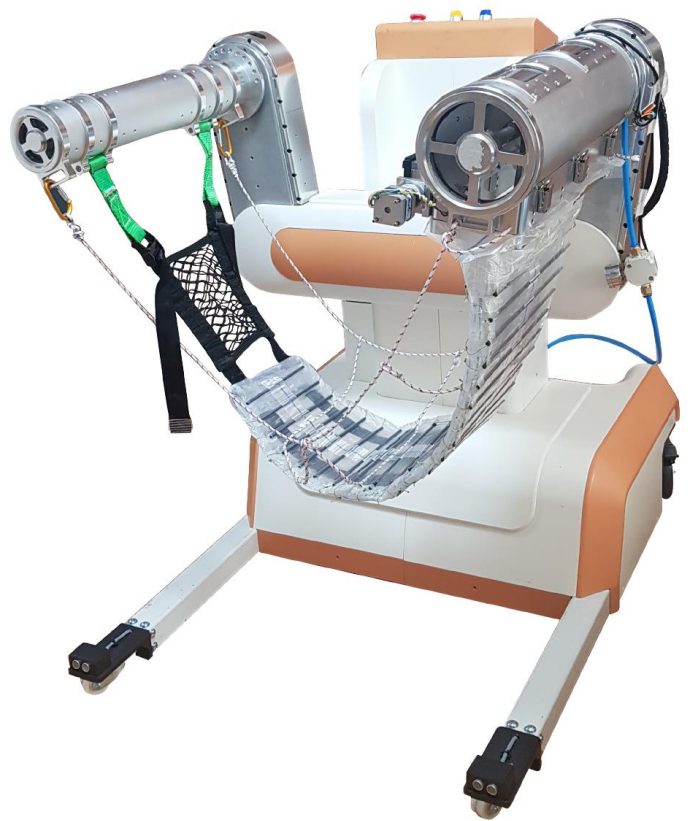
Meal support  
(Strength support, using one's own arm)



Expansion of technology to care robots  
Development of care robots  
Expansion of rehabilitation:

High Tech

Ministry of Industry  
Common product technology for care robots



Transfer support  
Man &Tel  
(Lift type, smart sling)

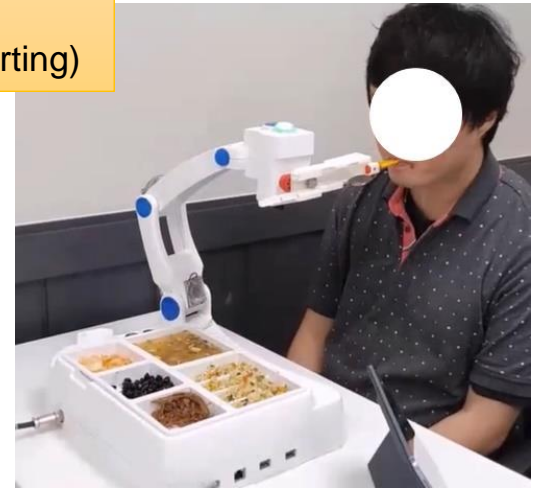


Bedsore prevention/posture change support  
Alpha Robotics  
(AI-based posture recognition technology,  
prediction of bedsore)



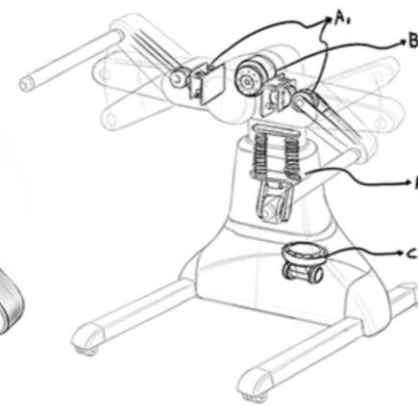
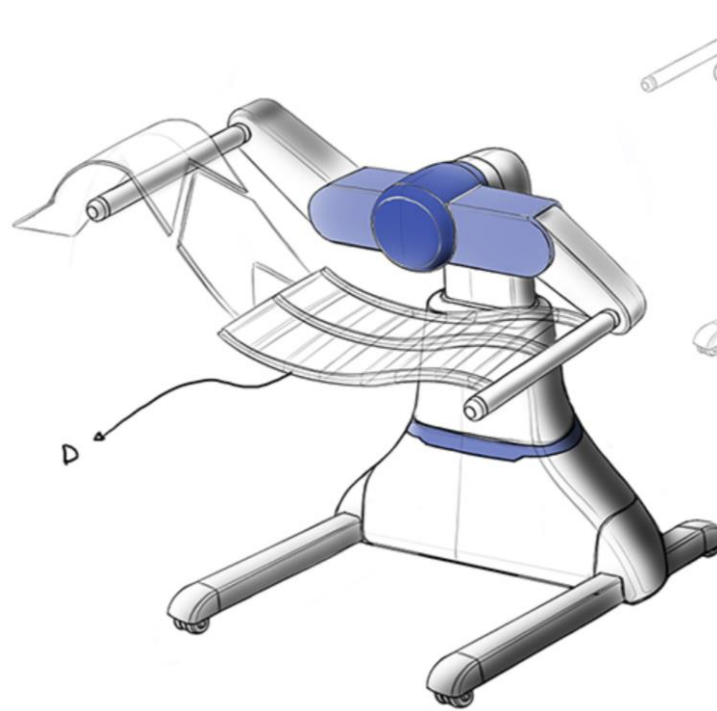
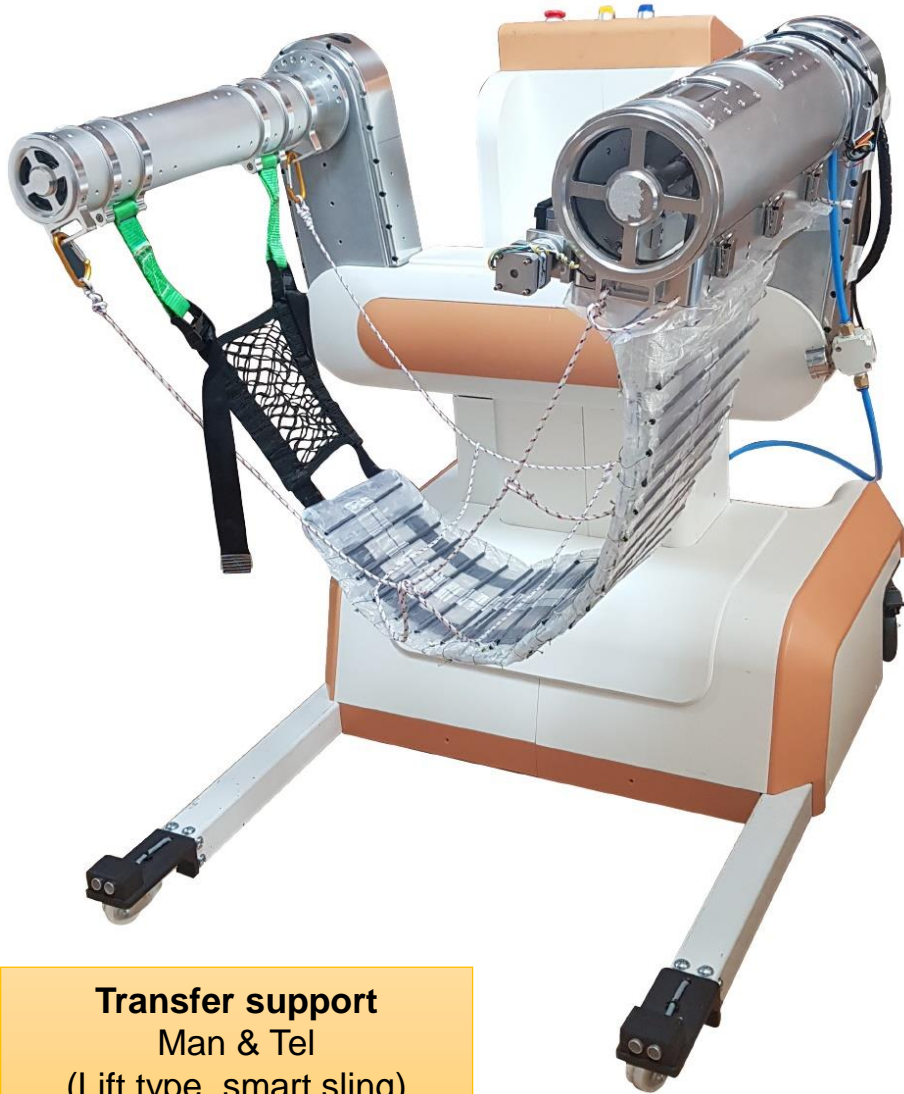
Excreted support  
Curaco  
(feces treatment)

Meal support  
Cymechs  
(Fully automatic, food sorting)

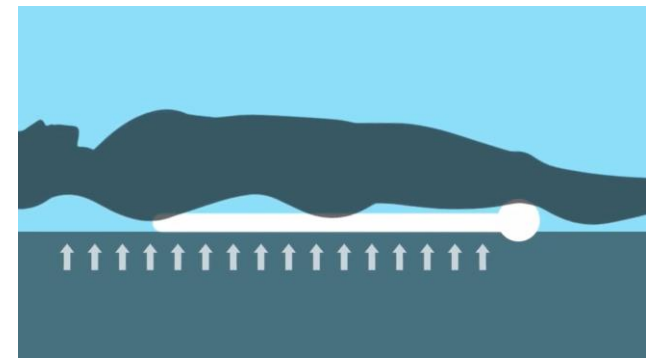
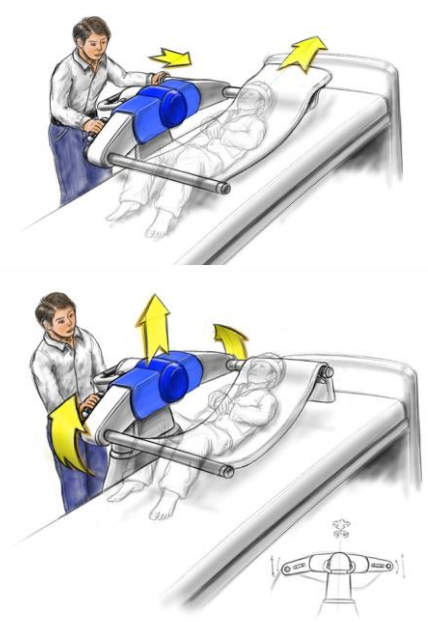


Expansion of robotic technology to care beyond therapeutic  
rehabilitation: Development of care robots and service models

# Transfer Robot with Smart Sling (Man & Tel, KIST, KU, ...)



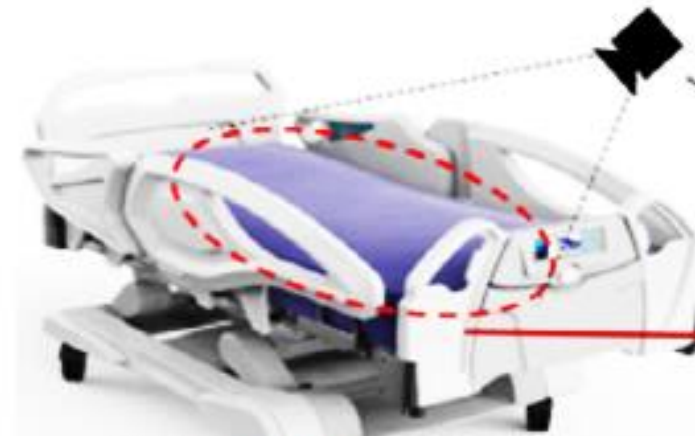
- A1: 중력보상 장치(기어타입)
- A2: 중력보상 장치(링크타입)
- B: 메인 액츄에이터
- C: 주행 의도 추종 주행 기
- D: 공압 방식의 스마트 슬링



**Transfer support**  
Man & Tel  
(Lift type, smart sling)

Expansion of robotic technology to various beyond therapeutic rehabilitation: Development of care robots and service models in Korea

# Posture Changing Robot (Alpha robotics, ...)



<저해상도 자세 인식 매트리스>

인공지능 기반 자세 인식기술

멀티 센싱

카메라 데이터

저해상도  
제압분포 데이터

고해상도  
자세 데이터



욕창 발생 가능성 예측 및  
제어 대상의 자세 결정

환자 상태에 따른 독립형 매트리스 제어 기술



에어 매트리스 제어  
모션 제어

**Bedsore prevention/posture change support**  
Alpha Robotics  
(AI-based posture recognition technology, prediction of bedsore)



# Toileting Robot (Curaco, ...)

- Acquired product approval from the Ministry of Food and Drug Safety for excretory care products (Nov. 2021)
- A change in the nursing paradigm to systematize the work that was done manually by nursing personnel in the medical field
- Reusable urine flow/volume measuring device, Curacare M1
- Example of urine volume measurement = Waste bin (feces collection tank) Collected amount – Washing water usage



Excreted support  
Curaco  
(feces treatment)

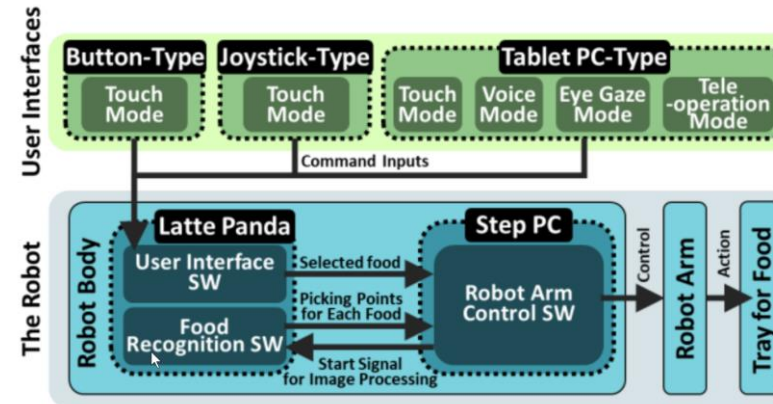
<http://www.irobotnews.com/news/articleView.html?idxno=26844>  
<http://medigatenews.com/news/2151493298>



Expansion of robotic technology to care beyond therapeutic rehabilitation: Development of care robots and service models in Korea

# Feeding Robot (KITECH, GIST, ...)

**Meal support**  
Cymechs  
(Fully automatic, food sorting)



## System Overview

- The Robot
  - 6 DoF robot arm
  - Robot arm controller
  - Interface/Recognition SW
- User Interfaces
  - Button-Type
  - Joystick-Type
  - Tablet PC-Type

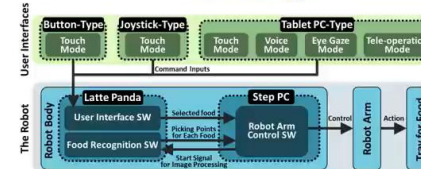


Fig 1. (b) the whole system structure



Fig 2. (a) original image. (b) segmentation result

**Low Tech**

**Ministry of Health & Welfare  
Translational research for care robots**

**Transfer support**  
Dongah Metal  
(2 pillars + mobile robot)



**Bedsore/posture change support**  
Goodpl  
(sensor based)



**Excreted support**  
Craders  
(Urine only, monitoring)

**Meal support**  
NT Robot  
(Strength support, using one's own arm)



Expansion of robotic technology to care beyond therapeutic rehabilitation: Development of care robots and service models in Korea

## Transfer robot (Dong-A Metal, PNU, YUH, KUH, ...)

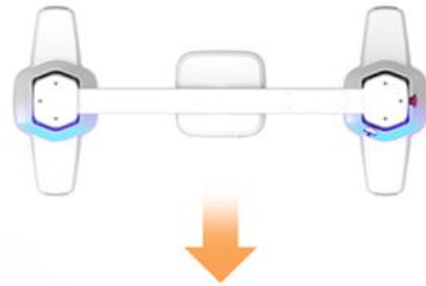
- Development of a safe transfer system with shake control technology applied and a modular patient transfer assistance system applicable to various use environments
- Integrated lift-off robot with a maximum load of 130 kg or more
- Move on two drive wheels that can change direction



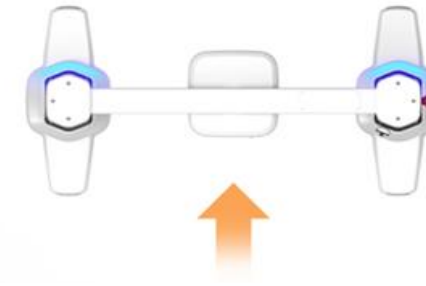
**Transfer support**  
Dongah Metal  
(2 pillars + mobile robot)

# Transfer Robotic System Configuration

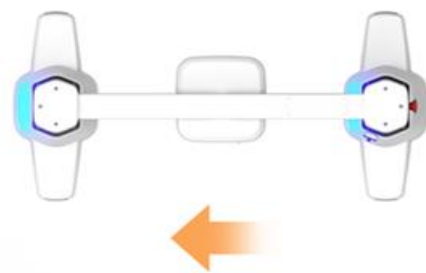
- Mobile Platform: Steering wheels + Ultrasound sensors



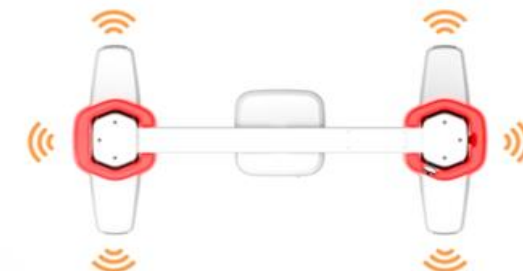
Forward movement



Backward movement



Left/Right movement

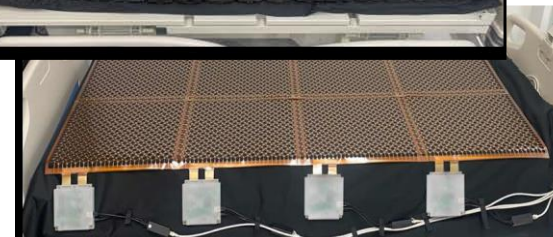


Autonomous stop

Expansion of robotic technology to care beyond their rehabilitation: Development of care robots and services

# Posture change robot (Goodpl, AbleDesigns, KUH)

- multi-axis driven posture change robot including pressure ulcer prevention monitoring devices
- Posture control bed + mattress + pressure sensor array
- Lateral Tilting included

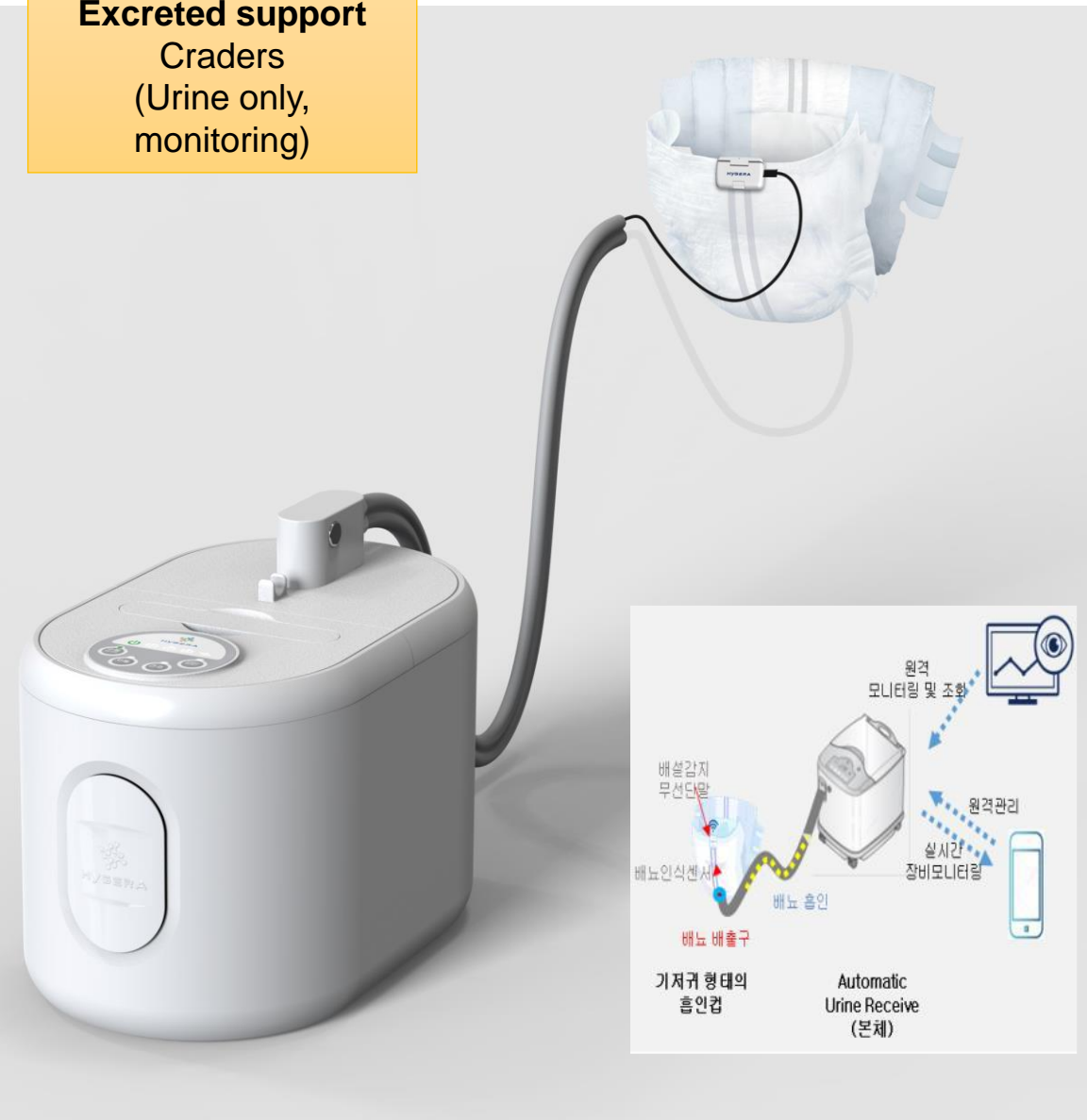


**Bedsore/posture change support**  
Goodpl  
(sensor based)

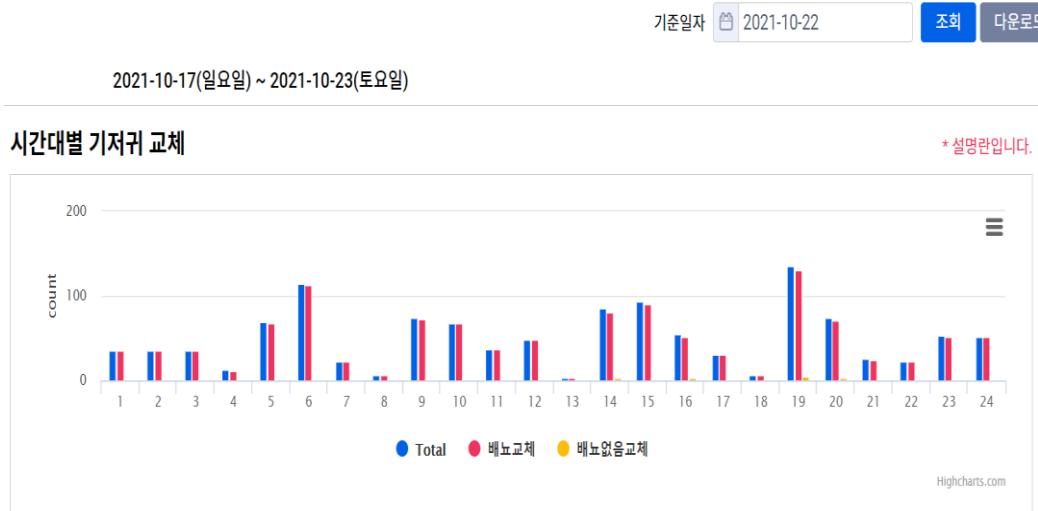
# Toileting robot for urine (Creidus, ...)

- Automatic **urination suction robotic device** with urine receptacle function as a smart diaper
- Data collection → Could increase quality of service
- Easy-to-carry
- Reduced diaper change quantity through urine suction function in diaper

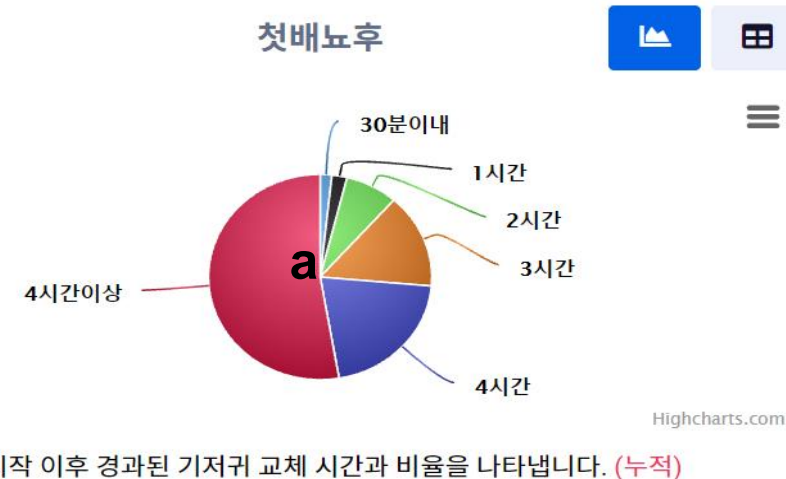
Excreted support Craders (Urine only, monitoring)



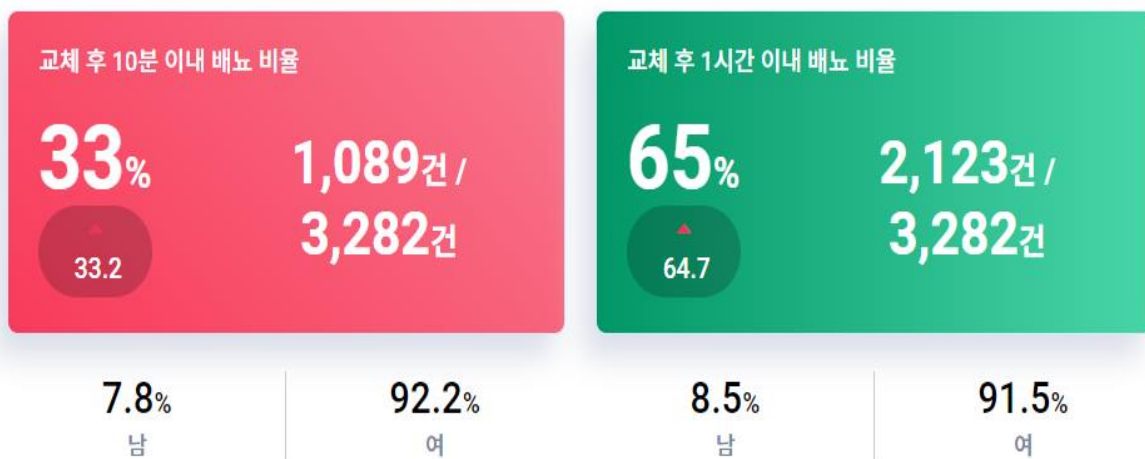
## Urinary management time



## After the first urination



## Urination rate after diaper change



## An urination-specific patient

젓은 야뇨		립뇨		IAD(기저귀 피부염)	
병실/CALL	성합	병실/CALL	성합	병실/CALL	성합
나302(24)		나304(5)		나304(5)	
나304(5)		다303(6)		가301(10)	
207(72)		나203(17)		나203(17)	
기203(7)		나302(2)			
201(33)		가302(21)			
203(37)					
다303(6)					
다302(3)					
가204(30)					
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가104(6)					
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※ 배뇨에 의한 기저귀 피부염 발생 가능성이 있는 경우입니다.

※ 10시간 이상 배뇨가 없었던 이르신 리스드입니다.

Expansion of robotic technology to care beyond therapeutic rehabilitation: Development of care robots and service models in Korea



# Feeding robot (NT Robot, SKKU, YU)

- Development of care robot with **active assistance type** structure for **older adults with limited manipulability** and **some people with severe disability**
- Use **one's arm**
- Different **assistive forces** can be applied when raising and lowering the arm.



Excreted support  
Craders  
(Urine only,  
monitoring)

# Comparative study of physical care burden for elderly excretion care on caregivers between human manual care and robot-aided care based on hierarchical excretion care task model

- **MC+RC** was the highest among the 3 excretion care work scenarios, followed by  $MC_{all}$  and  $RC_{all}$ .
- RC could reduce the physical burden of the caregiver's overall excretion care during the day, but the step of using the excretion robot for excretion treatment and the stage of managing and storing the excretion robot accompanied a heavy physical burden.



Figure 1. CareBidet(CURACO, South Korea) (a)

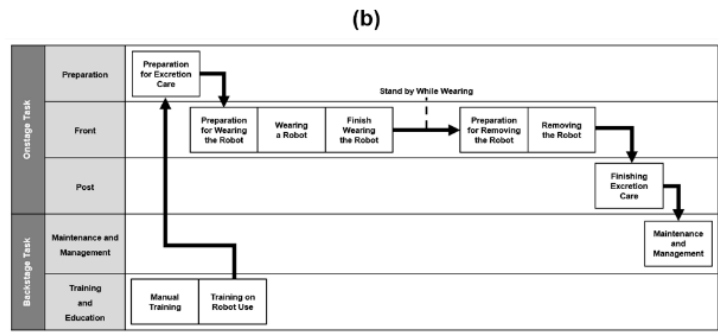
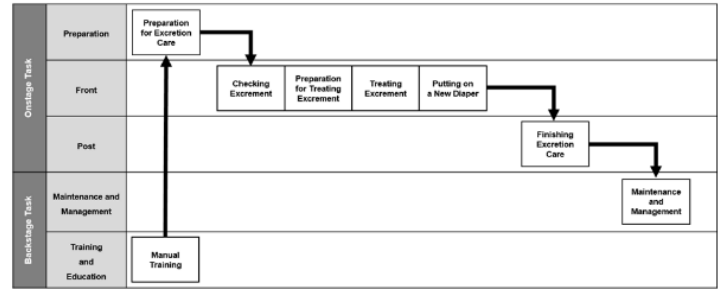
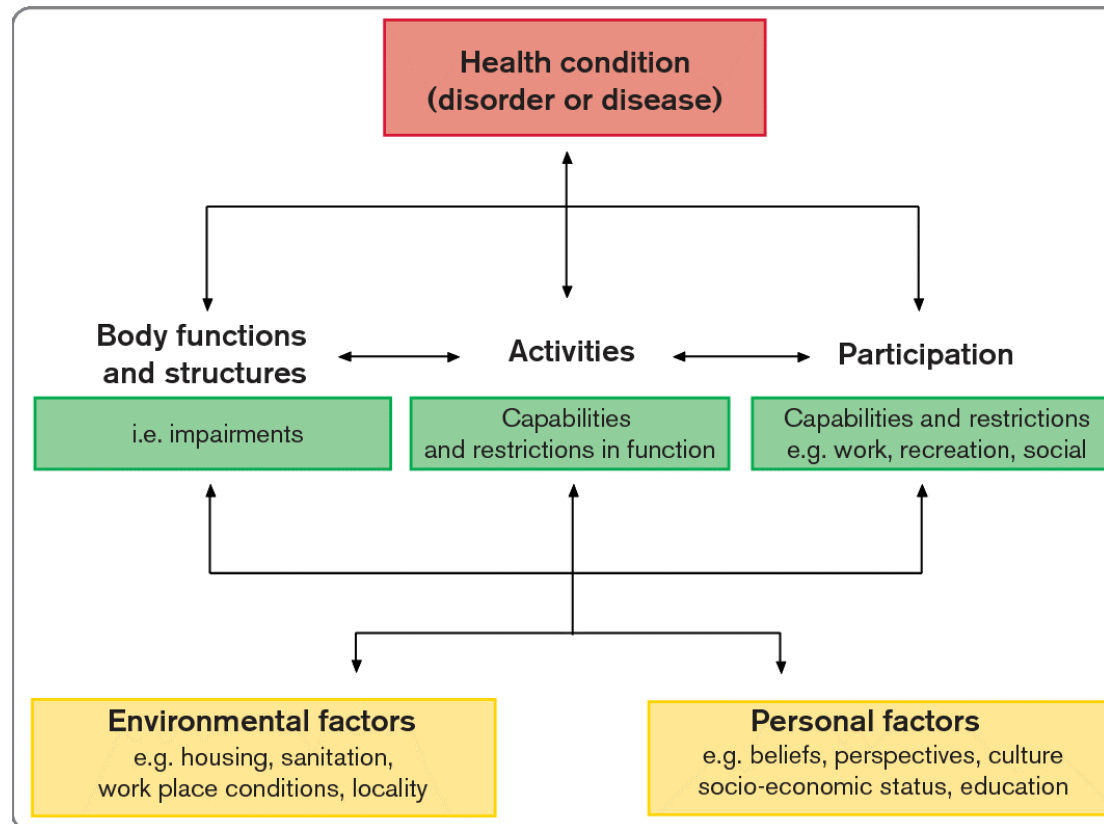


Figure 2. Hierarchical excretion care task model: (a) MC, (B) RC

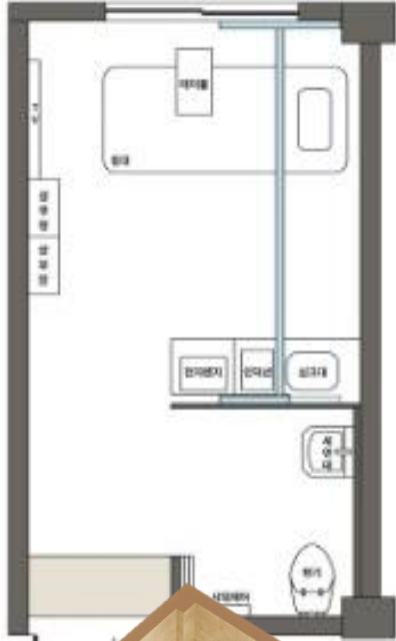
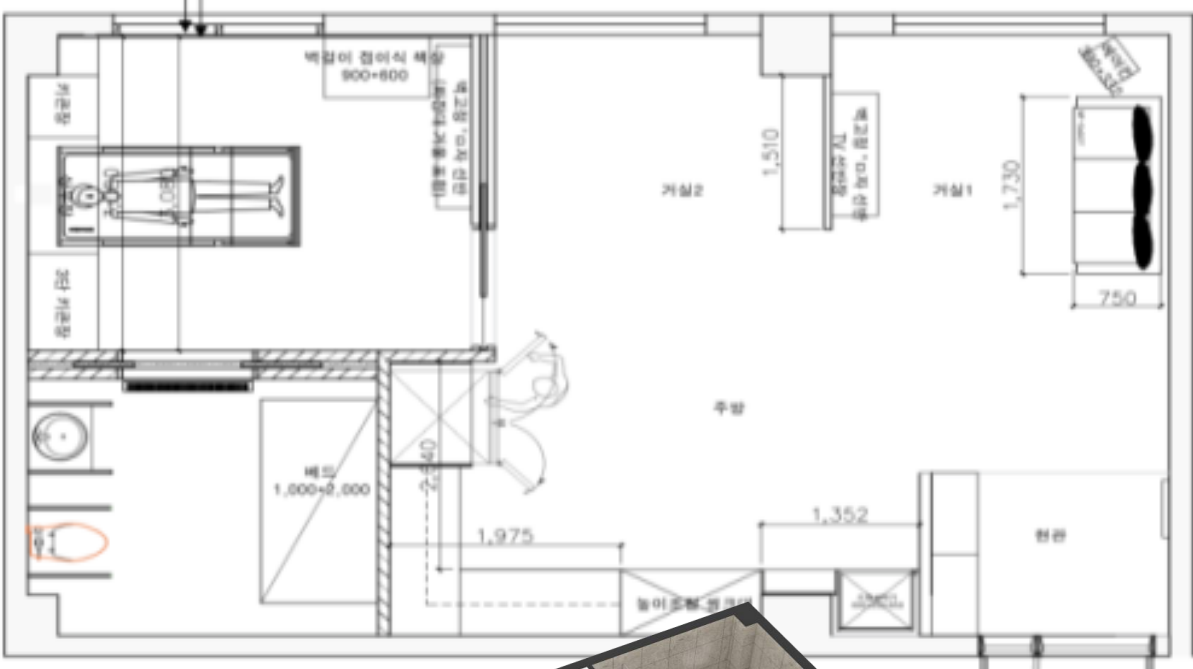
MC: human manual excretion care. RC: robot-aided excretion care  
 J.B. Ko, H.J. Keom, C.K. Lee, B.H. Won, J.S. Hong, "Comparative study of physical care burden for elderly excretion care on caregivers between human manual care and robot-aided care based on hierarchical excretion care task model," ISG2022

# Care Robots and Environments

- Care robots are significantly affected by the environment.
- ICF (International Classification of Functioning, Disability and Health)
  - Even health depends on the environment.

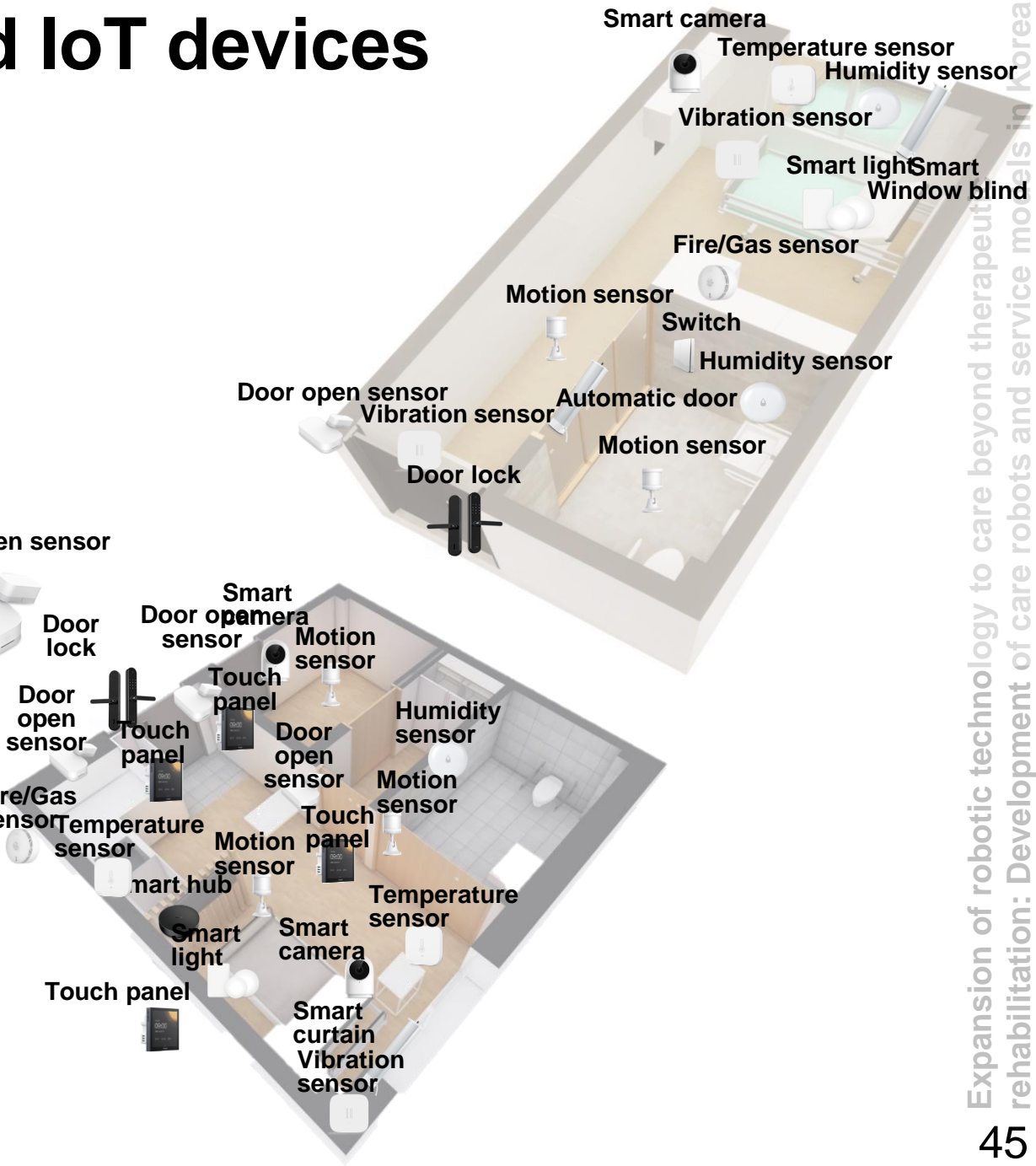
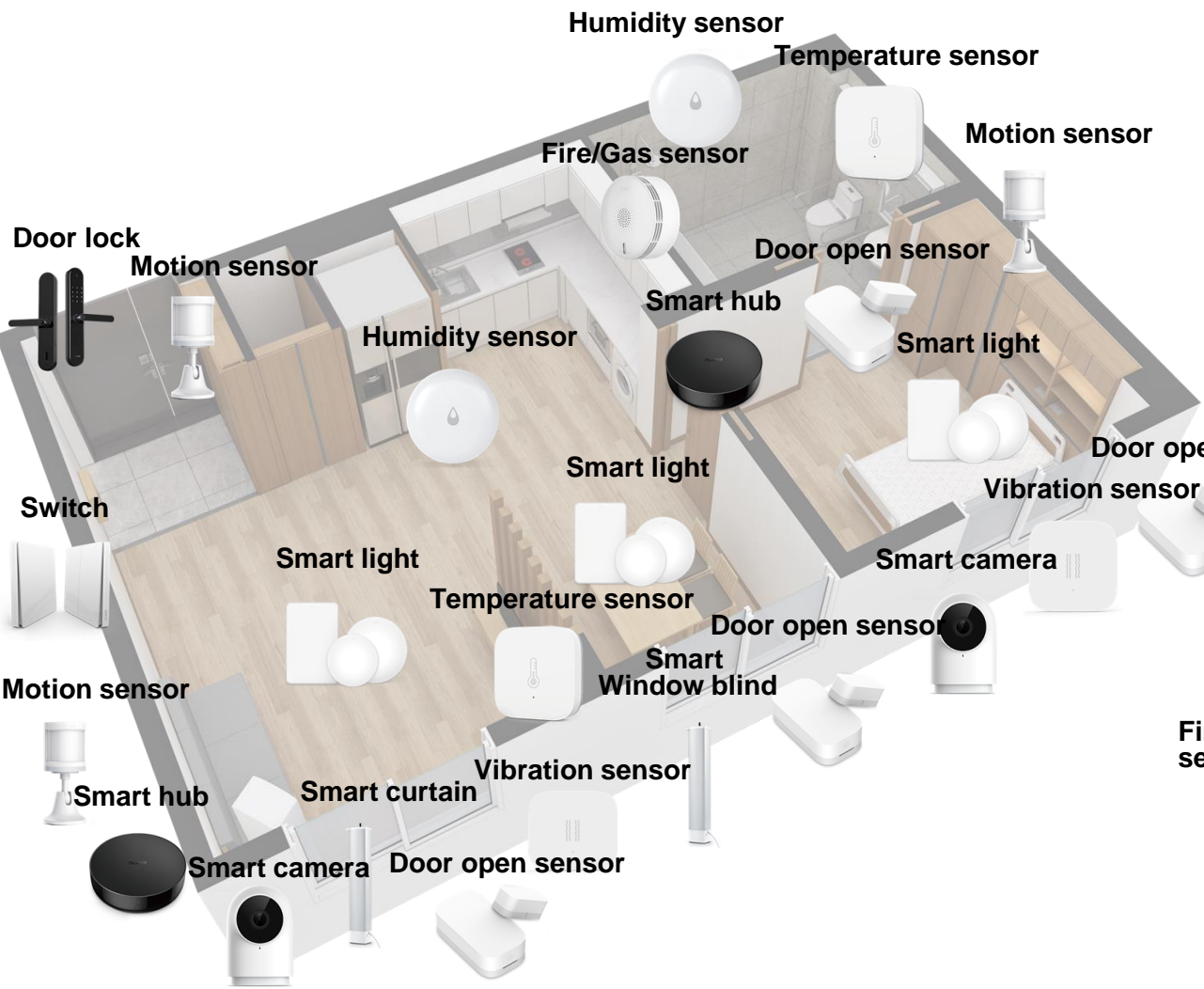


# Smart Care Space



Expansion of robotic technology to care beyond therapeutic rehabilitation: Development of care robots and service models in Korea

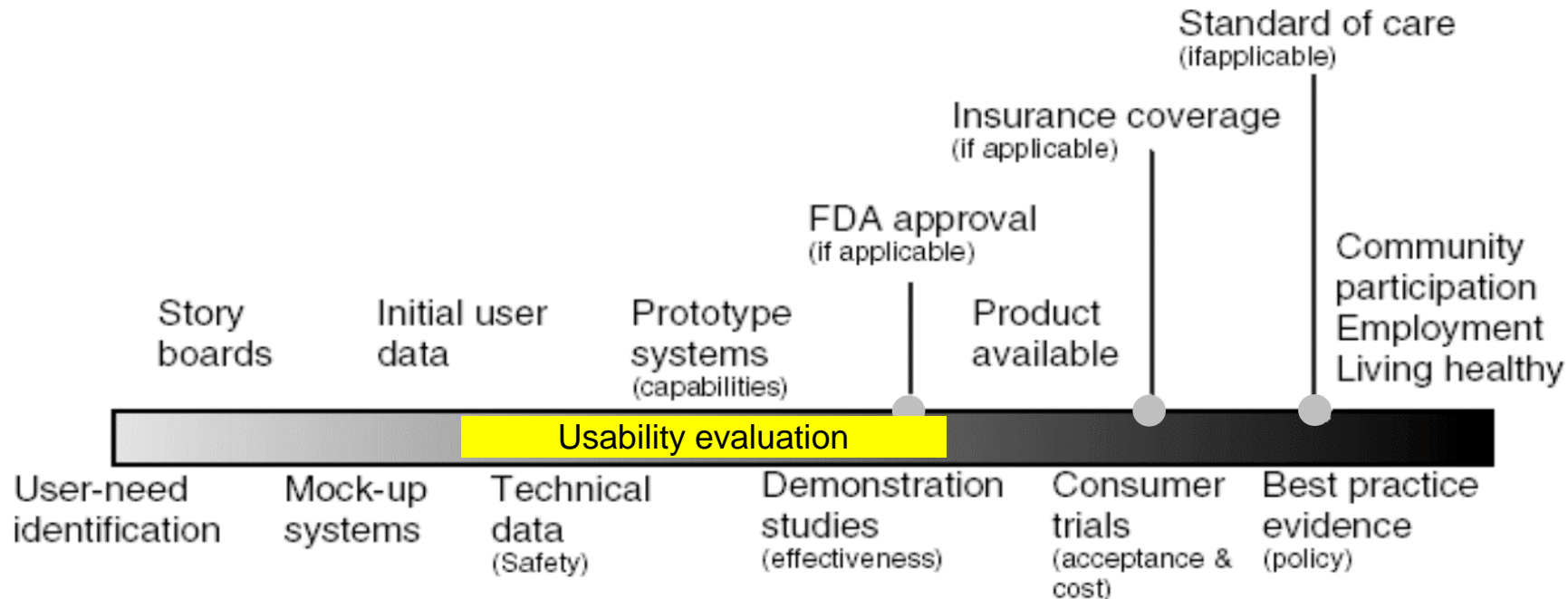
# Smart Care Space with installed IoT devices



Expansion of robotic technology to care beyond therapeutic rehabilitation: Development of care robots and service models in Korea

# Participatory Action Research

- Participation of consumers and stakeholders throughout the entire cycle. Practical direction, but not easy.
- Various usability evaluations with consumers or clients are required to develop care robots that support transfer, posture change, toileting, and eating (Lim, Song et al., 2022).

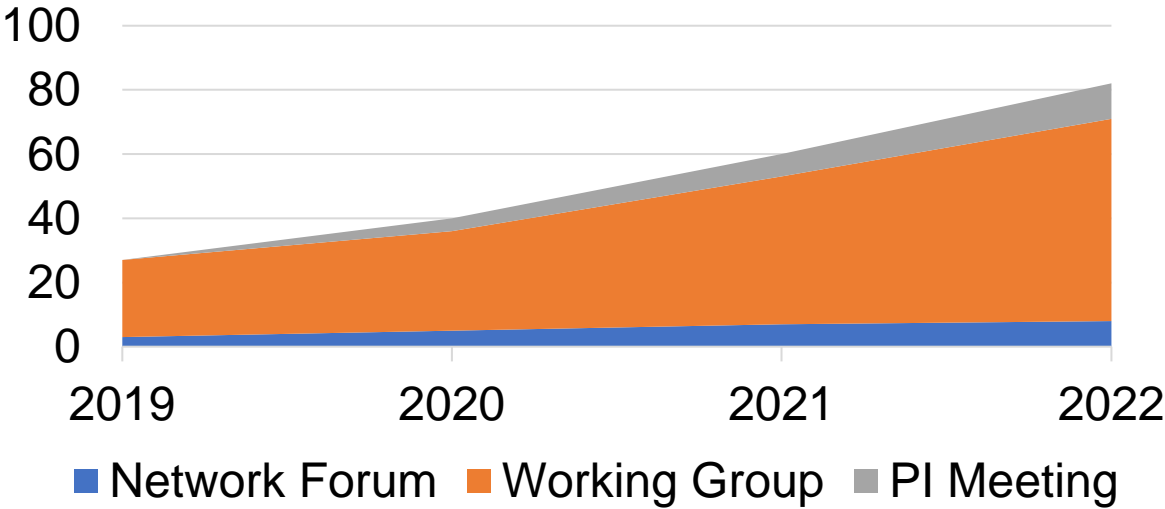


# Regular communication in translational research for care robots: Network Forum and Working Group

- The translational research for care robots, which started in 2019.
  - held a “network forum” once or twice a year in which both experts and stakeholders participated, and
  - held dozens of “working groups by field”.

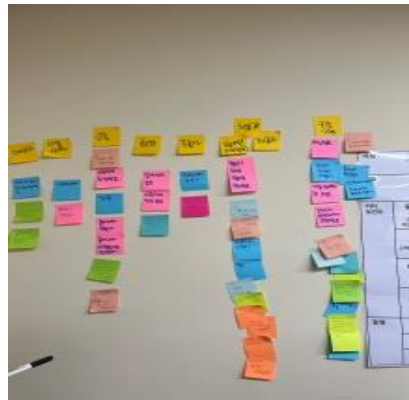


Cumulative number of events/meetings



# Hands-on Workshop for Care Robots based on Service Design

- Engineers, clinical experts, caregivers, etc
- 1<sup>st</sup> workshop: 8 experts use 8 types of transfer devices
- 2<sup>nd</sup> workshop: the people with cerebral palsy participated
- 3<sup>rd</sup> workshop: the people with SCI (C4 level) participated
- Deriving a Consumer Journey Map through Affinity Diagram
- **Opinions of Transfer devices**
  - Need to improve compatibility between beds and transfer devices
  - A systematic approach is needed according to the clinical characteristics of the people with disability



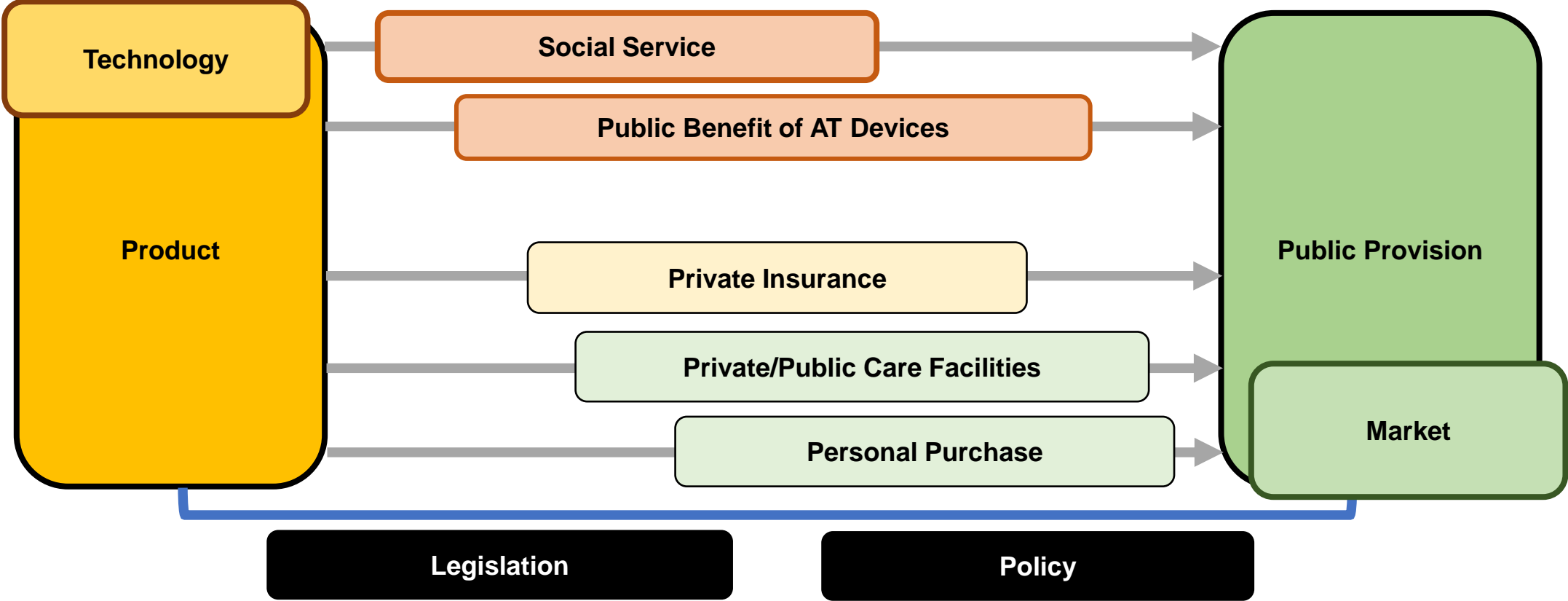


# Insights for transfer devices

- **(Compatibility)** The transfer device needs to improve compatibility with various environments including beds.
- (Wearability of sling) Improves the wearability of the sling.
- (Education/training) Familiarity with the manual is essential. Pay attention to safety accidents through repeated use and correct use.
- (Personal customization) A systematic approach is required according to the characteristics of PwD. Distinguish between generalization and specialization.
- (Disability characteristics) Case study is required according to the characteristics of PwD when making guidelines.
- For each device used, special information is added to the usage guideline.

# Service + Business Model to Public Provision + Private Market

- Not only technology, but also regulation and policy
- Various services, including public pay, have been investigated and analyzed. **Service Platform** will be considered.



# Application guidelines for 4 care robots

## Major opinions on usability test are included in application guidelines

### Table of Contents


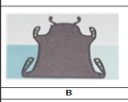

- Overview
- Purpose of application
- Coverage
- What is Transfer devices?
- Type of Transfer devices
- Type of slings
- Precautions for Use of Lifting Equipment and Slings
- Battery management
- Multipurpose (universal) sling measurement
- Assessment of custom sling needs
- Preparation for the use of lifting devices and slings
- the personal environment of the caregiver
- What do you want to achieve with Transfer?
- Where do you want to use this machine?
- How competent is the caregiver?
- Environmental Considerations for the Use of Transfer Devices
- Maintenance of a win-win machine
- Industrial accident cases and prevention methods related to this earth's construction
- Responsibility for risk assessment and training
- the law
- Support for the win and sling and sling
- References
- Term Definitions
- Supplementary Provisions

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- Overview
  - What is the pressure injury?
- Risk factors
- Who is at risk?
- How to reduce your risk of developing pressure injury
  - 4 stages of pressure injury
  - Body parts at risk for pressure sores
- Bed for preventing pressure injury and changing posture
- Characteristics and types of mattresses
  - Mattress Characteristics
  - Types of mattresses
- Selection of bed and bed accessories (bed accessories)
- Bed-related system for preventing pressure injury and changing posture
- Choosing the right equipment
- For more information
- Useful institutions to refer to
- References
- Precautions when using the pressure sore prevention and posture change care robot
  - Appendix 1 Patient safety information sheet\_Guidelines for prevention of pressure sores
  - Appendix 2 Norton Scale Evaluation Table
  - Appendix 3 Waterlow Scale Evaluation Table
  - Appendix 4 Braden's Bedsores Escalation Tool

### Type of slings

- Sling classification by type and product introduction

유형	설명	사용목적
 A Nightback sling - divided legs	<ul style="list-style-type: none"> <li>It provides the highest assistance among sitting slings to those who are unable to hold their heads.</li> <li>It provides assistance in height from the head to the buttocks.</li> <li>The legs are separated so it is comfortable and disperses and prevents the concentration of pressure under the thighs.</li> <li>It is convenient to apply in a sitting position such as a wheelchair or chair.</li> </ul>	<ul style="list-style-type: none"> <li>It is applied to care receivers who cannot hold their heads and have very weak muscle strength in the torso.</li> </ul>
 B Nightback sling - undivided legs	<ul style="list-style-type: none"> <li>It provides maximum assistance to caregivers who cannot control their heads.</li> <li>It can be adjusted under one caregiver for a short period of time after death with a wheelchair and placed under it.</li> </ul>	<ul style="list-style-type: none"> <li>It is applied to caregivers who can hold their heads but have reduced body balance or reduced muscle strength.</li> </ul>
 C Shoulder Nightback sling - divided legs	<ul style="list-style-type: none"> <li>It provides assistance for the entire body part except for the head.</li> <li>The legs are separated, so it is comfortable and disperses and prevents the concentration of pressure under the thighs.</li> </ul>	<ul style="list-style-type: none"> <li>It is applied to caregivers who can hold the head but have reduced body balance or reduced muscle strength.</li> </ul>

### and Slings

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### Risk factors

- reduced mobility
- Neurological or sensory impairment
- skin damage related to incontinence/moisture/diaper rash
- Temperature and Humidity
- Decreased nutrition and blood occlusion

People with low body fat have less subcutaneous fat and reduced muscle volume, so they have few pads over the bony prominences. People with high body fat have thick padding over the bony prominences, but this tissue is poorly vascularized, making it more vulnerable to shear forces. To restore tissue and prevent pressure sores, good nutrition is essential and good hydration is essential to maintain tissue resistance and elasticity.

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### Lifting

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- Chapter 1. Introduction of guidelines for the use of excretion assistance care robots
  - 1.1 What is excretion?
  - 1.2 What is a care robot?
  - 1.3 What are the guidelines for the excretion assistance care robot?
- Chapter 2. Introduction of excretion assistance care robots
  - 2.1 What is an excretion-assisted care robot?
  - 2.2 Where an excretion assistance care robot is required
  - 2.3 Key terms related to the excretion assistance care robot
  - 2.4 Types and Examples of Excretion Assisted Care Robots
  - 2.5 Equipment related to excretion assistance
- Chapter 3. Safety management of excretion assistance care robots
  - 3.1 Items to be checked before using the excretion assistance care robot
  - 3.2 Items to be checked while using the excretion assistance care robot
  - 3.3 Items to be confirmed after using the excretion assistance care robot
- Chapter 4. Examples of the use of excretion assistance care robots
  - 4.1 Use of Curaco Co., Ltd. In Smart Care Space
- Appendix
  - Appendix 1 Safety Management Checklist for Excretion Assisted Care Robots
  - Appendix 2 Physical Function Evaluation Table for Introduction and Monitoring of Excretion Assisted Care Robots
  - Appendix 3 System for Excretion Assistance Care Robot
  - Appendix 4 Healthy Excretion and Disorder
  - Appendix 5 What is Incontinent-related dermatitis?
- References

### Changing body position

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  - 1-1. Overview of meals
  - 1-2. purpose of application
- 2. What is a caring robot (device) for meals?
- 3. Types of caring robot and devices for meals
  - 3-1. Caring robots and devices for active eating
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  - 3-3. Eating aids
- 4. Selection and use of caring robots and devices for meals
  - 4-1. Requirements evaluation
  - 4-2. Selection and purchase of caring robots and devices for meals
  - 4-2-1. Advice
  - 4-2-2. Individual purchase
  - 4-3. Self-evaluation
  - 4-3-1. Identifying your own difficulties through self-evaluation
  - 4-4. Meal strategy for caregivers through career assistance
  - 4-4-1. Feeding strategies
  - 4-4-2. Continuous oral care after meals
  - 4-4-3. Observe for signs of eating problems
  - 4-4-4. Emergency treatment for suffocation in caregivers
  - 4-5. Maintenance and management of caring robots and devices for meals
- 5. References
- 6. Terminology

Appendix: Checklist for selecting caring robots and devices for meals

Appendix 2: For meals Caring robots and devices

Note 1. Main consequences of eating and swallowing problems

Note 2. Classification of the texture of the diet

### Lifting

### 2.4 Types and Examples of Excretion Assisted Care Robots

It can be used when the disabled, patients, and the elderly who have difficulty moving do not go to the bathroom and urinate in the bed. The worn part is a care robot that has a diaper shape, a diaper cup shape, automatically detects excrement, and automatically processes skin cleaning, drying, and device washing steps, and is divided into urine, urinate, and urinate.

#### 1) For feces and urine

Manufacturer	Model name	Country of Manufacture	Price
Curaco Co., Ltd	CURACARE M1	Korea	10 million won

Product Features

- Distinguish between feces and urinate
- Automatic cleaning - body cleaning - hot air drying
- Gender-tailored wear available
- Removes the odor of excrement with a deodorizing filter
- You can change your posture to 30 degrees left and right while wearing it

Product Information

Standard	Weight	Height	Width	Depth
Weight	1.5kg	1.2m	0.4m	0.4m
Height	1.2m	1.2m	0.4m	0.4m
Width	0.4m	0.4m	0.4m	0.4m
Depth	0.4m	0.4m	0.4m	0.4m

Component

Main body, diaper cup, bidet-like cushion, cap module (for women and men), height adjustment stage (female)

gender, men's

Gender, men's, wash water can, deodorizing filter, diaper cover, drain hose, hose cover, water filter

#### 2) For feces

Manufacturer	Model name	Country of Manufacture	Price
Curaco Co., Ltd	CURACARE M1	Korea	10 million won

Product Features

- Distinguish between feces and urinate
- Automatic cleaning - body cleaning - hot air drying
- Gender-tailored wear available

Additional Criteria

White phosphorus on the skin (infects fungal infection) or candida albicans (fungal infection)

### Changing body position

### 2. What is a caring robot (device) for meals?

For those who cannot eat on their own, caring robots and devices for meals support upper extremity muscle strength or deliver food to assist with meals. People who have very little hand and arm movements or who cannot control their muscles well are very dependent on their caregivers (caregivers) who provide meals. For caregivers with dysphagia, there is a risk of choking and someone must be nearby at all times, but otherwise it may be more useful to use a meal-care robot (device) that guarantees some degree of independence to the caregiver. However, an evaluation may be necessary to determine which system best meets an individual's needs, and often expensive to purchase an expensive caregiver (device).

The purpose of using the eating aid is to deliver food to the front of the mouth for people with disabilities or diseases affecting the upper extremities to increase independence and confidence in eating. It can be automated, or a robotic arm is used to carry out the intent of what the user will eat and when. Caregiver attention is required to use these.




Figure 1. Caring robot for meals (Cymax, Korea)

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### Toileting

### Feeding

### Toileting

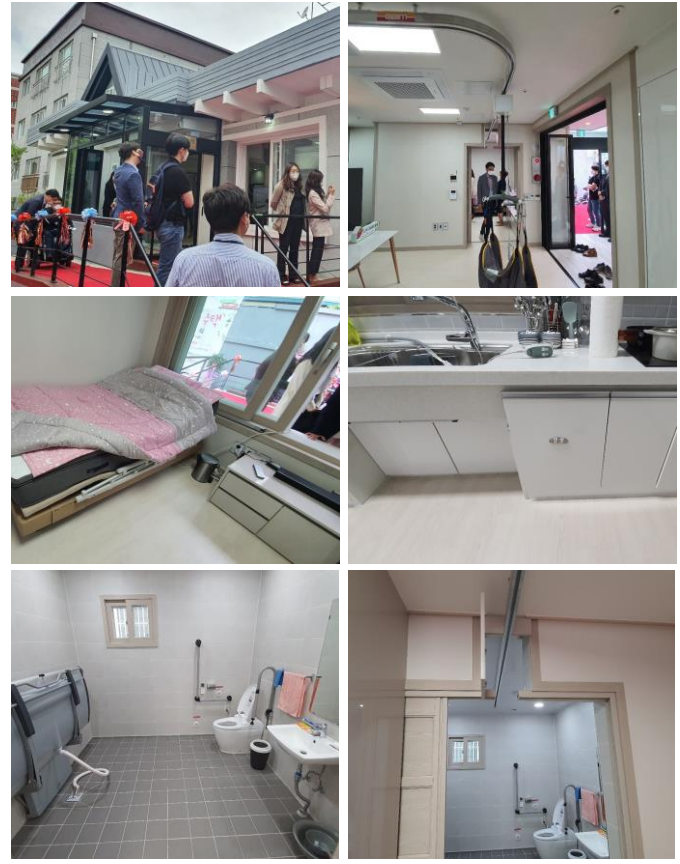
### Feeding

Expansion of robotic technology to care beyond therapeutic rehabilitation: Development of care robots and service models in Korea

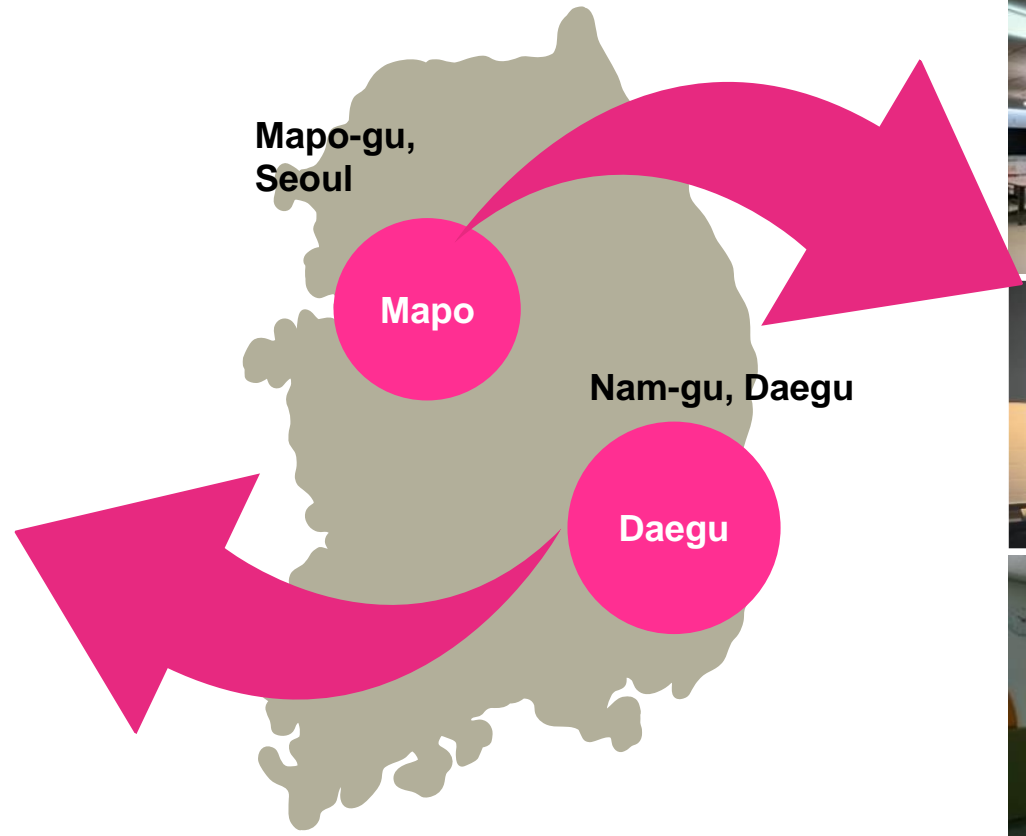
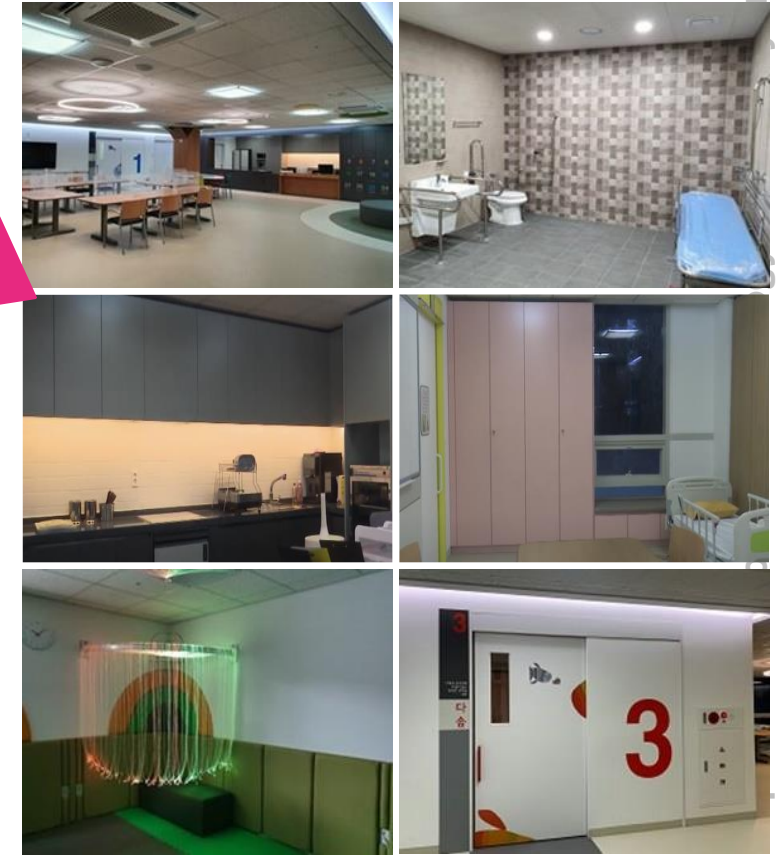
# Expansion of experience and knowledge to local governments

- Information on smart care fspaces was provided to local governments in need so that it could be helpful when installing similar spaces.

Transplant 1: Barrier-free independent housing



Transplant 2: Vision Center for the People with Brain Lesion



# Take Home Messages: Experience, Balance, Assisted

- Based on R&D **experience** on **Therapeutic Rehabilitation Robots**, it is expanding into **Care Robots**.
- Technology that **assists therapists** and **caregivers** rather than full automation
- **Innovative technology** and **practical technology** must be **balanced**.
  - Depth and scope should be expanded in a sustainable way.
- **Application and demonstration** according to various **situations** and **cultural perspectives**
  - **Good testbed, older adults, PwD**
  - **Hospitals, facilities, and home in diverse environments**
- Utilization of **Data-Network-AI-Robot** will increase.
- In the future, we will plan to **distribute care robots on a trial basis** and conduct a follow-up research and others.

# Previous Project (2019-2022) vs New Project (2023-2027)

Item	Care robots and service model development	Consumer-oriented care robot and service demonstration R&D project
Main Direction	<ul style="list-style-type: none"> <li>Care robot development</li> <li>Service model research</li> </ul>	<ul style="list-style-type: none"> <li>Care robot development</li> <li>Service model research</li> <li><b>Demonstration (R&amp;D) → will be expand to non-R&amp;D</b></li> </ul>
Target Populations	<ul style="list-style-type: none"> <li>People with Severe Disability</li> <li>Older adults with limited mobility</li> <li>Caregivers</li> </ul>	<ul style="list-style-type: none"> <li>People with Severe Disability, <b>People with Disability</b></li> <li>Older adults with limited mobility</li> <li>Caregivers, <b>Nurse</b></li> </ul>
Application Place	<ul style="list-style-type: none"> <li>Facility → Hospital, Home</li> </ul>	<ul style="list-style-type: none"> <li><b>Facility, Hospital, Home</b></li> </ul>
Robot	<ul style="list-style-type: none"> <li>Transfer, Changing body posture, Toileting, Feeding</li> </ul>	<ul style="list-style-type: none"> <li><b>Mobility, Bathing, Toileting, Wearable soft exoskeleton for the people with disability, Effect analysis of wearable soft exoskeleton, Monitoring, Transfer, Changing body posture, Feeding, and Communication.</b></li> </ul>
Period	<ul style="list-style-type: none"> <li>2019-2022 (3-4 years)</li> <li>Projects for Service Models: 4 years</li> <li>Projects for Care Robots: 3 years</li> </ul>	<ul style="list-style-type: none"> <li>2023-2027 (5 years)</li> </ul>