



Juntendo University

Tokyo, Chiba, Saitama and Shizuoka
Japan

Introduction about Juntendo University

Development of Online Cardiac Rehabilitation with Real-Time ECG Monitoring

Tetsuya Takahashi, PT, PhD (Hiroshima), MSc (Curtin)

Professor and Deputy-Chair, Department of Physical Therapy

高橋 哲也

Tetsuya Takahashi,
PT, PhD, MSc

EDUCATION

- Diploma, National Sendai Hospital Institute of Rehabilitation, - Japan, 1989
- M.Sc. in Physiotherapy, Curtin University of Technology, - Australia, 2001
- Ph.D. in Health Sciences, Hiroshima University, - Japan, 2004

RESEARCH EXPERTISE

- Cardiorespiratory Rehabilitation
- Digital health and Tele-Rehabilitation
- Frailty and Sarcopenia

WORK EXPERIENCE

- St. Marianna University Hospital, Ishioka Neurosurgery Hospital, Gunma Cardiovascular Center
- 2007- Professor, Hyogo University of Health Science, 2011- Tokyo University of Technology,
- 2018 – present Professor, Department of Physical Therapy, Juntendo University

ACADEMIC SERVICE

- 2006 – present. Board member, Japanese Association of Cardiovascular Rehabilitation
- 2015 – present. Board member, Japanese Physical Therapists Association
- 2020 – present. Board member, Japanese Society of Intensive Care Medicine
- 2021 – present. Board member, Japanese Society of Cardiovascular Physical Therapy



2024年2月19日 発売



Juntendo University

The Oldest Western Medical School in Japan

The founders of the university helped established Western medicine as an integral part of the country's medical framework.

- **1838** **Founded as Dutch Medical School**
- **1843** Renamed to Juntendo Clinic
- **1946** Opened Juntendo University School of Medicine
- **1959** Opened Graduate School of Medicine



Sato Taizen (1810-1864)

Founder of Juntendo. Established Juntendo Medical School in Edo (Tokyo) in 1838



Sato Takanaka (1827-1882)

Second Director of Juntendo. Established Juntendo Hospital, the first private hospital in Japan.



Sato Susumu (Baron) (1854-1921)

Third Director of Juntendo. Became the first person of Asian descent to earn a Ph.D. from Friedrich-Wilhelms-Universität zu Berlin.



1859 – Sakura (Chiba)



1875 – Hongo (Tokyo)



1905 – Hongo



1928 – Hongo



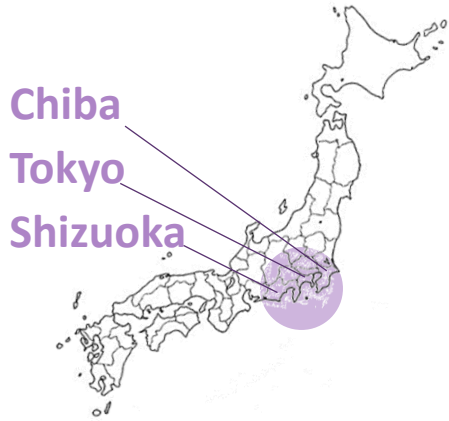
1996 – Hongo



2015 – Hongo



Faculty and Campus



5
Campus

9
Undergraduate Programs

4
Graduate Programs

Tokyo

Hongo Ochanomizu Campus

Bunkyo-ku, Tokyo



Faculty of Medicine
Faculty of International Liberal Arts
Faculty of Health Science
Graduate School of Medicine

Chiba

Sakura Campus

Sakura-shi, Chiba



Faculty of Health and Sports Science
Graduate School of Health and Sports Science

Chiba

Urayasu Campus

Urayasu-shi, Chiba



Faculty of Health Care and Nursing
Graduate School of Health Care and Nursing

Chiba

Hinode Campus

Urayasu-shi, Chiba



Faculty of Medical Science
Faculty of Data Science
Faculty of Pharmacy

Shizuoka

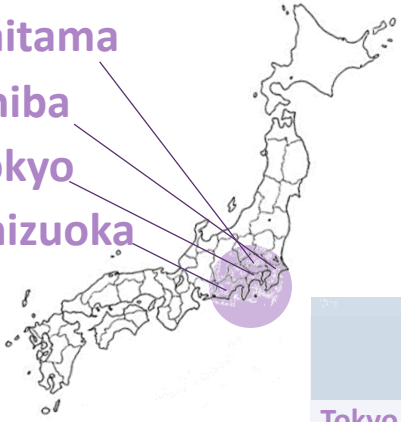
Mishima Campus

Mishima-shi, Shizuoka



Faculty of Health Science and Nursing

Saitama
Chiba
Tokyo
Shizuoka



Hospitals

Main Hospital

Tokyo

Juntendo University Hospital

1.051 beds



6

Hospitals

3533

Beds

Chiba

Juntendo Urayasu Hospital

785 beds



Shizuoka

Juntendo Shizuoka Hospital

577 beds



Saitama

Juntendo Koshigaya Hospital for Psychiatry

226 beds



Tokyo

Juntendo Nerima Hospital

490 beds



Tokyo

Juntendo Tokyo Koto Geriatric Medical Center

404 beds



Faculty Members

Dean



Shinsuke Kyogoku, MD, PhD.

Physical Therapy

Chair, Professor



Toshiyuki Fujiwara, MD, PhD.

Vice-chair, Professor



Tetsuya Takahashi, PT, PhD.

Professor



Tatsuo Sakai, MD, PhD.



Isao Nagaoka, MD, PhD.



Hitoshi Makabe, PT, PhD.



Hiroshi Ikeda, MD, PhD.



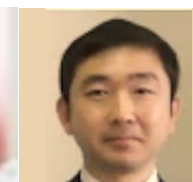
Tadamitsu Matsuda, PT, PhD.



Junya Aizawa, PT, PhD.



Tomofumi Yamaguchi, PT, PhD.



Tomoyuki Morisawa, PT, PhD.



Yoshinori Hiyama, PT, PhD.



Masakazu Saitoh, PT, PhD.

Associate professor

Lectures and Assistant Prof



Takayuki Miyamori, PT, PhD.



Yuji Fujino, PT, PhD.



Yoko Takahashi, PT, PhD.



Emi Nakamura, PT, PhD.



Ryuichi Sawa, PT, PhD.

Koshio Haruyama, PT, MSc.



Enrollment

Year 2023-2024

Department of Physical Therapy

	Male	Female	Total
Freshman	52	70	122
Sophomore	49	72	121
Junior	55	67	122
Senior	48	72	120

Department of Radiological Technology

	Male	Female	Total
Freshman	47	75	122
Sophomore	48	73	121
Junior	50	70	120
Senior	58	63	121

Laboratory

Physical Therapy



- A. Practice Room**
- B. Cardiopulmonary Lab.**
- C. Neurophysiology Lab.**
- D. Lecture Room**
- E. Motion Analysis Lab.**



Graduate School of Health Sciences (opening in April 2023)

Department of Radiological Technology



Master's Course in Physical Therapy	19
Master's Course in Medical Radiology	10

Neuro Rehabilitation Course

Development of new rehabilitation techniques for central nervous diseases

Clinical Neurophysiology

Rehabilitation Engineering

Neuro-science

Transcranial **Magnetic** Stimulation



Transcutaneous Spinal Cord **Electrical** Stimulation



Robotic system



Electrical vs. Magnetic stimulation

Electric Stimulator

Stimulate nerves and muscles with low-frequency current



Magnetic Stimulator

Stimulates by creating magnetic flux in a coil and generating "eddy currents"



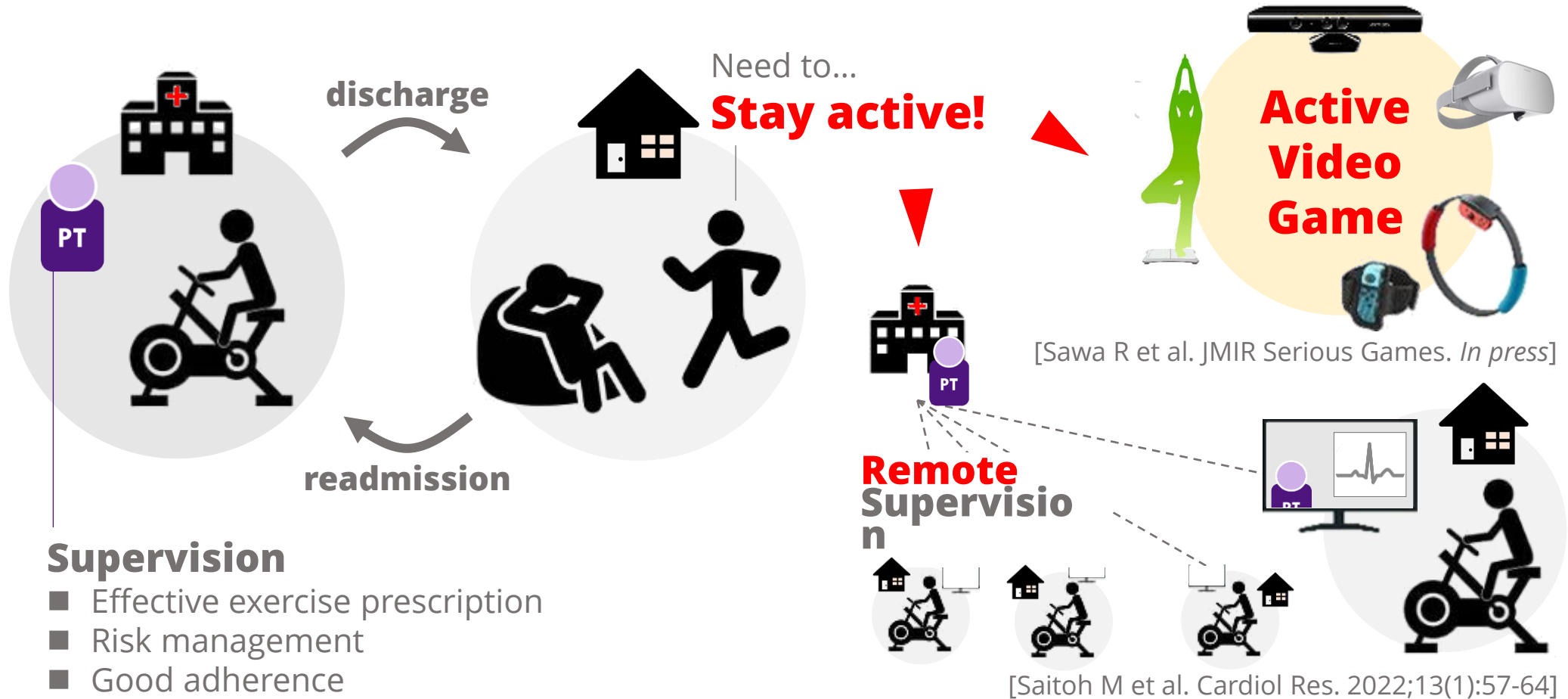
- **Neuromuscular Electrical Stimulation (NMES)** for patients with disabilities has been difficult to obtain muscle contraction, caused uncomfortable pain, and sometimes caused burns
- **Magnetic NeuroMuscular Stimulation (MNMS)** is independent of clothing and bone/tissue structure, and highly attractive due to noninvasive and painless.

Sports & Orthopedic Physical Therapy Course

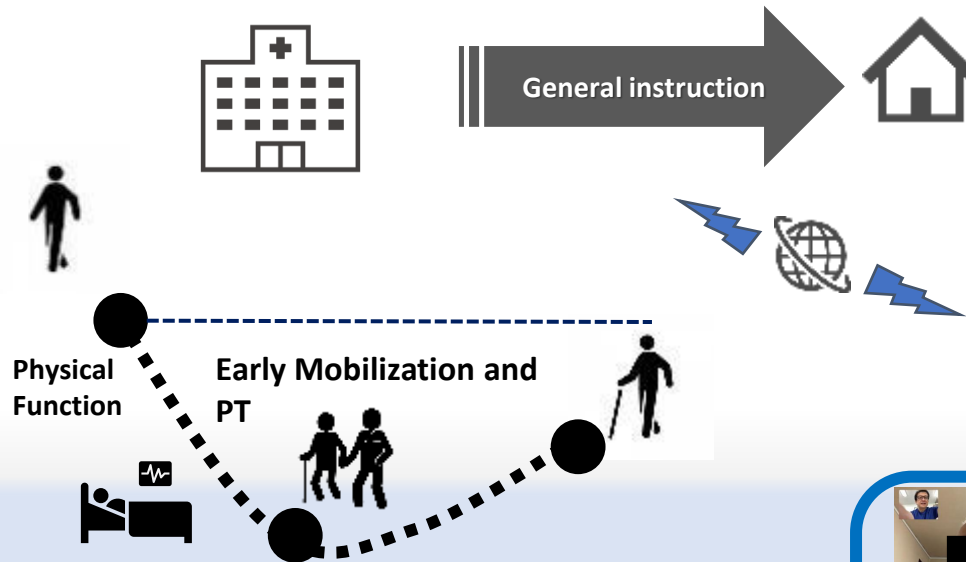
Psychological readiness after ACL reconstruction is known to be associated with re-injury and return to sports.



The Potential of Commercially Available Active Video Games for Application to Cardiac Rehabilitation: Scoping Review



Real Time Monitoring Tele-Cardiac Rehabilitation (1:1 model)



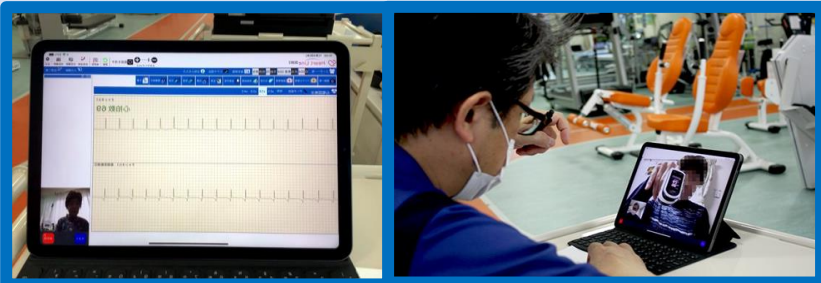
- Smoking cessation, Salt reduction
- Proper nutrition and fluid management
- Ready medication and regular exercise



Supervised remote Tele-cardiac rehab

1/week for 1 month after discharge

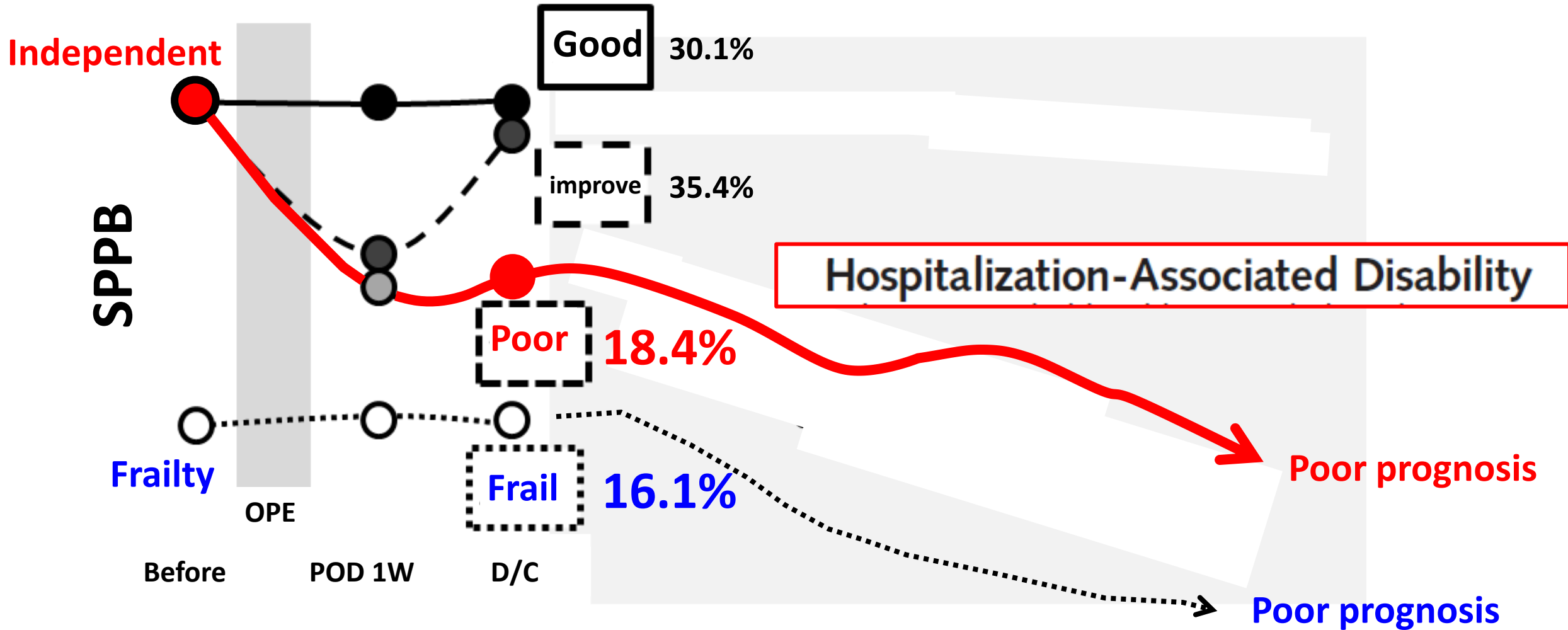
Supervised by physician and physical therapist

Home Exercise

- Warming up + aerobic exercise**
 腕を振りながら その場で足踏み
 椅子に座ってもよい
- Resistance training**
 椅子から立ち上がり
- Balance Exercise**
 片足立ち

Why do we need Tele-Cardiac Rehabilitation ?



Morisawa T, Takahashi T (Geriatrics & Gerontology International 2021, 21: 676-682. PMID: 34212472)

National Registry to identify

Hospitalization-Associated Disability

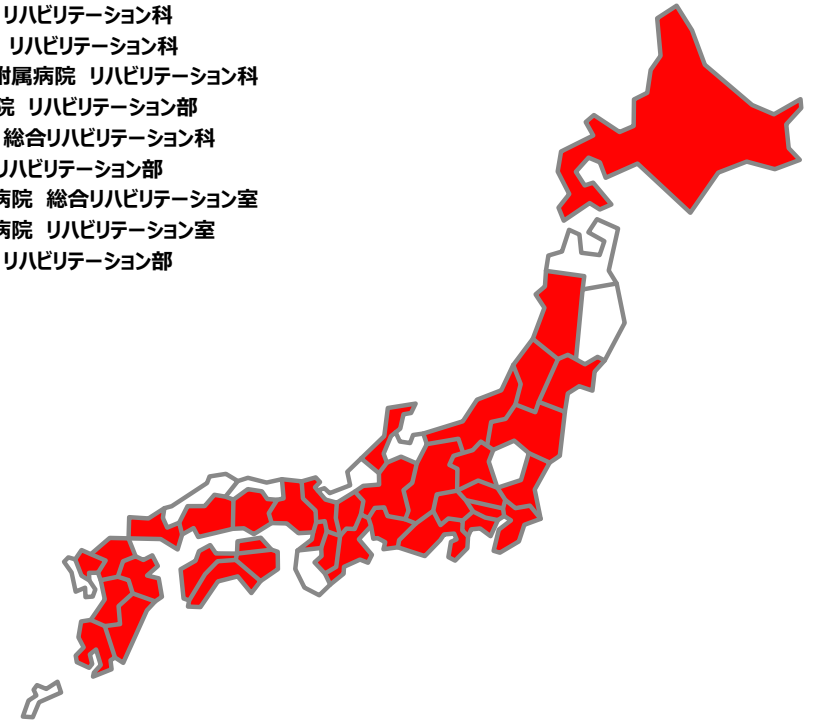
Japanese PT multi-center Registry Of Older Frail patients with Heart Failure (J-Proof HF)

96 facilities in 37 prefectures are participating in J-PROOF HF

- 函館五稜郭病院 リハビリテーション科
- NTT東日本札幌病院 リハビリテーションセンター
- 札幌中央病院リハビリテーション科
- 市立秋田総合病院 リハビリテーション科
- 東北医科薬科大学病院 リハビリテーション部
- 山形大学医学部附属病院リハビリテーション部
- 総合南東北病院リハビリテーション科
- 太田総合病院附属太田西ノ内病院 総合リハビリテーションセンター
- 筑波大学附属病院 リハビリテーション部
- 総合病院土浦協同病院リハビリテーション部
- 群馬県立心臓血管センター リハビリテーション課
- さいたま市立病院 リハビリテーション科
- 埼玉医科大学国際医療センター リハビリテーションセンター
- 岩槻南病院 心臓リハビリテーション科
- さいたま市民医療センター診療技術部リハ科
- 千葉西総合病院リハビリテーション室
- 千葉県循環器病センターリハビリテーション科
- 心臓血管研究所病院 リハビリテーション科
- 東京大学附属病院 リハビリテーション科
- 池上総合病院 リハビリテーション室
- 日本大学病院 リハビリテーション室
- 東京警察病院 リハビリテーション科
- みなみ野循環器病院 リハビリテーション科
- 東京女子医科大学病院リハビリテーション部
- 三井記念病院リハビリテーション部
- 榊原記念病院リハビリテーション科
- 順天堂大学医学部附属順天堂医院 リハビリテーション室
- 湘南藤沢徳洲会病院 リハビリテーション科
- 横須賀市立市民病院 リハビリテーション療法科
- 横須賀共済病院 リハビリテーション科
- 小田原市立病院 リハビリテーション室
- 東芝林間病院 リハビリテーション科
- 汐田総合病院リハビリテーション課
- 横浜市立大学附属病院リハビリテーション部
- 北里大学病院 リハビリテーション部
- 信州大学医学部附属病院リハビリテーション部
- 甲府共立病院リハビリテーション室

- 新潟医療センター リハビリテーション科
- 新潟大学地域医療教育センター魚沼基幹病院リハビリテーション科
- 浜松医療センター リハビリテーション技術科
- 済衆館病院 リハビリテーション科
- 名古屋大学医学部附属病院 リハビリテーション部
- 藤田医科大学病院リハビリテーション科
- 愛知医科大学病院 リハビリテーション部
- 愛知県厚生農業共同組合連合会海南病院リハビリテーション科
- 多治見市民病院リハビリテーション科
- 松阪中央総合病院 リハビリテーション科
- 三重中央医療センター リハビリテーション科
- 金沢医科大学病院医療技術部 リハビリテーションセンター
- 湖東記念病院 リハビリテーション科
- 公立甲賀病院 リハビリテーション課
- 滋賀医科大学附属病院 リハビリテーション科
- 京都府立医科大学附属病院 リハビリテーション部
- 天理よろづ相談所病院外来棟リハビリテーション室
- 高槻病院 リハビリテーションセンター
- 北野病院 リハビリテーション科
- 大阪労災病院 中央リハビリテーション部
- 守口生野記念病院 リハビリテーション科
- 住友病院 リハビリテーション科
- 千船病院 リハビリテーション科
- 枚方公済病院 リハビリテーション科
- 市立池田病院 リハビリテーション科
- 加古川中央市民病院 リハビリテーション室
- 西宮市立中央病院 リハビリテーションセンター
- 三木山陽病院 リハビリテーション科
- 北播磨総合医療センター リハビリテーション室
- 神戸市立医療センター中央市民病院 リハビリテーション科
- 神戸市立西神戸医療センター リハビリテーション技術部
- 東宝塚さとう病院 理学療法室
- 岡山赤十字病院 リハビリテーション科
- 岡山市立市民病院 リハビリテーション科
- 川崎医科大学附属病院 リハビリテーションセンター
- 倉敷中央病院 リハビリテーション部
- 心臓病センター榊原病院リハビリテーション室

- マツダ病院 リハビリテーション科
- 中国労災病院 中央リハビリテーション部
- 下関市立市民病院 リハビリテーション部
- 山口労災病院 中央リハビリテーション部
- 山口県立総合医療センター リハビリテーション科
- 徳島県立中央病院医療技術局 リハビリテーション技術科
- KKR高松病院 リハビリテーション科
- 高知医療センター リハビリテーション科
- 高知赤十字病院 リハビリテーション科
- 福岡徳洲会病院 リハビリテーション科
- 製鉄記念八幡病院 リハビリテーション部
- 千鳥橋病院 リハビリテーション技術部
- 福岡リハビリテーション病院 リハビリテーション部
- 済生会唐津病院 リハビリテーション科
- 嬉野医療センター リハビリテーション科
- 大分大学医学部附属病院 リハビリテーション科
- JCHO熊本総合病院 リハビリテーション部
- 朝日野総合病院 総合リハビリテーション科
- 済生会熊本病院リハビリテーション部
- 都城市郡医師会病院 総合リハビリテーション室
- 宮崎市郡医師会病院 リハビリテーション室
- 鹿児島大学病院 リハビリテーション部





Incidence of Hospitalization-Associated Disability in Older Patients With Heart Failure

Tetsuya Takahashi, PhD; Kentaro Iwata, PhD; Tomoyuki Morisawa, PhD;
Michitaka Kato, PhD; Yuji Kono, PhD; Masanobu Taya, MSc;
Yuki Iida, PhD; Yoshinari Funami, BSc; Kentaro Kamiya, PhD;
Koji Sakurada, PhD; Masakazu Saitoh, PhD

Background: This study determined the incidence of hospitalization-associated disability (HAD) and its characteristics in older patients with heart failure in Japan.

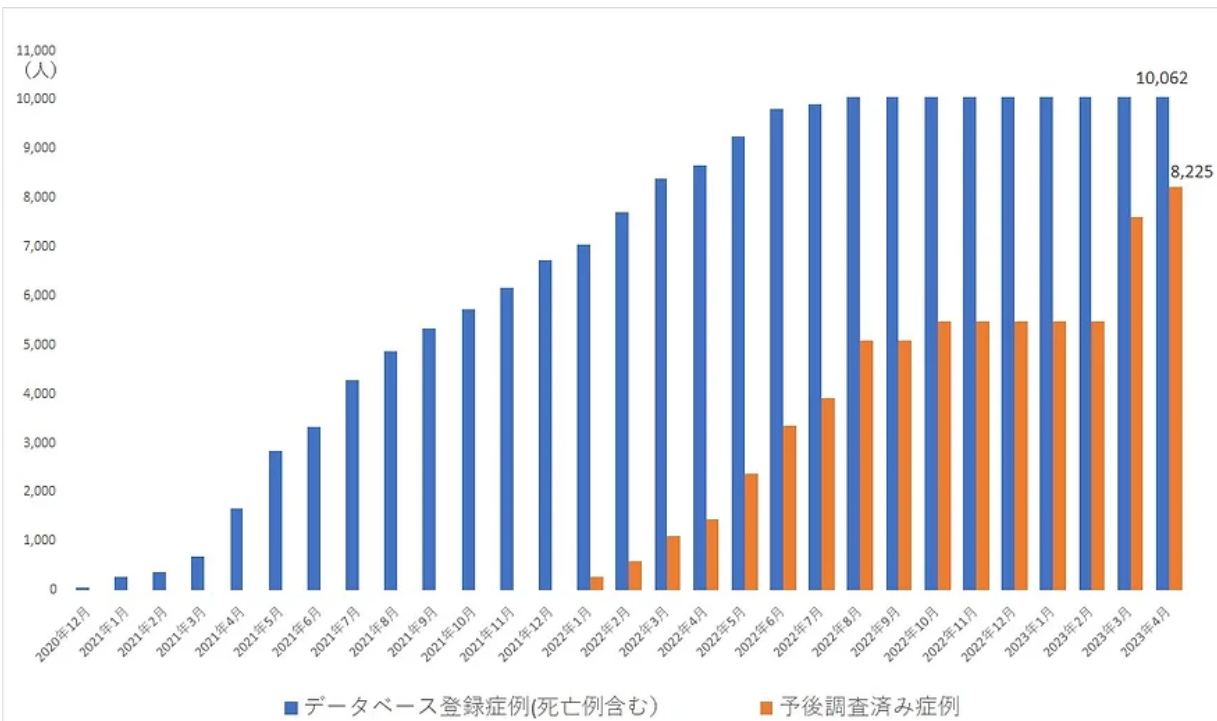
Methods and Results: Ninety-six institutions participated in this nationwide multicenter registry study (J-Proof HF). From December 2020 to March 2022, consecutive heart failure patients aged ≥ 65 years who were prescribed physical rehabilitation during hospitalization were enrolled. Of the 9,403 patients enrolled (median age 83.0 years, 50.9% male), 3,488 (37.1%) had HAD. Compared with the non-HAD group, the HAD group was older and had higher rates of hypertension, chronic kidney disease, and cerebrovascular disease comorbidity. The HAD group also had a significantly lower Barthel Index score and a significantly higher Kihon checklist score before admission. Of the 9,403 patients, 2,158 (23.0%) had a preadmission Barthel Index score of < 85 points. Binomial logistic analysis revealed that age and preadmission Kihon checklist score were associated with HAD in patients with a preadmission Barthel Index score of ≥ 85 , compared with New York Heart Association functional classification and preadmission cognitive decline in those with a Barthel Index score < 85 .

Conclusions: This nationwide registry survey found that 37.1% of older patients with HF had HAD and that these patients are indicated for convalescent rehabilitation. Further widespread implementation of rehabilitation for older patients with heart failure is expected in Japan.

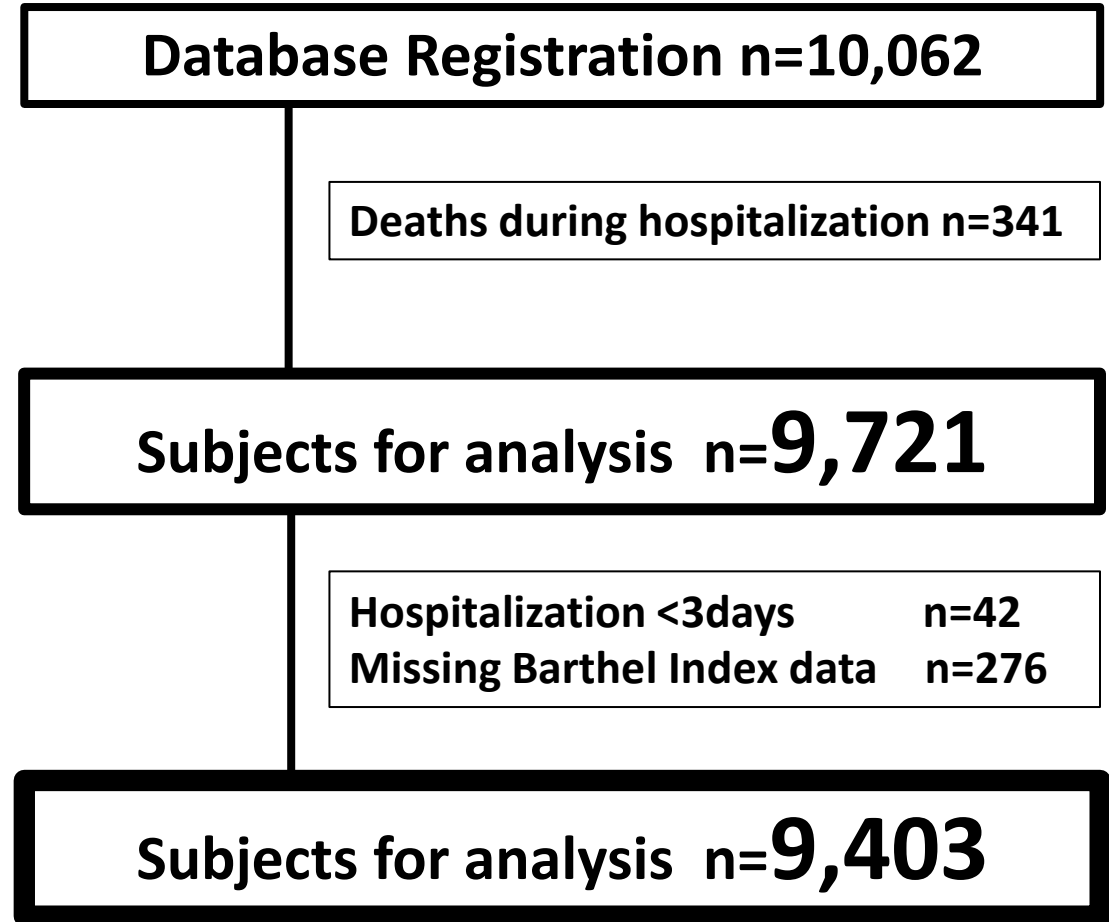
Key Words: Heart failure; Hospitalization-associated disability; Rehabilitation

Subjects

- Prospective multicenter observational study
- December 18, 2020 - March 31, 2022
- Inclusion criteria: 65 years of age or older with physical therapy during hospitalization



Monthly Patient Registration Trends



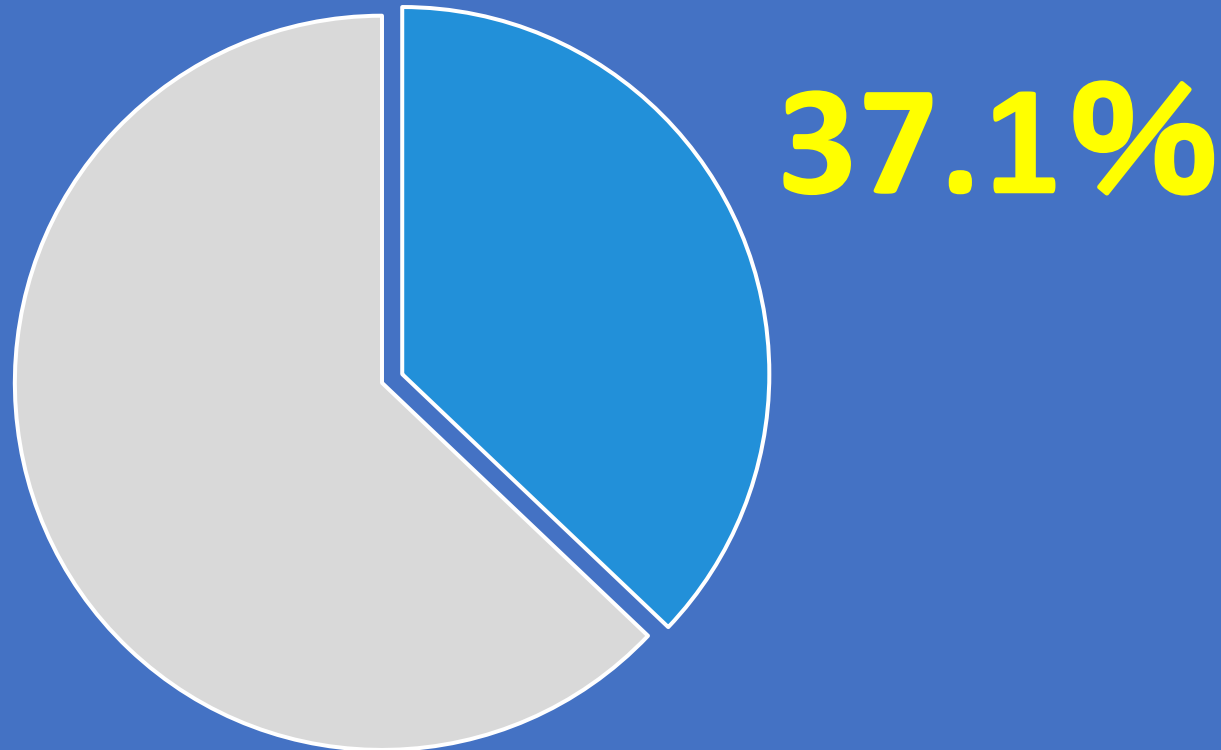
- Mean Age: 83.0 (65-106) years
- Male 50.9%



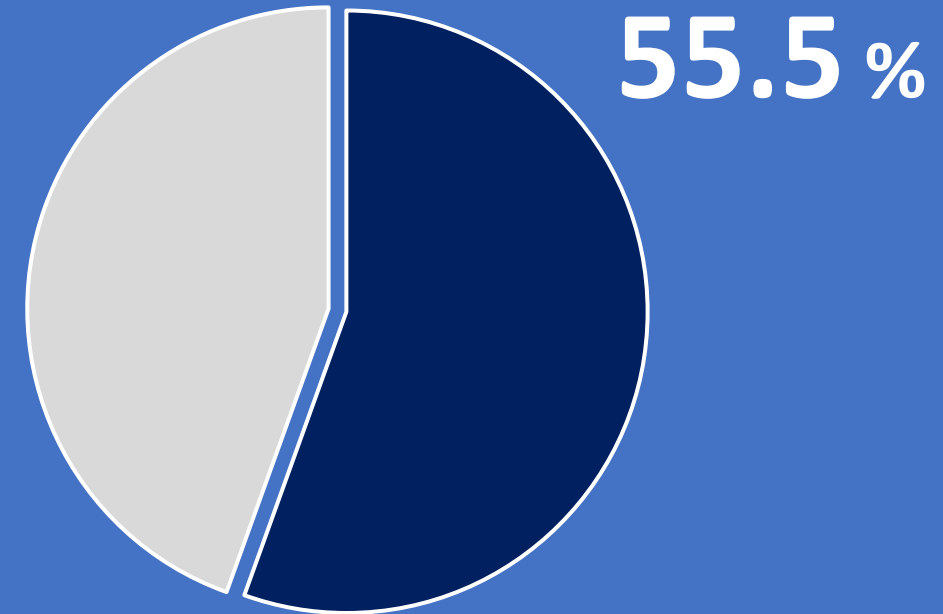
Japanese PT multi-center Registry of Older Frail patients with Heart Failure (J-Proof HF) a nationwide multi-center registry study conducted by the Japanese Society of Cardiovascular Physical Therapy

Subjects: 9,403 patients (age 83.0 years, 50.9% male)

Hospitalization-Associated Disability (HAD)



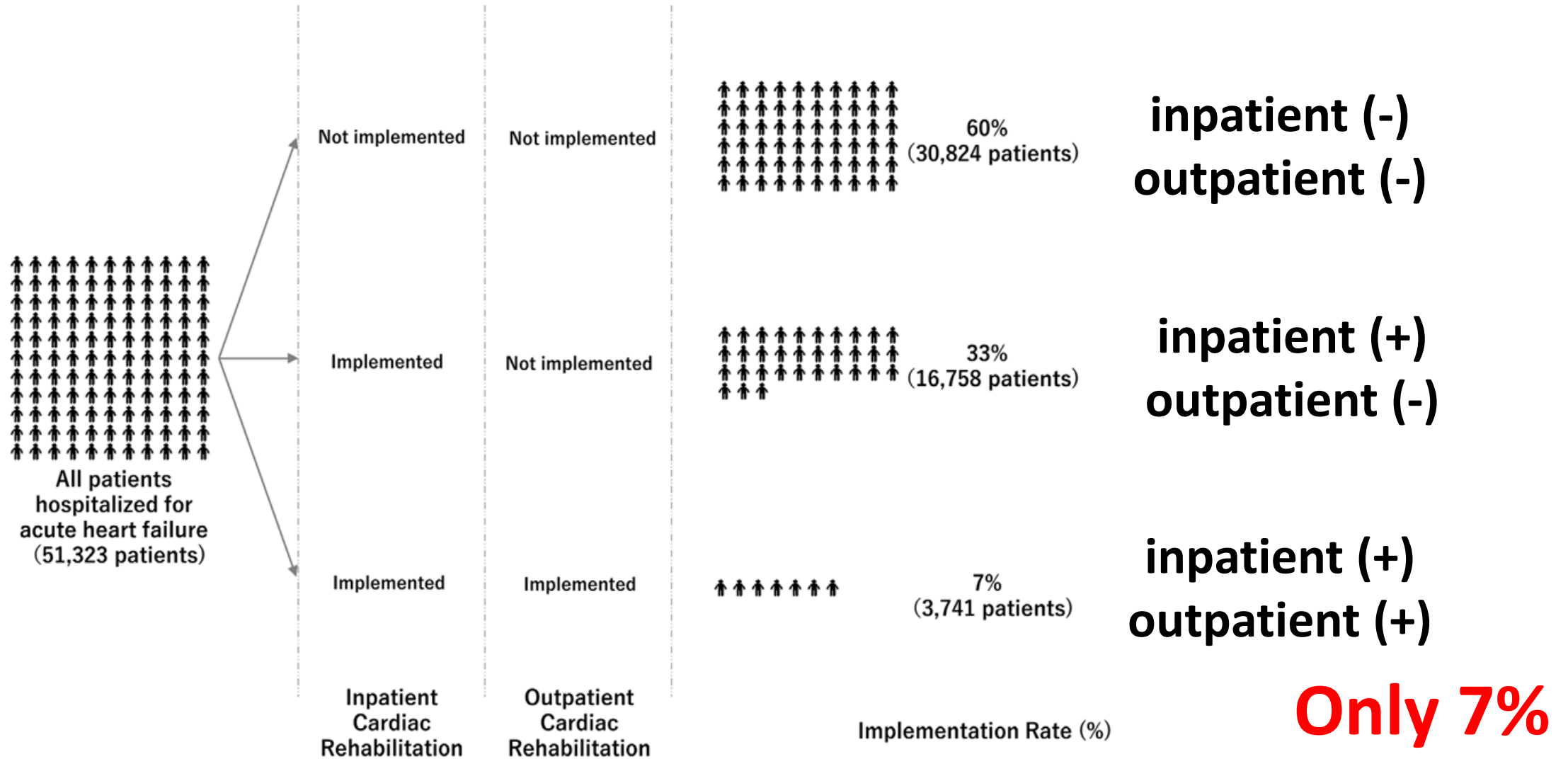
FIM score < 115 at discharge



Barthel Index at discharge decreased by at least 5 points compared to the Barthel Index prior to admission.

FIM: Functional Independence Measure

Percentages of heart failure referred for inpatient and/or outpatient cardiac rehabilitation



Outpatient cardiac rehab participation rates are extremely low.

Patient related

Older age

Low level of education

Low **socio-economic status**

Anxiety and depression

Lack of motivation

Lack of insight into benefits

Lack of **time**

Social and economic

Lack of resources and support

Lack of reimbursement

Transportation issues

Healthcare team

/system

Lack of expertise with heart failure

Lack of capacity

Lack of heart failure expertise in programmes

Lack of referral

Lack of education on the importance of exercise

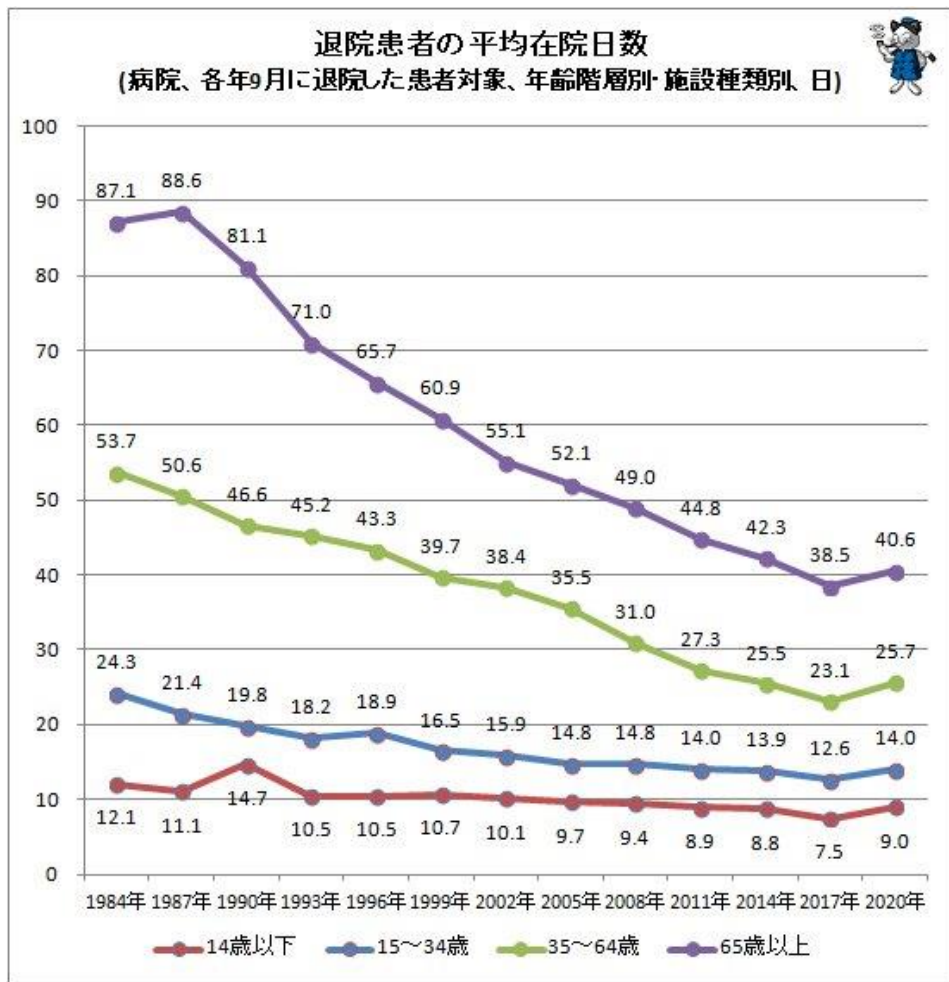
Condition related

Severity of symptoms

Level of disability

Rate of disease progression

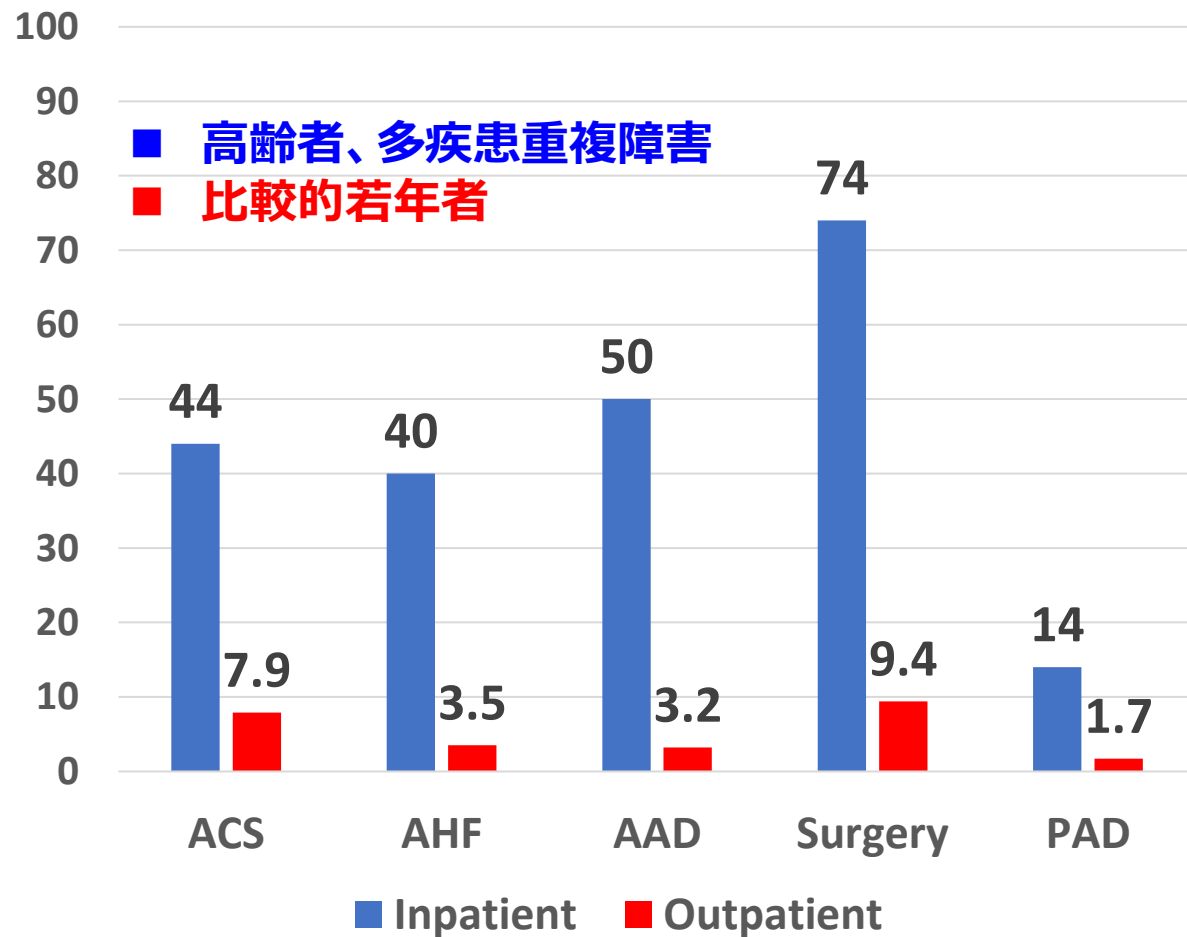
医療技術の進歩、病院の機能強化、医療費の削減、介護保険制度の普及などから**入院期間が短縮**している



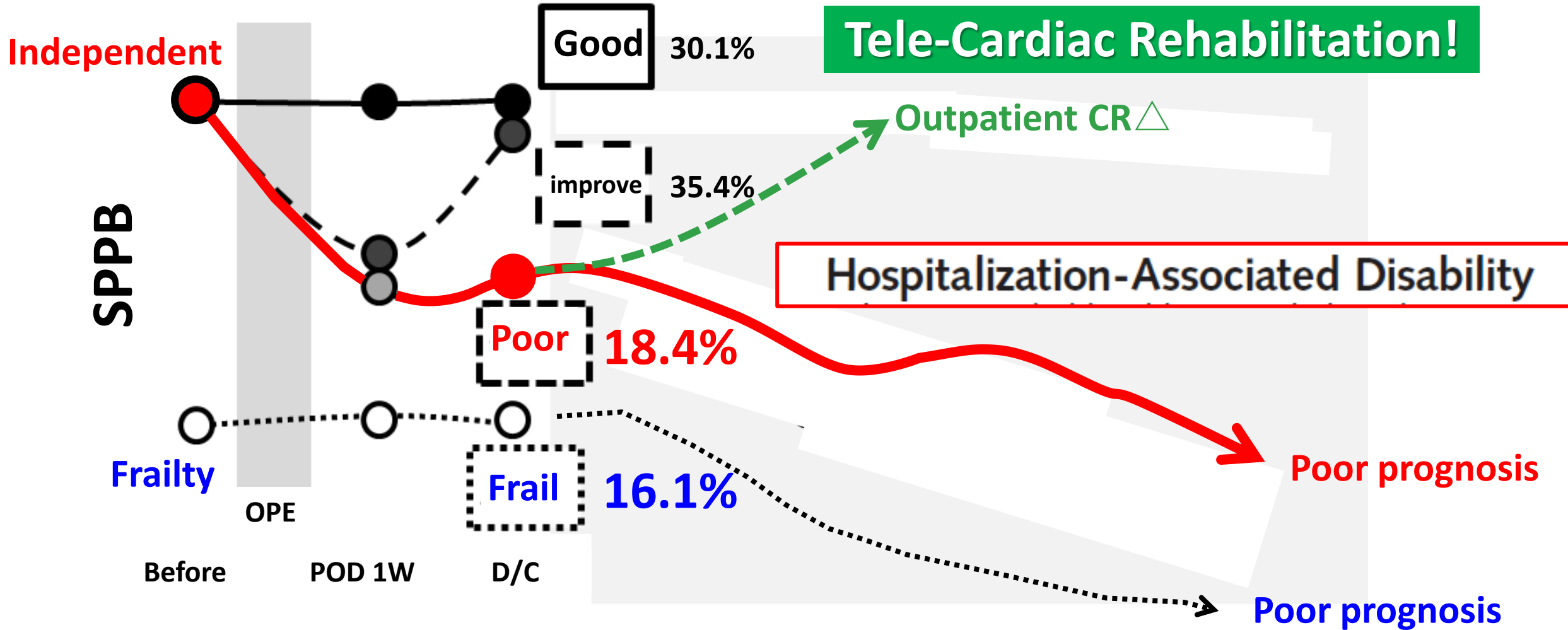
退院患者の平均在院日数
(病院、各年9月に退院した患者対象、年齢階層別・施設種類別、日)

心臓リハビリテーション参加率 (%)

外来通院の困難さが存在し、**外来リハビリ実施率は低い**
理由：高齡化、精神的不安、物理的距離、介助者不足



Why do we need Tele-Cardiac Rehabilitation ?

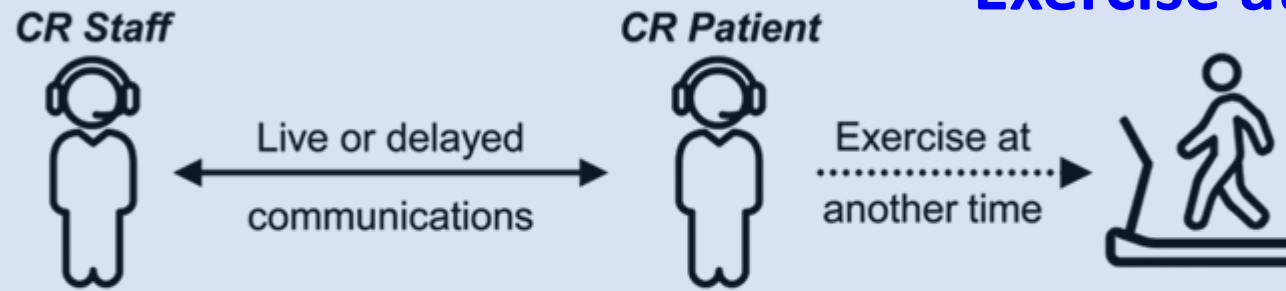


Tele-Cardiac Rehabilitation

HOME-BASED DELIVERY OF CARDIAC REHABILITATION

非同期モデル

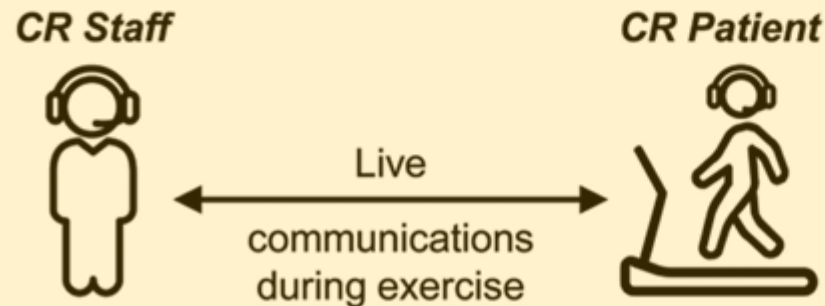
Asynchronous



Exercise at another time

同期モデル

Synchronous



Communications during exercise

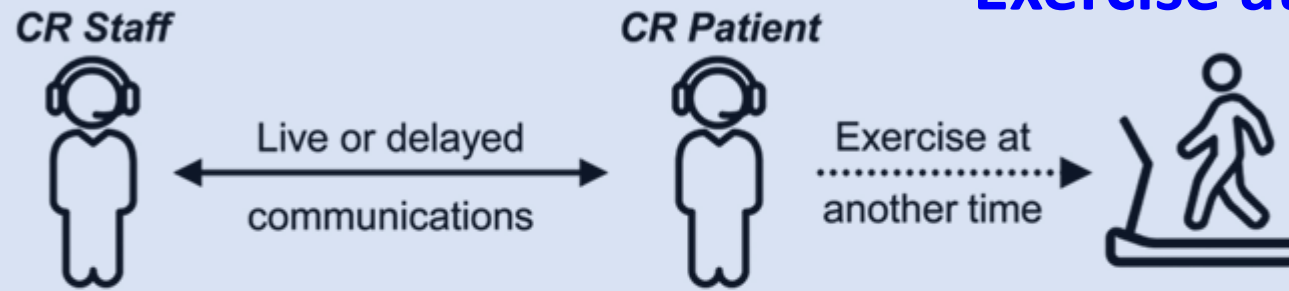
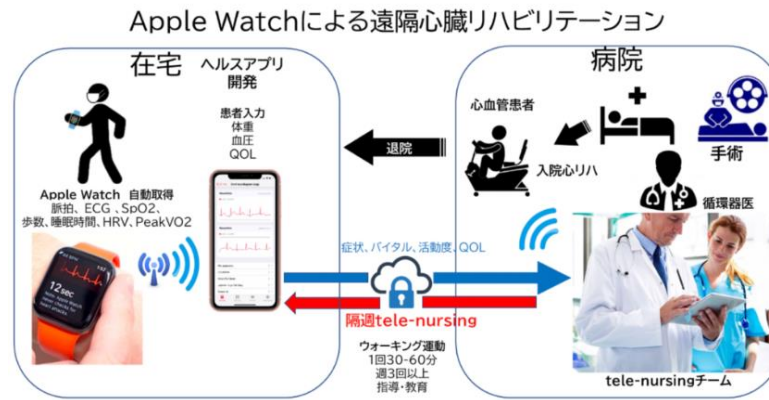
Digital technology and modes of CR delivery.

HOME-BASED DELIVERY OF CARDIAC REHABILITATION

非同期モデル

Asynchronous

Exercise at another time

公益財団法人 榊原記念財団 附属 榊原記念病院

- ◎血圧、脈拍、体重、症状の記録機能
- ◎記録のグラフ表示
- ◎毎日の歩数記録
- ◎血圧計、体重計などウェアラブルデバイス等の無線連携
- ◎服薬管理機能
- ◎カレンダー表示機能
- ◎リマインダー機能
- ◎家族等緊急連絡先、かかりつけ医の登録・連絡機能
- ◎医療者が利用者の状態をリアルタイムに把握

三重大学大学院医学系研究科 循環器・腎臓内科学

キュアコード 株式会社

Frailty • HAD model and Ergometer IoT model

患者宅 (Patient Home)   

運動確認・指導 (Exercise Confirmation and Guidance)

足踏み (Foot Tapping)  椅子から立ち上がり (Getting up from a chair) 


テレメトリ心電計 デュランタ (Telemetry Heart Rate Monitor Duranta) 

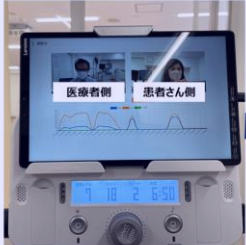





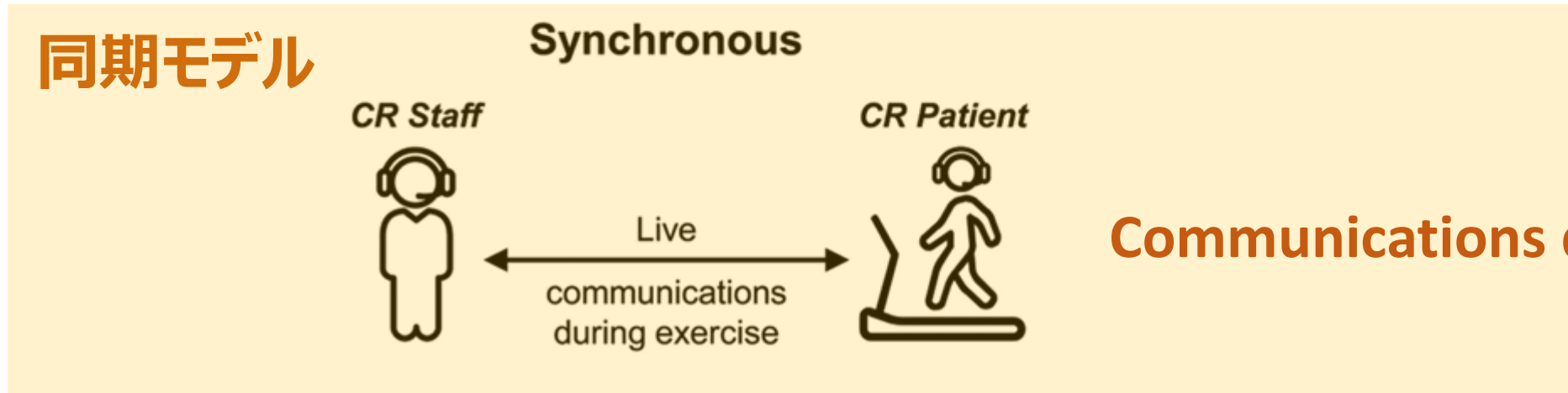
順天堂大学 (Saitama University)   **患者宅** (Patient Home) 



PHILIPS ECG (MX40) 

コミュニケーション タブレット (Communication Tablet) 

IoT化された 自転車エルゴメータ (IoT-enabled Bicycle Ergometer) 



Communications during exercise

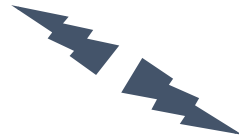
Backgrounds

- Participation in outpatient cardiac rehabilitation is remarkably low, although the benefits of cardiac rehabilitation are widely recognized.
- There is an urgent need to develop new models for outpatient cardiac rehabilitation programs.
- Juntendo University is developing an online cardiac rehabilitation system under real-time ECG monitoring by connecting the patient's home and Juntendo University via the Internet.
- In particular, a **multi-patients** online cardiac rehabilitation system that can monitor and supervise their exercise **simultaneously** is under development.

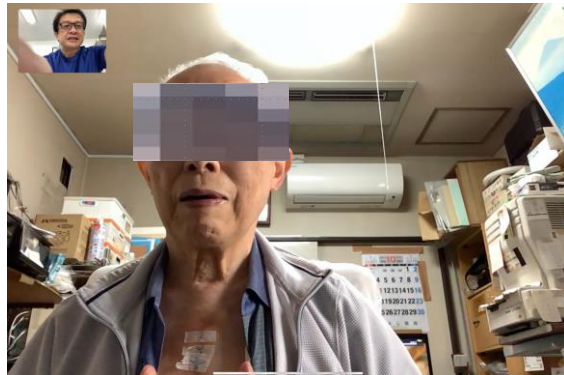
Real Time Monitoring Online-Cardiac Rehabilitation (1:1 model)

JCS2023, CO3-8

Juntendo



Videoconferences



**Interactive Communication
(facetime and skype)
+
(real time) ECG**

- Medical check
- post-discharge lifestyle instructions
- continuation of physical exercise to improve further physical function



ECG (Duranta)

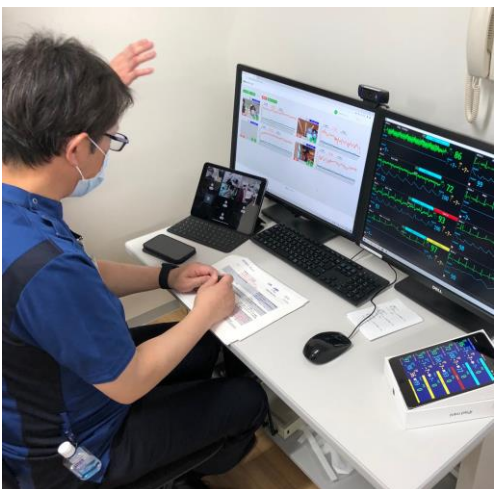


Blood pressure and pulse rate, SoP2



Physical function significantly improved one month after discharge

An Experimental Set of Online Cardiac Rehabilitation (1:1 model)



Viewer PC
+ App (Inter Reha Co.,Ltd.)



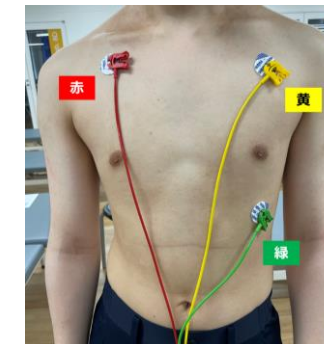
IPsec-VPN
VPN (virtual private network)
Mobile Router



Century Co Ltd
FutureNet



ECG (Philips MX40)



Bicycle ergometer
+ App (Inter Reha Co.,Ltd.)

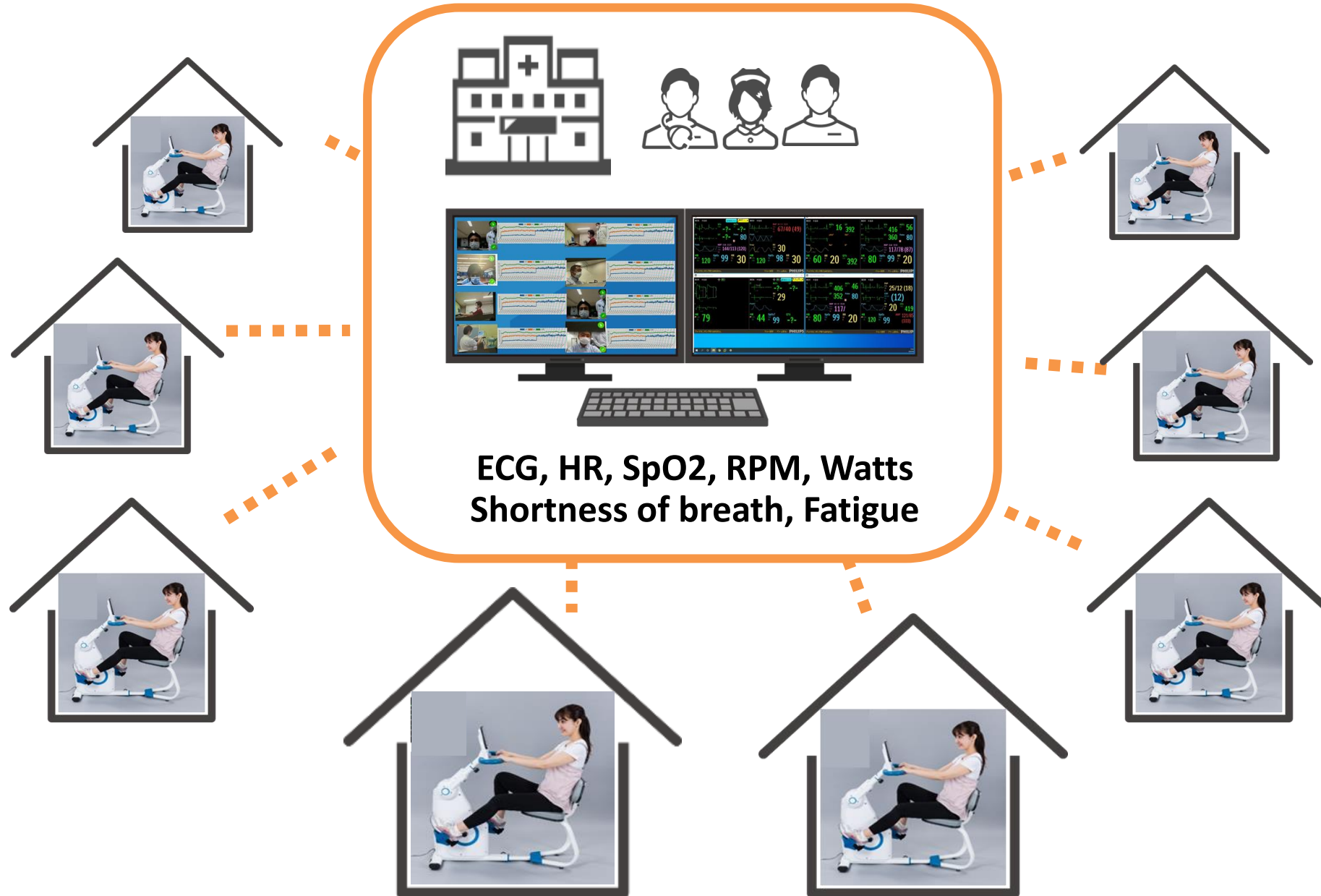
Communication Tablet



**Interactive
Video Communication
+
(real time) ECG
+
Exercise load control**

High cost, Need to be efficient

Muilt-Patient Real Time Monitoring Online-Cardiac Rehabilitation (1:n model)



Remote cardiac rehabilitation model using IoT ergometers (1 vs. N)



Patient **acceptance**

Reassurance

Encouragement (high adherence)

To be good adherence

Acceptable usability

Remaining problems to be improved

- Operation needs to be simplified
- Summary and record storage functions
- Patients cannot check their own ECGs
- **Patients cannot talk to each other**

Challenges in Developing a Multi-Patients Remote-Rehabilitation

Feasible

Good acceptance

Reassurance (Feeling secure)
Feeling encouraged to continue,
Adherence

• Operations

- Lack of digital literacy
- Inability to hear HCPs well
- Advance preparation for emergency response
- Privacy and security

• Cost

- Installation and Internet costs
- Medical reimbursement
- Evidence and health economic evaluation
- Automation and further efficiency

• Software

- Appointment, summary, or storage functions
- On-demand Data display

• Tele-Communication stability

- Video quality
- ECG transfer and exercise bike adjustment

Conclusion

- **Multi-patient online cardiac rehabilitation under real-time ECG monitoring was feasible.**
- **Further improvement is needed for practical application.**

