# Singapore's Tele-Rehabilitation (TR) Experience: Preliminary Results and Steps Forward


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Education

# The Basis for Telerehabilitation

- Singapore and Hong Kong both have an ageing population.
- The incidence and prevalence of disability increases with age.
- Rehabilitation reduces the burden of disability but…
  - Only a quarter of patients continue with centre-based rehabilitation after discharge
  - Home rehabilitation is expensive
- At a cost between the cost of centre and home based rehabilitation, telerehabilitation may improve:
  - Access to rehabilitation and subsequent independence.
  - Transition of rehabilitative care from hospital to home.

# Telerehabilitation

Can we use instead:

- *Training* for patients & caregivers on use of telerehabilitation system before discharge to home;
- *Live real-time video-conferencing* (e.g. FaceTime on iPads);
- *Sensors* to capture *physical data* to help therapists assess recovery process and prescribe next level of exercises;
- *Pushing training videos of* therapist-prescribed exercise *to patients*?

# Telerehabilitation

- Since 2010, National University of Singapore has been developing a tele-rehabilitation system in collaboration with acute and community hospitals in Singapore
- Incorporates previously mentioned elements
- Its efficiency was evaluated in a time motion study.
- Its effectiveness is currently being evaluated in a randomized controlled trial which will end in Dec 2016.

# Mdm Doris Zen’s Story

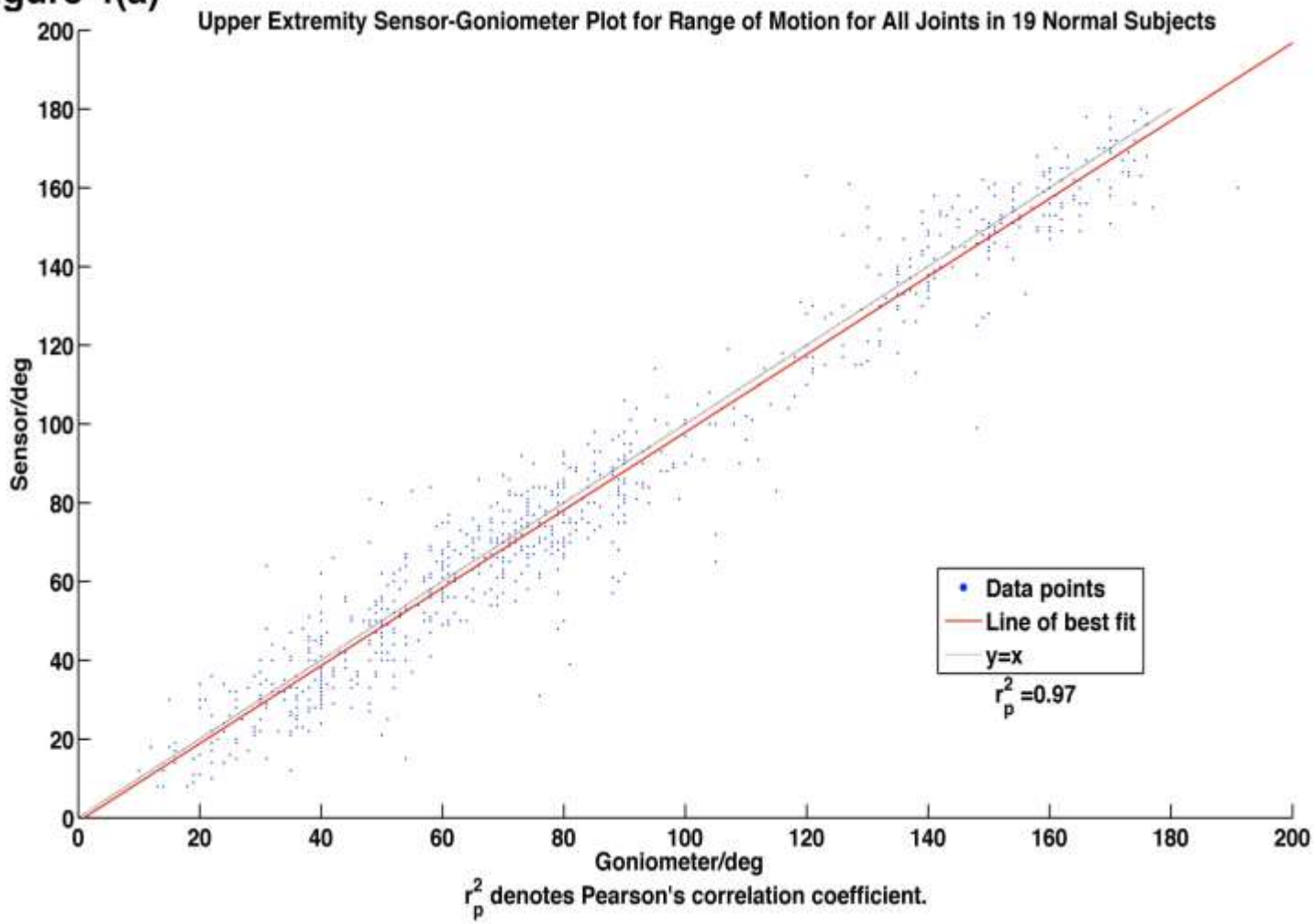
**(1:48)**

# How the Telerehabilitation System Works

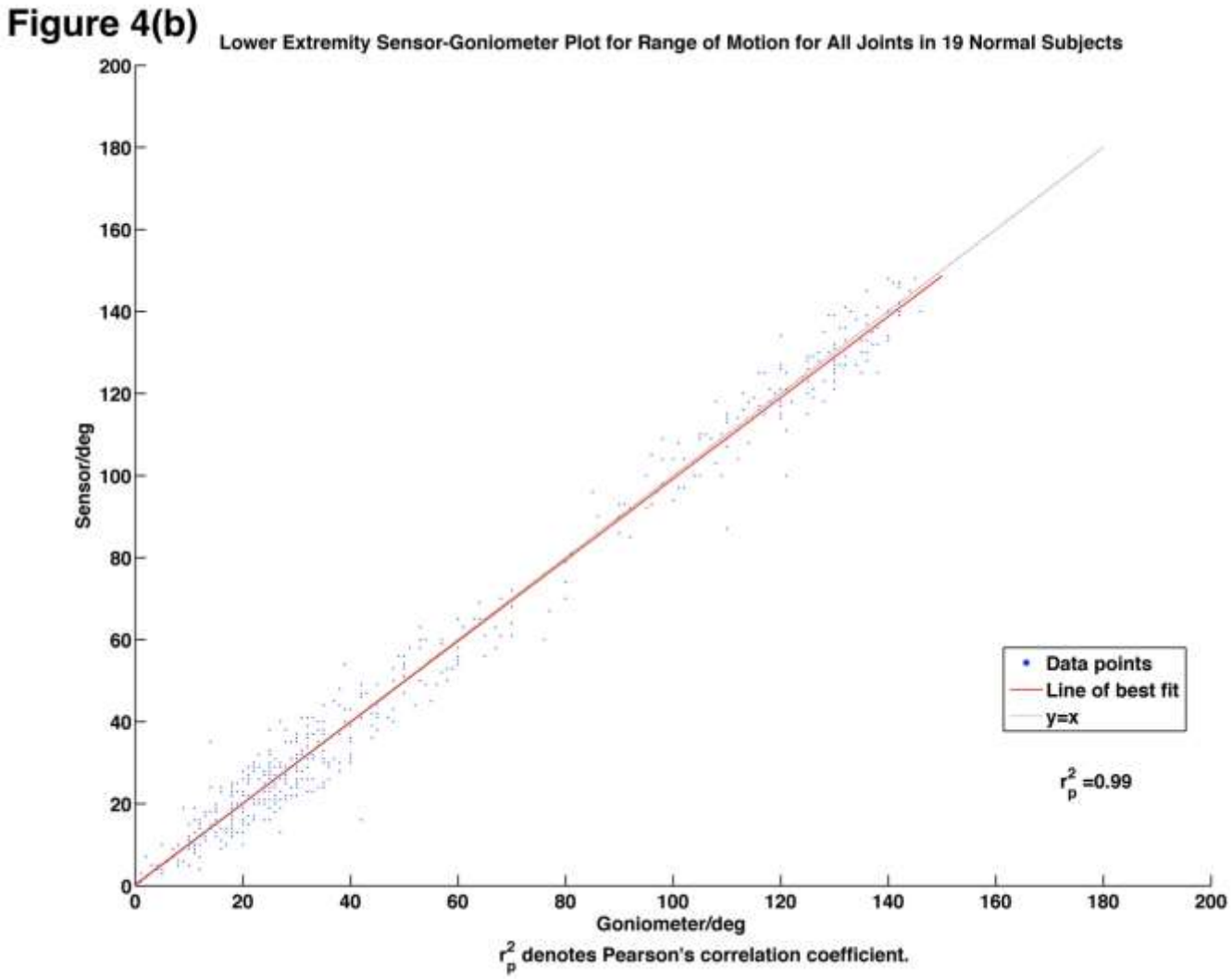
**(1:11)**

# Accuracy of Sensors (Upper Extremities, UE)

Figure 4(a)



# Accuracy of Sensors (Lower Extremities, LE)

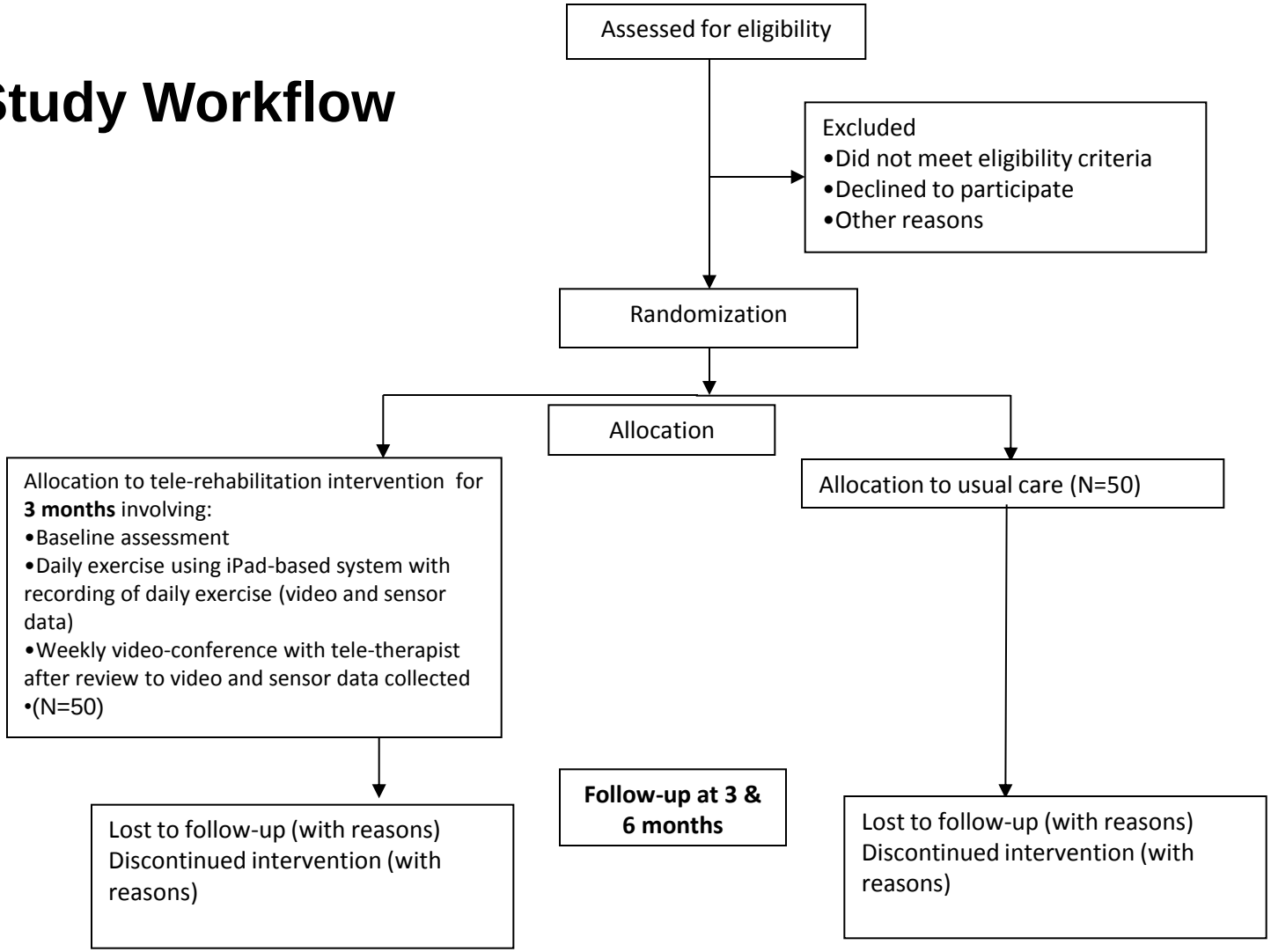


# Singapore Tele-technology Aided Rehabilitation in Stroke (STARS) Study: A Randomized Controlled Trial

Primary hypothesis

Among stroke survivors, a tele-rehabilitation intervention involving video-conferencing with a therapist and use of wearable monitoring devices during the first three months after stroke results greater functional recovery at three months, compared to usual care.

# Study Workflow



# Preliminary Results

- The primary time-point for outcomes in the RCT is 3 months and the target size is 50 controls and 50 intervention subjects based on sample size calculations.
- These are the results of the interim mid-term analysis of 30 subjects recruited (14 control and 16 intervention subjects):
  - Of the 14 control subjects, 2 subjects defaulted follow-up, leaving 12 control subjects available for analysis for data at 3 month time-point.
  - Of the 16 intervention subjects, 2 subjects defaulted follow-up, leaving 14 intervention subjects available for analysis for data at 3 month time-point.
- Statistical significance cannot be assessed in this interim analysis because target sample has not been reached and hence current sample size is not powered.
- This interim analysis only reports preliminary primary findings.

# Difference in Barthel Index (BI) score between baseline and three months

| Group | Mean Change | Interpretation |
|---|---|---|
| **Usual Care** | -0.75 | The **tele-rehabilitation** group *improved* in the functional status by 9.07 BI points, while the **usual care** *declined* by 0.75 BI points. |
| **Telerehabilitation** | +9.07 | |

(Barthel Index (BI) ranges from 0 to 100. The higher the improvement in Barthel Index score, the greater the functional improvement.)

# Difference in Barthel Index (BI) score between baseline and six months

| Group | Mean Change | Interpretation |
|---|---|---|
| **Usual Care** | +2.4 | The **tele-rehabilitation** group continued to *improve* between 3 and 6 months, even after tele-rehabilitation ended at 3 months. |
| **Tele-rehabilitation** | +11.50 | |

(Barthel Index (BI) ranges from 0 to 100. The higher the improvement in Barthel Index score, the greater the functional improvement.)

# Attendance at day rehabilitation centre during study

- At **recruitment**, 42% of controls were going for day outpatient rehab but only 14% of tele-rehab subjects were going for day outpatient rehab (which is expected as the tele-rehab group were already receiving tele-rehab).
- In contrast, at **three months**, 33% of controls were going for day outpatient rehab (a drop from 42%) but 64% of tele-rehab subjects (an increase from 14%) continued rehabilitation (after tele-rehab stopped) by going for day outpatient rehab.

# Attendance at day outpatient rehabilitation during study

- It seems that **without tele-rehab**, patient in usual care remain disabled and continue to face physical barriers to getting to day outpatient rehab centre from persistent disability.
- In contrast, **the tele-rehab group** improves in physical function and possibly starts a positive feedback cycle whereby they become more independent and more motivated to do more rehab to the extent that when tele-rehab stops at 3 months, they choose to continue rehab at the day outpatient rehab centre thereafter to 6 months.
- A **qualitative study** on participants after completion of trial to explore their experience with tele-rehab and reasons why both groups continue with day outpatient rehab to 6 months.

# Time Motion Study

- We also conducted a **time motion study** comparing the time spent and tasks executed during tele-rehabilitation in comparison with day outpatient and home rehabilitation.

- We measured the time spent by therapists and their therapy assistants, if applicable) on tasks of a typical rehabilitation session with a stroke patient who may be accompanied by a caregiver such as a family member or domestic helper, in the 3 settings:
  1. Home rehabilitation;
  2. Day outpatient rehabilitation;
  3. Tele-rehabilitation

# Time Motion Study Results

| Form of Rehabilitation | Mean (SD) Time Spent per Rehab Session (mins) | |
|---|---|---|
| | **Therapist** | **Caregiver** |
| **Day Outpatient** | 70.1 (7.3) | 187.4 (55.3) |
| **Home** | 79.1 (10.6) | 57.1 (8.5) |
| **Tele-Rehab** | 47.6 (13.5) | 14.4 (8.3) |

# Time Motion Study Results

- *Post-hoc analysis*: Even after excluding traveling time (patient traveling time in DR and therapist traveling time in HR), the duration of TR sessions still remained shorter than those of DR and HR.
- TR offers significant time savings for therapists compared to HR, and for patients compared to DR, not only by eliminating unproductive traveling time but also by independently increasing therapist efficiency.

# Singapore's Telemedicine Strategy

- **Health IT Master Plan**
  - National Electronic Medical Record (EMR) System
  - Infra-structure [e.g. New Generation Broadband Network (NGBN)- 1Gps; 90% home coverage]
  - Telemedicine:
    - National Telemedicine Guidelines (March 2015)
    - MOHH Telemedicine Planning Office
    - National Telemedicine Implementation Workgroup (TIW)

# National Telehealth Pilot Programmes

- National Telemedicine Implementation Workgroup (TIW) recommended *tele-rehabilitation* to be pilot tested on multiple sites and larger sample population to assess its suitability to be implemented as a national tele-health programme.
- *Video-conferencing* for national healthcare system and *tele vital sign monitoring* (VSM) were the other two telehealth initiatives shortlisted by the TIW for further assessment.
- *Requests for Proposals* (RFP) for *TR service and evaluation* was called on December 2015 to January 2016.

# National Tele-Rehabilitation Pilot Programme

- Aim: To assess if ***TR-supported (enhanced)*** day outpatient and home rehabilitation is as effective as *usual care* range of 9 broad conditions:
  1. Stroke
  2. Fractures
  3. Lower limb joint replacement (e.g. hip and knee)
  4. Lower limb amputations
  5. Pneumonia,
  6. Falls
  7. Cancer
  8. Deconditioning
  9. Musculoskeletal conditions

# National Tele-Rehabilitation Pilot Programme

- The pilot will examine the use of tele-rehabilitation ***(TR) to replace some rehab sessions*** in:
  - Day outpatient rehabilitation
  - Home rehabilitation

- A **controlled quasi-experimental study** design will be used.

# National Tele-Rehabilitation Pilot Programme

- The pilot is planned to be implemented in **4 settings** sites (5 acute hospitals, 3 community hospitals, 2 nursing homes and 3 day rehabilitation centres) and on at least *750 TR-enhanced patients* and *750 usual care (non TR-enhanced) patients* over 2 years.
- Other aims:
  - To increase therapists and patients' *exposure* to tele-rehabilitation as a new rehabilitation care model
  - Evaluate productivity gains in *TR-enhanced* rehab using *time motion studies*

# Tele-rehab – Patient journey

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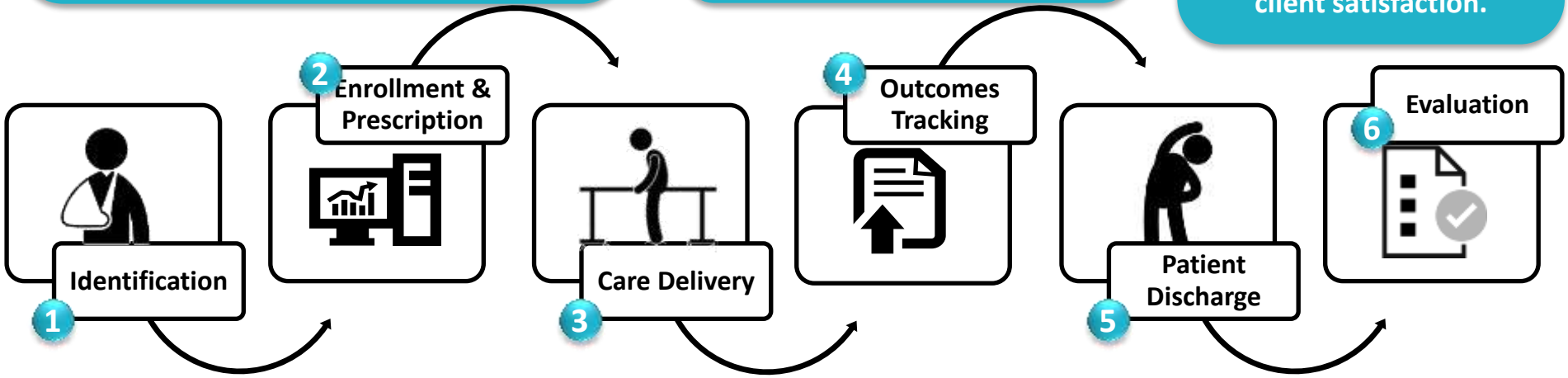
Enrolling patients for tele-rehabilitation through AIC IRMS, taking consent, and making advanced payment. Therapists can prescribe relevant rehabilitation exercises according to patients' conditions. Patients can make and modify appointment.

Tracking of tele-rehabilitation history, enabling therapists to review and generate patients' progress reports.

Evaluating the effectiveness of tele-rehabilitation (e.g. through compliance, clinical indicators or client satisfaction.




Identifying who is referred for tele-rehabilitation, assess patients' conditions, and determine subsidy eligibility.

Involving an initial home visit for set up of equipment at patients' home, and users training; daily recording of patients using tele-rehabilitation system to perform the prescribed exercises; and weekly virtual consults . Therapists n adjust prescribed exercises according to patients' progress.

Returning the equipment to provider, and for therapist to arrange follow up care for patients

# Common workflow for Tele-rehab

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## Identification

### Patient Identification

- Restructured hospitals
- Community hospitals
- Nursing homes
- Day rehab centres
- Polyclinics
- Home care on CHAS
- GPs on CHAS

### Stratification

- Disabling conditions, functional status
- Patient profile, caregivers availability

### Subsidy Eligibility

- Subsidies (financial info, means-testing)

## Enrollment & Prescription

### Patient Information

- AIC IRMS (personal particulars, referral source, medical history)
- Patient consent

### Care package

- Condition specific rehab prescription
- Service package (with/without iPad)
- Treatment duration

### Appointment booking

- Book/modify via phone call to referring agency

### Billing & payment

- Treatment costs
- Subsidies
- Medisave, insurance

## Care Delivery

### Inventory Management

- Inventory mgnt
- Link device to patient
- Device collection

### Set up & training

- Installation (onsite)
- User training (onsite/online)
- Technical support (onsite/online)

### Therapist Consultation

- Video conferencing
- Recording
- Exercise prescription
- Therapist specific "to-review" list

### Reminders & notification

- Appointment reminder
- Event outcome notification

## Outcomes Tracking

### Data Transmission

- Transmit data via 3G/4G gateway, wifi

### Tracking

- Patient treatment compliance status
- Patient progress status
- Capture of exercise video record
- Clinical notes (observations, prescription)
- Therapist time
- Integration to EMR/ NEHR

### Alert

- Sub-optimal rehab exercise movement detection (Analytics)

## Patient Discharge

### Reports

- Discharge summary
- Referral letters
- Integration to EMR/NEHR

### Inventory collection

- Delink device(s)
- Return of equipment

## Evaluation

### Programme Effectiveness

- Tele-rehab sessions actualised
- Interventions actualised
- Tele-rehab indicators
- Patient functional recovery

### Patient Satisfaction

- Patient satisfaction survey

# Thank you

# Any questions?