NUS National University of Singapore | Saw Swee Hock School of Public Health

Geriatric Rehabilitation Services in Singapore: Its Trade-Offs, Effectiveness, Cost-Utility and Barriers to Access

Dr Gerald Koh
Associate Professor
Saw Swee Hock School of Public Health
National University of Singapore
National University Health System

Research

Clinical Care

Education

What Do We Know About Stroke Rehabilitation in Singapore?

Study 1

- Data from Singapore's first cohort study of sub-acute stroke patients admitted into community hospitals for rehabilitation
- N = 200
- Study sites: AMKTHKH & SLH
- Study period: April 2002 – September 2003
- Survey points: Admission, 1 month, 6 months & 1 year

What Do We Know About Stroke Rehabilitation in Singapore?

Functional Recovery At One Year

- Greater participation in supervised rehabilitation >25% of time at 1 and 6 months independently predicted higher Barthel Index (BI) scores 1 year by 25%, adjusted for baseline function & other variables..
- Unsupervised rehabilitation at home had no effects on function at 1 year.

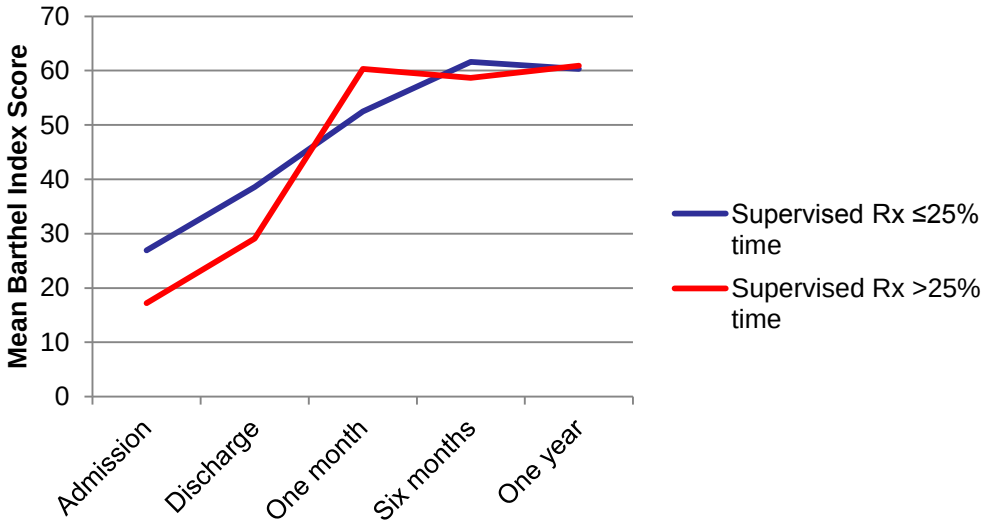
	Adjusted Mean BI Score at 1 Year (95% CI)	Adjusted β-estimate (95% CI)	p-value
Performing therapy at home			
One month			
> 75% of the time	64.7 (54.0 – 75.3)	-4.7 (-10.5 – 1.0)	0.103
≤ 75% of the time	69.4 (58.5 – 80.3)	-	
Six months			
> 75% of the time	67.5 (56.8 – 78.2)	1.0 (-5.0 – 7.0)	0.729
≤ 75% of the time	66.5 (55.6 – 77.4)	-	
Performing therapy at outpatient rehab centre			
One month			
> 25% of the time	72.4 (61.6 – 83.1)	10.7 (3.3 – 18.2)	**0.006**
≤ 25% of the time	61.7 (50.3 – 73.0)	-	
Six months			
> 25% of the time	74.7 (64.1 – 85.3)	15.3 (7.1 – 23.5)	**0.001**
≤ 25% of the time	59.4 (47.7 – 71.1)	-	

Koh GCH, Saxena SK, Ng TP, Yong D, Fong NP. The effect of duration, participation rate and supervision during community rehabilitation on functional outcomes in the first post stroke year in Singapore. *Arch Phys Med Rehabil* 2012;93:279-86.

What Do We Know About Stroke Rehabilitation in Singapore?

Time of Plateau of Functional Recovery

- Participation in supervised rehabilitation >25% of time predicted faster functional recovery (vs. ≤25% of time).
- Those performing supervised rehabilitation >25% of time plateaued at one month while those performing supervised rehabilitation ≤25% of time plateaued at 6 months (using mixed model analysis).

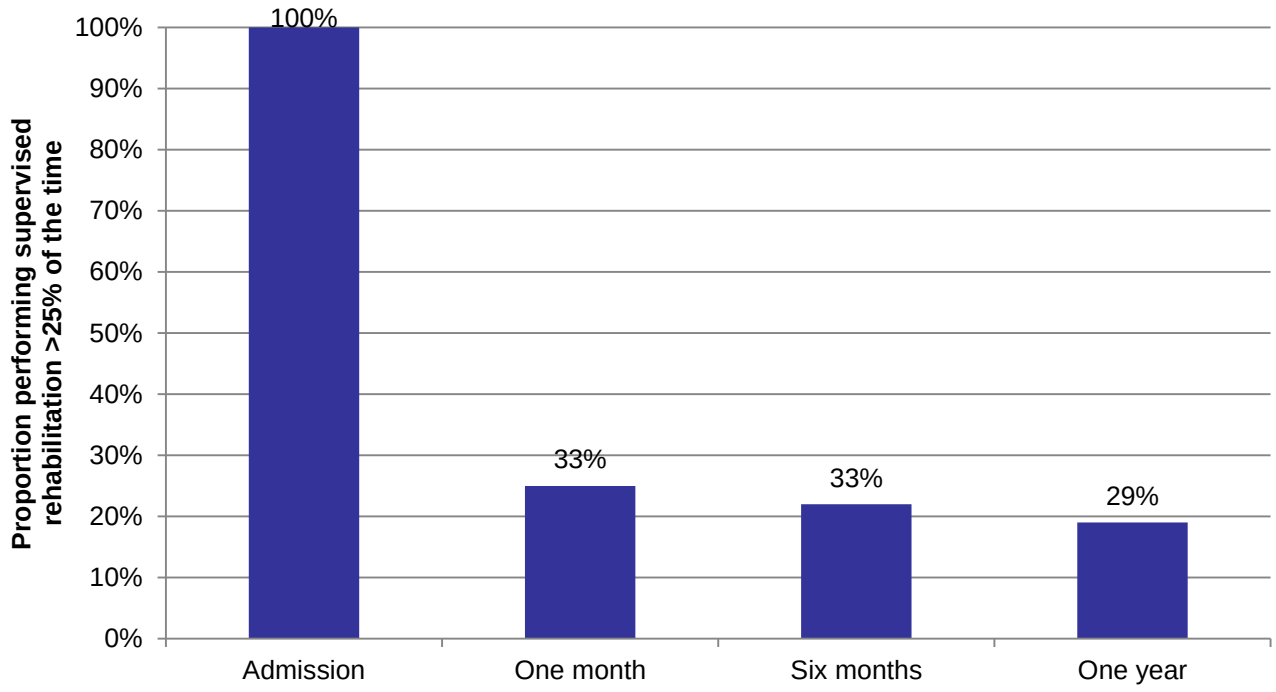


Koh GCH, Saxena SK, Ng TP, Yong D, Fong NP. The effect of duration, participation rate and supervision during community rehabilitation on functional outcomes in the first post stroke year in Singapore. *Arch Phys Med Rehabil* 2012;93:279-86.

What Do We Know About Stroke Rehabilitation in Singapore?

Performance of supervised rehabilitation

- The proportion of stroke patients performing supervised rehabilitation after discharged dropped to 25.3% at 1 month and declined to 19.0% by 1 year.



What Do We Know About Stroke Rehabilitation in Singapore?

Performance of supervised rehabilitation (cont'd)

- Performance of rehabilitation at 1 month was very strongly predictive of performance of supervised rehabilitation at 6 months and 1 year.
- Caregiver availability predicted **poorer** performance of supervised therapy than those with no caregivers.

Variables	Adjusted OR (95% CI)	p-value
At one month *		
Age >75 years (vs. ≤75 years)	0.43 (0.20 – 0.91)	0.028
At six months §		
Caregiver availability (vs. none)	0.07 (0.01 – 0.49)	0.007
Performance of supervised therapy >25% of the recommended time at 1 month	11.64 (4.52 – 29.97)	<0.001
At one year †		
Performance of supervised therapy >25% of the recommended time at 6 months	76.46 (12.52 – 466.98)	<0.001

Why Patients Do Not Go for Rehabilitation in Singapore

Study 2

- A mixed methods (qualitative & quantitative) study of all (stroke and non-stroke) patients admitted into AMKTHKH
- Eligibility criteria: Patients assessed by multi-disciplinary healthcare team to benefit from continuation of rehabilitation after discharge
- N = 70
- Study period: 2008-2009

Chen A, Koh YT, Leong S, Ng L, **GCH Koh**. Post-community hospital discharge rehabilitation attendance: self-perceived barriers and participation over time. *Ann Acad Med Singapore*. Accepted for publication.

Why Patients Do Not Go for Rehabilitation in Singapore

- Although the majority (76.8%) acknowledged that inpatient rehabilitation was beneficial, only 40.0% wanted to continue with rehabilitation after discharge.
- The barriers to adherence with rehabilitation after discharge were:
  - Functional
  - Social
  - Financial
  - Medical
  - Perceptual

Functional Barriers

Problems with ambulating from home to rehabilitation centre	62%
Problems with ambulating within the home	21%

2 | UPFRONT THE STRAITS TIMES THURSDAY APRIL 13, 2006

>> CONTINUED FROM PAGE ONE

Going up: Calls for lift upgrades

A BETTER LIFT, PLEASE: Ms Tay carries her grandmother on her back from the ninth floor lift to her grandmother's 10th-floor home. The 82-year-old woman is wheelchair-bound following a stroke.

"It's very hard to get around… Upgrading works are in progress around my home at the moment. Now, I have to take a lift to the fifth floor before taking the stairs to the third storey where I live."

[62-year-old Chinese female]

Functional Barriers

Problems with ambulating from home to rehabilitation centre	62%
Problems with ambulating within the home	21%

Social Barriers

Inconvenient for subject	57%
No caregiver available to accompany subject	31%
Subject does not wish to burden caregiver	29%
Inconvenient for caregiver	21%
Caregiver is too busy	19%
Subject is too busy	12%

"I am afraid I might fall again if I go alone. However, I would like to continue rehabilitation if I can."

[69-year-old Chinese male]

"There is no one to bring me for my rehabilitation sessions if there will be any. However, I would like to continue rehabilitation if I am able to do so as I find it good and useful."

[74-year-old Chinese female]

Financial Barriers

Financial problems from out-of-pocket payments	29%
Financial problems from high cost per session	21%
Financial problems from long duration of rehabilitation	5%

"I think (the cost of rehabilitation) will be okay for the first few weeks but will be a problem if it goes beyond that. After all, I already have to pay for my (other medical) bills."

[62-year-old Chinese female]

"Money is an important factor. I am concerned that I cannot use Medishield or Medisave (government insurance) for physiotherapy and transport. I currently have no income, thus I cannot pay."*

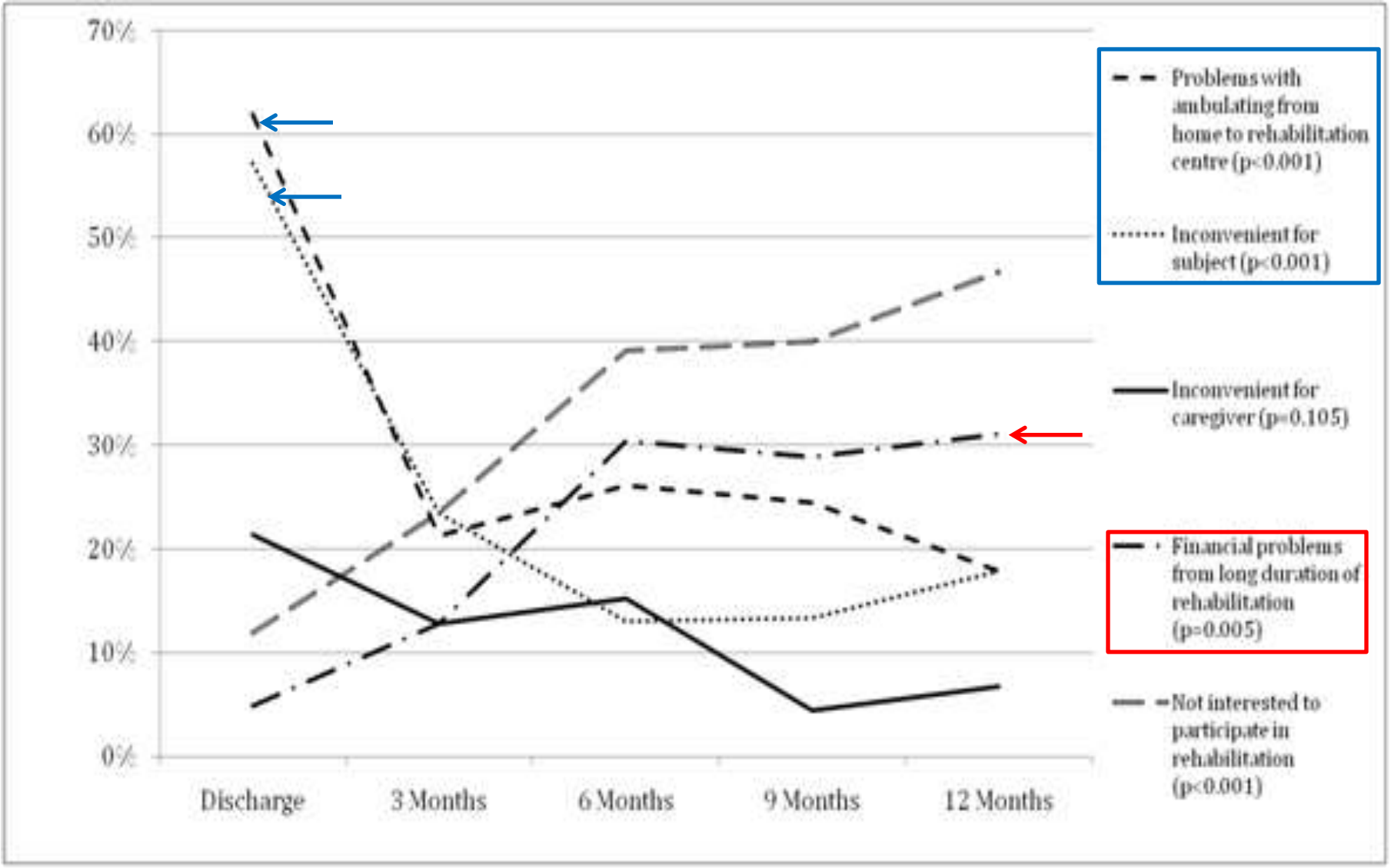
[52-year-old Indian male]

* From July 2012, Medisave was allowed to be used for day rehabilitation up to S$20 per day, subject to a maximum of S$1,500 a year.

Financial Barriers

	Specialist Outpatient	Day Rehabilitation Centre
Cost per Visit	$150 per visit	$50 per visit
Ratio of Cost Per Visit	3 : 1	
No. of Visit Over 3 Months	1 visit	Once a week X 12 weeks = 12 visits
Total Cost Over 3 Months	$150	$600
Ratio of Cost for Visits Over 3 Months	1 : 4	

How Did Barriers to Rehabilitation After Discharge Change with Time?



What Do We Know About Stroke Rehabilitation in Singapore?

Study 3

- Retrospective cohort study of all stroke patients admitted into 4 community hospitals in Singapore
- Data extracted from medical records
- N = 3,401
- Study period: Jan 1996 – Dec 2005 (10 years)

Koh GCH, Chen C, Cheong A, Tai BC, Choi KP, Fong NP, Chan KM, Tan BY, Petrella R, Thind A, Koh D, Chia KS. Trade-offs between effectiveness and efficiency in stroke rehabilitation. *Int J Stroke* 2012;7:606-14.

What Do We Know about Stroke Rehabilitation in Singapore

Rehabilitation Effectiveness (REs)[1]

- The degree of functional improvement divided by potential functional improvement.

- It is the improvement in BI score, divided by the maximum possible functional recovery (between time point T_x & a later time point T_y) where the maximum score for the Shah-Modified Barthel Index[2] is 100:

$$REs = \frac{BI_y - BI_x}{(100 - BI_x)} \times 100\%$$

- The value is multiplied by 100% to obtain a percentage.

1. Shah S, Vanclay F, Cooper B. Efficiency, effectiveness, and duration of stroke rehabilitation. Stroke 1990:21:241-6.
2. Shah S, Vanclay F, Cooper B. Improving the sensitivity of the Barthel Index for stroke rehabilitation. J Clin Epidemiol. 1989;42(8):703-709.

What Do We Know about Stroke Rehabilitation in Singapore

Rehabilitation Efficiency (REy)[1]

- **The degree of functional improvement (e.g. using the 100-point Shah-Modified Barthel Index[2]) divided by the duration of rehabilitation .**

- **It is the improvement in BI score, divided by the days between time point T_x and a later time point T_y:**

$$REy = \frac{BI_y - BI_x}{[\text{Days bet } T_x \text{ and } T_y)\ ]}$$

- **REy is multiplied by 30 days to obtain the improvement in BI score in a month.**

1. Shah S, Vanclay F, Cooper B. Efficiency, effectiveness, and duration of stroke rehabilitation. Stroke 1990:21:241-6.

2. Shah S, Vanclay F, Cooper B. Improving the sensitivity of the Barthel Index for stroke rehabilitation. J Clin Epidemiol. 1989;42(8):703-709.

What Do We Know about Stroke Rehabilitation in Singapore

The independent factors of poorer REs in CHs were:

- Older age
- Female gender
- Malay ethnicity
- Caregiver availability
- Infarct stroke type
- Longer time from stroke onset to admission
- Dementia
- Lower admission BI score
- Shorter length of hospital stay

What Do We Know about Stroke Rehabilitation in Singapore

- The independent factors of poorer REy in CHs were the same as REs except:
  - Peptic ulcer disease was associated instead of female gender
  - Higher admission BI scores
  - Longer length of hospital stay

- Caregiver availability (like with the stroke community cohort) was associated with poorer REs and REy.

Trade-offs between REs and REy

- Admission functional status

  An increase of 10 units in admission BI score predicted:

  - Increase in REs by 3.6% but
  - Decrease of in REy by 1.0 units per 30 days

- Length of hospital stay (LOHS)

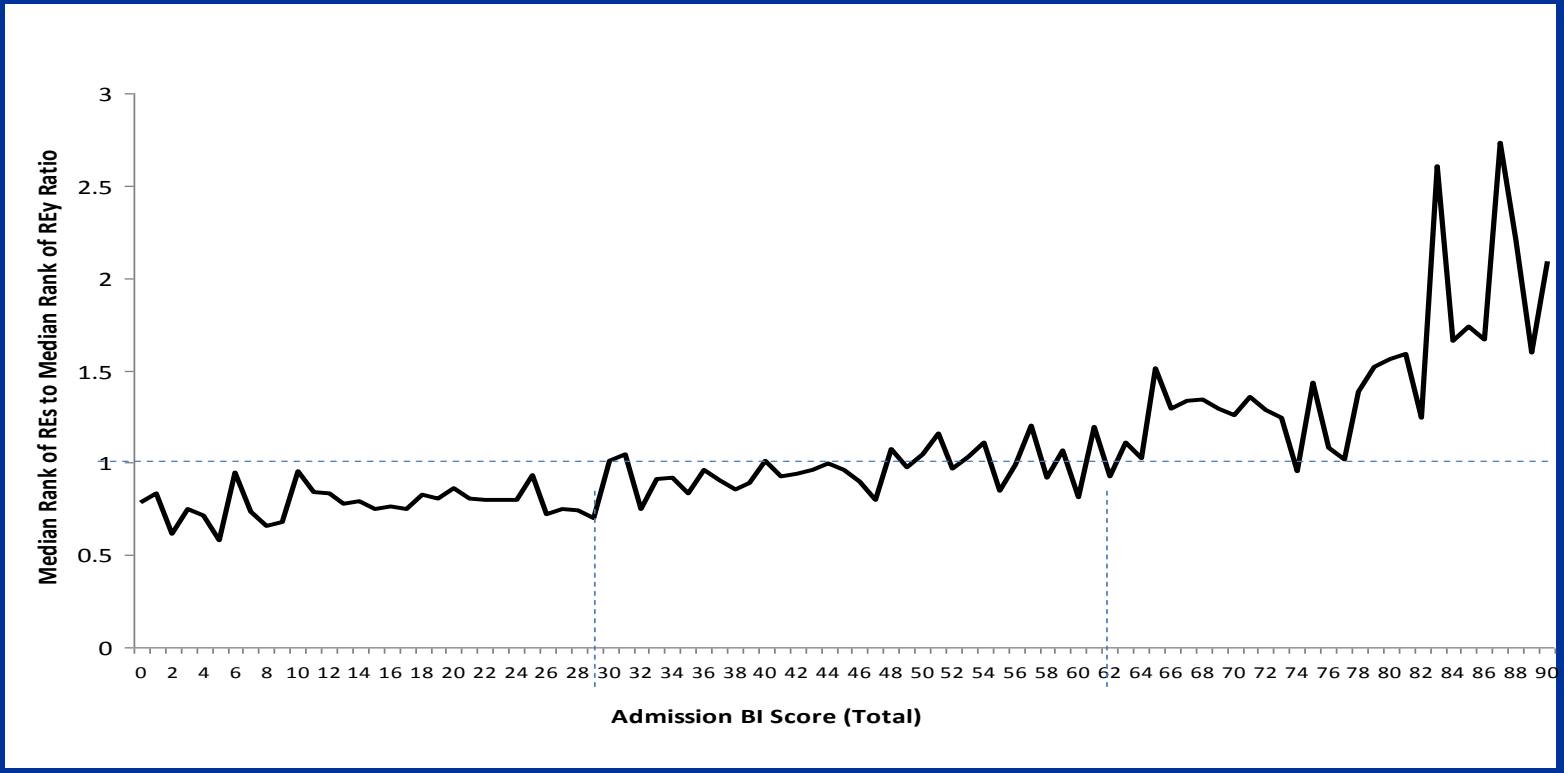
  An increase of 3 days in length of hospital stay (LOHS) predicted:

  - Increase in REs by 8.0% but
  - Decrease in REy by 2.3 units per 30 days

Trade-offs between REs and REy

Admission functional status

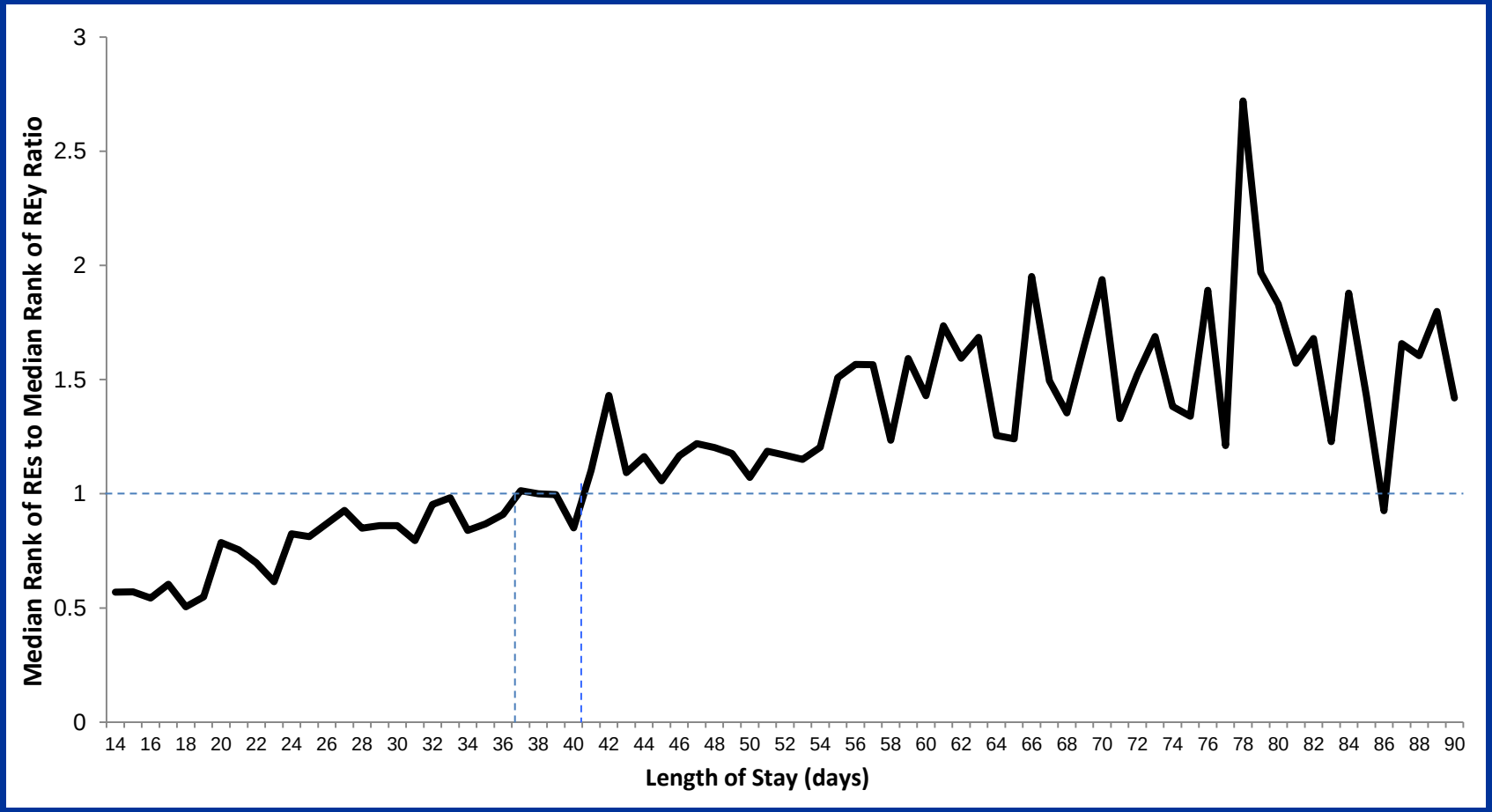
- The ideal admission BI score is 30 - 62 units



Trade-offs between REs and REy

Length of hospital stay

- The ideal length of hospital stay 37 – 41 days



Trends in length of stay and functional outcomes by disease for inpatient rehabilitation in Singapore community hospitals: 1996-2005

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St Luke's HOSPITAL

Multivariate modeling

- **Mixed Linear model (AdmBI, DcBI, LOS, REs, REy)**
- **Model 1:**
  - Random effect: Community hospital (hospital A, B, C, D)
  - Fixed effect: Year of admission (1996 to 2005).
- **Model 2:**
  - Random effect: Community hospital (hospital A, B, C, D)
  - Fixed effect: Year of admission (1996 to 2005), age, sex (male, female), race (Chinese, Malay, Indians, others), marital status (married, single/widowed/separated/divorced), caregiver availability (yes, no), admission BI

Multivariate models: AdmBI & DcBI

Rehabilitation measure for each impairment group, 1996-2005

	Unadjusted Beta (95% CI) †	Adjusted Beta (95% CI) ‡
Admission BI Score		
Total (n=12506)	1.50 (1.34-1.65)**	1.6 (1.44-1.75)**
Stroke (n=5075)	0.70 (0.44-0.96)**	0.85 (0.59-1.10)**
Fracture (n=3796)	1.45 (1.20-1.71)**	1.58 (1.34-1.83)**
Lower limb amputation (n=290)	0.20 (-0.73-1.13)	0.03 (-0.86-0.92)
Lower limb joint replacement (n=359)	1.80 (1.12-2.48)**	1.66 (0.99-2.32)**
Cancer (n=239)	1.49 (0.17-2.81)*	1.00 (-0.32-2.32)
Falls (n=204)	0.83 (-0.36-2.02)	0.81 (-0.39-2.01)
Pneumonia (n=204)	2.52 (1.27-3.78)**	2.47 (1.17-3.77)**
Others (n=2317)	1.17 (0.81-1.53)**	1.20 (0.85-1.55)**
Discharge BI Score		
Total (n=12506)	2.32 (2.15-2.49)**	0.95 (0.85 to 1.04)**
Stroke (n=5075)	1.63 (1.33-1.93)**	1.01 (0.85 to 1.17)**
Fracture (n=3796)	2.37 (2.08-2.65)**	1.09 (0.92 to 1.26)**
Lower limb amputation (n=290)	0.86 (-0.20-1.93)	0.69 (0.15 to 1.23)
Lower limb joint replacement (n=359)	2.58 (1.96-3.21)**	1.23 (0.85 to 1.61)**
Cancer (n=239)	2.19 (0.82-3.57)**	0.95 (0.21 to 1.69)*
Falls (n=204)	1.69 (0.49-2.90)**	1.11 (0.39 to 1.84)**
Pneumonia (n=204)	3.05 (1.58-4.51)**	0.32 (0.49 to 1.13)**
Others (n=2317)	1.87 (1.48-2.26)**	0.80 (0.58 to 1.01)**

** P-value <0.01 * 0.01 ≤ P-value <0.05

† Univariate mixed model adjusting for community hospital as random effects. Fixed effect is year of admission

‡ Multivariate mixed model adjusting for community hospital as random effects. Fixed effects are age, gender, race, marital status, caregiver availability, admission BI score, year of admission

Multivariate models: LOS

Rehabilitation outcome for each impairment group, 1996-2005

	Unadjusted Beta (95% CI) †	Adjusted Beta (95% CI) ‡
Length of stay		
Total (n=12506)	-1.35 (-1.48--1.23)**	-1.16 (-1.29 to -1.03)**
Stroke (n=5075)	-1.3 (-1.51--1.09)**	-1.12 (-1.32 to -0.91)**
Fracture (n=3796)	-1.04 (-1.27--0.82)**	-0.90 (1-.13 to -0.67))**
Lower limb amputation (n=290)	-2.05 (-3.09--1.01)**	-2.07 (-3.07 to -1.06)**
Lower limb joint replacement (n=359)	-1.32 (-1.91--0.73)**	-0.68 (-1.27 to -0.09)**
Cancer (n=239)	-1.16 (-2.02--0.31)**	-1.00 (-1.87 to -0.13)*
Falls (n=204)	-1.05 (-2.05--0.05)**	-0.98 (-2.00 to 0.04)*
Pneumonia (n=204)	-0.92 (-1.76--0.07)*	-0.96 (-1.88 to -0.04)*
Others (n=2317)	-1.44 (-1.72--1.17)**	-1.37 (-1.65 to -1.09)**

** P-value <0.01 * 0.01 ≤ P-value <0.05

† Univariate mixed model adjusting for community hospital as random effects. Fixed effect is year of admission

‡ Multivariate mixed model adjusting for community hospital as random effects. Fixed effects are age, gender, race, marital status, caregiver availability, year of admission

Multivariate models: REs & REy

Rehabilitation outcome for each impairment group, 1996-2005

	Unadjusted β (95% CI) †	Adjusted β (95% CI) ‡
Rehabilitation effectiveness (REs)		
Total (n=12506)	2.23 (2.04-2.42)**	1.71 (1.53 to 1.89)**
Stroke (n=5075)	1.73 (1.43-2.03)**	1.56 (1.29 to 1.84)**
Fracture (n=3796)	2.3 (1.95-2.65)**	1.88 (1.54 to 2.22)**
Lower limb amputation (n=290)	1.38 (0.13-2.62)*	1.31 (0.19 to 2.43)*
Lower limb joint replacement (n=359)	4.89 (3.81-5.96)**	4.21 (3.1 to 5.31)**
Cancer (n=239)	2.29 (0.71-3.88)**	1.79 (0.26 to 3.32)*
Falls (n=204)	1.74 (0.22-3.26)*	1.68 (0.15 to 3.22)*
Pneumonia (n=204)	1.61 (-0.01-3.22)	-0.03 (-1.64 to 1.58)
Others (n=2317)	2.07 (1.60-2.54)**	1.59 (1.15 to 2.04)**
Rehabilitation efficiency (REy)		
Total (n=12506)	1.09 (0.98-1.20)**	1.07 (0.96 to 1.18)**
Stroke (n=5075)	1.14 (0.97-1.32)**	1.12 (0.95 to 1.29)**
Fracture (n=3796)	1.09 (0.90-1.29)**	1.16 (0.96 to 1.36)**
Lower limb amputation (n=290)	0.83 (0.24-1.43)**	0.86 (0.27 to 1.46)**
Lower limb joint replacement (n=359)	1.25 (0.63-1.87)**	1.36 (0.71 to 2.01)**
Cancer (n=239)	0.86 (-0.15-1.87)	0.89 (0.16 to 1.93)
Falls (n=204)	1.49 (0.57-2.41)**	1.76 (0.85 to 2.68)**
Pneumonia (n=204)	-0.27 (-1.19-0.65)	-0.63 (-1.61 to 0.35)
Others (n=2317)	0.93 (0.65-1.20)**	0.95 (0.67 to 1.22)**

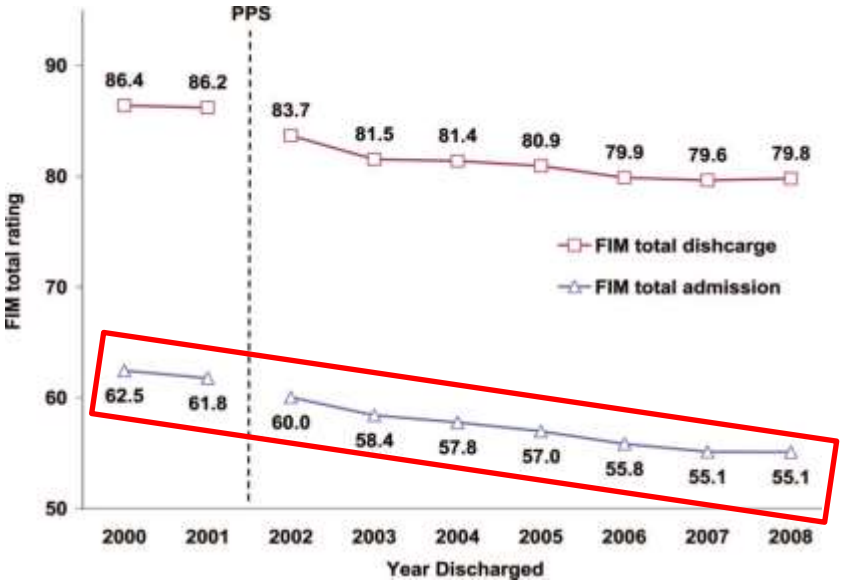
** P-value <0.01 * 0.01 ≤ P-value <0.05

† Univariate mixed model adjusting for community hospital as random effects. Fixed effect is year of admission

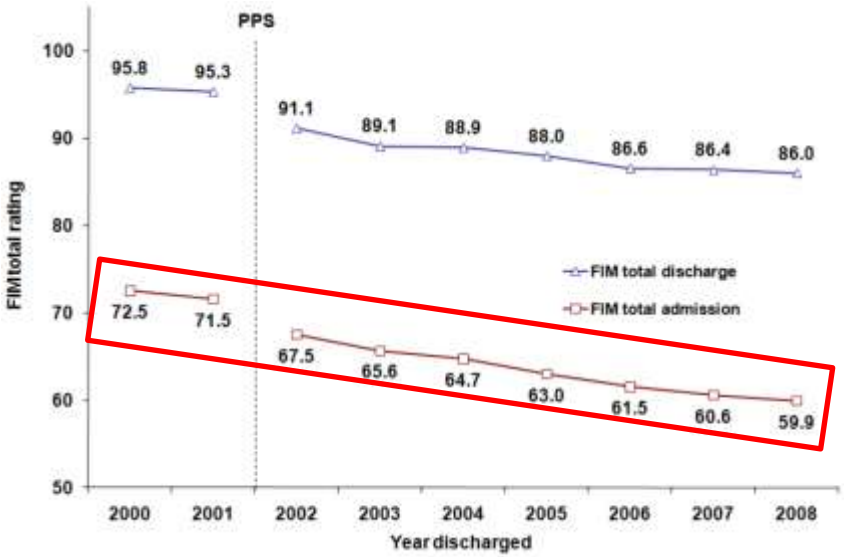
‡ Multivariate mixed model adjusting for community hospital as random effects. Fixed effects are age, gender, race, marital status, caregiver availability, admission BI score, year of admission

Decreasing trends in admission FIM (USA)

The Uniform Data System for Medical Rehabilitation Granger et al.

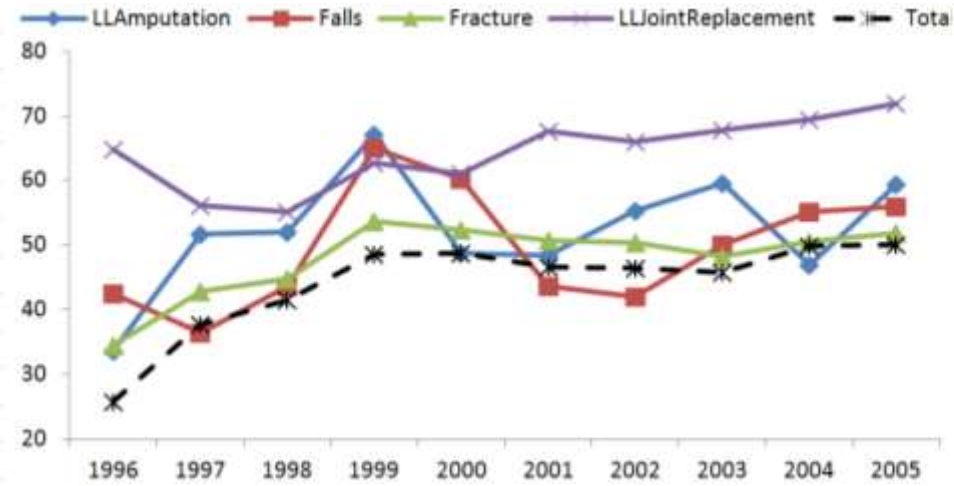


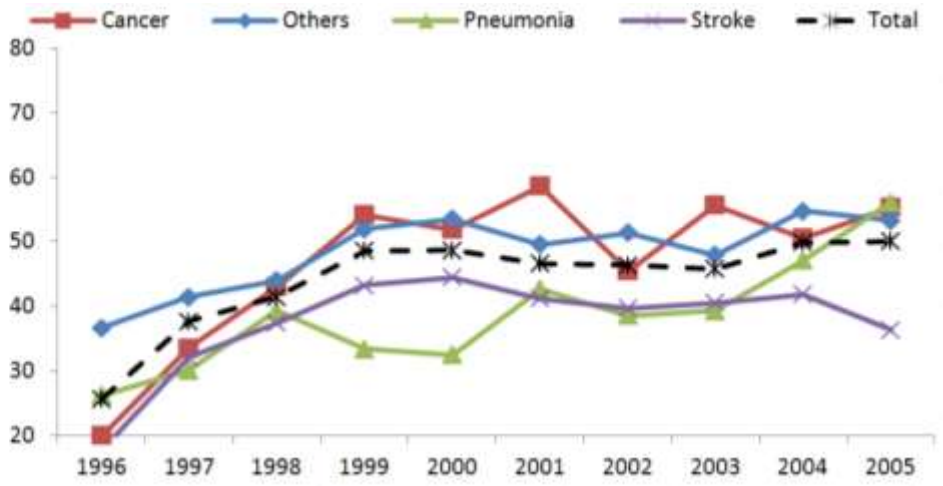
Stroke *N*=634,105



Hip fracture *N*=303,594

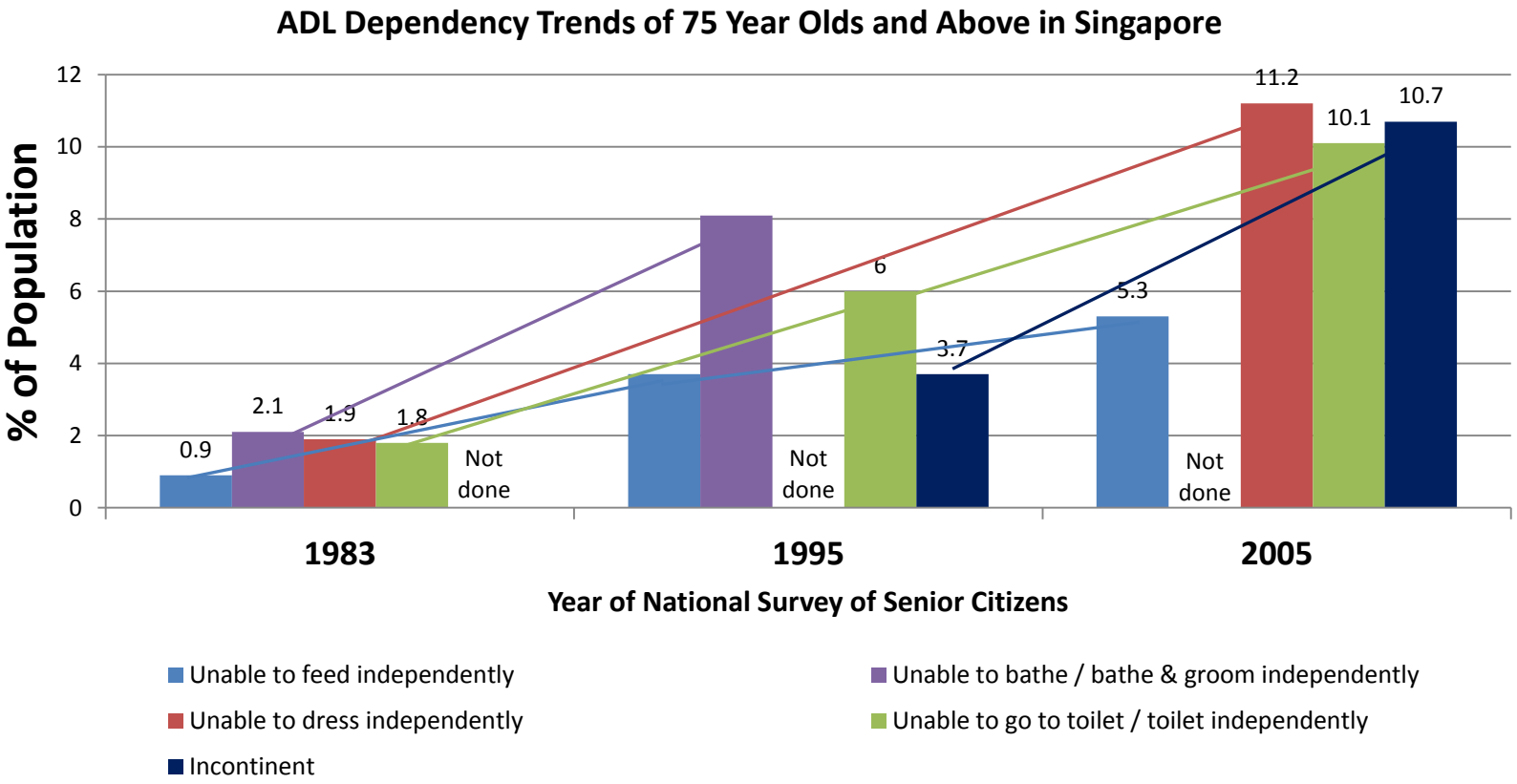
Increasing trend in admission BI score (Singapore CHs)





National ADL Dependency Trends in Singapore (≥75 year olds)

(Based on National Survey of Senior Citizens 1983, 1995 & 2005)



National ADL Dependency Trends in US

- In the US, Manton *et al* have found significant declines in chronic disability prevalence of 0.26% per year in the US elderly population from 1982 to 1989 using the US National Long-Term Care Surveys (NLTCS).[1,2]

- Repeat NLTCS in 1994 and 1999 found that the prevalence of disability continued to decline in the next 10 years and that the decline was greater in the late 1990s than the early 1990s (0.38% per year from 1989 to 1994 and 0.56% per year from 1994 to 1999).[3]

[1] Manton KG, Vaupel JW. Survival after the age of 80 in the United States, Sweden, France, England and Japan. N Engl J Med 1995;333:1232-5.

[2] Manton KG, Corder L, Stallard E. Estimates of change in chronic disability and institutional incidence and prevalence rates in the US elderly population from the 1982, 1984 and 1989 National Long Term Care Survey. J Gerontol B Psychol Sci Soc Sci. 1993;48:S153-66.

[3] Manton KG, Gu XL. Changes in the prevalence of chronic disability in the United States black and non-black population above age 65 from 1982 to 1999. Proc Natl Acad Sci USA 2001;98:6354-9.

What Do We Know About Stroke Rehabilitation in Singapore? A Summary

- Supervised therapy in community hospital improves functional recovery.
- Supervised therapy after discharge in the community inpatient speeds up and improves functional recovery.
- Participation in supervised therapy after discharge is very low in Singapore (only 25% at 1 month).
- To improve supervised therapy participation rates, the ‘pivot point’ is the first-month post-discharge period.

What Do We Know About Stroke Rehabilitation in Singapore? A Summary

- To improve supervised therapy participation rates, we must address the health, physical, social and financial barriers.
- Financial barriers to post-discharge rehabilitation increases with time.
- Patients with caregivers have poorer functional recovery than those without caregivers, both in community hospitals and post-discharge.
- Among stroke patients with caregivers, closeness of relationship with primary caregiver was associated with better REs and REy.

What Do We Know About Stroke Rehabilitation in Singapore? A Summary

- Rehabilitation effectiveness (REs) measures the achievement of rehabilitation potential, while rehabilitation efficiency (REy) measures the speed of functional recovery.
- There are trade-offs between REs and REy with respect to admission functional status and length of hospital stay.
- From 1996 to 2005, there has been an annual trend of :
  - Increasing mean admission and discharge BI score for all diseases
  - Increasing absolute functional gain (AFG) for all diseases (except pneumonia)
  - Decreasing length of CH stay for all diseases
  - Increasing REs and REy for all diseases

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Thank you

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