Disparities in survival among elders with disabilities: possible implications for long-term care insurance

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Abstract

Background Singapore is ageing rapidly and has one of the longest life expectancies in the world. Long-term care also represents one of the largest financial risks of the elderly, as the risk of disability increases with age. ElderShield, a long-term care insurance scheme provides payouts up to six years for elders with severe disability - having three or more ADL disabilities. The six years of coverage might be insufficient due to increases in the duration of the disability.

Methods In this paper, we studied all elders admitted to community hospitals in Singapore from 1996 to 2005, linked with national death records until December 2011. We modelled their survival risk after discharge from community hospitals using Cox proportional hazards regression, taking into account ADL disability, health status and other sociodemographic covariates.

Results Individuals with higher ADL disability counts have a higher hazard ratio (HR: 1.28, 1.76, 2.09 for mild, moderate and severe disability respectively compared to those with no disability), being in a higher subsidy ward class (HR: 1.13 and 1.41 for moderate and high subsidy respectively compared to no/low subsidy) and had greater comorbidity burden (HR: 1.33, 1.74, 2.74 for mild, moderate and severe comorbidity burden respectively compared to those with no comorbidity burden). We also found that survival probabilities for individuals with two disabilities were not statistically different from those with 3+ ADL disabilities. In addition, more elders with severe disability were living for longer than six years.

Conclusions Our results indicated that individuals with ADL disability might be living longer. This has possible implications on long-term care policies in the context of ElderShield insurance as it uses severe ADL disabilities as the criteria for payout, capped at six years. In 2020, Singapore expanded to CareShield Life with lifetime cash payout if severely disabled. Ensuring fiscal sustainability and affordable premium is challenging for any government, especially with Singapore's rapidly ageing demography. We conclude that the expansion of coverage from six years to lifetime coverage is timely as Singaporeans are living longer and disability risk increases with age. These payouts will be helpful for the disabled elders and their family, protecting them against some financial risk.

1. Background

Long-term care (LTC) represents one of the largest financial risks of the elderly worldwide. As populations face a rapidly ageing demographic, with higher risk of disability in older ages, this has led to a rise in long-term care expenditure, resource utilisation and the number of LTC workers in OECD countries from 2000 to 2017. For Japan, the number of LTC workers almost tripled from 727,339 to 2,028,341, from 2000 to 2017. In the United States, the number of LTC workers increased from 1,995,395 in 2005 to 2,791,842 in 2016. In the OECD, 30 countries with LTC represent 1.4% of public spending on average in 2017. [1] In Singapore, the number of intermediate and LTC facilities saw minor increases from 61 to 66 in 2006 to 2015 [2] and might be insufficient to meet future needs.

Singapore is projected to take 27 years to transition from an ageing society in 1999 with only 7% seniors to a 'super-aged society' with more than 20% seniors in 2026, surpassing Japan, China, Germany and the United States, which took or will take 36, 32, 76 and 86 years to make the transition respectively. [3, 4] While Singapore has one of the lowest healthcare spendings per capita among the developed countries and longest life expectancies in the world, [5] it is unclear if she can continue to keep cost low without compromising on health outcomes.

Questions regarding health care financing, cost containment, successful ageing and resource utilisation have been an increasing concern. With a rapidly ageing population, the risk of functional disability in many elderly persons will increase, resulting in an increased demand for long-term care and higher medical spending. [6-8] The economic

burden of functional disability and long-term care has also significantly driven healthcare expenditure among the elderly. [9-12] In Taiwan, the government reported a 7% increase in the prevalence of disabilities among older adults (from 29.6% in 1997 to 36.6% in 2010). [13] In addition, hospitalisation rates for elders in Taiwan with functional disabilities were found to be much higher than the general population. [14] Japanese medical spending was at least three times higher for disabled individuals in performing self-care, compared to their respective peers with no functional disabilities. [15]

Functional disabilities are expected to increase among the elderly population. [16] Furthermore, an increasingly ageing population makes this issue far more prominent and raises many questions regarding the sustainability of healthcare financing on both the societal and individual level. In Singapore, ElderShield is a long-term care insurance scheme that pays out (S\$400 per month) for a maximum period of six years for those with severe disability, to ensure long-term financial sustainability of ElderShield. This encompasses only basic financial protection for long-term care. Individuals may also purchase supplements for additional coverage on this scheme. From 2020, the plan will be replaced with CareShield Life, which removes the six years cap and will provide lifetime cash payouts for an individual with a severe disability. In addition, the payout will be increased to between S\$600 and \$1,200.

The recent proliferation of long-term care, technological improvement and availability of assistive devices may have contributed to a large reversal in later life functional outcomes. [17] However, not all can afford technological improvements or invest in healthcare [18], and this necessitates universal long-term care insurance schemes to hedge the public against later life functional disability. Hedging against potential financial risks in long-term care is important as long-term care represents a vast proportion of old-age spending. Elders may be present-bias, thus not able to evaluate eventual frailty or disability, events that happen with low probability but high-cost (similar to the onset of chronic diseases). They may also avoid paying for long-term care insurance and rely on family members to provide support later in life or utilise other informal care services. [19] Literature also suggests that long-term care may be essential for individuals who are severely disabled, helping them improve their quality of life and mental health, and delay mortality through various integrated long-term care programmes [20-22]. However, those who are in poor health are more likely to be unable to afford health and long-term care to improve living in old age. [23-25] In addition, females tend to have a lower lifetime income compared to males, are also more likely to live longer and possess experience functional disability later in life. [26] This begs the question of whether long-term care insurance achieves sufficient coverage among different groups within the Singapore healthcare system.

In this paper, a historical national population of individuals admitted to community hospitals was studied. We analysed how time to mortality changes on discharge for individuals of different functional disability counts, and adjusted for economic, sociodemographic and health status. Higher hazard ratios were associated with individuals who are male, more functionally disabled, Malay, have a greater comorbidity burden and higher subsidy ward. We discuss our findings in the context of ElderShield and CareShield and the low long-term care coverage in Singapore among disabled elders.

2. Methods

2.1 Study Population

There were a total of 19,360 community hospital admissions between 1996 and 2005, of which 17,046 were rehabilitation admissions. We excluded 2,604 (15.3%) second or subsequent admissions. A total of 14,442 unique patients with rehabilitation admission were extracted. Among them, 1,638 patients (11.3%) had either missing admission or discharge disability status. The final cohort consisted of 12,804 patients (**Appendix figure 1**), of whom

4,239 (33.1%) were alive at the end of the study. Community hospitals are rehabilitation hospitals that cater to patients who are fit for discharge from acute hospitals but require inpatient convalescent or subacute rehabilitative care before returning to a final domiciliary site. Inclusion criteria for this study were the first admission to community hospitals for inpatient rehabilitation from acute functional disability (e.g. stroke and hip fractures) and functional disability assessed at discharge.

2.2 Covariates

Covariates were controlled to elicit the specific effects of time to mortality upon discharge including sociodemographic variables such as age, gender (female, male), ethnicity (Chinese, Malay, Indian, others), marital status (single, married, widowed, separated or divorced), the Charlson comorbidity index (CCMI) group (0, 1-3, 4-6 and 7+), subsidy ward class and length of hospital stay. Hospitalisation subsidy level served as a proxy measure for socioeconomic status (SES). In Singapore, 81% of public hospitals' beds (B2 and C class) are highly subsidised. [27] B2+and B1 class lower subsidy and A class have no subsidy.

Comorbidity burden was measured using the CCMI. [28] Comorbidity data were manually extracted by trained medical practitioners by reviewing the patients' medical problem list and medical records. The CCMI measures the severity of medical illnesses and comprises of 19 different categories. The overall CCMI score is a sum of weighted scores of diseases. A higher score reflects an individual's greater cumulative disease burden. We categorised index scores into four groups: no comorbidity (0), low comorbidity (1–3), moderate comorbidity (4–6) and high comorbidity (7–16). The Charlson comorbidity score also has been shown to have high inter-rater reliability of a kappa score of 0.93. [29]

2.3 Exposures of interest

The number of functional disabilities was measured according to activities of daily living (ADL) measurements at discharge. These include an individual's ability to conduct washing, feeding, toileting, mobility, transferring and dressing. As individuals only qualify for ElderShield with three or more functional disabilities, we classified individuals with the number of disabilities to be 0, 1, 2 and 3+. We defined those with one disability as having a mild disability, two disabilities as moderate disability, and having three or more disabilities as a severe disability. For bivariable analyses, Chi-square tests were performed for categorical variables, Kruskal-Wallis tests for the length of stay and ANOVA test was performed for age across disability groups.

2.4 Outcome of interest

Survival time from discharge was computed by taking the difference of date of discharge with the time of death from the Ministry of Health death registry. All study subjects were censored on 31 December 2011. Survival status was cross-referenced with Singapore's National Death Registry. As ElderShield subsidy cutoffs at six years, we also recategorised survival time to 6 years or more and less than six years among those who died.

2.5 Multivariable Analysis

Cox proportional-hazards regressions were run with the severity of ADL disability, gender, age, race, marital status, subsidy ward class and comorbidity burden added to our specification sequentially. This was done to identify predictors of mortality. Schoenfeld residuals were used to test the proportional hazards (PH) assumption after model fitting. Stratifying factors such as primary diagnosis at admission, community hospitals and year of admission were included in the Cox model. All analyses were performed using STATA version 13 (StataCorp LP, USA) with the significance level set at 0.05. Statistical significance for all analysis was set at 5% level.

3. Results

Bivariable analysis was conducted on the severity of functional disability and was found to be statistically significant by length of stay, ethnicity, comorbidity burden, subsidy ward class and marital status. The sample length of inpatient stay was 32 days. Patients with mild disability had higher inpatient length of stay of 34 days. In addition, patients who were more likely to have severe functional disability were males (24.4% vs. 22.7%, $p=0.036$), Malays compared to the Chinese (31.5% vs. 22.7%, $p<0.001$), had greater comorbidity burden (6.9% vs. 3.7% for severe vs no comorbidity burden, $p<0.001$), were admitted to lower subsidy ward (21.2-32.2% vs. 18.2% in Class A – B2+ vs Class B2, $p<0.001$), married compared to the singles (25.4% vs. 13.3%, $p<0.001$). There was no significant difference in the mean age ($p=0.216$) across disabled groups. These results stratified by gender was reported in **Appendix Table 1a and 1b**.

Table 1: Characteristics of patients by severity of functional disability

Variables	Severity of ADL disability					P-value
	Total (n=12804)	No (0) (n=6845)	Mild (1) (n=1361)	Moderate (2) (n=664)	Severe (3+) (n=2997)	
Age (Years), Mean (SE)	73.0(11.5)	72.3(11.6)	73.5(11.6)	74.9(11.0)	74.5(11.4)	0.216 ^a
Length of Stay, Median (IQR)	32(20-47)	31(21-47)	34(23-49)	31(18-46)	31(17-49)	<0.001 ^b
Ethnicity, n (%)						
Chinese	11293 (88.1%)	6738 (59.7%)	1335 (11.8%)	653 (5.8%)	2567 (22.7%)	<0.001 ^c
Malay	848 (6.6%)	395 (46.6%)	115 (13.6%)	71 (13.6%)	267 (31.5%)	
Indian	518 (4.1%)	289 (55.7%)	66 (12.7%)	32 (6.2%)	132 (25.4%)	
Others	145 (1.1%)	90 (62.5%)	16 (12.0%)	7 (6.0%)	31 (23.4%)	
Gender, n (%)						
Male	5341 (41.7%)	3076(57.6%)	624(11.7%)	338(6.3%)	1303(24.4%)	0.036 ^c
Female	7463 (58.3%)	4436(59.4%)	908(12.2%)	424(5.7%)	1694(22.7%)	
Comorbidity burden, n (%)						
No (0)	2377(18.6%)	1745(73.4%)	263(11.1%)	87(3.7%)	282(11.9%)	<0.001 ^c
Mild (1 to 3)	5878(45.9%)	3463(58.9%)	717(12.2%)	374(6.4%)	1324(22.5%)	
Moderate (4 to 6)	4012(31.3%)	2035(50.7%)	472(11.8%)	265(6.6%)	1240(30.9%)	
Severe (7 +)	537(4.19%)	269(50.1%)	80(14.9%)	37(6.9%)	151(28.1%)	
Subsidy ward class, n (%)						
No/low (A - B2+ class)	1207(9.4%)	716(59.3%)	161(13.3%)	74(6.1%)	256(21.2%)	<0.001 ^c
Moderate (B2 class)	4478(35.0%)	2318(51.8%)	455(10.2%)	259(5.8%)	1446(32.3%)	
High (C class)	7119(55.6%)	4478(62.9%)	916(12.9%)	430(6.0%)	1295(18.2%)	
Marital status, n (%)						
Single	1099(8.6%)	798(72.6%)	109(9.9%)	46(4.2%)	146(13.3%)	<0.001 ^c
Married	5483(42.8%)	3086(56.3%)	649(11.8%)	358(6.5%)	1390(25.4%)	
Widowed	5853(45.7%)	3373(57.6%)	736(12.6%)	344(5.9%)	1400(23.9%)	
Separated/Divorced	369(2.9%)	255(69.1%)	38(10.3%)	15(4.1%)	61(16.5%)	

^a ANOVA test; ^b Kruskal-Wallis; ^c Chi-square test

We found statistically significant differences among various covariates and mortality (**Table 2**). Mortality risk was significantly associated with older age, a longer length of hospital stay, worse functional disability, ethnicity, gender, CCMI score and higher subsidy ward class. Those with lower mortality risk were females compared to males (64.9% vs. 69.7%, $p<0.001$), had a shorter length of stay, Chinese compared to Malay (66.9% vs. 69.1%, $p=0.009$), had lower comorbidity burden (53.4% vs. 83.1% in 0 vs. 7+ CCMI score, $p<0.001$), had no functional disability compared to those

with severe disability (58.7% vs. 82.5%, $p<0.001$). Old age was strongly associated with mortality ($p<0.001$). We found no significant difference in marital status across groups ($p=0.388$).

Table 2: Characteristics of patients by time to mortality

Variables	Mortality					P-value
	Total (n=12804)	Died at time of censoring (n=8565)	Died, ≥ 6 years after admission (n=2034)	Died, < 6 years after admission (n=6531)	Alive with ≥ 6 years after admission (n=4249)	
Age, mean (SE)	73.0(11.5)	75.6 (10.3)	73.6 (10.1)	76.3 (10.2)	67.7 (12.2)	$<0.001^a$
Length of Stay, median (IQR)	32(20-47)	32(20-48)	34 (21-51)	31 (19-47)	31 (20-46)	$<0.001^b$
Severity of disability, n(%)						
No (0 ADL disability)	7512 (58.7%)	4406(58.7%)	1195(15.9%)	3211(42.7%)	3106(41.3%)	$<0.001^c$
Mild (1 ADL disability)	1532 (11.9%)	1077(70.3%)	256(16.7%)	821(53.6%)	455(29.7%)	
Moderate (2 ADL disabilities)	763 (6%)	608(79.7%)	106(13.9%)	502(65.8%)	155(20.3%)	
Severe (3+ ADL disabilities)	2997 (23.4)	2474(82.5%)	477(15.9%)	1997(66.6%)	523(17.5%)	
Ethnicity, n(%)						
Chinese	11293 (88.1%)	7555(66.9%)	1833(16.2%)	5722(50.7%)	3738(33.1%)	0.009 ^c
Malay	848 (6.6%)	586(69.1%)	108(12.7%)	478(56.4%)	262(30.9%)	
Indian	518 (4.046%)	332(64.1%)	70(13.5%)	262(50.6%)	186(35.9%)	
Others	145 (1.07%)	92(63.4%)	23(15.9%)	69(47.6%)	53(36.6%)	
Gender, n(%)						
Male	5341 (41.7%)	3721(69.7%)	726(13.6%)	2995(56.1%)	1620(30.3%)	$<0.001^c$
Female	7463 (58.3%)	4844(64.9%)	1308(17.5%)	3536(47.4%)	2619(35.1%)	
Comorbidity Burden, n(%)						
No (0)	2377(18.6%)	1270(53.4%)	354(14.9%)	916(38.5%)	1107(46.6%)	$<0.001^c$
Mild (1 to 3)	5878(45.9%)	3886(66.1%)	972(16.5%)	2914(49.6%)	1992(33.9%)	
Moderate (4 to 6)	4012(31.3%)	2963(73.9%)	662(16.5%)	2301(57.4%)	1049(26.1%)	
Severe (7 +)	537(4.2%)	446(83.1%)	46(8.6%)	400(74.5%)	91(16.9%)	
Subsidy Ward Class, n (%)						
No/low (Class :A - B2+)	1207(9.4%)	783(64.9%)	245(20.3%)	538(44.6%)	424(35.1%)	$<0.001^c$
Moderate (Class: B2)	4478(35.0%)	3117(69.6%)	876(19.6%)	2241(50.0%)	1361(30.4%)	
High (Class: C)	7119(55.6%)	4665(65.5%)	913(12.8%)	3752(52.7%)	2454(34.5%)	
Marital status, n(%)						
Single	1099(8.6%)	581(52.9%)	154(14.0%)	427(38.9%)	518(47.1%)	0.388 ^c
Married	5483(42.8%)	3544(64.6%)	823(15.0%)	2721(49.6%)	1939(35.4%)	
Widowed	5853(45.7%)	4238(72.4%)	1010(17.3%)	3228(55.2%)	1615(27.6%)	
Separated/Divorced	369(2.9%)	202(54.7%)	47(12.7%)	155(42.0%)	167(45.3%)	

^a ANOVA test; ^b Kruskal-Wallis; ^c Chi-square test

Adjusting for all other confounders, individuals with higher ADL disability counts have a higher hazard ratio (HR: 1.28,1.76,2.09 for mild, moderate and severe disability respectively compared to those with no disability), Malay had higher hazard ratio compared to Chinese (HR:1.13), being in a higher subsidy ward class (HR: 1.13 and 1.41 for moderate and high subsidy respectively compared to no/low subsidy) and had greater comorbidity burden (HR: 1.33,

1.74, 2.74) for mild, moderate and severe comorbidity burden respectively compared to those with no comorbidity burden).

Table 3. Cox proportional hazards regression of survival time

Variables	Outcome: Survival Time		
	Hazard Ratio [¶]		
	Model (1)	Model (2)	Model (3)
Severity of disability			
No disability	1.00	1.00	1.00
Mild (1 ADL disability)	1.33 (1.24,1.43)***	1.33 (1.24,1.43)***	1.28 (1.20,1.38)***
Moderate (2 ADL disabilities)	1.84 (1.68,2.01)***	1.83 (1.67,2.00)***	1.76 (1.60,1.93)***
Severe (3+ ADL disabilities)	2.22 (2.09,2.36)***	2.20 (2.07,2.33)***	2.09 (1.97,2.22)***
Race			
Chinese		1.00	1.00
Malay		1.16 (1.06,1.27)**	1.13 (1.04,1.24)**
Indian		0.99 (0.88,1.11)	0.95 (0.84,1.06)
Others		0.91 (0.73,1.13)	0.91 (0.73,1.14)
Marital Status			
Single		1.00	1.00
Married		1.18 (1.07,1.30)***	1.11 (1.01,1.23)*
Widowed		1.45 (1.31,1.60)***	1.37 (1.25,1.52)***
Separated/Divorced		1.11 (0.94,1.32)	1.08 (0.91,1.28)
Subsidy Ward Class, n (%)			
No/low (Class: A - B2+)		1.00	1.00
Moderate (Class: B2)		1.11 (1.02,1.21)*	1.13 (1.04,1.23)**
High (Class: C)		1.38 (1.26,1.50)***	1.41 (1.29,1.53)***
Comorbidity Burden			
No (0)			1.00
Mild (1 to 3)			1.33 (1.24,1.43)***
Moderate (4 to 6)			1.74 (1.60,1.89)***
Severe (7+)			2.75 (2.42,3.12)***

* 0.05 <P-value ≤ 0.1; ** 0.001 < P-value < 0.05; *** P-value < 0.001

[¶] Hazard ratios were reported using Cox proportional hazard model. Models were stratified based on primary diagnosis at admission, gender, age group, community hospitals and year of admission. Multivariate models are adjusted for confounders such as ethnicity, marital status, subsidy ward class and the Charlson Comorbidity index.

Figure 1 plots the Kaplan-Meier unadjusted survival probability by ADL disability severity, which showed that the lines did not cross. There were differences in survival probabilities for individuals with no and mild disability versus those with moderate disability (two disabilities) and severe disability (three or more ADL disabilities).

4. Discussion

Our results indicated that individuals with ADL disability have a higher hazards ratio compared to individuals with no ADL disability. Furthermore, we identified other covariates which may lead to quicker mortality onset. These include being in a minority race (Malay), being male and admitted to a higher subsidy ward class. This confirms previous studies on ADL disability, ethnicity, gender and socioeconomic status as drivers of mortality onset. [25, 30-32]

However, we found that of survival after discharge for elders with a moderate disability to be comparable to elders with a severe disability after discharge. This has possible implications on long-term care policies in the context of ElderShield and CareShield Life, as both disability insurance schemes use severe ADL disabilities as the qualifying criteria for payout. While the CareShield Life Plan achieves more coverage than ElderShield, the payment into the plan

also increases. Nevertheless, ensuring fiscal sustainability and affordable premium is challenging for any government, especially with Singapore's rapidly ageing demography.

Our study also indicates that females tend to survive longer than males controlling for ADL disability status (**Appendix Figure 2**). This is consistent with existing literature reporting that disabled females require more physical assistance as they live longer compared to disabled males.[33] In all OECD countries, both genders have made huge gains in life expectancies – someone born now can expect to live for ten years longer than someone born 50 years ago.[34] In virtually all countries, life expectancies at birth are higher for women than for men. For the world as a whole female life expectancy is currently about 6% higher than for men.[35] Differences in longevity can in part be explained by their different behavioural, lifestyle and working patterns. Women are also thought to have a possible genetic advantage which makes them more resistant to a range of conditions.[35] Nevertheless, while women benefit from longer lives, they tend to live longer in poorer health in their old age. Furthermore, females tend to have lower labour force participation as well as lower pay in their time within the labour force. [5] However, both males and females receive the same payouts from the long-term care insurance schemes in Singapore. The issue is exacerbated with limited time payouts for ElderShield, which only covers disabled individuals for six years. This might not be socially optimal as they receive less income over time and require more assistance for long-term care in an equivalent portion of time compared to males. Disparities may even persist within preventive care for females and socioeconomically disadvantaged individuals [36, 37]. Targeted policy formulation should factor gender disparities in comorbidities, functional disability and financial inputs into long-term care insurance. This will facilitate maintenance of functional and health status, as well as productive participation within society. [38] Access to healthcare services and preventive care are the first steps to retaining function and health as this makes a positive difference in healthy longevity and disability-free lifespan among elders. [39] Integrated long-term care as a secondary measure allows elders to retain independence, reduce hospitalisation utilisation and may even reverse functional disability among elders. [40, 41] However, our results indicate that although Singapore's long-term care insurance requires equivalent input and provide equivalent assistance among people with three or more disabilities, the marginal effort required for different groups may be different and assistance given for groups may vary across time.

Limitations

Usage of retrospective data and data incompleteness may have led to data entry biases in the dataset. As follow-up data were not available, the relationship with long-term care insurance cannot be worked out explicitly. Furthermore, the study was limited to investigating variables that the database included and did not consider other factors may also affect time to mortality (e.g. cognition, mental health, quality of life and healthcare decision making). Using subsidy ward class as a socioeconomic indicator may not be an exact proxy, but at most introduces random error to our model specification. As ADL disability was measured at the time of discharge, we were unable to update disability status. However, an argument against the insufficiency of coverage among individuals still holds as elders staying in the community tend to live longer compared to those who had been in an institutionalised setting. Our study underestimates the burden of disability as elders in a nursing home were not routinely captured. Finally, the study was completed in an Asian population within a developed economy and an advanced healthcare system. Generalising these findings to Western populations should be done with care.

Conclusion

To the best of the author's knowledge, this is the first study in South-East Asia which addresses ADL disability by counts and time to mortality after discharge for elders. Our results indicated that individuals with ADL disability might be living longer. This has possible implications on long-term care policies in the context of ElderShield insurance as it

uses severe ADL disabilities as the criteria for payout, capped at six years. In 2020, Singapore expanded to CareShield Life with lifetime cash payout if severely disabled. In this paper, we put our results in the context with possible implications for long-term care insurance within Singapore, one of the fastest ageing countries in the world. We conclude that the expansion of coverage from six years to life is timely as Singaporeans are living longer and disability risk increases with age. These payouts will be helpful for the disabled elders and their family, protecting them against some financial risk.

Abbreviations

ADL: Activities of daily living; LTC: Long Term Care; HR: Hazards Ratio; ANOVA: Analysis of Variance; CCMI: Charlson comorbidity index

Declarations

Declarations

All authors have read and approved submission of the manuscript. Material in the manuscript has not been published and is not being considered for publication elsewhere in whole or in part in any language except as an abstract. All persons mentioned in the acknowledgment have seen and approved mention of their names in the article.

Ethics approval and consent to participate

The study was approved by the National University of Singapore Institutional Review Board (NUS-IRB) and ethics committees of Ang Mo Kio Thye Hua Kwan Hospital, Bright Vision Hospital, St Andrew's Community Hospital and St Luke's Hospital. Written informed consent of the patient was waived by approving NUS-IRB. The corresponding author and all research nurses have taken the oath of confidentiality under Singapore's Official Secrets Act, and only the minimum number of research personnel had access to the de-identified dataset.

Consent for Publication

Consent from participants will be obtained to publish the results from de-identified data.

Availability of data and material

Participants' data (e.g. case record forms, and consents) will be stored in a locked cabinet in a researchers' office. All data will be destroyed by researchers within five years after publications. During the study, only de-identified data will be used, and the data will only be accessible to the research team.

Competing interests

The authors do not have conflicts of interest to report.

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Authors' contributions

CC, and JTL developed the study concept. GK and NPF developed study design. GK, AC, NPF, BYT, EM, CHE, KMC, and KKL acquired the data. CC and JTL performed statistical analysis. CC, CNC, JTL, LW, MZC, SM, KBT and GK interpreted the results. CC and JTL drafted the manuscript. All authors revised the article critically and gave final approval for publication. None of the authors declared a conflict of interest.

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Figures

Figure 1

Kaplan–Meier survival probability by ADL disability. Figure 1 illustrates survival probabilities across time, by ADL disability using Kaplan–Meier curve. Severity of disability: No disability= 0 ADL disability (dotted line), Mild disability= 1 ADL Disability (dash line), Moderate disability= 2 ADL Disabilities (long-dash line), Severe disability= 3 or more ADL disabilities (solid line)

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