

HEALTH SERVICES & OUTCOMES RESEARCH



ANNUAL REPORT **2022**

FOREWORD

Vision

.....

To add years of healthy life to the people of Singapore through excellence in Health Services Research.

Mission

.....

To improve the value of healthcare by providing best available evidence for decision making and knowledge translation; and build capacity and advance knowledge in Health Services Research.

Year 2022 saw the nation living with Covid-19; and Ministry of Health (MOH) announcing the launch of Healthier Singapore, which aims to entrench a strong relationship between a resident and his primary care doctor through population health management.

In the past decade, 'Population Health' (Management) has had policy makers and providers expanding their vision, scope and care from patients to residents. MOH reformed the funding of institutions through capitation, where healthcare clusters are funded based on the size and age profile of their resident population, removing elements of volume-based funding. The department continues to support discussions on developing tools for capitation, and monitoring cost growth rate, volume of patients and residents seen over time.

To reduce the cost growth rate further, we analysed cost savings solutions by identifying high risk patients to avoid hospital admissions and re-admissions, or emergency need. A literature review showed that telephone triage may avert some emergency cases by right-siting patients. Rigorous evaluation of a continued coordinated geriatric care programme for frail patients presenting at an emergency department found it to reduce re-admissions.

In preventive health, routine administrative data strengthened the association between higher physical activity in healthy adults and improved cardio-metabolic performance, as well as precursors of prediabetes and diabetes. With the growing interest in mental health and wellbeing, we also studied depression and social isolation and their implications. Aside from impacting health outcomes, depressed and socially isolated adults have much lower productivity at work. Patients with strong family support who have had a major healthcare adversity recover better, while patients with depressive symptoms may default on medication compliance.

Annual deaths are rising from an ageing population, a result of the high births of early years. This has a significant impact on end-of-life care. Honouring people's wishes to die at home, away from the hospital, and expanding capacity for end-of-life care have significant barriers and feasibility challenges. There are also challenges in initiating Advance Care Planning (ACP) discussions, more so at nursing homes with cognitively impaired residents. An evaluation of a training curriculum



showed improved knowledge, attitudes and confidence in nursing home clinical staff to initiate ACP discussions on goals of care with residents and their families. At the hospital, prognosticating mortality in patients with end-stage organ disease complemented current palliative referral processes by attending physicians. A home ventilation service has reported improved quality of life for patients while reducing dependency on hospital care.

We hope you find these articles useful as we continue to find evidence behind decision making to add years of healthy life to the people we serve.

PROF JASON CHEAH

Deputy Group Chief Executive Officer
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National Healthcare Group

 **COMMENTARY**

 **LIVING WELL**

 **LIVING WITH ILLNESS**

 **CRISIS & COMPLEX CARE**

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COMMENTARY



CHATGPT: WHERE DO WE GO FROM HERE?

Teow Kiok Liang

HIGHLIGHTS

- Analysts can leverage new technology, such as ChatGPT to augment their research work, but not 'outsource' their brains to them.
- Analysts can 'beat' these tools by understanding stakeholders' deep concerns, contextualising and framing the problem better, and finally developing an informed recommendation tailored to stakeholders.

Preface

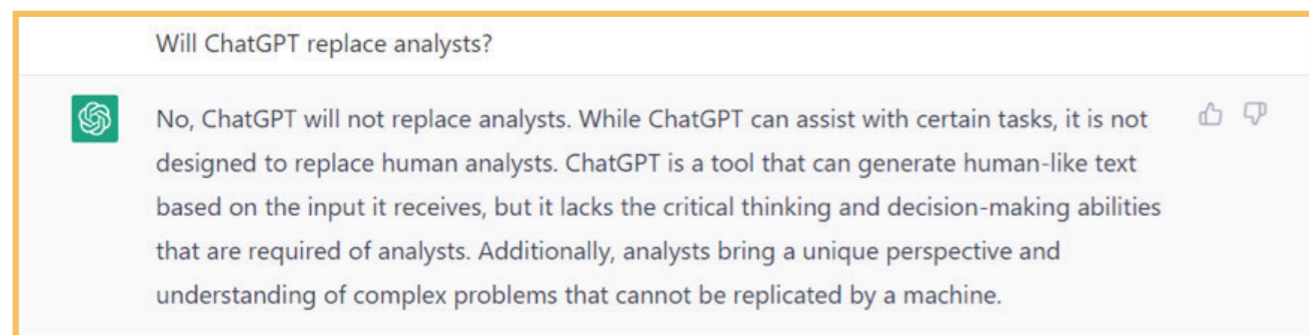
This article was penned in early February 2023. By the time it is published, researchers should be using ChatGPT or its equivalent widely. There will already have been lengthy discussions on the strengths and weaknesses of these tools, how they may threaten the existence of many jobs, and how humans can embrace this technology and move on. This will not be an unfamiliar scene when we reflect on the past.

My question is, as a research analyst, what is our value proposition with such tools? I hope some ideas presented here can endure the rapid development in this Artificial Intelligence space.

Introduction

The fear of machines taking over human job-roles is not a recent one, as seen from previous experiences with development of computers, software and robots. Searching for information became much easier when we moved from spending time in a library to sitting in front of a computer. ChatGPT (and other similar programs) may bring another revolution. Among other tasks, it integrates information in a coherent manner, adapts its answers to open-ended questions posed by users, thereby providing the same level of interactivity as a person. Or almost? These are similar tasks expected from a research analyst. So will analysts be replaced? ChatGPT said "No" (Figure 1, produced on 15 Feb 2023).

Figure 1. A response from ChatGPT



As analysts, we can use ChatGPT to search for information, write a piece of computer code, or generate an introduction for a report, among other tasks. Similarly our stakeholders who are asking the research question will do the same. The bar of baseline knowledge has been raised.

While ChatGPT can be a good companion, it should still subject to scrutiny, akin to how occasionally a good friend's advice can go wrong. The decision and responsibility of providing the final answer still lies with us.

So are there areas where ChatGPT cannot (presently) do while we can? I think, the biggest advantage that we have over ChatGPT is: as a person we can ask, probe and frame the right questions; while ChatGPT can only respond to questions framed and posed. Below are my elaborations on what we should do more.

Communicate with stakeholders.

Human-human communication has shifted from face-to-face, to voice call, and now typing. ChatGPT can give precise answers to questions, but the strong advantage we have is that we can be more interactive with the stakeholder. For instance, we can use analogies from a subject matter that are relatable to stakeholders to put across a clearer message. We can listen deeper, sense nonverbal cues, and probe stakeholder's concerns, allowing us to refine the study. Ultimately, we build understanding, relations and trust. Perhaps one day ChatGPT shall have a face, and a prettier one than us. But at least till now, clear communication with stakeholders still requires a level of back-and-forth dialogue that humans can provide better.

Know the context, space- and time- wise.

With a better understanding of the stakeholder's concern, we can better research around the context. A solution can be appropriate in a city-setting, but not in a rural area; suitable for a Caucasian population but not an Asian one; or requires tweaking across different healthcare systems and philosophies. This might be the first time an approach has been proposed; or it has been tried and dismissed for various reasons. Analogous to a doctor's clinical practice in knowing a patient's history and preferences, knowing the space and time dimensions of the issues help to provide tailored solutions.

Frame the issue in a systems perspective.

Is the question presented only part of the elephant? Is this the "right" question to address? Can we connect the dots so that we get a fuller picture? Take a broader view of the issue first, then zoom back. There are many techniques available to help look at issues more holistically, such as the 5 Whys, Systems Thinking, or Mutually Exclusive and Collectively Comprehensive (MECE). While ChatGPT may provide a precise answer to a problem posed, we can do better by seeking out the right questions and framing the question right.

Develop insight and make a stand.

ChatGPT can provide politically correct answers, or agree with you, but gives the caveat that it is a mere natural language processing model. Finally it asks you to check with a human specialist. A piece of good analysis is not just an exercise of copying and assembling information in a coherent manner. At the end of our study, we should develop insights into what factors are important, what can be thrown away; why the results are as such. We can claim full understanding of the subject matter only if we can provide a succinct summary, or give an analogy to simplify a subject matter. Finally, we should aim towards making a justified recommendation, rather than sitting on the fence.

Conclusion

As Sun Tzu said many years ago, knowing the enemy and yourself will get you unscathed through a hundred battles. Knowing how to leverage on modern-day tools to augment insights a human analyst can provide will ensure that our capabilities and relevance will endure in face of the inevitable challenges in time to come.



DYING AT HOME MAY NOT BE SO SIMPLE

Dr Tan Woan Shin

HIGHLIGHTS

- A person's final place of death is a complex interplay between individual characteristics, nature of the illness, discharge processes, palliative care policies, and societal perceptions of the desired place of death.
- A multifaceted approach, including improvements in the organisation, coordination, and delivery of health care, must be taken to support the processes involved in dying at home.

Background

With a rapid ageing population, the issue of where people prefer to die, is an important item on the Singaporean healthcare agenda. Socio-demographic changes, such as smaller family sizes and longer life expectancies, together with growing perceptions that hospitals provide higher quality end-of-life care, has halved the share of home deaths from 45% in 1970 to 23% in 2019 with corresponding increases in hospital deaths from 51% to 62%.

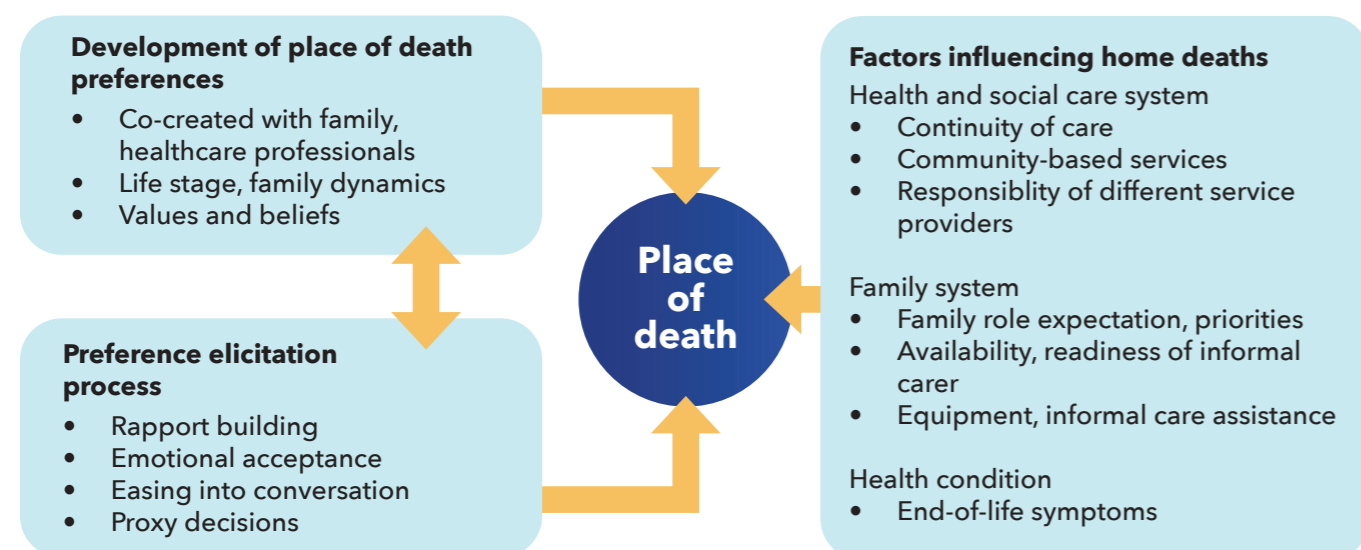
Where do people prefer to die?

Home is a place where meaningful and intimate time with our loved ones can be shared, and allows individuals to maintain greater independence and control over their way of life. This helps to achieve a sense of completion at the end-of-life.¹

Qualitative evidence indicates that family dynamics and role expectations feature strongly in the decision-making process regarding end-of-life care preferences. The preference for place of death is heavily negotiated and co-constructed by the patient, their families and healthcare professionals while, considering what is practical and affordable. Frequently, families also believe that better care can be provided by the hospital.²

It is widely believed that most individuals would naturally want to spend our final days at home. However, Singaporean studies have found that only 40% - 64% of seriously ill individuals held this preference,³⁻⁵ and approximately, 1 in 5 do not express any specific preference on place of death. Preferences may also evolve over time. Among individuals who preferred to die at home, 1 in 2 managed to do so.²

Figure 1. Preference elicitation and home death factors



Why is it so hard to achieve a home death?

Ultimately, the final place of death is a result of a complex interplay between the nature of the illness, discharge processes, caregiver readiness, palliative care policies, and societal perceptions of the desired place of death.

Proponents of advance care planning (ACP) have encouraged patients, families and healthcare professionals to discuss about end-of-life care wishes. Indeed, based on a large decedent cohort study (n=75,650), having a documented home death preference via ACP and receiving palliative care independently increased the odds of home deaths by 3.6 and 6.9 times respectively.⁶ However, ACP completion rates in Singapore are low, and referrals to palliative support only occurs in the last weeks and months of life. Uncertainty surrounding prognostication have also inhibited clinicians from also initiating difficult conversations and from involving palliative care support.

Family support influences the ability to die at home. Transiting between acute care settings and the home can be challenging for caregivers. The healthcare system must provide support for familial caregivers by equipping them with practical nursing skills to support care at home, and at the same time make home hospice care more available. Home palliative care teams can help to reassure family members by being present, and by providing skilled home care. However, it takes time to train more doctors, nurses and para-professionals. In the short-term, resources to provide formal care to support dying at home may be limited. Rapid emergence and growth in alternative end-of-life care and caregiving models is needed to reverse the current trend of hospital deaths.

In Singapore, financial factors also heavily influence the decisions made for end-of-life care as a significant proportion of healthcare is being paid for out-of-pocket. Amidst a fast-ageing population and sharp rises in the old-age dependence ratio, age-in-place and dying-in-place policies may unintentionally raise the costs for the family, thus requiring trade-offs to be made. It can be challenging for families to balance preferences for end-of-life care against what they can reasonably afford.

Conclusion

A multifaceted approach, including improvements in the organization, coordination, and delivery of health care, is needed to address the steep decline in the proportion of deaths at home over the last five decades. A home death may expose the patient to the risk of poor or unsafe care in the absence of widely accessible, inexpensive home care provision and prompt access to equipment. To prove that the home environment promotes a better and more dignified death, systematic monitoring and evaluations should be done moving ahead.

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 **COMMENTARY**

 **LIVING WELL**

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 **CRISIS & COMPLEX CARE**

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LIVING WELL

SOURCE AND ROLE OF SOCIAL SUPPORT IN HEALTH RESILIENCE

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HIGHLIGHTS

- The four main pillars of support relied upon by individuals adapting to health adversity were found to be 1) family as an anchor, 2) peer group encouragement, 3) workplace empathy and security, and 4) spirituality and religion.
- Family provided key holistic support during recovery and was essential in minimising the negative effects of health adversity.

Introduction

Social support has been reported to be a major protective factor of health resilience. However, there is limited understanding on the perceived roles and sources of social support tapped on by community dwelling adults as they cope and overcome health adversities. In this study, we explored the perceived sources and role of social support relied on by adults during health-related adversities.

Methods

A descriptive phenomenological research design was employed. The study team conducted the interviews based on an interview guide. The interview guide enabled the study team to elicit narrative information from individuals on their experiences preparing for health adversities and their perceived social support or resources that supported them as they overcame their health adversity. Purposeful sampling was conducted to collect in-depth information from community-dwelling adults across various age groups (21-34 years old; 35-44 years old; 45-64 years old and ≥65 years old) who had experienced ill health. In-depth interviews were transcribed verbatim and analysed for themes related to sources and role of social support.

Results

51 participants took part in the in-depth interviews (**Table 1**). Four main themes and nine sub-themes describing the main sources and roles of social support emerged from our data analysis (**Table 2**).

One's family members played a vital role by providing practical support and companionship, and by actively making family-level lifestyle adjustments to support the individuals as they adopted new habits and norms. Similarly, peers helped to maintain the emotional well-being of individuals but this was confined to friends with similar shared experiences to prevent unsolicited advice.

Flexible work arrangements allowed individuals to balance the need to attend to their medical appointments while maintaining their jobs. Having job security provided individuals a sense of assurance and ensured financial security. Lastly, individuals may rely on their spiritual and religious beliefs to come to an acceptance of their illness, and to draw on spiritual and religious rituals to manage their stress and anxiety. Together, these four pillars of support and the roles it played created a conducive environment for individuals to adapt and overcome the challenges brought forth by the health adversities (**Table 2**).

Table 1. Profile of participants

Characteristics	n (%)
Age, years	
21-34	16 (28.6)
35-44	13 (23.2)
45-64	14 (25.0)
≥65	13 (23.2)
Gender, female	37 (72.6)
Ethnicity	
Chinese	36 (70.6)
Malay	6 (11.8)
Indian	5 (9.8)
Others	4 (7.8)
Marital Status	
Single	19 (37.3)
Married	25 (49.0)
Widowed	1 (1.9)
Divorced/ separated	6 (11.8)

Table 2. Four themes of roles of social support in health resilience

Themes	Description	Subthemes
Family as anchor	Information, instrumental and emotional support provided by family facilitated adoption to health challenges	1. Practical support and companionship 2. Empathetic support 3. Family lifestyle adjustment
Peer group encouragement	Encouragement and being understood during a period of increased vulnerability provided a sense of comfort and assurance	1. Companionship and encouragement 2. Shared perspective on health adversity 3. Privacy concerns
Workplace empathy and security	Job security and flexibility in work arrangements allowed recovery with a peace of mind	1. Support from colleagues 2. Job security 3. Flexibility in work arrangements
Spirituality and religion	Spirituality and religious teachings provided solace and solutions during a period of uncertainty	

Conclusion

Community-dwelling adults relied on various sources of social support when they meet a health adversity. Family played a central role in providing holistic support in recovery and mitigating negative effects of health adversity by providing assurance that they are being cared for. Our findings will support public health professionals to design programmes to strengthen and build social support network to further enhance health resilience.

THE SHAPE OF OGTT CURVES AND ITS CORRELATION WITH PHYSIOLOGICAL CHARACTERISTICS, METABOLIC PHENOTYPE AND EXERCISE PROFILE

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HIGHLIGHTS

- Insulin resistance, insulin sensitivity and insulin secretory function were higher for sedentary subjects than active subjects, regardless of the shape of OGTT curves.
- Significant differences in levels of several biomarkers were seen between monophasic and biphasic glucose curves in healthy subjects.
- A higher proportion of active subjects had biphasic OGTT curves compared to those in the sedentary group.

Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease. Many factors play important roles in the development of glucose intolerance in individuals with T2DM, such as impaired insulin secretion and insulin resistance. In practice, homeostatic model assessment for insulin resistance (HOMA-IR), Matsuda index (MI), triglycerides/high-density lipoprotein (TG/HDL) have been used to measure insulin resistance, while homeostatic model assessment for beta cell function (HOMA-B) has been used to measure insulin secretion. However, these indices have been noted to be indirect and not intuitive in application.

The oral glucose tolerance test (OGTT) has commonly been used to diagnose diabetes based on impaired fasting glucose and glucose tolerance. Recent studies have shown that the shape of the OGTT curves not only correlates with beta cell function and insulin resistance, but also differentiates diabetes risk, with individuals with a biphasic curve less likely to develop T2DM than those with a monophasic curve. Hence, in this study, we extend the analysis to focus on healthy subjects and examine the shape of OGTT curves and its correlation with physiological characteristics (e.g., HOMA-IR, MI, TG/HDL and HOMA-B), metabolic phenotype and exercise profile.

Methods

We analysed the data of habitually active and sedentary adults clinically assessed to be healthy (free from disease, medication, and treatment) through medical screening. None were obese or in a high-risk category of BMI for Asians. Their physical activity profiles were based on a self-declared 5-year history. Physical activity was defined as engaging in three or more sessions per week of moderate to vigorous-intensity exercises, for at least 45 minutes per session. Sedentary behaviour was defined as engaging in two or less sessions per week of light-intensity exercises, lasting no more than 30 minutes per session. Study subjects took the OGTT after an overnight fast, involving five time-points of blood samples at 0, 30, 60, 90, 120 minutes after ingestion of the glucose solution. The shape of the OGTT curves was identified based on the total number of stationary points of the smoothed glucose curve. HOMA-IR, MI and HOMA-B were calculated based on published formulae. Summary statistics were calculated using proportions for categorical data and means (SD) for continuous variables.

Results

A total of 179 subjects (50.3% females; 83.2% Chinese) were analysed, with 97 being active and 82 sedentary (mean age 46.4, 45.2 respectively). 157 subjects were of monophasic and biphasic OGTT curves. **Table 1** shows a higher proportion (25%) of active subjects having biphasic curves compared to sedentary subjects (18.8%). Also, there were significant differences in levels of several biomarkers between monophasic and biphasic OGTT curves. **Table 2** demonstrates that insulin resistance and beta cell function were higher in sedentary subjects in contrast to active subjects, regardless of the shape of the OGTT curves. Being physically active was associated with better insulin resistance and beta cell function amongst subjects with monophasic response but not those with biphasic response.

Table 1. Exercise profile and metabolic phenotype by the shape of glucose curves

Variables	Total (N=157)	Monophasic (N=122)	Biphasic (N=35)	p-value
Sedentary n (%)	69 (43.9)	56 (81.2)	13 (18.8)	0.44
Active n (%)	88 (56.1)	66 (75.0)	22 (25.0)	
BMI, mean (sd)	22.17 (2.79)	22.15 (2.87)	22.24 (2.53)	0.86
TC (mmol/l), mean (sd)	5.30 (0.98)	5.34 (1.00)	5.17 (0.92)	0.37
HDL (mmol/l), mean (sd)	1.74 (0.48)	1.72 (0.49)	1.82 (0.47)	0.26
LDL (mmol/l), mean (sd)	3.07 (0.77)	3.12 (0.8)	2.92 (0.67)	0.15
TC/HDL, mean (sd)	3.21 (0.85)	3.28 (0.89)	2.96 (0.65)	0.02
LDL/HDL, mean (sd)	1.86 (0.65)	1.91 (0.67)	1.68 (0.55)	0.04
TG (mmol/l), mean (sd)	1.07 (0.55)	1.1 (0.59)	0.94 (0.41)	0.07
TG/HDL, mean (sd)	0.71 (0.57)	0.75 (0.61)	0.58 (0.40)	0.07
SBP, mean (sd)	114.45 (10.86)	115.42 (10.70)	111.06 (10.85)	0.04
DBP, mean (sd)	69.65 (8.27)	70.3 (8.22)	67.4 (8.16)	0.07

BMI: body mass index; DBP: diastolic blood pressure; HDL: high-density lipoprotein; LDL: low-density lipoprotein; SBP: systolic blood pressure; TC: total cholesterol; TG: triglycerides

Table 2. Insulin resistance and beta cell function by the shape of glucose curves and exercise profile

Monophasic OGTT curve	Total (N=122)	Sedentary (N=56)	Active (N=66)	p-value
TG/HDL mean(sd)	0.75 (0.61)	0.85 (0.71)	0.66 (0.51)	0.10
HOMA-IR mean(sd)	1.29 (0.85)	1.51 (0.99)	1.10 (0.66)	0.01
Matsuda index mean(sd)	9.14 (6.26)	7.47 (4.60)	10.6 (7.14)	0.01
HOMA-B mean(sd)	76.97 (51.39)	92.13 (62.24)	63.91 (35.34)	0.00
Biphasic OGTT curve	Total (N=35)	Sedentary (N=13)	Active (N=22)	p-value
TG/HDL mean(sd)	0.58 (0.40)	0.79 (0.54)	0.46 (0.20)	0.07
HOMA-IR mean(sd)	1.20 (0.66)	1.46 (0.85)	1.04 (0.48)	0.18
Matsuda index mean(sd)	9.92 (4.50)	8.07 (4.41)	11.06 (4.25)	0.04
HOMA-B mean(sd)	82.6 (45.54)	98.32 (56.95)	73.31 (35.51)	0.19

HDL: high-density lipoprotein; HOMA-B: homeostatic model assessment for beta cell function; HOMA-IR: homeostatic model assessment for insulin resistance; OGTT: oral glucose tolerance test; TG: triglycerides

Conclusions

This study showed that, for healthy subjects, insulin resistance measured by HOMA-IR, TG/HDL and MI, and insulin secretory function, measured by HOMA-B, was higher in the sedentary group than in the active group, regardless of the shape of OGTT curves. A higher proportion of active subjects have biphasic curves than sedentary group, suggestive of a lower risk of developing pre-diabetes or T2DM, compared with sedentary subjects among those with biphasic OGTT curves.

 **COMMENTARY**

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LIVING WITH ILLNESS

GROWTH IN NUMBER OF PATIENTS UNDER NATIONAL HEALTHCARE GROUP AND ITS IMPLICATIONS ON CAPITATION

Dr Ang Yee Gary, Teow Kiok Liang

HIGHLIGHTS

- As Singapore moves to capitation payment, there is an increasing need to project the number of unique patients for future years to better prepare for budget projection.
- The growth in number of NHG patients is 4.6% per year for those living in NHG zones, and this is significantly higher than the 0.3% growth in the number of NHG residents.

Introduction

Capitation refers to a payment method in healthcare where a fixed amount is paid to healthcare providers for each enrolled patient, regardless of the actual number of services provided. The concept of unique patients is relevant to capitation payment because it affects the amount of money that providers receive. Healthcare organizations need to understand the flow of unique patients and the importance of projecting the growth of unique patients in a capitated health system. These would enable healthcare organisations to plan for the future, allocate scarce resources, and make decisions about staffing, facility expansion and other key aspects of healthcare delivery.

The inflow of new patients is affected by population screening that uncovers undiagnosed patients, health literacy levels, referral rates from private providers to publicly funded providers, and transfers from other publicly funded providers. On the other hand, the number of patients that are discharged/transferred to other providers or have defaulted follow-ups are affected by clinical practice and patients' choice and health beliefs. In this analysis, we aimed to determine the historical growth in number of unique patients in National Healthcare Group (NHG) institutions, as well as the growth in the number of residents living in NHG zones.

Methods

For this study, we looked at the unique patient count from 2015 to 2019 across Tan Tock Seng Hospital, Institute of Mental Health, Khoo Teck Puat Hospital, Admiralty Medical Centre and National Healthcare Group Polyclinics. We compared the growth rates in the number of unique residents living in NHG zones, and the number of unique patients attending NHG institutions and also living in NHG zones. We restricted the analysis to include only Singaporeans and Permanent Residents as they were eligible for subsidised care.

Results

Table 1 showed the number of unique patients in NHG institutions who were also living in NHG zones from 2015 to 2019. The number of residents in NHG zones increased from 1,548,000 in 2015 to 1,565,970 in 2019, or a cumulative annual growth rate of 0.3%. **Figure 1** showed the flow diagram for 1 year transition. The yearly increment was 4.6% for NHG patients living in NHG zones.

Conclusions

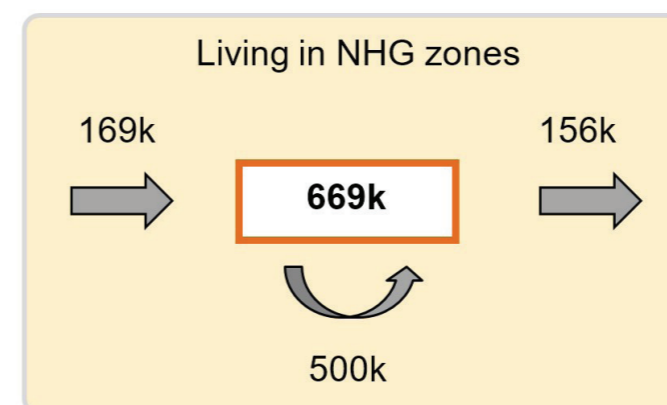
The yearly increment in NHG patients living in NHG zones was much higher than the increment in residents. As capitation is based primarily on the growth in number of residents living in the designated region that is much lower than patient growth, this may result in inadequate funding for healthcare institutions. The implication would be that for a sustainable healthcare system, we would need to slow the growth of patients to the same rate as the growth of residents, assuming no change in utilization per patient.

Table 1. Unique resident count, and patient count in NHG institutions among those living in NHG Zones (2015-2019)

	2015	2016	2017	2018	2019
Unique resident count	1,548,000	1,542,900	1,546,190	1,550,340	1,565,970
Year on Year increase (%)		-0.3	0.2	0.3	1.0
Unique patient count	559,974	586,555	624,450	656,065	669,227
Year on Year increase (%)		4.7	6.5	5.1	2.0
Age in years, Mean (SD)	45.8 (22.8)	45.8 (22.9)	46.3 (23.1)	46.6 (23.3)	47.1 (23.3)
Number of new patients (Not seen in the previous year)		171,342	184,676	181,121	169,111
Age in years, Mean (SD)		36.8 (21.1)	38.6 (22.0)	37.5 (21.7)	37.2 (21.5)
Number of discharged/ defaulted patients in the previous year		144,761	146,781	149,506	155,949
Age in years, Mean (SD)		38.9 (21.2)	38.7 (21.3)	38.5 (21.5)	38.5 (21.8)

SD: standard deviation

Figure 1. Flow Diagram for 1-year transition



NHG: National Healthcare Group

ASSOCIATION BETWEEN DOMAIN-SPECIFIC PHYSICAL ACTIVITY AND LIPID PROFILE IN A MULTI-ETHNIC ASIAN POPULATION: A LONGITUDINAL STUDY

Ge Lixia, Dr Saima Hilal¹, Dr Falk Mueller-Riemenschneider¹, Dr Tan Chuen Seng¹

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HIGHLIGHTS

- This study observed that different domains of moderate to vigorous physical activity (MVPA) had differential associations with lipid profile. Specific physical activity (PA) domains may need to be distinguished rather than assuming all to be protective against different lipids for future research.
- HDL-C is more likely to respond positively to MVPA, and favourable HDL-C could be potentially achieved by increasing leisure-time or occupational MVPA.

Introduction

Numerous cross-sectional studies have demonstrated the benefits of total physical activity (PA), leisure-time PA and the role of lipid profile in slowing the progression of cardiovascular diseases. Existing findings on different PA domains and lipid profile are varied and remain inconclusive. Currently, evidence from longitudinal studies of all four domains and their associations over time is lacking. Hence, this study aimed to examine the associations between each domain-specific PA and lipids with longitudinal data.

Methods

Participants who completed two waves of the Singapore Multi-Ethnic Cohort were included in this study (N=3950). Data of domain-specific moderate-to-vigorous PA (MVPA) were repeatedly collected using a validated PA questionnaire. The energy expenditure amount of each domain-specific MVPA (leisure-time, transportation, occupational, household) were calculated and categorized into four levels: No MVPA (T0), Low (T1), Middle (T2), and High (T3) MVPA. The latter three groups were derived by categorizing non-zero values into tertiles using the cut-offs derived from the initial wave data. The main outcomes were the three lipids, including low-density and high-density lipoprotein cholesterol (LDL-C, HDL-C), and triglycerides which were measured during the health screening at both waves.

The longitudinal association of each domain-specific MVPA with each lipid was examined using Generalized Estimating Equations (GEE, Gaussian distribution, identity link function, exchangeable working correlation), accounting for identified static factors (socio-demographics, smoking and drinking status, family history of heart disease, hypertension, and diabetes) and time-varying confounding factors (history of hypertension and high cholesterol, dietary pattern, body mass index, and the other three domain-specific MVPA).

Results

The mean age of participants was 45 years with over 60% aged between 40-60 years. Approximately 58% were females and 47% were Chinese. Around 24% were ever smokers and 41% were ever drinkers, close to 13% had hypertension and 19% had high cholesterol. About 5% participants did not engage in MVPA across all domains, and those that did not engage in domain-specific MVPA ranged from 23% with no household MVPA to 83% with no transportation and occupational MVPA (Table 1).

All four domains of MVPA were independently associated with HDL-C, but only leisure-time and occupational MVPA had positive and linear associations, with the estimated effects of the respective high MVPA corresponding to 0.030 mmol/L (95% confidence interval (CI): 0.015-0.045) (leisure-time) and 0.063 mmol/L (95%CI: 0.043-0.083) (occupational), when compared with no respective MVPA (Figure 1). Occupational and household MVPA exhibited a positive and linear dose-dependent relationship with LDL-C. None of the domain-specific MVPA were associated with triglycerides.

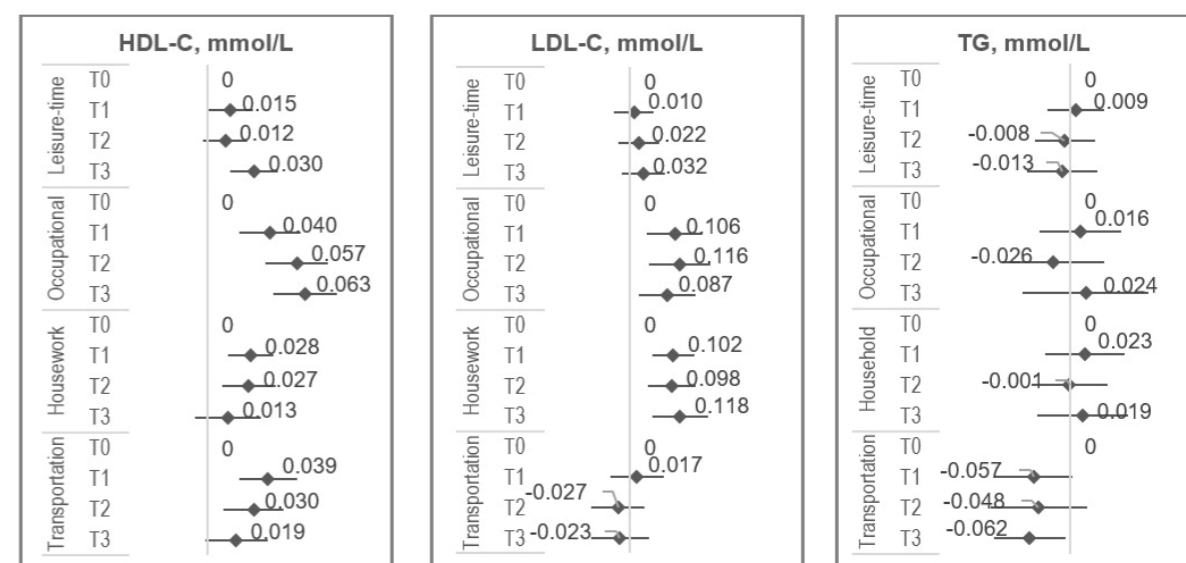
Conclusions

This study showed that leisure-time and occupational MVPA had favourable association with HDL-C; occupational and household MVPA had unfavourable associations with LDL-C. Hence, the overall beneficial impact of higher PA levels may not necessarily hold in the context of domain-specific MVPA and consequentially on cardiovascular health. Further investigation is needed to corroborate our findings to have a more profound understanding of their relationships.

Table 1. Participants' characteristics at initial wave (N=3950)

Characteristics	n	%	Characteristics	n	%
Age group			Smoking status		
<40	1194	30.2	Ever smoker	958	24.3
40-60	2419	61.2	Ever drinker	1630	41.3
>60	337	8.5	Family history of heart disease	1032	26.1
Female	2287	57.9	Family history of hypertension	2033	51.5
Ethnicity			Family history of diabetes	1554	39.3
Chinese	1845	46.7	History of hypertension	506	12.8
Malay	963	24.4	History of high cholesterol	729	18.5
Indian	1142	28.9	No MVPA (T0)	207	5.2
Married	3114	78.8	Domain-specific MVPA		
Educational level			No leisure-time MVPA (T0)	1344	34.0
Primary or lower	891	22.6	No transportation MVPA (T0)	3280	83.0
Secondary	1532	38.8	No occupational MVPA (T0)	3292	83.3
Post-Secondary or higher	1527	38.7	No household MVPA (T0)	893	22.6
Working	2668	67.5	Body Mass Index, kg/m2 (mean, SD)	24.9	4.9
Housing type			Lipid profile		
HDB 1 to 3-Room	742	18.8	LDL-C, mmol/L (mean, SD)	1.3	0.4
HDB 4-Room	1580	40.0	HDL-C, mmol/L (mean, SD)	3.3	0.9
HDB 5-Room & above	1628	41.2	Triglyceride, mmol/L (median, Q1-Q3)	1.1	0.8 -1.6

Figure 1. Independent association of domain specific MVPA & lipids, β (95% CI)



DIFFERENCES IN CAUSES AND FACTORS OF MEDICATION NON-ADHERENCE AMONG YOUNG AND OLD COMMUNITY-DWELLING ADULTS: A CROSS-SECTIONAL STUDY

Ge Lixia, Dr Heng Bee Hoon, Dr Yap Chun Wei

HIGHLIGHTS

- The prevalence of unintentional and intentional medication adherence was higher in young adults than old adults, but similar main causes of medication non-adherence were identified in both age groups.
- The presence of depressive symptoms was associated with higher odds of non-adherence in both young and older adults.

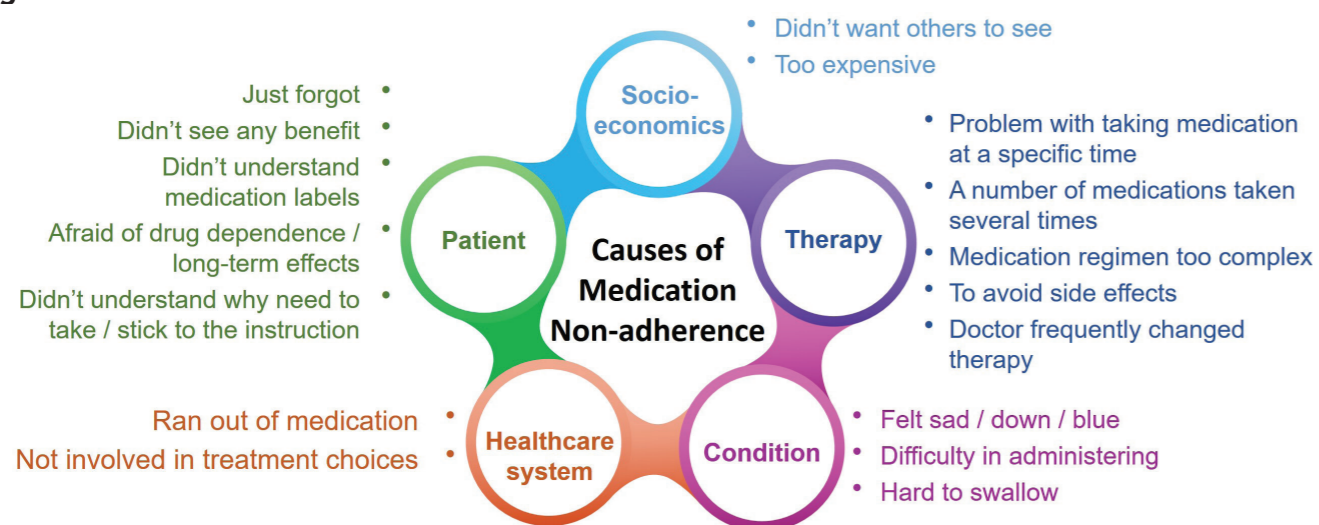
Introduction

Medication non-adherence has become a striking problem among patients with chronic diseases worldwide, with different prevalence in young and older adults. Hence, it is necessary to identify context-specific factors and causes that contribute to medication non-adherence in these two age groups. We conducted this study to 1) estimate the prevalence of intentional and unintentional medication non-adherence in young adults (aged 21-64 years) and older adults (aged ≥65 years) respectively; 2) identify and compare the main causes of medication non-adherence; and 3) examine the association between potential factors and medication non-adherence in each age group.

Methods

This cross-sectional study sampled 1,528 participants on medications from the Phase 2 Population Health Index Survey conducted in the North and Central regions of Singapore in 2019. Unintentional and intentional medication non-adherence was determined by participants' responses to two questions on their frequency of forgetting to take their medications (unintentional) and purposely missing a dose of medication or adjusting it to suit own needs (intentional). Causes of medication non-adherence were collected using a modified questionnaire containing 17 pre-defined causes in 5 domains (Figure 1). Chi-squared tests and Fisher's Exact tests were conducted to examine the differences in characteristics and causes of medication non-adherence between two age groups. Multiple logistic regressions were conducted to identify demographic characteristics, lifestyle factors and comorbidities associated with medication non-adherence.

Figure 1. Pre-defined causes of medication non-adherence



Results

The prevalence of non-adherence (reported "sometimes" or more frequent) was 20.0% and 10.4% in young and old adults, respectively, with young adults reporting higher unintentional (17.4% vs 7.8%) and intentional non-adherence rates (8.3% vs 3.5%) than older adults. As shown in Table 1, being afraid of developing drug dependence, forgetting to take their medication, and having issues with taking their medication at a specific timing were the most common reasons for non-adherence in both groups. Compared to young adults (1.7%), older adults were more likely to report a lack of understanding of medication labels as a reason for non-adherence (6.5%, p<0.05).

Table 1. The top 3 causes of medication non-adherence by groups

Domain	Cause of medication non-adherence	Young adults (n=766)	Older adults (n=764)	p-value
Patient	Afraid of developing drug dependence / worry about long-term effects	107 (36.4)	55 (32.4)	0.42
Patient	I just forgot	45 (15.3)	23 (13.5)	0.68
Therapy	Had problems with taking medication at specific time	45 (15.3)	18 (10.6)	0.16

As presented in Table 2, the presence of depressive symptoms was associated with higher odds of non-adherence in both young and older adults. Being of Malay ethnicity, employed, of personal income of ≤S\$1000, and a smoker were associated with higher odds of non-adherence in young adults.

Table 2. Factors associated with medication non-adherence in each age group

	Young adults (n=766)			Old adults (n=764)		
	OR	95% CI	p-value	OR	95% CI	p-value
Female (Ref: Male)	0.82	0.54, 1.23	0.34	1.69	0.96, 2.97	0.07
Ethnicity (Ref: Chinese)						
Malay	1.82	1.10, 3.01	0.02	1.42	0.65, 3.06	0.38
Indian	1.27	0.73, 2.20	0.40	2.15	1.01, 4.58	0.05
Others	0.69	0.22, 2.13	0.52	3.73	0.71, 19.6	0.12
Income level (Ref:>S\$4,000)						
S\$1,001 - S\$4,000	0.73	0.46, 1.16	0.19	0.61	0.22, 1.65	0.33
≤\$1,000	2.38	1.31, 4.34	0.01	0.81	0.38, 1.72	0.58
Living alone	0.83	0.47, 1.49	0.54	0.77	0.43, 1.36	0.37
Employed	3.95	2.16, 7.21	<0.01	1.58	0.77, 3.25	0.21
Currently smoking	0.57	0.33, 0.99	0.05	2.08	0.86, 5.05	0.10
Alcohol abuse	1.44	0.87, 2.39	0.15	0.50	0.15, 1.72	0.28
Presence of any DHL	1.06	0.67, 1.67	0.79	1.81	0.68, 4.79	0.23
Taking ≥ 2 medications	1.35	0.92, 1.99	0.13	1.15	0.63, 2.12	0.65
Presence of depressive symptoms	2.46	1.41, 4.29	<0.01	2.71	1.31, 5.62	0.01

CI: confidence interval; DHL: Diabetes, hypertension, or hyperlipidemia; OR: Odds ratio

Conclusions

Some differences in causes of medication non-compliance and factors associated with it in young and older adults were identified. A deeper understanding of these reasons for non-compliance and patient profiles could potentially guide healthcare professionals in designing tailored interventions for respective groups to ensure patients are able to take their medication as intended.

A NOVEL EXTENSION OF PEARL'S MEDIATION FORMULA TO ESTIMATE SEQUENTIAL MEDIATED CAUSAL EFFECTS

Dr Li Ruijie

HIGHLIGHTS

- Complex theories about how interventions work typically consist of multiple variables in a sequential causal chain.
- The causal effects from these models are hard to estimate using existing implementations of Pearl's mediation formula.
- An extension to the mediation formula was developed to accommodate any number of sequentially mediated causal effects.

Background

Mediational analysis is a form of causal inference aimed at quantifying indirect causal effects. An example where such an analysis would be useful is when a treatment causes a change in an outcome via an intermediary. In such a scenario, the causal effects can be split into the direct effect, i.e. the effect of the treatment on the outcome directly and the indirect effect, i.e. the effect of the treatment on the outcome via a third variable.

The conduct of mediational analysis had long been a challenge in two main areas: defining mediated causal effects and estimating the defined causal effects. Both of these challenges were addressed by Pearl in his seminal work on the mediation formula, which are a set of formulas that serves both as a definition and a mathematical expression of the mediated causal effects.¹ A notable characteristic of this definition is its non-parametric nature, which places no additional assumptions or restrictions on the methods used to estimate the causal effects.

However, the mediation formula addresses the scenario where there is only a single mediator. The mediation formula in its original form is suitable for deriving expressions to estimate causal effects in simple theoretical models where there is at most a single mediator. However, given the complexity of biological and healthcare systems, theoretical models with at most a single mediator are rare, and in the vast majority of instances, theoretical models contain multiple mediators in a sequence. These models indicate a need for the mediation formula to be generalised to be more widely applicable.

Proposing an extension of Pearl's mediation formula

An effort was undertaken to extend Pearl's mediation formula, as part of a larger piece of work to enable the estimation of sequentially mediated causal effects.² The original mediation formula allowed one to estimate causal effects such as the following expression for an indirect effect with a single mediator:

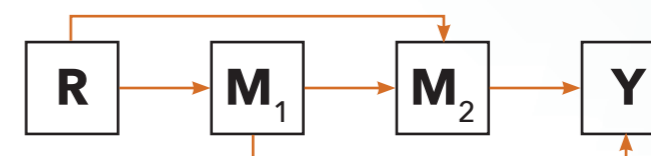
$$E[Y(R=1, M(R=1)) - Y(R=1, M(R=0))]$$

where, Y is the outcome of interest,
R is the treatment assignment and $R = \{0, 1\}$ corresponds to the values for control and experimental respectively, and
M is the mediator.

The extension aimed to allow expressing and estimating mediated causal effects where there are two or more mediators such as the following expression for an indirect effect through M_1 only:

$$E[Y(R=1, M_2(R=1, M_1(R=1)), M_1(R=1)) - Y(R=1, M_2(R=1, M_1(R=0)), M_1(R=0))]$$

where, M_1 is the first mediator and
 M_2 is the second mediator within a theoretical model represented as follows:



The key insight into how Pearl's mediation formula could be extended came from the understanding of the mediation formula as an application of a known statistical law, known as the law of iterated expectations, or otherwise also known as the Tower law. In the estimation of mediated causal effects, one of the required steps is to be able to simplify regression expressions with nested regressions within it. Such expressions can be simplified using the law and for the case of multiple sequential mediators, it is simply a matter of applying the law iteratively until all the nested expressions have been expressed in a non-nested expression.

Application

This novel extension accommodates any number of sequential mediators and the corresponding methods developed to estimate the mediated causal effects can do likewise. An example of where such a technique is crucial in the evaluation of an intervention and the mechanism of action is multiply indirect.

This was the case in the evaluation of a treatment of patients with eating disorders^{3,4} where the treatment was administered to the caregiver of the patient. The treatment worked by imparting caregiving skills and advice, as well as providing peer support to the caregivers. This newly gained knowledge and support was hypothesised to improve caregiving skills and as a result of the improved skills, reduce caregiving related stress. This reduction of stress was hypothesised to reduce generalised anxiety, and subsequently a reduction of eating disorders symptoms in the patient. The hypothesised relationships form a chain of events from the intervention to improved caregiving skills, followed by a reduction of caregiving stress, anxiety of the caregiver, and eating disorder symptoms of the patient. This chain of events requires the aforementioned extension of the mediation formula in order to test the relationships, and demonstrates a real world use of the extension.

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ASSOCIATION OF SOCIAL ISOLATION WITH PRODUCTIVITY LOSS AMONG INDIVIDUALS WITH DEPRESSIVE SYMPTOMS: A POPULATION-BASED STUDY

Joey Ha Wei Yee, Dr Michelle Jessica Pereira, Ge Lixia, Dr Yap Chun Wei

HIGHLIGHTS

- Socially isolated individuals with depressive symptoms incur mean health-related productivity loss of 3.7 times higher as compared to non-isolated individuals with depressive symptoms.
- Concomitant depressive symptoms and social isolation produce substantial productivity losses.

Introduction

Health-related productivity loss (HRPL) measures the extent of workplace absenteeism (missed time from work) and presenteeism (reduced performance at work) due to health problems. While the economic burden of depression in Singapore is well recognised, little is known on how social isolation, which implicates at least one-third of Singaporean adults, affects this relationship. Hence, we used population-based health survey data collected in the Central and Northern region of Singapore to study the differences in HRPL in working adults who reported depressive symptoms with and without social isolation.

Methods

The NHG Population Health Index Surveyed employed adults (≥ 21 years) in Singapore's Central and Northern region, between 2018 and 2019. There was a total of 2,521 participants, and 1,610 employed participants from the survey for this cross-sectional study. The main outcome variable of this study was the HRPL as measured by the Work Productivity and Activity Impairment inventory. Two key factors of interest were depressive symptoms as assessed by the 9-item Patient Health Questionnaire (PHQ-9) and social isolation as assessed by the 6-item Lubben Social Network Scale (LSNS-6). Participants were categorised into: those with depressive symptoms (≥ 5 on PHQ-9), and those without depressive symptoms (0-4 on PHQ-9); those with social isolation (0-16 on LSNS-6), and those without social isolation (≥ 17 on LSNS-6).

To ascertain the differences in HRPL among working adults who reported depressive symptoms with and without social isolation, we used a gamma log-linked generalised linear model (GLM) as the productivity loss outcome variable was right-skewed and not normally distributed. The model was adjusted for socio-demographic variables (age, gender, ethnicity, employment status, housing type) and self-reported history of chronic conditions (diabetes, hypertension and dyslipidaemia). Depressive symptoms and social isolation were both added to the first model as independent variables to determine their effects on HRPL. In the second model, the regression was conditioned on individuals having depressive symptoms ($n = 81$) so as to determine the association of social isolation with productivity loss in individuals with depressive symptoms.

Results

The unadjusted mean productivity loss is described in **Table 1**. Productivity loss was amplified when social isolation and depressive symptoms are concomitant (absenteeism = 9.8%, presenteeism = 24.2% and overall HRPL = 28.6%). The GLM analyses are shown in **Table 2**. Mean HRPL scores were 3.29 times (95% CI 0.80, 1.45) higher in participants with depressive symptoms than those without. Participants with both depressive symptoms and social isolation incur productivity loss of 3.75 times (95% CI 1.45, 9.71) higher as compared to non-isolated individuals with depressive symptoms. Among the other covariates, individuals who are younger, of Malay or Indian ethnicity, working full-time or have dyslipidaemia are found to be more likely to incur productivity loss.

Table 1. Unadjusted Mean Percentage of Productivity Loss

Mean % (SD)	Participants with social isolation (n = 678)	Participants with depressive symptoms (n = 81)	Participants with depressive symptoms and social isolation (n = 50)
Absenteeism	2.2% (11.7)	7.3% (19.3)	9.8% (23.3)
Presenteeism	6.1% (14.6)	20.6% (24.9)	24.2% (25.2)
Overall HRPL*	7.4% (17.8)	22.9% (27.6)	28.6% (29.9)

HRPL: health related productivity loss; SD: standard deviation

Table 2. Adjusted Productivity Loss

Variables	Mean ratio (95% CI)	
	Model 1: Employed participants (N = 1,610)	Model 2: Conditioned on those having depressive symptoms (n = 81)
Social Isolation (Ref. LSNS score >16)	1.08 (0.80, 1.45)	3.75 (1.45, 9.71)**
Depressive Symptoms (Ref. PHQ9 score <5)	3.29 (2.25, 4.81)***	
Age	0.99 (0.97, 1.00)*	1.02 (0.98, 1.06)
Female (Ref. Male)	1.16 (0.88, 1.53)	1.68 (0.68, 4.14)
Race (Ref. Chinese)		
Malay	2.71 (1.98, 3.72)***	4.16 (1.47, 11.78)**
Indian	1.60 (1.04, 2.46)*	2.08 (0.79, 5.48)
Others	1.44 (0.68, 3.03)	2.93 (0.57, 15.15)
Housing type (Ref. 1-2 room)		
3-room	0.75 (0.44, 1.26)	0.74 (0.25, 2.21)
4-room	0.91 (0.54, 1.52)	1.14 (0.37, 3.46)
5-room and larger/private housing	0.61 (0.35, 1.06)	0.92 (0.21, 4.04)
Employment type (Ref. Part-time)	1.84 (1.22, 2.80)**	4.67 (1.08, 20.15)*
Diabetes (Ref. No diabetes)	1.51 (0.93, 2.43)	2.16 (0.31, 14.87)
Hypertension (Ref. No Hypertension)	0.85 (0.57, 1.27)	2.16 (0.31, 14.87)
Dyslipidaemia (Ref. No Dyslipidaemia)	1.59 (1.01, 2.52)*	0.14 (0.01, 1.58)

CI: confidence interval; LSNS: Lubben Social Network Scale; PHQ-9: Patient Health Questionnaire
*: $p < 0.05$; **: $p < 0.01$; ***: $p < 0.001$

Conclusions

Alongside depressive symptoms, the findings highlight the association of social isolation with productivity loss. Increasing public awareness on the impact of depressive symptoms compounded by social isolation, and strengthening personal or community connections could potentially help alleviate workplace impacts. More attention may be directed to this population where individuals could be connected to psychosocial resources and support both in the community and at the workplace.

FINAL QUALITY OF LIFE OUTCOMES OF HOME VENTILATION AND RESPIRATORY SUPPORT PATIENTS

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¹ Home Ventilation and Respiratory Support Service, Tan Tock Seng Hospital

HIGHLIGHTS

- Improvements were seen in the quality of life for ventilator-assisted individuals and their caregivers 1 year after receiving Home Ventilation and Respiratory Support Services.

Introduction

Ventilator-assisted individuals (VAIs) suffer from severe chronic respiratory failure and require mechanical ventilation support. Prior to the establishment of Tan Tock Seng Hospital's Home Ventilation and Respiratory Support Service (HVRSS) in 2009, VAIs and their families had to either remain in acute hospitals, or risk going home unsupported. International studies have reported that quality of life (QoL) of VAIs have improved after receiving home ventilation support. However, in Singapore, no studies were found on the QoL impact of home ventilation service for VAIs and caregivers (CGs). Hence, we aimed to better understand the QoL impact of these two groups under the care of HVRSS.

Methods

We conducted a prospective one-year pre-post cohort study on VAIs and their CGs who received HVRSS from July 2020 to December 2022. QoL instruments for VAIs includes the Severe Respiratory Insufficiency (SRI) questionnaire, Patient Health Questionnaire-9 (PHQ-9) and Perceived Stress Scale (PSS). As for CGs, PSS and Zarit Burden Interview-22 (ZBI-22) questionnaires were used. VAIs and CGs were requested to complete QoL measurements upon hospital discharge (baseline), and at 3 months and 1 year from discharge date. A brief description of QoL instruments are shown in **Table 1**.

Table 1. Details of instruments utilized

Instrument	Description	Used on
Patient Health Questionnaire-9	Assessment of depression based on the past 2 weeks. 9 items; Score: 0 - 27. Higher score; greater depression severity.	VAIs
Perceived Stress Scale	Assessment of perceived personal stress in the past month. 10 items; Score: 0 - 40. Higher score; higher stress level.	CGs and VAIs
Severe Respiratory Insufficiency	Assessment of general health in severe respiratory insufficiency in the previous week. 49 items; Score: 0 - 100. Higher values; better general health.	VAIs
Zarit Burden Interview-22	Assessment of caregiver burden of caregivers in their current situation. 22 items; Score: 0 - 88. Higher score; greater burden.	CGs

CG: caregiver; VAIs: ventilator-assisted individual

Results

Twenty-seven VAI and CG dyads were eligible but only 11 dyads participated in the study. One dyad was terminated from the study as the VAI had successfully weaned off ventilation support, and another 2 dyads did not complete the study due to health reasons. Of the 8 dyads who had completed the study, one dyad (F) had switched CGs at 3-month, and their baseline data were excluded from analysis. Another dyad (C) had defaulted

their 3-month follow up due to personal reasons. From **Figure 1**, the mean PSS score for VAIs reduced from baseline to 3-month, but not much changes noticed at 1-year. Mean PHQ-9 values reduced at 3-month and 1-year for VAIs, but mean VAI SRI scores increased at 3-month and plateaued at 1-year. For CGs, their mean PSS score was similar at baseline and 3-month, but was lower at 1-year, whereas their mean ZBI-22 score decreased at 3-month and 1-year.

Figure 1. Quality of life outcomes for 8 VAIs

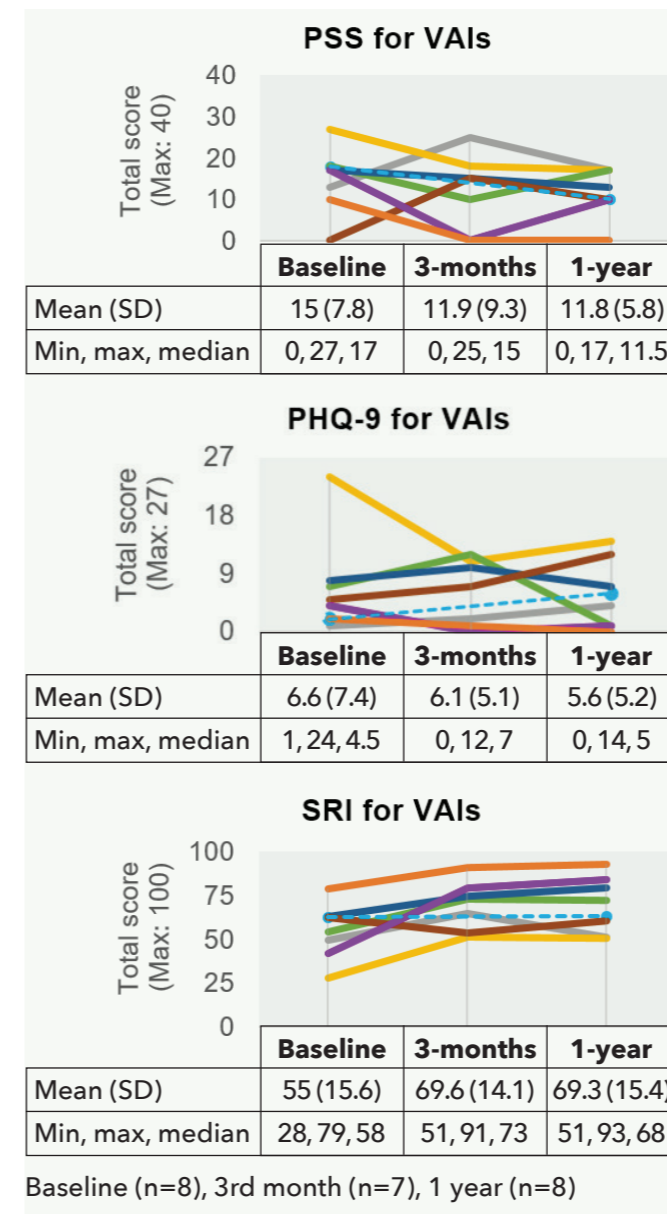
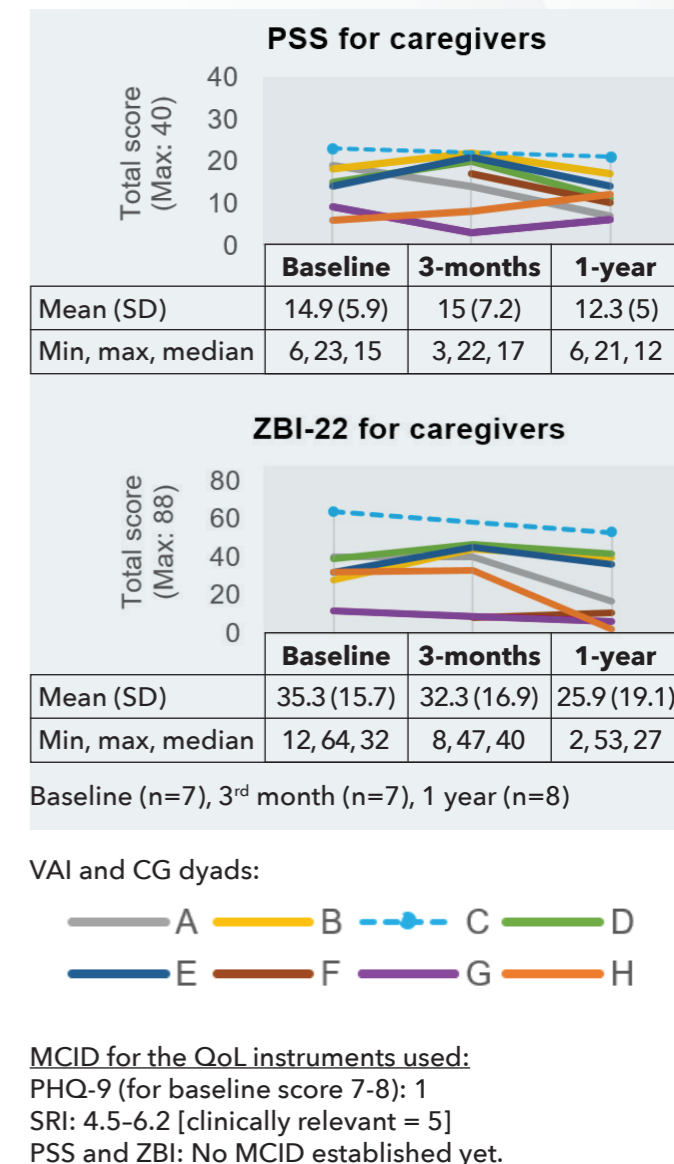


Figure 2. Quality of life outcomes for 8 CGs



*CG: caregiver; MCID: Minimum Clinically Important Differences; PHQ-9: Patient Health Questionnaire-9; PSS: Perceived Stress Scale; QoL: quality of life; SD: standard deviation; SRI: Severe Respiratory Insufficiency; VAI: Ventilator-assisted individual; ZBI-22: Zarit Burden Interview-22

Conclusions

Depression severity and stress levels for VAIs appear to decrease over time. SRI results suggested that VAIs experienced better general health in the short-term, but did not improve further at 1-year. As care is shifted from healthcare workers to CGs, it may be expected that CGs would experience higher stress and burden levels when VAIs are discharged home. However, these levels appeared to decrease at 1-year, suggesting the caregivers have become familiar with their roles and become less stressful. These findings will be useful for future care planning for VAIs and caregivers.

 **COMMENTARY**

 **LIVING WELL**

 **LIVING WITH ILLNESS**

 **CRISIS & COMPLEX CARE**

 **LIVING WITH FRAILTY**

 **LEAVING WELL**



CRISIS & COMPLEX CARE

USING AN OPTIMISATION FRAMEWORK TO AID THE ALLOCATION OF OPERATING THEATRE SESSIONS TO SPECIALTIES

Teow Kiok Liang, Dr Wong Weng Hoa¹, Lim May Lan¹, Kah Wai Jeremiah Chan¹, Hon Kuan Cheong¹, Dr Meng Fanwen

¹Alexandra Campus

HIGHLIGHTS

- Assigning operating theatre sessions to respective surgical specialties are complex given many combinations and considerations.
- The “Objective, Decision, Constraint” framework was used to structure this problem. Using an appropriate solver with the various operational constraints, an optimal solution can be obtained.

Introduction

Operating theatre (OT) sessions are scarce and expensive resources in a hospital, and have to be managed efficiently. The process of allocating these sessions to different specialties are challenging on 3 levels. At the strategic level, the operating theatre committee will determine the number of sessions per week for each specialty based on the demand. For smaller specialties, they may only get one session every fortnight. The next level of decision is to assign the specific sessions (i.e. specific operating theatre by am/pm day-of-week) to specific specialties. This is known as Master Surgical Scheduling (MSS) and is reviewed about every six months. At the final level, the listing of cases will be done a few days prior to the operations. This study will focus on the MSS process.

MSS takes detailed operational considerations into account. For instance, specialties may only be able to operate in certain theatres due to availability of specific equipment. Some may share common limited resources, including equipment such as Image Intensifier (I.I.) and Laminar Flow (L.F.), motivating the need to avoid concurrent usage as much as possible. The surgeons may also have restricted availabilities for OT sessions, due to their other administrative and clinical commitments.

MSS is a combinatorial problem and is often discussed in Operations Research literature. As Alexandra Hospital is planning to expand its theatre operations, we deployed this approach to aid the MSS process.

Methods

The research team held several discussions with end-users to solicit the operational requirements for a bi-weekly schedule. Based on the “Objective, Decision, Constraint” framework, a mixed integer programming model was built using IBM CPLEX Studio. End-users provided the input data.

The key considerations / constraints modelled were:

- I. Total number of sessions assigned at strategic level
- II. Availability of the surgeons / specialties
- III. Matching of specialties to theatres’ types
- IV. Minimising differences between odd and even week schedules
- V. Preference of same-day listing (i.e. operating from AM to PM, rather than two separate days)
- VI. Minimising concurrent use of scarce resources

Selected operations parameters (I, II and VI) were listed in **Table 1**. We ran the model to assign one Day Surgery Operating Theatre (DSOT) and 3 Major Operating Theatres (MOT) to 13 surgical specialties. Four scenarios were generated to match surgeons’ availabilities (consideration II) with same-day listing (consideration V).

Results

The model found solutions to meet all the constraints. The differences between odd and even week schedules were minimal and solely due to specialties that had one session in every two weeks. All four scenarios had the same likelihood of concurrent use of I.I. and L.F., indicating that there was no need to adjust surgeons’ availabilities. **Table 2** shows a sample set of results.

Conclusions

The framework of optimisation, coupled with the use of appropriate software, enabled the translation of users’ operational requirements to a mathematical model, and the best solutions among the many possibilities were populated. This approach would be a beneficial aid to assist the operations team in allocation of OT sessions.

Table 1. Sample input parameters for demand, availability and resource use

Specification	Session / Week		#Surgeons available					Probability of equipment usage	
	Odd	Even	Mon	Tue	Wed	Thurs	Fri	II	LF
S1	8	8	3	3	3	3	3	39%	0%
S2	7	8	3	1	3	2	0	66%	100%
...									

I.I.: Image Intensifier; L.F.: Laminar Flow; S: session

Table 2. Sample results for allocation of operating theatre sessions to specialties

		DSOT 1	MOT1	MOT3	MOT4
Monday	AM	S14	S1	S11	S1
	PM	S14	S1	S2	S1
Tuesday	AM	S12	S1	S1	S2
	PM	S12	S1	S1	S2
Wednesday	AM	S12	S3	S2	S2
	PM	S12	S3	S2	S2
Thursday	AM	S12	S7	S2/S8*	S6
	PM	S12	S7	S8	S6
Friday	AM	S13	S4	S5	S5
	PM	S13	S4	S10	S9

DSOT: Day Surgery Operating Theatre; MOT: Major Operating Theatres; S: Session; *S2 and S8 to be on odd and even week

THE ROLE OF TELEPHONE TRIAGE IN RIGHT-SITING POTENTIAL EMERGENCY DEPARTMENT PRESENTATIONS: A RAPID REVIEW OF REVIEWS

Joey Ha Wei Yee, Chieh Pann Pei, Dr Joseph Antonio D. Molina

HIGHLIGHTS

- Telephone triage appears to be safe, has high rate of case resolution at the local institutional level, good compliance rate and high satisfaction among patients.
- The implementation of telephone triage at localised public health institutions could potentially divert patients with non-emergency needs from the Emergency Department to other care settings, such as ambulatory care.

Introduction

In July 2022, public hospitals in Singapore saw a 25% surge in emergency department (ED) visits (Ministry of Health, 2022). Given that 40% of those ED visits were deemed non-emergency, the incident demonstrated an urgent need for healthcare administrators to explore alternative ways of managing healthcare demand, such as right-siting ED presentations. This study summarises the literature on outcomes of remote telephone triage when used in shifting non-emergency cases to other care services.

Methods

A rapid review was conducted by searching the electronic database, PubMed, for systematic reviews published between July 2012 and July 2022. Three authors independently screened the abstracts, reviewed the full-texts, and extracted data relevant to telephone triage and its effectiveness. Findings were synthesised qualitatively.

Results

The search yielded a total of 47 systematic reviews, including two additional reviews found via hand-searching. At the title and abstract screening stage, 34 studies were excluded as the intervention took place in non-ED settings (in the primary care or outpatient settings) or did not evaluate the effectiveness of telephone triage. At the full-text review stage, we assessed 13 full-texts and two reviews were excluded, as the target population was not a general adult population and the intervention was not primary triage.

We synthesised findings from 11 systematic reviews on remote triage services for adult patients (≥ 18 years old). Six studies examined outcomes in the general adult population, two studies examined outcomes for disease-specific populations, and three studies focused on accuracy and compliance of telephone triage decisions (Table 1). From these 11 studies, telephone triage appeared to be safe and had a high rate of case resolution at the local institutional level. Additionally, telephone triage was generally well-received with good compliance rates and high satisfaction among patients.

Conclusions

Despite the rise in telemedicine services, telephone triage remains largely an uncharted territory. Development of a digital 'front-door' may potentially facilitate better siting of care for patients with less critical needs from ED to other care settings such as ambulatory care, while preserving patient and system-level outcomes. A multi-factorial approach towards implementation, such as ensuring organisational and stakeholder buy-in, must be considered for remote triage to be integrated and effective.

Table 1. Outcomes of telephone triage

Outcomes	Effects
Health service utilisation	<ul style="list-style-type: none"> • For the general population of adult patients: Most primary studies did not demonstrate a change in primary care or ED utilisation, and remaining studies showed mixed results • For patients with respiratory disorders: Telephone triage may help reduce demand for hospital beds
Economic outcomes	<ul style="list-style-type: none"> • Insufficient evidence on favourable cost outcomes
Patient satisfaction	<ul style="list-style-type: none"> • Generally high levels of satisfaction found in studies
Problem resolution	<ul style="list-style-type: none"> • Local in-practice telephone triage has higher rate of call resolution as compared to regional or national triage systems
Safety	<ul style="list-style-type: none"> • No significant differences detected, suggesting that telephone triage is potentially safe
Accuracy, consistency and adherence to triage systems	<ul style="list-style-type: none"> • Accuracy measures are generally good, although clinical prediction models may be superior in detecting life-threatening conditions • Inconsistent telephone triage decisions potentially made when using different computerised decision-support software • Compliance to self-care and ED advice by patients is found to be good

ED: Emergency Department

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IDENTIFYING SINGAPORE RESIDENTS AT HIGH RISK OF FREQUENT HOSPITAL ADMISSIONS OR A&E VISITS

Dr Yap Chun Wei

HIGHLIGHTS

- Models for identifying those in the general population who are at high risk of frequent hospital admissions or accident and emergency (A&E) visits were developed.
- These models will be useful for population health interventions to reduce admissions and A&E visits.

Introduction

Frequent hospital admissions or frequent accident and emergency (A&E) visits are a significant issue for healthcare systems, as they are associated with increased costs and poor health outcomes. Current methods for identifying frequent admittees (FA) or frequent A&E users are typically developed using the patient population. Patients have higher risk of frequent hospital admissions or frequent A&E visits compared to the general Singapore residents. Thus, existing methods are likely to over-estimate the risk if applied to the general Singapore residents.

The goal of this study is to develop prediction models to accurately identify Singapore residents who are likely to become FAs or frequent A&E users, so that targeted interventions can be implemented to reduce their likelihood of hospital admissions or A&E visits. The objectives of this study are to: (1) develop a prediction model to identify residents at high risk of frequent hospital admissions in the next one year, (2) develop a prediction model to identify residents at high risk of frequent A&E visits in the next one year, and (3) evaluate the performance of both models in identifying high-risk individuals.

Methods

Singapore residents living in Central and North regions of Singapore and were alive at the end of financial year (FY) 2019 were included in the training set. Those who were alive at the end of FY2020 were included in the test set and those alive at the end of FY2021 were included in the validation set. Among the residents, FAs were identified based on three or more admissions in a financial year to Tan Tock Seng Hospital (TTSH) or Khoo Teck Puat Hospital (KTPH). Frequent A&E users were identified based on three or more A&E visits in a financial year to TTSH or KTPH.

A total of 159 predictors, which includes demographics, comorbidities, economic status, risk factors, care predictors, disease severity, and historical utilization, were used to construct two XGBoost models, one for FAs and another for frequent A&E users. The models were developed using the training set and optimized using the test set. The final models were then validated using the validation set.

Results

Out of approximately 1.4 million residents living in Central and North regions of Singapore, 4,062 (0.27%) of them were FAs in FY2021. Without a predictive model, random selection of 10,000 residents would identify only 27 FAs. Using the XGBoost model (AUC: 0.950), selection of the top 10,000 residents with the highest risks would identify 1697 FAs. Electronic frailty index, number of hospital admissions in the previous one year, and number of disease types diagnosed in the previous one year were among some of the strong predictors of frequent hospital admissions (**Table 1**).

In FY2021, 2,221 (0.15%) of residents living in Central and North regions of Singapore were frequent A&E users. Without a predictive model, only 15 frequent A&E users were identified from a random selection of 10,000 residents. Using the XGBoost model (AUC: 0.899), 799 frequent A&E users were identified from a selection of the top 10,000 residents with the highest risks. Number of A&E visits and number of doctors seen in the previous one year were identified as strong predictors of frequent A&E visits (**Table 2**).

Conclusions

Our study found that the use of a prediction model can identify Singapore residents at high risk of frequent hospital admissions or A&E visits. With the identification of high-risk individuals, healthcare providers can target interventions to these individuals. This can help to reduce the likelihood of frequent hospital admissions or A&E visits, hence lowering healthcare costs and improving health outcomes.

Table 1. Top predictors of frequent hospital admissions

Predictor	Relative importance
Electronic frailty index - No. of deficits	1.000
No. of unplanned acute hospital admissions in the previous one year	0.645
No. of ICD10AM disease subcategory (primary diagnosis) in the previous one year	0.364
Elixhauser readmission score	0.306
Hospital frailty risk score - High risk	0.238
No. of A&E visits in the previous one year	0.162
Total length of stay for all acute hospital admissions in the previous one year	0.148

A&E: Accident and emergency; ICD: International Classification of Diseases

Table 2. Top predictors of frequent A&E visits

Predictor	Relative importance
No. of A&E visits with no admissions in previous one year	1.000
No. of P3 A&E visits in previous one year	0.952
No. of doctors seen in previous one year	0.278
No. of AHRQ multiCCS level 1 (primary diagnosis) in previous one year	0.231
Male, age 6 to 40	0.212
Frequent user of A&E in previous one year	0.144
No. of AHRQ multiCCS level 2 (primary diagnosis) in previous one year	0.137
No. of P4 A&E visits in previous one year	0.134

AHRQ: Agency for Healthcare Research and Quality; A&E: Accident and emergency; multiCCS: multi-level Clinical Classification Software; P3: Priority 3; P4: Priority 4

VISUAL REPRESENTATION OF A PATIENT'S TIMELINE

Reuben Ong

HIGHLIGHTS

- Graphical presentation of tabular data allows for a swift review of patients' medical history.
- Graphical presentation of patients' healthcare episodes can provide valuable insight into the condition of the patient at a glance.

Introduction

Healthcare administrative databases provide a wealth of information to clinicians and researchers. These vast amounts of episodic data are often stored as separate tables according to their site of care (inpatient, emergency department, outpatient specialist clinics, etc.) While extracting and merging patient data from the various tables is often done to facilitate analysis on a broad scale across many patients, it is sometimes useful to view the information at the individual patient level to glean insights into particular patient's health condition.

Viewing such information in a tabular format is not ideal, as information on time between events and the trend among healthcare visits will not be readily apparent at a glance. The information is better represented as a color-visual timeline, outlining key details of episodes while portraying the time between events as distance along the timeline.

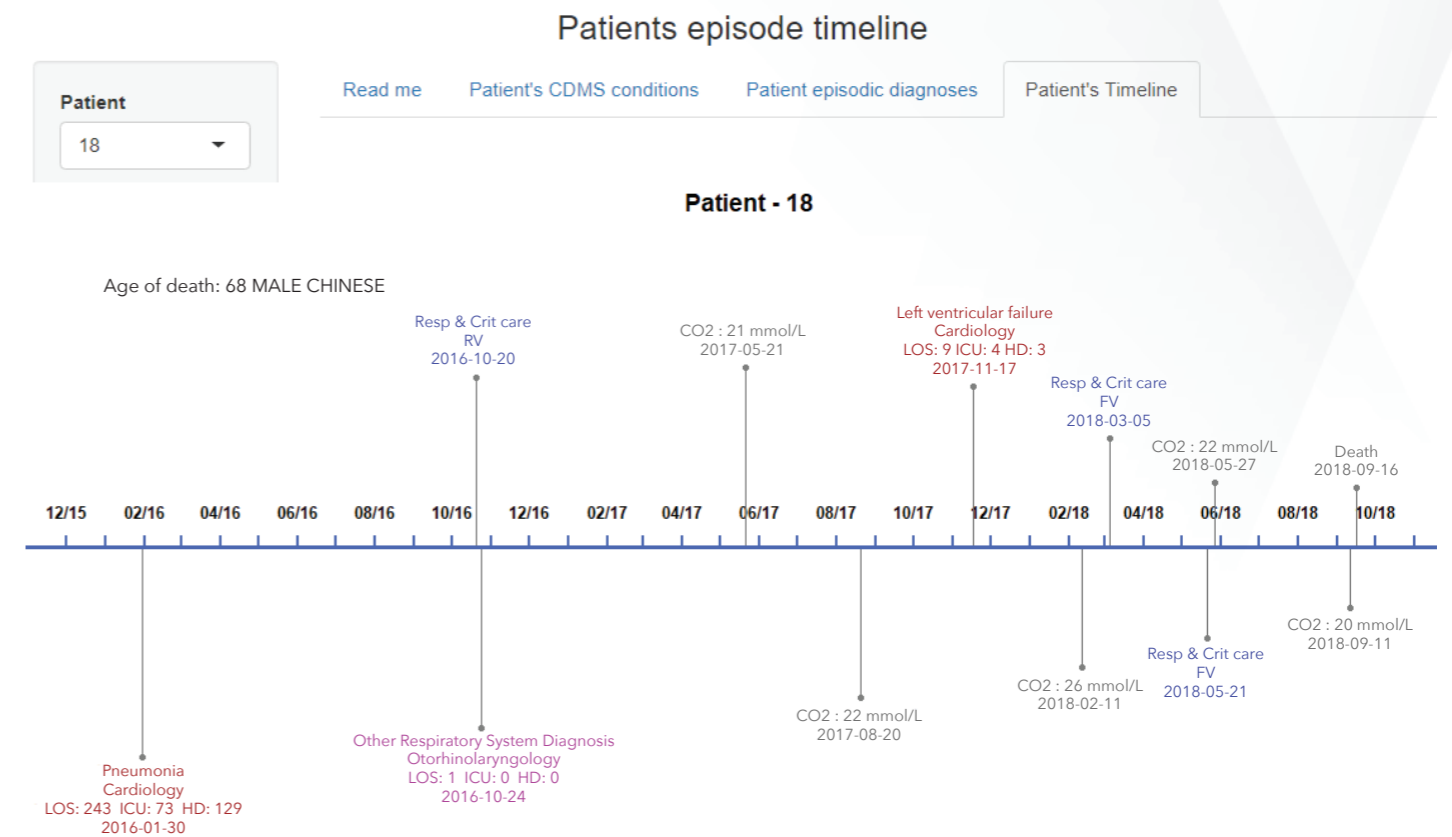
Methods

For a respiratory project, patient episodic data from administrative databases were extracted and represented on a timeline using the R Shiny application. Information on the date of admission, length of stay as well as the primary diagnosis of inpatient episodes, along with the department of outpatient specialist visits, were extracted. Lab test results of the patients' serum CO₂ were also included onto the timeline. Text processing was utilised to succinctly present diagnoses and department names, and different colors were used to represent the site of care (brown: hospitalisation, blue: outpatient specialist clinic, purple: day surgery, grey: lab tests). Patients' identities were anonymized and an input panel on the left allowed for the selection of a particular patient according to a generic index.

Conclusions

Patients' episodic data tables can be presented as a visual timeline to allow rapid insight into the patient's health condition. The R Shiny application can be customized according to various needs, such as filtering by patient demographics. The timeline application would prove useful for clinicians to quickly understand the history of the patient under their care. As for researchers, the timelines of individual patients may provide insight into a typical cohort patient, such as their progressive trend in diagnosis conditions, or into an atypical outlier patient to better understand why they differ from the rest of the cohort and warrant exclusion.

Figure 1. Example R-Shiny presentation of Timeline (Fictitious Patient)



CO₂: Patient's serum CO₂ lab test result; FV: First visit; RV: Repeat visit; HD: High Dependency ward; ICU: Intensive Care Unit; LOS: Length of Stay; Resp & Crit care: Respiratory and Critical care.

 **COMMENTARY**

 **LIVING WELL**

 **LIVING WITH ILLNESS**

 **CRISIS & COMPLEX CARE**

 **LIVING WITH FRAILTY**

 **LEAVING WELL**



LIVING WITH FRAILTY

MULTICOMPONENT FRAILTY INTERVENTIONS AT THE EMERGENCY DEPARTMENT AND ITS BENEFIT IN QUALITY-ADJUSTED LIFE YEARS GAINED

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HIGHLIGHTS

- Multicomponent frailty interventions may improve quality-of-life, especially for patients with Clinical Frailty Scale scores of 4 and 5.

Introduction

The Emergency Department Interventions for Frailty (EDIFY) programme reduces the number of potentially avoidable acute admissions, shortens the length of stay and improves functional outcomes in older persons who may be discharged back to the community safely through early review from geriatric experts. The multicomponent frailty intervention consists of follow-up telephonic consultations, care planning, discharge counselling and education. We aimed to examine EDIFY's ability in improving health-related quality-of-life (HRQOL) of frail older adults who presented at the Emergency Department (ED).

Methods

A quasi-experiment was conducted at Tan Tock Seng Hospital ED. Patients aged ≥ 65 years, with Clinical Frailty Scale (CFS) scores between 4 to 6 (vulnerable to moderately frail), pending acute admissions, and deemed suitable for discharge or transfer to low-acuity care were systematically assigned to EDIFY or standard-care according to their week of ED presentation. HRQOL was measured using self-reported EQ-5D-5L over 6 months. We used Singapore utility scores to compute participants' index scores and subsequently derived overall quality-adjusted life years (QALYs) gained by calculating the change in QALYs from baseline. Simple linear regressions modelled QALYs gained for complete cases and regressions were adjusted for baseline index score, age, gender, pre-morbid CFS score, SARC-F score, Modified Barthel Index (MBI) score, Mini Nutritional Assessment (MNA) score and Charlson Comorbidity Index (CCI) score.

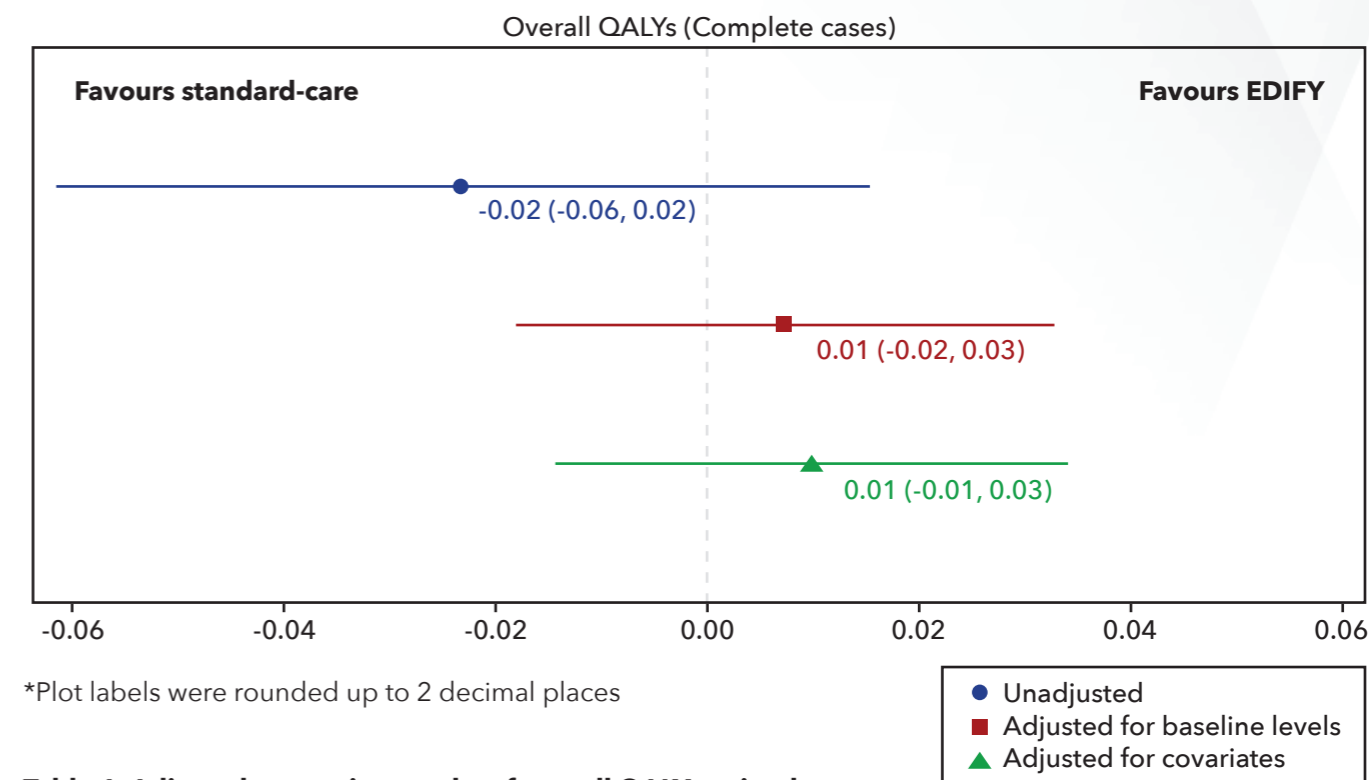
Results

Among 140 participants (EDIFY = 70; standard-care = 70), 87 participants (EDIFY = 44; standard-care = 43) had reported index scores at baseline and at least one follow-up, and were regarded as complete cases for analysis. The unadjusted mean QALYs gained was 0.022 with a standard deviation (SD) of 0.075 for EDIFY and 0.045 with an SD of 0.103 for standard-care. Upon adjusting for baseline levels and other covariates, there were higher gains in QALY for EDIFY as compared to standard-care (Figure 1). As described in Table 1, overall QALYs gained were higher for EDIFY than standard-care ($\beta = 0.010$, $p = 0.417$). Additionally, EDIFY participants with CFS scores of 4 and 5 appeared to have higher gains in QALYs as compared to those with CFS score of 6 (CFS 4: $\beta = 0.129$, $p = 0.001$; CFS 5: $\beta = 0.130$, $p = 0.001$).

Conclusions

Early geriatric specialist interventions at the front-door of acute hospitals via EDIFY has the potential to improve quality-of-life outcomes of frail older adults. Treatment effects could possibly be enhanced using a frailty-targeted approach where interventions are targeted at patients in their early stages of (pre) frailty, having CFS scores of 4 and 5.

Figure 1. Unadjusted and adjusted overall QALYs gained (β and 95% CI) by EDIFY as compared to standard-care*



*Plot labels were rounded up to 2 decimal places

Table 1. Adjusted regression results of overall QALYs gained

Variables	EDIFY (n = 44) versus standard-care (n = 43)		
	Intervention coefficients (β)	95% confidence interval	p-value
Overall QALYs	0.010	-0.014, 0.034	0.417
Baseline index score	-0.277***	-0.322, -0.233	0.000
Age ≥ 80 (Ref: 65 to 79)	0.014	-0.011, 0.039	0.263
Female (Ref: Male)	-0.006	-0.031, 0.019	0.626
CFS score (Ref: 6)			
CFS score 4	0.129***	0.056, 0.201	0.001
CFS score 5	0.130***	0.058, 0.202	0.001
SARC-F score	-0.004	-0.011, 0.004	0.334
MBI score	0.000	-0.001, 0.002	0.655
MNA score	0.004	-0.003, 0.011	0.244
CCI score	-0.001	-0.007, 0.006	0.817

CCI: Charlson Comorbidity Index; CFS: Clinical Frailty Scale; QALY: quality-adjusted life year; MBI: Modified Barthel Index; MNA: Mini Nutritional Assessment; SARC-F: Strength, assistance with walking, rising from a chair, climbing stairs, and falls.

NURSING HOME RESIDENTS' PROFILE, SURVIVAL AND WORKLOAD PROJECTION

Zhu Zhecheng

HIGHLIGHTS

- The number of nursing home residents in Singapore is projected to increase by 80% in 2030, compared to 2019.
- NH residents are older and have high chronic disease prevalence.
- Age and gender significantly impact NH residents' survival rate.

Introduction

Nursing homes (NHs) are important healthcare facilities to support Singapore's aged population. NHs provide care for seniors with severe frailty who cannot live independently. As Singapore is ageing rapidly, demand for NHs will increase at an alarming rate. This study described NH residents by demographics and chronic disease burden, and a survival analysis was conducted to illustrate the survival rate of NH residents. Based on these findings, we used a stock and flow approach to project NH workload by 2030.

Methods

The profile of Singapore's NH residents in 2019, covered demographics such as age group, gender, ethnic group and place of living. Chronic disease burden of NH residents included 20 conditions from Chronic Disease Management Programme (CDMP). Three cohorts of NH residents (2016-2018) were selected for survival analysis. Each year's cohort comprised of residents admitted to a nursing home for the first time in that year. Cox regression was applied to identify significant factors affecting survival rate. Covariates included age, gender, ethnic group and the 20 CDMP conditions. A stock and flow approach was applied to project the number of NH residents in 2030. The yearly NH admission rate was assumed to increase by 3% per annum due to population ageing, and the yearly NH discharge rate was assumed to follow the average rate of 2016-2019 of 16%.

Results

The mean and median age of NH residents were 76.8 and 79 years. From **Figure 1**, 91% of NH residents were aged 60 years old and above, with majority being male. 84% were Chinese and 45% were living within the NHG catchment. The chronic disease prevalence was generally high, and 54% of NH residents had dementia.

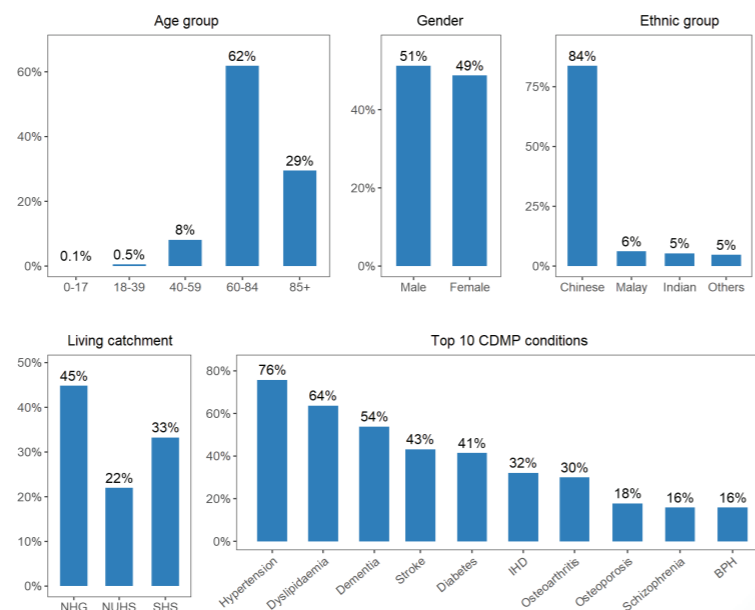
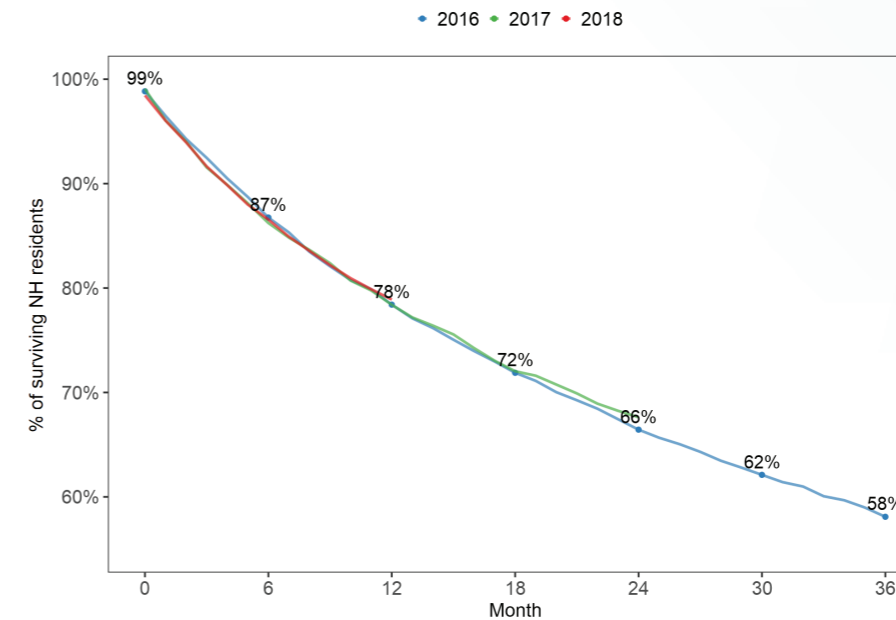


Figure 1 (right). NH residents' demographics and disease prevalence in 2019



From **Figure 2**, all three cohorts of residents illustrated same trend of survival, with the first to third year survival rates of 78%, 66% and 58% respectively. Cox regression showed that age and gender were consistently significant predictors across all three cohorts, and older and male residents had significantly lower survival rate.

Figure 2 (left). Survival curve of NH residents since first NH admission by cohort

Figure 3. NH workload projection till 2030

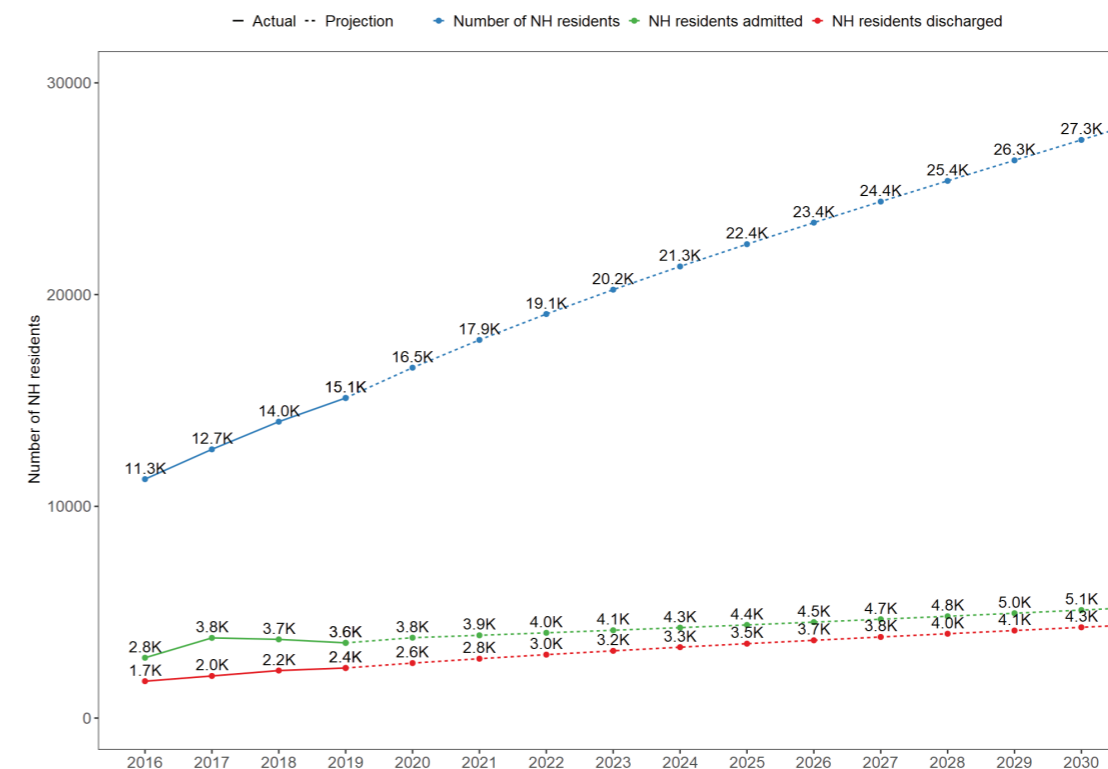


Figure 3 showed that the projected number of NH residents in 2030 reached 27.3K, an 80% increment compared to 15.1K in 2019. The difference between 2019 and 2030 indicated that 12K extra nursing home beds would be needed.

Conclusions

This study provided profiling, survival and workload projection of NH residents in Singapore. Results showed that NH patients' survival drastically fell within the first 3 years, and was significantly impacted by age at admission and gender. The projected number by 2030 indicated that a large number of beds and a larger workforce will be needed to cater to the increase in workload.

EVALUATING THE IMPACT OF A VIRTUAL TRAINING PROGRAMME FOR ADVANCE CARE PLANNING FACILITATION IN NURSING HOMES IN SINGAPORE

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HIGHLIGHTS

- Participants of a virtual training in Advance Care Planning facilitation generally maintained or increased their agreement with the importance and impact of these discussions, and their confidence in facilitating them.
- However, some participants were uncertain about the activation and completion of discussions, and navigating them with residents with mild cognitive impairment.

Introduction

Advance Care Planning (ACP) discussions facilitate the communication and documentation of nursing home (NH) residents' end-of-life care preferences. However, a lack of trained facilitators, and existing workflows have impeded the integration of ACP in NHs, motivating a need to build capacity to address residents' palliative care needs. In 2020, Project Respecting Preferences, Empowering Conversations Together (RESPECT) was launched to support nursing homes in the Central Health region to implement and sustain the practice of ACP.

A key component of Project RESPECT was to provide training and mentoring of NH staff to facilitate ACP discussions. A one-day virtual training in either General ACP (GACP) or Preferred Plan of Care (PPC) facilitation was conducted for NH staff by facilitators from Tan Tock Seng Hospital. Participants learnt about goals, ethics and legislation relating to ACP, and how to facilitate a discussion. We aimed to evaluate the impact of this training curriculum on participants' knowledge, attitudes and confidence (KAC) in ACP facilitation.

Methods

NH staff who had no prior experience with either GACP or PPC discussions were included in the study and completed a KAC survey before training, and at three-months. Questions were modified from published ACP-related KAC surveys and contextualised to Singapore. Knowledge about ACP was assessed based on 17 True/False questions. Attitudes towards ACP were elicited based on agreement with 14 statements on a 5-point Likert scale. Confidence in ACP facilitation was measured for 12 skills on a 5-point Likert scale. Study participants completed the same survey before the start of the training session, and after 3 months. Responses to the knowledge questions at 3 months, as well as changes in attitudes and confidence over time were reported.

Results

Over 16 months, 19 training sessions were conducted for attendees from 8 nursing homes. Of the 71 attendees eligible for the surveys, 49 and 32 participants completed the baseline and follow-up surveys respectively.

Knowledge of ACP

At 3 months' follow-up, all participants showed understanding that a resident's treatment preferences would be influenced by their values and beliefs, as well as the purpose of an ACP and the roles of the Nominated Healthcare Spokesperson and doctors in decision-making. However, there were incorrect answers to 13 out of 17 questions. A substantial proportion of participants responded incorrectly to questions on the type of ACP required and when it can be completed; when the care plan can be activated and what the option of limited additional intervention entailed; and when the decisions of patients with cognitive impairment can be altered (Table 1).

Table 1. ACP Knowledge questions with frequent incorrect responses at 3 months

Statement	Answer	Correct	Incorrect
Criteria for use			
The type of ACP required is dependent on the prognosis on the resident	TRUE	20 (63%)	12 (38%)
An ACP discussion can be completed without a Nominated Healthcare Spokesperson	TRUE	16 (50%)	16 (50%)
An ACP document can be only activated in the event that the resident has lost decision-making capacity	TRUE	16 (50%)	16 (50%)
Preferences			
Residents who opt for limited additional intervention in their Preferred Plan of Care may be intubated if the need arises	FALSE	18 (56%)	14 (44%)
Legality and mental capacity			
A resident living with mild dementia can change their ACP	TRUE	18 (56%)	14 (44%)
Any family member of a resident living with dementia can change this person's ACP	FALSE	25 (78%)	7 (22%)

ACP: Advance Care Planning

Attitudes towards ACP

Comparing results at baseline and follow-up, most participants maintained or increased their agreement with the importance and impact of ACP. A third of participants reported an increase in agreement that every resident should have access to an ACP discussion, and that NH staff must be actively involved to help residents complete an ACP (31%). In contrast, a substantial proportion of participants reported a decrease in agreement that ACP allowed residents to feel control over their lives and reduced the likelihood of futile treatment (13%). The statement proposing that it was the NH's role to facilitate ACP discussions with residents received mixed responses, with 31% and 13% of participants reporting an increase and decrease in agreement respectively.

Confidence towards ACP facilitation

Participants' confidence in facilitating ACP generally maintained or increased. More than 50% of participants indicated they had increased confidence in their knowledge of legislation regarding ACPs (56%), as well as in their ability to discuss residents' wishes and preferences for future care and respond to questions of the family on ACPs (53%).

Conclusions

Participants' KAC appeared to improve after the training. However, some participants exhibited uncertainty around care-planning processes for residents with cognitive impairment, and when to initiate/activate ACP. The training curriculum will be adapted to provide more case studies, with a focus on navigating discussions with patients with dementia.

 **COMMENTARY**

 **LIVING WELL**

 **LIVING WITH ILLNESS**

 **CRISIS & COMPLEX CARE**

 **LIVING WITH FRAILTY**

 **LEAVING WELL**



LEAVING WELL

LONG TERM FORECAST OF TOTAL DEATHS IN SINGAPORE

Palvannan R.K., Teow Kiok Liang

HIGHLIGHTS

- With demographic shifts, Singapore is facing declining birth rates and rising death rates.
- The number of deaths has steadily climbed to over 22,800 annually and is expected to double before 2040. This has significant implications on end of life care in both hospitals and homes.

Introduction

As a developing nation in the 1960s, Singapore had seen a boom in the birth rates of more than 40,000 per year. Over the years, with rapid economic growth, birth rate has dropped with lower fertility rates. That has resulted in immigration policies and incentives for replacement. Currently, we no longer have a demographic dividend of a young population and are acutely aware of an increasingly ageing society, which is quantified by the proportion of the population aged 65 years and above, or the mean age of the population.

With a long life expectancy of 84 years, we are seeing changes in the pattern of disease burden, having more patients with chronic conditions such as dementia and disability. Public policies and health interventions have been shifting their focus towards reducing the disability burden, where the disability burden with a healthy life expectancy is 72 years now. As of 2021, the number of deaths stands at 22,800 and will continue to grow, doubling to more than 40,000 by 2040. Therefore, it is necessary to examine the long-term growth in total deaths and its consequences on the healthcare system, and in particular palliative care, as end of life care is mostly delivered with the focus on palliation.

Methods

We used the historical life tables from the Department of Statistics and projected the population size, and number of births and deaths until 2040. We have assumed constant mortality risk and a net immigration inflow of 20,000 per year for replacement.

Results

The death projections have been illustrated in **Figure 1**. We project that the death rates will double by around 2037. This rate, however, may potentially slow down with slight increase in life expectancy. We have compared with the United Nations' Population Division's death projections, which show higher numbers.¹ A pattern of number of deaths exceeding the number of births, until it reaches a steady state, was also observed in the projections of other East Asian nations e.g. Hong Kong, Taiwan and South Korea.

Discussion

As the population's baby boom cohort ages, the number of deaths will surge, although this trend has been delayed by a rapid increase in life expectancy. The demand for after-death facilities and services will follow similarly.²

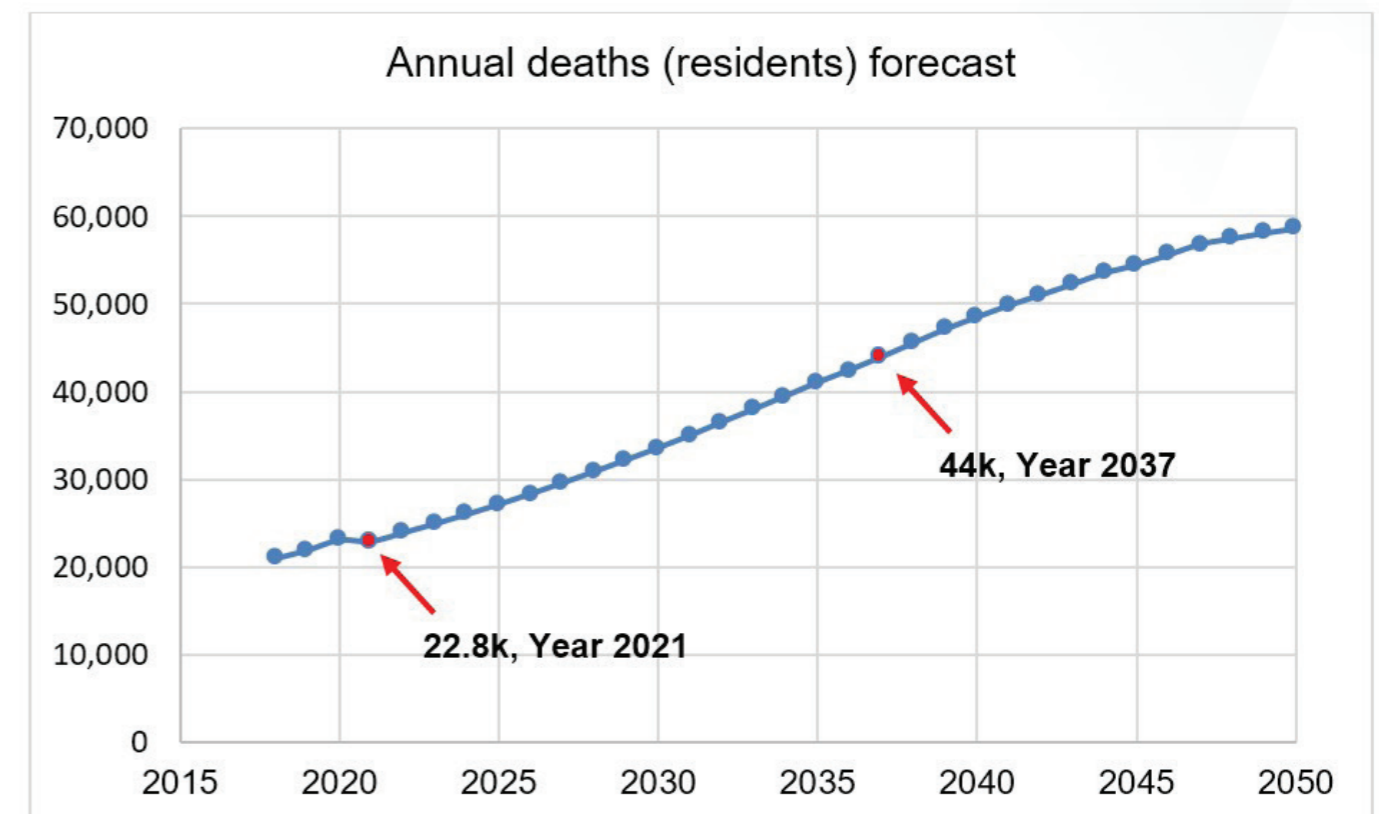
The implication of a doubled death burden on the healthcare system is rather straightforward. The absolute demand for and cost of end of life care will increase from what it is today. Certain medical capacities that are strongly associated with the causes of death may be challenged: oncology, cardiology, geriatrics, trauma and emergency. Today about 60% of deaths occur in hospital. If there is a further impetus to shift more deaths to take place in the surrounded comfort of the home, more needs to be done to address the existing barriers. In terms of cost, based on age-specific cost of healthcare utilization costs, national cost projections due to ageing have

been done and the rising number of deaths have indirectly been accounted for in the cost increase. However, with the doubling number of deaths, additional efforts to deliver end of life care and shift deaths to home, have to be taken into account when projecting costs too.

Conclusions

While we are increasingly familiar with the growth in ageing burden, we have to also focus on the effects of the increase in death burden, which is a natural balancing of steady state dynamics of births and deaths. An increase in capacity in the specialties proximal to end of life care, and support of dying at home instead of the hospital will be greatly required.

Figure 1. Projection of annual deaths using historical life tables



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PROFILING DECEASED HOME VENTILATION & RESPIRATORY SUPPORT SERVICE PATIENTS, THEIR END-OF-LIFE CARE RECEIVED AND OCCURRENCE OF VENTILATION WITHDRAWAL DISCUSSIONS

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HIGHLIGHTS

- A third of patients managed under HVRSS did not have an ACP discussion or receive palliative care at the end of life. In particular, ventilation withdrawal was rarely discussed.

Introduction

Ventilator-assisted individuals (VAIs) suffer from severe chronic respiratory failure and require mechanical ventilation support. Prior to the establishment of Tan Tock Seng Hospital's Home Ventilation and Respiratory Support Service (HVRSS) in 2009, VAIs and their families had limited options: to either remain in acute hospitals, or risk going home unsupported. With HVRSS' implementation as the primary care provider for these patients at home, it is unknown if these VAIs had received end-of-life services and whether ventilation withdrawal was discussed prior death.

Methods

Patients studied were deceased as of 2019, had at least one HVRSS outpatient or home visit, and had sufficient TTSH electronic medical documentation. Study data comprised information from electronic medical records, as well as primary data collected by the HVRSS team, the Advance Care Planning (ACP) programme and the Department of Palliative Medicine. Patients' socio-demographic characteristics, clinical profile and end-of-life care receipt was described.

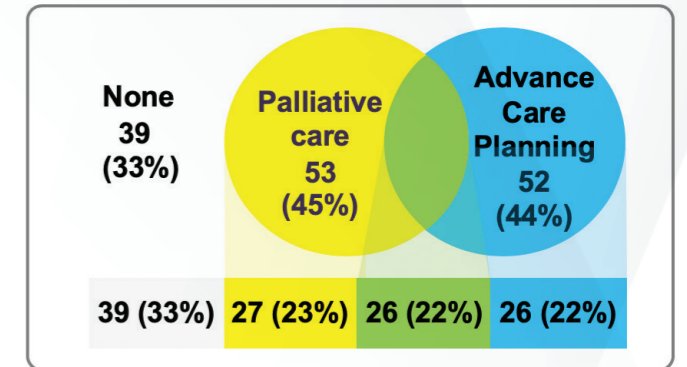
Results

Of 333 HVRSS patients, only 118 met the inclusion criteria. Seventy-five (63.6%) were male, and most were of Chinese ethnicity (84.7%). The mean age of patients at enrolment into HVRSS was 64.2 years (SD=16.1), and their average duration under the HVRSS was 1.8 (SD=1.8) years. Majority of the patients lived in 4-Room HDB apartments (26.3%) and patients' main caregivers or spokespeople tend to be patient's spouse (44.9%) or children (37.3%). The primary diagnoses in the patient cohort were Motor Neuron Disease (n=56; 47.5%), Neuromuscular Disease (n=15; 12.7%) and Spinal Cord Injury (n=16; 13.6%). A comparison of the patients' ventilation status at enrolment and at death in **Table 1** showed that 25 (21.2%) required more intensive ventilation support; and 9 (7.6%) required less intensive ventilation support over the duration of the program.

Table 1. Patient ventilation status at enrolment and death

Vent status at enrolment		n (%)	Vent status at death				
			IV Dependent	IV Assisted	NIV Dependent	NIV Assisted	Not on vent
IV Dependent	44 (37%)	40	3	-	1	-	
IV Assisted	6 (5%)	3	2	-	-	1	
NIV Dependent	14 (12%)	-	-	13	1	-	
NIV Assisted	37 (31%)	4	-	12	18	3	
Not on vent	17 (15%)	-	-	1	5	11	
Grand Total, N	118	47 (40%)	5 (4%)	26 (22%)	25 (21%)	15 (13%)	

Figure 1. Breakdown of VAIs who received Palliative care and/or had ACP done



Of the 118 VAIs, 55 (46.6%) VAIs had at least one hospital admission within 90-days before death, with mean length of stay per admission of 23.3 days (SD=25.2, range: 1-91).

Only 79 (66.9%) VAIs had received either ACP or palliative care services (**Figure 1**). On average, patients spent 1.6 years with an active ACP (SD=1.6); or 0.5 years under palliative care management (SD=1.4). Type of Palliative care and ACP services received are shown in **Table 2**.

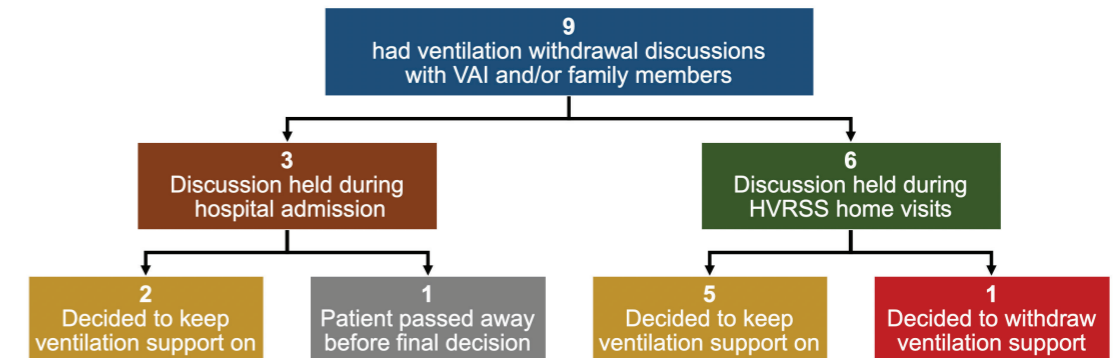
Table 2. Type of end-of-life services received

	Services / interventions	n (%)	Discharge reasons	n (%)
Palliative care (n=53)	• Initiating EOL care discussion and Pain & Symptoms management	20 (37.7)	<ul style="list-style-type: none"> No further service required/received To other services Passed away Missing data* 	18 (34.0)
	• Initiating EOL care discussion	3 (5.7)		3 (5.7)
	• Pain & Symptom management	16 (30.2)		27 (50.9)
	• Missing data*	14 (26.4)		5 (9.4)
Advance Care Planning (n=52)	Preferred Plan of Care - Preferred place of death		Death	52 (100)
	• Own home	38 (73.0)		
	• Healthcare institutions	8 (15.4)		
	• Own home or healthcare institution	2 (3.8)		
	• Did not discuss/no preference	3 (5.8)		

* Missing data are services received from outside of TTSH or with no electronic medical records found.

Ventilation withdrawal discussions occurred for only 9 VAIs (7.6%), with 5 (55.6%) of the VAIs receiving only Palliative care; 3 (33.3%) only ACP; and 1 (11.1%) patient receiving both Palliative care and ACP. Out of the 9 VAIs who had ventilation withdrawal discussions, 7 (77.8%) decided to keep the ventilation support on, whilst only 1 (11.1%) decided to proceed with the ventilation support withdrawal.

Figure 2. Breakdown of VAIs and/or family members of VAIs who had ventilation withdrawal discussions prior death



Conclusions

A third of patients managed under HVRSS did not have an ACP discussion or receive palliative care at the end of life. In particular, ventilation withdrawal was rarely discussed. Findings are relevant for service planning to ensure that VAIs are given the opportunity to discuss their end-of-life care.

PROGNOSTIC FACTORS FOR ALL-CAUSE MORTALITY IN PATIENTS DIAGNOSED WITH END-STAGE HEART FAILURE: A SCOPING REVIEW

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HIGHLIGHTS

- We identified six domains of prognostic factors for patients diagnosed with end stage heart failure, with cardiovascular health and overall health status being the largest categories.
- Nine potential models could be potentially externally validated to predict one-year all-cause mortality in our local setting.

Introduction

Due to the unpredictable disease trajectory, palliative care services are under-utilised by patients with end-stage heart failure (ESHF). Often, ESHF patients are referred to palliative care in the last few weeks of life. Optimal management of patients with ESHF requires accurate assessment of prognosis to facilitate earlier access to palliative care services, which improve quality of life and alleviate suffering. While there are numerous risk prediction models for heart failure, there are limited prognostic models for populations with ESHF. To develop a prognostic model, we must first identify the factors associated with mortality in this specific population. The aim of this scoping review was to identify factors associated with all-cause mortality (ACM) among patients with ESHF.

Methods

We adopted the frameworks proposed by Arksey and O'Malley and Riley for this review.^{1,2} We searched Medline, EMBASE, PubMed, CINAHL, Cochrane Library and Web of Science, for articles published between January 2010 and September 2020. Grey literature was identified from ProQuest, Google Scholar, BASE, Science.gov, OpenGrey, and bibliographic databases of National University of Singapore and Nanyang Technological University. Primary studies considered eligible for this review included adults aged ≥18 years old who were diagnosed with ESHF, defined as New York Heart Association (NYHA) class III/IV, American Heart Association/American College of Cardiology (AHA/ACC) Stage D or described as an advanced heart failure population, and assessed for factors associated with up to three-years ACM using multivariable analysis. The Quality of Prognostic Studies (QUIPS) tool was used to appraise the quality of the included studies across six domains - study participants, study attrition, prognostic factor measurement, outcome measurement, study confounders, and statistical analysis and reporting.¹ We summarised key characteristics of the included studies and provided an overview of prognostic factors investigated across the literature.

Results

A total of 119 multivariable models across 65 studies were included. Most of these studies were based on Western and/or European cohorts (n=60) and in acute care settings (n=56). 40 studies were secondary analyses of datasets derived from clinical trials, which were dominated by the Efficacy of Vasopressin Antagonism in Heart Failure Outcome with Tolvaptan (EVEREST; n=19 studies; 43 models) and Evaluation Study of Congestive Heart Failure and Pulmonary Artery Catheterization Effectiveness (ESCAPE; n=14 studies; 22 models) trials. Almost all

studies were rated as low-to-moderate bias across all six domains of QUIPS.

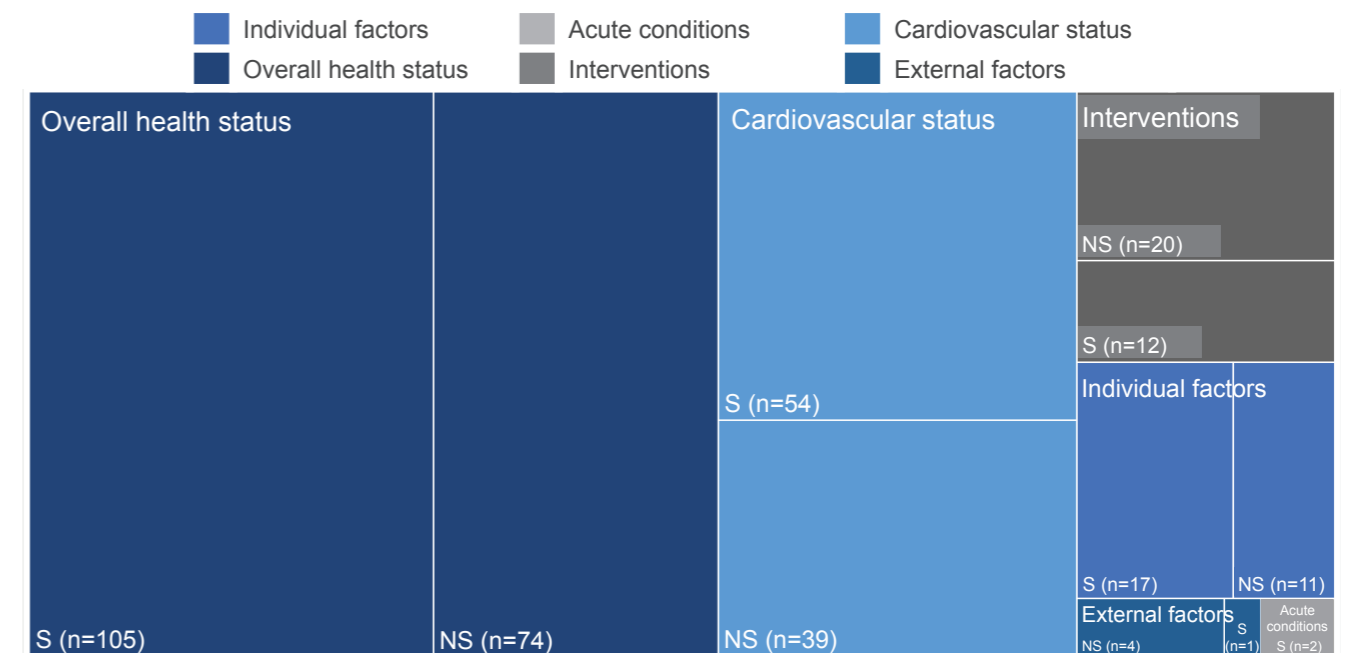
We broadly categorised the prognostic factors identified from the literature into six domains (Figure 1). Cardiovascular status and overall health status were the largest categories of prognostic factors that were commonly included across the 119 models. Under the cardiovascular status domain, variables related to cardiac-related medical parameters, cardiac imaging, clinical presentation, and cardiac biomarkers, were frequently investigated, and found to be associated with increased risk of ACM. For overall health status, variables related to renal function, other biomarkers used for research, full-blood count and liver function were commonly investigated and found to be prognostic indicators of ACM.

Three studies developed or externally validated nine prognostic models in ESHF populations. The models' discriminatory performances, defined as the area-under-the-curve (AUC), were found to be acceptable in these external cohorts (AUC ranged between 0.75 and 0.81). These models could potentially be validated in our local setting to predict one-year ACM to facilitate early referrals to palliative care.

Conclusions

This review provided an in-depth understanding of prognostic factors associated with ACM among ESHF populations that can be used to facilitate model development to predict short-term mortality. Further validation of the identified prognostic models is required to determine model performance in our local ESHF population.

Figure 1. Domains of prognostic variables in ESHF populations



S: Number of instances that the variables in each sub-domain was found to be significant across 119 models; NS: Number of instances that the variables in each sub-domain was found to not be significant across 119 models

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RISK FACTORS FOR ALL-CAUSE SHORT-TERM MORTALITY IN PATIENTS WITH END STAGE RENAL DISEASE: A SCOPING REVIEW

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HIGHLIGHTS

- 13 domains of risk factors have been identified to influence all-cause short term mortality in patients with ESRD.
- Further studies to examine the prognostic value of these risk factors will be needed.

Introduction

End-stage renal disease (ESRD) is a costly and disabling condition with a high mortality rate. However, there is a lack of commonly accepted and widely used prognostication frameworks for predicting and communicating prognostic information to patients and caregivers. In the context of advance care planning, prognostic information on short-term mortality can pave the way for conversations between physicians and patients on future care preferences such as palliative care. The aim was to review the risk factors that influenced the risk of all-cause short-term mortality in patients with ESRD.

Methods

A scoping review was conducted and reported in accordance with the established framework by Arksey and O'Malley and PRISMA guidelines^{1,2}. MEDLINE, Embase, PubMed, CINAHL, Cochrane Library and Web of Science electronic databases were searched for articles published between 2000 and 11 November 2020. Articles describing risk factors predicting short-term mortality (≤ 3 years) in patients with ESRD were included. Four reviewers independently performed title, abstract and full text screening as well as data extraction. Information on study design, sample size, missing data, statistical methodology, variables assessed, outcome information, risk factors in the final analyses, and model validation were extracted. Risk of bias in each study was assessed using the Quality In Prognosis Studies (QUIPS) tool checklist. Any inconsistencies between two reviewers were settled through discussions among the four authors.

Results

A total of 20,840 articles were identified and 113 studies were included for this review. Sample sizes of included studies ranged from 30 to 944,650 participants. The average ages of participants were between 45 years and 87.4 years. Of the 113 studies included, 6.2% of studies included only patients undergoing peritoneal dialysis (PD), 67.3% of studies included only patients undergoing haemodialysis (HD) and 20.4% included both PD and HD patients. Of the 7 studies that performed model validation, 4 conducted external validation. Across the 113 studies, 235 models assessed risk factors associated with mortality, which could be categorised into 13 domains (**Table 1**). The domain of proxy measures for poor health (e.g., history of readmission to hospitals, hospitalisations) was most commonly associated with increased all-cause short-term mortality risk. Majority of the studies were rated 'moderate risk of bias' for a lack of reporting on model diagnostics and limited adjustments on covariates.

Conclusions

This review provided a summary on the domains of the risk factors that influenced the risk of all-cause short-term mortality in patients with ESRD. While numerous studies have been conducted to examine the risk factors of short-term mortality, further studies are needed to examine the prognostic value of these risk factors.

Table 1. Overview of domains

Categorisation of domains	
1. Demographics/ lifestyle	8. Treatment related indicators
2. Comorbidities	9. Kidney status
3. Intradialytic blood pressure	10. Health status
4. Biomarkers	11. Cause of ESRD
5. Cardiovascular measurements	12. Access to healthcare care/ information
6. Frailty status	13. Proxy measures for poor health
7. Medications	

ESRD: End-stage renal disease

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DEVELOPMENT OF THE PROGNOSTIC MODEL FOR END-STAGE LUNG DISEASE (PRO-MEL) - PRELIMINARY RESULTS

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HIGHLIGHTS

- Of 1000 patients with a diagnosis of end-stage lung disease in Tan Tock Seng Hospital from July 2016 to October 2017, 12.2% died within one year.
- A logistic regression model developed to predict one-year mortality in these patients was able to differentiate decedents and survivors, with minimal bias in predicted risk scores.
- However, using a predicted risk score of 0.30 and above as an indication of high mortality risk, the model correctly identified only three in ten decedents and nine in ten survivors.

Introduction

End-stage lung disease (ESLD) comprises a heterogeneous group of chronic lung conditions where patients typically experience heavy burden of symptoms, such as dyspnea, cough and psychosocial issues. With an unpredictable trajectory towards death, referral to palliative care occurs less often than desired, usually weeks to days before death. Prognostication in these patients can help identify patients at high risk of deterioration, facilitating recommendations for earlier referrals to palliative care. We hence aimed to develop a prognostic model for one-year all-cause mortality in ESLD.

Methods

A retrospective cohort study design was adopted. Patients were recruited into the study if they had a recorded ESLD diagnosis at Tan Tock Seng Hospital from July 2016 to October 2017. Data was retrieved from the administrative and clinical databases of a group of public healthcare institutions in Singapore. Information extracted was classified into the domains of socio-demographics, lung disease characteristics, history and parameters of pulmonary function, biomarkers, functional or physiological measurements, historical utilisation as well as burden of comorbid conditions. The date of ESLD diagnosis within the study period was denoted as the reference visit date. All-cause mortality within 365-days of the reference visit date was the outcome of interest.

Missing data was imputed using multiple imputation by chained equations. Models were built using three variable selection methods, namely forward stepwise selection, backward stepwise selection and least absolute shrinkage and selection operator (LASSO) Variables selected for each method were tabulated, and those that were selected across all imputed datasets were used to construct the final models for each approach. Model performance measures reported are described in **Table 1**. Model coefficients and performance pooled across all imputed datasets were reported.

Table 1. Model performance aspects and measures reported

Model performance aspect	Description	Measure(s)
Discrimination	Ability to distinguish between survivors and decedents	Area under curve (AUC)
Calibration	Agreement between the observed and predicted mortality risks	Calibration intercept and slope

Model performance aspect	Description	Measure(s)
Clinical usefulness	Ability to impact decision-making	Sensitivity and specificity (of a specified predicted risk score threshold)

Results

Of 1000 patients who had an ESLD diagnosis from July 2016 to October 2017, 122 (12.2%) died within one year of the reference visit date. The median time to death for decedents was 132 (interquartile range: 47-224) days. The identified cohort comprised patients who had a diagnosis of chronic obstructive pulmonary disease (COPD) or emphysema (55%), bronchiectasis (38%), or interstitial lung diseases (12%), as well as multiple ESLD diagnoses (6%). Only 14 (1.4%) patients received an inpatient palliative referral.

Across the three variable selection methods, the final model selected via forward stepwise reported the smallest bias in calibration (intercept=0.01, slope=0.91), and an AUC of 0.76 (**Table 2**). Pooled model estimates for the forward stepwise model are reported in Table 3. Classifying patients with a predicted risk score of 0.30 and above to be at high risk of death, the model had sensitivity and specificity of 0.34 and 0.95 respectively, indicating that the model would correctly identify three of ten decedents and nine of ten survivors.

Table 2. Pooled model performance measures

	Estimate (95% CI)		
	Forward stepwise	Backward stepwise	LASSO
AUC	0.76 (0.76, 0.76)	0.72 (0.72, 0.73)	0.78 (0.78, 0.78)
Intercept	0.01 (-0.01, 0.03)	0.00 (-0.02, 0.02)	0.01 (-0.02, 0.03)
Slope	0.91 (0.89, 0.93)	0.88 (0.86, 0.90)	0.86 (0.84, 0.88)

AUC: Area Under Curve; CI: Confidence Interval; LASSO: Least Absolute Shrinkage and Selection Operator

Table 3. Pooled estimates of final model (Forward stepwise variable selection)

Prognostic factors	Pooled odds ratio (95% CI)
Age, per year increase	1.03 (1.01, 1.05)
Male gender, vs female gender	1.67 (1.03, 2.70)
Malay race, non-Malay race	2.49 (1.25, 4.94)
Diagnosed with interstitial pulmonary diseases, yes vs no	3.65 (2.02, 6.58)
Ever started on long term oxygen therapy, yes vs no	4.69 (1.82, 12.08)
Most recent Body Mass Index<18.5, yes vs no	3.06 (1.79, 5.24)
Require assistance with at least 1 Activity of Daily Living, yes vs no	2.63 (1.45, 4.75)
History of specialist outpatient visits in 6 months prior, yes vs no	0.43 (0.27, 0.69)
History/presence of cancer, yes vs no	3.43 (1.70, 6.94)
History/presence of cerebrovascular disease, yes vs no	2.83 (1.28, 6.23)

Conclusions

We identified a cohort of patients with ESLD, most of whom were diagnosed with COPD or emphysema and the mortality rate was 12.2% within one-year of diagnosis. PRO-MEL attained high discrimination but low sensitivity. This prognostic model could inform the decision to refer patients at high risk of death for Advance Care Planning discussions. The model will be subsequently validated in more recent patient cohorts to demonstrate its generalizability in predicting one-year mortality in patients with ESLD.

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10. **Pereira, M.J.**, Chong, E., **Molina, J.D., Ng, S.H.**, Goh, E.F., Zhu, B., Chan, M., & Lim, W.S. (2022). Evaluating Quality-of-Life, Length of Stay and Cost-Effectiveness of a Front-Door Geriatrics Program: An Exploratory Proof-of-Concept Study. *The Journal of Frailty & Aging*, 1 - 7.
11. Smail-Faugeron V, **Tan A**, Caille A, Yordanov Y, Hajage D, Tubach F, Martin G, Dechartres A. Meta-analyses frequently include old trials that are associated with a larger intervention effect: a meta-epidemiological study. *J Clin Epidemiol.* 2022 May;145:144-153. doi: 10.1016/j.jclinepi.2022.01.023. Epub 2022 Feb 4. PMID: 35131467.
12. **Tan WS**, Nai ZL, Tan HTR, Nicholas S, Choo R, Ginting ML, Tan E, Teng PHJ, Lim WS, Wong CH, **Ding YY**; Geriatric Services Hub Programme Group. Protocol for a mixed-methods and multi-site assessment of the implementation process and outcomes of a new community-based frailty programme. *BMC Geriatr.* 2022 Jul 15;22(1):586. doi: 10.1186/s12877-022-03254-6. PMID: 35840898; PMCID: PMC9288058.
13. Abraham M, Lim MJ, **Tan WS**, Cheah J. Global Trends Towards Population Health Management and Key Lessons and Initiatives in the Singapore Context. *Int J Integr Care.* 2022 Sep 16;22(3):19. doi: 10.5334/ijic.7016. PMID: 36186512; PMCID: PMC9479664.

GRANTS AND TRAINING AWARDS

RESEARCH GRANTS

2022 - 2024

Palliative Care Centre for Excellence in Research and Education: Research Grant \$22,250
Identifying distinct trajectories of healthcare expenditure among end-stage organ disease patients

Ms Sheryl Ng Hui Xian (PI)
Dr Tan Woan Shin (Mentor)
Ms Palvinder Kaur (Co-I)
Dr Allyn Hum Yin Mei (Co-I)
Dr Mervyn Koh Yong Hwang (Co-I)
Dr Andy Ho Hau Yan (Co-I)
Ms Tay Ri Yin (Co-I)
Dr Laurence Tan Lean Chin (Co-I)

2022 - 2027

NMRC - National Innovation Challenge (NIC) on Active and Confident Ageing ~\$8 million
Project Carer Matters 2

Dr Chan Ee Yuee (TTSH)(PI),
Dr Hoi Shu Yin
Prof Ian Leong Yi Onn
Prof Ding Yew Yoong
Prof Goh Kim Huat
Mave Tam
Shen Nansheng
Dr Tan Woan Shin
George Glass
Dr Ng Yih Yng

TRAINING AWARDS

2022 - 2026

NHG-LEARN Fund - NHG HQ sponsorship for formal qualification (L.E.A.R.N. scheme)
Saw Swee Hock School of Public Health, National University of Singapore

Ms Palvinder Kaur (PhD)

CONFERENCE PRESENTATION AND AWARDS

May 2022

GERI Knowledge to Practice Series

Multi-site, Multiple Methods Evaluation of the Geriatric Services Hub

Invited Speaker

Dr Tan Woan Shin

Advance Care Planning in Asia: A Research Sandpit

Evidence and Outcomes of Advance Care Planning

Invited speaker

Dr Tan Woan Shin

June 2022

TechXLR8 Asia

AI in Healthcare

Invited speaker & Panelist

Dr Ang Yee Gary

September 2022

16th Singapore Public Health & Occupational Medicine Conference

Association between domain-specific physical activity and lipid profile in a multi-ethnic Asian population: a longitudinal study - **2nd place**

Oral

Lixia Ge, Asst Prof Saima Hilal, Assoc Prof Falk Muller-Riemenschneider, Assoc Prof Chuen Seng Tan

NHG Quality Day 2022

Diabetic Foot in Primary and Tertiary (Definite) Care - **Merit Award**

Poster

Dr Lo Zhiwen, Dr Elaine Tan, Dr Liew Huiling, Dr Shaun Chan, Dr Hoi Wai Han, Dr Ang Yee Gary, Deborah Lim

October 2022

Singapore Health & Biomedical Congress 2022

Differences in factors and causes of medication non-adherence among young and old community-dwelling adults in Singapore - **Best Poster Award - Gold (Nursing)**

Poster

Ge Lixia

External validation and recalibration of the PROgnostic Model for Advanced Dementia (PRO-MADe) - **Singapore Young Investigator Award - Merit (Health Services Research)**

Oral

Palvinder Kaur, Palvannan K, Sheryl Ng Hui Xian, Jermain Chu, Carin Low Zhi Jun, Dr Tan Woan Shin, Assoc Prof Ding Yew Yoong, Adj Assoc Prof Allyn Hum

Validation of Risk Prediction Equation for Incident Chronic Kidney Disease in a Diabetic Singapore Cohort - **Singapore Clinician Investigator Award - Bronze (Clinical Research)**

Poster

Dr Wong Siow Yi, Dr Weng Wanting, Reuben Ong, Sheryl Ng, Dr Ang Yee Gary, Dr Lim Chee Kong, Assoc Prof Yeo See Cheng

A Graph-theoretic Facility Layout Planning for An Eye Specialist Outpatient Clinic

Poster

Dr Meng Fanwen, Teow Kiok Liang, Lim May Lan

Comparing Logistic Regression and Cox Proportional Hazards models: a retrospective study prognosticating 5-year CKD-3A risk among primary care diabetes patients

Poster

Reuben Ong, Sheryl Ng Hui Xian, Dr Ang Yee Gary, Palvinder Kaur, Dr Wong Siow-Yi, Dr Weng Wanting, Dr Lim Chee Kong, Adj Asst Prof Yeo See Cheng

Cost effectiveness analysis of rapid PCR (rPCR) screening for Carbapenemase-Producing repetition Gram negative bacilli (CPGNB) in Singapore

Poster

Dr Sun Yan, Pei Yun Hon, Wei Xiang Lian, Janis Loh, Jia Qi Kum, Janice Leong, Christine Chu, Bee Fong Poh, Kalisvar Marimuthu, Oon Tek Ng, Angela Chow, Brenda SP Ang, Partha P De, Shawn Vasoo

Evaluation of risk stratification in Agency for Care Effectiveness appropriate care guide on "Diabetes Foot Assessment in people with diabetes"

Poster

Dr Ang Yee Gary, Dr Sun Yan

October 2022

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Singapore Health & Biomedical Congress 2022

Impact of Chronic Care Plan - A bundle payment plan with incentives for patients to improve chronic disease care

Poster

Dr Christopher Chong Wern Siew, **Dr Yip Wan Fen**, Jeremy Lew Kaiwei, David Kok Hwa Chieh, Dr Tan Woan Shin, Assoc Prof Tang Wern Ee

Integrated Diabetes Care Program -An evaluation of clinical outcomes

Poster

Palvinder Kaur, Dr Michelle Jessica Pereira, Dr Joseph Antonio D. Molina, Dr Quek Zhi Han, Oei Chien Wei, Dorothy Chen, Teo Hwei Yee, Dr Quek Peng Lim Timothy

Is social isolation impacting workplace productivity? A population-based study on productivity loss from depression compounded by social isolation

Poster

Joey Ha Wei Yee, Dr Michelle Jessica Pereira, Ge Lixia, Dr Yap Chun Wei

Pre-post survey of knowledge, attitudes and confidence of nursing home staff undergoing virtual training for Advance Care Planning facilitation

Poster

Sheryl Ng Hui Xian, Joanne Selva Retnam, Roland Chong, Linda Yiu, Dr Raymond Ng, Dr Tan Woan Shin, Dr Adeline Lam

Profile of deceased Home Ventilation & Respiratory Support Service (HVRSS) patients and their end-of-life care received

Poster

Chieh Pann Pei, Dr Michelle Jessica Pereira, Dr Joseph Antonio D. Molina, Nicole Kow Mei Ting, Zhang Junjun, Dr Yee Choon Meng, Dr Lee Rui Min, Sun Tao, Li Aiyu, Dr Chan Yeow

Singapore Resident Population projection and observations

Poster

Teow Kiok Liang

Sources of social support in health resilience: A comparison across adults of different age groups

Poster

Dr Yip Wan Fen, Ge Lixia, Chieh Pann Pei, Eric Chua Siang Seng, Assoc Prof Ringo Ho Moon-Ho, Evon Chua Yiwen, Adj Assoc Prof Ian Leong Yi Onn, Assoc Prof Andy Ho Hau Yan, Dr Tan Woan Shin

October 2022

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Singapore Health & Biomedical Congress 2022

The role of telephone triage in right-siting potential Emergency Department presentations: A review of reviews

Poster

Joey Ha Wei Yee, Chieh Pann Pei, Dr Joseph Antonio Molina

November 2022

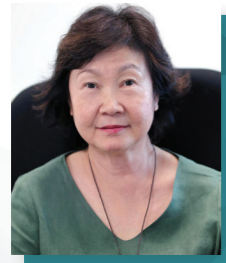
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National Healthcare Innovation and Productivity Medals 2022

Diabetic Foot in Primary and Tertiary (Definite) Care - Medal Award

Dr Lo Zhiwen, Dr Elaine Tan, Dr Liew Huiling, Dr Shaun Chan, Dr Hoi Wai Han, **Dr Ang Yee Gary**, Deborah Lim

THE TEAM



Dr Heng Bee Hoon
MBBS, MSc (Public Health), FAMS
Senior Director



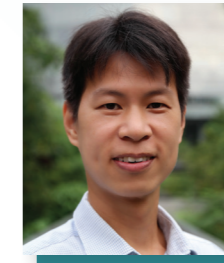
A/Prof Ding Yew Yoong
MBBS, FRCP, FAMS, MPH, PhD
Visiting Consultant
(Senior Consultant &
Clinical Associate Professor,
Geriatric Medicine, TTSH)



Dr Ang Yee Gary
MBBS, MPH, Dip (Family Med),
GDMH, Dip (Family Practice
Dermatology)
Consultant (Public Health)



Ms Christina Chieh Pann Pei
BSc (Biotechnology)
Senior Executive



Mr Eric Chua Siang Seng
BSc (Hons) (Business Management),
Dip (Electrical & Electronics Engineering)
Senior Executive



Ms Ge Lixia
BMed (Nursing),
MSc (Physiology), MPH
Senior Research Analyst



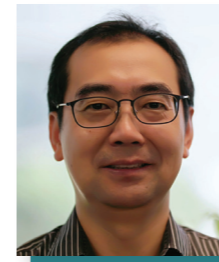
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Senior Research Analyst



Dr Li Ruijie
Dip (Occupational Therapy), MSc
(Occupational Therapy), PhD
(Biostatistics)
Principal Research Analyst



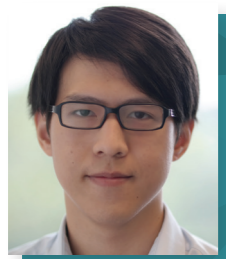
Dr Meng Fanwen
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Principal Research Analyst



Dr Joseph Antonio D. Molina
MD, MSc (Public Health)
Head of Implementation &
Outcomes Evaluation (Programmes)



Ms Sheryl Ng Hui Xian
BSc (Hons) (Statistics), MPH
Senior Research Analyst



Mr Reuben Ong
BA (Psychology)
(Magna Cum Laude)
Executive



Dr Michelle Jessica Pereira
BPhy (Hons I), MPhy (Sports
Physiotherapy),
PhD (Public Health and Health Services,
Applied Health Economics)
Principal Research Analyst



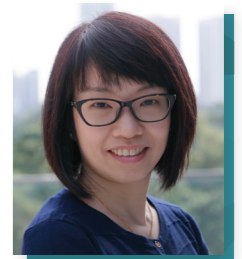
Mr Palvannan R. K.
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Engineering)
Head of Data Science &
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