
HEALTH SERVICES & OUTCOMES RESEARCH
HSOR
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2012
National Healthcare Group
Adding years of healthy life

FOREWORD

Year 2012 saw the birth of the Regional Health Systems (RHS), that shifted NHG's focus to population health management in the Central Region and seamless integration of care for our patients from the hospital to the community. In line with these developments, HSOR supported stakeholders in NHG institutions in providing information and knowledge for their planning, organisation and delivery of services. There was a need to review processes, evaluate systems and support capacity planning of new facilities such as the integrated intermediate care hub and new polyclinics, using operations research and other techniques. In support of population health management, a multidisciplinary team carried out profiling and risk stratification of patients within the NHG, and prediction modelling of patients at risk of readmission or death. This required the use of health informatics encompassing merging multiple large routine administrative systems, data mining, decision modelling and geographic information science. As the majority of residents within our Central Region are largely unknown to the NHG, a pilot survey in collaboration with the community to assess their health and social needs was designed and piloted. Care integration and pilot programmes on new models of care were evaluated for effectiveness, patient satisfaction, quality of life, and cost impact. *Providing the best available evidence for decision making and knowledge translation* is a critical mission of the department.

Efforts in capacity building in health services research was further strengthened. Talks, workshops and courses were held during the year — topics included Health Services Research, Operations Research, Economic Evaluation in Healthcare, Framing the Research Question, Designing a Research Protocol, and Health Programme Planning and Evaluation. *Capacity building in health services research* is an important second mission. Another contribution towards health profession education is the curriculum and content development for the Lee Kong Chian School of Medicine by members of the team with adjunct faculty appointments in Public Health and Health Services & Outcomes Research.

The experiences and knowledge of the team were shared at local and international conferences, and publications in peer reviewed journals. The recognition of contribution of new knowledge was exemplified by awards and research grants. Support by collaborators, partners and stakeholders in our institutions and agencies beyond NHG had made *advancing knowledge in health services research*, the third mission of the department possible. A summary of some of the work is in this report. I wish you an enjoyable read.

Prof Chee Yam Cheng
Group Chief Executive Officer
National Healthcare Group

HSOR

The evidence behind your decisions

OUR VISION

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

OUR MISSION

We will improve the quality of healthcare by providing best available evidence for decision making and knowledge translation; and building capacity and advancing knowledge in HSR.

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PROJECTS

POPULATION HEALTH & MANAGEMENT OF DISEASES

DETERMINANTS OF HEALTH-RELATED QUALITY OF LIFE AMONG COMMUNITY-DWELLING ELDERLY IN SINGAPORE

Dr Pradeep Paul George Gunapal, Dr Heng Bee Hoon, Wong Lai Yin, Charis Ng Wei Ling

BACKGROUND

Singapore is experiencing an unprecedented age shift, the country's growing elderly population has multiple coexisting medical conditions which are often associated with functional decline, disability, higher hospital admissions and emergency department attendances.

Against this backdrop, this study was conducted to identify the determinants of health-related quality of life (HRQoL) among community-dwelling elderly in Singapore.

METHODS

A population-based cross-sectional survey was done to assess the health status, health and social care resource needs and utilisation profile of individuals aged 60 years and above. The survey was conducted between April and May 2011 among a random sample of 4,200 residents living in Marine Parade. A structured questionnaire was used to collect data on demographic characteristics, chronic disease profile, health screenings, healthcare utilisation, physical activity, activities of daily living (ADL) and functional ability, and HRQoL. Quality of life was assessed using the EQ-5D. UK value sets were used to derive the EQ-5D utility index for Singapore. Ordinary least squares (OLS) regression was used to identify independent predictors of HRQoL.

RESULTS

A total of 3,752 residents were eligible for inclusion in the study, of which 2,558 residents were interviewed, giving an overall response rate of 68.2%. Excluding 104 proxy respondents, there were 2,454 respondents for the final analysis. Most of the respondents were females (57.2%) and aged between 65 and 74 years (48.5%). 79.1% of the respondents were Chinese. Approximately three-fourth (77.5%) of the survey respondents reported having at least one of the 13 chronic medical conditions. High blood pressure (57.7%), high blood cholesterol (51.6%), diabetes (22.9%), arthritis (16.6%), osteoporosis (9.6%), heart attack (4.9%), asthma (4.2%) and stroke (3.5%) were the most commonly reported conditions. Independent predictors of HRQoL with greatest decrements in the EQ-5D index and visual analog scores (VAS) were unemployment, self-reported depression, arthritis, osteoporosis, and ADL limitations such as "unable to shower" and "unable to do housework", and elderly with depressive symptoms (Geriatric Depression Scale score $\geq$ 5) (Table 1).

Table 1 – Regression coefficients for significant predictors of the EQ-5D VAS and index score

Categories	EQ-5D VAS ($R^2 = 0.12$)		EQ-5D Index ($R^2 = 0.36$)	
	UnS (b)	S(B)	UnS (b)	S(B)
Intercept	87.587**		0.976**	
Age	0.076	0.038	0.001**	0.053
Females	-1.453*	-0.052*	0.001	0.004
Indian	3.140*	0.048	-0.042**	-0.064
Work status : Unemployed	-6.510**†	-0.070	-0.098**†	-0.105
Income < $500	-3.845*	-0.122	-0.023	-0.073
Owner	0.395	0.012	-0.032**	-0.094
Tenant	-2.963	-0.079	-0.063**†	-0.167
Housing type: 4-room	-5.610*†	-0.194	-0.021	-0.070
Housing type: 1-/2-room	-6.217**†	-0.197	-0.023	-0.072
Self-reported Chronic Conditions				
Urinary incontinence	-2.789**	-0.065	-0.012	-0.030
Hearing problems	-2.132**	-0.052	-0.006	-0.017
Falls	-1.742	-0.043	-0.018*	-0.045
High blood pressure	-1.794**	-0.064	-0.011	-0.040
Chest pain	-1.714	-0.025	-0.049**	-0.073
Dementia	8.846	0.033	0.145**	0.055
Depression	-6.682*†	-0.051	-0.142**†	-0.111
Arthritis	-3.121**	-0.082	-0.043**	-0.116
Osteoporosis	-2.782*	-0.058	-0.051**	-0.108
Activities of Daily Living				
Unable to feed	-8.146	-0.030	-0.179**†	-0.069
Unable to dress	-7.661	-0.057	-0.191**†	-0.146
Unable to get out of bed/chair	11.868**	0.114	0.012	0.012
Unable to shower	-9.265*	-0.090	-0.063	-0.063
Unable to use the toilet	-0.444	-0.003	-0.094**	-0.080
Unable to use the telephone	9.107**	0.074	0.020	0.017
Unable to shop for groceries/clothes	-0.492	-0.009	-0.041*	-0.078
Unable to do housework	-4.853**†	-0.102	0.005	0.011
Unable to handle his/her money	-3.091	-0.031	-0.064**	-0.066
Geriatric Depression Scale (GDS-15) score	-0.119**	-0.087	-0.000**	-0.055

UnS – Unstandardised Coefficients; S – Standardised Coefficients
Reference categories: Males, Chinese, Working full-time, Income ≥ $3,000, Ownership status Others, Housing type 5-room, absence of the above-stated chronic conditions and no limitations in the above ADLs.
*$p < 0.05$, **$p < 0.01$
† Top five predictors associated with lower absolute EQ-5D index / VAS with largest coefficients

CONCLUSIONS

Singapore is countering ageing by rolling out several active ageing initiatives to enhance the quality of life of the elderly. At this juncture, this study identified significant predictors of HRQoL in elderly Singapore residents, which could be potential targets for active ageing interventions. The study also provides community-based EQ-5D index and VAS scores associated with a wide variety of chronic conditions and ADL limitations, which can be used to estimate quality-adjusted life-years in cost-effectiveness analyses.

SOCIOECONOMIC STATUS AND SOCIAL SUPPORT WITH DEPRESSIVE SYMPTOMS AMONG THE ELDERLY IN SINGAPORE

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BACKGROUND

Depression in the elderly is a major public health issue, and is often a function of many contributing factors, which include biological, psychosocial, or environmental characteristics. Socioeconomic status (SES) and social support are risk factors for depression. Studies have suggested that low SES reduces individuals' capacity to manage stress, and increases one's vulnerability to negative emotions and cognitions. Having a weak external social network was also found to be associated with higher depressive symptom scores in elderly Singaporeans. Social support may also moderate the impact of SES on health. However, the association between social relations and health across SES groups in the Singapore population is unclear.

This study aimed to investigate the influence of SES and social support in elderly depression, and the modifying effect of social support on the relationship between SES and depression.

METHODS

A community-based survey was conducted on residents 60 years and above living in 2- to 5-room housing in the Marine Parade estate. Depressive symptoms were determined using the 15-item Geriatric Depression Scale. Scores ≥ 5 were suggestive of depression. SES was measured by education level and housing type. Social support was measured using living arrangement, frequency of contact with family members, and the perception of being socially isolated. Multivariable logistic regression was performed to determine the odds ratio (OR) of depressive symptoms with respect to SES and social support, and interaction terms between the two variables.

RESULTS

Of 2,447 responses analysed, 188 (7.8%) respondents had depressive symptoms. Living in 2-room housing, living alone or with domestic helper, infrequent leisure time with children/grandchildren or being childless, and feeling socially isolated were independently associated with depressive symptoms (Table 1).

Table 2 presents the adjusted ORs of the interaction between social support measured by living arrangement and SES measured by housing type. Reflecting the highest extent of social support and SES, residents living with their spouse and children/grandchildren in 4-/5-room housing defined the reference group. Relative to the reference group, the highest ORs for depressive symptoms were those living with spouse and children in 2-room (OR=3.06, $p<0.05$), followed by living with children only in 3-room (OR=2.98, $p<0.05$), and living alone or with domestic helper in 4-/5-room (OR=2.73, $p<0.05$). Living with spouse only appears to buffer against depressive symptoms across socioeconomic classes, although the effect was not statistically significant.

Table 1 – ORs of having depressive symptoms with respect to SES and social support

	Odds Ratio	95% CI	*p* value
Socioeconomic Status (SES)			
Highest Education Level			
Primary & lower	1.29	0.94 – 1.77	0.112
Housing Type			
3-room	1.10	0.61 – 1.98	0.755
2-room	3.06	1.52 – 6.16	0.002
Social Support			
Living Arrangement			
Spouse only	1.05	0.57 – 1.93	0.879
Children/grandchildren only	0.74	0.31 – 1.77	0.494
Alone or with domestic helper	2.73	1.31 – 5.69	0.007
Others (relatives, friends, tenant)	1.82	0.78 – 4.24	0.166
Frequency of Leisure Time Spent			
Less than once a month	1.51	1.04 – 2.19	0.028
Childless	1.73	1.14 – 2.60	0.009
Social Isolation			
Occasionally or often	7.12	4.87 – 10.40	< 0.001

CI – Confidence interval
Reference categories: Secondary & higher, 4-/5-room, Spouse with children/grandchildren, At least once a month, Never or rarely

Table 2 – ORs of interactions between SES and social support

		Social Support				
		Alone or With Domestic Helper	Others (relatives, friends & tenant)	Children/ Grandchildren Only	Spouse Only	Spouse & Children/ Grandchildren
Socioeconomic Status	2-room	0.47	**0.29***	0.93	1.06	**3.06***
	3-room	0.54	0.39	**2.98***	1.00	1.10
	4-/5-room	**2.73***	1.82	0.74	1.05	1.00 (ref)

* $p < 0.05$

CONCLUSIONS

Low social support and low SES significantly increased the odds of depressive symptoms. The moderating effect of social support on depression was however not consistent across SES groups. Specific interventions would need to target different SES groups to better help older adults at risk of developing depression.

RISK STRATIFICATION MODEL FOR POPULATION MANAGEMENT IN CENTRAL REGION

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BACKGROUND

The identification of a patient's health risk level is the first important step towards planning, developing and implementing a personalised patient care plan by the health care provider, in collaboration with the patient. A patient-centred care plan may help the patient achieve better clinical outcomes and quality of life through prevention strategies, stabilising existing chronic disease conditions, and preventing acceleration to a higher risk category with higher costs.

It is a great challenge to accurately predict patients' risk level and as real time as possible using readily available information, due to the heterogeneity of patients and the complexity of health and health care. Currently there is no readily implementable model that stratifies the patients' risk in the Central Region of Singapore. A patient's actual risk level is usually measured by the resource utilisation in the health care system. Patients with higher number of hospital admissions are considered as higher risk.

This study aimed to develop and validate a prognostic model for stratifying patients' risk of readmitting to hospital within 1 year after discharge using routinely collected patient data.

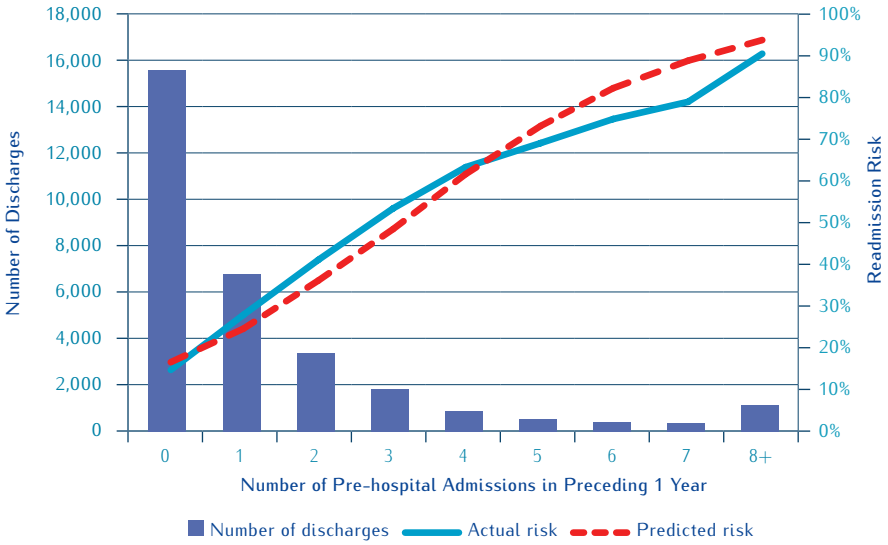
METHODS

Logistic regression was applied for predictive modelling, and split validation was used for model validation. Patients discharged from medical disciplines in Tan Tock Seng Hospital in 2010 were included in the study. Patients who died in the hospital, died without readmission, discharged against doctor's advice, or who were not Singapore Citizens or Permanent Residents were excluded from the study. All patients were followed up for 1 year. Data were extracted from administrative databases, and the number of readmissions in 1 year after discharge was the primary outcome of the study.

RESULTS

Patients' readmission risk was associated with utilisation history, age, diagnoses, comorbid conditions (renal disease, diabetes, chronic obstructive pulmonary disease, cancer, heart failure, rheumatologic diseases, and liver disease), Medifund or public assistance, and admission type (emergency or elective). The number of hospital admissions in the preceding 1 year was identified as the most important predictor. The c-statistics of the ROC by the model using only the number of hospital admissions in preceding 1 year was 0.76 (95% CI: 0.76-0.78). The actual admission risk monotonically increased with the number of prior admissions (Figure 1). Among patients with ≥ 5 admissions in the preceding year, more than 70.0% were readmitted more than once. The predicted readmission risk by the model fitted the actual readmission risk well; the goodness of fit test also showed that the difference between the predicted and actual readmission risk was not significant.

Figure 1 – Predicted and actual readmission risk with the number of hospital admissions in preceding 1 year



CONCLUSIONS

The easily implementable proactive risk stratification model using only one predictor stratifies patients' risk of hospital readmission with good prediction accuracy. Well-structured interventions targeted at patients with different risk levels may improve patients' outcomes and reduce hospital expenditure.

PROFILING TAN TOCK SENG HOSPITAL PATIENTS TO INFORM POPULATION HEALTH MANAGEMENT IN SINGAPORE

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BACKGROUND

As a first step to initiate population health management strategies within the hospital care setting, it is crucial to have a good understanding of the patient pool that the hospital caters to. This cross-sectional study focused on inpatients admitted to Tan Tock Seng Hospital (TTSH) in 2011.

METHODS

Data on all inpatients admitted to TTSH in 2011 were extracted from the Operations Data Source (ODS). Chronic disease information for each patient was obtained by linking patients to the Chronic Disease Management Database (CDMD).

RESULTS

A total of 47,155 inpatients accounted for 67,093 episodes (Table 1). The average number of inpatient episodes per patient was 1.5. Inpatients having $\geq$ 2 episodes were more likely to present with chronic diseases such as diabetes, hypertension, dyslipidemia and chronic kidney disease compared to inpatients with one episode in 2011 (Table 1). Resource utilisation in terms of average number of Emergency Department (ED) and Specialist Outpatient Clinic (SOC) visits was also higher for inpatients with $\geq$ 2 episodes compared to inpatients with one episode in 2011 (Table 1).

Overall, increasing age and increasing number of chronic diseases were associated with an increase in the average number of inpatient episodes (1.1 visits for inpatients $<$ 15 year old to 1.6 for inpatients $\geq$ 85 years; 1.1 for inpatients with no comorbidities to 2.5 for inpatients with nine comorbidities).

Inpatients with $\geq$ 5 chronic diseases had a median age higher than that of inpatients with one chronic disease (69 years vs 49 years). The average length of stay (ALOS) for all inpatients was 7 days. Inpatients with more chronic diseases had higher ALOS, especially for inpatients with a combination of diabetes, hypertension, dyslipidemia, stroke (ALOS=14.4 days).

Table 1 – Characteristics of inpatients admitted to Tan Tock Seng Hospital in 2011

	All		With 1 Episode		With ≥ 2 Episodes	
Number of episodes	67,093		36,270		30,823	
Number of patients	47,155		36,270		10,885	
Average number of episodes	1.5		1.0		2.8	
Age (years)*						
Median (all)	60		57		68	
Median (Male)	58		55		65	
Median (Female)	63		59		72	
< 15	20	(0.1%)	19	(0.1%)	1	(0.0%)
15–44	12,540	(26.5%)	11,141	(30.4%)	1,399	(12.9%)
45–64	15,256	(32.4%)	11,938	(32.5%)	3,318	(30.5%)
65–84	15,581	(33.0%)	10,844	(30.5%)	4,737	(43.5%)
≥ 85	3,758	(8.0%)	2,328	(6.5%)	1,430	(13.1%)
Gender*						
Male	25,045	(53.1%)	19,175	(52.9%)	5,870	(53.9%)
Female	22,110	(46.9%)	17,095	(47.1%)	5,015	(46.1%)
Ethnicity*						
Chinese	33,957	(72.1%)	25,707	(70.9%)	8,250	(75.8%)
Malay	4,836	(10.3%)	3,692	(10.1%)	1,144	(10.5%)
Indian	4,870	(10.3%)	3,811	(10.6%)	1,059	(9.7%)
Other	3,492	(7.3%)	3,060	(8.4%)	432	(4.0%)
Chronic Diseases#						
Diabetes	14,193	(30.1%)	9,546	(26.3%)	4,647	(42.7%)
Hypertension	21,309	(45.2%)	14,441	(39.8%)	6,868	(63.0%)
Dyslipidemia	24,908	(52.8%)	17,352	(47.8%)	7,556	(69.4%)
Stroke	7,357	(15.6%)	4,668	(12.9%)	2,689	(24.7%)
BMI ≥ 23 Kg/m^2	15,873	(33.7%)	11,259	(31.0%)	4,614	(42.4%)
Chronic Heart Disease (CHD)	8,089	(17.2%)	5,101	(14.1%)	2,988	(27.5%)
Heart Failure	3,643	(7.7%)	1,891	(5.2%)	1,752	(16.1%)
Chronic Kidney Disease (CKD)	11,564	(24.5%)	7,025	(19.4%)	4,539	(41.7%)
Asthma	2,781	(5.9%)	1,876	(5.2%)	905	(8.3%)
Chronic Obstructive Pulmonary Disease (COPD)	1,864	(4.0%)	1,022	(2.8%)	842	(7.7%)
Hip fracture	1,533	(3.3%)	922	(2.5%)	611	(5.6%)
Osteoporosis	1,455	(3.1%)	856	(2.4%)	599	(5.5%)
Total Number of ED Visits[a]	68,496		40,080		28,416	
Average number of ED visits per patient	1.8		1.4		2.9	
Total Number of SOC Visits[b]	343,125		215,431		127,694	
Average number of SOC visits per patient	9.4		8.0		13.1	

* Number and proportion of patients presented
\# Column percentage presented
All Chi Square *p* values were < 0.001

[a] Source – EDWeb from TTSH ED for 2011
[b] Source – ODS for 2011

CONCLUSIONS

Older patients and patients with more chronic diseases are more likely to be admitted as inpatients within one calendar year. With the ageing Singapore population, it is vital to implement effective population health improvement strategies. A few ways in which this can be achieved are by:

a) Empowering primary care physicians — this will not only reduce avoidable readmissions, but also decrease the burden on ED and inpatient wards.

b) Activating and engaging patients through appropriate patient education programmes to better understand their health status and take responsibility of their own health — this will result in an overall improvement of health status especially for the 'high risk' people in the population.

c) Lastly, it is vital to pay attention to capacity building in Singapore keeping in mind that by year 2030, one in every five individuals will be ≥ 65 years, with the majority falling under the 'high resource utilisers' group.

HEALTH SCREENING PERCEPTIONS IN SINGAPORE — A GROUNDED THEORY STUDY

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BACKGROUND

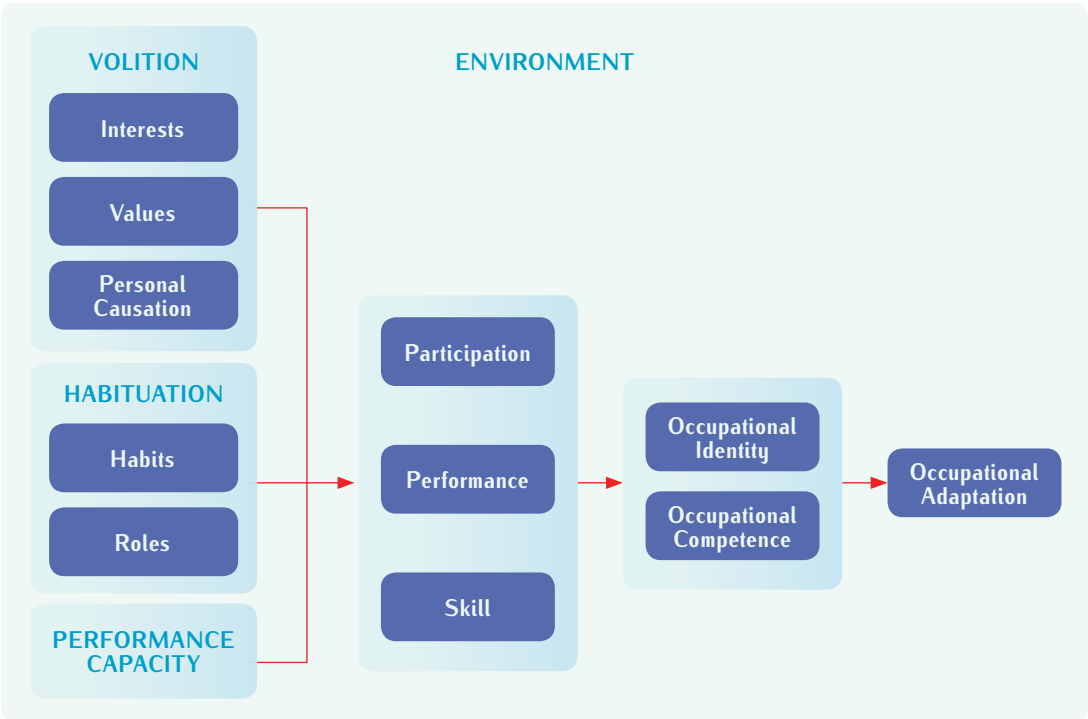
Routine health screening has been increasingly used to detect various forms of diseases such as hypertension, hyperlipidaemia, diabetes, cancers etc. These screenings have led to early detection of diseases, leading to a reduction in mortality and morbidity. These reductions would not have been possible had screening not been initiated in the first place. Hence, to sustain reductions in mortality and morbidity, we need to better understand the perceived barriers and motivators of health screening.

The objective of the study was to develop an understanding of the health screening perceptions in Singapore using a grounded theory approach.

METHODS

The study was conducted within Tan Tock Seng Hospital. Visitors to the hospital were sampled at random and the inclusion criteria was individuals aged 40 and above, as it was the minimum age recommended by Singapore's Clinical Practice Guidelines for the routine screening for various diseases. The main mode of inquiry was semi-structured interviews designed around the theme of health screening. The Model of Human Occupation (MOHO) was used to structure the questions of the interview (Figure 1). MOHO provided a framework to consider the response from the interviewees in relation to health screening. Concurrently, a grounded theory approach guided the line of interviewing to explore how the various perceptions were formed.

Figure 1 – Model of Human Occupation (adapted from Kielhofner, G. (2002) A Model of Human Occupation: Theory and Application)



RESULTS

Five main themes emerged from the analysis — "price considerations", "value of screening", "motivation to screen", "barriers to screening" and "attitude towards health". The "price considerations" theme revealed that there were mainly two groups of respondents: one group had a predetermined price point in which they were prepared to pay for health screening while the other considered the price in relation to the type of health screening services offered. The "value of screening" theme comprised two opposing sub-themes: "sees value in screening" and "questions value of screening". Reasons for the opposing values stem partly from prior experiences with health screenings. The group that valued screening used the screening results as an assurance that their health was in good order whereas the group that questioned the value of screening have had the experience where repeated screenings yielded nothing or inconclusive results.

The "motivation to screen" theme groups the reasons cited by the respondents on why they opted to undergo health screening. Three subthemes emerged from this theme which corresponded to the "volition", "habituation" and "environment" constructs of MOHO. Environmental factors appeared to push respondents towards health screening as a prerequisite for events like buying insurance and passing the Individual Physical Proficiency Test. Sub-themes under volition covered mainly intrinsic sources of motivation such as curiosity and desire for early detection of diseases. This was one subtheme under habituation which was "established habit".

The "barriers to screening" theme discussed the deterrents to health screening. Similar to the "motivation to screen" theme, the sub-themes corresponded to the constructs "environment", "volition" and "habituation" of MOHO. Environmental barriers related primarily to costs, easy accessibility to care and long queues for free screenings. Volitional barriers included "unwilling to detect early as it disrupts quality of life" and "false positives create worry". Habituation barriers related to the lack of a habit for screening and competing roles. These related to "competing priorities" and "having no time due to work". The "attitude towards health" theme included the sub-themes "does not actively maintain health" and "fatalistic towards health". These sub-themes can be conceptualised as part of the volitional sub-system of MOHO.

CONCLUSIONS

The results can be further synthesised using the MOHO to structure and conceptualise the various themes. Many of the themes related to the "values" construct within MOHO. An example was the sub-theme "pressure from family members". These values provided insight into how a person's values influenced their decision to undergo health screening. From the sub-theme highlighted above, it provided us with possible interventional strategies such as focusing on the family units rather than individuals in efforts to promote health screening.

The "personal causation" construct of MOHO also yielded valuable insights into the health screening perceptions. Sub-theme "fatalism towards health" from "attitude towards health" suggested a perceived lack of control over one's health. This can adversely lead to a desire not to undertake health screening. The uncovering of this theme provided us with some ideas on potential ways to encourage health screening.

The "environment" construct of MOHO was also found to be an important influencer of health screening behaviour. Various external environmental conditions such as improved accessibility, lowered costs and health screening as a prerequisite for certain processes were push factors for health screening.

Further studies can look into the relationships between the various factors and the specific profiles of the respondents. This will allow better targeting of the respondents in promotional activities to encourage health screening uptake.

EVALUATION OF THE FALLS COMMUNITY HEALTH ENGAGEMENT PROGRAMME (FALLS-CHEP)

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BACKGROUND

Falls are common yet preventable causes of morbidity which may result in prolonged and serious disability even among healthy elderly individuals. While hospital-based patient safety standards are in place to prevent falls among hospitalised patients, there is an equally pressing need for community-based preventive programmes. The Community Health Engagement Programme (CHEP) is a 5-year community-based programme which aims to improve physical performance and reduce the incidence of falls among individuals 57+ years old through interventions which include health screening, education, exercises and when necessary, specialist referrals.

METHODS

Through Senior Activity Centres of pre-selected blocks, residents of 1-2 room flats were invited to participate in the programme. Participants were screened for their risk of falling, and were grouped by risk levels based on the Berg's balance and time-up-and-go tests. Occupational physiotherapists and nurses provided each group with exercise training, health education and home safety assessment in the first 3 months. During the maintenance phase in the following 9 months, trained community volunteers took over the supervision of exercises. Monthly falls incidence was assessed through phone calls. Five physical performance tests and qualitative assessments of health-related quality of life, falls efficacy and mobility were conducted at baseline, 12-, 24- and 52-weeks. Results were compared between baseline and each follow-up.

RESULTS

There were 745 participants, with a median age of 73 years; 28.0% were male and 84.0% were of Chinese ethnicity. Falls incidence was higher in the year before programme participation (OR=2.43, 95% CI: 1.39-4.24). There were fewer falls per person on the 3rd and 4th quarter of follow-up than baseline (95% CI of difference: 0.013-0.164 and 0.041-0.172, respectively) (Figure 1). The number of falls was not significantly different between baseline and the first two quarters of follow-up. Results of the Berg Balance, Six Minute Walk, Chair Rise, Step Test and the three qualitative assessments were significantly better at 12-, 24- and 52-weeks than baseline (Figure 2). Improvement was significant for the Time-up-and-go test up to week 24. Home safety improved post-intervention (95% CI of difference in Safer score: 2.01-2.43).

Figure 1 – Average number of falls per person per month

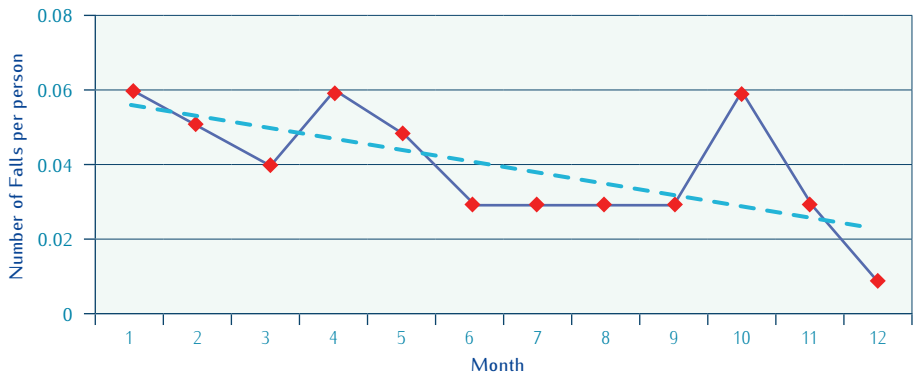
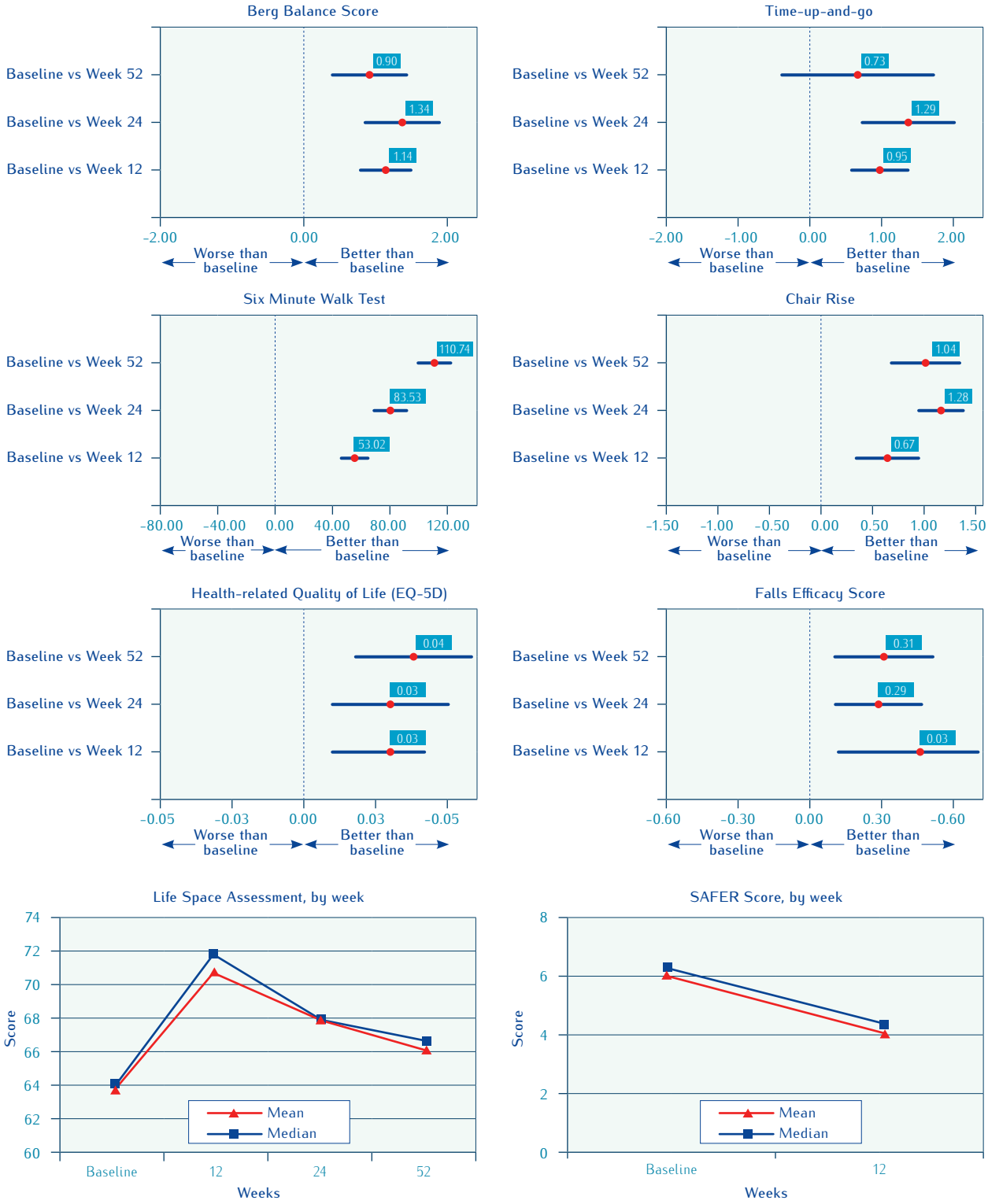


Figure 2 – Difference between baseline and follow-up results



CONCLUSIONS

Favourable results during the maintenance phase suggested that residents can be empowered to take responsibility for preventing falls in their own community.

EFFECTIVENESS OF AN END-OF-LIFE PROGRAMME IN REDUCING HEALTHCARE UTILISATION FOR NURSING HOME RESIDENTS

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BACKGROUND

Repeated hospitalisations are common in nursing home residents at the end-of-life. Studies indicate that palliative care can reduce hospitalisation and thereby improve quality of life. However, resource constraints prevent nursing homes from providing palliative care. In 2009, Project CARE (CAre at the end-of-life for Residents in homes for the Elderly) was initiated by Tan Tock Seng Hospital to provide palliative care in seven nursing homes. Physicians identified residents with a prognosis of 1 year or less. Advance care planning was done to elicit residents' or their family members' preferences for end-of-life care. Residents who preferred to receive conservative or limited additional care in the nursing home received palliative care.

The aim of this study was to evaluate the effectiveness of Project CARE in reducing healthcare utilisation.

METHODS

A quasi experimental study design was applied, comparing nursing home residents who received palliative care with a historical matched cohort group who received routine care. The historical cohort group was chosen over a 2-year period prior to the initiation of Project CARE. Outcomes were hospitalisation (yes/no), number of hospitalisations and cumulative length of stay in the 1- and 3-months before death. Bivariate analyses were conducted to compare resident characteristics. Significant differences were adjusted for in the multivariate analyses. Logistic regression and zero-inflated Poisson regression analyses were applied.

RESULTS

There were 96 and 242 residents receiving palliative care and routine care respectively. There were no significant differences in age, gender, and race. Significant differences were found in days of observation, nursing needs and number of comorbid conditions (Table 1). Adjusting for differences in resident characteristics, the odds of residents receiving routine care being hospitalised was 3.4 to 6.9 times higher (Table 2). Expected number of hospitalisations and cumulative length of stay was respectively, 2.1 to 3.0 and 1.3 to 2.0 times higher for residents receiving routine care than palliative care (Table 2).

Table 1 – Baseline comparison of the intervention and comparator groups

	Intervention (n = 96)	Comparator (n = 242)	*p* value
Age, median (IQR)	87.5 (78 - 95)	86.0 (78 - 92)	0.12
Male, %	40.6	40.9	0.96
Race, %			
Chinese	93.8	88.8	0.17
Others (Malay, Indian)	6.2	11.2	
RAF Subscore , mean (SD)	39.6 (9.7)	42.1 (7.5)	0.03
RAF Total, mean (SD)	55.7 (12.8)	55.4 (9.9)	0.85
Number of Comorbidities, mean (SD)	7.9 (3.8)	3.9 (2.1)	< 0.001
Days Observed, median (IQR)			
1-month	30.0 (30 – 30)	30.0 (30 – 30)	0.01
3-months	89.5 (37 – 90)	90.0 (90 – 90)	< 0.001

IQR – Interquartile Range; RAF – Resident Assessment Form; SD – Standard Deviation

Table 2 – Adjusted odds ratios (95% CI) for outcomes*

	No Comorbid	With Comorbid
Hospitalisation		
1-month of life	3.4 (1.8, 6.4)	4.6 (2.4, 9.5)
3-months of life	5.2 (2.7, 9.7)	6.9 (3.4, 13.9)
Number of Hospitalisations		
1-month of life	2.1 (1.3, 3.4)	2.5 (1.5, 4.1)
3-months of life	2.8 (1.8, 4.1)	3.0 (2.0, 4.6)
Cumulative Length of Stay		
1-month of life	2.1 (1.3, 3.4)	2.5 (1.5, 4.1)
3-months of life	2.8 (1.8, 4.1)	3.0 (2.0, 4.6)

CI – Confidence Interval
* Reference group: Intervention

CONCLUSIONS

Project CARE was effective in reducing healthcare utilisation of nursing home residents in the last 1-month and 3-months of life. These results supported the continuation of Project CARE in the seven nursing homes and expansion to other nursing homes. Mindful of the small sample size of the study, further studies are recommended to validate the results of this study. Future steps will also include developing a sustainable funding model to support end-of-life initiatives such as Project CARE.

LATE STAGE EVALUATION OF THE SINGAPORE NATIONAL ASTHMA PROGRAMME (SNAP)

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BACKGROUND

Asthma is a common chronic disorder. The prevalence of life-time and current asthma was 10.5% and 3.9% respectively in Singapore residents aged 18 to 69 years old with an estimated total cost of US$33.93 million per annum. Patients with poorly controlled asthma have frequent relapse of asthma attacks, unplanned visits to doctors, emergency department visits, or hospital admissions which contribute to the burden of disease. To address the amount of acute healthcare resource use for asthma, the Singapore National Asthma Programme (SNAP) was launched in 2001. SNAP provides uniform, structured, and continuous care for patients in ambulatory-care facilities by using evidence-based care paths for clinical decision making, patient education and training in self-management plans, asthma care nurses and care manager support, and regular reviews in specialist clinics for high-risk asthma patients.

The study aimed to evaluate whether SNAP was effective in reducing emergency room attendances and hospitalisations for asthma patients compared to routine care.

METHODS

The study cohort included individuals diagnosed with asthma and excluded individuals who were non-Singapore Residents and aged $\leq$ 20 years. Demographic, clinical and resource use data were extracted from the National Healthcare Group Chronic Disease Management Data-mart. We defined "participants" as patients who were newly enrolled into SNAP at respiratory medicine clinics between 1 January 2008 and 31 December 2010. Non-participants comprised patients who were not enrolled in the programme. Both groups were matched using propensity scores (PS). Outcomes at 1-year were assessed. To address excess zeros arising in the analysis of resource utilisation data, zero-inflated negative binomial models were used.

RESULTS

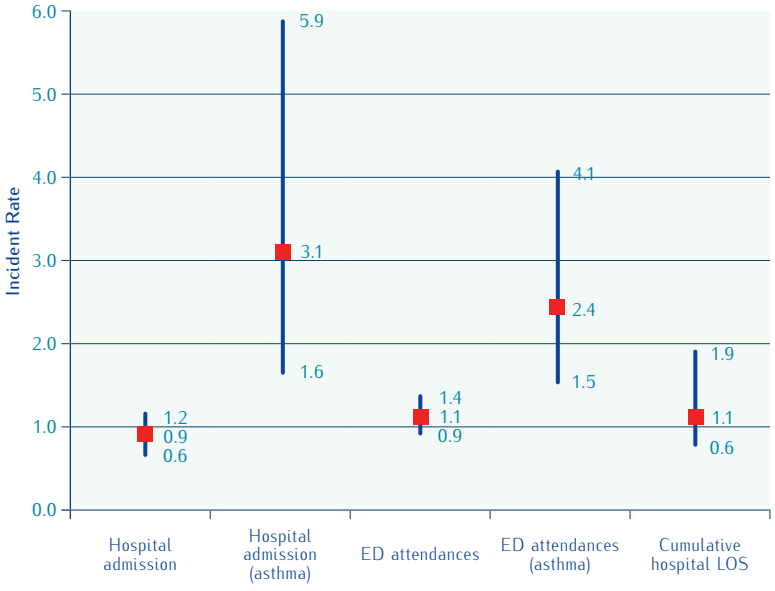
Our PS-matched sample comprised 631 participants and 631 non-participants. We did not find the number of all-cause hospitalisations and emergency room attendances to differ significantly between participants and non-participants (Table 1). However, the incident rate for asthma-related hospitalisation was 3.1 (95% CI: 1.6-5.9) and asthma-related emergency room attendances was 2.4 (95% CI: 1.5-4.1), indicating higher resource use for patients in SNAP (Figure 1).

Table 1 – Unadjusted 1-year utilisation outcomes for Propensity-Score matched participants and non-participants

	Count (%)				
Variable	**Participants**		**Non-Participants**		***p* value**
All-cause hospitalisations	115	(18.2)	115	(18.2)	1.000
Asthma-related hospitalisations	45	(7.1)	29	(4.6)	0.055
All-cause ED visits	187	(29.6)	173	(27.4)	0.383
Asthma-related ED visits	79	(12.5)	56	(8.9)	0.036
Cumulative Hospital Length of Stay (LOS)					0.838
1 - 10 days	97	(15.4)	93	(14.7)	
11 - 20 days	12	(1.9)	12	(1.9)	
21 - 30 days	3	(0.5)	3	(0.5)	
31+ days	3	(0.5)	3	(0.5)	

ED – Emergency Department

Figure 1 – Effects of SNAP for a Propensity-Score matched sample



CONCLUSIONS

Due to data constraints, we were only able to evaluate the outcomes of individuals on SNAP versus standard care at a late stage. The gap between routine care and programme care may have narrowed and thus affected the outcomes of our results. Future research supported by process indicators not captured in this study is required to provide insights into the current process of programme and routine care.

PREDICTING RAPID PROGRESSION OF CHRONIC KIDNEY DISEASE PATIENTS

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[1] Tan Tock Seng Hospital, Department of Renal Medicine

[2] National Healthcare Group Polyclinics, Family Medicine Development

BACKGROUND

Chronic kidney disease (CKD) is a progressive loss in renal function over a period of months or years. The stages of CKD are shown in Table 1. The burden of CKD and end stage renal failure (ESRF) is increasing over the years with an eventual impact on the demand for renal replacement therapy services. CKD is a major public health problem. Adverse outcomes can be prevented through early detection and treatment.

The objective of the study was to identify the predictors for rapid progression (defined as within 5 years) of Stage 3A and 3B CKD patients to Stage 4/5.

Table 1 – Stages of Chronic Kidney Disease

Stage	Description
1	eGFR > 90 ml/min/1.73m^2 with pathologic abnormalities or other markers of kidney damage
2	eGFR 60-89 ml/min/1.73m^2
3A	eGFR 45-59 ml/min/1.73m^2
3B	eGFR 30-44 ml/min/1.73m^2
4	eGFR 15-29 ml/min/1.73m^2
5	End-Stage Renal Failure, eGFR < 15ml/min/1.73m^2

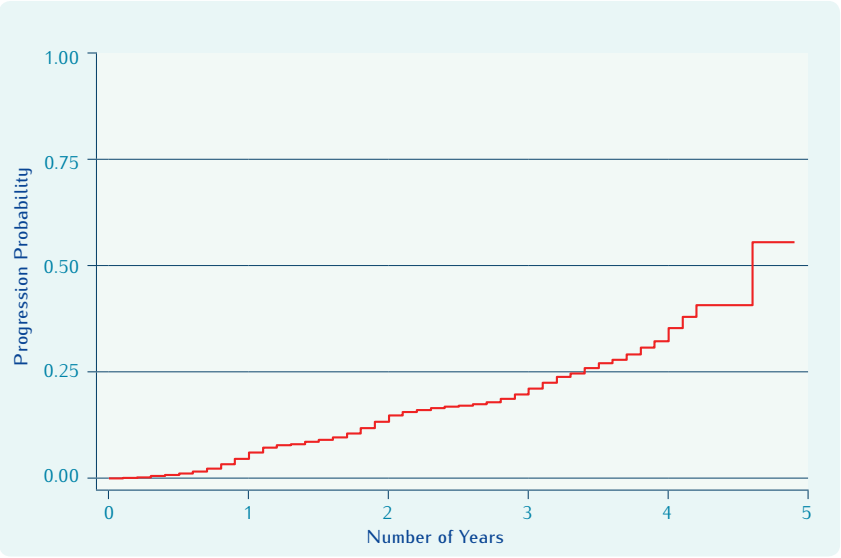
METHODS

This was a retrospective cohort study of Stage 3A and 3B CKD patients from the National Healthcare Group Renal Registry from 1 January to 31 December 2007. Patients were followed up for 5 years until 31 December 2011. The clinical indicators of patients who have progressed to Stage 4/5 of CKD were examined. Univariate Cox's regression was performed, followed by multivariate Cox's regression.

RESULTS

3,366 patients with Stage 3A and 3B CKD were identified. Of these, 833 progressed to Stage 4/5 within 5 years (Figure 1). Univariate regression revealed the following significant variables: use of insulin (Hazards Ratio (HR): 2.62), presence of macroalbuminuria (HR: 1.39), male gender (HR 1.32), lower haemoglobin (HR: 1.27), lower glomerular filtration rate (GFR) (HR: 1.14), higher level of triglycerides (HR: 1.09), higher fasting plasma glucose level (HR: 1.04), lower diastolic blood pressure (HR: 1.01), and the use of angiotensin converting enzyme inhibitors (HR: 0.82). Multivariate regression showed that only three variables remained statistically significant — lower haemoglobin level (HR: 1.25), lower GFR level (HR: 1.14), and higher plasma glucose level (HR: 1.05).

Figure 1 – Kaplan-Meier progression estimate for Stage 3A and 3B CKD patients



CONCLUSIONS

Certain predictors of rapid progression in Stage 3A and 3B CKD patients to Stage 4/5 have been identified. However, there is a need to validate the model in a different cohort before external validity can be shown.

QUALITY OF CARE OF PATIENTS WITH CHRONIC KIDNEY DISEASE IN NATIONAL HEALTHCARE GROUP POLYCLINICS FROM 2007 TO 2011

Dr Gary Ang Yee, Dr Heng Bee Hoon, Dr Adrian Liew Seng Teck[1], Dr Chong Phui-Nah[2]

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[2] National Healthcare Group Polyclinics, Family Medicine Development

BACKGROUND

Chronic Kidney Disease (CKD) is a major public health problem, where majority of patients are managed in the primary care. Major risk factors include advanced age, hypertension and diabetes mellitus. The control of risk factors is paramount to preventing CKD progression.

The objective of the study was to describe the epidemiology and quality of care of patients with CKD Stages 3 to 5 at the National Healthcare Group Polyclinics (NHGP).

METHODS

The study was carried out using data from the NHG Renal Registry. Patients were included if they were identified to have CKD based on ICD-9-CM codes and laboratory results.

RESULTS

Overall, the number of CKD patients increased more than two-fold from 4,734 in 2007 to 10,245 in 2011 (Figure 1). The demographics of the study population are shown in Table 1. In 2011, majority were in Stage 3A (39.6%) and 3B (37.6%), had hypertension (98.2%), dyslipidemia (97.2%) and diabetes mellitus (68.7%). From 2007 to 2011, among patients with hypertension, the use of angiotensin-converting-enzyme inhibitors and/or angiotensin receptor blockers increased from 78.4% to 84.1%; and the proportion with good systolic blood pressure control (< 130mmHg) improved from 18.7% to 36.3%. Among those with dyslipidemia, the use of statins increased from 81.0% to 87.1%; and the proportion with low density lipoproteins (LDL) < 2.6mmol/L increased from 40.0% to 54.7%. However, among those with diabetes mellitus, mean glycated haemoglobin (HBA1c) increased from 7.4% to 7.6%; and the proportion with HBA1c $\leq$ 7.0% decreased from 44.5% to 39.4%.

Figure 1 – Total number of CKD patients in NHGP, 2007-2011

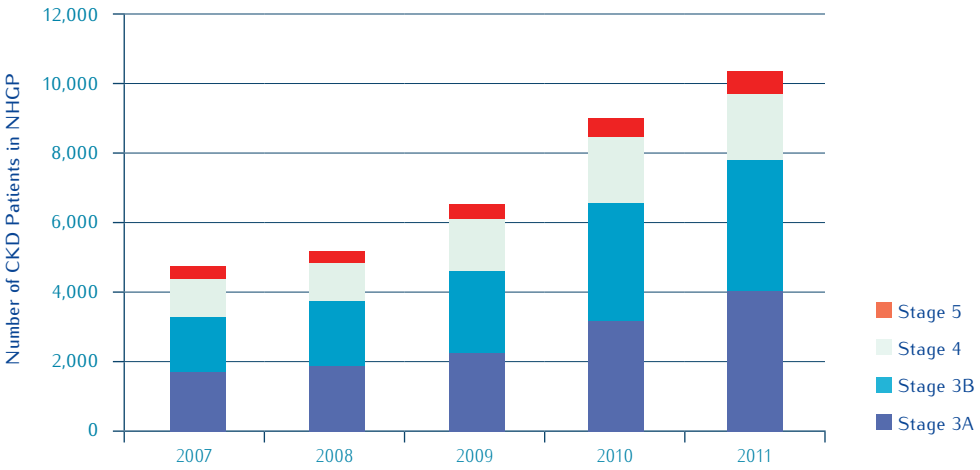


Table 1 – Demographics of CKD patients

	2007 (n = 4,734)		2008 (n = 5,207)		2009 (n = 6,469)		2010 (n = 8,894)		2011 (n = 10,245)	
Age, mean (SD)	71.5	(10.7)	70.9	(10.7)	71.0	(10.6)	71.3	(10.6)	71.8	(10.4)
Gender										
Male (%)	2,610	(55.1)	2,890	(55.5)	3,591	(55.5)	4,901	(55.1)	5,517	(53.9)
Ethnicity										
Chinese (%)	3,534	(74.7)	3,826	(73.5)	4,651	(71.9)	6,501	(73.1)	7,487	(73.1)
Malays (%)	763	(16.1)	882	(16.9)	1,184	(18.3)	1,546	(17.4)	1,745	(17.0)
Indians (%)	290	(6.1)	320	(6.2)	405	(6.3)	539	(6.0)	631	(6.2)
Others (%)	147	(3.1)	179	(3.4)	229	(3.5)	308	(3.5)	382	(3.7)

SD – Standard Deviation

CONCLUSIONS

The number of CKD patients in NHGP increased significantly from 2007 to 2011 at an average annual rate of 21.3%. Majority of patients in 2011 were in Stage 3A and 3B. While the blood pressure and LDL control among patients were encouraging, the glycemic control could be further improved.

PROJECTS

ORGANISATION & DELIVERY OF SERVICES

ATTENDANCE PROJECTION OF JURONG EAST AND JURONG WEST POLYCLINICS

Dr Zhu Zhecheng, Alice Tang[1]
[1] National Healthcare Group Polyclinics, Lean Office

BACKGROUND

The National Healthcare Group Polyclinics (NHGP) is doing capacity planning for the Jurong area for the next 10 years. The current Jurong East Polyclinic (JE) will be redeveloped in the near future and a new polyclinic will be set up in Jurong West (JW) to meet the future demand in the nearby region. The management wanted to know the demand projection for this area.

There were a few questions to be answered:
(i) For the JE Polyclinic redevelopment plan, what is the near term demand for JE Polyclinic?
(ii) For the JW Polyclinic plan, what is the projected attendance of JE and JW Polyclinics for the next 10 years? and
(iii) How will the new polyclinic impact on the attendance of the existing polyclinics?

METHODS

A 5-step top down approach was applied in this study to project the future attendance (Figure 1).

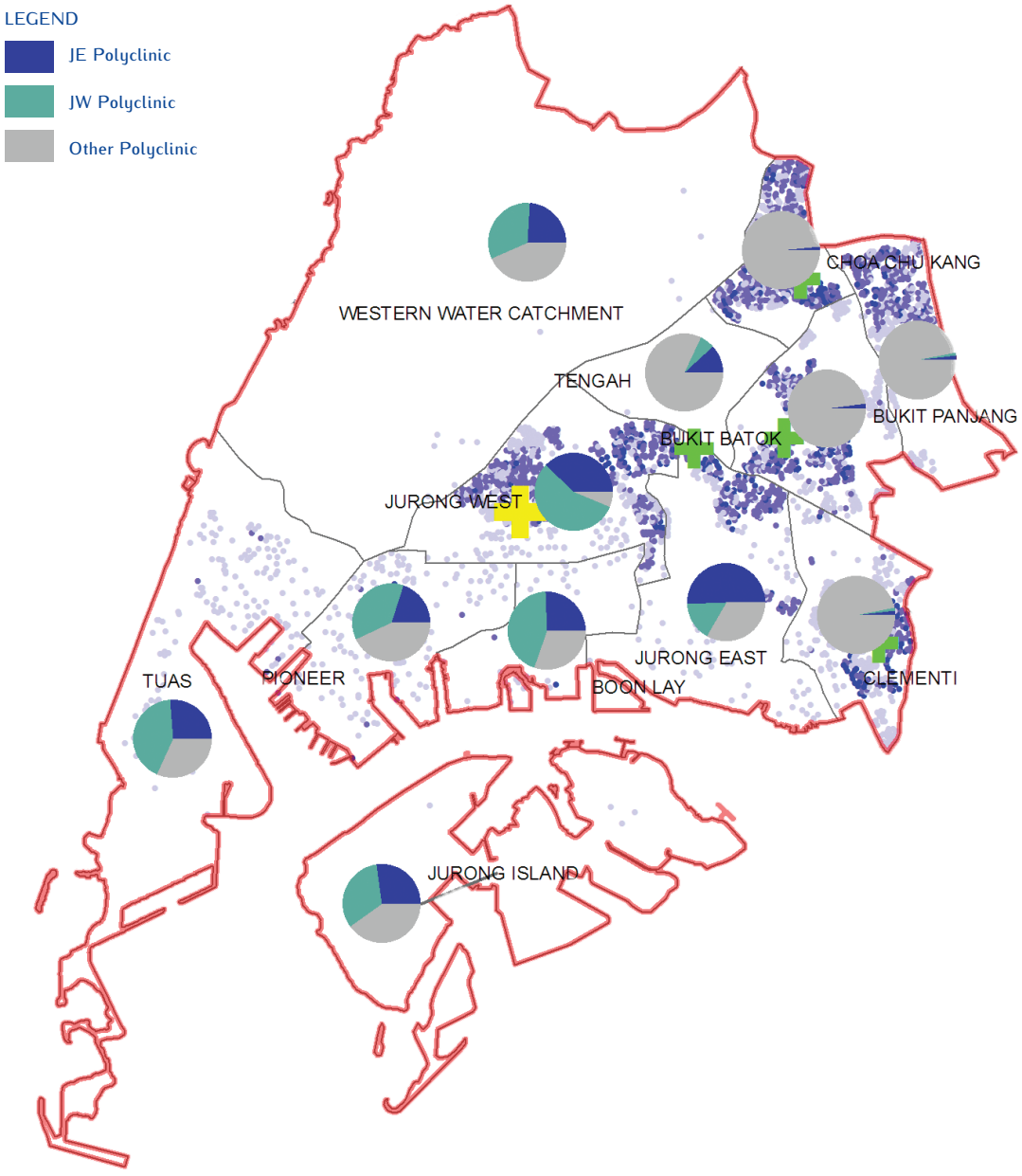
- Overall population projection
  - » The population projection was taken from the Department of Statistics.
- Overall attendance projection
  - » Attendance was based on the utilisation per population
  - » Utilisation was adjusted by population ageing and calibrated using 2010 and 2011 data
  - » Consider the possible unmet demand of JW area by adjusting the age-specific utilisation of this area
- Attendance projection per Development Guide Plan (DGP)
  - » Each DGP followed the same pattern as the average of 2010 and 2011
  - » JW attendance was recalculated by including the possible unmet demand
- JE and JW Polyclinics catchment per DGP
  - » The catchment of the whole western region was recalculated based on the new geographic distribution of the polyclinics and calibrated with the past catchment in 2010 and 2011
- JE and JW Polyclinics attendance projection
  - » The overall attendance projection was calculated by aggregating the catchment per DGP

Figure 1 – 5-step top down approach to project the future attendance

RESULTS

Figure 2 illustrates the projected catchment of JE and JW Polyclinics in the western region. It was observed that most attendances come from JE and JW areas.

Figure 2 – Projected catchment of Jurong East and Jurong West Polyclinics



CONCLUSIONS

Such a study helped the NHGP management to identify the demand growth and future polyclinic workload, better plan the available resources to meet the growing demand, and to better estimate the impact of the new polyclinic on existing ones.

INPATIENT CAPACITY PLANNING OF A POST-ACUTE HOSPITAL — THE INTEGRATED INTERMEDIATE CARE HUB

Palvannan R. Kannapiran, Dr Liew Li Lian[1], Sherry Tham[1], Sharon Chan[1], Michael Leow[1]
[1] Tan Tock Seng Hospital, Operations (Community)

BACKGROUND

Tan Tock Seng Hospital's (TTSH) post-acute care services are currently distributed by location. Post-acute services include *sub-acute*, *slow stream rehabilitation*, *specialist rehabilitation* and *hospice care* catering largely to elderly patients. The first three services provide critical transitional care for functional restoration before integration to the community without immediate repeat institutionalisation. However, due to the lack of downstream post-acute capacity, patients are presently housed in TTSH even though they do not require intense organ specific acute services.

To address this need, TTSH planned to house the four care services in one location next to the main hospital in the Novena campus by 2018, which will be called the Integrated Intermediate Care Hub (IICH). This integrated planning called for clear definitions of the services, care model and possibly their synergy.

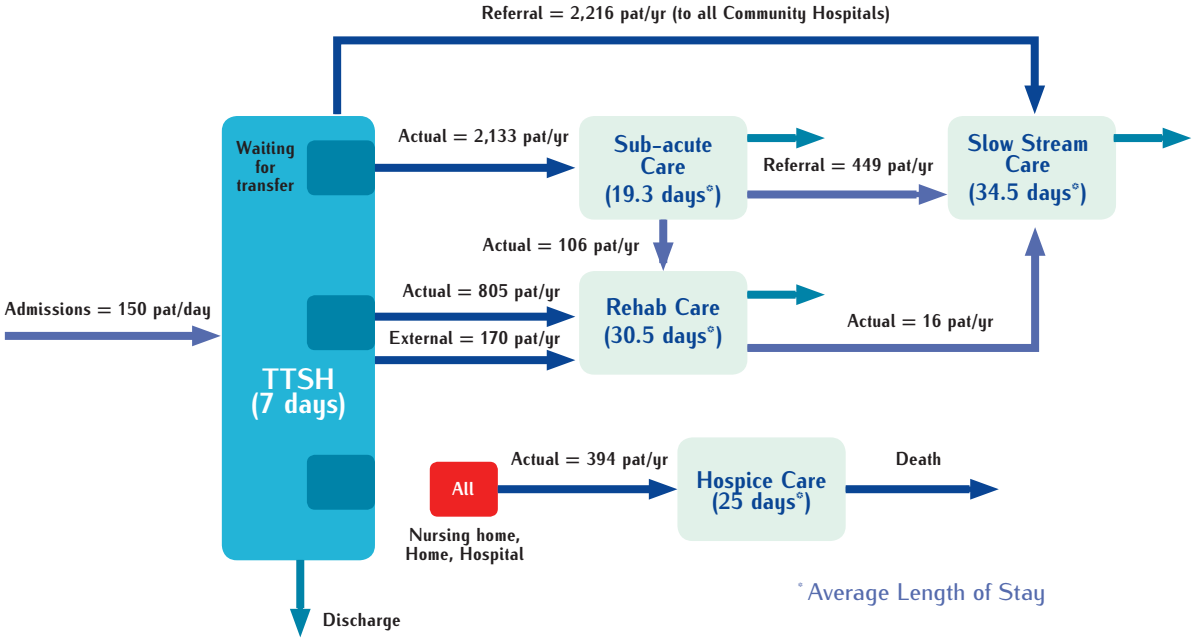
Sub-acute care is for debilitated elderly patients who need continued medical management arising from their co-morbid conditions once they are stabilised. *Slow stream rehabilitation* allows for slower recovery and convalescence for reversal of deconditioning following an acute episode and caregiver training in the local context. *Specialist rehabilitation* is active functional restoration of patients with trauma to brain, spinal cord and orthopaedic and stroke recovery. *Hospice care* is the palliative last stage in the life of terminally ill patients who may need occasional sub-acute services. The hospital will see geriatricians, palliative and rehabilitation medicine physicians, nurses and allied health professionals providing the critical transitional care to the community.

The aim of the study was to plan the post-acute inpatient capacity to meet the demand of inpatients that TTSH will be seeing in 10 years' time (in 2022), so as to right-site the patients in post-acute settings with lower cost structure and managed by the appropriate specialists.

METHODS

The current patient flow was mapped out (Figure 1). We used a probabilistic open Jackson flow model which is a compact Markov model to plan for the capacity required with several considerations. The variations in patient demand and length of stay were obtained for 2011. To estimate the demand, we assumed a constant utilisation of post-acute services for the specific age group. We also planned for an earlier transfer of 2 days from inpatient to IICH. To reduce unnecessary occupation of acute beds, we planned for a short waiting time of 1 day for transfer. We also planned for appropriate partitions in hospitals considering gender, non-subsidised care and sub-specialisations. The impact of the opening of new hospitals was also factored in. We acknowledged the unmet demand in palliative care and used bed to population norms from the United Kingdom when adjusting the needed and projected demand in the future.

Figure 1 – Patient flow from TTSH to post-acute services (2011)



RESULTS

There was a need for about 880 beds to meet the post-acute demand in 2022. It was then decided that the existing Ren Ci facility together with IICH will be able to house this capacity. Therefore, the plan is for IICH to open in 2018 with about 70.0% of its full capacity to meet this demand.

CONCLUSIONS

Building an 880-bed post-acute care hospital for a 1,300-bed hospital seems large. Firstly, we were planning for an ageing society — not somewhere in the distant future — but ageing right now. The average age of the patients using post-acute care is around 65 years and the growth rate of this post-acute segment ranges from 3.5% to 4.5% annually. This elderly segment growth is fast and their usage of hospital services is high. TTSH is known to have one of the highest age group among its patients with a large geriatric department to cater for it.

Secondly, 880 beds is the post-acute capacity needed in 10 years' time, whereas 1,300 beds is the current inpatient capacity. Instead of growing the inpatient capacity further, the post-acute capacity with a lower cost structure was increased to manage the total demand. Thirdly, almost half the projected capacity of 880 beds are existing beds that will be relocated. The balance capacity is created to meet the growth in demand. Now that an integrated hospital will be built, further attention would be directed towards the testing of evolving care models and their synergy at least in resource usage.

PREDICTION OF BED WAITING TIME FOR EMERGENCY DEPARTMENT PATIENTS USING AN INTERACTIVE FRAMEWORK

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[1] Tan Tock Seng Hospital, Hospital Resource Management

BACKGROUND

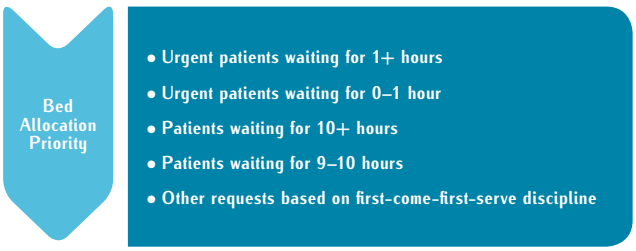
Waiting times in hospitals can affect patients' satisfaction and quality of care. Patients often need to wait due to various reasons such as limited capacity, variable demand, and process inefficiency. In Tan Tock Seng Hospital's (TTSH) bed management unit (BMU), there are two main types of bed requests namely, Emergency Department (ED) bed requests and non-ED bed requests. Sometimes patients wait up to ≥ 10 hours for beds.

The objective of the study was to predict bed waiting time for ED patients over the next few hours up to 4 days, and to recommend strategies to meet the Key Performance Indicators (KPIs) in the case of bed shortfalls.

METHODS

There were two KPIs adopted in the study: (i) urgent patients (about 30.0% of new requests) should not wait for > 2 hours; and (ii) all patients should not wait for > 10 hours. Patients were classified according to gender. The rule of bed allocation is stated in Figure 1 with a high priority for urgent patients. The strategy under consideration is referred as the number of extra beds needed at each hour of any weekday if any, which is defined as the sum of number of urgent patients waiting, and patients waiting for ≥ 9 hours minus the number of current usable beds. We identified the current number of patients waiting for 0-1 hour, 1-2 hours, and ≥ 10 hours. Based on the bed allocation priority rule and the KPIs, we predicted hourly patient waiting lists with the recommended strategy for next several days starting from any time point. The model was based on the information of current bed requests, current available beds, projected hourly bed discharges and bed requests, including both ED patients and non-ED patients.

Figure 1 – Rule of bed allocation priority



RESULTS

We developed an interactive model for bed allocation using Excel (Figure 2). The model can predict hourly patients' waiting list and bed surplus/shortfall, starting from any hour of a day until the next 125 hours (i.e., ≥ 5 days). The model was user friendly and possessed unique features. For example, managers only need to input the starting time point and patient waiting list at that time. There was no need to manually input the projected bed requests and discharge data based on the time of day and day of week, as these were automatically loaded in the Excel model. Managers were also allowed to overwrite projected requests and discharges, and the strategies recommended by the model.

Figure 2 – An interactive framework for bed planning

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Next 2 hr			Time	Current time		Next 1 hr		Next 2 hr		Next 3 hr		Next 4 hr		Next 5 hr		Next 6 hr		Next 7 hr	
4	Mon 12:00			6/25/12 10:00	Mon 10:00		Mon 11:00		Mon 12:00		Mon 13:00		Mon 14:00		Mon 15:00		Mon 16:00		Mon 17:00	
5	M	F			M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
6	7	9		Bed discharges (projected)			3	3	7	9	10	11	9	11	6	9	5	7	4	5
7	3	3		ED bed requests (projected)			3	2	3	2	4	5	4	6	4	5	4	5	5	4
8	2	2		Non-ED requests (projected)			0	0	2	2	2	2	2	2	2	2	2	2	2	2
9	0	0		Overwrite bed discharges			0	0	0	0	0	0	9	11	0	0	0	0	0	0
10	0	0		Overwrite ED requests			0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0		Overwrite Non-ED requests			0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	8	12		Available beds	10	10	5	6	8	13	12	20	15	24	15	25	14	25	12	23
14	0.85	0.85		Matching%	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
15	6	10		Useable beds	8	8	4	5	6	11	10	17	12	20	12	21	11	21	10	19
16	0.30	0.30		%Urgent new requests			0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
17	1	1		Patients waiting for 0-1 hr (urgent)	1	0	1	1	2	1	2	2	2	2	2	2	2	2	2	2
18	0	0		Patients waiting for +1 hr (urgent)	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	4	4		Patients waiting for 0-1 hr (non-urgent)	0	0	2	1	3	3	4	5	4	6	4	5	4	5	5	4
20	1	0		Patients waiting for 1-2 hr (non-urgent)	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
21	0	0		Patients waiting for 2-3 hr	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0		Patients waiting for 3-4 hr	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0		Patients waiting for 4-5 hr	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0		Patients waiting for 5-6 hr	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0		Patients waiting for 6-7 hr	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0		Patients waiting for 7-8 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0		Patients waiting for 8-9 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0		Patients waiting for 9-10 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0		Patients waiting for +10 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30																				
31	6	5		Total bed demand	17	17	5	2	6	4	6	7	6	8	6	7	6	7	7	6
32	0	5		Bed surplus	-9	-9	-1	3	0	7	4	10	6	12	6	14	5	14	3	13
33	0	0		Recommended Strategy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0		Actual Strategy	7	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	6	10		Final bed supply	15	18	4	5	6	11	10	17	12	20	12	21	11	21	10	19
36	0	5		Final useable bed surplus	-2	1	-1	3	0	7	4	10	6	12	6	14	5	14	3	13
37	2	7		Real bed surplus	0	3	0	4	2	9	6	13	9	16	9	18	8	18	5	17
38	0	0		Patients waiting for 0-1 hr (urgent)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0		Patients waiting for +1 hr (urgent)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0		Patients waiting for 0-1 hr (non-urgent)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0		Patients waiting for 1-2 hr (non-urgent)	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0		Patients waiting for 2-3 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0		Patients waiting for 3-4 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0		Patients waiting for 4-5 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0		Patients waiting for 5-6 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0		Patients waiting for 6-7 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0		Patients waiting for 7-8 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0		Patients waiting for 8-9 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0		Patients waiting for 9-10 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0		Patients waiting for +10 hr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CONCLUSIONS

The projection of bed waiting time for ED patients can help TTSH to better manage the beds to meet their target KPIs.

MANPOWER PLANNING FOR TAN TOCK SENG HOSPITAL CONTACT CENTRE USING QUEUEING MODELS

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BACKGROUND

Contact centres have become a preferred and prevailing means for companies to communicate with their customers. To improve the relationship with customers, most organisations have re-engineered their infrastructure to include from one to many contact centres, either internally managed or outsourced. For many companies such as hospitals, airlines, and hotels, contact centres provide a primary link between the customer and the service provider.

This project aimed to analyse Tan Tock Seng Hospital's (TTSH) contact centre performance (for appointment lines) from a demand-resource perspective and to project manpower resources for a given Key Performance Indicator (KPI), using queueing models.

METHODS

Two performance indicators, *Service level* and *Abandonment rate*, were adopted in the analysis. Service level refers to the fraction of calls answered within the target while abandonment rate represents the fraction of calls abandoned after the target. Call arrivals were assumed to follow a Poisson distribution and service duration followed an exponential distribution. For a given performance indicator, two queueing models, M/M/N model (i.e., Erlang-C model) and M/M/N+M model (i.e., Erlang-A model), were used to estimate manpower planning.

RESULTS

The average daily demand of calls offered are shown in Table 1, from which we can see that the volume of calls during morning (9am–12pm) were relatively high while the calls offered from 5pm-6pm was the least.

By setting an 85.0% service level as a KPI, Table 2 details the projected manpower based on time of day, using both Erlang-A and Erlang-C models. The results showed that projected number of agents using Erlang-C model was higher than using Erlang-A model. This was because Erlang-C model did not take into account the factor of abandonment, which led to overestimation to some extent.

As shown in Table 3, the workload during lunch time (11am–2pm) varies greatly. Without changing the current total capacity, we used a mathematical model to balance the workload during this period. The staff rescheduling is shown in Table 3, in which the workload is levelled to 14.9 calls per staff during this period.

Table 1 – Average calls offered

Time	Mean
8am–9am	151
9am–10am	219
10am–11am	218
11am–12pm	228
12pm–1pm	166
1pm–2pm	161
2pm–3pm	191
3pm–4pm	186
4pm–5pm	157
5pm–6pm	70

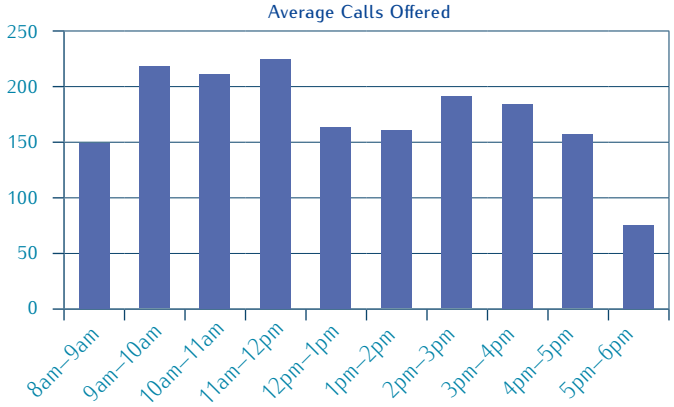

Table 2 – Manpower projection for given KPI (service level)

Time	Current % Answered Within Target	KPI % Answered Within Target	Staffing		
			Current	Projection with Erlang-A	Projection with Erlang-C
8am–9am	89.8%	85.0%	14	14	16
9am–10am	88.7%	85.0%	18	19	21
10am–11am	86.5%	85.0%	18	19	21
11am–12pm	68.5%	85.0%	15	19	22
12pm–1pm	78.0%	85.0%	13	15	17
1pm–2pm	79.8%	85.0%	12	14	15
2pm–3pm	60.1%	85.0%	12	17	17
3pm–4pm	77.9%	85.0%	16	16	17
4pm–5pm	86.2%	85.0%	15	14	15
5pm–6pm	83.4%	85.0%	7	8	8

Table 3 – Staff rescheduling during lunch time

Time	Service Level	Current		After Levelling	
		Actual Staff	Call/Staff/ Hour	Proposed Staff	Call/Staff/ Hour
8am–9am	89.8%	13.5	12.4		
9am–10am	88.7%	18.3	13.3		
10am–11am	86.5%	18.0	13.3		
11am–12pm	68.5%	15.0	16.6	17	14.9
12pm–1pm	78.0%	13.1	14.1	12	14.9
1pm–2pm	79.8%	11.8	13.7	11	14.9
2pm–3pm	60.1%	12.2	15.7		
3pm–4pm	77.9%	15.8	11.7		
4pm–5pm	86.2%	15.4	10.2		
5pm–6pm	83.4%	6.9	10.2		

CONCLUSIONS

The manpower planning conducted in this study could help the TTSH contact centre to plan their capacity to meet their target KPIs. Service level of the contact centre can be seen from a demand-resource perspective. Models can be built to estimate staffing requirements when there are changes to demand, service duration, and service standards.

NATIONAL UNIVERSITY HOSPITAL CARDIAC ECHO LAB CAPACITY ANALYSIS AND SIMULATION

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BACKGROUND

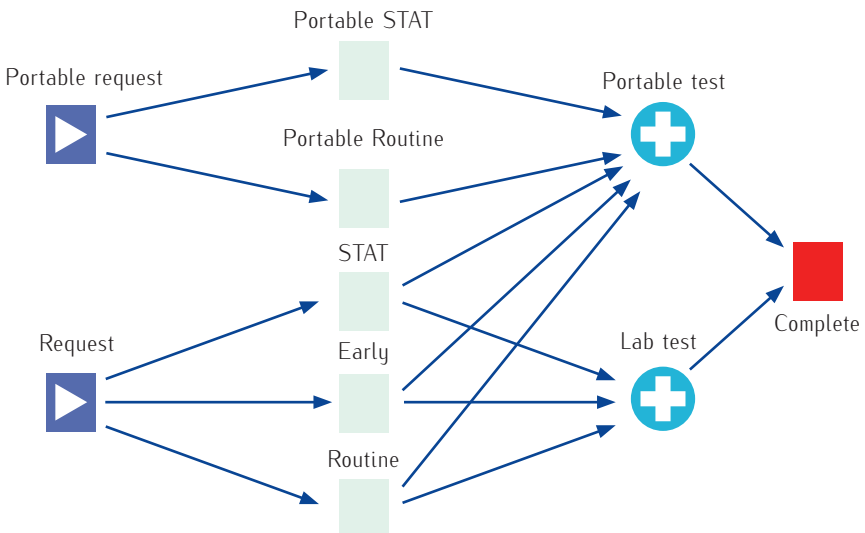
The National University Hospital (NUH) Cardiac Echo Lab caters Echo lab tests for both inpatient and outpatient requests. Part of the inpatient requests need to be done in the wards due to patients' conditions, while the rest are done in the lab. The duration of each test ranges from 30 minutes to 60 minutes based on request types. There are five types of inpatient requests: STAT, Early, Routine, Portable STAT and Portable Routine. There are two types of outpatient requests: SUB and PTE.

The Echo Lab operates at full capacity from Mondays to Fridays and half capacity on Saturdays. The number of requests has a day-of-week fluctuation pattern. One of the Key Performance Indicators (KPI) in the Echo Lab is to meet the target waiting time since reducing waiting time is important to inpatient length of stay and improving patient satisfaction. The target waiting time of different requests varies. For inpatient requests, the target waiting time for STAT is 1 day, Early 2 days, Routine 3 days, Portable STAT 1 day, and Portal Routine 3 days. For outpatient requests, the target waiting time for SUB is 3 months, and PTE 2 weeks. The waiting time of inpatient requests has priority over outpatient requests. The management needs to know how to plan the capacity of Echo Lab to meet the target waiting time.

METHODS

Two approaches were applied to estimate the capacity. For the inpatient request, a discrete event simulation model illustrated in Figure 1 was constructed to simulate the patient flow and capacity configuration. The model took two types of inputs: (i) the number of requests per day using bootstrapping from actual transaction data; and (ii) the number of slots provided per day. The output of the model included the simulated waiting time of each request. For the outpatient requests, due to the incomplete dataset and relatively long and insensitive waiting time, Little's Law was applied to estimate the length of waiting list and first-come-first-serve was assumed within the same class to estimate the waiting time.

Figure 1 - Discrete event simulation of inpatient part of Echo Lab



RESULTS

Table 1 lists the detailed slot allocation for both inpatient and outpatient requests. The inpatient part was based on the simulation results and the outpatient part was based on Little's Law. It is observed from Table 1 that more slots are needed than the number of inpatient requests. Although these slots are not fully utilised, they need to be reserved to ensure a short waiting time.

Table 1 – Slot allocation for inpatient and outpatient requests

	Lab	Portable	Inpatient (Lab+Portable)	Outpatient (SUB)	Outpatient (PTE)
Requests per week (Oct 2011 to Apr 2012)	92	41	133		
Slots needed per week	110	55	165	126	49
Slot Allocation					
Monday	20	10	30		
Tuesday	20	10	30		
Wednesday	20	10	30		
Thursday	20	10	30		
Friday	20	10	30		
Saturday	10	5	15		
95th Percentile Waiting Time					
STAT	1				
Early	1				
Routine	2				
Portable STAT		1			
Portable Routine		3		**Average Waiting Time**	
All			2	90	14

CONCLUSIONS

The capacity analysis and simulation conducted in this study helped NUH Cardiac Echo Lab to plan their capacity and detailed slot allocation to meet their target KPI.

OPTIMISING PACKAGE SIZE IN THE AUTOMATED DISPENSING MACHINE OF OUTPATIENT PHARMACY

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[2] Tan Tock Seng Hospital, Pharmacy
[3] National University Hospital, Pharmacy

BACKGROUND

The outpatient pharmacies of three institutions were deploying automated drug dispensing systems. From an operational efficiency view point, these machines can pick boxes very quickly and therefore speed up the drug dispensing process. The practice in Singapore is to provide need-based order dispenses, rather than original (commercial) pack sizes. As such, the required quantities from the patients can take a wide range, and are likely to differ from the commercial pack sizes. Hence the tablets have to be repacked into boxes of suitable sizes to make up the order quantity that each patient needs. When the order quantity cannot be fulfilled by the automation process, manual picking is then needed.

The aim of this study was to devise the optimal repack box sizes for each drug item, such that there will be minimal manual picking and number of boxes used.

METHODS

Historical dispensing data were first analysed to quantitatively define the usage patterns. A mixed integer programming (MIP) model was then created and implemented to model the constraints and objective of the problem. In order to repeat the runs for all the drug items which were in hundreds, scripts were then developed to allow the model to be called repeatedly.

RESULTS

Overall, we can obtain an average of 5.0% manual picking and two boxes per line item. We also have results on the expected number and size of the boxes to be used, which will help the institution on inventory planning. Another output from this study was the reduced MIP model which can be used for real-time dispensing.

CASE STUDY

We used a certain drug item D from institution X as an illustration. The historical data for analysis comprised about 10,000 orders, with a total of 800,000 tablets, and 167 different order quantities. This long-tail distribution made the problem size much larger. The top seven frequently ordered quantities accounted for 50.8% of orders shown in Table 1.

We varied the number of repack sizes from three to six. The results in Table 2 shows the repack sizes selected, percentage of orders that required manual picking, average number of boxes per order (including those requiring manual intervention), and percentage of orders that required $\geq$ 4 boxes.

As expected, the overall results got better with more choices of repack sizes. As this was a combinatorial problem, we did not expect the "greedy" rule of picking the top quantity ordered (e.g., "28", "14", "60") to coincide with the optimal results. On hindsight, repack size "7" was always included, as this would reduce the percentage requiring manual intervention, which was set as a key objective.

Interestingly, but not surprisingly, the incumbent repack sizes were not retained when we moved along 4 box-combination to 6 box-combination. For instance, repack size "30" was included in the 3 box-combination, but was dropped out in the 4 box-combination. Similarly repack size "60" was dropped out in the 6 box-combination.

Table 1 – Frequency distribution of drug item D (Omeprazole 20mg) dispensed at institution X

Order Quantity	% of Order
28	10.5
14	10.2
60	8.3
63	6.4
120	5.5
56	5.3
30	4.6

Table 2 – Results of the optimised repack sizes

Repack Combination	Selected Repack Sizes	% Manual	% ≥ 4 Boxes	Average Number of Boxes
3	7, 28, 30	4.2	15.5	2.89
4	7, 10, 28, 60	1.9	3.7	2.45
5	7, 10, 28, 56, 60	1.9	2.6	2.18
6	7, 21, 28, 30, 56, 63, 120	4.2	0.4	1.84

CONCLUSIONS

This modelling exercise helped to come up with a plan that minimised manual effort and therefore manpower requirement. At the same time, it aimed to reduce repacking costs. In view of the growing health care demand, the model helped us to tap the full potential of the automated dispensing system and improve our productivity in a scientific manner.

INTEGRATED HOSPITAL SIMULATION — A MOH-HSR STUDY

Teow Kiok Liang, Palvannan R. Kannapiran, Dr Zhu Zhecheng

BACKGROUND

In the hospitals, administrative data like utilisation are routinely collected to support decision making. Senior hospital managers who oversee multiple departments have a holistic view of the patient flows within the hospital. Nevertheless, it is still an important problem to make sense of the complex data and plan for capacity.

One complexity is due to the many flows between interconnected service points like the Accident and Emergency (A&E), operating theatre, inpatient and outpatient. Another reason is the variability in demand and supply, such as emergency arrivals, consult and treatment duration. At the strategic level, the decision to expand infrastructure and the expansion itself typically takes a while. Hence we often see capacity trying to catch up with demand.

This is a Ministry of Health (MOH) Health Service Research grant to develop a simulation model to capture the complex interactions within a hospital for medium- to long-term planning. The main service centres modelled included the A&E, Specialist Outpatient Clinics (SOC), inpatient wards (IP) and operating theatres.

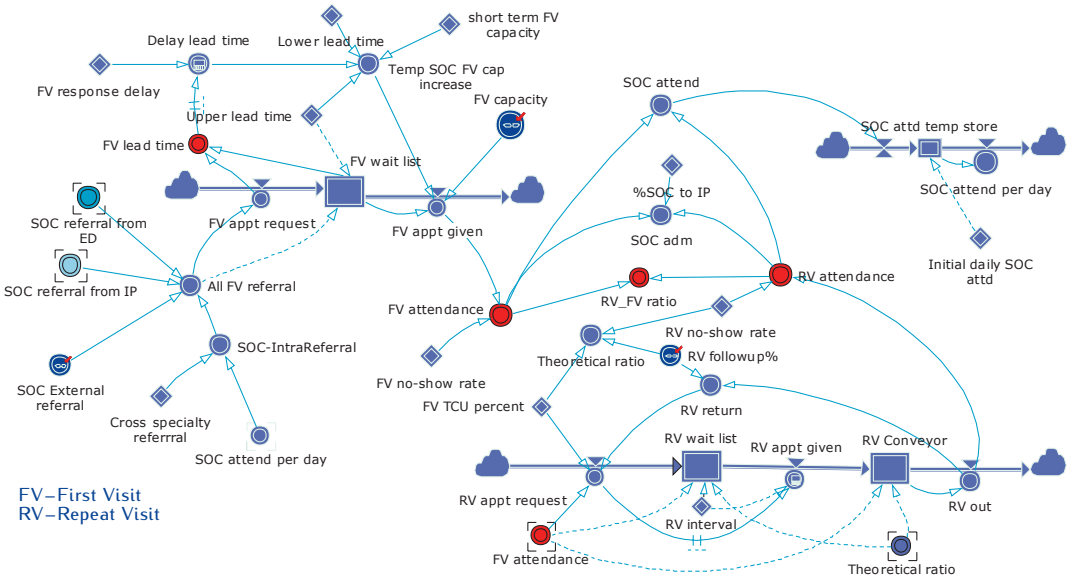
METHODS

We used system dynamics (SD) to map and simulate patient flow using administrative data. This process was done iteratively with the team members in the hospitals, who held the domain knowledge.

The number of requests was modelled as "inflow" and the number of patients who were in the system was the "stock". The rate of patients being discharged from the system was the "outflow" rate. An example of a stock-and-flow diagram is shown in Figure 1.

We also modelled feedback mechanisms that maintained balances in the system, but may create unintended consequences.

Figure 1 – Stock-and-flow diagram of SOC



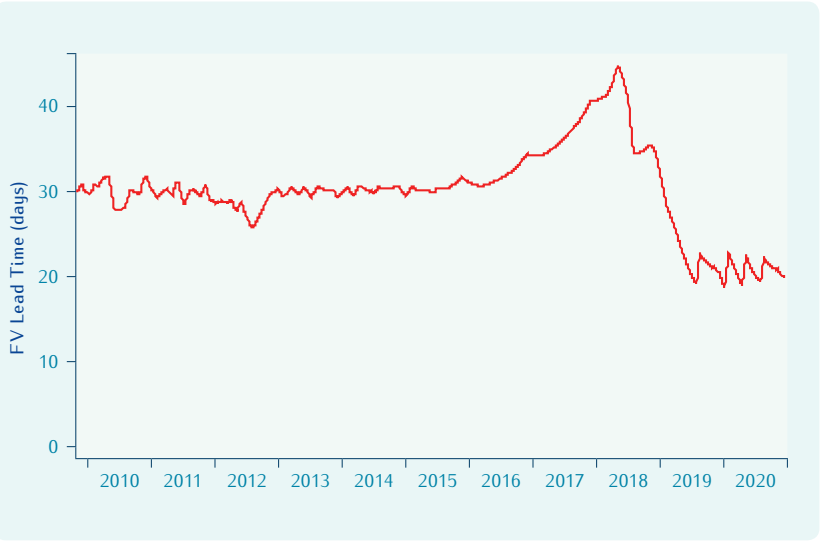
RESULTS

A generic SD model was built using Powersim. Specific data can be entered to simulate different scenarios. Some insights and recommendations have been proposed. An example is provided in Figure 2.

We found that while utilisation data were routinely collected and reported, we often do not have readily available information on demand, and there were tendencies to treat utilisation data as demand. For instance, we may use historical SOC attendances growth rate as "rate of growth in demand". We also may not clearly track capacity. For instance, while we know and track inpatient capacity well (i.e. bed in service), the definition of SOC capacity was less clear and not widely tracked. The Repeat Visit-First Visit (RV-FV) ratio was another indicator that needed further investigation.

We also highlighted several balancing feedback mechanisms which may not be clearly visible. These mechanisms provided some self-correction for demand-supply, but could also hide potential risks, such as visibility of capacity shortfall.

Figure 2 – A hypothetic simulation of SOC first visit lead time



CONCLUSIONS

We developed a hospital simulation model based on a system dynamics approach and programmed the model using the software Powersim. While the model construction has been completed, one can still continue to customise and simulate the model with different assumptions. The fundamental application of this model was for a medium- to long-term planning tool and is not suitable for high fidelity and short-term planning.

PROJECTS

HEALTH ECONOMICS

COST OF INFORMAL CARE FOR COMMUNITY-DWELLING MILD TO MODERATE DEMENTIA PATIENTS IN SINGAPORE

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BACKGROUND

With the rapid ageing of the population worldwide, the prevalence of Alzheimer's disease (AD) — generally considered to be the commonest subtype of dementia — is expected to increase from the current estimated 25 million to 63 million in 2030. Cost of informal care constitutes an important component of total dementia care cost. It also reflects resource utilisation by patients and caregivers. A unique aspect in Singapore is that informal care for frail older persons with dementia is not only provided by the family members, but also supplemented or even replaced by a live-in foreign domestic help from neighbouring Southeast Asian countries, which significantly impact the cost of informal care.

We aimed to quantify the informal cost of care for mild to moderate dementia subjects.

METHODS

We recruited 165 patient-caregiver dyads with mild to moderate dementia. Informal care burden was assessed using the Resource Utilisation for Dementia-Lite (RUD-Lite). The caregiver was asked a number of questions regarding the amount of time spent helping the patient with basic and instrumental activities of daily living. Information on the time spent by paid domestic help to care for the patients was also collected. A generalised linear model was fitted for the association between cost of informal care and cognitive impairment, taking into account patient demographics, disease factors, and use of paid domestic help. Marginal estimates were obtained from the model for illustration and discussion purposes.

RESULTS

Total hours of informal care by primary caregiver doubled in moderate dementia patients, with 57.9% having paid domestic help to assist in care (Table 1). The unadjusted median total annual cost of informal care was $15,750 in mild dementia patients compared to $33,408 in moderate dementia patients (Table 2). Functional factors and use of paid domestic help was significantly associated with informal care costs. Costs were consistently higher for patients without paid domestic help for mild and moderate dementia.

Table 1 – Caregiver characteristics

	Mild Dementia (n = 127)		Moderate Dementia (n = 38)	
Age, mean (SD)	57.4	(13.9)	61.2	(11.2)
Male, %	35.4		47.4	
Years of Formal Education, mean (SD)	7.2	(4.5)	7.0	(4.8)
Relationship to Patient, %				
Spouse	36.2		28.9	
Sibling	2.4		2.9	
Child	56.7		57.1	
Others	4.7		11.1	
Currently Working for Pay, %				
Yes	46.5		47.4	
No	53.5		52.6	
Living with Patient, %				
Yes	65.4		84.2*	
No	34.6		15.8	
Number of Other CGs Involved in Care, mean (SD)	1.3	(1.2)	1.5	(1.3)
Level of Contribution by Primary Informal Caregiver Compared to All Other Caregivers Involved, %				
1-20%	19.7		10.5	
21-40%	18.9		23.7	
41-60%	14.2		28.9	
61-80%	13.4		13.2	
81-100%	33.9		23.7	
Presence of Maid, %	31.5		57.9	
Level of Contribution by Maid, %	43.0		50.0	
Zarit Caregiver Burden, mean (SD)	23.3	(13.9)	32.1	(15.7)

SD – Standard Deviation; CG – Caregiver
*$p < 0.05$

Table 2 – Informal care (hours/month) and annual total cost of informal care information

	Mild Dementia (n = 127)		Moderate Dementia (n = 38)	
ADL, mean (SD)	3.7	(22.8)	18.1*	(31.4)
iADL, mean (SD)	53.4	(60.3)	73.6	(74.0)
Supervision, mean (SD)	20.1	(34.7)	48.8*	(69.6)
Total hours of Informal Care by Primary Caregiver (SD)	77.2	(95.1)	140.6	(131.8)
Median ADL hours (IQR)	0	(0 - 240)	0	(0 - 120)
Median iADL hours (IQR)	30	(0 - 240)	53	(2.5 - 360)
Median Supervision hours	3	(0 - 240)	30	(0 - 360)
Total cost of Informal Care/month, median (IQR)	$1,313	($525 – $3,150)	$2,784	($1,089 - $4,620)
Annual Informal Care cost	$15,750		$33,408	

ADL – Activities of Daily Living; iADL – Independent Activities of Daily Living; SD – Standard Deviation; IQR – Interquartile Range
*$p < 0.05$

CONCLUSIONS

This study demonstrated the informal care costs of caring for mild to moderate dementia patients in Singapore, with unique cost savings provided by live-in paid domestic help, and potentially may aid policy makers in the allocation of resources and support to caregivers.

COST IMPACT ANALYSIS OF AN END-OF-LIFE PROGRAMME ON NURSING HOME RESIDENTS IN SINGAPORE

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BACKGROUND

For healthcare systems worldwide, dying is a costly affair. Very often, cost at the end-of-life is high because unnecessary aggressive treatments were administered on patients instead of palliative care. In Singapore, routine care among nursing home residents in their final stage of life is hospital admission, which incurs high health care costs. Project CARE (CAre at the end-of-life for Residents in homes for the Elderly), an end-of-life programme initiated by Tan Tock Seng Hospital (TTSH), involves providing end-of-life care for residents in seven nursing homes, training the nursing homes so that they would be able to provide palliative care, and approaching residents and families to complete an Advance Care Plan (ACP).

Our objective was to evaluate the cost impact of Project CARE on nursing home residents compared to routine care.

METHODS

This was a quasi-experimental study design with a matched historical control group. Using a clinical algorithm, residents with a risk of dying within 1 year were enrolled into the programme. A retrospective-matched cohort using the same clinical algorithm was chosen as the control group. We adopted the healthcare system perspective by including the costs of Project CARE services, length of hospitalisation, nursing home days, Emergency Department visits (ED), Specialist Outpatient Clinic visits (SOC), and primary care visits. Per-resident costs between the two groups measured in 2011 Singapore dollars were analysed over the last 3-months and 1-month of life. Incremental costs were estimated from the inverse probability weighted linear regression model adjusted for baseline differences.

RESULTS

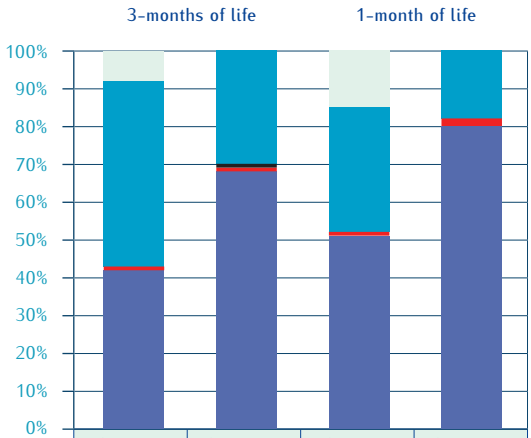
The final sample comprised 48 Project CARE cases and 197 controls. In comparison to the Project CARE group, the control group had lesser comorbidities, higher nursing needs and longer duration of observation (Table 1). At both 1– and 3-months prior to death, the proportion of total healthcare cost attributable to hospitalisation was larger in the control group (Figure 1). The proportion of hospitalisation costs were lower for residents enrolled in the Project CARE programme (3-months: 42.0% vs 68.0%; 1-month: 51.0% vs 80.0%). Retransformation of the treatment indicator yielded incremental mean costs of -$3,723 (-$1,848 to -$5,557) and -$7,128 (-$9,730 to -$4,524) per patient at 1-month and 3-months prior to death respectively (Table 2).

Table 1 – Baseline characteristics

	Project CARE (n = 48)		Controls (n = 197)		*p* value
Age, mean (IQR)	88	(81 – 95)	86	(78 – 92)	0.06 [U*]
Female (%)	29	(60.4)	117	(59.4)	0.90 [χ]
Race					
Chinese (%)	45	(93.7)	177	(89.9)	0.41 [χ]
Non-Chinese (%) (Malays and Indians)	3	(6.3)	20	(10.1)	–
RAF Subscore (IQR)	40	(33 – 48)	46	(39 – 48)	0.03 [U*]
Number of Comorbidities					
1 to 5 (%)	12	(25.0)	158	(80.2)	0.00 [χ*]
6 to 10 (%)	24	(50.0)	38	(19.3)	–
11 to 15 (%)	10	(20.8)	1	(0.5)	–
16 to 20 (%)	2	(4.2)	0	(0.0)	–

IQR – Interquartile Range; RAF – Resident Assessment Form
[U] Mann Whitney U-test, [χ] Chi-square test
[*] $p \leq 0.25$

Figure 1 – Mean costs per patient by components of care as percentages of overall costs



	3-months of life		1-month of life	
	Project CARE	Controls	Project CARE	Controls
Project CARE services	8%	0%	15%	0%
NH LOS*	49%	30%	33%	18%
Polyclinic visits	0%	0%	0%	0%
SOC visits	0%	1%	0%	0%
ED visits	1%	1%	1%	2%
Hospitalisation	42%	68%	51%	80%

[*] Nursing Home Length of Stay

Table 2 – Adjusted incremental mean costs from inverse probability weighted linear regression model

	Project CARE	Controls	Incremental Mean Cost (CI)[§]
1-month	$8,625[¥]	$15,753[¥]	-$7,128* (-$9,730 to -$4,524)
3-months	$3,987[¥]	$7,710[¥]	-$3,723* (-$1,848 to -$5,557)

CI – Confidence Interval
[§] Adjusted for age, RAF subscore and comorbidities
[¥] Recycled predictions method
[*] $p \leq 0.05$

CONCLUSIONS

The results of this study demonstrated savings in healthcare resources for an end-of-life care programme. The default option for end-of-life care among the control group in the nursing home is hospital admission, and this translated into a larger proportion of cost attributed to hospitalisation compared to the Project CARE group. Therefore, cost savings were primarily derived from reduced hospital admission costs. With a significant proportion of the population requiring nursing home care in the future, these results could assist governments and policymakers in their decision-making on the allocation of healthcare resources.

IMPACT OF A PORTABLE MEDICATION SUBSIDY FOR NURSING HOME PATIENTS

Tan Woan Shin, Chong Jiun Yih[1], Chan Soo Chung[1], All Saints Nursing Home
[1] National Healthcare Group Pharmacy

BACKGROUND

The elderly usually have multiple medical conditions, requiring prescription drugs to treat diseases, and to prevent complications arising from them. On the average, nursing home residents in Singapore receive 5.3 medications. Given that medication subsidies are tied to consultations with doctors in public healthcare facilities, a patient may be filling out his or her prescription at different clinics. Multiple prescribers are contributing factors to drug misadventure or adverse drug reaction. Handling medications from different sources also increases the likelihood of administration errors. A local study found the incidence of inappropriate medication use in nursing homes to be as high as 70.0%.

To address the above issues, since November 2003, the National Healthcare Group (NHG) Pharmacy's team of trained pharmacists has been providing a comprehensive suite of medication management services to nursing homes. This includes the Convidose™ system, which pre-packs patients' medications into individual sachets, according to the stipulated quantity and time the pills need to be consumed. Nonetheless, we are still unable to achieve single source dispensing due to the system of medication subsidy disbursement.

This study aimed to quantify the current costs to nursing homes as a result of operating in an environment with multiple prescription sources, and with medication subsidies tied to consultations in public healthcare facilities. We also estimated the cost of making medication subsidies portable for nursing home residents.

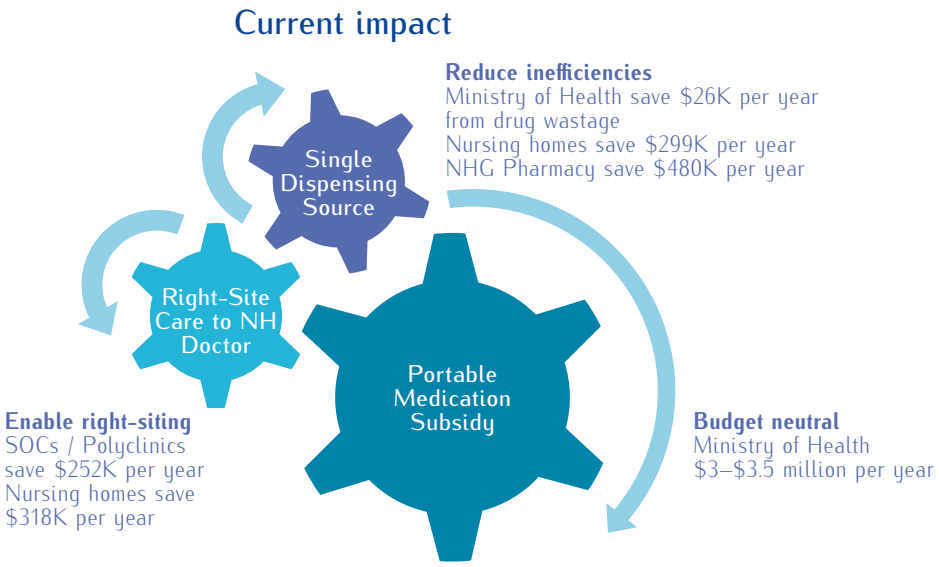
METHODS

Primary data collection on the number of polyclinic visits, specialist outpatient visits, and ambulance trips was carried out by the All Saints Nursing Home (Hougang and Tampines). NHG Pharmacy also collected data on the amount of time spent during the prescription picking, packing and checking process. First, to compute the current level of medication subsidies paid out to nursing home residents, we merged their subsidy status with prescription data from NHG Pharmacy. Second, with portable subsidies, clinic visits will not be necessary to be eligible for subsidised medicine. We computed the cost savings based on the number of such visits, and the nursing home resources required to facilitate the visit. Lastly, potential savings due to a single dispensing source was estimated by costing all man-effort spent to handle multiple prescribers. The results were extrapolated to the national level.

RESULTS

Based on the current number of nursing home beds, we estimated the current level of subsidies to cost the Ministry of Health $3.0 to $3.5 million each year (Figure 1). This amount is required to be channelled for medication subsidy to become portable for nursing home residents. In turn, we will be able to save $539,000 a year in terms of process efficiencies incurred as a result of having multiple prescribers. In addition, by reducing the number of unnecessary visits to polyclinics and specialist outpatient clinics, we potentially stand to save $570,000 per year.

Figure 1 – Estimated national impact of portable medication subsidy



CONCLUSIONS

Progression towards a single source of medication dispensing will help to improve medication safety and process efficiency. The introduction of a portable medication subsidy system will de-link subsidies from consultation and facilitate the eventual shift of care to the most appropriate site and personnel.

PROJECTS

RESEARCH DESIGN & METHODOLOGIES

THE PERCEPTIONS OF TELEMEDICINE AMONG PATIENTS IN PRIMARY CARE — A LITERATURE REVIEW

Cheryl Lobo, Dr Pradeep Paul George Gunapal, Dr Joseph Antonio D. Molina

BACKGROUND

The term telemedicine has been used to describe the use of Information and Communication Technologies (ICTs) to improve patient outcomes by increasing access to care and medical information. In Singapore, the internet and Short Message Service (SMS) technologies are beginning to play a role in the way healthcare is delivered. The National Healthcare Group Polyclinics (NHGP), which manages nine primary care clinics in the central region of Singapore, was seeking to implement telemedicine in its primary care clinics.

The objective of this study was to conduct a literature review to understand the perceptions of telemedicine among patients in primary care.

METHODS

A literature search was conducted to find reliable and relevant evidence. Following the Finding "5S" model by Brian Haynes of McMaster University, we focused the search on relevant systematic reviews and primary studies. As there were no systematic reviews on the topic, we undertook a search in the bibliographic database MEDLINE for relevant primary studies.

A search protocol was constructed, and three concepts were identified. We used PubMed PubReMiner to find an exhaustive list of synonyms (thesaurus terms and free-text/keywords) and MESH terms.

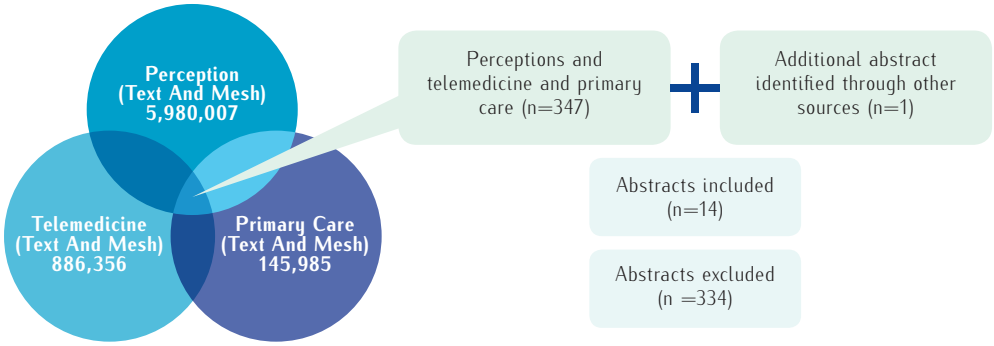
All articles that had the key concepts "perceptions", "telemedicine" and "primary care" in the title or abstract were included, and articles involving paediatrics were excluded.

Next the search strategy was built by searching each of the synonyms/MESH terms within the concept, the Boolean operator "OR" was used to join synonyms and terms together, so that articles retrieved would have at least one of the synonyms or MESH terms. Boolean operator "AND" was used to combine the three key concepts. Other tools like truncation and wildcard was used. Limits were applied to the final results, and records published in the last 5 years in English were included. Only articles with abstracts available were chosen.

RESULTS

A total of 348 abstracts were identified by systematic searching. Figure 1 shows the search results. After excluding 334 abstracts, 14 abstracts were included for review.

Figure 1 – Search results



Due to resource and time constraints, only one database was searched which may have resulted in the loss of about 9.0% to 18.0% of potentially relevant articles. However, from the articles retrieved from MEDLINE, we can see that telemedicine is a broad term that includes various applications of ICTs, ranging from telephone consultations, symptom information provided electronically before a consultation, to Internet portal-based coaching, automated telephone appointment reminders, interactive voice response (IVR), telemonitoring, and telepsychiatry. Table 1 summarises some of our key findings.

Table 1 – Summary of key findings

Article	Country	ICT/Telemedicine intervention	Key Findings
Hill et al. (2012) Communication technology access, use, and preferences among primary care patients: From the Residency Research Network of (RRNeT). Journal of the American Board of Family Medicine; 25(5): 625-634	USA	Cell phones, and home computers	The study was done predominantly in low-income patient population, and found that many patients in the sample did not seek health information electronically nor did they want to communicate electronically with their physicians.
Luo et al. (2009) Acceptance of information and communication technologies for healthcare delivery: A SingHealth Polyclinics study. Annals Academy of Medicine Singapore; 38(6): 529-536	Singapore	Short message system (SMS), and internet usage	This study highlighted the concerns of patients towards the use of SMS and internet in healthcare delivery. The most frequently cited concern was the perceived reduction in direct patient-doctor interaction. The study concluded that these technologies should only be used to enhance or complement current services with minimal cost to patients.
Leveille et al. (2009) Health coaching via an internet portal for primary care patients with chronic conditions: A randomised controlled trial. Medical Care; 47(1): 41-47	USA	Health coaching via patient internet portals	The results showed some possible benefits in care for chronic conditions, but without significant change in patient outcomes.
Fairhurst et al. (2008) Texting appointment reminders to repeated non-attenders in primary care: Randomised controlled study. Quality & Safety in Health Care; 17(5): 373-376.	Scotland	Texting appointment reminders for general practice appointments	Although the intervention showed promise, it failed to demonstrate significant reduction in non-attendance rates.
Johansen et al. (2011) An exploratory study of patient attitudes towards symptom reporting in a primary care setting. Benefits for medical consultation and syndro-mic surveillance? Methods of Information in Medicine; 50(5): 479-486.	Norway	Computer-based communication	The results of this study support the applicability of electronically mediated pre-consultation systems both for improving primary care consultation and for use in symptom based surveillance, including real-time surveillance.
LaVela et al. (2012) Understanding health care communication preferences of veteran primary care users. Patient Education and Counselling; 88(3): 420-426.	USA	Telephone, and electronic communication	For most primary care needs, telephone communication was preferred, although by a greater proportion of infrequent vs regular computer users. In-person communication was preferred for reasons that may require an exam or visual instructions. About 1/3 of regular computer users preferred electronic communication for routine needs, e.g., preventive reminders, test results, and refills.
Dixon et al. (2008) Virtual visits in a general medicine practice: A pilot study. Telemedicine Journal and E-Health; 14(6): 525-530.	USA	Videoconferencing technology (virtual visit)	Both patients and the physician found the virtual visit a potentially useful alternative to the traditional visit for many medical conditions. This may have significant implications for the general medical care environment. Patients may benefit from reduced opportunity costs associated with physician visits and clinicians may benefit from decreased overhead costs. Further research is ongoing to investigate the generalisability of these findings.

VALIDATION OF THE PAEDIATRIC HEARING IMPAIRMENT CAREGIVER EXPERIENCE QUESTIONNAIRE IN THE SINGAPORE POPULATION

A/Prof Lynne Lim[1], Xiang Ling[2], Li Ruijie, Naomi Wong[1], Dr Kevin Yuen[3]

[1] National University Health System, Otolaryngology – Head Neck Surgery Department

[2] National University of Singapore, Department of Otolaryngology

[3] The Hong Kong Institute of Education, Department of Special Education and Counselling

BACKGROUND

Parents of children with hearing loss often experience increased parenting stress associated with problems faced by the child. Due to the unique nature of the stressors, there are currently no suitable instruments to measure the stress. Hence, the Paediatric Hearing Impairment Caregiver Experience Questionnaire (PHICE) was developed.

The PHICE questionnaire is a 68-item instrument spanning eight domains: communication, education, emotional well-being, equipment, financial, healthcare, social, and support. The items are scored on an 8-point Likert scale. While this instrument has been validated in the United States, its use was deemed inappropriate for use locally due to the varying social and educational infrastructures and culture of the hearing impaired in the two countries.

The objectives of the study are to modify and validate the PHICE to make it relevant locally, and to create a shorter version of the questionnaire.

METHODS

125 caregivers of hearing-impaired children attending the otolaryngology, audiology, and aural rehabilitation at a local clinic were administered the full questionnaire. An exploratory factor analysis was conducted. A 5-factor structure was adopted, and items with high cross-loadings were dropped. The 5-factor structure was then analysed using a confirmatory factor analysis. Cronbach's α was computed to assess internal consistency.

RESULTS

A 5-factor structure corresponding to the factors: "Adaptation to hearing loss", "Childcare support", "Healthcare", "Education" and "Policy" was adopted. Confirmatory factor analysis suggested a good model fit (RMSEA=0.067, RMR=0.329, SRMR=0.0752, NFI=0.830, CFI=0.949) when compared with the original 8-factor structure. Cronbach's α were high (> 0.75) for each subscale. An additional three items were eventually added back to the instrument as they were deemed to be clinically relevant, resulting in a total of 42 items.

The factor structure of the original questionnaire has been changed significantly from an 8-factor structure to a 5-factor structure with only three overlapping factors. Given the large reassignment of items, it may be suggested that the new structure could be an artefact of factor analysis and may not be meaningful in clinical usage. Table 1 lists the overlapping and non-overlapping factors between the old and new factor structures.

Table 1 – Comparison of old and new factor structures

	Old Factor Structure (8-factor)	New Factor Structure (5-factor)
Factors Changed	Communication Emotional Equipment Finance Social	Adaptation Policy
Factors Retained	Support Health Education	Support Healthcare Education

Overlapping factors

The overlapping factors are shown in Table 2. As some items were removed from the new factor structure, the same items were removed in the old factor structure for a fairer comparison. The number of shared items between these shared items varied between two to six items which suggested that qualitatively, the factors shared some similarity.

Table 2 – Overlapping factors and number of shared items

Factors	Number of Items		Number of Shared Items
	Old	New	
Support	6	12	2
Health	9	8	6
Education	7	6	6

Non-overlapping factors

Five other subscales from the old factor structure were regrouped into two subscales. The reassignments of the subscales helped better defined the meaning of each subscale by the new composition of the items and were supported by the confirmatory analysis.

CONCLUSIONS

The PHICE has been revised, reorganised in terms of the subscales composition and the resulting 42-item instrument is deemed to be structurally valid and internally consistent.

PUBLICATIONS

ORIGINAL ARTICLES

1. *Wu CX*, ***Tan WS***, *Toh MPHS*, ***Heng BH***. Stratifying healthcare costs using the Diabetes Complication Severity Index. Journal of Diabetes and Its Complications 2012; 26 (2): 107-112

2. ***Tan WS***, ***Ding YY***, ***Chong WF***, *Tay JC*, *Tan JYL*. Impact of data source and time reference of functional status on hospital mortality prediction. BMC Health Services Research 2012; 12 (May 2012): 115

3. ***Zhu ZC***, ***Heng BH***, ***Teow KL***. Estimating ICU bed capacity using discrete event simulation. International Journal of Health Care Quality Assurance 2012; 25 (2): 134-144

4. *Wong LY*, ***Heng BH***, ***Ng CWL***, ***Molina JAD***, ***George PP***, *Cheah JTS*. Geriatric syndromes and depressed mood in lower-income Singaporeans with diabetes: Implications for diabetes management and health promotion. Annals Academy of Medicine (Singapore) 2012; 41 (2): 67-76

5. ***Zhu ZC***. Optimal scheduling in walk-in outpatient clinics: A mixed hybrid flow shop problem approach. International Journal of Modelling in Operations Management 2012; 2 (3): 279-287

6. ***Sun Y***, ***Teow KL***, ***Heng BH***, *Ooi CK*, *Tay SY*. Real-time prediction of waiting time in the emergency department, using quantile regression. Annals of Emergency Medicine 2012; 60 (3): 299-308

7. *Wu CX*, ***Tan WS***, *Toh MPHS*, ***Heng BH.*** Derivation and validation of a risk index to predict all-cause mortality in Type 2 diabetes mellitus. Journal of Endocrinology and Metabolism 2012; 2 (2): 88-95

8. ***Ng CWL***, ***Heng BH***, ***Molina JAD***, *Wong LY*, ***Gunapal PP***, *Cheah JTS*. Demographic and lifestyle characteristics associated with non-willingness to participate in health promotion programmes among adults of lower socioeconomic status. Global Health Promotion 2012; 19 (4): 9-19

9. ***Gunapal PP***, ***Heng BH***, ***Molina JAD***, *Wong LY*, ***Ng CWL***, *Cheah JTS*. Self-reported chronic diseases and health status and health service utilisation — Results from a community health survey in Singapore. International Journal for Equity in Health 2012; 11 (16 Aug 2012): 44

10. *Abisheganaden J*, ***Ding YY***, ***Chong WF***, ***Heng BH***, *Lim TK*. Predicting mortality among older adults hospitalised for community-acquired pneumonia: An enhanced Confusion, Urea, Respiratory rate and Blood Pressure score compared with Pneumonia Severity Index. Respirology 2012; 17 (6): 969-975

SYSTEMATIC REVIEWS

11. *Ng KP*, ***Ng CWL***. The effects of practice size on quality of care in primary care settings: A systematic review. Joanna Briggs Institute Library of Systematic Reviews 2012; 10 (27): 1549-1633

AWARDS AND GRANTS

CONFERENCE PRESENTATION AWARDS

3rd Singapore Health & Biomedical Congress, Singapore
September 2012

Young Investigator Award (Quality & Health Services Research) — Silver
Anusha Govinda Raj
Effectiveness of a palliative care programme in reducing hospital admissions for nursing home residents

1st Singapore International Public Health Conference & 7th Singapore Public Health & Occupational Medicine Conference, Singapore
October 2012

Young Investigator Best Oral Presentation — Runner-Up
Tan Woan Shin
Results of the liberalisation of Medisave for a population-based diabetes management programme in Singapore

Student Best Oral Presentation — Runner-Up
Charis Ng Wei Ling
Association of socioeconomic status and social support with depressive symptoms among the elderly in Singapore

Young Investigator Best Poster Presentation — Runner-Up
Dr Pradeep Paul George Gunapal
Evaluation of a comprehensive management programme for COPD

RESEARCH GRANTS

NHG Small Innovative Grant
Meticillin-resistant staphylococcus aureus (MRSA) screening at hospital admission: The cost effectiveness of universal screening vs screening only high risk patients
Dr Sun Yan (Principal Investigator)
Palvannan R. Kannapiran (Co-investigator)
Kelvin Teo Wee Sheng (Co-investigator)
Dr Heng Bee Hoon (Co-investigator)
$95,000

TRAINING AND EDUCATION

Introduction to Operational Research (Master of Clinical Investigation Programme, NUS)

March 2012

Speaker: ***Teow Kiok Liang***

The short lecture provided students with an introduction to the principles and practices of Operations Research (OR), and its role in human decision making. The focus was on understanding queue terminology, relations between parameters for planning, and the use of selected models and discrete event simulation for waiting time scheduling, resource planning and variability management.

10th & 11th Operations Research Appreciation Course (ORAC)

July 2012 & November 2012

Speakers: ***Dr Meng Fanwen***
Dr Zhu Zhecheng
Palvannan R. Kannapiran
Teow Kiok Liang

The 2-day course introduced OR concepts with healthcare applications. It focused on building intuition around theory, walked through illustrative examples and showed insights from results that supported and informed decision making. Case studies showed applications of OR techniques as well as the process of problem solving during the engagement with the decision maker.

Health Services Research (Singapore Health and Biomedical Congress)

September 2012

Speakers: ***Dr Gary Ang Yee***
Dr Pradeep Paul George Gunapal
Tan Woan Shin
Anusha Govinda Raj
Dr Martin Utley, University College London
Palvannan R. Kannapiran
Dr Sun Yan
Teow Kiok Liang

Held in conjunction with the Singapore Health and Biomedical Congress, the health services research track consisted of two sessions titled "Population Health Management — Predicting and Measuring Outcomes", and "Modelling for Healthcare Decision Making". The first session included studies on the identification of high-risk patients with chronic kidney disease with risk of renal failure and evaluated programme outcomes of COPD patients, asthma patients and nursing home patients with end-of-life care. The second session focused on studies that showed how causal models can help to inform decisions when there is little data, understand the feedback dynamics in hospital patient flow, and if targeted screening of MRSA colonised patients was cost effective.

Framing the Research Question

September 2012
Speaker: ***Dr Joseph Antonio D. Molina***
The talk was delivered as part of the Study Design Workshop for the 2012 NHG-KTPH Clinician Leadership in Research (CLR) Programme. The talk gave the audience an overview of how the research question related to the other parts of a research proposal. It focused on methods for searching for good research topics, framing the problem and the criteria for a good research question.

Introduction to Economic Evaluation in Healthcare

October 2012
Speakers: ***Tan Woan Shin***
Kelvin Teo Wee Sheng
Palvannan R. Kannapiran
The 1-day course provided an introduction to the rationale and methods of economic evaluation in healthcare. It explained how economists evaluated the costs and benefits of health interventions, the types of economic evaluation, and provided an introduction to the analytical methods. The course was conducted using a mix of presentations of theories, and real life examples.

Introduction to Health Services Research

November 2012
Speakers: ***Anusha Govinda Raj***
Chong Wai Fung
Kelvin Teo Wee Sheng
Dr Pradeep Paul George Gunapal
Dr Joseph Antonio D. Molina
This workshop was delivered for the 2012 NHG-KTPH Clinician Leadership in Research (CLR) Programme. It was specifically designed for the Health Services Research (HSR) track of the CLR. The full day course included talks on distinctive features of HSR, research designs, HSR case studies, real world considerations in conducting HSR as well as an introduction to economic evaluations.

How to Design a Research Protocol: Step by Step

December 2012
Speaker: ***Dr Joseph Antonio D. Molina***
The talk was part of the full day Research Methodology Workshop organised by the NHG Eye Institute. The talk focused on the different parts of a research protocol, from the research question to data analysis, including other essential components such as research ethics and project administration. The talk aimed to equip participants with a good understanding of each part of the protocol and to enable them to relate each of these to the various steps involved in study implementation.

THE TEAM

1. **Dr Heng Bee Hoon**
MBBS, MSc (Public Health), FAMS
Director

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

3. **Charis Ng Wei Ling**
BA (Psychology & Communications)
Senior Research Analyst

4. **Cheryl Lobo**
BA (History)
Research Assistant

5. **Chong Wai Fung**
BN, MBA, MPH
Principal Research Analyst

6. **Dr Gary Ang Yee**
MBBS, MPH
Registrar

7. **Dr Joseph Antonio D. Molina**
MD, MSc (Public Health)
Principal Research Analyst

8. **Kelvin Teo Wee Sheng**
BA (Economics) (Magna Cum Laude), MA (Economics)
Research Analyst

9. **Li Ruijie**
MSc (Occupational Therapy)
Senior Research Analyst

10. **Dr May Me Thet**
MBBS, MSc (Public Health)
Research Analyst

11. **Dr Meng Fanwen**
MSc (Operations Research), PhD (Operations Research)
Operations Research Specialist

12. **Dr Nakul Saxena**
BPharm, PhD (Epidemiology)
Research Analyst

13. **Palvannan R. Kannapiran**
BEng (Mechanical Engineering), MEng (Industrial & Systems Engineering)
Operations Research Specialist

14. **Dr Pradeep Paul George Gunapal**
BSMS, MSc (Epidemiology)
Principal Research Analyst

15. **Dr Sun Yan**
MSc (Data Mining), PhD (Medical Informatics)
Medical Informatics and Biostatistics Specialist

16. **Tan Woan Shin**
BSocSc (Hons) (Economics), MSocSc (Economics)
Principal Research Analyst

17. **Teow Kiok Liang**
BEng (Electrical Engineering), MSc (Industrial & Systems Engineering)
Operations Research Specialist

18. **Dr Zhu Zhecheng**
MSc (Information Engineering), PhD (Industrial & Systems Engineering)
Operations Research Specialist

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