HEALTH SERVICES & OUTCOMES RESEARCH

HSOR

The evidence behind your decisions

2010

National
Healthcare
Group

Adding years of healthy life

FOREWORD

2010 marks another year of growth for the Department of Health Services & Outcomes Research (HSOR) that envisions to further improve the quality of healthcare in NHG by providing the best available evidence for decision making and knowledge translation, building capacity and advancing knowledge in health services research. Since its inception in 2005, the multidisciplinary team of specialists, researchers, analysts and research assistants from diverse backgrounds, grew to 24 members. The growth is necessary to support the changing nature and spectrum of work from micro-level issues (e.g. outcomes of a specific disease management programme) to more system-level issues (e.g. continuity of care programmes in the community), and provide evidence-base that has a wider impact.

The work of HSOR is user-driven, working closely with clinical heads and managers on the ground in formulating the questions and translating the evidence into decisions and practice. Emphasis is on making the research relevant to stakeholders, pragmatic yet rigorous and academic, valid and reliable, and linking the stakeholder with the best available evidence at the point of need in a useful form. Dealing with the complexity of the health care system and the real world calls for the ability to deploy the right information and the use of a range of techniques, ranging from surveys, risk adjustment and predictive modelling, data-mining, cost-analysis, simulation and programming; through the synergy of the multidisciplinary team.

The department grew with more partners beyond the NHG. Together with collaborators from NUH, TTSH, NTFGH, Duke-NUS and UK's University of Southampton, a project on Integrated Hospital Simulation Model has been awarded the 2nd MOH Health Services Research Competitive Research Grant. It was also engaged to carry out a community-based survey on the needs of the elderly in an electoral district to aid in planning of a multi-agency, multi-Ministry intervention focussing on wellness, care coordination and ageing in place.

Then there is the need to build capacity in health services research within NHG. In response to the growing demand among stakeholders, HSOR conducted introductory workshops on topics such as survey research, health programme evaluation, research methods, operations research, health technology assessment, qualitative research, health economics, analytical and predictive methods, risk adjustment; and provided the faculty for the NHG Clinician Leadership in Research Programme. The University of Adelaide also appointed nine HSOR staff to its faculty for its Master of Clinical Science in Evidence Based Healthcare Programme. The department continues to publish in local and international peer-reviewed journals; and present in local and international scientific meetings and conferences, to contribute and share new knowledge.

This report highlights some of HSOR's key projects.

Prof Chee Yam Cheng
Chief Executive Officer,
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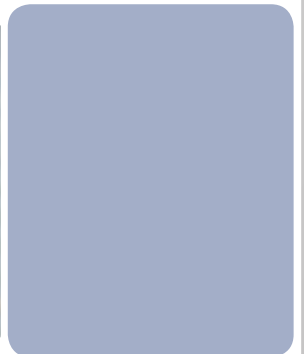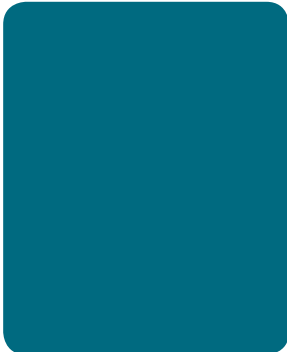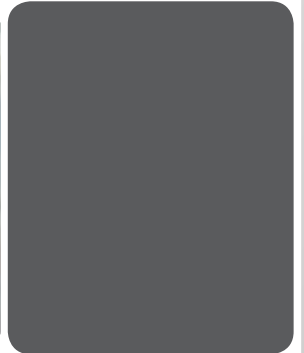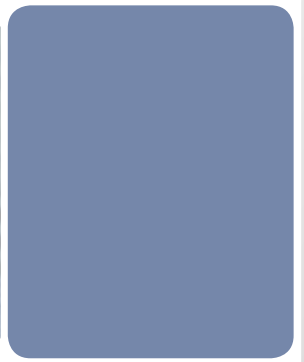
PROJECTS

Association between quality of care and short term outcomes for very old patients hospitalised for acute illnesses

BACKGROUND

Quality of care is important but difficult to measure. Adherence to care processes was used previously to link quality and outcomes. The underlying assumption was adherence to care process may result in better quality of care. The Assessing Care Of Vulnerable Elders (ACOVE) quality indicators have been developed to measure quality of care for vulnerable, older people hospitalised for acute illnesses.

OBJECTIVES

We sought to determine the association between adherence to care processes using selected ACOVE quality indicators, and short term outcomes for very old patients admitted for acute illnesses in a tertiary hospital.

METHODS

This was a retrospective review of medical records of a random sample of all patients aged 80 years and above admitted to the Department of General Medicine and Department of Geriatric Medicine from 2005 to 2008, with an equal number of cases (750) selected for each year. The quality indicators selected were cognitive and functional assessment, discharge planning, delirium evaluation and treatment, mobilisation, and aspiration precautions. If patients met the inclusion criteria for each specific quality indicator, they were assessed to determine if the process-of-care was carried out and documented. The outcomes of interest were in-hospital mortality, 30-day mortality and hospital readmission within 15 days of discharge.

RESULTS

Of the 3,000 cases selected, the medical records for 2,923 cases were available for review. The mean age of the study participants was 86 years, and 38% were male. The adherence for the quality indicators ranged from 33.8% for cognitive and functional assessment to 86.1% for discharge planning.

In the univariate analyses (Table 1), adherence to delirium evaluation and treatment, and the documentation of cognitive and functional assessment were associated with a reduction in in-hospital and 30-day mortality rates. The association between adherence to quality indicators and hospital readmission was not statistically significant.

After adjustments using the bivariate probit regression, adherence to aspiration precautions was associated with lower in-hospital mortality (rho=-0.128; 95% CI: -0.233,-0.021).

Table 1 – Univariate tests of quality indicators to outcomes

Quality indicators	Met process–of–care measures	in–hospital death		30–day mortality		Readmission within 15 days of discharge	
		%	p–value	%	p–value	%	p–value
Cognitive and functional assessment	Yes	6.2	**<0.001**	10.3	**<0.001**	10.2	0.277
	No	16.2		22.3		11.6	
Discharge planning	Yes			7.6	0.188	13.4	0.631
	No			1.2		14.5	
Delirium evaluation	Yes	17.5	**<0.001**	22.6	**0.002**	11.5	0.665
	No	26.1		32.5		12.5	
Mobilisation	Yes	2.3	0.113	6.4	0.239	10.8	0.379
	No	0.9		4.5		9.1	
Aspiration precautions	Yes	8.4	0.794	14.8	0.386	12.1	0.415
	No	8.7		13.6		11.1	

DISCUSSION

The link between adherence to process–of–care measures and outcomes was not clear. The quality of care received, as measured by adherence to process–of–care measures, did not seem to have an impact on the short–term outcomes for very old patients admitted for acute illnesses. One possible reason for this finding could be the lack of documentation by the physicians. For example, nurses may mobilise patients within 48 hours as part of their care plan, and therefore the physicians did not document such orders. The non–documentation could have led to a bias towards the null.

Hospital readmission within 15 days could be attributed to poor quality of care during the index admission, or other non–modifiable factors such as disease progression or other unrelated medical conditions. Adherence to aspiration precautions may be associated with lower in–hospital mortality as very old patients are more susceptible to aspiration pneumonia with severe consequences.

CONCLUSION

Adherence to aspiration precautions was the only quality indicator that had an impact on the short term outcome, specifically in–hospital death, for elderly patients hospitalised for acute medical conditions.

Association of younger age with poor glycaemic and cholesterol control among Type 2 diabetes mellitus (T2DM) in Singapore

BACKGROUND

The prevalence of diabetes mellitus in Singapore increased from 8.2% in 2004 to 11.5% in 2010 amongst its population aged between 18 and 69 years. Epidemiologic studies have reported significant association between HbA1c level and diabetes-related vascular complications. Younger adults with early exposure to hyperglycaemia were at high risk for end-organ damage. Few studies have reported the relationship of age to glycaemic control in patients with T2DM and there has been little comparison between young adults and elderly patients especially in the Asian population. This study investigated the relationship between age and glycaemic control in patients with T2DM attending NHG polyclinics.

METHODS

We included T2DM patients who had at least two visits to the same polyclinic for diabetes treatment in 2009. Demographic characteristics, medical records and laboratory results were extracted from the enterprise-wide chronic disease registry. The mean HbA1c, blood pressure and LDL-cholesterol were trended by age. Multivariate logistic regression was used to identify the factors predicting poor glycaemic (HbA1c>8%) control.

RESULTS

Among the 58,057 T2DM patients, the mean HbA1c and LDL-cholesterol decreased with age (Figures 1 and 2). Mean HbA1c was 8.1±1.6% for patients <45 years old and 6.9±1.0% for patients 85+ years old. The corresponding mean LDL-cholesterol levels were 2.8±0.8 and 2.6±0.7 mmol/L (Table 1). The Malay and Indian groups had significantly poorer glycaemic control compared to the Chinese, AdjOR 1.65 (95%CI: 1.54-1.77) and 1.50 (95%CI: 1.40-1.61), respectively. Other significant predictors of poor glycaemic control included the male gender, presence of maculopathy or retinopathy, peripheral vascular disease, coronary heart disease, heart failure, and being on insulin therapy (AdjOR 8.00; 95%CI: 7.54-8.48). Patients with poor LDL-cholesterol (4.1+ mmol/L) were 4.2 times more likely to have poor glycaemic control (95%CI: 3.78-4.66) than those with LDL-cholesterol <2.6 mmol/L, while those with Grade 2 hypertension (≥ 160/100 mmHg) were 1.5 times (95%CI: 1.35-1.76) more likely than those without hypertension.
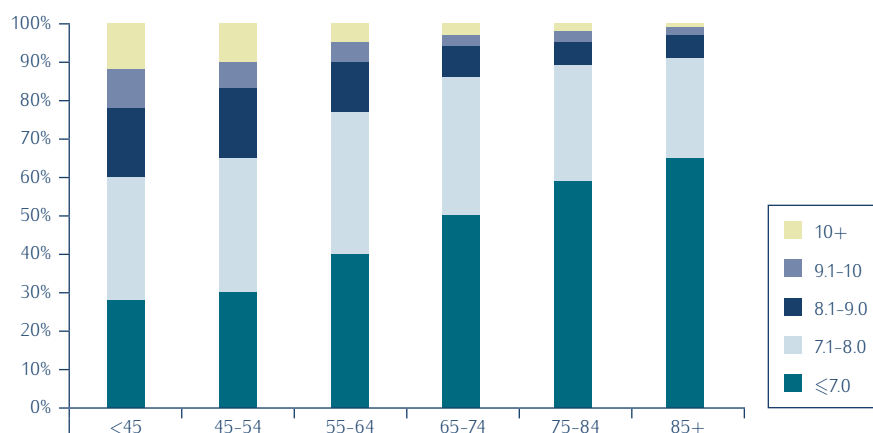
Figure 1 – Distribution of mean HbA1c (%) by age group

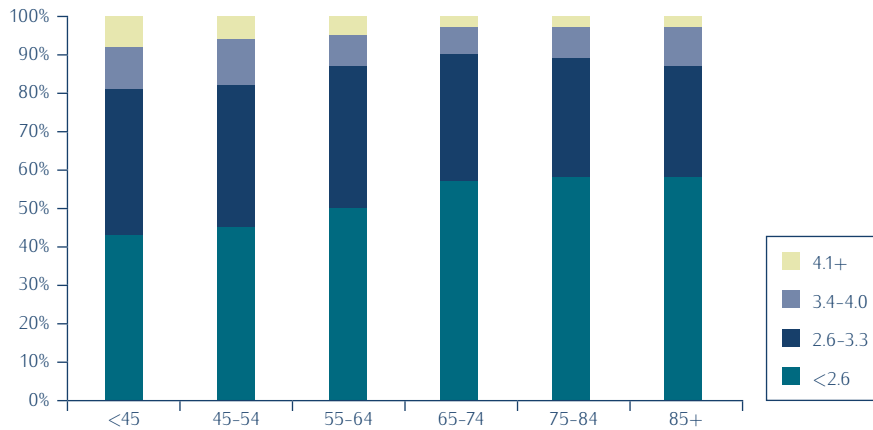Figure 2 – Distribution of mean LDL–cholesterol (mmol/L) by age group

Table 1 – Mean HbA1c, LDL–cholesterol, serum creatinine and blood pressure by age group

| | Unit | Age Group | | | | | | | | | | | |
| | | <45 | | 45–54 | | 55–64 | | 65–74 | | 75–84 | | 85+ | | All | |
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
HbA1c	%	8.08	1.62	7.88	1.49	7.52	1.26	7.20	1.05	7.03	1.01	6.86	0.99	7.42	1.27
LDL–cholesterol	mmol/L	2.84	0.81	2.79	0.76	2.68	0.72	2.58	0.68	2.56	0.70	2.55	0.73	2.65	0.72
Serum creatinine	mmol/L	69.42	36.39	75.16	42.91	81.93	44.02	90.83	50.75	98.52	49.87	108.24	62.68	86.38	48.12
Diastolic blood pressure	mmHg	76.25	7.57	76.10	7.67	74.40	7.72	71.90	7.78	69.92	8.10	68.70	8.24	73.17	8.12
Systolic blood pressure	mmHg	124.31	12.23	127.41	12.92	130.62	46.66	132.33	13.58	134.23	55.43	132.57	14.94	130.93	35.64

KEY FINDINGS

Our study showed that younger patients with T2DM had poorer glycaemic and cholesterol control than older patients in Singapore. The poor glycaemic control among the younger T2DM patients was also associated with poorer cholesterol and blood pressure control.

Younger patients have a higher lifetime risk of developing micro– and macro–vascular complications and should be treated much more aggressively to achieve "optimal" glycaemic, blood pressure and cholesterol control.

In addition to treating raised HbA1c, physicians should be alerted to commence or reinforce aggressive lifestyle intervention, lipid–lowering and anti–hypertensive therapy especially for the younger T2DM patients.

More research should be done to investigate reasons for the poorer control so that targeted interventions can be designed for younger patients.

Early risk of stroke after first–ever transient ischaemic attack (TIA)

INTRODUCTION

The risk of stroke in the early period after a transient ischemic attack can be very high. A recent systematic review showed that the risks reported across studies ranged from 1.4% to 9.9% at 2 days, from 3.2% to 17.7% at 30 days, and from 3.9% to 17.3% at 90 days; and the corresponding pooled estimate using the random effects model were 3.5% (2.1%–5.0%), 8.0% (5.7%–10.2%), and 9.2% (6.8%–11.5%) at 2, 30, and 90 days, respectively. Guidelines highlighted the need for early comprehensive assessment and treatment of patients after TIA to reduce the risk of subsequent stroke, but it was uncertain how urgently patients needed to be seen, and there were great variation in practice. The objective of this study was to estimate the early risk of stroke at 7, 30, 90 days and 1 year following the first–ever TIA and time to stroke among patients who developed stroke.

DESIGN AND SETTING

This was a retrospective cohort study. Patients presented to the emergency departments of three public hospitals in Singapore with first–ever TIA from 2005 to 2008 were included and followed up for 1 year. All study patients' data were extracted from the Chronic Disease Management System (CDMS). Outcome measures were the occurrence of stroke and time from TIA to stroke occurrence. Logistic regression and the Cox proportional hazard model were applied to study the risk adjusted odds and risk ratios.

STATISTICAL ANALYSIS

Both univariate and multivariate analyses were conducted to study the early risk of stroke among two cohorts (admitted vs discharged). Patient characteristics of the two cohorts at the time of TIA presentation were compared using either the chi–square test or student's T–test. The crude early risks at 7, 30, 90 days and 1 year were compared by Fisher's exact test, and the adjusted risks were compared by multiple logistic regression. The time intervals from the first–ever TIA to the occurrence of stroke in the two cohorts were analysed by Kaplan–Meier analysis and compared by a log–rank test. The adjusted risk ratios of the two cohorts were compared by Cox regression. Confounders adjusted in this study included patient's age, gender and ethnic group, and comorbid conditions (diabetes, hypertension, dyslipidemia, renal disease, peripheral vascular disease, coronary vascular disease, atrial fibrillation).

RESULTS

The admitted cohort had significantly lower stroke occurrence rates than the discharged group at 7 days (1.2% vs 4.4%, p<0.001), 30 days (3.1% vs 5.9%, p<0.001), and 90 days (5.0% vs 6.9%, p=0.005). There were no significant differences between the two cohorts at 1 year (9.9% vs 9.7%, p=0.772) (Table 1 and Figure 1). The adjusted risks of stroke in the discharged cohort from 7 days to 1 year were higher than those in the admitted cohort. Among patients who developed stroke, the median duration from TIA to stroke was 104 days (95%CI: 66–142) in the discharged cohort, and 220 days (95%CI: 170–270) in the admitted cohort.

Table 1 – A comparison of crude and adjusted odds ratio of stroke within 1 year of a first–ever TIA between discharged vs admitted patients

Interval to stroke	Crude odds ratio				Adjusted odds ratio			
	Odds ratio	95% CI		p value	Odds ratio	95% CI		p value
		Lower	Upper			Lower	Upper	
7 days	3.95	2.55	6.11	<0.001	5.41	3.47	8.41	<0.001
30 days	1.92	1.44	2.57	<0.001	2.67	1.99	3.58	<0.001
90 days	1.41	1.11	1.79	0.005	1.94	1.52	2.49	<0.001
1 year	1.03	0.85	1.24	ns	1.40	1.16	1.70	0.001

Figure 1 – Percentage of discharged vs admitted patients who developed stroke 7, 30, 90 days and 1 year after first–ever TIA
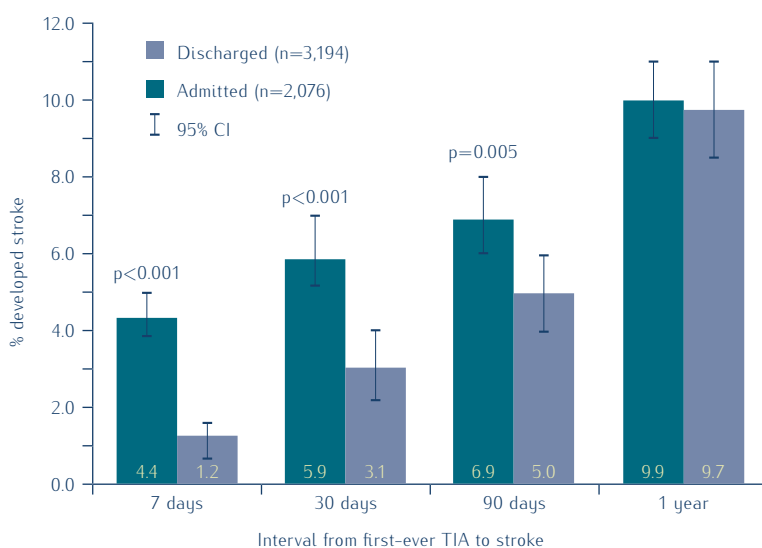
CONCLUSION

Early risk of stroke after TIA may be as high as 4.4% at 7 days, 5.9% at 30 days, 6.9% at 90 days, and 9.9% at 1 year. The risk of stroke within 1 year is lower in admitted patients compared to those discharged from the emergency department. The risk difference between the groups narrowed progressively, and at 1 year, the risk of stroke in both cohorts was similar. The findings suggested that patients with TIA symptoms would benefit from early comprehensive investigation and management. The fact that the risk of stroke was about 10% at 1 year, and that this risk was similar in both cohorts regardless of admission, suggested the need for long–term intervention to reduce stroke occurrence. Further research into the differences between the admitted and discharged cohorts is also recommended.

Systematic review of the diagnostic accuracy of the single–, two– and three– field digital retinal photography (DRP) for screening diabetic retinopathy

BACKGROUND

Diabetes leads to several complications, one of which is retinopathy. Diabetic retinopathy is a result of high blood sugar levels causing damage to the blood vessels that serve the retina leading to blindness. In Singapore, diabetic retinopathy is a leading cause of blindness. Among 13,296 diabetes patients screened at six polyclinics in 1995, 21.8% were found to have diabetic retinopathy.

Individuals with diabetic retinopathy may not experience any visual symptoms. Hence, regular eye examinations are important for its early detection and treatment before blindness develop. While laser treatment is effective in slowing the progression of diabetic retinopathy, it does not restore lost vision.

Screening methods for diabetic retinopathy include ophthalmoscopy, retinal photography and variations of both. Retinal photography presents an added advantage to ophthalmoscopy in tracking the patient's disease progression. In addition, the use of digital imaging technology allows for easy and inexpensive storage. Some practices dilate the pupil prior to photography to produce an image of better quality.

The gold standard for diabetic retinopathy screening is to photograph seven visual fields. In practice however, fewer fields such as single–, two– or three–fields are often used to reduce cost and time. To date, there has not been any systematic review comparing the diagnostic accuracy of the single–, two– and three–field DRP. This systematic review was initiated to identify the optimal number of fields for screening.

METHODS

A comprehensive search was conducted for studies published from January 1985 to December 2008 using the search terms: 'diabetic retinopathy', 'screening', 'retina', 'fundus', 'photograph', from Medline, Embase and CINAHL databases. Studies that used seven–field stereoscopic fundus photography (7SF) or indirect ophthalmoscopy as the reference standard were included. Study appraisal and data extraction were performed by two reviewers using an adapted version of the critical appraisal tool for diagnostic studies developed by the Critical Appraisal Skills Programme at the Public Health Resource Unit, National Health Service, UK. Data from included studies were extracted using a modified Joanna Briggs Institute data extraction tool. Studies were grouped by the reference standard used and summarised.

RESULTS

Twenty–two primary studies met the review criteria. Fifteen studies applied the single–field followed by two–fields (5 studies) or three–fields (7 studies). Five studies compared more than one–field type with the reference standard. The heterogeneity of studies precluded a quantitative synthesis, due to differences in patient characteristics, sample selection, methods of screening, grading scales, inclusion of ungradeable images and units of analysis. There was a large overlap in the sensitivity and specificity across the number of fields, but there was a discernible trend for higher sensitivity and lower specificity with increasing number of fields (Table 1).

Table 1 – Range of results stratified by application of dilation and reference standard

No. of fields	Undilated		Dilated		All	
	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)
Reference Standard: 7SF						
1	66.0–87.0	45.0–86.0	75.0	96.0	66.0–87.0	45.0–96.0
2	86.4–97.9	78.1–95.4	–	–	86.4–97.9	78.1–95.4
3	97.6	71.9	85.0–87.0*	81.0–86.0	85.0–97.6	71.9–86.0
Reference Standard: Indirect ophthalmoscopy						
1	38.0–100.0	47.0–100.0	80.0–89.7	79.2–98.3	38.0–100.0	47.0–100.0
2	92.0	96.0	83.0–96.5	79.0–100.0	83.0–96.5	79.0–100.0
3	92.3	97.5	90.0–97.4	90.0–98.3	90.0–97.4	90.0–98.3

RECOMMENDATIONS

1. Field specialists need a consensus on the methods involved in the use of digital photography for screening diabetic retinopathy with regards to:
   (a) the extent and area of retinal coverage for photography
   (b) minimum resolution for image viewing
   (c) a standard scale for grading retinopathy
   (d) referral criteria

2. Future studies should also follow the reporting standards for studies of diagnostic accuracy to allow generalisability of results to other settings. Studies lacked in the reporting of sample characteristics such as age, gender, diabetes type, and duration of diabetes, personnel performing the screening and reference standard as well as the training and handling of indeterminate results.

3. A prospective study comparing the single–, two– and three–fields, with and without dilation will provide the required evidence for the selection of optimal number of fields for screening. Thus far, no such studies have been carried out anywhere in the world.

CONCLUSIONS

The evidence from the review was insufficient for recommending the optimal number of screening fields. Until further research is available, clinicians may choose to use a single–field for screening, given that it would require less time and lower costs. Although the dilation of pupils was useful in reducing the proportion of ungradeable images, a targeted approach for dilation would be recommended, as opposed to dilating all pupils.

Outcomes of Medical Intensive Care Unit (MICU) and High Dependency Unit (HDU) admission among patients admitted from the emergency department (ED) of an acute care hospital in Singapore

INTRODUCTION

Various studies have demonstrated that delays in ICU transfer may prolong hospital length of stay, and increase ICU, in-hospital and 30-day mortality. The decision to admit, and when to admit to the ICU rests largely on the professional judgment of the ED or ICU physician. There is a need to evaluate the quality of these decisions as reflected by patient outcomes in the local context. In this study, delays in the delivery of critical care as well as the consequences of these delays were measured using retrospective data. Results may serve as a basis for the design of interventions to address the common causes of these delays. Identification of potential consequences of these delays may enable clinicians to design appropriate anticipatory management for critically ill patients.

OBJECTIVES

The study aimed to determine if there was a difference in in-hospital and 60-day mortality, in-hospital length of stay (LOS) and MICU/HDU LOS on admission to MICU/HDU between the following groups:

1. MICU/HDU patients seen at the ED in the previous 24 hours and who were admitted directly to MICU/HDU (direct admission)
2. MICU/HDU patients seen at the ED in the previous 24 hours and who were initially admitted to the general wards, and subsequently transferred to the MICU/HDU within 24 hours (indirect admission)

METHODS

This was a retrospective cohort study. Patients were included into the study if they were: (a) discharged from MICU/HDU in 2009 and were admitted from the ED and, (b) transferred to MICU/HDU within 24 hours of presentation at the ED. Patients were categorised into those directly admitted to the MICU/HDU from the ED, and those initially admitted to the wards before being transferred to the MICU/HDU within 24 hours of presentation at the ED. In-hospital and 60-day mortality, MICU/HDU and total in-hospital length of stay were compared between these two groups.

Except for 60-day mortality, data on the other outcomes, exposure variable (timing of MICU/HDU admission), and other covariates were obtained from the ED and MICU/HDU case notes, and the Operations Data Store (ODS) – an administrative database of NHG.

Aside from the specified independent and dependent variables, data on selected covariates were retrospectively collected for the purpose of carrying out risk adjustment. These were obtained from the ODS and from the ED and MICU/HDU case notes. Covariates included the following:
- Demographics – age, gender, ethnicity
- Charlson index based on history of chronic comorbidities
- Recent (7 days) discharge from hospital prior to current admission
- Recent (7 days) presentation at an ED
- Vital signs on arrival – heart rate, respiratory rate, blood pressure, temperature
- Treatment rendered at the ED
- Vital signs on presentation at MICU/HDU
- APACHE II score on presentation at MICU/HDU

RESULTS

There were 706 patients included in the study, 491 (69.5%) of whom were directly admitted to MICU/HDU. Their mean age was 59.7 years. Univariate analysis revealed that there was no difference between direct and indirect admissions with respect to gender (58.8% vs. 57.4% males, respectively), ethnicity, the proportion who presented at the ED in the

preceding 7 days, and the proportion who were hospitalised in the preceding 7 days. Unadjusted results showed that patients who were indirectly admitted had higher in-hospital and 60-day mortality, as well as a greater proportion who stayed at the ICU for 2 or more days (vs less than 2 days).

Multivariate (adjusted) results revealed that the following factors were significantly associated with the outcomes:

Outcome 1 – In-hospital mortality*

Covariate	Odds Ratio (95% CI)
Cardiopulmonary resuscitation Yes No (Ref)	 37.38 (6.89, 202.70) –
Admission to ICU **Indirect** **Direct (Ref)**	 **3.07 (1.39, 6.80)** **–**
Age	1.02 (1.01, 1.04)

Non-significant covariates: hospitalisation within the last 7 days, intubation at the ED, Charlson comorbidity index, gender, Apache score on arrival at ICU, whether patient was admitted at ICU or HD, and vital signs at ED including heart rate, respiratory rate, oxygen saturation, mean arterial pressure

Outcome 2 – Death within 60 days of admission[Ψ]

Covariate	Odds Ratio (95% CI)
Cardiopulmonary resuscitation Yes No (Ref)	 51.39 (9.25, 285.62) –
Admission to ICU **Indirect** **Direct (Ref)**	 **3.09 (1.40, 6.83)** **–**
Age	1.03 (1.01, 1.05)

Ψ Non-significant covariates: hospitalisation within the last 7 days, intubation at the ED, Charlson comorbidity index, gender, Apache score on arrival at ICU, whether patient was admitted at ICU or HD, and vital signs at ED including heart rate, respiratory rate, oxygen saturation, mean arterial pressure

Outcome 3 – Total in-hospital length of stay (8+ days vs 0-7 days)[μ]

Covariate	Odds Ratio (95% CI)
Age	1.03 (1.01, 1.05)

μ Non-significant covariates: hospitalisation within the last 7 days, timing of admission to ICU (direct vs indirect), intubation at the ED, Charlson comorbidity index, gender, Apache score on arrival at ICU, whether patient was admitted at ICU or HD, and vital signs at ED including heart rate, respiratory rate, oxygen saturation, mean arterial pressure

Outcome 4 – ICU/MICU length of stay (2+ days vs 0–1 day)[ν]

Covariate	Odds Ratio (95% CI)
Admission to ICU **Indirect** **Direct (Ref)**	 **2.54 (1.48, 4.36)** **–**
Charlson comorbidity index	0.85 (0.76, 0.96)
Age	1.01 (1.00, 1.03)
Oxygen saturation at ED <98 98–100 (Ref)	 1.94 (1.28, 2.93) –
Intubation at the ED Intubated Not intubated (Ref)	 1.93 (1.02, 3.68) –

ν Non-significant covariates: hospitalisation within the last 7 days, gender, whether patient was admitted at ICU or HD, resuscitation at the ED, and vital signs at ED including heart rate, respiratory rate, mean arterial pressure

FINDINGS
Direct vs indirect MICU/HDU admissions
- One-third (30.5%) of patients who were admitted to the MICU/HDU within 24 hours of arrival at the ED came from the general wards

Outcomes of indirect admission to MICU/HDU
- The risk of in-hospital death for patients who were indirectly admitted to MICU/HDU was 3 times higher (OR=3.07; 95% CI: 1.39, 6.80) than for directly admitted patients
- The risk of 60-day mortality for patients who were indirectly admitted to MICU/HDU was 3 times higher (OR=3.09; 95% CI: 1.40, 6.83) than for directly admitted patients
- The risk of staying 2+ days in ICU was more than twice (OR=2.54; 95% CI: 1.48, 4.36) for patients indirectly admitted from ED to MICU

CONCLUSIONS AND RECOMMENDATIONS
Thirty percent (215/706) of patients admitted to the MICU/HDU within 24 hours of arrival at the ED were initially admitted to the general wards before being transferred. As the outcomes of these patients were generally poorer than for directly admitted patients, it may be useful to examine the extent to which physicians' decisions, patients'/caregivers' decisions as well as other factors such as the availability of facilities and resources would affect the timing of admission to MICU/HDU.

Evaluation of the Empowerment Self-management Initiative (ESI) programme for patients with Type 2 diabetes on insulin

INTRODUCTION

Diabetes mellitus is the 7th commonest cause of death in Singapore. Improved blood glucose control is associated with reduction in the risk of developing microvascular and macrovascular complications and may improve the quality of life. In October 2007, NHGP rolled out the Empowerment Self-Management Initiative (ESI) Programme to encourage the uptake of a care manager-led self-monitoring of blood glucose (SMBG) programme in patients who were prescribed insulin therapy. While the components of care remained the same, the ESI programme undertook a structured approach towards disease education and insulin administration. The overall objective was to change patients' behaviour by increasing their self-efficacy and knowledge. Improved behaviour was expected to lead to better glycaemic control and health outcomes.

OBJECTIVE

This study sought to examine the effectiveness of the ESI programme for Type 2 diabetes mellitus (T2DM) patients who were newly prescribed on insulin therapy, compared to a control group. Outcomes included knowledge about T2DM, self-management ability, glycaemic and hypoglycaemic control, and health-related quality of life.

RESULTS

A total of 182 patients completed the study. No significant differences were found in terms of age, ethnicity and marital status between ESI and non-ESI patients. There were more males in the ESI group (66% vs 50.6%, p=0.035). A higher share have significantly higher levels of education (13.4% vs 4.7%, p=0.045) but shorter duration of diabetes (<21 years) (92.8% vs 77.7%, p=0.013).

Compared to baseline, both ESI and non-ESI patients showed marked improvements in diabetes knowledge (selected items from the Michigan Brief Diabetes Knowledge Test) and self-care activities (Summary of Diabetes Self-Care Activities) at 3-months. However, the differences between the groups at 3-month were not significant. It was found that correct answers to questions on diabetes knowledge ranged between 38.8% and 63.5% with the exception of the impact of exercise on blood glucose, which was correctly answered by more than 70% of the respondents. On the average, ESI and non-ESI patients only exercised 2.1 and 2.3 days within a week respectively.

In measuring the effectiveness of the SMBG programme component, we found that at 3-month, there was also an increase in the proportion of patients in both groups who could recognise symptoms of low blood sugar (non-ESI – 27%; ESI – 23.7%), and who knew how to do something to prevent a reaction from happening (non-ESI – 24.7%; ESI – 30.9%). Nonetheless, 12.9% and 24.7% from the non-ESI and ESI groups experienced at least one episode of hypoglycaemia in the four weeks before the 3-month follow-up (p=0.044). This could be attributed to heightened awareness of hypoglycemia due to regular SMBG. Overall, there were no significant differences in the mean hbA1c readings over time between the ESI and non-ESI group (p=0.978).

CONCLUSION

These observational findings illustrated that the ESI programme was comparable to current routine care. SMBG did not confer significantly better results compared to usual care in patients with T2DM starting insulin treatment. For both groups of patients, the results on the level of diabetes knowledge and self-care activities highlighted the need to examine how to improve these measures, especially among a group of patients with long-standing diabetes.

The evolving role of the community pharmacist in chronic disease management – A literature review

OBJECTIVE

Healthcare in Singapore faces major challenges in the management of chronic diseases and shortages in healthcare manpower in view of its rapidly aging population. One of the strategies adopted in other countries to address these challenges was to evolve the role of existing healthcare manpower. This study reviewed the roles and responsibilities of community pharmacists in chronic disease management internationally and in Singapore.

METHODS

A systematic search of international peer-reviewed literature was undertaken using Medline. Grey literature was identified through generic search engines. The search period was from January 1991 to July 2009. The search criteria were English language manuscripts and search terms "community pharmacist", "community pharmacy", "disease management" and "roles" as a major heading. Boolean operators were used to combine the search terms. Identified abstracts were independently reviewed, and the findings were presented as a narrative summary.

RESULTS

We reviewed 115 articles on an abstract level and retrieved 45 of these as full text articles for review and inclusion into the evidence report (Figure 1). Of the articles included in the review, 32% were from the United Kingdom.

Literature highlighted the multi-faceted role of the community pharmacist in disease management. Community pharmacists were involved either alone or in the disease management team in the management of asthma, arthritis, cardiovascular diseases, diabetes, depression, hypertension, osteoporosis and palliative care. Evidence of effectiveness for community pharmacy/community pharmacist interventions existed for the management of lipid disorders, diabetes, and hypertension and for preventive services such as weight management, osteoporosis prevention and flu immunisation services. Majority of the community pharmacists in Singapore played the traditional role of dispensing.

Attempts by the private community pharmacies to provide some professional services were not successful due to lack of funding. Factors that impeded the growth of community pharmacists were insufficient integration of community pharmacists' participation in clinical pathway design, poor relationship among pharmacists and physicians, lack of access to patient information, time constraints and inadequate compensation.

Figure 1 – Flow chart of literature search
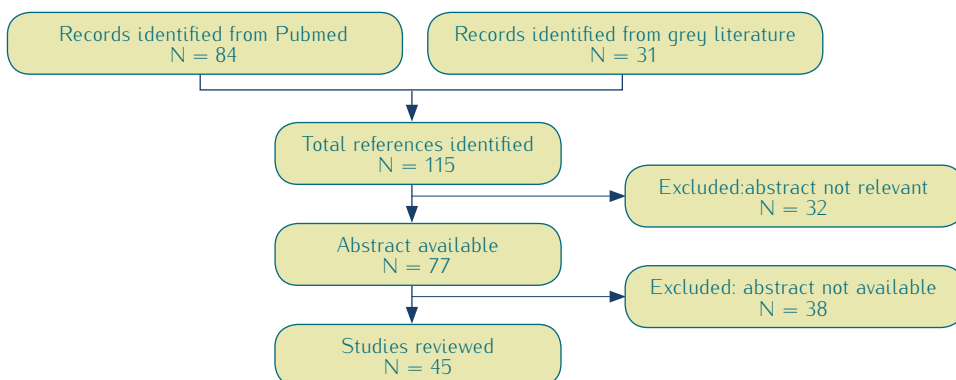
CONCLUSION

Evidence from observational studies pointed out the wide range of roles played by the community pharmacist and provided insights into their integration in chronic disease management programmes and health promotion.

Impact of fixed bed capacity of a stroke ward using Erlang loss model and modified stay distribution

BACKGROUND

Systematic reviews have shown that patients with stroke who receive a package of organised inpatient care in a dedicated acute stroke ward (ASW) have improved health outcomes [1]. In 2009, Tan Tock Seng Hospital admitted about 57,000 patients, of which 1,584 were patients with stroke. It recently commissioned a total of 36 beds to manage patients with stroke after a pilot with a smaller capacity showed good results. While some patients could be discharged quickly, others might require continued care and were transferred to the general ward. The aim of this study was to estimate if the dedicated ward with 36 beds would be able to hold the patients for up to 6 days for protocolised care while meeting two requirements: (a) cater for the full inpatient demand and, (b) allow immediate admission of new patients with stroke from the emergency department. We also studied the impact of changes in average length of stay (ALOS) and inpatient demand.

METHOD

The length of stay (LOS) of stroke patients was assumed to be an exponential distribution (ALOS 8.4 days, SD 10.7 days) and their emergency arrivals as a Poisson distribution (mean=4.3 patients per day). These distributions captured the large variations in both the length of stay and emergency arrivals.

Since new stroke patients had to be admitted immediately, we used the Erlang loss model [2] at a 1% loss to estimate the ALOS in the ASW (Lss) as 5.9 days. Figure 1 showed the modified distribution of the length of stay of the patients in the ASW. The vertical bar is the contribution of all the long stay patients who stayed for the protocolised care. The modified distribution was made of two components: the exponential distribution and uniform distribution. Knowing the ALOS in ASW (Lss) and the area under the curve of the long stay patients, we computed the holding period b from the expression $Lss = L - Le^{-b/L}$ where L is the original mean of the exponential distribution of the full LOS (8.4 days).

Figure 1 – Probability distribution of LOS

$$f(t) = \frac{1}{L}e^{-\frac{t}{L}}$$

$$Area = e^{-\frac{b}{L}}$$

Length of stay
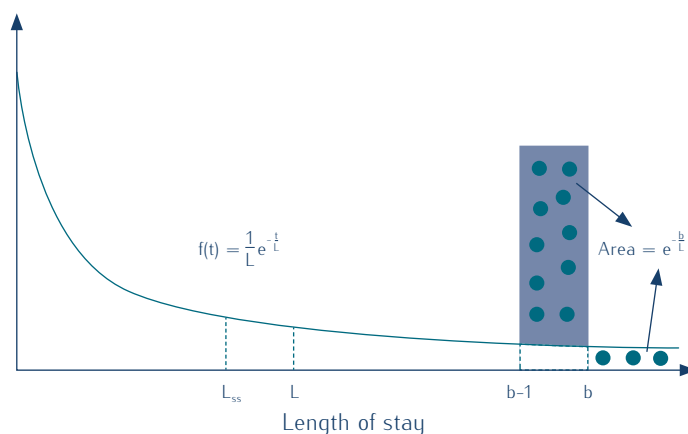
RESULTS

Table 1 showed that the 36-bed ASW can handle the current number of stroke patients (n=1,584) and hold long stay patients up to 10.1 days, which was safely above the 6-day requirement. The bed occupancy rate (BOR) was a low 70% to allow immediate admission. Also, the patients would have spent 70% of the hospital stay in the short stay ward. There would be operational issues should the number of stroke patients increase to above 2,000 patients.

Table 1 – Transfer period of ASW for different demand and ALOS

Patient profile		ASW projections				Remarks
Annual admission[1]	ALOS[2] (day)	ASW ALOS (day)	Transfer period (day)	BOR (%)	(%) of time in ASW	
1,300	7.4	7.2	25.4	70%	97%	36 beds is more than enough to admit the patients.
	8.4	7.2	16.1	70%	85%	
	9.4	7.2	13.5	70%	77%	
1,584	7.4	5.9	11.7	70%	80%	Current patient profile (shown in previous slide) need to transfer within 10 days
	8.4	5.8	10.1	70%	70%	
	9.4	5.9	9.2	70%	62%	
2,000	7.4	4.7	7.3	70%	63%	If we see 2,000 patients/year patients have to be transferred quickly (6–7days)
	8.4	4.7	6.8	70%	56%	
	9.4	4.7	6.4	70%	49%	

CONCLUSIONS

The use of the classical Erlang loss model and a modified distribution of the ASW LOS in the analysis provided assurance to the management that the 36 bed capacity was sufficient to implement ASW.

References
1. Peter Langhorne, Alex Pollock in conjunction with the Stroke Unit Trialists' collaboration, (2002), "What are the components of effective stroke unit care?" Age and Ageing, 35, 365-371.
2. Gross, D., Gross, D., Shortle, J. F., Thompson, J. M., and Harris, C. M., Fundamentals of queueing theory, Wiley series, 2009.

Patterns of inter-professional communication in an acute hospital

BACKGROUND

Communication among healthcare workers has often been singled out as key to quality healthcare delivery. In this study, we looked closely at the micro-communication patterns among doctors and nurses in the wards.

METHODS

We collected data using participant observations and semi-structured interviews. We made 112 hours of observations in General Medicine (GM), General Surgery (GS), and Intensive Care Unit (ICU) wards. Minute-to-minute observations between 0700 hours and 1000 hours, in which most ward rounds were conducted, were coded into adjacency matrices. These matrices were transformed to produce static and dynamic social network diagrams to examine the patterns of communication. Additionally, we conducted 42 interviews with doctors (n=20) and nurses (n=22) of varying levels of seniority. Interviews averaged 62 minutes (doctors 52 mins, nurses 70 mins). The interviews were transcribed, and the interview data was thematically analysed and used as the context in which the social network diagrams were interpreted.

FINDINGS

Communication within the ward among healthcare professionals was largely intra-professional. Inter-professional conversations were limited even during ward rounds. Communication of patient information was largely mediated by the information technology (IT) system and physical case notes. Doctors spent an average of 25% talking with fellow doctors whereas nurses spent an average of 19.17% talking with fellow nurses in the wards. In contrast, the proportion of time doctors and nurses spent communicating with each other was significantly lower at 1.4%, 0.7%, and 7.7% respectively, in GM, GS, and ICU (Table 1).

The proportion of time doctors and nurses spent on the computer doing administrative work (e.g., clerking patients, updating case notes, etc) was 26.3%, slightly more than the amount of time they spent on patients, which was 25.1%. Inspection of both static and dynamic social network diagrams revealed the same patterns of communication among doctors and nurses in the wards (Figures 1 to 3).

Table 1 – Interaction patterns among healthcare professionals in three departments

| Interaction | Recorded activity in minutes (% of total) | | | | | |
| | General Medicine | | General Surgery | | ICU | |
	Minutes	%	Minutes	%	Minutes	%
Doctor-doctor	442	13.8%	1,360	35.5%	840	24.9%
Nurse-nurse	831	25.9%	624	16.3%	542	16.1%
Clerk-health care worker	62	1.9%	11	0.3%	19	0.6%
Doctor-Nurse	46	1.4%	28	0.7%	260	7.7%
Time with computer	970	30.2%	759	19.8%	1,006	29.8%
Time with patient	864	26.8%	1,049	27.4%	704	20.9%
Total recorded activity	3,215	100%	3,831	100%	3,371	100%

Figure 1 – Intensity of interactions initiated in a GM ward

Figure 2 – Intensity of interactions initiated in a GS ward
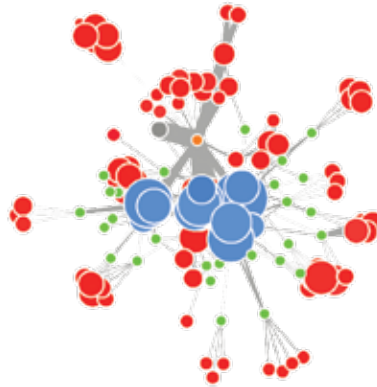
Figure 3 – Intensity of interactions initiated in an ICU
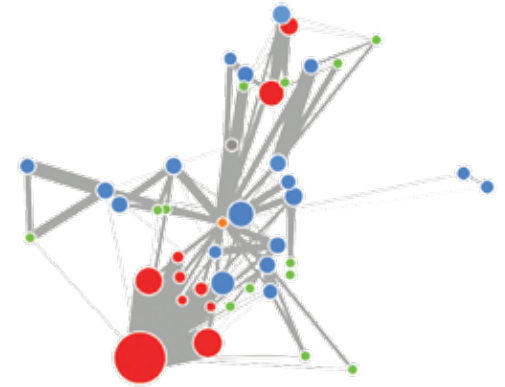
Orange node is the computer, blue nodes are nurses, red nodes are doctors, green nodes are patients, and gray node is the clerk. The thickness of ties connecting nodes is proportionate to the intensity of interaction among them. The size of the node is proportionate to the interactions initiated by a node.

KEY LESSONS LEARNED

The design of work flow in the ward must take into consideration the organisational as well as occupational cultures. Planners of work processes need to be cognisant of the impact of IT on the dynamics of the ward. The centrality of the IT system should be leveraged to facilitate face-to-face communication. To build a team-based care system, socialisation of healthcare workers via inter-professional education might be necessary.

Establishment of guidelines and tools for a formulary drug review

BACKGROUND

In 2009, the NHG Pharmacy & Therapeutics Office (P&T) embarked on a project to establish a Formulary Management Programme (FMP). The goals of the programme were:

a) To improve safe, appropriate and cost-effective use of medicines through an effective formulary management system

b) To establish tools and processes in line with international standards and best practices to support an effective formulary management system

We supported the P&T Office through the development of tools and guidelines, with reference to inputs from institutional P&T committee members and pharmacists. These tools and guidelines formed the toolkit for the streamlined process of a formulary drug review.

METHODS

The tools for the establishment of an evidence-based drug review process were developed through a thorough review of published literature and a search for standards and best practices of international agencies. Papers which described international standards and practices related to formulary management, drug application and review were searched, summarised and evaluated with regards to their relevance to the local setting. Priority was given to practices and standards which were practical and could reasonably be applied locally, were based on good quality evidence and were being implemented by internationally recognised institutions which catered to the establishment of practice guidelines. Literature searches were performed for each of the following areas subsumed under formulary management:

- Comprehensive submission and review processes
- Prioritisation criteria for drug applications
- Systems for reviewing clinical evidence for or against the drug
- Systems for reviewing pharmacoeconomic evidence for or against the drug
- Tools for appraising the quality of evidence
- Forms, templates and other data extraction tools

OUTPUTS OF THE PROJECT

After reviewing the literature, all relevant materials were synthesised and converted into prototypes of tools which could be used locally. A series of meetings and discussions with the stakeholders were held to present results of the synthesis and to provide recommendations. After several revisions to the proposal, a draft framework for a formulary drug review was presented to the Formulary Management Task Force. This consisted of:

1. Guidelines for formulary submissions – including a list of documents required for all drug applications, templates of forms, detailed descriptions and proposed contents of individual documents

2. Guidelines for pharmacoeconomic analysis including documentary requirements

3. Guidelines for evidence appraisal and synthesis
   a. Recommended databases and search strategies
   b. Recommended tools for appraising the quality of individual studies
   c. Tools for extracting data from individual studies
   d. Summary tables

The outputs have been incorporated into a comprehensive framework for formulary management.

Simulation and analysis to aid in the planning of pharmacy automation

INTRODUCTION

In the planning of a new pharmacy, two packing scenarios were considered: (a) traditional manual packing, where all the items are manually collected, packed and labelled and, (b) automated packing, where parts of the prescriptions are automatically packed. The aim of this study was to determine which of the two scenarios were more efficient in terms of speed and capacity.

METHODS

Discrete Event Simulation (DES) was used to model the two scenarios and compare them in different prescription loads. Actual pharmacy transaction data was used as input for the DES models. Outputs of the DES model included performance indicators such as waiting time, queue length, turnaround time and resource utilisation.

RESULTS

Figure 1 showed the simulation results of the fully manual and automation scenarios. Table 1 showed that the automation scenario was better than the fully manual scenario in all performance indicators.

Figure 1 – Simulation results of the fully manual and automation scenarios
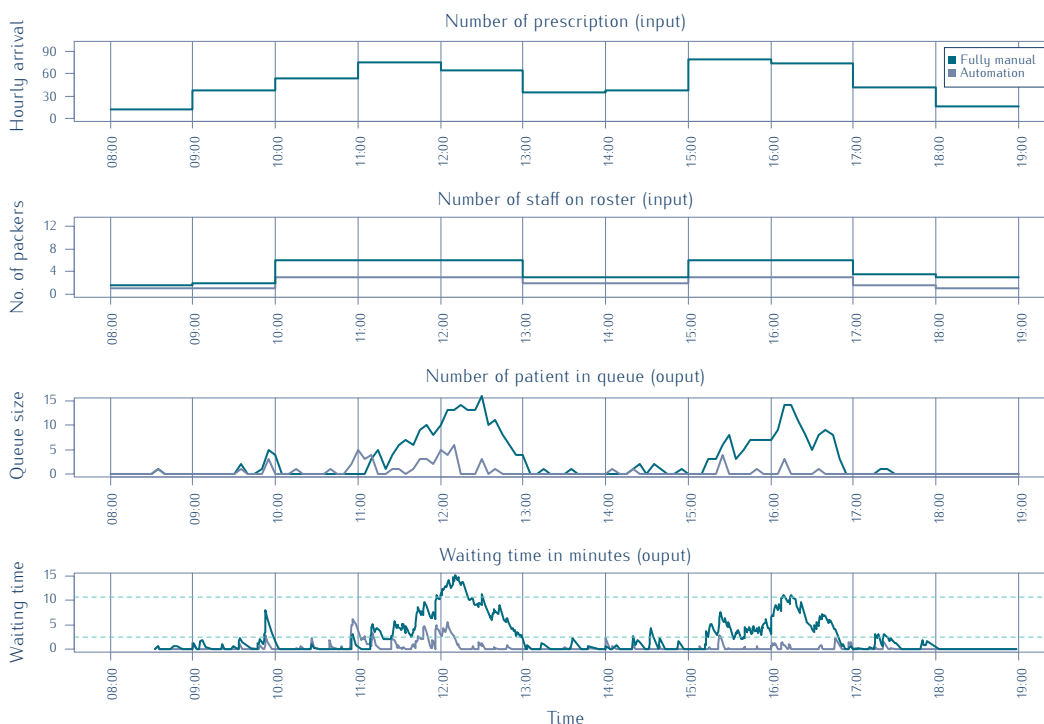
Table 1 – Simulation result comparison of the two scenarios

Scenario	Waiting time (mins)		Turnaround time (mins)	
	50th%tile	95th%tile	50th%tile	95th%tile
1. Automation	0	2.8	0.9	5.1
2. Fully manual	2.6	10.6	5.8	15.0

CONCLUSION

DES helped healthcare service providers make better decisions for their future plans or investments by testing and evaluating various what–if scenarios through computer based simulation.

Profiling discharge needs using clustering and decision tree

BACKGROUND

The Home Nursing Foundation, together with Tan Tock Seng Hospital (TTSH) implemented an integrated home care programme to manage patients within TTSH's catchment. This study aimed to identify clusters of patients according to their post-discharge needs to assist service planning.

METHODS

A cross-sectional study was conducted in TTSH between April 2010 and May 2010. Case managers and care-coordinators identified and assessed patients likely to require home care after their discharge. The survey collected data on patients' demographics, social support, and social economic status. Information on cognition, mood and behaviour, functional status, continence, disease diagnosis, and medication were also collected. Data analysis using statistical and data mining methods were applied to understand the profile of patients and their needs.

RESULTS

A total of 488 patients were analysed. The top 15 needs were identified (Figure 1), and using these needs as basis, we grouped the patients into three clusters using a 2-step clustering algorithm. Table 1 showed that the three clusters had quite different number of needs and Table 2 further highlighted the differences. Patients in Cluster 2 (23% of patients) had the least number of needs, typically not more than three, and were mostly wound care, management of chronic disease, or pain management. On the other hand, Cluster 3 (42% of patients) had the most number of needs, with an average of 7 out of 15. Cluster 1 (35% of patients) had about six needs on average. These two clusters also differed in terms of the specific needs required: Cluster 3 needed physiotherapy, occupational therapy, and caregiver training (CGT) on activities of daily living (ADL); Cluster 1 required monitoring for adherence to medication and management of exacerbations.

With the three clusters developed, a decision tree algorithm (Figure 3) was then applied to discriminate patient's cluster membership. Cluster 3 patients were quite distinct as they were likely to have functional decline and poorer functional status. Cluster 1 patients tend to have chronic obstructive lung disease (COLD) or hyperlipidaemia, and they generally could self-care.

Figure 1 – Top 15 service needs
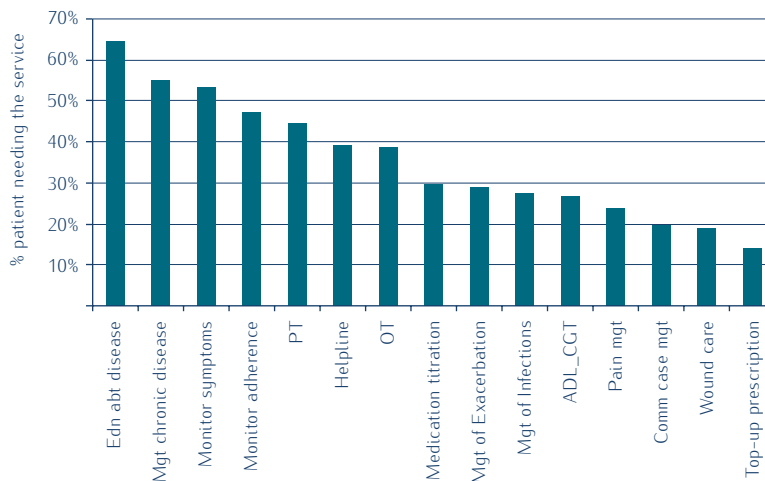
Table 1 – Average number of service needs for the three clusters

Cluster	No. of needs													
	0	1	2	3	4	5	6	7	8	9	10	11	12	Average
C1	0%	0%	1%	11%	15%	17%	19%	17%	12%	5%	2%	1%	0%	5.86
C2	19%	36%	25%	17%	3%	0%	0%	0%	0%	0%	0%	0%	0%	1.47
C3	0%	0%	1%	8%	11%	10%	14%	14%	11%	14%	9%	6%	2%	7.01

Table 2 – Prevalence of needs for the three clusters

Cluster	Edn abt disease	Mgt of CD	Monitor symptoms	Monitor adhere	PT	Help line	OT	Med titration	Mgt Ex- acer	Mgt of Infectn	ADL_ CGT	Pain mgt	Comm case mgt	Wound care	Top-up presc
C1	89%	71%	80%	73%	2%	54%	1%	34%	63%	36%	7%	21%	22%	5%	28%
C2	11%	23%	3%	4%	10%	12%	0%	0%	1%	4%	11%	21%	2%	45%	3%
C3	75%	60%	59%	51%	99%	42%	92%	42%	17%	34%	52%	27%	27%	16%	9%

Figure 2 – Decision tree to discriminate the three clusters
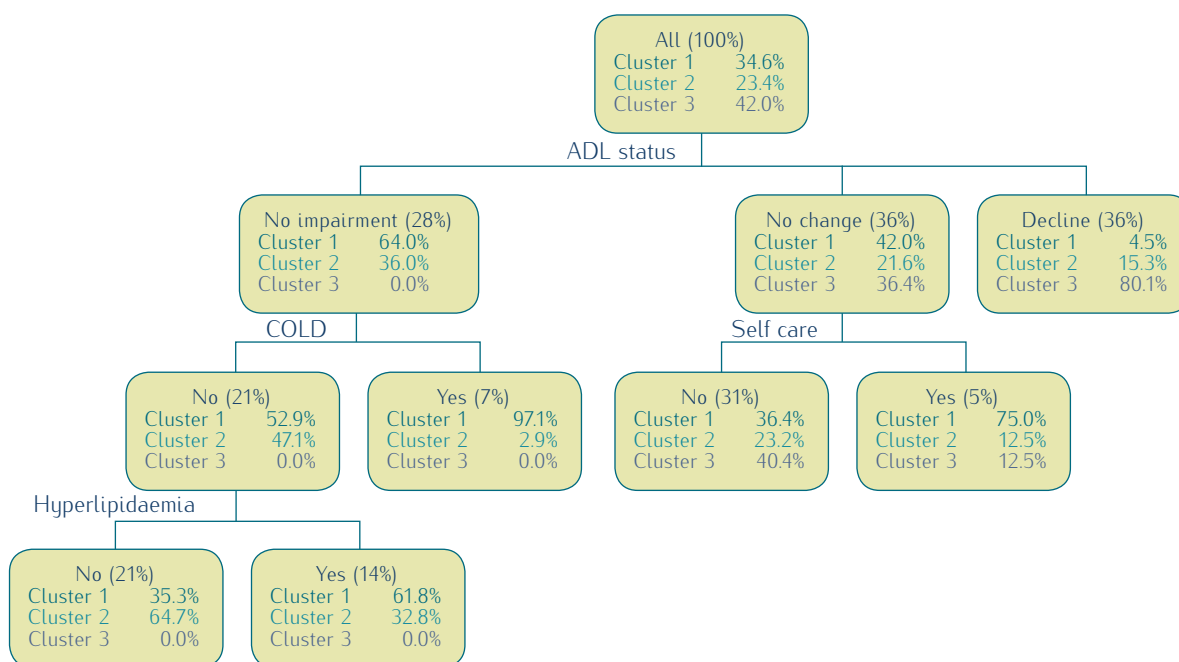
CONCLUSION

The data analysis techniques were data-driven and gave a compact stratification of needs of the population of interest. This insight could guide decision makers in policy making and services and resource planning.

Right-siting chronic kidney disease (CKD) care – A survey of knowledge and practices among general practitioners in Singapore

BACKGROUND
Chronic kidney disease is an emerging public health problem and has led to increasingly congested specialist outpatient clinics (SOC). Efforts are being made to right-site care of CKD (stage 1 to stage 3) patients to primary care physicians.

OBJECTIVE
This study aimed to identify factors influencing the screening and management of CKD among private general practitioners (GP) in Singapore. This will facilitate the planning of programmes to encourage GP participation in the care of CKD patients.

METHOD
A survey, developed in collaboration with experts in nephrology and general practice, was conducted among 1,202 GPs registered in the NHG GP Partner database. The questionnaire covered knowledge about screening tests for CKD, awareness of CKD guidelines, confidence in managing CKD stage 1 to 3 patients, and their opinions about right-siting CKD care from SOCs to primary care. The questionnaire was faxed to the physicians and followed up with three telephonic reminders. Data was collected between April 2010 and September 2010.

FINDINGS
Three hundred and two GPs completed the questionnaire; response rate was 25%. Majority of the respondents were males (70%) and Chinese (92%) with a median duration of practice of 18 years. Of these, 86% reported screening patients for CKD, 61% attended to less than 10 CKD patients per year, 50%, 33% and 13% were confident of managing patients with CKD stage 1, stage 2 and stage 3 respectively (Table 1). Ten percent of GPs reported using serum creatinine, urinalysis (UFEME), random urine albumin creatinine ratio or urine creatinine ratio for CKD screening. Thirty eight percent of GPs were aware of CKD guidelines but only 27.5 % of them specified definite guidelines. Majority (64%) agreed that right-siting of early CKD patients would ease congestion at SOCs (Figure 2).

Obstacles to CKD management listed by the GPs included the lack of patient trust, experience and communication with the specialist, and inability of the patient to pay. Motivational drivers of GPs towards CKD management included access to patient information, co-management and more interaction with renal physicians, and adequate remuneration for the time spent in managing CKD.

Table 1 – Confidence in managing CKD (Stage 1 to 3)

Question: My confidence level in managing patients with Chronic Kidney Disease (CKD)

	CKD (%)		
	Stage 1	**Stage 2**	**Stage 3**
Not confident at all	4	5	11
Not confident	12	20	37
Neutral	35	42	39
Quite confident	43	29	11
Very confident	7	4	2

Figure 2 – Opinions on right-siting CKD care

Statement: "GPs would help to reduce congestion at specialist outpatient clinics if they saw patients with CKD stage 1 to early stage 3"
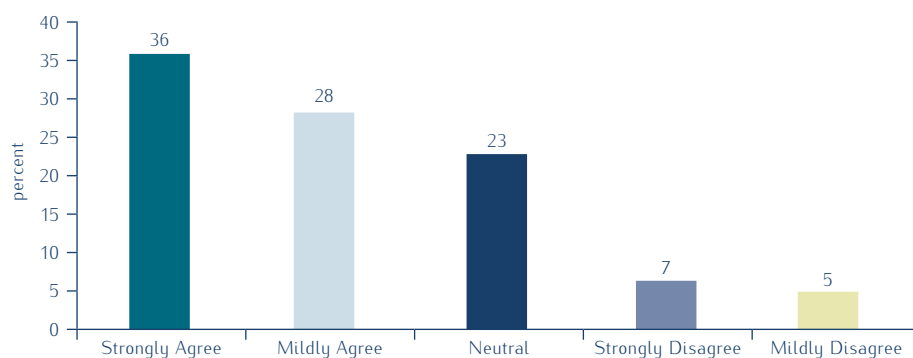
CONCLUSION
The survey identified factors that prevented and facilitated the wider acceptance of CKD right-siting by both the patients and the GPs. Future interventions or programmes would require a health systems approach.

Predicting hospital admissions at emergency department's (ED) triage using routine administrative data

INTRODUCTION

Early prediction of hospital admission among ED patients at triage may help reduce the waiting time at the ED by initiating the admission processes earlier. Patients who need admission would then have a reduced total wait time as the wait time for a bed is incorporated into the consultation wait time. By implementing a prediction model to assess patients' admission needs at the time of triage, the efficiency of the ED care and patient flow from the ED to inpatient wards can be improved.

OBJECTIVE

The objective of this study was to develop and validate a model using routine hospital administrative data, the patient's acuity of illness as assessed at triage, and specific questions from the patient's past medical history, to predict whether a patient is likely to require inpatient admission at the time of triage.

METHODS

This was a retrospective study using routinely collected hospital data to develop a predictive model to identify patients at high risk of hospital admission through the ED's triage. The primary outcome was admission to the general ward. Data collected at triage by nurses for patients who visited the ED in 2007 and 2008 were extracted from the hospital's information system. Variables included were demographics (age, gender and ethnic group), prior ED visit or hospital admission in the preceding 3 months, arrival mode, patient acuity category (PAC), and co-existing chronic diseases (diabetes, hypertension and dyslipidaemia). Chi-square tests were used to study the association between the selected possible risk factors and the need for hospital admission. Logistic regression was applied to develop the prediction model. Data were split for derivation (60%) and validation (40%). The receiver operating characteristic (ROC) and the goodness-of-fit test were applied on the validation dataset to evaluate the model.

RESULTS

Out of 317,581 ED patient visits, 30.2% resulted in immediate hospital admissions. In the developed predictive model, age, PAC status, and arrival mode were most predictive of the need for immediate hospital inpatient admission (Table 1). The c-statistics of the ROC curve was 0.849 (0.847-0.851). The non-significant goodness-of-fit test showed that the predicted patients' admission risks fit the patients' actual admission status well.

Table 1 – Significant independent predictors for hospital admission by logistic regression analysis

Predictors		Odds ratio	95% Confidence Interval	
			Lower	Upper
Age Group	[25–34]	1		
	<15	0.2	0.1	0.2
	15–24	0.6	0.6	0.7
	35–44	1.3	1.2	1.3
	45–54	1.5	1.5	1.6
	55–64	1.8	1.7	1.9
	65–74	2.5	2.4	2.6
	75–84	3.6	3.4	3.8
	85+	5.3	4.9	5.7
Race group	[Malay]	1		
	Chinese	1.1	1.1	1.2
	Indian	1.2	1.2	1.3
	Others	1.1	1.1	1.2
Arrival mode	[Walk–in]	1		
	Ambulance	1.7	1.7	1.8
PAC	[3]	1		
	1	20.2	19.1	21.4
	2	4.4	4.3	4.6
Prior ED visit in preceding 3 months	[No]	1		
	Yes	1.2	1.2	1.3
Prior hospital admission in preceding 3 months	[No]			
	Yes	1.4	1.3	1.5
Chronic conditions	[No]	1		
	Diabetes only	2.1	1.9	2.4
	Hypertension only	1.5	1.4	1.6
	Dyslipidaemia only	1.9	1.8	2.0
	Diabetes with hypertension	2.7	2.4	3.0
	Diabetes with hypertension and dyslipidaemia	2.6	2.5	2.7
	Diabetes with dyslipidaemia	2.1	1.9	2.2
	Dyslipidaemia with hypertension	1.9	1.8	2.0

[ ] reference group

CONCLUSION

A model for predicting the risk of immediate hospital admission at triage for all–cause ED patient visits was developed and validated using routinely collected hospital data. Early prediction of the need for hospital admission at triage may help identify patients deserving of early admission planning and resource allocation, and potentially reduce ED overcrowding.

Development of a supply/demand matrix for optimal specialist outpatient clinic (SOC) capacity planning to meet a target appointment waiting time

INTRODUCTION

One of the challenges for SOCs is to plan for an appropriate capacity to meet the fluctuating demand. An important key performance indicator within the SOC is the appointment waiting time, which is measured by the period from the appointment request time to the actualised appointment time.

SOC managers need a tool to meet the following two objectives:
1. Understand the quantitative relationship between SOC capacity and appointment waiting time
2. Plan the exact capacity needed in the planning horizon to meet a target appointment waiting time

METHODS

A supply/demand matrix based on linear programming was developed to estimate the optimal SOC capacity in terms of the number of first visit slots, and how these first visit slots were allocated along the planning horizon. Several versions of the matrix were developed to meet different planning objectives.

RESULTS

Figure 1 showed one scenario where the SOC managers provided the capacity of the planning horizon. The matrix allocated the capacity to minimise the number of appointments with a waiting time of more than 60 days.

Figure 2 showed another scenario where the SOC managers provided the planning target for the planning horizon where at least 95% of the appointment waiting time must be less than 60 days. The matrix calculated the minimum slots needed to meet the planning target and how the slots were allocated along the planning horizon.

Figure 1 – Supply/demand matrix: Scenario 1

Planning horizon Year 2011

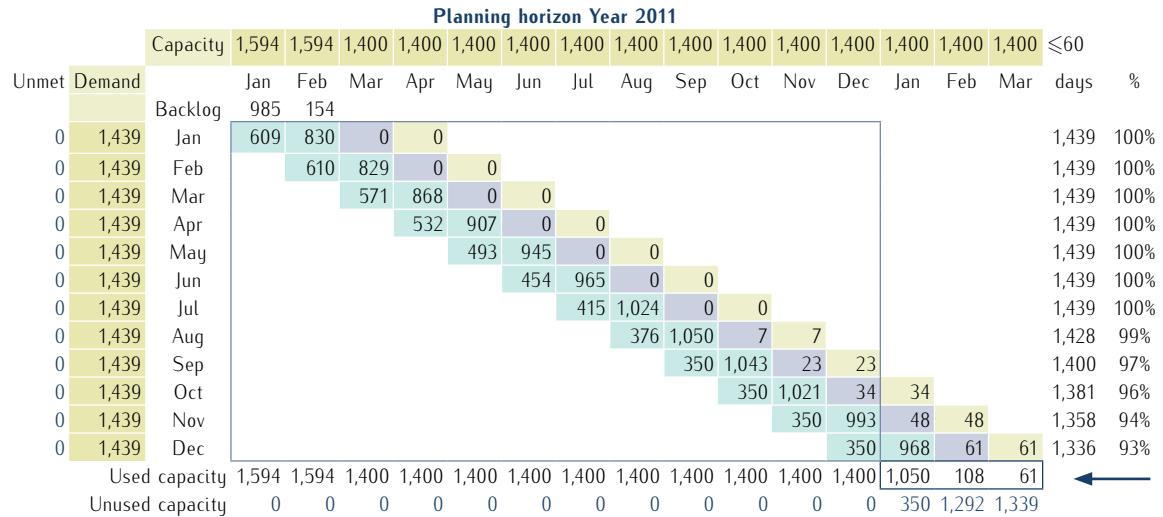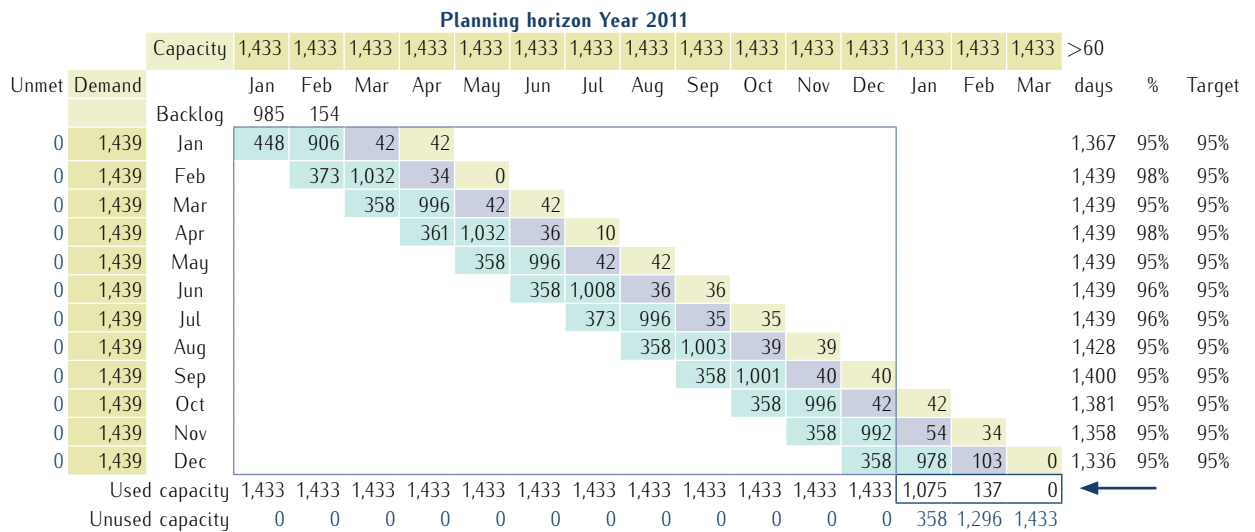| Unmet	Demand		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	days	%
		Capacity	1,594	1,594	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	≤60	
		Backlog	985	154															
0	1,439	Jan	609	830	0	0												1,439	100%
0	1,439	Feb		610	829	0	0											1,439	100%
0	1,439	Mar			571	868	0	0										1,439	100%
0	1,439	Apr				532	907	0	0									1,439	100%
0	1,439	May					493	945	0	0								1,439	100%
0	1,439	Jun						454	965	0	0							1,439	100%
0	1,439	Jul							415	1,024	0	0						1,439	100%
0	1,439	Aug								376	1,050	7	7					1,428	99%
0	1,439	Sep									350	1,043	23	23				1,400	97%
0	1,439	Oct										350	1,021	34	34			1,381	96%
0	1,439	Nov											350	993	48	48		1,358	94%
0	1,439	Dec												350	968	61	61	1,336	93%
		Used capacity	1,594	1,594	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,050	108	61		
		Unused capacity	0	0	0	0	0	0	0	0	0	0	0	0	350	1,292	1,339		

Figure 2 – Supply/demand matrix: Scenario 2

Planning horizon Year 2011

Unmet	Demand		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	days	%	Target
		Capacity	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	>60		
		Backlog	985	154																
0	1,439	Jan	448	906	42	42												1,367	95%	95%
0	1,439	Feb		373	1,032	34	0											1,439	98%	95%
0	1,439	Mar			358	996	42	42										1,439	95%	95%
0	1,439	Apr				361	1,032	36	10									1,439	98%	95%
0	1,439	May					358	996	42	42								1,439	95%	95%
0	1,439	Jun						358	1,008	36	36							1,439	96%	95%
0	1,439	Jul							373	996	35	35						1,439	96%	95%
0	1,439	Aug								358	1,003	39	39					1,428	95%	95%
0	1,439	Sep									358	1,001	40	40				1,400	95%	95%
0	1,439	Oct										358	996	42	42			1,381	95%	95%
0	1,439	Nov											358	992	54	34		1,358	95%	95%
0	1,439	Dec												358	978	103	0	1,336	95%	95%
		Used capacity	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,433	1,075	137	0			
		Unused capacity	0	0	0	0	0	0	0	0	0	0	0	0	358	1,296	1,433			

CONCLUSION

The supply/demand matrix helped the SOC managers to understand the relationship between capacity and appointment waiting time and facilitated accurate capacity planning.

Optimising Medical Officers' (MO) work hours to improve patient safety and staff welfare

BACKGROUND

Traditionally, MOs go on call for durations of 24 to 48 hours due to manpower shortage, the apprenticeship–style training and to ensure continuity of patient care. Detrimental effects of prolonged work hours on patient care and staff welfare have recently been examined and evidence suggested that:

- the effects of alcohol intoxication and sleep deprivation on workers' performance were similar
- serious medical and diagnostic errors among doctors exposed to traditional work schedules occurred more frequently
- there were more incidents of motor vehicle accidents among physicians who drove after an extended shift

A new shift system (night and half–shift) took effect in a public sector hospital in 2010. Under the new system, four MOs were on call from 1700 to 2200 hours, with another four MOs taking over from 2200 to 0800 hours. Aside from this, the number of MOs assigned to each hospital unit was "optimised" such that there were more MOs assigned to "busy" areas, and fewer to "light" areas. The following table demonstrated the differences between the old and new systems:

Weekday Calls				Weekend Calls			
New (Night & Half–shift system)*		Old system (Overnight call system)ψ		New (Night & Half–shift system)*		Old system (Overnight call system)ψ	
Call schedule	Total Call Hours	Call Schedule	Total Call Hours	Call schedule	Total Call Hours	Call Schedule	Total Call Hours
0800hrs to 2200hrs (half shift)	14 hours	0800hrs to 1200hrs (+1 day)	28 hours	1200hrs to 2200hrs (half shift)	10 hours	0800hrs to 1200hrs (+1 day)	28 hours
2200hrs to 0800hrs (night shift)	10 hours			2200hrs to 0800hrs (night shift)	10 hours		

*Under the night and half shift system, a new set of MOs on night shift take over from MOs on half shift
ψUnder the overnight call system, a single set of MOs went on continuous call for 28 hours

OBJECTIVE

This project aimed to evaluate the perceived effectiveness of the new night and half–shift system on patient care outcomes as well as staff welfare.

METHOD

Surveys were conducted for all MOs and nurses of the Division of Medicine in April 2010. The survey, based on literature and contextualised to the local setting, covered perceived effects of the change in the shift system on patient care/patient care events, training and education, performance, and career satisfaction of MOs. The MOs' survey of 35 questions was conducted online, while the nurses' survey of 8 questions was self–administered.

RESULTS

Response rates were 42.6% (46/108) for MOs and 96.7% (290/300) for nurses. Less than 20% of MOs reported being burned-out under the new system, while close to 70% felt burned-out under the overnight system. In terms of MOs' welfare, 92.5% preferred the new shift system over the overnight system. The only disadvantage cited by MOs and nurses was the difficulty in identifying the MO responsible for providing care to a particular patient. Other major differences in perceptions between the old and new systems included the following:

LEARNING POINTS

Opportunities for improvement are available even for well-entrenched systems and practices, and these may be achieved even when the amount of resources are kept constant.

Direct medical cost of chronic obstructive pulmonary disease (COPD) in Singapore

INTRODUCTION

COPD is a major cause of morbidity and mortality worldwide. In Singapore, it was ranked the 9th and 8th leading cause of hospital admissions and mortality respectively in 2009. As a progressive disease that is not fully reversible, the economic burden of COPD on the individual and the society is expected to grow due to Singapore's rapidly ageing population. Despite its negative impact on health, no study has measured the economic burden of COPD in this population. Our objective was to measure the health care utilisation and cost related to COPD from 2005 to 2009 in the public health care system in Singapore.

METHODS

We adopted the public healthcare perspective in this study, including the cost incurred for inpatient, specialist outpatient, emergency department (ED) and primary care visits. Cost for a disease management intervention was also included. Prevalence and health services utilisation data came from the Chronic Disease Management Data–mart (CDMD) maintained by NHG.

A weighted attribution approach was used to allocate costs to each health utilisation episode based on two decision rules. The first decision rule for hospitalisation utilised the Diagnostic–Related Group (DRG) codes and International Classification of Diseases Ninth Revision (ICD-9-CM) diagnostic codes and the length of stay (LOS) (Table 1: Footnote 1-4). The second decision rule for visits to ED, specialist clinics and primary care clinics was based on the primary diagnosis codes of each medical encounter (Table 1: Footnote 3-4). For both decision rules, 100% weightage was applied to all utilisations with primary diagnosis of COPD. Less of the cost was attributed to COPD when the primary diagnosis was a related disorder. DRG costs were used to estimate hospitalisation costs whereas other unit costs were provided from the institutions' finance department. All costs were expressed in 2009, and converted to U.S. dollars (USD) with 2009 exchange rate (US$1=S$1.45).

RESULTS

The mean total cost attributable to COPD was approximately $9.9 million (Table 1). Inpatient admissions were the major cost driver contributing an average of $7.2 million per year. Specialist consultations at specialist clinics were the second most costly form of care. COPD patients consumed $1.6 million of outpatient services at the hospital–based specialist clinics. The medical management of COPD reported higher mean cost than the medical management of related conditions ($2.6 million vs $2 million). Extended LOS for unrelated conditions added a mean cost of $2.6 million annually. Between 2005 and 2009, the overall distribution of direct medical costs attributable to COPD remained relatively stable for visits made to ED, specialist clinics and primary care clinics. For specialist outpatient consultations, COPD visits reported higher mean cost than visits made for COPD–related disorders ($985,000 vs $659,000). Treatment for related disorders at primary care clinics were the least costly form of care with a mean cost of $50,000 over 5 years.

The proportion of hospitalisation costs declined from 74% in 2008 to 68% in 2009 (Figure 1). Figure 2 depicted the share of mean cost incurred for the treatment of conditions related (29%) and unrelated to COPD (26%).

Table 1 – Annual direct medical costs of COPD by component of care (U.S. dollars, in thousands)

	2005	2006	2007	2008	2009	5-year mean (±S.D.)
Hospitalizations						
COPD[1]	$2,094	$2,346	$2,450	$3,132	$3,160	$2,636 ($483)
Related DRGs[2]	$1,790	$1,669	$1,978	$2,386	$1,990	$1,963 ($272)
Unrelated DRGs	$2,404	$2,600	$2,538	$3,019	$2,363	$2,585 ($261)
Total	$6,288	$6,614	$6,967	$8,537	$7,513	$7,184 ($882)
ED visits						
COPD[3]	$292	$286	$299	$315	$380	$314 ($34)
Related disorders[4]	$208	$187	$192	$187	$167	$188 ($13)
Total	$500	$473	$491	$502	$546	$502 ($24)
SOC visits						
COPD[3]	$793	$952	$1,025	$1,051	$1,103	$985 ($120)
Related disorders[4]	$559	$631	$713	$693	$699	$659 ($64)
Total	$1,352	$1,583	$1,738	$1,744	$1,802	$1,644 ($182)
Primary care visits						
COPD[3]	$220	$246	$240	$234	$254	$239 ($13)
Related disorders[4]	$66	$57	$49	$37	$38	$50 ($12)
Total	$286	$303	$289	$272	$292	$288 ($11)
Disease management						
Total program cost	$0	$0	$0	$428	$865	$259 ($386)
Grand total	$8,427	$8,973	$9,485	$11,483	$11,018	$9,877 ($1,319)

AN-DRG:
1. Chronic obstructive lung disease (177)
2. Related conditions: Other respiratory system operating room procedures (163 – 165), Respiratory infections or inflammations (170 – 172), Pulmonary oedema and respiratory failure (176), Interstitial lung disease (196 – 198), Pneumothorax (183 – 184), Bronchitis and asthma (185 – 187), Respiratory signs and symptoms (181 – 182), Other respiratory system diagnoses. (199 – 201), Respiratory system diagnosis with ventilator support (166), Heart failure and shock (252)

ICD-9-CM codes:
3. COPD: Chronic bronchitis (491), Emphysema (492) and Chronic airway obstructive, not elsewhere classified (496)
4. Related disorders: Disorders of fluid, electrolyte and acid-base balance (276), Heart failure (428), Acute bronchitis and bronchiolitis (466), Pneumonia (482 and 486), Influenza (487), Bronchitis (490), Asthma (493), Other diseases of the lung (518), General symptoms (780), Symptoms involving respiratory system and other chest symptoms (786)

Figure 1 – Yearly distribution of direct medical costs by components of care
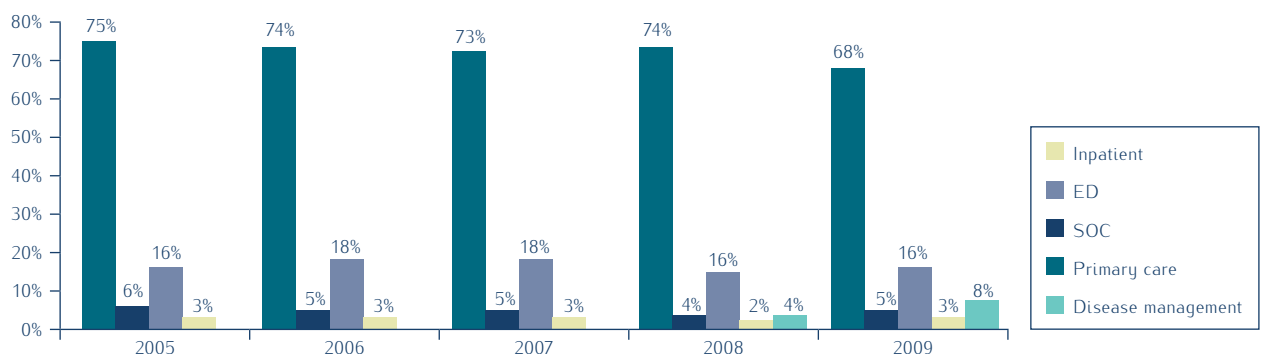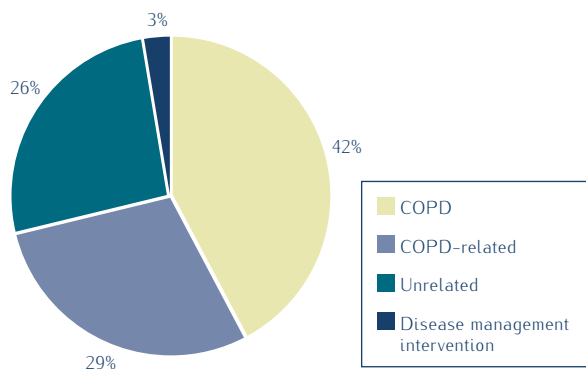

Figure 2 – Distribution of mean costs by conditions managed and disease management intervention

CONCLUSION

The economic burden of COPD to the public healthcare system is substantial. As COPD is irreversible and only partly responds to treatment, implementing primary prevention efforts could decrease the incidence and healthcare costs. The high burden attributable to COPD-related diseases further underscored the need for care strategies such as disease management programmes to move beyond the current single disease paradigm.

PUBLICATIONS

1. DE VERTEUIL R, TAN WS. Self-monitoring of blood glucose in Type 2 diabetes mellitus: Systematic review of economic evidence. Joanna Briggs Institute Library of Systematic Reviews 2010; 8(7): 302-342

2. GEORGE PP, HENG BH, SEOW E, MOLINA JAD, TAY SY. Predictors of frequent attenders of emergency department at an acute general hospital in Singapore. Emergency Medical Journal 2010; 27(11): 843-848

3. GEORGE PP, MOLINA JAD, CHEAH JTS, CHAN SC, LIM BP. The evolving role of the community pharmacist in chronic disease management – A literature review. Annals Academy of Medicine Singapore 2010 Nov; 39(11): 861-867

4. HENG BH, SUN Y, CHEAH JTS, JONG M. The Singapore National Healthcare Group Diabetes Registry – Descriptive epidemiology of Type 2 diabetes mellitus. Annals Academy of Medicine Singapore 2010; 39(5): 348-352

5. MOLINA JAD, LOBO CA, GOH HK, SEOW E, HENG BH. Review of studies and guidelines on fasting and procedural sedation at the emergency department. International Journal of Evidence-based Healthcare 2010; 8: 75-78

6. TAN WS, CHONG WF, CHUA KS, HENG BH, CHAN KF. Factors associated with delayed discharges after inpatient stroke rehabilitation in Singapore. Annals Academy of Medicine Singapore 2010; 39(6): 431-441

7. WONG LY, TOH MPHS, KONG KH. Barriers to patient referral for complementary and alternative medicines and its implications on interventions. Complementary Therapies in Medicine 2010; 18(3-4): 135-142

8. PALVANNAN RK, TEOW KL. Queuing for healthcare. Journal of Medical Systems 2010 May 8 [Epub ahead of print]

9. WONG LY, HENG BH, CHEAH JTS, TAN CB. Using spatial accessibility to identify polyclinic service gaps and volume of under-served population in Singapore using Geographic Information System. The International Journal of Health Planning and Management 2010 Jul 29 [Epub ahead of print]

10. ZHU ZC, HENG BH, TEOW KL. Analysis of factors causing long patient waiting time and clinic overtime in outpatient clinics. Journal of Medical Systems 2010 Aug 5 [Epub ahead of print]

CONFERENCE PRESENTATIONS

May

International Society for Pharmacoeconomics and Outcomes Research (ISPOR) Conference, Atlanta

1. George PP, Molina JAD, Heng BH, Tan NWH, Lim TH.
   Bevacizumab for neo-vascular age related macular degeneration –
   Evidence summary

2. Molina JAD, Jiang GZ, Heng BH, Ong BK.
   Venous thromboembolism in the Singaporean population –
   The need to revisit risk assessment tools for prophylaxis

June

AcademyHealth Annual Research Meeting (ARM), Boston

3. Chong WF, Ding YY, Heng BH.
   Measuring comorbidities in patients with community-acquired
   pneumonia: Can routine computerised administrative data replace
   chart reviews in performance measurement?

4. Tan WS, Ding YY, Heng BH, Tay JC, Tan JY.
   Interpreting in-hospital mortality among older hospitalised persons:
   Do we need to adjust for physical function and social support?

July

Operational Research Applied to Health Services (ORAHS), Genova

5. Zhu ZC, Heng BH, Teow KL.
   Application of genetic algorithm on outpatient clinic appointment
   scheduling

August

5th Singapore Public Health & Occupational Medicine (PHOM) Conference and 4th Asian Regional Health Technology Assessment Conference, Singapore

6. Ng CWL, Heng BH, Molina JAD, Wong LY, George PP, Cheah JTS.
   Factors associated with unwillingness to participate in health
   promotion programmes among adults with lower socioeconomic status

7. Wong LY, Heng BH, Ng CWL, Molina JAD, George PP, Cheah JTS.
   A community-based survey of geriatric syndrome and depression
   among respondents with diabetes mellitus in the lower income group
   and its implications on diabetes management and health promotion

CONFERENCE PRESENTATIONS

September

International Society for Pharmacoeconomics and Outcomes Research (ISPOR) 4th Asia Pacific Conference, Phuket

8. Lim BK, Jong M, Toh MPHS.
   Vascular diseases and durability of good glycaemic control in patients with Type 2 diabetes mellitus

9. Lim BK, Toh MPHS, Jong M, Chionh SB, Sum CF.
   Diabetes-related complications and glycaemic control in Type 2 diabetic mellitus patients at specialist outpatient clinics in Singapore

OR52 Conference, London

10. Palvannan RK, Teow KL, Woon C, Ho CH.
    Queueing analysis and simulation modelling support Lean initiatives in hospitals

October

7th National Healthcare Quality Improvement, Singapore

11. Molina JAD, Vu C, Heng BH, Chia CK, Liew A.
    Do changes in doctors' work hours and shift schedules improve patient care and staff welfare?

November

1st Singapore Health and Biomedical Congress, Singapore

12. Molina JAD, Heng BH, Ng CWL, Wong LY, George PP, Cheah JTS.
    Mode of payment for chronic disease treatment at outpatient services among residents staying in 1-2 room HDB apartments

13. Sun Y, Heng BH, Tay SY, Seow E.
    Predicting hospital admissions at emergency department's triage using routine administrative data

14. Teow KL, Ng KP, Heng BH, Tan WS, Chong WF, Leong I, Koh SF, Loh SC.
    Profiling discharge needs using clustering and decision tree

15. Zhu ZC, Heng BH, Teow KL.
    Estimating ICU bed capacity using discrete event simulation

AWARDS
AND GRANTS

AWARDS

5th Singapore Public Health & Occupational Medicine Conference (PHOM) and 4th Asian Regional Health Technology Assessment Conference, Singapore
August 2010

BEST ORAL PRESENTATION
Ms Wong Lai Yin

A community–based survey of geriatric syndrome and depression among respondents with diabetes mellitus in the lower income group and its implications on diabetes management and health promotion

1st Singapore Health and Biomedical Congress, Singapore
November 2010

SINGAPORE YOUNG INVESTIGATOR AWARD – SILVER (QUALITY, HEALTH SERVICES RESEARCH)
Dr Sun Yan

Predicting hospital admissions at emergency department's triage using routine administrative data

TRAINING GRANTS

NHG Healthcare Manpower Development Programme
Dr Joseph Antonio D Molina (Epidemiology)

TRAINING AND EDUCATION

8th Healthcare Operations Research Appreciation Course
28 – 29 January
HSOR trainers: Mr Palvannan Kannapiran, Mr Teow Kiok Liang, Dr Zhu Zhecheng

Operations Research (OR) techniques are useful to determine the best course of action of a decision problem under limited resources. As a problem solving technique, OR is both a science and an art. The scientific element lies in providing mathematical techniques and algorithms for solving appropriate decision problems. OR is an art because success in all the phases that precede and succeed the solution of a mathematical model, depends largely on the creativity and personal abilities of the decision maker. Gathering of the data for model construction, validation of the model, and implementation of the obtained solution depends on the ability of the OR team to establish good lines of communication with the sources of information as well as with the individuals in charge of implementation of the recommended solutions.

The two-day course aimed to introduce OR concepts with healthcare applications. Its focus was on building intuition around theory, to support and inform decision making. Case studies were used to show applications of OR techniques as well as the process of problem solving during the engagement with the decision maker.

Introduction to Survey Research
21 October
HSOR trainers: Ms Chong Wai Fung, Dr Joseph Antonio D Molina, Mr Pradeep Paul George Gunapal, Ms Wong Lai Yin

The course was conducted for the Quality and Resource Management (QRM) department and NHG College. As surveys were useful tools for evaluation activities conducted by both departments, the course aimed to familiarise the staff with the fundamentals of survey research. The topics included an overview of the survey process, the uses of survey research, questionnaire design and evaluation, data collection, sampling techniques, data analysis and ethical issues.

Health Services Research Symposium

13 November
HSOR trainers: Dr Joseph Antonio D Molina, Ms Tan Woan Shin, Mr Teow Kiok Liang, Dr Sun Yan

Prof Alan Pearson
Executive Director, Joanna Briggs Institute, University of Adelaide

A/Prof Angelique Chan
Department of Sociology, Duke–NUS Graduate Medical School

Prof Chia Kee Seng
Head, Department of Epidemiology and Public Health, National University of Singapore

Prof Lee Hin Peng
Department of Epidemiology and Public Health, National University of Singapore

Mr Foo Hee Jug
CEO, Jurong Health Services Pte Ltd

Ms Grace Chiang
COO, National Healthcare Group Polyclinics

Ms Joycelyn Ling
Director, Tan Tock Seng Hospital

Prof Cheung Yin Bun
Head, Biostatistics, Singapore Clinical Research Institute

Dr Luo Nan
Assistant Professor, National University Health System

The Health Services Research Symposium was held in conjunction with the 1st Singapore Health and Biomedical Congress. Health Services Research (HSR) studies how social, demographic, financial, organisational factors, system structures and operational processes affect the patient's care in terms of access, cost and outcomes. A multi–disciplinary approach is necessary when we plan and evaluate health services interventions that have evidence of improving the patient outcome in his or her physical, mental and social dimensions. In this one–day symposium, our speakers from research and practice shared concepts, challenges and research findings on a range of HSR topics including: the role of patient–centred care in improving chronic illness in the community; understanding care giver burden – a community health issue in Singapore; challenges in operational integration of care with external partners; use of predictive modelling technique to project admission and readmission risk for resource planning.

HSOR

The evidence behind your decisions

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